Robert K. Toutkoushian
Michael B. Paulsen

Economics of Higher Education

Background, Concepts, and Applications

Springer

Economics of Higher Education

Robert K. Toutkoushian • Michael B. Paulsen

Economics of Higher Education

Background, Concepts, and Applications

Springer

Robert K. Toutkoushian
Meigs Hall 114
The University of Georgia
Athens, Georgia
USA

Michael B. Paulsen
N491 Lindquist Center
The University of Iowa
Iowa City, Iowa
USA

ISBN 978-94-017-7504-5 ISBN 978-94-017-7506-9 (eBook)
DOI 10.1007/978-94-017-7506-9

Library of Congress Control Number: 2016932304

Printed on acid-free paper

This Springer imprint is published by SpringerNature
The registered company is Springer Science+Business Media B.V. Dordrecht.

Acknowledgments

There are many individuals who have contributed to the development of this book over the past few years. We are grateful to our students at the University of Iowa and the University of Georgia on whom we have tested our ideas and drafts of these chapters inside and outside the classroom. Their reactions, feedback, and suggestions for improvements have been invaluable to us. In particular, we owe a debt of gratitude to the following students who have given us detailed feedback on, or assistance with assembling and reviewing literature for, one or more chapters in this book: KC Culver, Jason Lee, and Kelly Ochs Rosinger. We would also like to acknowledge Manuel Gonzalez-Canché for his assistance with the discussion of student loans in Chap. 4.

We would like to thank Springer Publishing Company for their willingness to support this book and their patience as we revised and restructured the book. We would also like to thank our respective academic departments and universities for their support of the time and effort that we needed to put into writing the book.

I (Rob) would like to thank all of the economics professors at Indiana University of Pennsylvania and Indiana University (Bloomington) for helping me to appreciate economic reasoning. In particular, professors such as Nicholas Karatjas, Art Martel, and Robert Stonebraker taught me that thinking like an economist can be fun, and William Becker introduced me to the many ways that economics could be applied to education issues. I am also grateful to Stephen Hoenack for giving me my first opportunity to apply economics to problems in higher education and to Ed MacKay for providing me with an outlet to combine research with higher education policy issues in New Hampshire.

I (Mike) would like to thank my economics professors at the University of Wisconsin (Milwaukee), especially Richard Perlman, Melvin Lurie, and William Holahan, who helped me discover my affinity for a specialization in the economics of education. I am also grateful to Thomas Pogue, professor of economics at the University of Iowa, who was my mentor and role model of the academic economist. Thanks to both Tom Pogue and Robert Engel for helping me to narrow the scope of my economic research to topics in *higher* education.

Finally, we owe a great deal of gratitude to our families and spouses (Jenni and Laurey) who have had to put up with us while we became preoccupied – and some would say obsessed – with writing various sections of the book and wanting to get it right.

Contents

About the Authors

Robert K. Toutkoushian is a professor in the Institute of Higher Education at the University of Georgia. He has a PhD in economics from Indiana University (Bloomington), where he specialized in econometrics and finance. Prior to his faculty appointment at Georgia, he worked as a research associate at the University of Minnesota, as an executive director of policy analysis for the University System of New Hampshire, and as a faculty member in the educational leadership program at Indiana University. In addition to his faculty appointment, he serves as the editor of the journal *Research in Higher Education* and has served as editor of New Directions for Institutional Research and associate editor of the economics and finance section of *Higher Education: Handbook of Theory and Research*. He has published more than 50 studies in peer-reviewed journals and edited books on a wide range of topics on the economics of higher education, including faculty compensation, higher education costs, student demand for higher education, performance indicators, decentralized budgeting, institutional productivity, and state funding for higher education.

Michael B. Paulsen is a professor in the Higher Education and Student Affairs program at The University of Iowa. He has a PhD in higher education and economics from The University of Iowa and an MA in economics from the University of Wisconsin (Milwaukee), where he specialized in labor economics, public sector economics, and economics of education. Prior to his faculty appointment at The University of Iowa, he was a professor of higher education at the Universities of Illinois, Alabama, and New Orleans; and a professor of economics at St. Ambrose University. In addition to his faculty appointment, he serves as the series editor of the scholarly book series *Higher Education: Handbook of Theory and Research* and a consulting editor for *Research in Higher Education* and the *ASHE Higher Education Reports*. He has over 60 publications—books, journal articles, book chapters—including his book *The Finance of Higher Education*. His publications in economics of higher education have focused on college choice, tuition inflation, effects of prices/subsidies on student persistence, higher education costs, growth in workforce productivity, demand for higher education, and effects of financial conditions on curricular change.

Chapter 1
Introduction

Why write a book about the economics of higher education? In large part, the need for the book follows from the nature of the field of higher education. Unlike many academic disciplines which have developed their own specific theoretical underpinnings, higher education draws on theories and models from a number of disciplines including economics, sociology, political science, psychology, and so on. In fact, a perusal of the faculty in most any higher education department will reveal that professors were trained in many different fields.

This diversity in academic backgrounds has its advantages and disadvantages. On the positive side, the range of perspectives fosters many interesting discussions and brings together various approaches to study important problems about students, institutions, faculty, and society. In fact, the problems we face in higher education are so complex that no single perspective is sufficient to understand all facets of these problems. At the same time, conversations among academics in higher education can be hampered by the fact that they do not all share a common knowledge base and vocabulary from these fields. Each discipline has its own terminology, norms, and approaches to work, and thus the challenge for academics in higher education is similar to having to learn multiple languages in order to communicate with each other.

This communication problem does pose some challenges when it comes to economics. Economists use terms such as marginal cost, positive externality, and utility that are not readily understood by the general public. Research papers written by economists often rely on complex mathematical models requiring the reader to have studied advanced calculus and linear algebra to understand. And many economists who work on education issues prefer to discuss their work with other like-minded economists and are not as focused on explaining their work to academics outside of the field who nonetheless would benefit from their insights, methods, and results.

The overall goal of our book *Economics of Higher Education: Background, Concepts, and Applications* is to examine the many ways that economic principles and theories have been, and can be, applied to understanding higher education

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_1

problems and issues. In writing this book, we have several more specific goals and objectives. Our first goal is to help raise the level of understanding of economics among academics who work in the field of higher education. Both of us were originally trained as economists and teach classes at our universities on the economics of higher education, and regularly publish our research in education journals. As economists, we believe in the value of economic concepts and theories and see many ways in which the field could make greater contributions to the study of higher education. Accordingly, we have attempted to write the book in such a way that it would be accessible to a wide audience while still maintaining sufficient academic rigor.

At the same time, our second goal for the book is to work in the opposite direction as well, and help rank-and-file economists understand the issues and nuances that go along with the field of higher education. Economists who have not specifically studied higher education can sometimes look at the field through the more traditional lenses that they use in other contexts, and in the process not be able to account for much of observed behavior in the field of higher education. For example, economists may use human capital theory to view going to college as being similar to investing in a stock or bond, in that students and their families pay money in the hope of earning a higher monetary return in the future. Although there is a lot of value in taking this perspective, it does not explain, for example, why some students choose majors such as history where the expected financial return is relatively low, or why some students choose to attend less-prestigious institutions (the so-called "undermatching" phenomenon). The problem is that the investment in human capital model overlooks some of the unique attributes of college which (as we explain in the book) should properly be viewed as both an investment and consumption good, and where the utility of the decision can include non-market benefits and costs. Likewise, economists may initially apply their models of the theory of the firm to explain how colleges and universities operate, and yet be puzzled by the fact that highly-selective institutions such as Princeton and Yale deliberately choose to have excess demand for their services and in the process forego substantial profits that they could have earned. Even though our treatment of these topics in this book is not as mathematically complex as is typical for economic studies, we hope that there will be enough food for fodder, so to speak, for economists to learn more about the field and perhaps develop even better models to help the field progress and develop.

Third, in the book we strive to go beyond simply summarizing existing work and offer a number of new insights and ideas into how economics can inform the study of higher education. In Chap. 3, for example, we expand the traditional model of higher education as an investment in human capital to incorporate the utility of student decisions, the non-monetary benefits from going to college, and the implications of shared decision making between students and their parents. Chapter 4 presents a broader view of the many issues surrounding how to measure the financial returns to higher education. In Chaps. 5 and 8 we explain how higher education should be viewed not as a single good or service but really a bundle of educational services that students consume, and the resulting implications this has for understanding student (and institutional) behavior. And in Chap. 8, we offer new ideas about college and university goals and what motivates their institutional behavior, as well as new ideas on how to think about the ways in which colleges and universities compete with each other in markets.

It is probably clear at this point that our book is targeted towards a number of different audiences. The book should be useful as a textbook resource for graduate students in the field of higher education who are taking courses in the economics of higher education, higher education finance, and/or higher education policy analysis. Both of us have taught these courses at our respective institutions, and have struggled to find a text that was written at an appropriate level for our students and focuses entirely on higher education. The book should also be useful for faculty members in departments with higher education programs who not only teach these classes, but engage in scholarly work on topics covered in the book such as student access to higher education, higher education policy analysis, financial aid, and faculty compensation. A third group of readers that may be interested in the book include higher education policy makers and researchers who work outside of academic higher education departments but nonetheless conduct and/or disseminate research on higher education topics. Finally, we hope that the book is a useful primer for economists who are interested in applying their tools and techniques to problems and issues in postsecondary education.

We take a relatively unique approach to the structure and organization of this book in the hope of reaching the various intended audiences. The first chapter provides an overview of economic reasoning, terminology, and methods, and provides a foundation that is helpful for understanding the material in the rest of the book. The remaining Chaps. 3, 4, 5, 6, 7, 8, and 9 can be grouped into "demand-side" and "supply-side" topics that relate in one way or another to the study of the economics of higher education (see Fig. 1.1). Finally, Chap. 10 also spans the range of demand- and supply-side topics by providing examples of current research and indicators of future research corresponding to the scope and topics of each previous chapter.

Each chapter begins with a Background section in which we provide the reader with some historical perspective on the economic origins of the concepts discussed in the chapter. This section will be of particular value to non-economists who may not be aware of how, for example, human capital theory came to be. Because this is not the central purpose of the book, however, we have only included an abbreviated discussion of these origins and point interested readers towards other sources for further reading.

After presenting and explaining the central economic concepts and theories in the core sections of each chapter, we follow this with two subsections. The first subsection is titled Extensions, and the purpose of this is to talk about how the basic economic concepts and models described in the previous section have been, or could be, extended in new and interesting directions. As an example, in Chap. 5 we follow the explanation of demand and supply in higher education markets with a discussion of how economists are applying quasi-experimental methods to measure own-price elasticity of demand. The second subsection in each chapter is titled

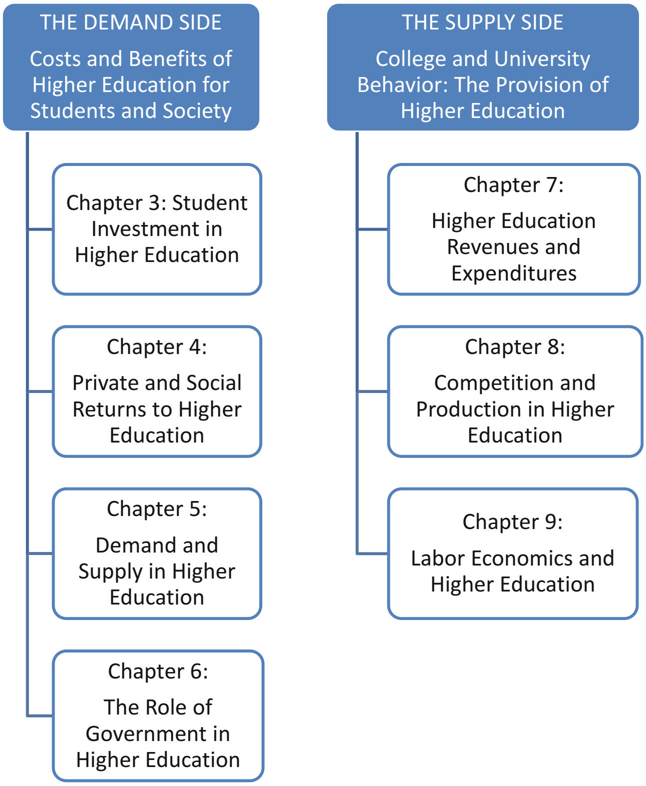


Fig. 1.1 Organization of main chapters in this book

Policy Focus, where we examine one or more ways in which higher education policy relates to the given topic. Policy analysis topics that we cover in the book include high-price/high-aid versus low-price/low-aid pricing for public universities; the role of application fees policies in the college-choice process; student loans and borrowing behavior; the impact of online/distance education on postsecondary markets; the rationale for, and nature of, college mergers and closings; and the role of social media in faculty work.

We used a mix of approaches to presenting the material in an attempt to reach the different audiences who might benefit from the book. As is typical for principles- and intermediate-level economics books, there are a number of graphs that are used to explain key concepts. At other times, however, we must rely on equations to develop the material for the reader due to its common usage in important economic studies. When possible, however, we augment the mathematical models with hypothetical illustrations and show key results in tabular form. This is most apparent in Chap. 3, where we begin by using equations to lay out a five-stage model of how students make decisions about college, and then apply the equations to an imaginary student to show how the equations lead to specific results that we illustrate using tables.

As noted earlier, our aim was to write a book that would be challenging to both economists and academics who study higher education, and yet be accessible to a broader audience than is typically found for such material. Admittedly this is a fine line to walk, and some chapters may be more difficult to follow than others due to the complexity of the material and the methods used. It is unnecessary for readers to have prior knowledge of calculus or statistics to follow most of the discussions in the book; however, having such knowledge would be helpful in a few places, and we have attempted to provide the reader with help at selected points in the book. We also provide glossaries of the mathematical symbols used in some chapters. Likewise, we do not presume that the reader has prior knowledge of economic concepts, theories, or terminology. We introduce and explain economic concepts such as demand, supply, utility, externalities, and marginal cost to the reader and provide references for further reading on background material as well. Finally, we made decisions about the terminology that we use throughout the book that may differ from what some readers have seen in other contexts. For example, throughout the book we use the terms "postsecondary education," "higher education," "college" and "university" interchangeably to represent education levels above high school, even though some may argue that the words "higher education" do not relate to institutions offering 2-year degrees. When it is necessary to make finer distinctions, however, we have done so.

The book consists of 10 chapters. Chapter 2 provides the reader with an overview of economic reasoning and terminology that is used throughout the book, and is most relevant for those without prior exposure to economics. The first section introduces the origins and evolution of the subfield known as the economics of higher education and then discusses how the scholarly work of economists has expanded the scope of the subfield and developed many fruitful areas of inquiry. In addition, this chapter examines how economists think and do their work, and presents a set of key economic concepts in the context of how economists use optimal decision-making models and models of the marketplace to study the behavior of individuals, institutions, and governments in higher education.

In Chap. 3, we provide a detailed presentation of how students make decisions about whether and where to go to college. This model begins with human capital theory, viewing college-going as an investment in one's human capital. The chapter lays out the basic framework for how economists explain the decisions of students and their families about investing in higher education. We describe the private financial costs and benefits of college, and how students' perceptions and comparisons of these costs and benefits—as well as the non-market costs and benefits of college—affect the choices they make regarding whether and where to go to college. We then present a five-stage model of college choice and use the model to illustrate how economists use comparative statics to study the effects of higher education policies that can provide incentives to encourage more students to choose to go to college or attend a specific institution.

Viewing higher education as an investment, the investors themselves—students and parents, as well as society in general—naturally want to know the size of the return on this investment. In Chap. 4, we use the private benefits and costs of college to conceptualize and calculate the private return to college in terms of the net present value of benefits minus costs, the ratio of benefits to costs, and the internal rate of return. We extend this to analyze social returns, where the calculations account for the added costs incurred by and the added benefits that accrue to others in society to support a student's investment in college. We apply these approaches to the calculation of the returns to investment in different levels of degrees (associate's, bachelor's, master's, doctoral). The chapter also includes an extensive examination of the methodological challenges and issues associated with calculations of the returns to investment in higher education.

In Chap. 5, we examine the theories of demand and supply and the competitive-marketplace model and discuss how they can be applied to the study of higher education markets. We begin by providing a brief background on the economic concepts of markets, demand, and supply. Then we derive the individual's demand curve from the basic tenets of the traditional economic theory of individual consumer behavior. We follow this by showing how the college choice model from Chap. 3 can also be used to develop the demand for higher education. In this section, we distinguish between individual and market demand, and then turn to the supply side of higher education markets. In the next section, we combine supply and demand to determine the market-clearing price for higher education services and the corresponding equilibrium quantity or enrollment level. We then examine the concept of elasticity, its calculation, and the various ways in which economists apply elasticity to higher education. We end the chapter by discussing a number of extensions of demand studies and by analyzing selected higher education policy applications.

In Chap. 6, we explore the economic justifications for the role of government in supporting postsecondary education, emphasizing that the primary economic rationale for governmental financial support of higher education is based on evidence of the positive externalities created when students go to college. Externalities may lead to market failures that result in students' underinvestment in higher education without government involvement. We differentiate between the private or internal benefits that accrue only to students who go to college and the public or external benefits that accrue to society and are not considered by students in their college-going decisions. Our analysis emphasizes the application of the concepts and theories from public sector economics and welfare economics that constitute a useful analytical framework for examining the role of public policy in higher education markets. We examine the effects of public policies or interventions that take the form of financial incentives that reduce the cost paid by students, in order to encourage a socially-optimal number of students to go to college.

In Chap. 7, we study the economics of revenues and costs of higher education, highlighting the institutions that constitute the supply side of higher education markets. We show how economists analyze revenues for organizations, with a special emphasis on the important role that subsidies play as a source of revenue to fund their operations. On the costs or expenditures side, we discuss how economists study the cost structure for organizations, and how this relates to colleges and universities. We extend the basic model to explore how some institutions use a decentralized budgeting model to assign revenues and costs to academic units within the institution. We also focus on the policy implications of institutional closings and mergers and how it relates to topics discussed in this chapter.

In Chap. 8, we analyze how colleges and universities behave in markets. The chapter includes a discussion of higher education markets and how they compare to the models frequently used by economists for firms in the for-profit world. We discuss the goals and objectives of postsecondary institutions in light of the fact that most institutions do not pursue profit maximization, at least in a strict sense. We then turn to the ways in which colleges and universities compete with each other for students, either on the basis of price or product differentiation. The extension to the model considers the likely impacts of the growth of online or distance education on postsecondary markets. Finally, the chapter concludes with a policy focus on the ways in which states provide funding to their public institutions, and how these approaches relate to competition and goals with regard to institutional performance.

Chapter 9 looks at the many ways in which concepts and theories from labor economics can be applied to higher education. We begin by presenting information on labor demand and supply, and how they come together to determine equilibrium wages and employment levels in postsecondary markets. We review historical changes that have occurred in academic labor markets, and then focus attention on the determinants of faculty pay. For the extension to the model, we consider the labor economic implications for non-tenure track (or adjunct) faculty. Finally, we conclude the chapter with a policy focus on how faculty integrate social media into their work, and some of the opportunity costs that can arise.

In the last chapter (Chap. 10), we discuss examples of current research, and indicators of future research, that correspond to the scope and topics of each of the prior chapters. In particular, this chapter serves as a place to highlight recent and emerging work in the field, alert readers to important research that could not be adequately covered elsewhere in our book, and offer some suggestions for further reading within the topical scope of each chapter of the book.

Given the ambitious goals of the book, there are admittedly a number of limitations that should be acknowledged at the onset. First, we cannot cover all of the important and relevant topics in higher education to which economics has been or may be applied. In selecting topics for inclusion, we strived to pick those that are most central to the study of higher education and would be helpful for faculty members who teach classes on the economics of higher education, higher education finance, and higher education policy analysis. In the last chapter of the book, we provide the reader with analyses of recent research, corresponding to each chapter in the book, with some suggestions for further reading.

A second limitation with the book is that we could not cover or include all of the important contributions that economists have made to the field. It was not our goal to provide a complete history of the subfield of economics of higher education, nor to cite every study that has had an impact on the field. Nonetheless, readers will see that we have cited a large number of economists and other academics who have been central to the study of higher education, and we have perhaps erred on the side of citing too many studies rather than too few.

Finally, by attempting to write a book that would have something for everyone, so to speak, we acknowledge that our approach may not always hit the mark. The book is likely to be too simplistic for some readers, particularly economists who are used to communicating their ideas solely through complex mathematical models and already understand the economic concepts that we explain to readers. Likewise, the book may prove to be too difficult for some readers who are not mathematically inclined and do not have any prior exposure to economic terminology. In short, it would be impossible to write a book that would be everything to everyone, and perhaps this book will serve as a starting place for future works by others who can fill niches that we have not done here.

It is our sincere hope that this book serves not only as a valuable teaching resource for those of us who teach graduate-level courses in higher education programs, but also contributes to the intellectual development of the field and serves as a foundation for further research on the economics of higher education. Many economic concepts are fairly intuitive once the reader becomes familiar with the terminology and manner in which the concepts are presented by economists.

Chapter 2
Overview of Economic Reasoning and Terminology

Abstract In this chapter, we provide an overview of the many different ways that economic reasoning can be applied to the study of higher education. We begin by taking a look at the origins and evolution of the field of economics and the subfield of the economics of higher education, and follow that with an examination of how the subsequent scholarly work of economists expanded the scope of the field and established many additional areas of inquiry within this subfield. In the next section, we discuss how economists think about problems and how they do their work. This section illustrates that although economics has some similarities to other scientific fields in terms of its basic approaches to problems and its methodologies, the field also has its own terminology and unique concepts that are important to understand. The final section introduces the reader to a number of important economic concepts, primarily in the context of some of the fundamentals of basic economic models of optimal decision making often used in the analysis of the behavior of economic actors and decision makers—i.e., students, faculty, departments, institutions and governments—in the higher education context.

Introduction

Economics is the study of choice. It is a social science that focuses on how decision makers use their resources (such as money and time) in pursuit of their goals. The most fundamental problem to an economist in virtually every situation is that resources are limited in quantity. Because of this scarcity of resources, decision makers must always give up something in order to get more of something else. This is reflected in the saying: "There really is no such thing as a 'free lunch'". This means that even a person who consumes a lunch for which she didn't pay the bill still misses out on the opportunities to use that time to engage in other activities, such as taking a nap, taking a brisk walk, running an errand, or getting some additional work done.

Economists study how individual or organizational decision makers can best utilize their limited means to pursue their (unlimited) ends. All of the decisions that consumers, workers, organizations, and governments make are done in the face of

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_2

constraints such as limited time, income, or other resources. And all decision makers have constraints they must accommodate. Because economists focus on explaining the actions of these decision makers, they view the discipline of economics as useful for examining a wide range of decision makers in a variety of decision-making contexts—including higher education. In this sense, economics is a very general and flexible way of thinking about the world.

Academics who study the economics of higher education adapt and apply economic models of decision making to deepen our understanding and better inform our analysis of the behavior of students, faculty, administrators, institutions and governments at the local, state, and national levels. For example, students are decision makers who make choices about whether or not to go to college, which college to attend, how much time to devote to their studies, and more; but they are constrained by their limited time and income. Professors are also decision makers in that each must decide how to use his or her time to conduct research, teach students, and engage in service activities. Economists likewise view an academic department or an entire institution as a decision-making unit. For example, the enrollment management office on campus—in ways consistent with the preferences of the central administration—chooses how many and what mix of students to admit; deans and department chairs choose whether or not to hire additional faculty and what the new faculty member's salary will be; and college presidents must decide how to allocate resources between academic and non-academic units to achieve the institution's goals. In their decision making, these units will be constrained by campus-wide and campus-unit budgets with special attention to how much revenue additional students will generate and how much additional expenditures will be required to meet faculty payroll.

In this book, we look at the many different ways that economic reasoning can be applied to the study of higher education. We begin the first section of this introductory chapter by taking a look at the origins and evolution of the field of economics and the subfield of the economics of higher education, and follow that with an examination of how the subsequent scholarly work of economists expanded the scope of the field and established many additional areas of inquiry within this subfield. In the next section, we discuss how economists think and how they do their work. This section illustrates that although economics has some similarities to other scientific fields in terms of its basic approaches to problems and its methodologies, the field also has its own terminology and unique concepts that are important to understand. The final section introduces the reader to a number of important economic concepts, primarily in the context of some of the fundamentals of basic economic models of optimal decision making often used in the analysis of the behavior of economic actors and decision makers—i.e., students, faculty, departments, institutions and governments—in the higher education context.

Background

Adam Smith is usually credited with being the "father of modern-day economics," and with good reason. With the publication of *The Wealth of Nations* in 1776, Smith introduced the world to much of the framework that underlies the way that economists think about problems and issues. *The Wealth of Nations* is among the most highly-cited academic books and has been required reading for generations of economists. However, there were also a number of other academics who contributed to the development of economics prior to the work of Smith. In fact, discussions of selected economic concepts such as wealth can be traced back to ancient Greece and the work of academics such as Xenophon, Plato, and Aristotle around 350 BC. In the Middle Ages, Thomas Aquinas and Duns Scotus debated economic ideas about "just prices," and Ibn Khaldun examined issues including the specialization of labor and money as a medium of exchange. Closer to the time of Adam Smith, academics including Sir William Petty, Sir James Steuart, Jeremy Bentham, David Ricardo, and others began articulating ideas about economic reasoning in the seventeenth and eighteenth centuries, leading to the recognition of economics as a unique academic discipline.

The work by economists in the seventeenth and early eighteenth century relied heavily on exposition and did not use graphs, mathematics, or statistics to explain key concepts. In the nineteenth century, a new generation of economists built upon the ideas developed by Smith and his contemporaries and led to the development of the ways in which economics is portrayed today. These ideas came to be known as "neoclassical economics" and introduced notions such as marginal analysis into the field. Of particular note is Alfred Marshall's 1890 book *Principles of Economics*, which is recognized by many as the first major economics textbook and helped introduce graphs as a key instructional tool for the field.

Modern-day economics has seen a number of subsequent developments from the classical / neoclassical period. The Great Depression of the 1930s saw the introduction of "Keynesian economics" as John Maynard Keynes developed economic theories to justify government involvement in markets to spur economic growth. Other economics including Hayek and Friedman countered by advocating for free markets and less government interventions in markets. "Supply side economics" came to represent monetarist policies in the 1980s in which some economists argued that policies directed at the supply side of markets rather than demanders was the most appropriate course of action. There have also been many other trends and developments within the field of economics that are beyond the scope of what we can review in this book.[1] Within the broad heading of economics, economists

[1] There have been numerous books and articles written on the history of economic thought. Readers who are interested in learning more about the history of economic thought and how it has evolved over time are referred to Screpanti and Zamagni (2005), Hunt and Lautzenheiser (1992), DesJardins and Toutkoushian (2005), and Canterbery (2010).

began to specialize in subfields of inquiry such as labor economics, macroeconomics, microeconomics, monetary economics, econometrics, and many others.

The focus of our book is on the subfield known as the "economics of higher education" which is part of the broader study of the economics of education. This subfield's origins can be traced back to human capital theory. When economists began in earnest to study how education affects people, their analysis often focused on how the acquisition of higher education increases students' human capital, which subsequently pays off for them in terms of greater lifetime earnings. Because economists view labor as an important resource in production, the study of education became important to macroeconomists as a means to explain national productivity and economic growth, and to microeconomists and labor economists as a way to examine earnings and income inequality.

The concept of human capital has a long but uneven history within the field of economics. Traditionally, economists identified land, labor, and capital as the three primary types of resources used in the production of goods and services. This early view of labor as a resource for production coincided with the industrial revolution and its concurrent emphasis on manual labor. The practice of relating humans to a form of capital dates back at least to the work of Sir William Petty in the late seventeenth century, who developed measures of the monetary value of human capital (Hull, 1899). The connection between worker productivity and earnings was made explicit in the pioneering work of Adam Smith in *The Wealth of Nations* and reiterated over the years by Irving Fisher (1906) and many others.

The idea that people acquire skills and human capital through education followed from this early work. Given that education required an investment of time and money, economists began to ask whether the benefits from education exceed the cost. Among the first explicit examinations of higher education as an investment in human capital is the study by J. R. Walsh (1935), who compared the earnings of college graduates to the cost of their education. He concluded that there was a positive return on investment for students who earned bachelor's degrees and also found that, at the time of his study and using his limited methods, there was a negative return on investment for students who earned graduate degrees.

Education did not become an established area of inquiry for economists, however, until the late 1950s when a new generation of economists including Jacob Mincer, Gary Becker, W. Lee Hansen, Burton Weisbrod, and Theodore Schultz entered the field. As noted by Becker (1960), the Cold War and the race to develop technologies to compete with the Soviet Union led to a renewed emphasis in the United States on the need for the nation to increase its collective human capital through education. In his 1961 presidential address to the American Economic Association, Theodore Schultz focused on education as an investment in human capital, and as a result the study of education began to receive visibility and credibility among economists. In this speech, Schultz was critical of the field of economics for overlooking the ways in which human capital can be enhanced through an investment of time and financial resources:

> "The failure to treat human resources explicitly as a form of capital, as a produced means of production, as the product of investment, has fostered the retention of the classical notion of labor as a capacity to manual work requiring little knowledge and skill, a capacity with which, according to this notion, laborers are endowed about equally. This notion of labor was wrong in the classical period and is patently wrong now." (1961, p. 3)

In December of that same year, the first conference devoted to the investment in human capital (titled "Exploratory Conference on Capital Investment in Human Beings") was held in New York City. Key papers on the investment in human capital were delivered at the conference by Schultz, Becker, and Weisbrod, among others. Published work by these and other scholars appeared at about the same time, serving to further clarify and deepen the understanding of human capital and its economic aspects.[2] Soon thereafter, Becker (1964) published the highly-cited book titled *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. In this book, Becker develops and presents his general theory of human capital and its formation and applies it to examine differences in earnings due to various student characteristics, generate age-earnings profiles, analyze the returns to general and specific on-the-job training, calculate private rates of return to college education with adjustments to account for differences in students' abilities and early home environments, and estimate social returns to college with emphasis on the importance of external benefits.

This period of intense scholarly work around 1960 established the foundation for, and marked the beginning of, the formal study of the economics of education. There have since been a number of books published on the general topic of the economics of education. Within a few years, Mark Blaug—Professor of Economics of Education at The University of London—published the first of what would eventually be three editions of his increasingly comprehensive *Economics of Education: A Selected Annotated Bibliography* (1966, 1970a, 1978) of scholarly work in this new field. In his third edition (1978), Blaug reminds readers of a view he expressed in his second edition (1970a), stating at that time that "the economics of education still lacks a satisfactory introductory textbook for students" (p. 9). By 1978, he reports that a remarkable 16 such textbook-like volumes had been published on the general topic of the economics of education. In the United States, the most highly-regarded and widely-used textbook in this area has been the 1990 book by Elchanan Cohn and Terry Geske titled *Economics of Education* (3rd edition). The volumes in print on the economics of education vary considerably, however, in several important ways. Some books focused on primary and secondary education issues, or higher education, or both. Books also differ in terms of their target audiences, with most being primarily written for economists which makes

[2] For example, see Becker (1962), Hansen (1963), Schultz (1961, 1962, 1963), and Weisbrod (1961, 1962). For an early edited collection of chapters focused on economics of higher education, see Mushkin (1962).

them less accessible to non-economists who are not familiar with the terminology and techniques preferred by economists.[3]

Scholarly work on human capital theory and the economics of education has increased substantially since these early years. Over the next 50 years, economists have studied topics that focus on all levels and forms of education, including pre-school, elementary school, secondary school, vocational school, various levels of higher education, graduate and professional school, corporate or industrial training, online learning, home schooling, and more. Our primary concern in this book is with scholarship related to the study of higher education.[4] Although economists of higher education have examined many specific topics in the broad area of higher education, the majority of such work can be arranged into several categories. The research conducted by economists in each of these categories has served to greatly expand the scope of the field and establish new and growing areas of inquiry under the heading of the economics of higher education.

One topic that has attracted considerable interest is the contribution of education to economic growth. Changes in the traditional factors of production—land, labor and capital—are thought to help explain economic growth. However, there is a substantial residual left unexplained by traditional factors. As a result, economists have examined the extent to which the residual can be explained by changes in the quality of labor attributable to education—i.e., investment in human capital.[5]

Economists have been and continue to be very interested in studying and estimating the rate of return to investment in higher education. Private rates of return to college and other levels of higher education are important to potential students and their families to better inform their decisions about college. And social rates of return are of special relevance for governments and policy makers who make decisions about how to allocate national, state and local resources between higher education and other uses in ways that are optimal for the well-being of society. An important part of rate-of-return research has been investigating how the earnings of college graduates vary according to student characteristics such as ability, race/ethnicity, gender, family background, and major field of study, as

[3] Blaug classifies some of these books in terms of how much prior economic study each would require. Little economics is needed to appreciate Benson (1968), Rogers and Richlin (1971) or O'Donoghue (1971); elementary economics would be sufficient preparation for Schultz (1963), Perlman (1973), Vaizey (1973), and Sheehan (1973); and more than elementary economics would be best in preparation for Blaug (1970b), Thurow (1970) and Cohn (1972).

[4] As noted in the Introduction, unless stated otherwise we use the expressions "higher education," "postsecondary education," and "college" interchangeably to encompass all forms of postsecondary education, including 2-year institutions, 4-year institutions, and graduate institutions.

[5] Examples of work in this area include Barro and Sala-I-Martin (1995), Baumol, Blackman and Wolff (1989), Denison (1962, 1985), Jorgensen (1984), McMahon (1984), Psacharopoulos (1984), and more recently, Paulsen and Fatima (2007). Leslie and Brinkman (1988) and Pencavel (1993) have reviewed the early literature in this area.

well as institutional characteristics such as high school quality, college type and selectivity.[6]

By the late 1960s and early 1970s, institutions and their enrollment managers started to become concerned about a pessimistic demographic outlook based on an expectation of slow growth or decline in the traditional college-going age group—especially as the largest numbers of "baby boomers" (i.e., children born between the end of World War II and the early 1960s) were already working their way through the higher education system—coupled with a temporary recession in the job market for college graduates. Institutions focused on efforts to maintain and forecast their enrollment, and therefore began to be interested in how a student and his/her family makes decisions about whether to go to college, and if so, where to enroll. Eventually, institutions turned recruitment strategies toward underserved pools of students that were not shrinking in numbers—such as women, black and Hispanic students, older students, part-time students and international students. About this time, and in this context, economists—viewing students' enrollment decisions as investments in their human capital—began to study the demand for higher education. Aggregate-level demand studies used data on environmental characteristics (e.g., enrollment, high school graduates, starting salaries of college relative to high school graduates, unemployment, etc.), and institutional characteristics (e.g., tuition, financial aid, and other factors) to estimate the coefficients of demand functions that helped explain student enrollment behavior, inform tuition setting policies, and provided a means to forecast enrollment at the institutional, state and national levels, and inform tuition setting policies.[7]

Economists also studied the demand for higher education using individual-student data. This research was well-grounded in human capital theory, but unlike the aggregate-level studies, these studies focused more intensely on the effects of student and institutional characteristics on whether or not a student applies to or attends college and to which particular college(s) a student chooses to apply or attend. These individual-level student demand studies have come to be called college-choice studies. They rely on data on individual student characteristics (such as race, gender, income, ability, achievement, parental educational and occupational attainment, college-prep curriculum, college-going plans of peers,

---

[6] There have been many theoretical and empirical studies, reports and reviews in this area. Some examples include Baum, Ma, and Payea (2010), Heckman, Lochner, and Todd (2008), Kane and Rouse (1999), McMahon (1991, 2009), Psacharopoulos and Patrinos (2004), Toutkoushian, Shafiq, and Trivette (2013).

[7] The majority of the early aggregate demand studies were conducted in the 1970s and 1980s. For example, Campbell and Siegel (1967), Galper and Dunn (1969) and Freeman (1976) were national-level studies; Hopkins (1974) and Wish and Hamilton (1980) were state-level studies; and Hoenack and Weiler (1979) and Paulsen and Pogue (1988) were institution-level studies. The early demand studies were reviewed in W. Becker (1990) and Paulsen (1990). Economists continue to be interested in aggregate demand studies; for example, Cheslock (2005) uses institutional data to examine the enrollment demand of transfer students at public and private institutions and Curs and Singell (2002) examine enrollment demand of in-state and out-of-state students.

and more), as well as institutional characteristics (including tuition, financial aid, room and board, location, admissions selectivity, curricular offerings and other factors) to estimate the coefficients of demand functions that help explain student-college choice behavior and guide enrollment managers in admissions, recruitment policies, and financial aid.[8]

The two types of demand studies mentioned above—aggregate-level and individual-level studies—also serve as contexts within which economists estimate the price-sensitivity of students to changes in tuition or financial aid. This has been an area in which economists of higher education have been very active in their research. More specifically, coefficients that estimate the effect of tuition on student enrollment decisions are indicators of student price-sensitivity. Economists and policy makers have been particularly interested in studies that examine the extent to which price-sensitivity varies across students according to individual characteristics.[9]

Economists have likewise applied economic principles and models to labor issues in higher education. The interest in labor economics can be traced back to the mid-1960s and early 1970s due to significant developments in equal-pay legislation in the United States. These developments included the passage of the Equal Pay Act of 1964, and changes in Title VII of the Civil Rights Act that extended it to education institutions through the Equal Employment and Opportunity Act of 1972. As a result, economists began to conduct salary-equity studies in earnest for colleges and universities, usually focusing on whether female faculty were paid less than similarly-qualified male faculty. Economists have been concerned about which control variables to include in regression models as well as the relative benefits of using institutional versus national datasets. Moreover, economists have made and continue to make important contributions to the development of methodological approaches most effective for estimating and correcting salary inequities and pay discrimination, especially in higher education.[10]

In the United States, federal, state, and institutional financial-aid policies—in considerable variety—have been used to promote participation in higher education.

[8] Some of the most influential early studies of college choice include those by Bishop (1977), Manski and Wise (1983), Kohn, Manski, and Mundel (1976), Radner and Miller (1975). Like the aggregate-level studies, these early college-choice studies were reviewed by W. Becker (1990) and Paulsen (1990). The economists and their peers who conducted the early individual-student-data college-choice studies provided foundational theoretical and methodological insights that have informed additional research through the years, including more contemporary student-college-choice studies (e.g., Andrews, DesJardins, & Ranchhod, 2010; Avery & Hoxby, 2004; DesJardins & McCall, 2014; Long, 2004; Niu, Tienda, & Cortes, 2006; Perna, 2006; Perna & Titus, 2004; Toutkoushian, 2001).

[9] The literature on this important area of economic inquiry has been well-reviewed by Heller (1997), Leslie and Brinkman (1988), McPherson (1978), and Paulsen (1998).

[10] Examples of some of the earlier empirical work on this topic include Ferber, Loeb, and Lowry (1978), Hoffman (1976), Loeb, Ferber, and Lowry (1978), and Oaxaca (1973). For reviews of early and more recent literature, as well as both the conceptual and methodological aspects of the salary-equity literature in higher education, see Toutkoushian (2002, 2003).

Economists have intensely studied higher education issues related to financial aid, such as the effects of grants, scholarships, and loans on college access, persistence and graduation rates of diverse groups of students. Of the many topics for study in higher education finance, several have drawn considerable interest such as the impact of federal Pell grants, the effectiveness of merit-based grants relative to need-based grants at the state and institutional levels, the impact of financial-aid-related information and assistance policies on students, the use of tuition-discounting practices, and the causes and consequences of rising tuition.[11]

Most of the contemporary rhetoric about the benefits of higher education centers on the private benefits of college for students, such as higher lifetime earnings. When making college-going decisions, students are presumed to only consider the private or internal benefits and costs of college. However, it is commonly argued that when a person goes to college, he or she also generates a range of additional public or external benefits for other members of society. For example, in comparison to high-school graduates, college graduates engage in more civic participation, volunteerism, increased voting, less criminal activity, less dependence on public welfare programs, greater workforce productivity, and more. Much of the attention from economists has focused on whether these spillover benefits are due to the person going to college or simply reflect differences in the type of people who go to college. If these benefits are created by college and are not taken into account by students when making enrollment decisions, then there is a concern from society's point of view that too few students will go to college. Economists have conducted many studies of the external benefits of higher education; however, aside from the greater tax dollars from college graduates used to fund programs that enhance society's well-being, many of the other potential public benefits from higher education are challenging to quantify.[12]

One of the primary reasons that college tuition and fees continue to rise is because of the escalating cost of providing educational services to students. Economists have focused on this issue in a variety of ways, one of which is to model and estimate institutional cost and productivity functions. A better understanding of what contributes to the costs and productivity of resources used to perform the missions of colleges and universities can inform institutions and policy makers about how to slow the increase in costs of educating students, how to more

[11] Many economists of higher education have conducted research in these areas. Selected examples include studies of Pell grants (Curs, Singell & Waddell, 2007; Turner, 1998), merit-based or need-based state grants (Andrews et al., 2010; Avery & Hoxby, 2004; Castleman & Long, 2013; Dynarski, 2004; DesJardins & McCall, 2014; Kane 1999, 2007; McPherson & Shapiro, 1998), causes and consequences of rising tuition (Breneman, 1994; Ehrenberg, 2000; Long, 2004; Paulsen, 2000; Paulsen & St. John, 2002; Rizzo & Ehrenberg, 2004), and financial aid information policies (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012).

[12] Some examples of economists' efforts to identify and measure external benefits can be seen in the work of Baum et al. (2010), Hansen and Weisbrod (1969), McMahon (2009), Paulsen and Fatima (2007), and Wolfe and Haveman (2002).

efficiently operate a college or university, and understand the role of costs in higher education pricing and quality.[13]

How Economists Think and Do Their Work

Economic analysis is grounded in several fundamental assumptions about the nature of the basic problem of scarce resources and the way individuals and organizations act in the face of this scarcity. In this context, *scarcity* means that while individuals and organizations may have virtually unlimited wants and desires, the resources that can be used to satisfy these wants and desires are limited. Economics is a scientific discipline and economists apply basic principles of the scientific method in their work. This approach begins with observing real-world phenomena, developing theories and models to help understand these phenomena, and then testing these theories with data. Unlike many disciplines in the "hard sciences," however, economists often rely on existing data to test theories rather than generate new data through experiments.[14]

The models developed by economists assume that decision makers engage in *optimization* behavior. Simply put, optimization implies that individuals and organizations try to make the best of their situation in light of the *constraints* they face due to the economic problem of scarce resources. One way to show the optimization problem is through graphs as in Fig. 2.1. Suppose that a decision maker can use its resources to produce or acquire two variables (denoted X_1 and X_2). Combinations of these two variables give the decision maker a certain amount of "benefit," represented by the curves Φ_1, Φ_2, and Φ_3, where benefit is a general concept denoting something of value that the decision maker wants to obtain (such as profit or utility). Each curve shows the different combinations of X_1 and X_2 that would give the decision maker the same level of benefit. Higher curves represent combinations of the two variables that correspond to greater benefits. Therefore, combinations of X_1 and X_2 that fall on the curve Φ_3 are preferred by the decision maker to all combinations along the curves Φ_1 and Φ_2. In theory the decision maker has an

[13] Economists have conducted many theoretical analyses and empirical studies of the costs and productivity of higher education institutions, including these examples: Bowen (1980), Brinkman (1985, 1990), Brinkman and Leslie (1986), Clotfelter (1996), Dundar and Lewis (1995), Ehrenberg (2000), Hoenack (1990), Hopkins (1990), Paulsen (1989), Rothschild and White (1995), Toutkoushian (1999), and Winston (1997, 1999).

[14] There are exceptions to this rule. Experimental economics has emerged as an important subfield within economics, where economists such as Vernon Smith, Arlington Williams, James Walker and many others design controlled laboratory experiments using computer models to test economic theories. Within the subfield of the economics of higher education, economists have on occasion used randomized experiments to test theories about the effects of financial aid on student decisions.

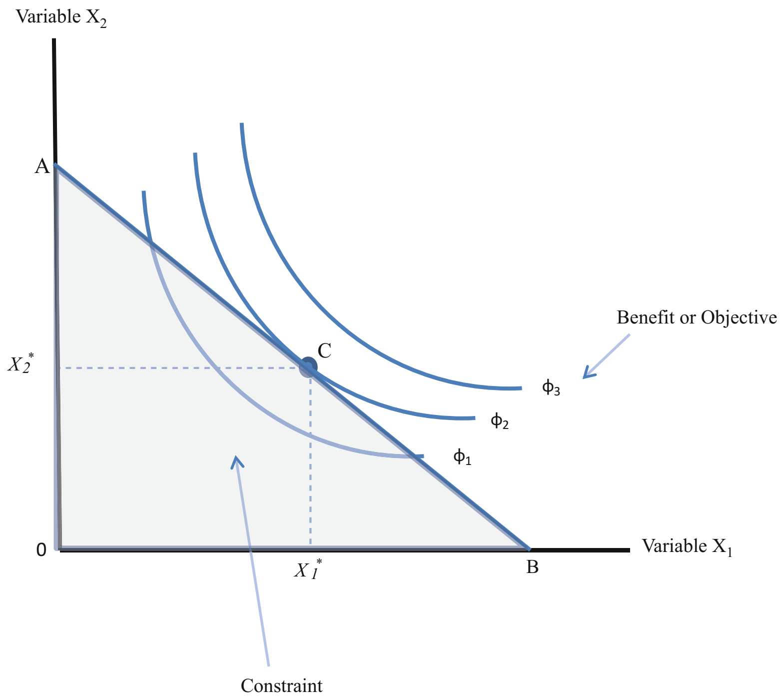


Fig. 2.1 Graphical depiction of optimization problem for a decision maker

infinite number of such curves with each denoting a different level of benefit, but for the purpose of exposition we only show three such curves here.

The decision maker's constraint is represented by the shaded area AB0. The line AB at the outer edge of the constraint shows all combinations of X_1 and X_2 where the resource is being fully utilized (i.e., there is nothing left over). This constraint is also a general construct that may refer to financial resources, natural resources, or time. The position and slope of the constraint is determined by the "prices" attached to each of these variables, and the total amount of the resource that the decision maker can use to select quantities of the two variables. The decision maker cannot choose combinations of the two variables that lie outside of the shaded area AB0 because they exceed the constraint. For example, a professor cannot spend 14 h each day on work-related activities and 16 h/day on non-work activities because it exceeds the person's time constraint of a maximum of 24 h available per day.

The optimum point for the decision maker is represented graphically by point C. At point C, the decision maker has chosen the combination of X_1 and X_2 that result in the largest benefit and still stays within the constraint that it faces. By comparison, the decision maker could have chosen the allocation of resources represented by point D, but this would have a lower benefit level (Φ_1) than at point C (benefit level = Φ_2).

Another way to represent the same optimization problem for a decision maker in Fig. 2.1 is with mathematical equations. Equations have an advantage over graphs in that they can more precisely identify the inputs, outcomes, relationships, and key results involved in a decision-making process. Instead of simply saying that the decision maker is best off with X_1^* of the first variable as in Fig. 2.1, a mathematical model may be able to show this optimal value as a specific function of other variables or perhaps a single number (such as $X_1^* = 10\big)$. The drawback to mathematical equations is that they may be more difficult to understand and solve, especially when the equations used to represent the decision maker's benefits and constraints are complicated functions.

In a mathematical optimization model, the economist may start out by specifying the decision maker's benefits as a function of the two variables:

$$\Phi = \Phi\,(X_1, X_2) \tag{2.1}$$

where $\Phi\,(X_1, X_2)$ = equation showing how combinations of the two variables translate into benefits for the decision maker. As we will discuss in Chap. 7, economists frequently use the Cobb-Douglas function to represent Φ, where the function is written as:

$$\Phi = \alpha X_1^{\beta} X_2^{1-\beta} \tag{2.2}$$

The constraint for the decision maker can likewise be expressed in the form of an equation such as:

$$I \geq I(X_1, X_2) \tag{2.3}$$

where $I(X_1, X_2)$ shows how the scarce resource (I) can be distributed between the two variables given the prices of these variables. It is common to write the constraint in a linear form:

$$I \geq p_1 X_1 + p_2 X_2 \tag{2.4}$$

with p_1 and p_2 denoting the prices for the two variables. The constraint says that the decision maker cannot choose combinations of X_1 and X_2 that exceed the total amount of the decision maker's scarce resource.

The next step for the economist would be to combine the benefit and constraint functions into a single equation. This is often referred to as a Lagrangian function (L) and may be written in a general form as follows:

$$L = \Phi(X_1, X_2) + \lambda(I - p_1 X_1 - p_2 X_2 = 0) \tag{2.5}$$

There are three unknown variables in this specific Lagrangian function (X_1, X_2, and λ) and three parameters that are fixed numbers over which the decision maker has no control (p_1, p_2, I). The optimization goal for the decision maker is to determine what combination of values for the unknown variables would make the Lagrangian function in Eq. (2.5) as large as possible. This is found by taking the partial derivatives of L with respect to X_1, X_2, and λ, setting the resulting partial derivative equations equal to zero, and then finding the values of the variables that make all three equations true at the same time.[15] This is referred to in mathematics as solving a system of equations. The resulting solution for, say, variable X_1 could then be written in the form of another equation such as $X_1^* = f(p_1, p_2, I)$ or it could be a specific number if the values of the parameters are known.

Assumptions, Assumptions

In formulating a model, economists—like scholars in other scientific disciplines– usually make assumptions about the process being examined. There are two general types of assumptions used by economists: simplifying assumptions and behavioral assumptions. Simplifying assumptions are, as suggested by the name, made to help simplify the relationship of interest in the real-world economy, and use this abstraction to reduce or eliminate attention on unnecessary details and intensify the focus on the essence of the specific relationship the theory is designed to explain. In the model shown above, for example, a simplifying assumption was made that there were only two variables (X_1, X_2) that generated benefits for the decision maker. In reality, there may be a large number of variables that actually contribute to benefits, and perhaps do so in ways that are more complicated than represented by the Cobb-Douglas function in Eq. (2.2). Once the basic theoretical explanation of the relationship is well understood, then the same principles can be readily extended to cases with more variables.

Other assumptions made by economists are behavioral because they relate to how decision makers are assumed to act within the model. For instance, economists frequently assume that decision makers engage in *rational behavior* in response to scarcity. This does not mean that they believe that all decision makers do the exact same thing; rather, it means that individuals and organizations engage in systematic, purposeful, goal-directed behavior, making decisions in ways that maximize their benefits relative to costs, and do so in a way that is consistent with their perceptions, preferences and goals. Another behavioral assumption that economists make is that state governments act in ways to try and maximize the net benefits for its citizens. The assumption does not specify exactly what should go into "net benefits," only that the state can make this determination on its own and act

[15] The symbol 'λ' is referred to as a "shadow price". The shadow price shows how changes in the level of the constraint affect L. In most instances, economists are primarily interested in the values of the two variables (X_1, X_2) that maximize this equation, and pay less attention to the solution for the shadow price variable.

accordingly. Clearly, neither of these examples of common behavioral assumptions imposes unrealistic constraints on the decision maker.

In building a model, economists face a tradeoff with regard to the number and restrictiveness of assumptions that they use. To make their models appear to be more realistic, they may relax a number of assumptions that they initially made. In doing so, however, their models will become more complicated and difficult to solve and explain to others. It is therefore common for economists to begin with a model that includes more simplifying assumptions, and then relax certain assumptions to see if and how the results from their analysis change. Most economists also take the view that when it comes to testing the validity of a theory, whether or not the theory makes accurate predictions about the relationship under study is more important than how realistic each of the assumptions are in the model itself.[16] For example, even if decision makers do not actually solve a Lagrangian equation when making choices, if their actions are consistent with this process, then this model is still a useful way to study optimal decision-making.

We can apply the concept of optimizing behavior to multiple types of individual or institutional decision makers in higher education. Let's take the case of a college-bound high-school senior who has two colleges in her choice set (a simplifying assumption): the lower-cost, in-state, public four-year university, and a higher-cost, highly-selective, small private college. The senior is also in the market to buy a car, and is deciding between a subcompact (and less-expensive) car, and a more-expensive sports car.[17] Suppose further that if price were not an issue, the small private college is her most preferred institution and the sports car would be her most preferred automobile. A behavioral assumption is that she wants to make a decision that will maximize her happiness (or utility). Attending either of these colleges would increase her happiness by (a) enabling her to earn more money in the future, (b) encouraging her participation in extracurricular activities that make her happy, and (c) helping her learn to become independent. And buying either one of these cars would make her happy as well. Her choice is affected by scarce resources, however, due to the fact that she has a limited budget to spend on college and an automobile. As a result, she might determine that she cannot afford both the private college and the sports car, and may conclude that her most preferred institution (the highly-selective—and most expensive—college in her choice set) is too expensive for her to attend because of the utility she would lose from having to buy the subcompact rather than the sports car. In this case, she behaves rationally and engages in optimization behavior by choosing to attend the 4-year public university and buying the sports car, because this option will maximize her satisfaction or

[16] Friedman first made this argument in his *Essays on Positive Economics* (1953). However, Simon subsequently emphasized the realism of the assumptions in his work on rational decision making (1979).

[17] Cornwell and Mustard (2007) studied the effects of Georgia's HOPE scholarship on car sales, and found evidence that is consistent with the example that we describe here.

utility related to college-going within the constraints posed by her budget relative to the tuition and other expenses of college.

As another example of optimization, consider a small private college that has two goals: to enroll more high-ability students, and bring in more tuition revenue. The college—which is the decision maker in this example—experiences scarce resources due to the fact that it has limited scholarship funds to give to students. In addition, the college would have to give larger scholarships to its most desired (high-ability) applicants for the fall freshmen class. The college might then behave rationally and engage in optimization behavior by giving more scholarships to some less-preferred, but higher-paying, students—even though they would contribute less to the ability of the student body than other applicants—because this option will bring in some additional tuition revenue, sacrifice only some of the student ability it would prefer, and it is consistent with the budget constraints and enrollment target of the institution.

Finally, let's examine a department chairperson (who is also a decision maker) at a large university who must decide whether or not to offer new online versions of introductory courses required of all students in the department. The chairperson believes that there would be benefits to the department from offering the new courses, but knows that there is a scarcity of resources due to the fact that the department has a limited budget and number of faculty that could be used to develop and implement the new program. Diverting resources towards this effort would mean that the department would have to give up doing something else; for example, the department may have to cancel existing courses or drop plans to engage in certain research projects. If the benefits from the new program outweigh the costs, then the department chairperson would behave rationally by choosing to offer the online courses.

Some economists use mathematical models to develop theories of how things work, and use graphs to explain the relevant concepts to various audiences. Other economists focus their work not on the development or dissemination of theories, but rather on using statistics to test existing theories. There is a wide range of statistical methods that is used in this work, ranging from simple univariate hypothesis tests to complicated multivariate inferential methods. The specific methods used depend on the form of the underlying model and the data available to the researcher.

To see the connection between these three approaches, suppose that an economist is interested in studying enrollment variations at public flagship universities. Equation (2.6) might help the economist reason clearly about the elements of a basic theory. She might develop a theoretical model where enrollments at public flagship universities are thought to be affected by the price the flagship university charges, the price charged by competing private four-year institutions in the same state, and the average family income in the state. Furthermore, the model may predict that there is a negative relationship between the price charged by public flagship institutions and their enrollments. This might be represented in a linear form as follows:

$$E_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 P_{Sit} + \beta_3 I_{it} + \varepsilon_{it} \quad (2.6)$$

where:

E_{it} = number of students enrolled at public flagship institution i in year t
P_{it} = price of attending four-year public flagship institution i in year t
P_{Sit} = average price of the state's 4-year private institutions for institution i in year t
I_{it} = average income in the state of institution i in year t
β_1 = coefficient showing how changes in the price of the institution affect enrollments
β_2 = coefficient showing how changes in the average price of 4-year private institutions affect enrollments
β_3 = coefficient showing how changes in average income in the state affect enrollments

If the above-mentioned theory is correct, then the parameter $\beta_1 < 0$, which means that prices at a public flagship university are inversely related to the level of enrollment at a public flagship university, *ceteris paribus* (i.e., all else equal to its initial value).[18] Likewise, the model might predict that $\beta_2 > 0$, which means that prices at the state's 4-year private institutions (substitutes for a 4-year public flagship university) are directly related to the level of enrollment at the corresponding public flagship university, *ceteris paribus*. Similarly, from theory the economist expects that $\beta_3 > 0$, which means that average incomes in the state (a measure of state residents' ability to pay for college) are directly related to the level of enrollment at a state flagship university, *ceteris paribus*.

The economist could use graphs to visually illustrate these theorized relationships. For example, Fig. 2.2 provides graphical representations to illustrate the empirical estimates of two of these theorized relationships—i.e., those corresponding to β_1 and β_2. As noted previously, according to theory the prices at a public flagship university are expected to be inversely related to the level of enrollment at that public flagship university, *ceteris paribus* (i.e., holding P_{Sit} and I_{it} constant or equal to their initial values). In brief, we express this relationship as $\beta_1 < 0$. Part A of Fig. 2.2 depicts this relationship. As a public flagship university's price increases from P_1 to P_2, the quantity of enrollment at the flagship university decreases from Q_2 to Q_1, *ceteris paribus*.

On the other hand, prices at the state's four-year private institutions (a "substitute good" for the public university P_S) are directly related to the level

[18] *Ceteris paribus* is probably the most common example of economists' use of simplifying assumptions. In this example, the *ceteris paribus* assumption serves to abstract a theoretical model from all the complex details in the economy in order to focus attention on one particular relationship of importance—in this case, the effect of an increase in the price of education at a public flagship university on the level of enrollment demand at that university, *ceteris paribus*.

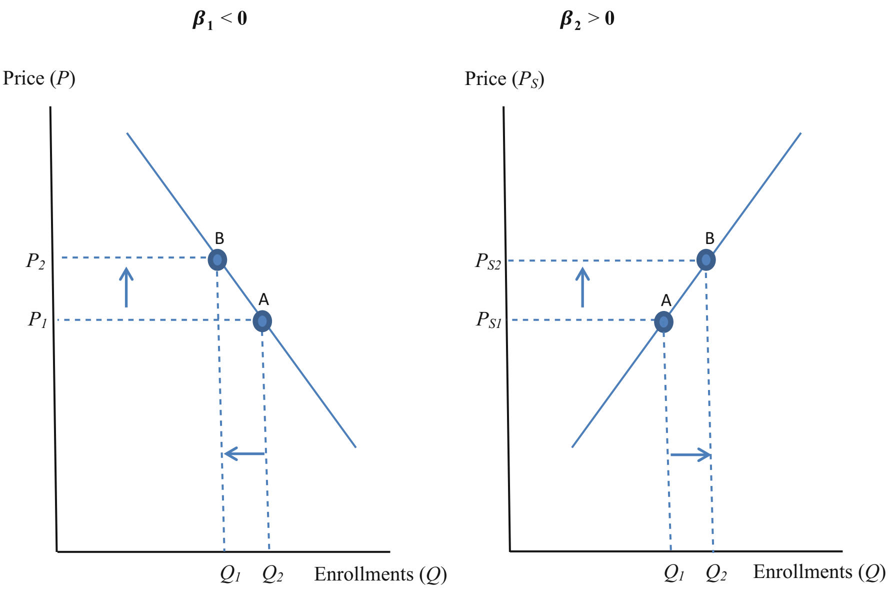


Fig. 2.2 Graphical representations of β_1 and β_2, *ceteris paribus*

of enrollment at the corresponding public flagship university, *ceteris paribus* (i.e., holding P_{it} and I_{it} constant or equal to their initial values). We express this relationship as $\beta_2 > 0$, as shown in Part B of Fig. 2.2. As prices at the state's four-year private institutions increase from P_{S1} to P_{S2}, the quantity of enrollment at the public flagship university, a less-expensive substitute, increases from Q_1 to Q_2, *ceteris paribus*.

These theoretical predictions could then possibly be tested using statistical methods provided that suitable data were available. Suppose that the economist assembles data on the variables E, P, P_S and I for the flagship public university in each of the 50 states, in order to estimate the coefficients of the model in Eq. (2.6). One approach might be to log-linearize the equation prior to estimation so that coefficients would represent the percent changes in public flagship university enrollment per one-percent change in each of the respective independent variables[19]:

$$lnE_{it} = \beta_0 + \beta_1 lnP_{it} + \beta_2 lnP_{Sit} + \beta_3 lnI_{it} + \varepsilon_{it} \tag{2.7}$$

As a result, the coefficient $\beta_1 = \%\Delta E_{it}/\%\Delta P_{it}$ which is the percent change in public flagship university enrollment per 1 % change in the price charged by the

[19] For clarity and simplicity in this introductory example, we do not address any additional theoretical and methodological issues involving the development of the elements represented in the equation or additional statistical issues that economists might consider in formulating the most optimal statistical approaches to estimation of the parameters of the equation.

public flagship university, *ceteris paribus*. Similarly, $\beta_2 = \%\Delta E_{it} / \%\Delta P_{Sit}$ or the percent change in public flagship university enrollment per 1 % change in average price of the state's 4-year private institutions, *ceteris paribus*. Finally, $\beta_3 = \%\Delta E_{it} / \%\Delta I_{it}$ or the percent change in public flagship university enrollment per 1 % change in average income in the state, *ceteris paribus*. (These three quantities are referred to by economists as elasticities, and will be explained in more detail in Chap. 5). After the data have been assembled, the economist could use a statistical software program such as Stata or SAS to estimate these quantities and use the results to test the underlying theory. For example, if the null hypothesis H_0: $\beta_1 \geq 0$ is rejected, then the empirical evidence supports the theoretical prediction about the demand equation (i.e. $\beta_1 < 0$).

Review of Key Economic Concepts

At the heart of economics is the study of choice. Decision makers such as individuals, households, organizations and nations are all alike in one way: they all have a goal or objective that they value, and they all have limited resources with which to reach their goals. As a result, each entity has to make difficult choices between alternative allocations of their limited resources in order to pursue their goals. To analyze a decision maker's behavior in these situations, economists begin by asking three central questions:

- Who is the decision maker?
- What goal is the decision maker trying to achieve?
- What are the decision maker's constraints?

As discussed earlier, economists assume that decision makers engage in optimization behavior in that they seek to maximize the achievement of their goals subject to the constraints they face. This is a highly-generalizable assumption and one that economists use to analyze the behavior of multiple decision makers in higher education contexts, such as students, departments, administrators, faculty or institutions.[20] Students are certainly very prominent decision makers in the higher education context. They make many choices such as whether or not to attend college (i.e., formation of college-going aspirations), to which colleges they will apply, which college they will attend, whether or not to persist in college (from semester-to-semester and year-to-year), which courses they will take, what to choose for their major field of study, whether or not to stay in college through

[20] The economic concepts used in the economic models of optimal decision-making presented in this chapter are also discussed in most introductory or intermediate level microeconomics textbooks, such as Frank (2009), Mankiw (2014), McEachern (2013), Pindyck and Rubinfeld (2012) and many more. And economists have previously used similar concepts and models to analyze decision-making behavior in the higher education context (e.g., Brewer, Hentschke, & Eide, 2010; Paulsen & Toutkoushian, 2006, 2008).

graduation, whether or not to go to graduate or professional school, and more.[21] Although students are important, there are also many other decision makers within the broad scope of higher education that can be examined through economic analysis. Professors, for example, must decide how to allocate their scarce time between teaching, research, and service. Academic departments have to make decisions about how to distribute its budget between faculty, staff, and other uses. A college or university faces decisions regarding how much resources should be devoted to various academic departments. State governments must determine how much scarce funding to distribute between competing demands from higher education, K-12 education, corrections, transportation, and so on. And federal or national governments must make similar decisions regarding the allocation of scarce resources among competing demands including higher education.

Implicit in the economist's notion of optimization is that the decision maker acts in ways that are perceived to be in its best interest. That is, it is assumed that the decision maker only considers the private costs and benefits of actions and chooses the action that would result in the greatest net benefit. Economists believe that in most situations not only is acting in one's self-interest best for the decision maker, but it also results in the best outcome for society as a whole.[22]

Because different decision makers, including students, have different goals—and the same decision maker can even have different goals at different times and in different contexts—economists often express these goals with a more generalizable form. They often conceptualize and express a decision maker's goals in terms of the *utility* or satisfaction received from pursuit of their goals. Thus, when students make choices, they are doing so to maximize their utility subject to the constraints they face. Utility is a very flexible construct in that the satisfaction that people receive from the same good or service can differ widely across individuals. The only assumptions that economists typically impose on a decision maker's preferences are: (1) each decision maker can determine for itself how much utility it gets from the particular good; (2) the decision maker can rank single goods and combinations of goods in terms of how much utility they get from each, (3) all goods are "good," meaning that they give the recipient positive utility, and (4) total utility increases at a decreasing rate. Although utility cannot be directly measured, this is not a problem for economic reasoning or models due to the emphasis in the field on comparative statics (to be discussed later in this chapter).

Economic models of decision making represent various levels of utility or satisfaction using indifference curves. Each *indifference curve* shows all combinations of two goods or services that would yield the same level of utility and higher indifference curves correspond to higher levels of utility or satisfaction. Each

---

[21] For greater elaboration on the elements of the *student choice construct*—i.e., students make a sequence of choices and each choice constitutes a policy target, students make choices in unique situated contexts, there are diverse patterns of choice that vary by race, class, gender, and other student characteristics, and diverse patterns of choice by diverse groups merit separate study—see Paulsen and St. John (2002) and St. John, Asker, and Hu (2001).

[22] We discuss exceptions to this rule in Chap. 6.

decision maker is thought to possess an infinite number of such indifference curves, each one corresponding to a unique level of happiness or utility. Indifference curves are usually drawn as functions that are convex to the origin (i.e., curves that bow inward towards the origin) such as shown in Fig. 2.3. This particular shape is useful in situations where decision makers prefer to have combinations of goods rather than use all their scarce resources for only one good, and reflects the assumptions made about utility.

The entire set of indifference curves represents a decision maker's preferences because they show which combinations of goods or services are valued the most by the decision maker. These preferences are usually assumed to be constant over the short run, meaning that the values that a decision maker places on goods and services do not change quickly. As a discipline, economics has not focused much attention on how preferences are formed. Other fields such as psychology and sociology are arguably better suited to answer questions about why people like certain things more than others. The only assumption made by economists is that the decision maker has a set of preferences that conform to the four rules stated earlier. This is not to say, however, that preferences cannot change. Tastes and preferences can and do vary over time, and some psychologists argue that a person's preferences are not well formed until he or she reaches their mid-20s. In this sense, advertising can be thought of not only as a means to provide consumers with better information about the benefits of a particular product, but also as an effort to shift the person's preferences towards their product.

To see how preferences and constraints are used in optimization, consider a student who has to allocate her income between paying for college and paying for everything else. She would maximize her utility by dividing her budget between units of higher education (*ED*), which could represent years of college or number of credit hours) and a composite of other goods and services (*OG*) so that the combination of *ED* and *OG* she chooses is on the highest possible indifference curve while using all of her income. Point C in Fig. 2.3 portrays this optimal combination. The optimum amount the student should spend on higher education is denoted in this graph by the point *ED**. Note that Fig. 2.3 is nothing more than a specific example of the general optimization problem shown in Fig. 2.1. The only differences are that in Fig. 2.3 the benefit to the decision maker is specified as utility and the constraint as income.

Given a fixed budget constraint, as illustrated by the straight line in Fig. 2.3, to purchase additional units of higher education (+*ED*) the student would have to give up some of her spending on other goods (−*OG*). This illustrates a very important economic concept: *opportunity costs*. Basically, the opportunity cost of doing something is the value to the decision maker of all that has to be given up or foregone due to choosing this particular option. The opportunity cost of higher education in this example is the amount of other goods she has to give up or forego (−*OG*) in order to attain an additional unit of higher education (+*ED*). The concept of opportunity cost is highly generalizable and applicable in virtually any decision-making process.

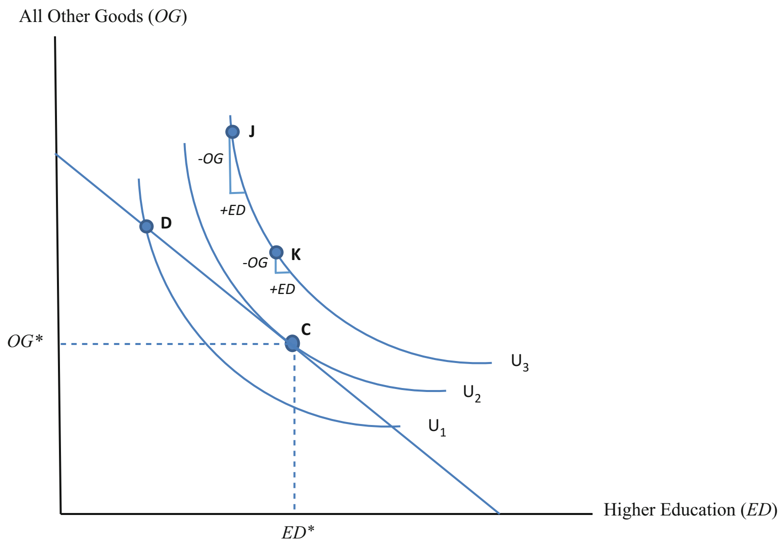


Fig. 2.3 Student's optimization of investment in higher education

Another important economic concept is marginal utility. Economists define *marginal utility* as the additional utility obtained from consuming one more unit of a good or service. For the student decision maker portrayed in Fig. 2.3, marginal utility would be the additional utility associated with obtaining one more unit of higher education (+*ED*). An important principle related to marginal utility is the *law of diminishing marginal utility*. This economic principle states that as more of a good or service is consumed, the additional units yield decreasing amounts of marginal utility for the consumer. The shape of an indifference curve (i.e., convex to the origin) reflects this principle. Consider indifference curve U_3 in Fig. 2.3. When the student is consuming relatively fewer units of higher education, such as at point J, she is willing to give up a large amount of other goods (−*OG*) in order to obtain one more unit of higher education (+*ED*). However, when she has consumed more units of higher education, such as at point K, she is now willing to give up only smaller amounts of other goods (−*OG*) in order to obtain one more unit of higher education (+*ED*). The smaller and smaller amounts of other goods and services she is willing to give up or forego to obtain additional units of higher education reflects the law of diminishing marginal utility. The concept of diminishing returns can also be applied to the productivity of resources such as labor.

The same optimization approach could be used to examine how a professor makes decisions regarding how to allocate her time. Suppose that a professor is considering teaching an additional course in the fall semester. If she were to do this, then she will have less time for other activities, such as conducting research and taking part in service or personal activities. Note that in this example, the scarce resource being allocated by the decision maker is time and not money. The value to the faculty member of these alternatives foregone is the opportunity cost of teaching an additional course.

Another important feature of the model of optimal decision making is that economists assume that individuals engage in rational behavior when making decisions. A set of indifference curves—as in Fig. 2.3—portrays one decision maker's set of preferences. This individual student's preferences are based on her perceptions of the values of the various benefits and costs of higher education (*ED*) and other goods and services (*OG*). However, each individual student's preferences are very subjective and unique and there is substantial interpersonal variation in preferences. This is due to factors such as different home and school environments, different levels or qualities of college-going information available to individuals, different life experiences, differences in socioeconomic status, different moral or religious beliefs, different personalities and more. Variations in interpersonal preferences manifest themselves in many ways. For example, while one student may place higher values on or derive greater utility from the tangible benefits from salaries of bachelor's degree graduates in high-paying professional fields of study (e.g., accounting or engineering), another student may assign higher values or utility to the intangible benefits of lower-paying, but (to them) more personally-rewarding work of bachelor's degree graduates in some lower-paying fields (e.g., education or social work). Because of these interpersonal differences in preferences, two students facing the very same budget constraint might decide on two different levels of investment in higher education. Nevertheless, economists would say that both students would still be engaged in rational behavior as long as each student maximizes her utility in accordance with her own unique, but different, preferences for higher education relative to other goods.[23]

Another important feature of economic analysis is its usefulness for examining how incentives can affect the behavior of decision makers. When policy makers at the federal, state or institutional level enact policies, these policies often provide incentives for decision makers to change their behavior in ways that align with the policy maker's interest. To an economist, policies do this by altering the constraints faced by the decision maker, which then leads to a new optimum point for the decision maker. For example, if the state of Iowa were to introduce a new financial aid program that provides scholarships to low-income students who attend two-year colleges, then the budget constraints for low-income students in the state would change because the price of attending a two-year college has decreased. As a result, this new program would lead to new optimum values for low-income students and perhaps persuade some to go to college who would not have done so otherwise. Note that economists focus on changing constraints as a way to entice decision makers to act in certain ways, rather than to try and change the preferences of

[23] The fact that preferences are difficult to observe presents challenges for those who seek to determine whether an action was rational or not. For a thorough analysis and discussion of the concept of rational behavior and its application to higher education, see DesJardins and Toutkoushian (2005).

decision makers. Low-income students who are offered the scholarship get the same enjoyment out of attending a two-year college as they would without the scholarship, but now are more likely to attend a two-year college due to the incentive provided by the price reduction. When studying the choices made by decision makers in higher education—e.g., students, faculty, departments, institutions, etc.—economists pay special attention to how decision makers respond to incentives and changes in those incentives.[24] For example, since the early 1990s quite a few states have implemented large merit-based grants-to-students programs. Such grants would expand the budget constraints of many students, thereby creating a stronger incentive for students to attend and persist in college.[25]

Comparative Statics

The notion of comparative statics is very important in economics. In its most simple form, comparative statics focuses attention on how a change in a policy or other factor affects an optimum decision or equilibrium in the model. Arguably, the tools of economics are better suited for explaining changes in equilibrium than for explaining how a specific equilibrium was reached in the first place. The focus of comparative statics on changes in equilibrium also means that if preferences are assumed constant during the change, then whether or not an economist can observe these preferences does not affect the analysis.

Economists rely on comparative statics as a tool for examining the predicted impact of a higher education policy on an outcome of interest. In principle, all of the components of the college choice model to be discussed in Chap. 3 are subject to change: institutions can adjust tuition rates, financial aid, consumptive benefits, and so on. At the same time, some factors such as preferences for college may be more stable over short periods of time than other factors and it may be reasonable to treat them as if they were constant. The goal of the comparative static analysis may be simply to identify the predicted direction of an effect of a change in one factor on an outcome, or if the economist has good information about the underlying function examined, it may be to go further and estimate the magnitude of the change.

When presented with a mathematical function showing how a series of factors affect an outcome of interest, such as $Y = f(X_1, \ldots, X_n)$, the first partial derivative of the function with respect to the factor of interest ($\partial Y / \partial X_i$) is interpreted as a comparative static analysis because it represents how Y changes due to a very small change in X_i, holding other factors in the equation constant. If $\partial Y / \partial X_i < 0$, then as

[24] In Chap. 5, we examine more fully the effects of policy changes on the budget constraint, including adjustments in the budget constraint that result in changes in students' decisions about their optimal level of higher education (*ED*).

[25] See the latest surveys and reports from the National Association of State Student Grant and Aid Programs (NASSGAP) for detailed information about both need-based and merit-based grant programs in various states.

X_i increases it is predicted to decrease Y, *ceteris paribus*, and vice-versa. These partial derivatives may be complex depending on the underlying model and assumptions as to how X_i affects Y. If, for example, the variable X_i affects Y though a third variable Z, then the Chain Rule from calculus would be needed to perform the comparative static exercise (see an example in Chap. 3). The total change in Y due to a change in X_i will also depend on the size of the change in X_i. For example, a $1000 increase in tuition should have a larger effect on the demand for higher education than would a $50 tuition increase. The total change in Y that is predicted by a change in X_i can therefore be written in general form as $(\Delta Y_i) = (\Delta X_i)(\partial Y/\partial X_i)$, where ΔY = number of units change in Y due to X_i, and ΔX_i = number of units change in X_i.

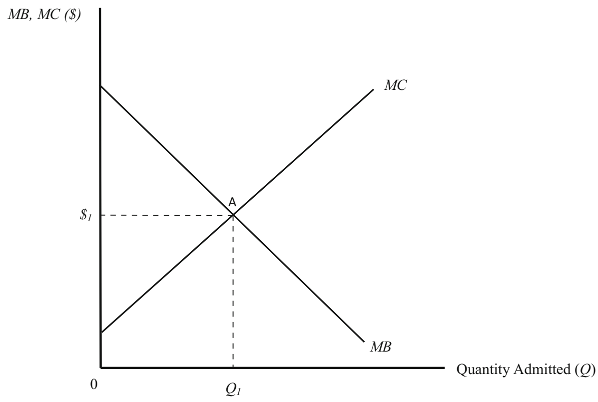
Marginal Analysis

It is very common for economists to view decision makers as being "at-the-margin" in their decision-making process. In other words, given their perceived benefits and costs, preferences and constraints, they are "sitting on the fence" and are about ready to make a choice. Examples from higher education include: (1) a student will choose whether or not to complete an additional year of higher education; (2) an enrollment manager in the admissions office will choose whether or not to admit an additional full-paying student; (3) a faculty member will choose whether or not to teach an additional course, and (4) a department chairperson will choose whether or not to offer an additional online course. Economists often use *marginalism* as another way to analyze optimal decision-making—for either individual or institutional decision-making behavior. In economics, *marginal analysis* means that a decision maker engages in optimization behavior by comparing the change in benefits, or the *marginal benefit*, to the change in costs, or the *marginal cost*, associated with the decision maker's choice.

Consider the case where an institution is making the decision regarding whether to admit a new applicant. The institution must estimate the value of this additional student to the institution, in terms of the net tuition revenue that he or she will add to the institution if admitted, as well as other less-tangible benefits such as how the student affects the institution's diversity, prestige and reputation. This combined additional value is the applicant's marginal benefit to the college. The institution would also have to evaluate how much additional costs would be incurred by admitting the student. These additional costs may come in the form of direct instructional costs for more faculty, indirect costs for administrative and support services, and other expenses. The total additional expense incurred by the institution is the student's marginal cost.

A typical representation of marginal costs and benefits is shown in Fig. 2.4. Marginal benefits fall as the quantity of the object under consideration rises. In our example, this might mean that the marginal benefits of students to the institution fall

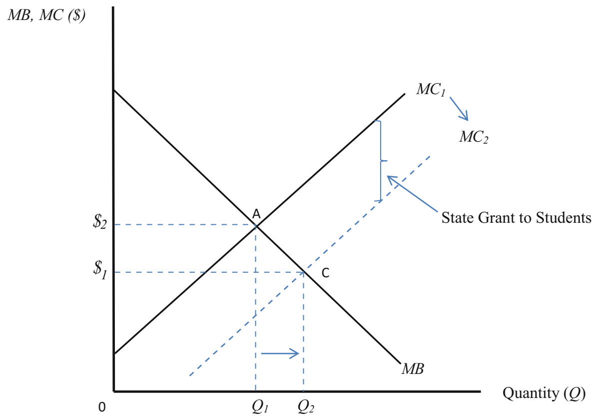
Fig. 2.4 An institution's marginal benefits and costs from admissions



as more students are admitted (i.e., the most valuable are admitted first). Likewise, marginal costs are frequently modeled as increasing as the quantity of the object rises. This would mean that the marginal cost of an admitted student rises as more are admitted (i.e., the least costly are admitted first). So, as long as the *MB* of an applicant is greater than the *MC* of an applicant, the institution would be better off by admitting the additional student. From the institution's perspective, the optimal level of admissions corresponds to point A in Fig. 2.4, where $MB = MC = \$_1$ and the institution would admit Q_1 students. We could apply this same optimal decision-making framework to any decision maker in higher education. Although the precise nature of the marginal benefits and the marginal costs would differ, the logic of the decision-making process would be identical for the student considering investing in an additional year of college, the faculty member considering teaching an additional course, and the department chairperson considering offering an additional online course.

For further illustration, let's look at the case where a student must decide whether or not to enroll in an additional year of college, and the government enacts a policy to help encourage the student to do so. Figure 2.5 illustrates the effects of a government policy in the *MB-MC* optimal decision-making framework. If the student receives a state merit grant equal to the value shown by the height of the "brace" shown in Fig. 2.5, this will produce a downward/rightward shift in the *MC* from its previous level. The grant reduces the student's marginal cost for an additional year of college from MC_1 *to* MC_2, and the new *MC* curve changes the student's decision. A student in this model would enroll in an additional year of college as long as *MB* is greater than or equal to *MC*. The new optimal level of investment in years of college corresponds to point C in Fig. 2.5, where $MB = MC_2 = \$_1$ and the student would now invest in Q_2 years of college. Using comparative statics, we compare the pre-policy optimal investment (Q_1), corresponding to point A in the figure, with the post-policy optimal investment (Q_2), corresponding to point C in the figure, and observe that the merit grant policy provided an incentive that motivated students to invest in $Q_2 - Q_1$ more years of college. The impact of the merit-grants policy is to increase student investment in higher education. We consider these policy issues in more detail in Chap. 6.

Fig. 2.5 Effects of grants to students on marginal costs and benefits from higher education



The discussion about marginal analysis highlights another feature of economic analysis: the importance of both costs and benefits in decision making. When considering an action or decision, economists emphasize the importance of both the benefits of the action and the costs of the action in deciding what to do. In general, the benefits have to exceed the costs to make the action worthwhile. This is important because sometimes in higher education a decision maker may overlook the costs and focus instead on the potential benefits of particular actions. There are many policies and actions in higher education that would arguably provide benefits to decision makers. For example, most every high school graduate would obtain some benefits from enrolling in college. Does this mean that every high school graduate should go to college? To an economist, the answer involves comparing the benefits that a student would receive to the cost that the student would incur. If the costs and benefits of college vary across individuals, then some students may find that even though they would benefit from going to college, the costs to them would be greater than the benefits and thus it would not be in their best interest to do so. Likewise, if the spillover benefit to a state from a given student from going to college is positive but less than the amount of financial aid needed to entice the student to do so, then the state should not give the student the subsidy.

Demand, Supply, and Competitive Markets

Finally, one of the most important sets of theoretical models relies on the concepts of demand, supply and competitive markets. As noted earlier, the interactions of demanders and suppliers in competitive markets determine how much of a good or service will be produced, how much will be consumed, at what price it will be sold, and how it will be distributed. These exchanges between demanders and suppliers are voluntary and occur only when both parties feel that they will benefit from such transactions. Suppliers benefit from the price per unit sold that they receive from demanders. But the price suppliers require must be at least high enough for them to cover their costs of producing the good or service. In a market of for-profit suppliers, this price must be sufficient to cover costs of production plus provide a profit; while in a market of non-profit suppliers a price that covers the costs of production is sufficient. These prices are reflected in the market supply curve. Demanders also benefit from market transactions due to the utility they gain when they acquire the good or service. But the price demanders pay must not exceed what they are willing and able to pay, given their incomes and the alternative goods and services they could acquire with their available financial resources. These prices are shown in the market demand curve.

Markets serve as a mechanism for decision makers to trade with each other. Drawing on the notion of comparative advantage, each decision maker engages in those activities where it is better than most other decision makers. These advantages may come from natural ability (e.g., some people are better than others at building houses) or from access to key resources (e.g., some nations are better able to extract oil than others due to their location). Economists believe that society benefits the most when each decision maker does what it can do best, and then trade with each other in markets to get those goods and services where they do not have a comparative advantage.

Figure 2.6 shows a graphical version of a market in which demanders and suppliers interact in ways that determine the price at which a good or service will

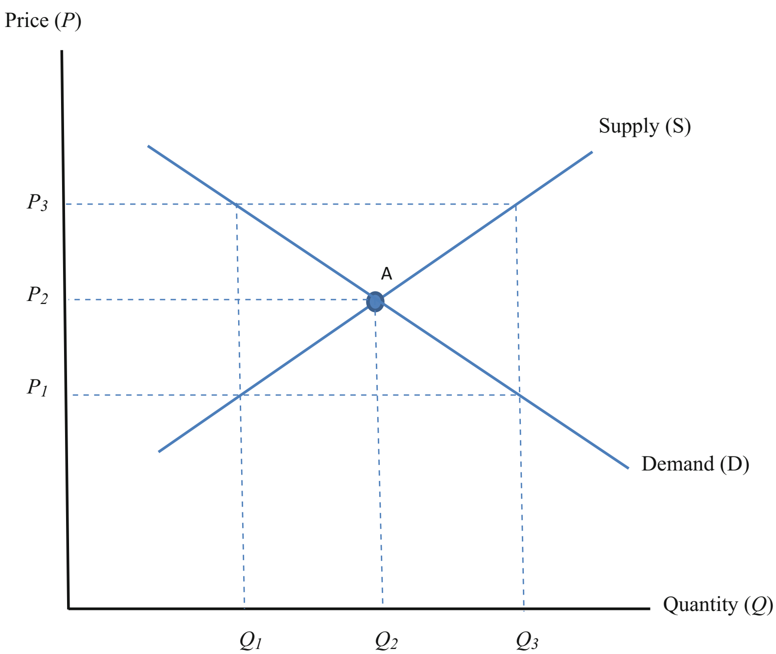


Fig. 2.6 Equilibrium in a postsecondary market

be exchanged and the quantity that will be produced and consumed. The *market demand* curve is the sum of the demand curves of all the individual consumers and the *market supply* curve is the sum of the supply curves of all the individual producers. Point A in Fig. 2.6 is where demand and supply intersect, and is the point at which demanders and suppliers reach agreement on price and quantity exchanged. Economists refer to this point as the *equilibrium* in the market, corresponding to an equilibrium price P_2 and an equilibrium quantity Q_2. If prices are above equilibrium, then market forces will work to lower prices towards equilibrium because sellers will have an incentive to reduce prices to sell their inventory. Likewise, when prices are below equilibrium, demanders will offer more money to get the good or service which in turn drives prices up towards equilibrium. All of this happens without any formal coordination or agreement among buyers and sellers. To paraphrase Adam Smith, it is as if an "invisible hand" moves prices towards its equilibrium value.

Along the market demand curve, as prices rise from P_1 to P_2 to P_3, each higher price corresponds to a smaller quantity demanded—i.e., Q_3 to Q_2 to Q_1, respectively. Economists refer to this pattern as the *law of demand*: price and quantity demanded are inversely related, *ceteris paribus*. Along the market supply curve, as prices rise from P_1 to P_2 to P_3, each higher price corresponds to a larger quantity supplied—i.e., Q_1 to Q_2 to Q_3, respectively. Economists refer to this pattern as the *law of supply*: price and quantity supplied are directly related, *ceteris paribus*.

In the statements of the laws of demand and supply, the *ceteris paribus* assumption is very important. This is a good example of how economists make simplifying assumptions to develop a theoretical model that relies on abstraction from all the complexities of an active marketplace and environment in order to focus our attention on just the relationship between prices and quantities along a single demand or supply curve. We can readily observe the predicted patterns of prices and quantities *only if* nothing else changes in the market that causes a shift to an entirely new and different demand or supply curve. However, when the *ceteris paribus* assumption does not apply, then in the full complexity of market dynamics, we might observe prices go up while the quantity that consumers purchase also increases. This observation could be due to any number of complicating factors that actually shift either the demand or the supply curve to a whole new position. One such factor could be a tax cut for the middle class. In this instance, we may observe prices of a product going up, while the quantities consumers purchase also go up. The reason we see quantity demanded increase as price goes up is that the tax cut increases consumers' take-home pay and disposable incomes and it is the increase in consumers' incomes that causes quantity demanded to go up, *not* the price increase.

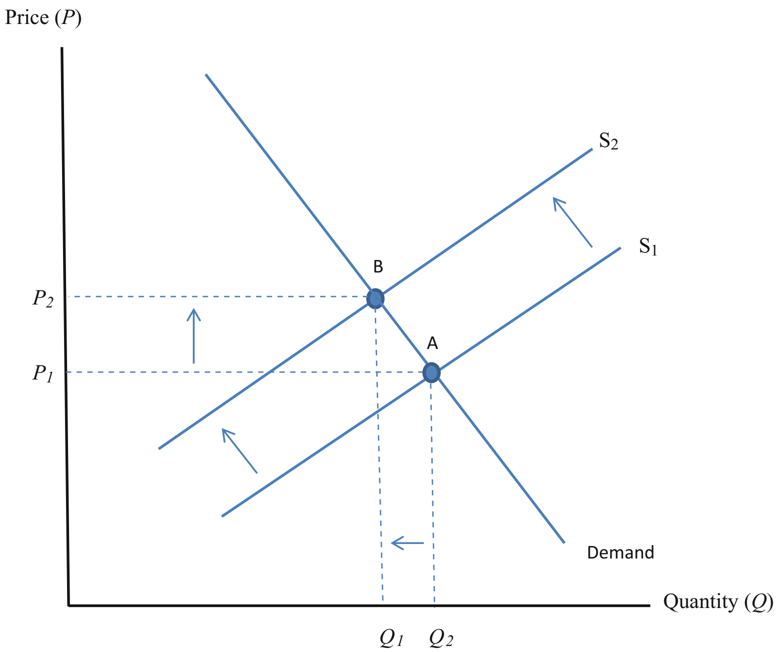


Fig. 2.7 Effect of decrease in supply on equilibrium in a postsecondary market

Higher Education Markets

There are many different markets within the higher education industry. They vary greatly in terms of size and scope.[26] Examples of markets for students could include: a primarily state-wide market comprised of all public 4-year institutions in a single state; a primarily national market of all highly-selective private colleges; a primarily regional market of all moderately selective small private colleges in a set of contiguous states; or a primarily local market of all public and private, 4-year and 2-year institutions in a large urban/metropolitan area. Regardless of the scope of the market, in the full complexity of market dynamics, various non-price factors commonly change and result in shifts in demand or supply. These shifts, in turn, lead to new equilibrium points in the market at new equilibrium prices and quantities.

For the purposes of illustration, we assume here that the market portrayed in Fig. 2.7 is the market for all public 4-year universities in a single state. For each of these public universities, the great majority—though not all—of their students are

[26] We discuss markets in more detail in Chaps. 5 and 8. Interested readers are also referred to W. Becker and Toutkoushian (2013) for a thorough examination of the nature and characteristics of markets in higher education.

residents from within the state. In this market, the original equilibrium is at point A, where interactions between the universities and their students have generated an equilibrium price of P_1 and an equilibrium quantity enrolled of Q_2. However, in recent years, one of the most common and persistent policy changes in state markets is for the legislature to reduce the year-to-year appropriations to their public universities. Because public universities have long relied on this state funding to help cover the costs of educating their students, a reduction in state appropriations means that these public universities must turn to other sources of revenue such as tuition and fees from students and their families. The reduction in subsidies to public universities and the resultant increase in the universities' uncovered costs of educating their students leads to a decrease in supply. The decrease in supply means that for each quantity of students enrolled these institutions now require a higher price from students than before in order to cover the costs of educating students.

The market in Fig. 2.7 portrays the decrease in supply as a leftward/upward shift. The supply curve shifts from S_1 to S_2 and the new supply curve intersects demand at point B, where the new equilibrium price is now P_2 and the new equilibrium quantity enrolled is Q_1. Using comparative statics, economists would compare equilibrium points in markets before (A) and after (B) a policy change to determine the effects of that policy. In this case, the policy change—i.e., a decrease in state appropriations to public institutions—leads to a shift in the supply curve, resulting in a new market equilibrium at point B, and an increase in tuition price from P_1 to P_2, along with a small decrease in quantity enrolled from Q_2 to Q_1.[27]

Final Thoughts

As is true of most any academic discipline, economics is field with its own language and set of tools that it uses to examine issues under its purview. Perhaps the main challenge facing non-economists who delve into this area is that they must become familiar with the way in which economists conduct and present their work. A thorough explanation of all of these concepts and tools is beyond the scope of this chapter and this book. However, it is our hope that having this early exposure to key concepts—such as optimization, marginal analysis, utility, and demand and supply—here in this chapter will prove to be helpful for those readers who do not have prior experience in the field. In subsequent chapters, we try to err on the side of simpler mathematical representations rather than the more complex. However, there may still be instances where the level of mathematics we use might be challenging to some readers. Hopefully, our focus on the intuition behind the math will help in these situations.

[27] Research by economists of higher education has consistently shown that reductions in state appropriations lead to increases in tuition charged by public universities (see e.g., Paulsen, 1991; Rizzo & Ehrenberg, 2004; Rusk & Leslie, 1978).

References

Andrews, R., DesJardins, S., & Ranchhod, V. (2010). The effects of the Kalamazoo Promise on college choice. *Economics of Education Review, 29*, 722–737.

Avery, C., & Hoxby, C. (2004). Do and should financial aid affect students' college choices. In C. Hoxby (Ed.), *College choices*. Chicago: University of Chicago Press.

Barro, R., & Sala-I-Martin, X. (1995). *Economic growth*. New York: McGraw-Hill.

Baum, S., Ma, J., & Payea, K. (2010). *Education pays 2010*. New York: The College Board.

Baumol, W., Blackman, S., & Wolff, E. (1989). *Productivity and American leadership*. Cambridge, MA: MIT Press.

Becker, G. (1960). Underinvestment in college education. *American Economic Review, 50*, 346–354.

Becker, G. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy, 70*, 9–49.

Becker, G. (1964). *Human capital: A theoretical and empirical analysis with special reference to education*. Chicago: University of Chicago Press.

Becker, W. (1990). The demand for higher education. In S. Hoenack & E. Collins (Eds.), *The economic of American Universities: Management, operations, and fiscal environments* (pp. 155–188). Albany, NY: State University of New York Press.

Becker, W., & Toutkoushian, R. (2013). On the meaning of markets in higher education. In M. Paulsen (Ed.), *Higher education: Handbook of theory and research* (Vol. XXVIII, pp. 323–376). Dordrecht, The Netherlands: Springer.

Benson, C. (1968). *The economics of public education*. Boston: Houghton Mifflin.

Bishop, J. (1977). The effect of public policies on the demand for higher education. *Journal of Human Resources, 5*, 286–307.

Blaug, M. (1966). *Economics of education: A selected annotated bibliography*. Oxford: Pergamon Press.

Blaug, M. (1970a). *Economics of education: A selected annotated bibliography* (2nd ed.). Oxford, UK: Pergamon Press.

Blaug, M. (1970b). *An introduction to the economics of education*. London: The Penguin Press.

Blaug, M. (1978). *Economics of education: A selected annotated bibliography* (3rd ed.). Oxford, UK: Pergamon Press.

Bettinger, E., Long, B., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *Quarterly Journal of Economics, 127*, 1–38.

Bowen, H. (1980). *The cost of higher education: How much do colleges and universities spend per student and how much should they spend?* San Francisco: Jossey-Bass.

Breneman, D. (1994). *Liberal arts colleges: Thriving, surviving, or endangered*. Washington, DC: Brookings Institution.

Brewer, D., Hentschke, G., & Eide, E. (2010). Theoretical concepts in the economics of education. In D. Brewer & P. McEwan (Eds.), *Economics of education* (pp. 3–8). New York: Elsevier.

Brinkman, P. (1985). Simultaneous equation bias in higher education cost functions. *Research in Higher Education, 23*, 201–218.

Brinkman, P. (1990). Higher education cost functions. In S. Hoenack & E. Collins (Eds.), *The economics of American universities: Management, operations, and fiscal environment*. New York: State University of New York Press.

Brinkman, P., & Leslie, L. (1986). Economies of scale in higher education: Sixty years of research. *Review of Higher Education, 10*, 1–28.

Campbell, R., & Siegel, B. (1967). The demand for higher education in the United States, 1919–1964. *American Economic Review, 57*, 482–484.

Canterbery, E. (2010). *A brief history of economics: Artful approaches to the dismal science* (2nd ed.). Hackensack, NJ: World Scientific Publishing.

Castleman, B., & Long, B. (2013). *Looking beyond enrollment: The causal effect of need-based grants on college access, persistence, and graduation* (National Bureau of Economic Research (NBER) Working Paper No. 19306). Cambridge, MA: National Bureau of Economic Research.

Cheslock, J. (2005). Differences between public and private institutions of higher education in the enrollment of transfer students. *Economics of Education Review, 24*, 263–274.

Clotfelter, C. (1996). *Buying the best: Cost escalation in elite higher education*. Princeton, NJ: Princeton University Press.

Cohn, E. (1972). *The economics of education*. Lexington, MA: D.C. Heath & Co.

Cohn, E., & Geske, T. (1990). *The economics of education* (3rd ed.). New York: Pergamon Press.

Cornwell, C., & Mustard, D. (2007). Merit-based college scholarships and car sales. *Education Finance and Policy, 2*, 133–151.

Curs, B., & Singell, L. (2002). An analysis of the application and enrollment processes for in-state and out-of-state students at a large public university. *Economics of Education Review, 21*, 111–124.

Curs, B., Singell, L., & Waddell, G. (2007). The Pell program at thirty years. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XXII, pp. 281–334). New York: Springer.

Denison, E. (1962). *The sources of economic growth in the United States*. New York: Committee for Economic Development.

Denison, E. (1985). *Trends in American economic growth, 1929–1982*. Washington, DC: Brookings Institution.

DesJardins, S., & McCall, B. (2014). The impact of the Gates Millennium Scholars Program on college and post-college related choices of high ability, low-income minority students. *Economics of Education Review, 38*, 124–138.

DesJardins, S., & Toutkoushian, R. (2005). Are students really rational? The development of rational thought and its application to student choice. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 20, pp. 191–240). Dordrecht, The Netherlands: Kluwer.

Dundar, H., & Lewis, D. (1995). Departmental productivity in American universities: Economies of scale and scope. *Economics of Education Review, 14*, 119–144.

Dynarski, S. (2004). The new merit aid. In C. Hoxby (Ed.), *College choices*. Chicago: University of Chicago Press.

Ehrenberg, R. (2000). *Tuition rising: Why college costs so much*. Cambridge, MA: Harvard University Press.

Ferber, M., Loeb, J., & Lowry, H. (1978). The economic status of women faculty: A reappraisal. *The Journal of Human Resources, 13*, 385–401.

Fisher, I. (1906). *The nature of capital and income*. New York: Macmillan.

Frank, R. (2009). *Microeconomics and behavior*. New York: McGraw-Hill Irwin.

Freeman, R. (1976). *The overeducated American*. New York: Academic.

Friedman, M. (1953). *Essays in positive economics*. Chicago: University of Chicago Press.

Galper, H., & Dunn, R. (1969). A short-run demand function for higher education in the United States. *Journal of Political Economy, 77*, 765–777.

Hansen, W. (1963). Total and private rates of return to investment in schooling. *Journal of Political Economy, 71*, 128–140.

Hansen, W., & Weisbrod, B. (1969). *Benefits, costs and finance of public higher education*. Chicago: Markham Publishing.

Heckman, J., Lochner, L., & Todd, P. (2008). Earnings functions and rates of return. *Journal of Human Capital, 2*, 1–31.

Heller, D. (1997). Student price response in higher education: An update to Leslie and Brinkman. *Journal of Higher Education, 68*, 624–659.

Hoenack, S. (1990). An economist's perspective on costs within higher education institutions. In S. Hoenack & E. Collins (Eds.), *The economics of American universities: Management, operations, and fiscal environment*. New York: State University of New York Press.

Hoenack, S., & Weiler, W. (1979). Cost-related tuition policies and university enrollments. *Journal of Human Resources, 10*, 332–360.

Hoffman, E. (1976). Faculty salaries: Is there discrimination by sex, race, and discipline? Additional evidence. *American Economic Review, 66*, 196–198.

Hopkins, D. (1990). The higher education production function: Theoretical foundations and empirical findings. In S. Hoenack & E. Collins (Eds.), *The economics of American universities*. Albany, NY: State University of New York Press.

Hull, C. (Ed.). (1899). *The economic writings of Sir William Petty*, 2 vols. Cambridge, MA: Cambridge University Press.

Hunt, E., & Lautzenheiser, M. (1992). *History of economic thought: A critical perspective*. Armonk, NY: ME Sharpe.

Jorgenson, D. (1984). The contribution of education to U.S. economic growth. In E. Dean (Ed.), *Education and economic productivity*. Cambridge, MA: Ballinger.

Kane, T. (2007). Evaluating the impact of the D.C. tuition assistance grant program. *Journal of Human Resources, 42*, 555–582.

Kane, T. (1999). The price of admission: Rethinking how Americans pay for college. Washington, DC: The Brookings Institution Press.

Kane, T., & Rouse, C. (1999). The community college: Educating students at the margin between college and work. *Journal of Economic Perspectives, 13*, 63–84.

Kohn, M., Manski, C., & Mundel, D. (1976). An empirical investigation of factors which influence college-going behavior. *Annals of Economic and Social Measurement, 5*, 391–419.

Leslie, L., & Brinkman, P. (1988). *The economic value of higher education*. New York: American Council on Education/MacMillan.

Loeb, J., Ferber, M., & Lowry, H. (1978). The effectiveness of affirmative action for women. *The Journal of Higher Education, 49*, 218–230.

Long, B. (2004). How have college decisions changed overtime? An application of the conditional logistic choice model. *Journal of Econometrics, 121*, 271–296.

Mankiw, G. (2014). *Principles of microeconomics*. Cincinnati, OH: South-Western Publishing.

Manski, C., & Wise, D. (1983). *College Choice in America*. Cambridge, MA: Harvard University Press.

McEachern, W. (2013). *Microeconomics: A contemporary introduction*. Cincinnati, OH: South-Western Publishing.

McMahon, W. (1984). The relation of R & D to productivity growth. *Economics of Education Review, 3*, 299–313.

McMahon, W. (1991). Relative returns to human and physical capital in the U.S. and efficient investment strategies. *Economics of Education Review, 10*, 283–296.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: The Johns Hopkins University Press.

McPherson, M. (1978). The demand for higher education. In D. Breneman & C. Finn (Eds.), *Public policy and private higher education*. Washington, DC: The Brooking Institution.

McPherson, M., & Shapiro, M. (1998). *The student aid game: Meeting need and rewarding talent in American higher education*. Princeton, NJ: Princeton University Press.

Mushkin, S. (Ed.). (1962). *Economics of higher education*. Washington, DC: Office of Education.

Niu, S., Tienda, M., & Cortes, K. (2006). College selectivity and the Texas top 10 % law. *Economics of Education Review, 25*, 259–272.

Oaxaca, R. (1973). Male–female wage differentials in urban labor markets. *International Economic Review, 14*, 693–709.

O'Donoghue, M. (1971). *Economic dimensions in education*. Dublin, OH: Gill & Macmillan.

Paulsen, M. (1989). Estimating instructional cost functions at small independent colleges. *Journal of Education Finance, 15*, 53–66.

Paulsen, M. (1990). *College choice: Understanding student enrollment behavior* (ASHE Higher Education Report). Washington, DC: The George Washington University.

Paulsen, M. (1991). College tuition: Demand and supply determinants, 1960–1986. *Review of Higher Education, 14*, 339–358.

Paulsen, M. (1998). Recent research on the economics of attending college: Returns on investment and responsiveness to price. *Research in Higher Education, 39*, 471–489.

Paulsen, M. (2000). Economic perspectives on rising college tuition: A theoretical and empirical exploration. In J. Smart (Ed.), *Higher education: Handbook of theory and research*. New York: Agathon Press.

Paulsen, M., & Fatima, N. (2007). Higher education and growth in state workforce productivity, 1980–2000: Evidence of the public benefits of college. In P. Richards (Ed.), *Global issues in higher education* (pp. 37–56). New York: Nova.

Paulsen, M., & Pogue, T. (1988). Higher education enrollment: The interaction of labor market conditions, curriculum, and selectivity. *Economics of Education Review, 7*, 275–290.

Paulsen, M., & St. John, E. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *The Journal of Higher Education, 73*, 189–236.

Paulsen, M., & Toutkoushian, R. (2006). Overview of economic concepts, models, and methods for institutional research. In R. Toutkoushian & M. Paulsen (Eds.), *Applying economics to institutional research* (New Directions for Institutional Research, No. 132, pp. 5–24). San Francisco: Jossey-Bass.

Paulsen, M., & Toutkoushian, R. (2008). Economic models and policy analysis in higher education: A diagrammatic exposition. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XXIII, pp. 1–48). Dordrecht, The Netherlands: Springer.

Pencavel, J. (1993). Higher education, economic growth, and earnings. In W. Becker & D. Lewis (Eds.), *Higher education and economic growth* (pp. 51–85). Boston, MA: Kluwer Academic Publishers.

Perlman, R. (1973). *The economics of education: Conceptual problems and policy issues*. New York: McGraw-Hill.

Perna, L. (2006). Studying college access and choice: A proposed conceptual model. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XXI, pp. 99–157). Dordrecht, The Netherlands: Springer.

Perna, L., & Titus, M. (2004). Understanding differences in the choice of college attended: The role of state public policies. *Review of Higher Education, 27*, 501–525.

Pindyck, R., & Rubinfeld, D. (2012). *Microeconomics*. Upper Saddle River, NJ: Prentice Hall.

Psacharopoulos, G. (1984). The contribution of education to economic growth: International comparisons. In J. Kendrick (Ed.), *International comparisons of productivity and causes of the slowdown* (pp. 335–355). Washington, DC: American Enterprise Institute.

Psacharopoulos, G., & Patrinos, H. (2004). Returns to investment in education: A further update. *Education Economics, 12*, 111–134.

Radner, R., & Miller, L. (1975). *Demand and supply in U.S. higher education*. New York: McGraw-Hill.

Rizzo, M., & Ehrenberg, R. (2004). Resident and nonresident tuition and enrollment at flagship state universities. In C. Hoxby (Ed.), *College choices: The economics of where to go, when to go, and how to pay for it* (pp. 303–349). Chicago: National Bureau of Economic Research.

Rogers, D., & Richlin, H. (1971). *Economics and education: Principles and applications*. New York: The Free Press.

Rothschild, M., & White, L. (1995). The analytics of pricing in higher education and other services in which customers are inputs. *Journal of Political Economy, 103*, 573–586.

Rusk, J., & Leslie, L. (1978). The setting of tuition in public higher education. *Journal of Higher Education, 49*, 531–547.

Schultz, T. (1961). Investment in human capital. *American Economic Review, 51*, 1–17.

Schultz, T. (1962). Reflections on investment in man. *The Journal of Political Economy, 70*, 1–8.

Schultz, T. (1963). *The economic value of education*. New York: Columbia University Press.

Screpanti, E., & Zamagni, S. (2005). *An outline of the history of economic thought*. Oxford: OUP.

Sheehan, J. (1973). *The economics of education*. London: Allen & Unwin.

Simon, H. (1979). Rational decision making in business organizations. *American Economic Review, 69*, 493–513.

Smith, A. (1776). *The wealth of nations*. London: Methuen & Co., Ltd.

St. John, E., Asker, E., & Hu, S. (2001). The role of finances in student choice: A review of theory and research. In M. Paulsen & J. Smart (Eds.), *The finance of higher education: Theory, research, policy & practice* (pp. 55–94). New York: Agathon Press.

Thurow, L. (1970). *Investment in human capital*. Belmont, CA: Wadsworth.

Toutkoushian, R. (1999). The value of cost functions for policymaking and institutional research. *Research in Higher Education, 40*, 1–15.

Toutkoushian, R. (2001). Do parental income and educational attainment affect the initial choices of New Hampshire's college-bound students? *Economics of Education Review, 20*, 245–262.

Toutkoushian, R. (Ed.). (2002). *Conducting salary-equity studies: Alternative approaches to research* (New Directions for Institutional Research, No. 115). San Francisco: Jossey-Bass.

Toutkoushian, R. (Ed.). (2003). *Unresolved issues in conducting salary-equity studies* (New Directions for Institutional Research, No. 117). San Francisco: Jossey-Bass.

Toutkoushian, R., Shafiq, M., & Trivette, M. (2013). Accounting for risk of non-completion in private and social rates of return to higher education. *Journal of Education Finance, 39*, 73–95.

Turner, S. (1998). The vision and reality of Pell grants: Unforeseen consequences for students and institutions. In L. Gladieux, B. Astor, & W. Swail (Eds.), *Memory, reason, imagination: A quarter century of Pell grants*. Washington, DC: College Board.

Vaizey, J. (1973). *The economics of education*. London: Macmillan.

Walsh, J. (1935). Capital concept applied to man. *Quarterly Journal of Economics, 69*, 255–285.

Weisbrod, B. (1961). The valuation of human capital. *The Journal of Political Economy, 69*, 425–437.

Weisbrod, B. (1962). Education and investment in human capital. *The Journal of Political Economy, 70*, 106–123.

Winston, G. (1997). Why can't a college be more like a firm? *Change*, September–October, 33–38.

Winston, G. (1999). Subsidies, hierarchy and peers: The awkward economics of higher education. *Journal of Economic Perspectives, 13*, 13–36.

Wish, J., & Hamilton, W. (1980). Replicating Freeman's recursive adjustment model of demand for higher education. *Research in Higher Education, 12*, 83–95.

Wolfe, B., & Haveman, R. (2002). Social and nonmarket benefits from education in an advanced economy. In *Conference series: [Proceedings]*, Federal Reserve Bank of Boston, 47, 97–142.

Chapter 3
Student Investment in Higher Education

Abstract In this chapter, we explore how economists conceptualize the college choice process that students undertake to decide if and where to go to college. We begin by providing some background on what is meant by "human capital," and then focus on the costs and benefits to an individual of going to college and earning a degree. We then turn to how students are thought to use this information to make decisions about whether to attend college and where to enroll. To do this, we introduce a five-stage model of college choice. After the model, we consider ways in which the model may be extended to look at post-enrollment decisions of students, the role of parents in the college-choice process, and the choice of college major. We end the chapter by using the model to discuss how economists use comparative statics to focus on the effects of higher education policies that might encourage more students to go to college or select a specific institution.

Introduction

From the perspective of parents, college admissions officers, and higher education policy makers, how students decide whether and where to go to college can seem irrational and beyond the scope of reason. It is disheartening to many higher education observers to see instances of academically talented students who do not even take the necessary steps to prepare for going to college, much less apply for admission or ultimately enroll in a college or university. Among those students who do apply to college, many appear to base their choice of schools on factors that are not directly related to the quality of education such as the amenities in the student union, the availability of wireless internet service in the dormitories, and the win/loss record of the basketball team.

Going to college requires students and their families to make a substantial investment of both their time and money. The sticker prices charged by institutions can exceed $50,000/year at private institutions, and although prices are notably lower at in-state public institutions, they can still easily top $10,000/ year. Given that four or more years are typically needed for students to fully

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_3

"consume" higher education services and earn a degree, the direct costs and foregone earnings (indirect costs) are incurred multiple times and are not traditional one-time expenditures such as buying a television set. The hope among students and their families is that the benefits from going to college outweigh the costs, and the consensus among economists is that this is indeed the case (see Chap. 4).

There are competing views as to why it is that going to college leads to higher earnings. One possibility is that when an individual goes to college, the person gains skills that raise their value to employers in labor markets. These skills are referred to as *human capital*. Viewed in this way, attending college is often said to be an investment in one's human capital. This is somewhat analogous to exercise as being an investment in one's health, where the foregone time, effort and costs associated with exercising hopefully translate into future health benefits. Another explanation for the higher pay of college graduates is that whether and where a person goes to college helps employers identify individuals who are likely to be better workers. Colleges therefore act as a screening mechanism for employers.

For several reasons, a student's decision on whether or not to go to college is very complicated. The true costs of attending college are hard for students to determine *a priori* due to the confusing way in which colleges and universities price their services, and the extent to which some portion of prices may be offset by financial aid. The student's benefits from college will not be realized for a number of years into the future, and can vary dramatically by the choice of major and academic performance. And given that roughly one-third of the students who seek a bachelor's degree do not graduate, there is always the real possibility that a student who enrolls in college will not earn a degree and secure the better-paying jobs that would go along with a college credential. The decisions become more complex as the student moves from deciding whether to go to college to where to go to college, in that the costs and benefits can differ across institutions offering the same degrees.

In this chapter, we explore how economists conceptualize the college choice process that students undertake to decide if and where to go to college. We begin by providing some background on what is meant by "human capital," and then focus on the costs and benefits to an individual of going to college and earning a degree. We then turn to how students are thought to use this information to make decisions about whether to attend college and where to enroll. To do this, we introduce a five-stage model of college choice. After the model, we consider ways in which the model may be extended to look at post-enrollment decisions of students, the role of parents in the college-choice process, and the choice of college major. We end the chapter by using the model to discuss how economists use comparative statics to focus on the effects of higher education policies that might encourage more students to go to college or select a specific institution.

Background

As noted in Chap. 2, the study of the economics of education can be traced back to the interest of economists in how education is a means to raise human capital.[1] The early view of labor was primarily that of a resource for production, which coincided with the industrial revolution and the emphasis at the time on manual labor. The notion that people can acquire more skills and human capital through education followed from this early work.

An important and enduring question in the economic literature was whether the benefits from investing in higher education exceeded the cost. In his 1867 study, Wittstein asserted that a person's lifetime earnings should equal the cost of maintaining a person's human capital plus the cost of their education. Although Walsh also examined the financial costs and benefits of investing in human capital through education, he cautioned that his analysis focused solely on monetary returns from investing in higher education, and thus did not take into account any of the non-financial benefits received by students when they go to college.

One of the first complete treatments of education as an investment in human capital is found in Jacob Mincer's 1958 article "Investment in Human Capital and Personal Income Distribution." In this study, Mincer argued that because training (or education) involved direct and indirect costs, individuals who received training would require higher salaries to compensate them for their costs. As a result, Mincer's analysis focused on how differences in training among workers help explain variations in their earnings. In this seminal article, Mincer also outlined the basic methods that are still used today to estimate the financial return on investing in human capital.[2] This work was extended by Gary Becker (1960, 1962), who stressed the importance of considering the indirect benefits of higher education, which came to be known as positive externalities (see Chap. 6) as well as the private benefits of higher education, and comparing the returns on education to the returns on other capital goods. Despite the focus in the literature on how education is a means for people to possibly enhance their human capital, Mincer (1958) was quick to point out that people can increase their human capital in many other ways; in fact, skills and knowledge can be gained through virtually everything that people do during the course of the day.

The role of education in increasing human capital is important not only for individuals but also for society as a whole. There have been many studies that have

---

[1] An excellent review of the history of economic discussions of human capital can be found in Kiker (1966). Other important early works that inform the development of human capital theory include Smith (1776), Hull (1899), Walsh (1935), Fisher (1906), and Wittstein (1867).

[2] Mincer (1958) noted, however, that his method for comparing the costs and benefits from investing in training was a generalization of the process originally developed by Friedman and Kuznets (1945). Also see Schultz (1961, 1962), Weisbrod (1962), Hansen (1963), Eide and Showalter (2010), and Woodhall (1995).

attempted to measure the connections between education and economic growth.[3] Human capital is also thought to bring with it a wide range of benefits to society such as economic growth, reduced crime rates, increased literacy among citizens, and so on. In Chap. 6, we consider in more detail these “positive externalities” that may arise from higher education, and why it could be argued that government subsidies are needed to help encourage more people to go to college.

Economists often take a somewhat unique approach to examining the decisions made by students about investing in their human capital through education. Some education policy makers argue in favor of greater college participation rates and larger investments in higher education on the grounds that it would produce benefits for society. Although economists would agree that all people can raise their human capital and hence benefit to some degree through going to college, they would ask whether the benefits from more education outweigh the costs. To an economist, there may be situations where acquiring more education is not a good decision for an individual or for society if the costs exceed the benefits. It may be that some people can benefit more than others through going to college, depending on their initial stock of human capital, their academic ability, their career interests, and many other factors.

Although much of the economic literature attributes the higher earnings of college graduates to the skills they acquired in college, economists have also suggested that some or all of the income gains are due to the screening or signaling function of college. According to this notion, which was popularized by Kenneth Arrow (1973), Michael Spence (1973), and Joseph Stiglitz (1975), one of the roles of education is to sort students based on ability and provide employers with a convenient and relatively inexpensive screening mechanism for future workers.[4] Advocates of this idea note that the education system is well suited to the task of screening because students have undergone multiple assessments with multiple individuals during their education, and thus a student’s performance in school and where they received their education can provide signals to employers about the likely quality and productivity of individuals. In this view, education translates into higher earnings not because of the specific skills gained by students during their time in college, but rather because employers act on signals about individuals such as whether they earned a college degree and/or graduated from a more prestigious institution. Both the human capital theory and the signaling theory, however, predict that there is a positive connection between a person’s quantity and quality of education and their earnings in labor markets.

In the next section of this chapter, we lay out the basic framework for how economists account for the postsecondary decisions of students and their families

---

[3] See, for example, Benhabib and Spiegel (1994), Bils and Klenow (2000), Fukase (2010), Portela, Alessie, and Teulings (2010), Psacharopoulos (1984), Topel (1999), Temple (2001), Wobmann (2003), and Hanushek and Wobmann (2007).

[4] Stiglitz (1975) notes that earlier studies by Young (1958) and Hull and Peters (1969) had advanced the idea that education acts as a screening mechanism.

through the use of human capital theory and economic reasoning.[5] We begin with the private financial costs and benefits of college, and how this information can affect the choices made by students regarding whether and where to go to college. Even though the financial costs and benefits of this decision are a crucial part of the framework, the final decision is actually based on the satisfaction or utility of the choice and not solely the net financial gain or loss. Students can gain utility from the things that they can buy with their income, and from their other experiences in college. As explained in Chap. 2, utility is a very general concept in that people are assumed to form their own unique preferences for things, and it may be true that some individuals get more enjoyment than do others out of studying and learning new concepts. This is important for understanding why some students may rationally choose not to go to college even though the financial benefits to them might exceed the costs, or they may rationally select majors where the financial returns are relatively small.

There are also benefits and costs to the general public when people go to college. A sizable portion of postsecondary costs are paid by parties that do not receive the service, such as federal and state governments. This is done with the expectation that the general public will benefit from the subsidy. Although we focus exclusively on the costs and benefits received by private individuals from going to college in this chapter, we will later examine the additional costs and benefits to the general public from postsecondary education in Chaps. 4 and 6.

Throughout this chapter, our discussion focuses on a student who must decide at time $t = 1$ whether they want to attend college for a period of years denoted T^{l}. Starting in year $t = T^{l} + 1$, the student enters the labor market until time $t = T^{r}$, and then lives until time $t = T$. These assumptions are obvious simplifications because students can drop out of college or graduate from college at various points in time, depending on factors such as their academic performance and ability to pay. The timing of a student's departure from college can, of course, have an impact on their expected benefits and costs.

Private Costs of College

Anyone who has gone to college or sent a child to college is painfully aware of the fact that it can be expensive. According to the College Board, the average cost of attendance in tuition, fees, and room and board in 2014–2015 at a private, 4-year not-for-profit institution was $42,419. Even for those students who enroll in a

[5] As noted in the Introduction to this book, unless stated otherwise we use the phrases "postsecondary education," "higher education," "college," "university," and "institution" interchangeably to encompass all forms of postsecondary education, including 2-year institutions, 4-year institutions, and graduate institutions.

public, 4-year institution in their home state, the average annual cost of attendance in the same year was $18,943.[6]

Economists stress that every human activity involves the use of scarce resources, and going to college is no exception. Not only are there direct costs in the form of tuition and mandatory fees, but there are indirect costs because the time (resource) that is required of a person to go to college could have been used for other purposes such as working in the labor market, leisure, or any number of activities that would give individuals financial and non-financial benefits. It is important to take all of these costs into consideration when evaluating the total cost to an individual of going to college.

We begin with the most obvious cost of attending college: direct costs. Direct costs are all those expenses which a student and his/her family incur that would not be needed if he or she were not attending college. Thus, tuition and fees are examples of direct costs of higher education, whereas food and housing would not usually be considered a direct cost of higher education because this expense would be incurred regardless of whether the student went to college.[7] Other direct costs of postsecondary education would include things such as books and supplies for college, as well as travel expenses due to being in college. For most students, though, tuition and fees are arguably the largest single component of their direct – also known as out-of-pocket – costs.

One way in which the direct costs of college to students and their families can be reduced is through financial aid. Financial aid in the form of either grants or scholarships is effectively a price reduction for students, and this applies regardless of whether the money was awarded on the basis of financial need, merit, or some other purpose. From the perspective of students and their families, however, financial aid may not always be interpreted the same as an equal reduction in price. Consumers often do not know the amount of financial aid that they would receive from different colleges when they apply, and even when provided such information may not be able to interpret it correctly (for example, grants versus loans and renewable versus non-renewable scholarships).

The price charged to students can be further reduced through subsidies to institutions that are in turn used to lower tuition rates. These subsidies include state appropriations to public institutions, donations from alumni and benefactors, earnings on an institution's endowment, and profits from auxiliary enterprises. For the most part, loans to students are not treated as a price reduction because the aid must be repaid in the future. In this view, loans are effectively a transfer of direct costs from one point in time to another rather than a true reduction in direct cost to the student. We explore the connections between pricing, subsidies, and institutional costs more fully in Chaps. 7 and 8.

---

[6] See College Board's report *Trends in College Pricing* 2014, Table 1A.

[7] Housing may be a direct cost of college for some students if they were planning on living at home in the absence of going to college. Even in this instance, however, there are costs associated with living at home that would need to be taken into account if the goal was to obtain an accurate picture of the additional cost incurred due to attending college.

Although the direct costs of higher education receive considerable attention from students and their families, the indirect costs of attending college are also an important part of the total cost. There is an opportunity cost for students when they go to college in that each year that the person is enrolled in college could have been spent in the labor market earning income. Because substantial time is needed to earn a degree, the indirect costs – also known as foregone income – associated with higher education can be quite large. These indirect costs can best be thought of as the average earnings that students give up while they are in college.[8] The indirect costs can be reduced if students are able to work full- or part-time during college. Even in this instance, however, additional indirect costs may be incurred if students have to take more time to complete their college education due to working part time. A further complication is that students do not know the actual direct and indirect costs at the time that they decide whether to pursue a college education, and must base decisions on their expectations of these quantities.

Pulling these concepts together, the annual expected private cost of going to college ($C(pri)_t$) is the sum of the expected tuition and fees (P) minus grants and scholarships (F) plus the foregone after-tax earnings while in college:

$$C(pri)_t = P_t - F_t + (1 - tx^{na})(1 - w_t)I_t^{na} \tag{3.1}$$

where I_t^{na} = expected income for those who do not attend college, tx^{na} = tax rate on income for those who do not attend college, w = proportion of foregone income earned while in college from part-time or full-time employment, and all variables are measured in current (non-inflation adjusted) dollars. We refer to these as private costs because they are paid by those who consume the service: students and their families. The total private cost from earning a degree (graduates) is then found by summing the annual costs over the years in which the student is enrolled in college. This cost can be expressed in real dollars by adjusting each year's quantity for the corresponding rate of inflation (i), and converted to present value by further adjusting using the discount rate that individuals apply to future dollars (z):

$$C(pri)^g = \sum_{t=1}^{T1} C(pri)_t/(1 + i)^{t-1}(1 + z)^{t-1} \tag{3.2}$$

The discount rate represents the time preference that people attach to money due to the added interest that could be earned on investments and the added utility that comes with being able to use money in the present rather than the future. If the discount rate in this formula is zero, then the person is indifferent between inflation-

[8] The indirect costs should also take into account the possibility that an individual would not be able to find employment. This can be done by either measuring the foregone earnings for all individuals regardless of employment status (such as the median income for all individuals ages 18–24), or by weighting the average earnings for employed individuals by the probability of being employed.

Table 3.1 Hypothetical illustration of private costs of college

Year	Direct cost (A)	Indirect costs (B)	Total cost (C = A + B)	Total cost adjusted for inflation	Total cost adjusted for inflation and discount rate
1	$10,000	$28,000	$38,000	$38,000	$38,000
2	$10,500	$28,840	$39,340	$37,827	$37,085
3	$11,025	$29,705	$40,730	$37,657	$36,195
4	$11,576	$30,596	$42,172	$37,491	$35,329
Totals	**$43,101**	**$117,142**	**$160,243**	**$150,975**	**$146,609**

Notes: Illustration assumes that tuition minus financial aid increases by 5 % per year, after-tax incomes without going to college rise by 3 % per year, inflation is 4 % per year, and the discount rate for the time preference of money is 2 % per year. It is also assumed that net tuition in year 1 is $10,000, income in year 1 without going to college is $35,000, and the tax rate on income for individuals not going to college is 20 %

adjusted dollars in the present and the future. It is likely, however, that people will have a preference for dollars in the present than in the future (hence the expression "A bird in the hand is worth two in the bush"). In this case, the individual's discount rate will be some value greater than zero.

We illustrate the private cost calculations using data for a hypothetical student in Table 3.1. Let's suppose that the student is considering a college where in the first year tuition and fees (P) are $25,000. Because she would receive a $15,000 scholarship ($F$), her direct costs would be $25,000–$15,000 = $10,000 in the first year. She believes that if she did not go to college, she could find a job that would pay her $35,000 before taxes ($I_1^{na}$), and that she would have to pay 20 % of her salary in taxes (tx^{na}). If she went to college, she has decided that she would not work during college ($w = 0$). Accordingly, the total cost of college in the first year would be $38,000. Suppose now that the student enrolled for four consecutive years ($T^1 = 4$), and that she believed net tuition ($P_t - F_t$) would rise by 5 % per year and incomes for high school graduates would rise by 3 % per year. As a result, her direct and indirect costs would total $43,101 and $117,142 respectively, for a total cost of $160,243. If the rate of inflation (i) was 4 % per year, then the constant dollar total costs would drop to $150,975. Likewise, with an annual discount rate (z) of 2 % the present value of total costs would fall even further to $146,609.

Private Cost of Attending Versus Graduating College An important issue for students when they go to college is that there is a substantial risk that they will not earn the degree they are seeking. Although most students who begin college probably feel that they will graduate, data on college students show that many will not be successful. The National Center for Higher Education Management Systems (2009) found that even when students who transfer to other institutions are considered, nationally only about two-thirds of first-time, full-time students who start at 4-year institutions seeking a bachelor's degree will graduate within six years. Graduation rates are even lower for students who enroll at 2-year institutions. Therefore, students should take into account the risk that they will not earn a degree when calculating the true costs that they are likely to incur on average by enrolling

Table 3.2 Hypothetical illustration of cost of attending college

Year	Total cost adjusted for inflation and discount rate (A)	Probability of enrollment (B)	Expected cost of attending college (C = A*B)
1	$38,000	1.00	$38,000
2	$37,085	0.60	$22,251
3	$36,195	0.50	$18,098
4	$35,329	0.40	$14,131
Totals	**$146,609**		**$92,480**

Notes: Illustration assumes that tuition minus financial aid increases by 5 % per year, after-tax incomes without going to college rise by 3 % per year, inflation is 4 % per year, and the discount rate for the time preference of money is 2 % per year. It is also assumed that net tuition in year 1 is $10,000, income in year 1 without going to college is $35,000, and the tax rate on income for individuals not going to college is 20 %

in college. This can be done by defining the present value expected costs from attending college ($C(pri)^a$) as a weighted average of the annual expected costs, where the weights correspond to the probabilities that the student will be enrolled each year (denoted π_t^r):

$$C(pri)^a = \sum_{t=1}^{T1} \pi_t^r C(pri)_t / (1+i)^{t-1}(1+z)^{t-1} \tag{3.3}$$

Returning to the hypothetical student (see Table 3.2), if she feels that there is a 60 % chance that she will still be enrolled in college in the second year, then as of time $t = 1$ she would expect to incur 60 % of the second year inflation-adjusted and discounted costs, which is $22,251. If the probabilities of our hypothetical student enrolling in years 2, 3, and 4 were $\pi_2^r = 60$ %, $\pi_3^r = 50$ %, and $\pi_4^r = 40$ % respectively, then as shown in Table 3.2 her total expected cost of attending college would be $92,480.

Private Benefits of College

If higher education is an investment similar to stocks and bonds, then a natural question becomes what is the payoff to students and their families from making this investment? There are a couple of key features of investing in college that merit discussion before proceeding. First, unlike investing in stocks and bonds where the focus is solely on market (financial) benefits, students who go to college may also reap a number of non-market benefits.[9] For example, if college helps teach students

[9] In this chapter, when we consider a student's demand for college, we assume that all non-market benefits are "private" benefits. In Chap. 6 we relax this assumption and consider the possibility of both private and public non-market benefits.

to engage in more positive behaviors, then it may lead to improved health and reduced likelihoods of committing crimes over the person's lifetime. There may be additional, but less tangible, benefits from college such as the satisfaction gained from having a better understanding of the world.

The non-market benefits of college also include a wide range of "consumptive benefits."[10] According to economists, individuals purchase goods and services for either investment or consumptive purposes. In general, consumptive benefits are the added utilities students receive from consuming goods and services that go along with a college education, such as the utility from participating in events at the university or the town where it is located, making friends and relationships at college, joining a social fraternity or sorority, and learning to become independent and live on their own. Some consumptive benefits may even be realized after a student graduates from college. As a result, higher education is best viewed as both an investment and consumptive service.

It should also be noted that some of the market and non-market benefits from college may occur after the individual has retired from the labor force. If a person receives a higher income due to going to college, for example, then the person is likely to have more income in retirement as well. Furthermore, people who have gone to college may benefit from being healthier during their retirement years.

As discussed in the section on costs, a student faces substantial risk and uncertainty when they invest in going to college. The market benefits from college can vary according to the institution attended, ability of the student, major chosen, and many other factors. This would be somewhat analogous to investing in different stocks, in that they may well have different returns which are not known with certainty when the investment is made. Unlike stocks and bonds, however, which yield the same financial benefit to everyone who purchases and sells the asset at the same time, the financial benefit to students who attend college can differ from student to student. The benefits may vary with the academic ability of the student, in that those who are more academically talented may have more to gain from going to college, and also vary by choice of major. Similarly, students who are interested in jobs that require postsecondary training are likely to gain more (and give up less) from going to college than other students.

The annual private market benefits from graduating versus not going to college ($B(pri)_t^g$) is the after-tax difference between the expected annual earnings from graduating (I_t^g) and not attending college:

$$B(pri)_t^g = (1 - tx^g)I_t^g - (1 - tx^{na})I_t^{na} \tag{3.4}$$

where $tx^g =$ tax rate for graduates. After the person retires from the labor market, the earnings difference in Eq. (3.4) can be thought of as the after-tax differences in annual retirement benefits as opposed to income. The present value of real private

[10] An early discussion of the consumptive benefits of higher education can be found in Hansen and Weisbrod (1969).

Table 3.3 Hypothetical illustration of private benefits of graduating college

Year	Pre-tax incomes: Graduate college	Pre-tax incomes: Not attend college	After-tax incomes: Graduate college	After-tax incomes: Not attend college	Benefit	Benefit adjusted for inflation (base year = 1)	Benefit adjusted for inflation and discount rate
1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	$60,000	$40,000	$48,000	$32,000	$16,000	$13,677	$12,635
6	$63,000	$41,600	$50,400	$33,280	$17,120	$14,071	$12,745
7	$66,150	$43,264	$52,920	$34,611	$18,309	$14,470	$12,849
8	$69,458	$44,995	$55,566	$35,996	$19,570	$14,872	$12,947
9	$72,930	$46,794	$58,344	$37,435	$20,909	$15,278	$13,040
10	$76,577	$48,666	$61,262	$38,933	$22,329	$15,688	$13,127
11	$80,406	$50,613	$64,325	$40,490	$23,834	$16,102	$13,209
12	$84,426	$52,637	$67,541	$42,110	$25,431	$16,519	$13,286
13	$88,647	$54,743	$70,918	$43,794	$27,124	$16,941	$13,358
14	$93,080	$56,932	$74,464	$45,546	$28,918	$17,367	$13,425
Totals	**$754,674**	**$480,244**	**$603,739**	**$384,195**	**$219,543**	**$154,985**	**$130,621**

Notes: Illustration assumes that incomes for college graduates increase by 5 % per year, incomes for individuals who do not attend college rise by 4 % per year, the income tax rate is 20 %, the annual rate of inflation is 4 %, and the annual discount rate is 2 %. n/a = benefits are not applicable because the student is in college during years 1–4. The base year for inflation adjustments is $t=1$

benefits from having a college degree is then found by summing the annual benefits for graduates over their remaining lifetime, and adjusting for the discount and inflation rates:

$$B(pri)^g = \sum_{t=T1+1}^{T} B(pri)_t^g / (1+i)^{t-1}(1+z)^{t-1} \tag{3.5}$$

To illustrate, in Table 3.3 we show the private benefit calculations for a student who graduates from college after 4 years, and then spends the next 10 years in the labor market. In the first year of work (year 5), the student earns $60,000 before taxes ($I_5^g$), which translates into $48,000 after taxes assuming a 20 % income tax rate (tx^g). Suppose that the student could have expected to earn $40,000 before taxes ($I_5^{na}$) if he did not go to college (or $32,000 after taxes if $tx^{na} = 20\ \%$). In year 5, this results in an after-tax income gain of $16,000. The gains for the next 9 years will vary, however, due to the growth rates in incomes and the rates of inflation and discount that are applied to future earnings. Let's assume that incomes for graduates rise by 5 % per year, and incomes for non-college attendees increase at a lower rate

(4 %) per year. Furthermore, suppose that inflation averages 4 % per year and the discount rate is 2 % per year. Accordingly, over the next 10 years the student would earn \$754,674 with a college degree or \$480,244 without going to college. The cumulative after-tax gain of \$219,543 then becomes \$154,985 after adjusting for inflation and \$130,621 after further adjusting for the discount rate.

Private Benefits of Attending Versus Graduating College When students, their families, and education policy makers talk about the market benefits to individuals from college, often what they have in mind are the benefits for those who earn a degree as shown in Eq. (3.5). However, these benefits only apply to those students who attend college and graduate. This distinction is important because the earnings for those who complete college will be higher than for those who started college but did not graduate.

The risk of non-completion can be incorporated into the benefit calculations in the model by defining the expected income from attending college (I_t^a) as a weighted average of the expected incomes for those who earned a degree and those who enrolled in college but did not earn a degree (I_t^{ng}), as in:

$$I_t^a = \pi^g I_t^g + (1 - \pi^g) I_t^{ng} \tag{3.6}$$

where π^g = probability of graduating. Therefore, I_t^a represents the average earnings for all those who go to college, including those who drop out prior to graduating. There are a number of reasons why students may start college and not earn a degree, including poor academic performance, financial constraints, and personal and family circumstances that may lead even academically-prepared students to drop out of college. The resulting expected annual benefit from attending college can now be written as:

$$B(pri)_t^a = \pi^g (1 - tx^g) I_t^g + (1 - \pi^g)(1 - tx^{ng}) I_t^{ng} - (1 - tx^{na}) I_t^{na} \tag{3.7}$$

and the expected present value of real private benefits from going to college becomes:

$$B(pri)^a = \sum_{t=T1+1}^{T} B(pri)_t^a / (1+i)^{t-1} (1+z)^{t-1} \tag{3.8}$$

On average graduates will earn more than those who began college but did not graduate. The empirical evidence suggests that future earnings do not increase at a constant rate for each additional year of education, but rather increase at a slower rate for the first few years of college and then rise significantly for those who complete their degree.[11] This phenomenon has been referred to by some economists

[11] Studies of note on this topic include Belman and Heywood (1991, 1997), and Jaeger and Page (1996).

Table 3.4 Hypothetical illustration of private benefits of attending college

Year	After-tax incomes: Graduate college	Attend college	Not attend college	Benefit	Benefit adjusted for inflation (base year = 1)	Benefit adjusted for inflation and discount rate
1	n/a	n/a	n/a	n/a	n/a	n/a
2	n/a	n/a	n/a	n/a	n/a	n/a
3	n/a	n/a	n/a	n/a	n/a	n/a
4	n/a	n/a	n/a	n/a	n/a	n/a
5	$48,000	$41,600	$32,000	$9600	$8206	$7581
6	$50,400	$43,552	$33,280	$10,272	$8443	$7647
7	$52,920	$45,596	$34,611	$10,985	$8682	$7709
8	$55,566	$47,738	$35,996	$11,742	$8923	$7768
9	$58,344	$49,980	$37,435	$12,545	$9167	$7824
10	$61,262	$52,330	$38,933	$13,397	$9413	$7876
11	$64,325	$54,791	$40,490	$14,301	$9661	$7926
12	$67,541	$57,369	$42,110	$15,259	$9912	$7972
13	$70,918	$60,068	$43,794	$16,274	$10,165	$8015
14	$74,464	$62,897	$45,546	$17,351	$10,420	$8055
Totals	**$603,739**	**$515,922**	**$384,195**	**$131,727**	**$92,992**	**$78,373**

Notes: Illustration assumes that incomes for college graduates increase by 5 % per year, incomes for individuals who do not attend college rise by 4 % per year, the income tax rate is 20 %, the annual rate of inflation is 4 %, and the annual discount rate is 2 %. n/a = benefits are not applicable because the student is in college during years 1–4. The base year for inflation adjustments is t=1

as a “sheepskin effect.” Some researchers have asserted that the nonlinear pattern between education and earnings reflects increases in demand for skilled labor and global competition, while others attribute the earnings differences to human capital or screening (Spence 1973; Stiglitz 1975).[12] Regardless of the explanation for the earnings difference, the income gain from completing college is higher than the income gain from attending college when not all students graduate ($\pi^g < 1$).

An illustration of the expected financial benefits from attending (rather than graduating) college is shown in Table 3.4. The example builds on the illustration in Table 3.3 where a student attends college for 4 years and then spends the next 10 years in the labor market. We use the same assumptions as in Table 3.3, except that we now assume that the student only has a 60 % chance of graduating. As a result, her weighted average income in year 5 if she went to college for 4 years would be $41,600 and her income gain over not going to college is $41,600–$32,000 = $9,600. The cumulative gain over the next 10 years would be

[12] Carnevale, Jayasundera, and Cheah (2012) and McMahon (2009) are among the researchers who have emphasized the increased demand for skilled labor as an explanation for the rising return on higher education. Alternative explanations have been provided by Bitzan (2009), Hwang, Liao, and Huang (2013), Heywood (1994), and Park (2011). The notion of education as a screening mechanism can be traced back to Spence (1973) and Stiglitz (1975).

\$131,727, or \$78,373 after adjusting for inflation and the discount rate. Note that these gains are smaller than the gains for college graduates shown in Table 3.3.[13]

Net Present Value of College

Now that we have described the market costs and benefits for students from investing in higher education, we can put the two together and calculate the net gain or loss from the investment. The private net present value from graduating college $\left(NPV(pri)^g\right)$ is the present value of benefits from graduating minus the present value of costs from graduating, as in:

$$NPV(pri)^g = B(pri)^g - C(pri)^g \tag{3.9}$$

Likewise, the private net present value from attending college $\left(NPV(pri)^a\right)$ is the difference between the present values of benefits and costs for all those who attend college:

$$NPV(pri)^a = B(pri)^a - C(pri)^a \tag{3.10}$$

A graphical depiction of the private market costs and benefits of pursuing an undergraduate degree is shown in Fig. 3.1. For simplicity, we assume here that the student attended college for T^I years, and did not work for pay during college. Between years $t=1$ and $t=T^I$, the student incurs net direct costs equal to the area in the rectangle immediately below the time line. The rectangle below the net direct costs represents the portion of price that is offset by grants and scholarships. Indirect costs in the form of foregone earnings are shown as the area below the income line for non-college attendees and above the horizontal axis from $t=1$ to $t=T^I$. Beginning in time $t=T^I+1$, the student would have expected future income streams from graduating $\left(I_t^g\right)$, going to college but not earning a degree $\left(I_t^{ng}\right)$, and not going to college $\left(I_t^{na}\right)$.[14] The income streams rise during the years when the student expects to be in the labor market (up to time $t=T^r$), and then after retirement

[13] It is assumed here that the student spends 4 years in college, after which she either graduates or does not graduate. However, students can drop out of college and graduate at a number of different points in time. We return to this issue in Chap. 4 when we discuss in more detail how to measure the return to postsecondary education.

[14] It is common for economists to use curves rather than straight lines to represent the income trajectories for individuals by educational attainment. We opted to use straight lines in this chapter to avoid having to select an appropriate functional form for income growth rates, and to make the figures easier to read.

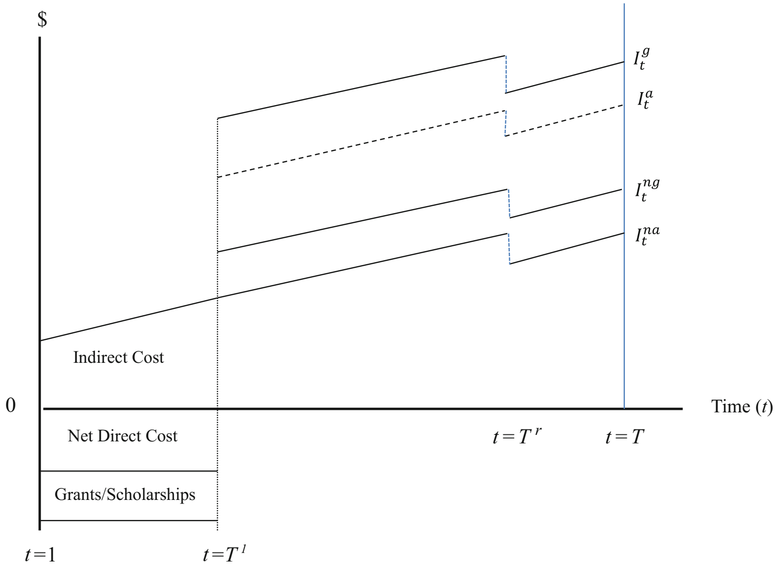


Fig. 3.1 Depiction of private costs and benefits of a bachelor's degree

the income streams shift downward as the person relies on retirement benefits. The private market benefit for degree completers is represented as the area between the income streams for graduates and those who did not attend college. Likewise, the private market benefit for college attendees is the area between the line for expected income from attending college and the line for non-college attendees. The net present value of benefits for each group would subtract their costs from these benefits after discounting each for the student's time preference. Keep in mind, however, that the expected costs for all students will be smaller than the costs for graduates due to the likelihood that some students who enroll in college will drop out prior to earning a degree, and they would incur fewer direct and indirect costs. Also of note, increases in the discount rate will lead to a decrease in the gap of future incomes between college and high school graduates.

A similar depiction of the costs and benefits from pursuing a graduate degree is shown in Fig. 3.2. In this figure, we consider a student who has decided to first pursue a bachelor's degree from time $t=1$ to $t=T^1$ and then a master's degree from time $t=T^1+1$ to $t=T^2$, and we represent the costs and benefits of doing so relative to having a high school diploma. A similar, but more complicated, figure could be drawn for students who further plan on pursuing a doctoral or professional degree. In comparison to the student who only pursues a bachelor's degree, a student seeking a graduate degree will incur more direct and indirect costs due to spending more time in college and less time in the labor market. The indirect costs increase further after the student receives a bachelor's degree because he or she could now earn more than before in the labor market. On the benefit side of the equation, the

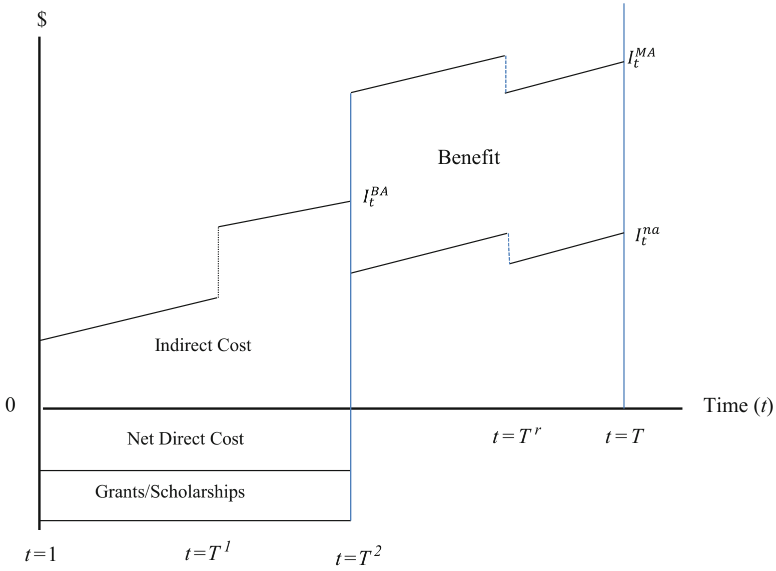


Fig. 3.2 Depiction of private costs and benefits of a master's degree

benefits from having a master's degree may be larger or smaller than the benefits from having a bachelor's degree, depending on whether the higher earnings from having a master's degree offsets the reduction of time in the labor market. The benefits may be influenced by the choice of major, where the student lives, and other factors. Therefore, it is not always clear *a priori* whether students who decide to pursue both a bachelor's and master's degree do better than those who stop after earning a bachelor's degree.

So, is there also a financial payoff to pursuing a master's degree for those who have already earned a bachelor's degree? Given that the earnings premium from having a master's degree versus a bachelor's degree is high (approximately $12,500/year as of 2011) and the duration of master's programs is short (2 or 3 years), it is likely that on average the benefits from pursuing a master's degree would more than cover the additional costs. The answer also depends on the amount of financial assistance that students receive for graduate school. Often a large portion of a graduate student's tuition and fees will be covered by an assistantship or fellowship, in which case the direct costs are very low. In addition, some students may work part-time or full-time while pursuing a master's degree, and some may rationally pursue master's degrees with a lower financial payoff because they anticipate a substantial payoff in non-market benefits that generate personal satisfaction and other intrinsic rewards. We will revisit this topic in Chap. 4, where we discuss in detail the approaches used by economists for measuring the return to various levels of education.

A Five-Stage Model of the College Choice Process

Now that we have described the private costs and benefits from attending and/or completing college, it is time to examine how this information can be used to help explain the decisions made by students and their families about whether to go to college, and if so, where to enroll. The economics literature on college choice dates back to studies from the 1960s in which economists estimated demand models for higher education (see Chap. 5). In the 1970s and early 1980s, however, economists had begun to use random utility models to focus on how students make decisions about postsecondary education.[15] Economists and non-economists also contributed to this literature by stressing that the college choice process is a series of stages where the decisions about postsecondary education at later points in time are influenced by the choices made earlier.[16] Researchers are divided as to precisely how many stages there are in the college choice process, although in general the steps have been grouped into three broad categories: predisposition, search, and choice (Hossler, Braxton, & Coopersmith, 1989; Paulsen, 1990). This process could also be applied to graduate education; however, here we focus on whether or not a high school student and his/her family decide to pursue an undergraduate education.[17]

We combine the economic and higher education perspectives into five stages to describe the college choice process made by students and their families, as shown in Fig. 3.3. In the first stage, which would normally be associated with the years prior to high school, the student determines whether he or she is interested in pursuing a postsecondary degree, thereby forming aspirations to attend college. We refer to this stage as the "predisposition stage." For those students who are interested in going to college, they can take several steps to help achieve this goal, including enrolling in college-preparatory courses in high school, taking standardized admission tests such as the Scholastic Aptitude Test (SAT) or the ACT, and saving money to pay for college. In the second stage, students who want to go to college form a list of institutions that they might consider attending, referred to as the "initial search stage." Students who reach this search stage may send their standardized test scores to these institutions and perhaps request information from the colleges. In the third stage, students conduct more detailed investigations into the costs, benefits, and

[15] Early studies of note include Kohn, Manski, and Mundel (1976); Chapman (1981); Manski and Wise (1983); and Fuller, Manski, and Wise (1982).

[16] See, for example, Bergerson (2009), Chapman (1981), Hossler and Gallagher (1987), Litten (1982), Hanson and Litten (1982), Hossler, Braxton, and Coopersmith (1989), Hossler, Schmit, and Vesper (1999), Paulsen (1990), Cabrera and La Nasa (2000), and Perna (2006).

[17] Although studies often refer to the college choices made by students, it should be noted that postsecondary decisions are usually made by both students and their families. This is important for the college choice model because students and their families may have different preferences and goals/objectives with regard to postsecondary education, and there will likely be variations in the relative influence that parents have on their children's decisions. We examine this issue in the Extensions section of this chapter.

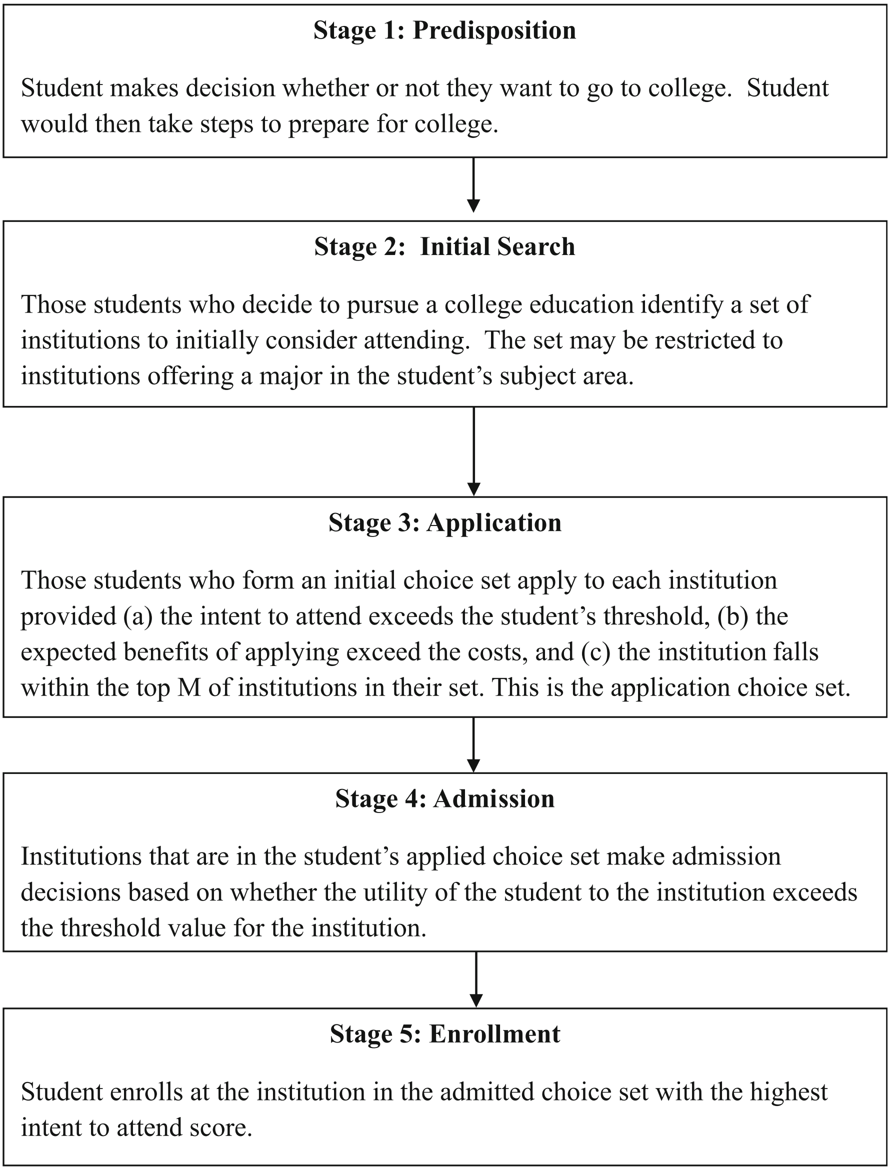


Fig. 3.3 Depiction of stages of college choice for a student

course or program offerings of schools in their initial choice set and apply to a subset of the initial choice set institutions. We refer to this as the "application stage." Enrolling in a specific college, however, depends on both the student applying to the institution and the institution offering admission to the same student. Therefore in the fourth stage ("admission stage"), each of the institutions in the applied choice set makes decisions about whether to offer admission to the student, leading to the student's admitted choice set. Finally, in the last stage the student makes an enrollment decision from the set of institutions in the admitted choice set. We refer to this as the "enrollment stage."

Before delving into a more detailed discussion of each stage, a couple of observations are important to keep in mind. First, the decisions made in latter stages of the model are conditional on the decisions made in all prior stages. For example, a student must have decided that he or she wants to go to college (Stage 1) before forming an initial choice set (Stage 2). Similarly, applying to a college (Stage 3) depends on the student being predisposed for college and having formed an initial choice set. In Stage 4, institutions can only admit students who have applied to the institution. Finally, the enrollment decision of the student (Stage 5) is therefore affected by the choices made in Stages 1 through 4.

Second, it is helpful to describe each stage of the model in terms of who is making the decision and whether the decision reflects demand, supply, or some combination of the two. In Stages 1, 2, 3, and 5, the student and their family is the decision maker, whereas colleges and universities make the admission decisions in Stage 4. The first stage clearly reflects the demand side of the market because the decisions made by students are unlikely to be affected by the number of places supplied by institutions. Although the second and third stages are related to demand, the supply of spaces may also affect a student's decision to either include the institution in his or her choice set or apply to the institution because the student may limit his or her choices based on estimates of where they may be accepted. The fourth stage of the model is a measure of supply but is also influenced by demand due to limitations from its applicant pool. Likewise, the last stage of the model is a combination of supply and demand because students cannot enroll at an institution unless they have been admitted. These distinctions are important because enrollments and applications are often treated exclusively as measures of demand.

We now focus on the five stages of the college choice model in more detail. In general, the decisions at each stage involve comparisons of the anticipated costs and benefits. Beginning with the first stage, at this point in time students have not yet identified institutions that they might want to attend, and may not have information on the actual prices, financial aid, and benefits for specific institutions. However, the concepts of costs and benefits we discussed earlier in the chapter can be used for this stage in the college choice process, with the parameters in the model representing expectations for higher education in general at the time that the choice is made. For example, the price variable (P_t) can be thought of as the average price that students and their families expect to pay to go to college as opposed to the price at a specific college, and F_t would be the average expected financial aid they anticipate receiving from grants and scholarships. These estimates could be based on research conducted by students and their parents, past experiences with siblings and friends who have gone to college, reports in the media about the price of college, and so forth. Likewise, the income variables in the formulas may represent their initial estimates of earnings for people with and without a college degree for the types of institutions that they might be interested in attending and the majors they might want to study.

If the decision to consider college was based solely on private financial costs and benefits, then a student would simply plug his or her estimates of the costs and benefits into Eq. (3.10) and choose to go to college if the net present value was positive. The actual decision process is more complicated than this, however, because students and their families also take into account the utility that they would receive from their occupation of choice after completing their education, as well as other benefits, costs, and constraints associated with this decision. In fact, the random utility models of college choice that were developed by economists assumed that students try to maximize their utility and not their financial gain.

To see how this might be explained in an economic model, assume that the *j*-th student has a latent or unobservable interest in pursuing a college education (denoted a_j^*). It could be argued that this latent demand is affected by several factors. The first of these is the utility from the net present value due to attending college. The reasoning here is that as the net present value rises, the person would become happier because he or she can use the extra money to buy things that give them enjoyment, or utility. Furthermore, the net present value of attending rather than graduating college should be used in the college choice process because students are deciding whether to attend college, and cannot completely control whether they graduate from college.[18]

The second factor relates to the non-financial gains that the student expects from college. There are many ways in which students may benefit from going to college that have nothing to do with their future earnings. These may include the utility from taking part in extracurricular activities, making friends and forming relationships, using amenities on campus such as dining services and health club facilities, and from having an opportunity to mature and gain independence. Although many of these non-pecuniary benefits occur during the time the student is in college, they may also be realized after graduation as alumni receive utility from remembering their experiences in college, continuing interactions with friends and classmates, and following the exploits of their alma mater. A more complicating aspect of this factor is the positive – or negative – utility that students attach to learning. For some individuals, the opportunity in college to study and learn new things is exciting and would give them positive utility. At the same time, not all aspects of being in college are enjoyable. The effort and stress needed to study and succeed in college may reduce a person's happiness with going to college.

The latent demand for college can also be affected by the student's ability to pay for college. A central part of an economic model of the demand for any good or service is the income or wealth level of the consumer. As incomes and wealth go up, consumers are better able to purchase the good or service in question, which should

[18] It is probably the case that many students overestimate their chances of graduating from college. If this is true, then they are overestimating the financial benefit from going to college. We explore this issue further in Chap. 4.

have a positive effect on the demand for college in general. The ability to pay for college will also be influenced by the net price that students have to pay after financial aid ($P_j - F_j$). Holding the market and non-market benefits constant, students would thus be more likely to want to go to college if their ability to pay for college improved. Another dimension of this factor is that the responsibility for paying for college is often shared, to varying degrees, by the student and their family. Thus, ability to pay likely reflects the income and wealth of the student's family as well as the student. We will return to this notion of shared decision making later in the chapter.

Finally, there may be other factors specific to the individual that could lead to an increase or decrease in their demand for college. Data for the United States show that among recent high school graduates, 72 % of females were enrolled in either a 2-year or 4-year postsecondary institution compared to 65 % of males (National Center for Education Statistics 2013). This gap may reflect differences between the genders in their inherent interest in higher education, or differences in other factors in the model such as their ability to pay for college, or some combination of the two. Similarly, data have also shown long-term differences in the college participation rates of recent high school graduates by race/ethnicity and by income level.[19]

Putting this together, the latent demand for college for the j-th student can be described as a function of the utility of net present value of private market benefits from attending college ($U(NPV(pri)_j^a$), the utility from private non-market benefits of going to college ($U(Z_j)$), the student's ability to pay for college (Y_j), and other personal and family characteristics that might affect the likelihood of going to college (X_j):

$$a_j^* = f\left(U\left(NPV(pri)_j^a\right), U\left(Z_j\right), Y_j, X_j\right) \tag{3.11}$$

where f is a mathematical function showing how these factors are combined to obtain the latent demand for pursing a college education.[20] This equation represents the predisposition for going to college in general as opposed to the demand for attending any specific institution.

In this equation, we might assume that the intent to go to college increases along with net market benefits (and hence each of the factors that affect costs and benefits), and their ability to pay for college. The ability to pay for college will be a function of the financial resources that the student and his/her family can use to

[19] See *Digest of Education Statistics 2012*, Tables 235 and 236.

[20] There are alternative ways in which an economist might represent the latent demand equation in (3.11). It is common, for example, to add an error term to the utility function to capture idiosyncratic variations across students in how they value the components of the choice model. We chose a simpler utility specification to help clarify that the student's decision is affected by the utility he or she obtains from the net financial benefits and the consumptive aspects of going to college. Independent of these utilities, the student may be more or less likely to want to go to college due to their ability to pay as well as personal and family characteristics.

Table 3.5 Hypothetical illustration of predisposition for college [stage one]

Category	Brett	Emily	Hannah	Kevin	Jenni
Net present value from college [$NPV(pri)^a$]	$300,000	$500,000	$200,000	$100,000	$400,000
Utility of net present value [$U(NPV(pri)^a)$]	6000 utils	10,000 utils	4000 utils	2000 utils	8000 utils
Family after-tax income [I_j]	$90,000	$60,000	$20,000	$40,000	$120,000
Net tuition [P_j–F_j]	$13,000	$13,000	$13,000	$13,000	$13,000
After-tax disposable income [Y_j]	$50,000	$29,000	$1000	$15,000	$71,000
Utility of non-market college Attributes [$U(Z_j)$]	7000 utils	6000 utils	5000 utils	3000 utils	1000 utils
Gender [X_j]	Male	Female	Female	Male	Female
Latent demand for college [$\boldsymbol{a}^*_j$]	214	209	137	83	143
Predisposed to college [$a_j = 0$ or 1]	Yes	Yes	No	No	No

Notes: Illustration assumes that $U(NPV(pri)^a) = 0.02 * NPV(pri)^a$ and $a_j^* = 0.004 * U(NPV(pri)_j^a) + 0.001 * Y_j + 0.02 * U(Z_j) + 20 * X_j$ where X is a dichotomous variable equal to 1 if female, 0 if male. Simulation also assumes that after-tax disposable income is calculated as $Y_j = 0.7*I_j - (P_j - F_j)$. Threshold value for each student to pursue college is assumed to be 200 utils

pay for college (I_j) and the net price of college ($P_j - F_j$). It is reasonable to assume that the ability to pay for college rises with income $(\partial Y/\partial I > 0)$ and falls with the net price $(\partial Y/\partial(P - F) < 0)$. A similar approach is used by the federal government when it calculates the amount of funds that a family should be able to pay for their child's college education (known as the family's "expected family contribution" or EFC). Each student's demand for college will also take into account the possible private non-market benefits of college, which is the sum of the student's annual non-market benefits during and after college (i.e., $Z_j = \sum_{t=1}^{T} Z_{jt}$).

Once a student's intent to go to college exceeds his or her minimum (and also unobservable) threshold value for going to any college (denoted $\bar{a}_j$), he or she would want to go to college, where $a_j = 1$ if the student pursues a college education and $a_j = 0$ if the student does not pursue a college education:

$$a_j = \begin{cases} 1 \ \ if \ \ a_j^* > \overline{a} \\ 0 \ \ if \ \ a_j^* \leq \overline{a} \end{cases} \tag{3.12}$$

Unlike the latent demand, the value a_j is observable through actions taken by the student, such as enrolling in college-preparatory classes or taking a standardized test such as the SAT or ACT.

The first stage of student choice is illustrated in Table 3.5, where we show data for five hypothetical students who must decide whether or not they want to go to college. Each student uses information to form initial estimates of the financial benefits and costs of going to college and the subsequent net present values (row 1). The variations in the amounts shown in this row could reflect differences in information about the costs and benefits from college, as well as the type of postsecondary education that they are considering. We use a simple linear equation to demonstrate how students might convert the net present values into utilities (row 2), where the student receives two units of utility, or utils, for every \$100 in net present value.

The third row shows the student's after-tax disposable income, which relates to their ability to pay for college. In this example, Hannah comes from a family with a very low income, whereas Jenni's family has more financial resources to pay for college. The next row shows the average net tuition that each student expects to pay if they went to college. Because students at this stage of college choice have not yet identified specific institutions of interest to them, the net price might reflect the average in-state tuition and fees at public institutions and not the net price for any specific college. The after-tax income and net price are then converted into a measure of ability to pay by the formula $Y_j = 0.7(1 - tx)I_j - \left(P_j - F_j\right)$. In this illustration, Y_j can be thought of as the expected after-tax income left over after paying net tuition, where the quantity $0.7(1 - tx)I_j =$ income left over after paying for housing and/or other necessities.[21] The utilities each student expects to receive from all of the non-financial aspects of going to college are contained in the sixth row. In this illustration, the first student (Brett) places a greater value than do the other four students on these non-market benefits from going to college. The student's gender is reported in the fifth column and is treated as a personal characteristic that may affect the initial demand for going to college.

Each student is then assumed to combine the utility from net present value of private market benefits, their ability to pay, their utility from non-market aspects of college, and their gender to form a latent demand for college such as the following:

$$a_j^* = 0.004 * U(NPV(pri)_j^a) + 0.001 * Y_j + 0.02 * U(Z_j) + 20 * X_j \qquad (3.13)$$

where $X = 1$ if the student is female, 0 if male. In this equation, the student's latent demand for going to college will increase when their utility from the net financial benefit of college rises, they are better able to pay for college, their utility from non-market benefits rises, or they are female. Although we chose a relatively simple linear equation to demonstrate how this might work, the same logic would be applied to more realistic – and hence complex – functional forms.[22] Each student then compares his or her latent demand to the minimum threshold value that they would need to decide to pursue a college education, which is set equal to $\overline{a} = 200$ in

[21] Of course the true relationships between family income, net price, and ability to pay for college will be more complicated than shown in this simple equation. Nonetheless, the logic behind the equation is consistent with the approach used by the federal government in the United States when estimating a student's expected family contribution and resulting financial need to pay for college.

[22] The absolute magnitude of the latent demand measure is not important for the model, and is only used as a means of illustrating how the process might work. A wide range of functional forms and coefficients could be used. The key for illustrative purposes is the directional effect of each factor and how it compares to the chosen threshold value for the student.

this illustration. As a result, only Brett and Emily would want to go to college since their latent demands exceed the threshold for attending college.

Moving to the second stage in the college choice process, a student who has decided that he or she would like to go to college then identifies a series of institutions to consider attending. This choice set may be identified by geographic location, such as colleges within driving distance from the student's home. The student may also restrict their choice set to only public institutions, institutions offering a major in their subject of interest, or those of specific sizes. More formally, the student would create an initial choice set by applying the latent demand formula in Eq. (3.11) to each of a series of K institutions:

$$a_{jk}^{*} = f\left(U\left(NPV(pri)_{jk}^{a}\right), U\left(Z_{jk}\right), Y_{jk}, X_{j}\right) \text{ for } k = 1, \ldots, K \tag{3.14}$$

The subscripts jk are used together to show that the utility of net present value of market and non-market benefits, as well as ability to pay, can vary by institution and student. Although in theory K could represent the set of all colleges and universities, students typically only focus on a subset of institutions that would be feasible for them to attend, such as colleges offering a Bachelor's degree in Chemistry, or having fewer than 10,000 students, or located within their home state's boundaries.

When written in this manner, the latent demand for the k-th institution can differ across students depending on their perceived market and non-market costs and benefits. Likewise, the net present value from each institution could be affected by the institution's prestige and reputation, risk of non-completion, cost of attendance, and so on. A student would then include the k-th institution in his or her initial choice set ($a_{jk} = 1$) as long as the latent demand exceeds the threshold for attendance:

$$a_{jk} = \begin{cases} 1 \;\; if \;\; a_{jk}^{*} > \overline{a}_{j} \\ 0 \;\; if \;\; a_{jk}^{*} \leq \overline{a} \end{cases} \quad \text{for } k = 1, \ldots, K \tag{3.15}$$

The initial choice set may be reflected in actions such as the student sending his or her SAT or ACT scores to an institution, making a visit to the campus, or contacting the institution for information.

In Table 3.6, we use hypothetical numbers to illustrate the second stage of the college choice model. We begin with data on the first student from Table 3.5 (Brett), who has decided that he would like to go to college. Let's suppose that Brett looks at sixteen institutions (A though P) and wants to narrow the group down to a subset of institutions for more serious consideration. He estimates the net present value of attending each of the institutions based on information about the prices, financial aid, benefits from graduating, and likelihoods of earning a degree, and then converts these values into utilities as before (column 1). The net prices that Brett believes he would have to pay at each institution range from a low of \$0 at institutions A and B to a high of \$50,000 at institution P (column 3). The different net prices give rise to differences in disposable income for attending each

Table 3.6 Hypothetical illustration of formation of initial choice set for a male student [stage two]

College	Utility of net present value $[U(NPV(pri)^a_{jk})]$	After-tax income [(1-*tx*) I_j]	Net price $[P_{jk} - F_{jk}]$	Disposable income $[Y_{jk}]$	Utility of non-market college attributes $[U(Z_{jk})]$	Latent demand to consider college k $[a^*_{jk}]$	Will student consider college k? $[a_{jk}]$
A	10,000	$90,000	$0	$63,000	5000	363	Yes
B	8000	$90,000	$0	$63,000	5000	323	Yes
C	6000	$90,000	$5000	$58,000	6000	298	Yes
D	6000	$90,000	$5000	$58,000	7000	318	Yes
E	8000	$90,000	$10,000	$53,000	5000	313	Yes
F	4000	$90,000	$10,000	$53,000	8000	293	Yes
G	5000	$90,000	$10,000	$53,000	9000	333	Yes
H	6000	$90,000	$10,000	$53,000	5000	273	Yes
I	4000	$90,000	$20,000	$43,000	6000	243	Yes
J	8000	$90,000	$20,000	$43,000	4000	283	Yes
K	6000	$90,000	$20,000	$43,000	1000	183	No
L	6000	$90,000	$30,000	$33,000	1000	173	No
M	7000	$90,000	$40,000	$23,000	1000	183	No
N	2000	$90,000	$40,000	$23,000	4000	143	No
O	4000	$90,000	$40,000	$23,000	2000	143	No
P	2000	$90,000	$50,000	$13,000	3000	113	No

Notes: Illustration assumes that $U(NPV(pri)^a) = 0.02{*}NPV(pri)^a$ and for a male student $a^*_j = 0.004 * U(NPV(pri)^a_{jk}) + 0.001 * Y_{jk} + 0.02 * U(Z_{jk})$. Threshold value for the student to pursue college is assumed to be 200 utils institution. Brett also assigns utilities to the non-market benefits from attending each institution, and combines all of this information to form latent demands for each institution. For this illustration, we used the same linear equation as in Stage 1 (Eq. 3.13) to estimate latent demand, except that the last term in the equation drops out because the student is male and thus $X = 0$. Brett then compares the latent demands for each institution to his threshold for attendance (assumed to be $\overline{a} = 200$) and places the first ten institutions in his initial choice set because the latent demands for each exceed the threshold.

In the third stage in the college choice process, a student narrows down the initial choice set and decides on those institutions, if any, to which he or she will apply. At first glance the decision would appear to be relatively straightforward: the student would apply to every institution for which their latent demand exceeds the threshold ($a^*_{jk} > \overline{a}_j$). However, a student may not apply to every institution meeting this criteria due to the time and money needed to apply to colleges. The costs of applying to an institution (denoted CA_{jk}) not only include the application fee, but also other financial costs for campus visits and other out-of-pocket expenses. A student and his/her family will likewise face non-market costs when applying to an institution given that time and effort are needed to acquire information about an institution, complete an application form (including the often dreaded essay), fill out other forms for financial aid, visit campuses, and so on. The cost of applying to an institution is therefore affected by factors such as the distance to the institution from the student's home, the application fee, and the difficulty of the application process.[23]

On the benefit side, a student only gains from applying to an institution if he or she is admitted (stage four of the college choice model). The admission process at some institutions is very competitive, with only a small fraction of applicants being admitted. For example, out of the 26,664 applicants to Princeton University for Fall 2012, only 2095 (7.9 %) were offered admission. The probability of being admitted to an institution depends on the selectivity level of the institution and where the student falls on the distribution of applicants. Assuming that the student can form estimates of the probability of being admitted (p_{jk}) for each institution in the choice set, he or she can find the expected value of applying by multiplying the net present value of attendance, if admitted, by the probability of being admitted, for each institution $\left((NPV^a_{jk})\left(p_{jk}\right)\right)$.

Taken together, the expected net value of applying to an institution (NV_{jk}) is the expected benefit of applying minus the cost of applying:

[23] Some states, such as Georgia, have implemented common application forms for their public institutions so that students can complete one application form and use it for multiple institutions within the state. Likewise, many institutions both public and private now participate in a common application process. The hope among policy makers is that the use of common application forms will reduce the cost to students of applying and therefore lead to increases in applications.

$$NV_{jk} = \left(NPV^{a}_{jk}\right)\left(p_{jk}\right) - CA_{jk} \tag{3.16}$$

As a result, if a student believes that the likelihood of being admitted to a specific institution is very low, or the cost of applying is high, he or she may not apply to the institution even though the expected benefit from attending would exceed their threshold value. This may help explain why many average- or even above-average ability students do not apply to highly-selective and prestigious institutions. Similarly, the high travel costs associated with institutions far from a student's residence may be one reason why students are more likely to apply to colleges that are within a convenient travel distance from their homes.

The monetary and non-monetary cost of applying to a college may serve to limit the number of institutions to which a student will apply regardless of whether his/her latent demand for the institution exceeds the threshold. For this reason, a student and his/her family may decide that they will apply to a maximum of *M* institutions based on their budget of time and money for completing applications. Note that the application budget is another example of a limited resource for a decision maker.

Pulling all this together, a student's latent interest in applying to the *k*-th institution (denoted $q(d)^{*}_{jk}$) would be affected by all of the factors that influence placing the institution in the initial choice set, plus the costs and benefits of applying to the institution. The likelihood of applying to the *k*-th institution is then affected by its ranking relative to other institutions in the choice set. It is at this point in the model where the costs and benefits of other institutions come into play because students can substitute one institution for another; in economics terminology, they are considered substitute goods. For example, if other institutions were to reduce their tuition rates or increase their financial aid offers, it would increase their chances of being ranked in the student's top *M* institutions and thus receiving an application. This means that the demand for applying to institution *k* depends not only on its price but the prices charged by its competitors as well. A student's income or wealth may also have different effects on different institutions because as income rises, a student may be able to substitute away from choosing a less-expensive institution and towards a more-expensive institution. The effect of income changes on the demand for individual institutions depends on whether an institution is viewed by a student as being a normal or inferior good. We explore the notions of substitute goods and income effects in more detail in Chap. 5.

Even though the intent to apply is unobservable, the economist can see whether a student actually applies $(q(d)_{jk} = 1)$ or does not apply $(q(d)_{jk} = 0)$ to each institution. More formally, the student applies to an institution in their initial choice set as long as: (1) the latent demand exceeds the minimum threshold, (2) the benefit from applying exceeds the cost, and (3) the institution's latent demand ranks among the top *M* in the initial choice set (denoted mathematically $k \in M$):

$$q(d)_{jk} = \begin{cases} 1 \ \ if \ \ a^{*}_{jk} > \overline{a}_j, \ \ NV_{jk} > 0, \ \ k \in M \\ \qquad 0 \ \ otherwise \end{cases} \text{for} \, k = 1, \ldots, K \tag{3.17}$$

The decision to apply to the k-th institution would be a function of all of the factors affecting the latent demands for each of the institutions in the initial choice set ($a_{jk}{}^{*}$) as well as NPV_{jk}, p_{jk} , CA_{jk}, and M. Note that the student could choose to apply to fewer than M institutions if there are not enough institutions in the initial choice set that have sufficiently high latent demands and/or positive net benefits of applying. It is in this way that the supply side of the market may influence the student's choice in the third stage of the model. The supply restrictions of institutions would affect the perceived probability of being admitted, which in turn affect the net benefit from applying. As a result, even if a student would have a high demand for attending a very selective and prestigious institution such as Princeton University, he or she may not apply because of the supply constraint imposed by the university.

In Table 3.7 we continue with the previous illustration to examine how a student might make application decisions. Recall from Table 3.6 that Brett had formed an initial choice set of ten colleges (A through J). Due to the costs of applying and his time and income constraints, he has decided to apply to no more than four institutions. In Table 3.7, Brett forms subjective probabilities of receiving the net present values from each institution, and the resulting expected benefits from applying (columns 2, 3, and 4). For institution A, for example, the expected benefit of applying ($1,000) is found by multiplying the net present value from attending ($500,000) by the probability of being admitted (0.002). The student also forms estimates of the cost of applying to each institution, which would include expenses incurred for application fees, travel, and so on, as well as non-monetary costs for the time and effort needed to apply. The next column shows the difference between the expected benefits and costs of applying. Brett eliminates from consideration any institution for which the costs of applying exceed the benefits, leaving six institutions. Finally, because his budget limits him to apply to a maximum of four institutions, he ranks the six institutions in terms of their latent demands and applies to the top four within this group (C, D, G, and H).

The fourth stage of the college choice model is where the supply side of the market has its greatest influence. This stage is often overlooked when modeling the college choice process, but it is important for understanding how enrollment decisions are affected by the demand and supply sides of the market. Not only do students have the freedom to select institutions they would want to attend, but institutions have the freedom to decide which applicants they will admit. In this way, higher education markets are similar to marriage markets in that both parties must be willing and able to select the other before a transaction (marriage or enrollment) can occur. Colleges and universities often rely on a similar set of student attributes when making decisions regarding which subset of applicants will be offered admission. These include a student's academic performance and aptitude as measured by grade point average in high school and SAT/ACT scores, as well as special talents and attributes of the student that are believed to help the

Table 3.7 Hypothetical illustration of application decisions for a student [stage three]

Institution in initial choice set	Net present value from institution k [NPV^a_{jk}]	Probability of receiving NPV [p_{jk}]	Expected benefits of applying $\left[\left(NPV^a_{jk}\right)(p_{jk})\right]$	Expected cost of applying [CA_{jk}]	Expected benefits of applying minus cost [NV_{jk}]	Do expected benefits of applying exceed cost?	Top four of latent demand? [$q(d)_{jk}$]
A	\$500,000	0.0020	\$1000	\$2500	−\$1500	No	–
B	\$400,000	0.0005	\$200	\$1500	−\$1300	No	–
C	\$300,000	0.3000	\$90,000	\$1000	\$89,000	Yes	Yes
D	\$300,000	0.5000	\$150,000	\$2000	\$148,000	Yes	Yes
E	\$400,000	0.2000	\$80,000	\$400	\$79,600	Yes	No
F	\$200,000	0.4000	\$80,000	\$300	\$79,700	Yes	No
G	\$250,000	0.8000	\$200,000	\$1000	\$199,000	Yes	Yes
H	\$300,000	0.3000	\$90,000	\$500	\$89,500	Yes	Yes
I	\$200,000	0.0001	\$20	\$800	−\$780	No	–
J	\$400,000	0.0010	\$400	\$2000	−\$1600	No	–

Notes: Illustration assumes that the student can apply to a maximum of four institutions. Latent demands for each institution are reported in Table 3.2

institution fulfill its designated mission. We represent the total (and also unobservable) value of the j-th student to the k-th institution as $q(s)^*_{jk}$, where (s) denotes that this decision is made by institutions and represents the supply side of the market. Because institutions can only admit those students who apply, however, the supply choices are also affected by student demand from the previous stages. The institution's admission decisions can be framed in terms of whether the value of the j-th student exceeds the threshold value set by the college for admission ($\bar{s}_k$):

$$q(s)_{jk} = \begin{cases} 1 & if \quad q(s)^*_{jk} > \bar{s}_k \\ 0 & if \quad q(s)^*_{jk} \leq \bar{s}_k \end{cases} \text{ for } k = 1, \ldots, M \tag{3.18}$$

If $q(s)_{jk} = 1$, then the institution admits the j-th applicant, and does not admit the applicant when the latent supply score is below the threshold. After the fourth stage, the student has been admitted to a subset of N institutions from their application set M, where $N \leq M$ (and N could equal zero).

The threshold value set by each institution for admission is related to its selectivity. The threshold values are affected by the enrollment target set by the institution, the number of applications received, and so on. Institutions that admit virtually all applicants ("open admissions institutions") would set $\bar{s}_k$ at a relatively low level. In contrast, an institution that has many more applicants than spaces ("selective admissions institutions") would set $\bar{s}_k$ at a relatively high level and still be able to enroll a sufficient number of students to meet its revenue target. Accordingly, a student with the same latent supply score may be admitted to one college and not another depending on the threshold values set by each institution.

The college choice process now turns back to the student for the fifth and final stage of the model. It is at this point where the student ranks each of the N institutions to which he or she has been admitted, and then enrolls in the one institution ($e_{jk} = 1$ if enroll, 0 if not enroll) with the highest latent demand, as in:

$$e_{jk} = \begin{cases} 1 \quad if \quad a^*_{jk} = \max\left\{a^*_{j1}, \ldots, a^*_{jN}\right\} \\ \qquad 0 \quad otherwise \end{cases} \text{ for } k = 1, \ldots, N \tag{3.19}$$

The enrollment decision reflects both student demand and institutional supply given that a student cannot enroll in a college if he or she has not been admitted.

The last two stages of the college choice process are illustrated in Table 3.8. Recall that our student had previously decided to apply to four institutions: C, D, G, and H. Suppose that each institution has estimated that Brett's utility to them is 150 utils based on his GPA, standardized test scores, and difficulty of courses taken in high school. The institutions differ, however, in the minimum utility scores that they require for a student to be admitted, with the two more prestigious institutions in the set (G and H) having higher minimum thresholds for admittance. As a result, Brett would be admitted to only two of the four institutions in this example (C and D) where his utility to them exceeded their thresholds. In the last stage, Brett can

Table 3.8 Hypothetical illustration of college choice decision process for a student [stages four and five]

Initial choice set	Intent to attend college k [a^*_{jk}]	Is institution in the applied choice set?	Utility of student j to institution k [$q(s)^*_{jk}$]	Minimum utility needed to admit [$\bar{s}_k$]	Is institution in the admitted choice set? [$q(s)_{jk}$]	Did student enroll at the institution? [e_{jk}]
A	–	–	–	–	–	–
B	–	–	–	–	–	–
C	298	Yes	150	130	Yes	–
D	318	Yes	150	140	Yes	Yes
E	–	–	–	–	–	–
F	–	–	–	–	–	–
G	333	Yes	150	180	No	–
H	273	Yes	150	170	No	–
I	–	–	–	–	–	–
J	–	–	–	–	–	–

only select from among these two institutions, and would enroll at institution C because his latent demand for this institution was higher than it is for the other.

Extensions

The model of college choice we have described here focuses on some of the key factors influencing college choice. Nevertheless, this model is still a somewhat simplified version of the true underlying process being studied. This means that although the college choice model identifies a number of important aspects of how students and their families make decisions about whether and where to go to college, the model cannot capture all of the dimensions of this issue without becoming more complex. In this section, we offer brief discussions of some of the ways in which the college choice model can be expanded to gain a better understanding of the complexities of the college decision making process.

Persist, Drop Out, or Transfer. The college choice model focuses on the decisions made by students and their families regarding whether to initially enroll in college, and if so, where to enroll. However, students do not stop making college-going decisions once they arrive on campus. In fact, students are continuously updating their estimates of the costs and benefits of their postsecondary options and using the new information to determine if they want to persist and enroll at their current institution for another year, transfer to another institution (and if so, where), or drop out of college. The traditional college choice model can be adapted to look at how students make these decisions.

To see how this might work, imagine that a college freshman is considering whether or not to stay at her current college. She would begin by recalculating her expected benefits and costs if she were to persist at her current college and re-enroll for another year. The student's perceived costs would change because there is now one fewer year of college to finance through direct costs. On the other hand, the college might increase tuition for her sophomore year. Indirect costs could also change if the student believes that having completed one year of college raises the earnings she is giving up while in school. In addition, benefits may change because there is now one fewer year in which the student could reap the non-financial benefits from going to college. It could also be that as the student progresses through college, she obtains more and better information about the benefits and costs from the investment.

Now, let's suppose that the same student is considering applying and transferring to a different institution. She would not only have to take into account the financial costs and benefits of the other institutions she would consider, but also the costs of applying and transferring to the other institutions. The costs of applying would include the time and expenses associated with completing the application and gathering information about the institution. There may be additional financial costs that the student would incur if she were to transfer. Because courses completed at one institution may not always be counted towards graduation by another institution, she might find that it may take her more time to graduate if she were to transfer. This will increase the direct and indirect costs incurred from transferring.

Beyond financial costs, however, a student may experience non-financial costs from transferring. The student would have to spend time and effort becoming acclimated to the new institution. Perhaps even more important to the student is her lost utility from leaving friends and acquaintances at her current institution, and the time and effort needed to make friends at the new institution. Taken together, the financial and non-financial costs of transferring may be substantial, and in fact large enough to convince the student to stay at her current institution even if she feels that, in some other ways, she might be happier at another institution.

The resulting choice processes for students considering whether to persist at their current college, drop out of college, or transfer to another college are depicted in Fig. 3.4. The student recalculates the latent demands for each institution in the choice set and compares these to the threshold for going to college. If all of the estimates, after taking into account the costs and benefits of transferring, are below the threshold, then the student would drop out of college.[24] Provided that at least one institution has a latent demand above the threshold, the choice for the student now becomes whether to stay at the current college or transfer. For the student to transfer, the latent demand for another institution would have to exceed the demand at the current institution, and the benefits from transferring must exceed the costs.

[24] This only pertains to students who are performing well enough academically to enroll in college in the following year. Students who have grades that fall below an institution's minimum requirement would face a different choice set imposed by the supplier.

Step 1: Student revised latent demand estimates for current institution and all other institutions in her choice set

↓

Step 2: Student compares latent demand estimates to threshold, and drops out of college if all revised latent demands are below the threshold

↓

Step 3: Student ranks institutions based on revised latent demands, and transfers to another institution only if another institution has a higher latent demand and the benefits of transferring outweigh the costs

Fig. 3.4 Depiction of process to drop out of college or transfer

This extension of the college choice model can likewise be used to look at how the probability of transferring changes over the course of a student's education. Data from the federal government shows that college students are the most likely to leave their institution within the first year, whereas seniors are the least likely to leave (National Center for Education Statistics 2013). This observation is consistent with the predictions from the college choice model. If the costs fall as the length of time in college rises, then the net financial benefit from staying in college another year rises with each year. Only those students who either experience large reductions in non-financial benefits, or perhaps incur low private costs of transferring, might make the decision to leave their current institution.

The Role of Parents in College Choice In the standard college choice model, the student is thought of as the decision maker. However, it is typically the case that the decision is made jointly between the student and his/her parents. The extent to which parents influence the final decisions will, of course, vary considerably across students and families. We might think of students as falling along a continuum where at one extreme the student makes all of these decisions, at the other extreme the parents make all of the decisions, and in between these extremes the student and the parents are both involved in making these choices. This is important because parents and their children may have different preferences for the various benefits and costs of going to college.

The shared decision making might be incorporated into the college choice model by noting that parents can also form latent demands for sending their child to college.

For example, the student's latent demand for the k-th college and the latent demand that parents determine for their child going to college could be written as:

$$a_{jkp}^{*} = f_{p}\left(U\left(NPV(pri)_{jk}^{a}\right), U\left(Z_{jk}\right), Y_{j}, X_{j}\right) \tag{3.20}$$

$$a_{jks}^{*} = f_{s}\left(U\left(NPV(pri)_{jk}^{a}\right), U\left(Z_{jk}\right), Y_{j}, X_{j}\right) \tag{3.21}$$

where the third subscripts p and s are added to denote the parents and student, respectively. The subscripts for the function symbol show that parents and the student may attach different preferences or weights to the various components of latent demand. As a result, the student and his/her parents may not reach the same conclusion about whether the student should consider going to a specific college. The latent demand shown earlier in Eq. (3.14) is then a weighted average of the separate latent demands for the parents and child:

$$a_{jk}^{*} = \theta a_{jkp}^{*} + (1 - \theta) a_{jks}^{*} \tag{3.22}$$

with θ denoting the relative influence of parents in the college choice process. If $\theta = 0$, then parents have no say in the college decisions of their child, and if $\theta = 1$ it implies that parents make all of the decisions about college for their child. The same approach can be used for the other demand-side stages of the college choice model to explain how parents and their children work together to decide whether to go to college, and if so, where to go to college.

The different preferences of parents and their children for the latent demand components are affected by who incurs the costs and who receives the benefits. On the cost side, the student may only pay a portion of the direct costs if their parents have agreed to pay some or all of the net tuition. Accordingly, net price may be a more important determinant in college choice for parents than for their children. Parents and their children will also receive different benefits from college. On the financial side, the higher earnings from going to college accrue to the student. However, parents still benefit financially when their children do better in the labor market because it reduces the need to continue financially supporting their children, and increases the possibility that their children in turn may help financially support them in retirement. Students are also likely to place a greater emphasis than do their parents on the social and consumptive aspects of college given that they are the ones who benefit from them. The final decisions about postsecondary education come down to the relative influence that parents and students have in this process.

Choice of College Major In the model of college choice outlined here, little attention was given to the majors selected by students. Nonetheless, the student's choice of major would certainly affect all of the stages of college choice. Students who want to pursue occupations where a postsecondary education is required would be more predisposed than other students to want to go to college. The colleges included in a student's initial choice set, application set, and final institution of matriculation would be restricted to places that offer degrees in their choice of major, and the relative ranking of institutions within the choice set could be affected by an institution's reputation in certain subject areas. On the supply side, it is likely the case that admission decisions at many colleges are influenced by the perceived fit between the student's interests/major and the major fields of study offered by the institution. Thus the college choice model as discussed earlier presumes that the choice sets of students are shaped by their intended major.

The framework of the college choice model could be expanded to help examine how students make decisions about their intended major. It is well known that the financial payoffs for college graduates vary by major, with graduates in subject areas such as finance, engineering, and the hard sciences earning more on average than graduates in the humanities and selected social sciences.[25] Combined with the fact that colleges charge virtually the same price to students regardless of major, all else equal, students should be more interested in majoring in subjects with larger financial payoffs. Despite this observation, we see many students who continue to select majors where the job prospects and earnings are not very lucrative. As a result, some policy makers at the state and national levels are calling for colleges to increase their emphasis on degrees in higher-paying fields, especially those where there are observed or predicted shortages of qualified graduates.

As noted in the college choice model, however, decisions about postsecondary education are driven not solely by the financial gain from college, but rather by the utility gain for students. It is quite possible that students attach varying amounts of utility to the types of jobs that they might find from their choice of major. One student may really enjoy history, for example, and decides to major in history even though it would mean earning less money over their lifetime. Another student may expect high levels of utility from being an elementary school teacher, and therefore, elect to major in elementary education. Viewed in this way, these students would be acting rationally in deciding to major in less-lucrative subject areas, and policies aimed at redirecting students into higher-paying fields could actually reduce their levels of utility.

Policy Focus

Thus far, we have covered the costs and benefits of investing in postsecondary education, and have shown how economists think about the college choice process. The model shows that, when left to their own accord, students and their families will take into account information about the costs and benefits and opt to do what they perceive is in their own best interest. Economists represent this objective of decision makers as their trying to maximize their utility subject to their constraints.

[25] See, for example, Grogger and Eide (1995), James, Nabeel, Conaty, and To (1989), and Arcidiacono (2004).

However, there are instances where a variety of individuals and organizations may want to take actions that would lead students and their families to make different decisions about college. We refer to these entities as policy makers and their actions as policies. At the state or national level, for example, elected officials are often interested in finding policies that will entice more high school graduates to go to college under the belief that when they do so it can create spillover benefits (or positive externalities) for the region they represent (see Chap. 6). Private organizations and foundations may seek to encourage more students from traditionally-underrepresented groups to go to college in the hope of reducing perceived inequities in society. And administrators at colleges and universities are constantly looking for ways to convince more students – especially high-ability students – to attend their institutions.

In general, policy makers face two types of problems in trying to achieve their education goals. The first is that they cannot simply force students and their families to act in ways that they believe are right. Students in the United States and elsewhere have the freedom to make decisions about whether and where to go to college. Accordingly, policy makers try to use incentives (policies) that will then lead students to make different choices than they would have otherwise made. The second problem for policy makers is that many of the factors that influence the postsecondary decisions of students are beyond their control. These factors not only include items that can be readily defined and measured such as incomes in labor markets, but less tangible items such as the utility of income and non-market benefits. Economics as a field does not have a lot to say about how a person's preferences should be formed, nor how these preferences can be changed. As a result, the higher education policies favored by economists usually focus on aspects of the college choice model that can be directly manipulated by the policy maker, which we refer to as policy levers.

To see the types of levers that are available to policy makers, we expand the equations described earlier in the five-stage college choice model. The expected costs, benefits, and net benefit from investing in college, for example, can be affected by a number of factors discussed in this chapter. These effects can be expressed in a more general form by rewriting Eq. (3.10) to show that the net present value of market benefits from attending college is a function of these factors as follows[26]:

$$NPV(pri)^a = f\left(I^g,\ I^{ng}, I^{na}, \pi^g, \pi^r, T^1, T^r, T, tx^g, tx^{na}, P, F, w, z, i\right) \qquad (3.23)$$

[26] Although our focus in this chapter is on the role of economic theories in explaining student choice, sociological constructs such as habitus, cultural capital and social capital can shed further light on how perceptions of both the benefits and costs of investing in higher education vary across students and families. Interested readers are referred to the work of Bergerson (2009), Bourdieu (1977), Bourdieu and Passeron (1977), Coleman (1990), McDonough (1997), Paulsen (2001), and Perna (2006).

Policy makers can exert influence over several factors in this equation such as the tax rates on income, tuition rates charged by institutions, and financial aid given to students. Other factors including the earnings in labor markets with various levels of education cannot be controlled by policy makers. The functions for the various stages of college choice can also be expanded to show how they are affected by particular factors:

$$a_j^* = f\left(I^g,\ I^{ng}, I^{na}, \pi^g, \pi^r, T^1, T^r, T, tx^g, tx^{na}, P, F, w, z, i, Y, X\right) \tag{3.24}$$

$$a_{jk}^* = f\left(I_k^g,\ I_k^{ng}, I^{na}, \pi_k^g, \pi_k^r, T^1, T^r, T, tx^g, tx^{na}, P_k, F_k, w, z, i, Y, X\right) \tag{3.25}$$

$$q(d)_{jk} = f\left(a_{j1}^*, \ldots, a_{jK}^*, CA_{jk}, p_{jk}, M\right) \tag{3.26}$$

$$e_{jk} = f\left(a_{j1}^*, \ldots, a_{jK}^*, CA_{jk}, p_{jk}, M, N, q(s)_{j1}, \ldots, q(s)_{jM}, \bar{s}_k\right) \tag{3.27}$$

Federal Higher Education Policies Policy makers at the national or federal levels are often interested in devising policies that will lead to more students choosing to go to college and/or earn degrees. This is done with the belief that increases in educational attainment will help the nation raise its economic standard of living, compete more effectively with other nations for resources, and improve the quality of life for citizens. An example of this is President Obama's call in 2009 for the United States to significantly increase the number of students in the nation who go to college and earn some form of postsecondary credential (Soures 2009).

The challenge for federal policy makers is to find policy levers they can pull that would help them achieve this goal. Suppose that the federal government decided to focus on the first stage of the college choice model and implement policies that would entice more students to want to go to college. Most of the factors shown in the model, however, are beyond the control of the federal government. The federal government cannot increase the wages set in competitive labor markets for college-educated workers or reduce the wages for those who do not go to college. Because higher education institutions in the United States are not managed by the federal government, federal policy makers cannot directly control the prices charged by colleges and universities.

Federal policies therefore tend to focus on one factor that they can control – financial aid – as a means to reduce the net prices paid by students. The federal government can implement a financial aid program where they distribute funding to students and/or institutions in ways that they hope will lead to different decisions about postsecondary education on the part of the recipients. In the United States, the Pell Grant program provides grants to students from lower-income families that can be used to offset some of the tuition and fees charged by institutions.

To determine how an increase in federal financial aid may affect the number of students who initially consider going to college, we use calculus to find the first partial derivative of the latent demand Eq. (3.24) with respect to financial aid. Because the financial aid variable appears in two different places in the latent demand formula, and financial aid works through other variables to affect latent demand, we apply the Chain Rule from calculus to the latent demand equation to find the first partial derivative as follows[27]:

$$\frac{\partial a_j^*}{\partial F} = \left[\overset{(+)}{\left(\frac{\partial a_j}{\partial U(NPV^a)} \right)} \overset{(+)}{\left(\frac{\partial U(NPV^a)}{\partial (NPV^a)} \right)} \overset{(+)}{\left(\frac{\partial (NPV^a)}{\partial F} \right)} \right] \quad + \quad \left[\overset{(+)}{\left(\frac{\partial a_j^*}{\partial Y} \right)} \overset{(+)}{\left(\frac{\partial Y}{\partial F} \right)} \right] > 0 \tag{3.28}$$

Note that because financial aid affects both the net present value of attending college and the affordability of college, the total change in latent demand is broken into two parts denoted by square brackets. The first square bracket shows how changes in financial aid affect the net present value of going to college, and is broken down into three partial derivatives. The positive sign for the first derivative reflects the fact that as students would gain more utility from college, they would have a higher latent demand for college. The next derivative represents changes in utility due to an increase in the net present value from attending college, which is also assumed to be positive because both increases in benefits (e.g., higher earnings) and decreases in costs (e.g., lower net price) result in higher utility. Finally, the third part of the chain denotes how the net present value is affected by a change in financial aid. This partial derivative should be positive because increases in financial aid using a Pell Grant lower the direct cost of college, which in turn raises the net present value of going to college.

The second square bracket represents the change in demand due to the change in college affordability as financial aid increases. Each of the two partial derivatives in this section of the chain are likewise assumed to be positive because (a) demand rises as affordability rises, and (b) affordability rises as financial aid increases. This combined equation provides an estimate of the sensitivity of latent demand for pursuing a college degree due to changes in financial aid. Because it is reasonable that each of the five parts on the right-hand side of the expression in (3.28) is positive, the economist would predict that increases in federal financial aid will lead to increases in the latent demand for college.

Whether the increase in latent demand translates into increased numbers of students who decide to pursue a college education depends on the magnitude as well as the sign of the change in Eq. (3.28). This is depicted below in Fig. 3.5. The top horizontal line represents the latent demands for students prior to the federal grant. After receiving the grant, the latent demands of all students would shift to the right, with the magnitude depending on the derivative shown above and the size of

[27] The Chain Rule in calculus states that when a variable (Y) depends on a second variable (U), which in turn is dependent on a third variable (X), then the change in Y due to a one unit change in X can be broken down into two parts as follows: $\frac{dY}{dX} = \left(\frac{dY}{dU}\right)\left(\frac{dU}{dX}\right)$. The Chain Rule is useful in situations where the variable X affects Y through its impact on another variable (U). This can also be extended to chains with multiple links as shown above.

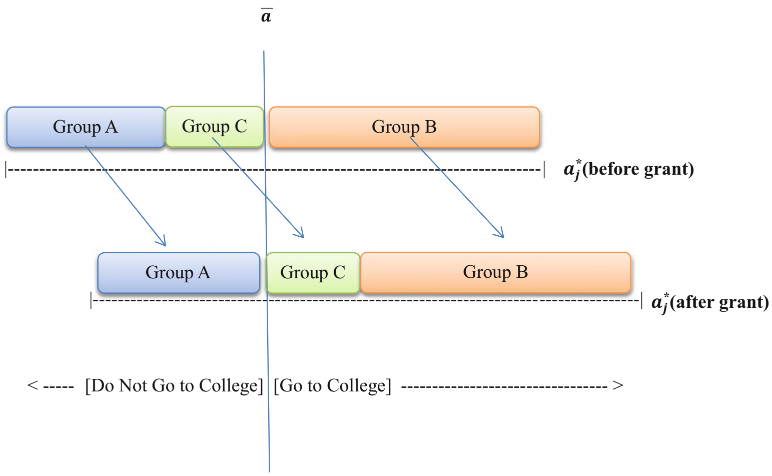


Fig. 3.5 Effects of federal grant on student decisions to want to go to college

the grant. The vertical line represents the threshold value that students need to pass in order to consider pursuing a college degree.

To see how the grant would affect students, we grouped them into three categories. The first group (A) consists of those students who, prior to the federal grant, had decided to not go to college based on their calculations of utility of expected costs and benefits. Even though the grant increased their latent demand for college, the increase was not sufficient to push them over the threshold value, and therefore they still would not want to attend college even with a grant. The second group of students (B) had decided to go to college prior to the grant, and would continue to do so after the grant because it simply increased their latent demands which were already above the threshold. Finally, there is the third group of students (C) in the middle for whom the grant is large enough to cause their latent demands to become greater than the threshold value. These would be the students who are predicted to change their behavior as a result of the federal government's financial aid policy. Of course, the larger the grant, the greater the chance that students will change their minds and decide to go to college.

The federal government can also encourage competition in higher education markets as a way to reduce the prices faced by students, which in turn should increase college aspirations among students. Across the globe, higher education institutions are expanding their offerings of online degree programs and massive open online courses (MOOC's) with the promise of making college more affordable and accessible to students. Because the costs of these programs are typically smaller than campus-based degree programs, the hope is that they will in turn have higher net present values for students and lead more students to want to go to college, and force campus-based institutions to lower their prices to remain competitive.

Even though online education and MOOC's have potential value to the higher education industry, it is not clear from the college choice model that they will have the revolutionary effect that some pundits are predicting for the industry. Online programs offer relatively few amenities to students, and thus they would be expected to have substantially fewer non-market benefits associated with them as compared to campus-based institutions. Students who place a lot of value on the non-market attributes of college may find that the added utility from paying lower prices are not sufficient to offset the lost utility from the non-financial attributes of college that they would have to give up. It can be argued that online degree programs and MOOC's may have the most impact on non-traditional college students as opposed to recent high school graduates. Non-traditional students such as working adults may be less interested in the non-market benefits from college and thus find online degree programs to be more appealing to them. Likewise, non-traditional students may be more geographically restricted in where they would go for college, so online education programs could expand the size of their markets considerably. We will return to the topic of online education and MOOC's in Chap. 8.

State Higher Education Policies At the state level, policy makers have similar objectives to federal policy makers in that they would like to find ways to entice more students to go to college. There are two key differences, however, between state and federal policy makers. First, state policy makers are primarily interested in the costs and benefits from policies at the state level as opposed to the national level. Elected officials in Utah, for example, are focused on what they can do that would lead more students from Utah to decide to go to college, and how much would it cost the state of Utah to achieve this outcome. As we discuss in Chap. 6, state-level policy makers therefore want to not only produce positive externalities through higher education, but also capture them by finding ways to keep students in their state during and after their time spent in college. If Utah were to provide citizens with a $5,000 per student subsidy to go to college, and students moved to California to use the subsidy, then there might be concern that state tax dollars from Utah were going to improve the quality of life in California.

A second key difference between federal and state policy makers is that they have different policy levers at their disposal. The responsibility for public higher education systems has been given to the states, and federal policy makers cannot control tuition rates; instead, they can only pressure states and institutions to do so. Depending on its governance structure, states can either set the tuition rates for their public institutions, or influence the tuition rates set by the institutions and their governing bodies by altering their funding to these institutions.

Accordingly, state higher education policies tend to focus on financial aid and tuition, and making institutions within the state's boundaries as attractive as possible so that more students will choose to stay in state and provide spillover benefits to the citizens of the state. For this reason, states often prefer higher education policies that require the student to use the financial subsidy at an in-state college or university. State financial aid (need- or merit-based) is usually restricted to be used at in-state institutions. Likewise, the price decrease for resident students at public colleges due to state appropriations is only received by students who decide to enroll at an in-state public institution.

To illustrate, imagine that the state has decided to implement a broad-based financial aid program in which students are given a grant that can then be used at any institution within the state's borders. In addition to the positive impact on the demand for college (Stage 1), the policy might also affect students by:

- increasing the number of institutions that become included in the student's initial choice set for those who have already decided to pursue college (Stage 2), which increases the number of applications and subsequent chance of enrolling at an in-state college;
- increasing the number of applications to in-state colleges for those who have formed initial choice sets (Stage 3), which increases the subsequent chance of enrolling; or
- increasing the chance of enrolling at an in-state college for those who have applied to college (Stage 5)

The hope is that the state financial aid will increase the net present value to students and their families from attending an in-state institution, relative to out-of-state institutions.

The decision to consider a particular institution would be affected by the grant program because it would reduce the direct cost of attendance, provided that the grant could be used at this institution:

$$\frac{\partial a^*_{jk}}{\partial F_{jk}} = \left[\overset{(+)}{\left(\frac{\partial a^*_{jk}}{\partial U\left(NPV^a_{jk}\right)} \right)} \overset{(+)}{\left(\frac{\partial U\left(NPV^a_{jk}\right)}{\partial \left(NPV^a_{jk}\right)} \right)} \overset{(+)}{\left(\frac{\partial \left(NPV^a_{jk}\right)}{\partial F_{jk}} \right)} \right] + \left[\overset{(+)}{\left(\frac{\partial a^*_{jk}}{\partial Y_{jk}} \right)} \overset{(+)}{\left(\frac{\partial Y_{jk}}{\partial F_{jk}} \right)} \right] > 0 \tag{3.29}$$

As with the federal grant policy, changes in financial aid affect demand by both increasing the net present value of attending the k-th institution and by making the k-th institution more affordable. If the grant could not be used at the k-th institution, then $F_{jk} = 0$ and the predicted effect on initial demand would be zero. For a state grant program, this would apply to most out-of-state institutions and perhaps many in-state private institutions as well.

The predicted effect of the grant program on whether or not the student applies to the college in question can be found by adding a link to the chain to represent how increases in the likelihood of being in the choice set would affect the chance of the student applying to the institution. Finally, the same approach can be used to describe how the grant might affect the chance of a student enrolling at a given institution. The magnitude of the effect of the grant on students depends not only on the partial derivatives shown above, but also on the size of the grant (ΔF_{jk}). The total effects on students would be estimated by multiplying the corresponding derivative by the size of the grant.

Institutional Higher Education Policies Policy makers at the institutional level, such as Boards of Trustees, Presidents, and other top administrators, are also interested in finding policies that will result in greater demand among students for their institution. Just as state-level policy makers in Utah are not interested in incurring costs that would benefit the State of California, policy makers at the University of Iowa are in general not interested in incurring costs that would lead to benefits for the University of Minnesota. Depending on the state and the public / private status of the institution, policy makers can directly control policy levers such as tuition rates, institutional financial aid, and admission criteria. Other factors such as graduation and retention rates can be affected to some degree by institutional policies, but not controlled with 100 % certainty.

Suppose that an institution were to consider a policy of reducing its application fee. The change in application fee would translate into a decrease in the expense of applying to an institution. Because this is not a factor in a student's decision about whether or not to pursue a college degree, $\partial a_j^* / \partial E_k = 0$. Likewise, it would not influence the chance of an institution being included in the student's initial choice set $\left(\partial a_{jk}^* / \partial E_k = 0\right)$ because the student at this point in the college search process is not focused on applying to any institution.

The decreased cost would, however, affect the actual application decision. The partial derivative of the application decision with respect to cost $(\partial q(d)_{jk} / \partial E_k < 0)$ shows that when application fees are reduced, it would be predicted to increase the likelihood that a student would apply to the institution. Likewise, the decreased application fee would raise the chance of a student enrolling at the institution $(\partial e_{jk} / \partial E_k)$. The total effects on students will depend on both these partial effects and the size of the application fee decrease (ΔE_k).

There are other policy options available to the campus-level policy maker. In fact, many of the changes made on campus by colleges and universities can be interpreted as attempts to increase the non-market benefits (Z_k) that students would receive from attending their institution. For example, when an institution builds a new dormitory with state-of-the-art technology and exercise equipment, it hopes that these enhancements will lead to an increase in utility for prospective students and increase the chance that students will apply and/or enroll at the institution. Even though many such improvements are not directly related to the quality of instructional services or financial return from attending the institution, they may be appealing to campus policy makers because they can definitely control these aspects of the bundle of services provided to students. In contrast, campus leaders cannot easily raise the quality of instruction and they definitely cannot influence the incomes earned by their graduates in labor markets.

Final Thoughts

The process by which students make decisions about whether and where to go to college is complex. There are multiple factors that a student takes into consideration, and the weights/values that students attach to a particular factor, such as price, can differ widely. To help make sense out of the decision process, economists rely on the notion that going to college is an investment in one's skills, or human capital, and that this investment will eventually be rewarded in the labor market.

The college choice framework developed by economists is rooted in an assumption of rational behavior where students make choices that they feel will maximize their expected lifetime utility. In this model, students estimate the costs and benefits from college, and the resulting utility that would be generated by the decision. The financial benefit from college is one, but not the only, factor in a student's decisions about whether to go to college, where to apply, and where to enroll. By basing the analysis of college-going decisions on utility rather than income, the model incorporates the impact of both market and non-market factors and can be applied to analyze, explain and predict a wide range of individual decisions and behaviors. Two students may look at the same information regarding financial costs and benefits of college, reach different decisions about going to college, and yet each could be making a rational decision. This is because of the many differences among students in their preferences for, and assignments of values to, the various benefits and costs of college.

In the next chapter, we examine in more detail how economists estimate the financial return to going to college. Later in the book (Chap. 5), we show how the demand for postsecondary education follows directly from the model of college choice. In particular, the demand function shows the various combinations of quantity of postsecondary education demanded at different prices, holding constant the other factors in the student's latent demand. Likewise, in Chap. 6 we return to the options available for policy makers to entice more students to go to college through government policies.

Glossary

Symbol	Definition
Subscript j	Student
Subscript t	Time
Subscript k	College
P	Price of college (tuition + fees)
F	Financial aid per student (grants and scholarships)
ΔF_k	Change in F (grant or scholarship) at the k-th college
tx^{na}, tx^{g}, tx^{ng}	Income tax rates for not attend college, graduate college, and not graduate
w	Proportion of foregone income earned while in college
I^{a}, I^{na}, I^{g}, I^{ng}	Incomes if attend college, not attend, graduate college, or not graduate
i	Annual rate of inflation
z	Annual discount rate for time preference of money
$T1$	Years in college
$T2$	Years in graduate or professional school

(continued)

Symbol	Definition
T^r	Year of retirement
T	Lifetime
π_t^r	Probability of enrolling in college in year t
π^g	Probability of graduating college
$C(pri)_t$	Annual private costs of college
$C(pri)^g$	Cumulative private costs of graduating college
$C(pri)^a$	Cumulative private costs of attending college
$B(pri)_t^g$	Annual private benefits of graduating college
$B(pri)_t^a$	Annual private benefits of attending college
$B(pri)^g$	Cumulative private benefits of graduating college
$B(pri)^a$	Cumulative private benefits of attending college
$NPV(pri)^g$	Private net present value of graduating college
$NPV(pri)^a$	Private net present value of attending college
a_j^*	Unobservable (latent) demand for going to college
a_j	Observable demand for going to college
$\overline{a}_j$	Threshold for demand for college
$U(\ )$	Utility function
$f(\ )$	Function or equation
Z_j	Non-market benefits of college
Y_j	Ability to pay for college
X_j	Personal characteristics of j-th student that affect demand for college
a_{jk}^*	Unobservable (latent) demand for going to the k-th college
a_{jk}	Observable demand for the k-th college
K	Number of institutions considered when forming initial choice set
M	Maximum number of institutions in the application set
N	Number of institutions to which the student was admitted
$q(d)_{jk}$	Whether applied to the k-th college
NV_{jk}	Net value of applying to the k-th college
p_{jk}	Probability of being admitted
CA_{jk}	Total cost of applying to the k-th college
E_k	Application fee for the k-th college
$q(s)_{jk}^*$	Unobservable value of the j-th student to the k-th college
$q(s)_{jk}$	Whether j-th student is admitted by the k-th college
$\overline{s}_k$	Threshold for admission at the k-th college
e_{jk}	Whether enrolled at the k-th college
a_{jkp}^*	Unobservable demand for the k-th institution by parents
a_{jks}^*	Unobservable demand for the k-th institution by students
θ	Relative influence of parents on college choice
$\partial Y/\partial X$	Change in variable Y due to a one-unit change in variable X

References

Arcidiacono, P. (2004). Ability sorting and the returns to college major. *Journal of Econometrics, 121*, 343–375.

Arrow, K. (1973). Higher education as a filter. *Journal of Public Economics, 2*, 193–216.

Becker, G. (1960). Underinvestment in college education. *American Economic Review, 50*, 346–354.

Becker, G. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy, 70*, 9–49.

Becker, G. (1975). *Human capital: A theoretical and empirical analysis, with special reference to education*. Chicago: University of Chicago Press.

Belman, D., & Heywood, J. (1991). Sheepskin effects in the returns to education: An examination of women and minorities. *The Review of Economics and Statistics, 73*, 720–724.

Belman, D., & Heywood, J. (1997). Sheepskin effects by cohort: Implications of job matching in a signaling model. *Oxford Economic Papers, 49*, 623–637.

Benhabib, J., & Spiegel, M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*, 143–174.

Bergerson, A. (2009). *College choice and access to college* (ASHE Higher Education Report, No. 4). San Francisco: Jossey-Bass.

Bils, M., & Klenow, P. (2000). Does schooling cause growth? *American Economic Review, 90*, 1160–1183.

Bitzan, J. (2009). Do sheepskin effects help explain racial earnings differences? *Economics of Education Review, 28*, 759–766.

Bourdieu, P. (1977). *Outline of a theory of practice* (Vol. 16). Cambridge, MA: Cambridge University Press.

Bourdieu, P., & Passeron, J. (1977). In R. Nice (Ed.), *Reproduction in education, culture and society*. London: Sage.

Cabrera, A., & La Nasa, S. (Eds.). (2000). *Understanding the college choice of disadvantaged students* (New directions for institutional research, no 107). San Francisco: Jossey-Bass.

Carnevale, A., Jayasundera, T., & Cheah, B. (2012). *The college advantage: Weathering the economic storm*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Chapman, D. (1981). A model of student college choice. *Journal of Higher Education, 52*, 490–505.

Coleman, J. (1990). *Equality and achievement in education*. Boulder, CO: Westview press.

College Board. (2014). *Trends in college pricing 2014*. Washington, DC: The College Board. Retrieved March 8, 2015, from https://secure-media.collegeboard.org/digitalServices/ misc/trends/2014-trends-college-pricing-report-final.pdf

Eide, E., & Showalter, M. (2010). Human capital. In D. Brewer & P. McEwan (Eds.), *Economics of education* (pp. 27–32). New York: Elsevier.

Fisher, I. (1906). *The nature of capital and income*. New York: Macmillan.

Friedman, M., & Kuznets, S. (1945). *Income from independent professional practice*. New York: National Bureau of Economic Research.

Fukase, E. (2010). Revisiting linkages between openness, education and economic growth: System GMM approach. *Journal of Economic Integration, 25*, 194–223.

Fuller, W., Manski, C., & Wise, D. (1982). New evidence on the economic determinants of postsecondary schooling choices. *The Journal of Human Resources, 17*, 477–498.

Grogger, J., & Eide, E. (1995). Changes in college skills and the rise in the college wage premium. *Journal of Human Resources, 30*, 280–310.

Hansen, W. (1963). Total and private rates of return to investment in schooling. *Journal of Political Economy, 71*, 128–140.

Hansen, W., & Weisbrod, B. (1969). *Benefits, costs, and finance of public higher education*. Chicago: Markham Publishing Company.

Hanson, K., & Litten, L. (1982). Mapping the road to academia: A review of research on women, men, and the college-selection process. In P. Perun (Ed.), *The undergraduate woman: Issues in education*. Lexington, MA: Lexington Books.

Hanushek, E., & Wobmann, L. (2007). *Education quality and economic growth*. Washington, DC: World Bank.

Heywood, J. (1994). How widespread are sheepskin returns to education in the U.S.? *Economics of Education Review, 13*, 227–234.

Hossler, D., Braxton, J., & Coopersmith, G. (1989). Understanding student college choice. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 5, pp. 231–288). New York: Agathon Press.

Hossler, D., & Gallagher, K. (1987). Studying college student choice: A three-phase model and the implications for policy-makers. *College and University, 2*, 207–221.

Hossler, D., Schmit, J., & Vesper, N. (1999). *Going to college: How social, economic, and educational factors influence the decisions students make*. Baltimore: Johns Hopkins University Press.

Hull, C. (Ed.). (1899). *The economic writings of Sir William Petty* (Vol. 2). Cambridge, UK: Cambridge University Press.

Hull, R., & Peters, L. (1969). *The peter principle: Why things always go wrong*. New York: William Morrow and Company.

Hwang, W., Liao, S., & Huang, M. (2013). Real option, human capital investment returns and higher educational policy. *Economic Modelling, 31*, 447–452.

Jaeger, D., & Page, M. (1996). Degrees matter: New evidence on sheepskin effects in returns to education. *The Review of Economics and Statistics, 78*, 733–740.

James, E., Nabeel, A., Conaty, J., & To, D. (1989). College quality and future earnings: Where should you send your child to college? *American Economic Review, 79*, 247–252.

Kiker, B. (1966). The historical roots of the concept of human capital. *The Journal of Political Economy, 74*, 481–499.

Kohn, M., Manski, C., & Mundel, D. (1976). An empirical investigation of factors influencing college going behavior. *Annals of Economic and Social Measurement, 5*, 391–419.

Litten, L. (1982). Different strokes in the applicant pool: Some refinements in a model of student college choice. *Journal of Higher Education, 53*, 383–402.

Manski, C., & Wise, D. (1983). *College choice in America*. Cambridge, MA: Harvard University Press.

McDonough, P. (1997). *Choosing colleges: How social class and schools structure opportunity*. Albany, NY: Suny Press.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore: The Johns Hopkins University Press.

Mincer, J. (1958). Investment in human capital and personal income distribution. *The Journal of Political Economy, 66*, 281–302.

National Center for Education Statistics. (2013). *Digest of education statistics 2012*. Washington, DC: Institute of Education Sciences.

National Center for Higher Education Management Systems. (2009). Six-year college graduation rates. Retrieved June 5, 2010, from http://www.higheredinfo.org/dbrowser/?level=nation&mode=graph&state=0&submeasure=27

Park, S. (2011). Returning to school for higher returns. *Economics of Education Review, 30*, 1215–1228.

Paulsen, M. (1990). *College choice: Understanding student enrollment behavior* (ASHE Higher Education Report, No. 6). Washington, DC: The George Washington University.

Paulsen, M. (2001). The economics of human capital and investment in higher education. In M. Paulsen & J. Smart (Eds.), *The finance of higher education: Theory, research, policy & practice* (pp. 55–94). New York: Agathon Press.

Perna, L. (2006). Studying college access and choice: A proposed conceptual model. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 21, pp. 99–157). Dordrecht, The Netherlands: Springer.

Portela, M., Alessie, R., & Teulings, C. (2010). Measurement error in education and growth regressions. *Scandinavian Journal of Economics, 112*, 618–639.

Psacharopoulos, G. (1984). The contribution of education to economic growth: International comparisons. In J. Kendrick (Ed.), *International comparisons of productivity and causes of the slowdown* (pp. 335–355). Washington, DC: American Enterprise Institute.

Schultz, T. (1961). Investment in human capital. *American Economic Review, 51*, 1–17.

Schultz, T. (1962). Reflections on investment in man. *The Journal of Political Economy, 70*, 1–8.

Smith, A. (1776). *The wealth of nations*. London: Methuen & Co., Ltd.

Soures, L. (2009, February 26). *A postsecondary degree or credential in every pot*. Center for American Progress. Retrieved January 20, 2014, from http://www.americanprogress.org/issues/labor/news/2009/02/26/5564/a-postsecondary-degree-or-credential-in-every-pot/

Spence, M. (1973). Job market signaling. *Quarterly Journal of Economics, 87*, 355–379.

Stiglitz, J. (1975). The theory of "screening", education, and the distribution of income. *American Economic Review, 65*, 283–300.

Temple, J. (2001). Growth effects of education and social capital in the OECD countries. *OECD Economic Studies, 33*, 57–101.

Topel, R. (1999). Labor markets and economic growth. In O. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (pp. 2943–2984). New York: Elsevier.

Walsh, J. (1935). Capital concept applied to man. *Quarterly Journal of Economics, 69*, 255–285.

Weisbrod, B. (1962). Education and investment in human capital. *The Journal of Political Economy, 70*, 106–123.

Wittstein, T. (1867). *Mathematische statistik und deren anwendung auf national-okonomie und versicherung-wissenschaft*. Hanover, Germany: Hanhsche Hofbuchlandlung.

Wobmann, L. (2003). Specifying human capital. *Journal of Economic Surveys, 17*, 239–270.

Woodhall, M. (1995). Human capital concepts. In M. Carnoy (Ed.), *International encyclopedia of economics of education* (2nd ed., pp. 24–28). New York: Elsevier.

Chapter 4
Private and Social Returns to Higher Education

Abstract In this chapter, we focus on the different ways in which economists measure the financial return on postsecondary education. We begin by providing some background on the work by economists on this topic, where studies of the return to postsecondary education grew out of the more general economic approach of cost-benefit analysis. We then explain how economists use aggregate-level data to measure the average return to postsecondary education, and demonstrate how the methods can be applied to different degree levels. Using data from 2011, we provide updated estimates of the return to earning an associate's or a bachelor's degree, as well as the average returns for all students who attend college as opposed to only graduates. In the Extension section of the chapter we discuss how economists use individual-level data to measure the financial benefits from college after controlling for observable student characteristics that may also affect earnings, and the emerging work on how to adjust these estimates for unobservable factors that can affect postsecondary decisions and earnings in labor markets. Finally, in the Policy Focus section we discuss policies relating to the use of return-on-education statistics to entice more students to go to college, and the extent to which students rely on loans to help finance their college education.

Introduction

In Chap. 3, we discussed how economists view going to college as an investment that is rewarded in the labor market after leaving college. If postsecondary education is indeed an investment, then the investors—students, their parents, and even the general public—will naturally want to know the size or magnitude of the return on this investment. And how does the return to postsecondary education compare to other uses of scarce resources such as time and money? The answers to these questions are particularly important as policy makers, academics, media commentators, and students and their families debate whether it is in the best interest of individuals and society to have more people going to college.

At first glance, it would appear that a college education is a wise financial decision for students. Postsecondary education stakeholders often point to the

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_4

Table 4.1 Median total money earnings in the United States in 2013 by educational attainment for individuals ages 25–64

	Only employed individuals		All individuals[a]	
Highest level of education	Median	Percent above high school (%)	Median	Percent above high school (%)
High school	$30,594	–	$20,986	–
Some college	$33,144	8	$25,262	20
Associate's degree	$37,338	22	$30,662	46
Bachelor's degree	$51,037	67	$42,887	104
Master's degree	$63,469	107	$57,200	173
Doctoral degree	$84,493	176	$75,895	262
Professional degree	$90,602	196	$80,984	286
Bachelor's or higher	$56,830	86	$50,099	139

[a]Medians for all individuals estimated by authors

Source: Income data were obtained from PINC-03. Educational Attainment–People 25 Years Old and Over, by Total Money Earnings in 2013, Work Experience in 2013, Age, Race, Hispanic Origin, and Sex, U.S. Census Bureau, Current Population Survey, 2012 Annual Social and Economic Supplement. The first two columns represent the median total money earnings for individuals ages 24–64 who reported being employed in 2013. The second set of columns are for the median earnings for all individuals in the age group 25–64, including those who reported no earnings. Table retrieved from http://www.census.gov/hhes/www/cpstables/032014/perinc/pinc03_000.htm

gaps in average salaries by educational attainment as evidence that there is a large financial payoff from earning a college degree. To illustrate, Table 4.1 shows the median earnings in 2013 for individuals ages 25–64 broken down by highest degree earned as reported by the U.S. Census Bureau.[1] The data reveal that the average earnings rises substantially with educational attainment. The median earnings for those who were employed in 2013 and held a bachelor's degree or higher ($56,830) was 86 % greater than the average earnings for someone whose highest degree was a high school diploma ($30,594). Because unemployment rates tend to fall as educational attainment rises, the average salary gaps by education level increase when unemployed individuals are included in the average earnings calculation as shown in the last two columns. It is therefore not surprising that numerous studies using data such as this have concluded that there are sizable financial gains from investing in education at the primary, secondary, undergraduate, and graduate levels.[2]

Not everyone, however, is convinced that the financial payoff from going to college is large enough to justify the investment. In his 1976 book, for example, Richard Freeman theorized that an excess supply of college-educated workers in

[1] See U.S. Census Bureau, PINC-03. Educational Attainment–People 25 Years Old and Over, by Total Money Earnings in 2013, Work Experience in 2013, Age, Race, Hispanic Origin, and Sex (http://www.census.gov/hhes/www/cpstables/032014/perinc/pinc03_000.htm).

[2] Examples of the range of studies of the return to higher education include Baum, Ma, and Payea (2010), Psacharopoulos (2008), Cohn and Hughes (1994), Benhabib and Spiegel (1994), McMahon (1991), and McMahon (2009).

the United States would lead to a reduction in the financial return on a college degree. Similar concerns have been raised since the mid-2000s, in response to the push among policy makers to get more students to go to college and earn degrees. These critics point to rapid increases in tuition to conclude that the return on a college degree is falling. In addition, they argue that many students are not academically prepared to do college work, and they "…shouldn't be wasting their own resources and those of their families and taxpayers" (Williams, 2012).

Experts and commentators even disagree as to how to interpret and use the same facts about the benefits of a college education. As an example, a 2015 Gallup poll asked college graduates to indicate their level of agreement with the statement: "My education from [university name] was worth the cost." The results from the poll for all respondents showed that 50 % strongly agreed with this statement, 27 % agreed with the statement, 13 % were neutral, 6 % disagreed with the statement, and 4 % strongly disagreed with the statement. Critics of higher education used the results to suggest that going to college is a poor investment. Headlines around the country announced "Is College Worth the Cost? Many Recent Graduates Don't Think So" (Selingo, 2015) and "Just Half of Graduates Strongly Agree Their College Education Was Worth the Cost" (Blumenstyk, 2015). On the other hand, others highlighted the fact that only 10 % of college graduates disagreed in some form with the statement, thus supporting the view that college is indeed a worthwhile investment for most (Martel, 2015).

For students who go to college and do not graduate, the financial situation is particularly bleak in that they incur substantial costs and yet reap smaller benefits due to not having access to highly-paid positions that require a college degree. Supporting evidence can be found in Table 4.1, where the median earnings for all individuals who attended college and did not earn a bachelor's degree ($25,262) was only 20 % higher than the average earnings for high school diploma holders ($20,986).

The question of whether there is a financial payoff to going to college is important for society as a whole, as well as for students and their families. Higher education costs are subsidized by many groups that do not directly consume the service, such as governments, private philanthropic organizations, and so on. They hope that the public will benefit from their investments due to the possible spillover benefits (or positive externalities) that are produced when more people go to college. These benefits may be financial, as reflected in improvements in economic growth or reductions in expenditures for health care and corrections. The benefits may also be non-market in nature, such as improved civic participation. We explore the topic of education subsidies in greater detail in Chaps. 6 and 7.

In this chapter, we focus on the different ways in which economists measure the financial return on postsecondary education. As will become clear, there are a number of conceptual and empirical issues that have to be addressed to calculate the return to higher education. On the conceptual side, should we only count the costs and benefits obtained by the student who goes to college, or should we also include the spillover costs and benefits to others in society? Should the return be measured for only those students who earn a degree, or for all students who attend college? Can we adjust estimates to take into account the many observable and unobservable factors that can influence the return on investment for a given student? On the empirical side, should we only consider financial costs and benefits, or should non-financial costs and benefits also be added to the totals? How should we measure the future income streams for individuals by education level? And should the net benefit be expressed in dollars, ratios of benefits to cost, or percentage returns on investments?

We begin by providing some background on the work by economists on this topic, where studies of the return to postsecondary education grew out of the more general economic approach of cost-benefit analysis. We then explain how economists use aggregate-level data to measure the average return to postsecondary education, and demonstrate how the methods can be applied to different degree levels. Using data from 2011, we provide updated estimates of the return to earning an associate's or a bachelor's degree, as well as the average returns for all students who attend college as opposed to only graduates. In the Extension section of the chapter we discuss how economists use individual-level data to measure the financial benefits from college after controlling for observable student characteristics that may also affect earnings, and the emerging work on how to adjust these estimates for unobservable factors that can affect postsecondary decisions and earnings in labor markets. Finally, in the Policy Focus section we discuss policies relating to the use of return-on-education statistics to entice more students to go to college, and the extent to which students rely on loans to help finance their college education.

Background

Economists have devoted significant attention to the study of the return on a wide range of investments. By the 1960s they had developed the general cost-benefit framework that is still in use today to calculate whether the future benefit from investing in education exceeds the cost.[3] As noted by Prest and Turvey (1965, p. 683), the cost-benefit approach "...is a practical way of assessing the desirability of projects, where it is important to take a long view (in the sense of looking at repercussions in the further, as well as the nearer, future) and a wide view (in the sense of allowing for side-effects of many kinds on many persons, industries, regions, etc.)." The practice of using cost-benefit reasoning to aid in decision making dates back at least to the mid 1800s where Dupuit (1844) applied this logic to evaluate public works projects in France. Cost-benefit analysis came into vogue in the United States in the early part of the twentieth century as a way to make decisions about government investments in engineering projects relating to

[3] Excellent reviews and descriptions of the cost-benefit framework can be found in McKean (1958), Prest and Turvey (1965), Mishan (1983), and Cohn and Geske (1986).

rivers and harbors. The same approach was applied in the 1930s to large-scale government projects associated with the New Deal legislation, and later other projects and initiatives that grew out of the expansion of the public sector in the United States. Economists often use a 10 % annual return on investment as a rough benchmark for determining whether a particular investment is a good decision because its return was better than what could be earned from other options.[4] The focus of this early work was on what would later be called the social return (as opposed to the private return) from making specific investments.

Cost-benefit analysis was deemed to be an appropriate analytical tool in settings where the investment in the project was substantial, the costs and benefits are realized at various points in time, and the decision to invest involves uncertainty about the costs and benefits (Prest & Turvey, 1965). This description certainly applies to higher education, where both individuals (students and their families) and the public at large allocate substantial resources to producing and acquiring education, and the private and public benefits are received long after the costs have been incurred. By the early 1960s, economists had begun to use the cost-benefit approach to estimate the return on investing in various levels of education, ranging from primary schooling to graduate education.[5] Hansen (1963) and Becker (1964), for example, found that investing in a 4-year college degree in the 1940s and 1950s yielded internal rates of return to students of between 11 and 15 %. Numerous studies have now been conducted in the United States and around the world, with the preponderance of the evidence showing that there are large financial rates of return to education at all levels.[6]

At the same time, challenges to the notion that investing in a college degree makes good financial sense have been raised by academics, policy makers, and media commentators. One of the earliest and most highly-publicized critics was Richard Freeman, an economist who argued in his book *The Overeducated American* (1976) that increases in the number of individuals who had earned college degrees by the early 1970s would eventually lead to declines in financial returns to those degrees (also see Freeman, 1971). When his book was published, postsecondary institutions had seen substantial increases in enrollments due to the demand shift from the G.I. Bill and the population upswing from the Baby Boomer generation, and real (inflation-adjusted) wages were declining in many sectors due to rampant inflation. Freeman painted a rather depressing picture—for both students and institutions—of what the future holds for them in the face of an oversupply of college graduates in labor markets.

It is generally acknowledged, however, that most of Freeman's dire predictions for the future labor market returns for college graduates did not come to pass.

[4] See McMahon (2009) for more discussion of the justification used for the 10 % benchmark.

[5] Some of the earliest return-to-education studies include the work by Becker (1964), Schultz (1963), Hansen (1963), and Hansen and Weisbrod (1969).

[6] Interested readers are referred to the literature reviews on the rates of return to education conducted by Psacharopoulos (1973, 1981, 1985, 1994), and Psacharopoulos and Patrinos (2004) and international studies including Asadullah (2006), Denny and Harmon (2001), Menon (2008), Shafiq (2007), and Tilak (2007).

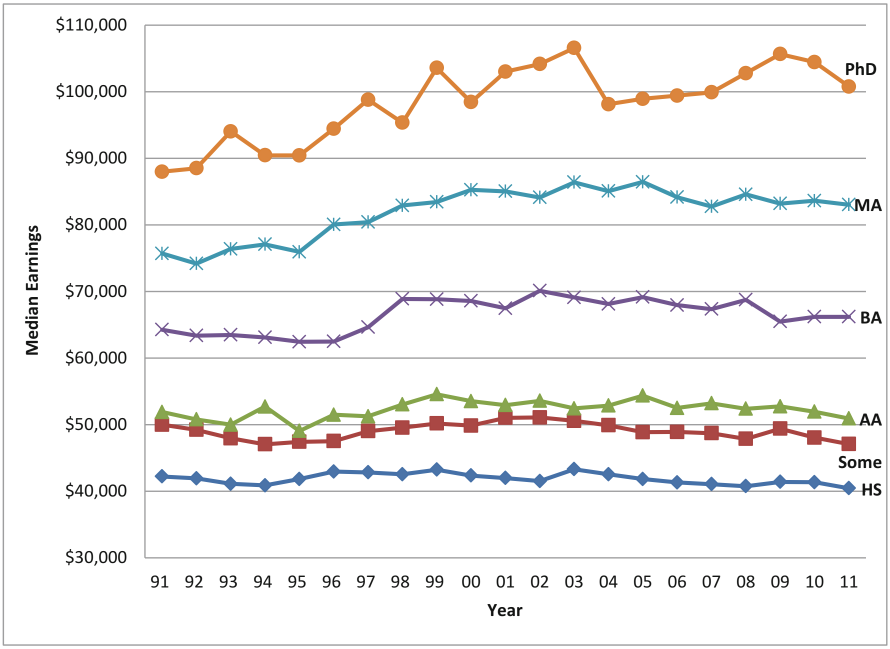


Fig. 4.1 Changes in median inflation-adjusted earnings by educational attainment, 1991–2011 (*Source*: U.S. Census Bureau, Table P-24. Educational Attainment–Full-Time, Year-Round Workers 25 Years Old and Over by Median Earnings and Sex: 1991 to 2011 (http://www.census.gov/hhes/www/income/data/historical/people/)

Changes in the U.S. and global economy placed a higher premium on knowledge and skills relative to manual labor, which helped to keep wages up for college graduates. Data reveal that the gap between the average earnings of bachelor-degree holders and high school graduates remained constant through the late 1970s and early 1980s, and then increased through the end of the 1990s.[7] Figure 4.1 shows the trend in median earnings for the subsequent 20-year period (adjusted for inflation) for full-time, year-round workers ages 20 and older in the United States, broken down by educational attainment. While the median earnings for those with a high school diploma kept pace with inflation during this time, the average earnings for workers with a bachelor's or graduate degree grew faster than inflation for much of the same time period. As a result, the gaps in median earnings by education level has actually widened over time.

Although there have always been those who have questioned the value of going to college, there has been a resurgence in such criticisms since the mid-2000s.[8]

[7] See Ashworth (1997), Lemieux (2006), Day and Newburger (2002) and Carnevale, Jayasundera, and Cheah (2012).

[8] As noted by Fain (2012) and Lederman (2013), among the more vocal critics are Samuelson (2012), Vedder (2012), and Williams (2012).

These critics have argued that the growth in college participation rates through the 1990s and 2000s have led to a situation similar to the 1970s where the supply of college-educated workers was increasing faster than the demand. They concluded that together with the economic downturn in the same decade, college-educated workers faced dire consequences in labor markets. Despite the different circumstances of the 1970s and 2000s, the rhetoric surrounding the claims that higher education is not a good investment is surprisingly similar. Compare, for example, the following quotes from Richard Freeman's 1976 book to those of Walter Williams in 2012:

> In the mid-1970s a very different picture of the college worker in the labor market seems to emerge. . .newspapers report new graduates having difficulty in obtaining college-level jobs. For prospective schoolteachers, primarily females, jobs in elementary and secondary schools are especially scarce. . .Recipients of bachelor's, master's and doctoral degrees in most fields accepted salaries. . .at real rates of pay far below those of their predecessors—and often in jobs quite divorced from their field of study and well below their levels of aspiration. (Freeman, 1976, p.4).

> More than one-third of working college graduates are in jobs that do not require a degree, such as flight attendants, taxi drivers and salesmen. Was college a wise use of these students' time and their parents' and taxpayers' resources? (Williams, 2012).

Conducting Return on Higher Education Studies

Economists who have studied the return on higher education have had to address a number of conceptual and empirical issues in their work. The first issue relates to the unit of analysis that is used. In general, studies can be grouped into two categories: aggregate-level studies and individual-level studies. Aggregate-level studies rely on data on the average benefits and costs for groups of students to calculate their average returns from college. Individual-level studies, on the other hand, use data on the characteristics of individual students to estimate the average financial benefit from college for students after controlling for observable factors that can also affect their income. This is accomplished through the use of an earnings equation, which can be traced back to the work of Jacob Mincer (1958, 1974). More recently, economists have attempted to use natural experiments and other quasi-experimental statistical techniques to address the possible connection between education, earnings, and unobservable factors such as motivation.

A second issue that must be addressed in return-to-education studies is whether return should be measured as a rate of return or a level of return. There are three approaches that have been used in aggregate studies: (1) the net present value of benefits minus costs, (2) the ratio of benefits to cost, and (3) the internal rate of return on costs that generate benefits.[9] The majority of academic studies using the

[9] Early details on these approaches can be found in Prest and Turvey (1965) and Cohn and Geske (1986).

aggregate-level approach measure rely on the internal rate of return (such as 15 % per year). However, it is common to see other studies instead report the level of return as in the lifetime earnings premium for degree completion, measured in the units of currency relevant for the study (such as $800,000), and other studies provide ratios of benefits to costs (such as 3.5 to 1). We argue here that rather than choosing between these three options, analysts should calculate each of them because they give useful information about ways to conceptualize the financial returns to college.

Economists also distinguish between the return or net benefits received by the individual who goes to college (private) and the return or net benefits to others in society (public). Although the early work on cost-benefit analysis focused exclusively on the social return to investing in a project, studies in education have also examined the private return experienced only by students and their families. Of course, this makes sense for education because unlike large public works projects where all investments are made by the government, both the student consuming the service and others who support it must decide whether or not to invest their time and money. Federal, state, and local governments devote financial resources to help students go to college. From the discussion in Chap. 3, these subsidies are predicted to increase the demand among students for going to college by reducing the net price that they would pay. In these instances, governments hope that, due to their investments, an increased number of students will go to college and in turn generate more spillover benefits for society (referred to by economists as "positive externalities").

Another important issue that economists must address is what types of costs and benefits to include in these calculations. The financial or market costs and benefits are the most obvious choice for the private and social return calculations because they are what we usually think of when it comes to investments. Market costs and benefits also have the added advantage of being easier for the researcher to measure. However, there are a number of other potential costs and benefits associated with going to college that are not easy to measure, but nonetheless may be important. For example, the impact of having a better educated citizenry on a nation's standard of living or medical and correctional expenditures are difficult to estimate. There are also a wide range of potential non-market benefits from education, such as the improved civic behavior of citizens with more education, which are difficult to measure and translate into financial benefits and costs.[10]

[10] A comprehensive examination of these issues can be found in Walter McMahon's book *Higher Learning, Greater Good* (2009).

Aggregate-Level Studies of the Return to College

In this section, we outline the aggregate-level approaches that are used for measuring the return to college. In this type of study, the economist uses data on the average costs and benefits faced by students to estimate the average return they receive when they go to college and possibly earn a degree. Aggregate-level studies have the advantages of using readily-available data, and being easy to explain and apply to a wide range of students and stakeholders. The assumptions made by researchers using these methods can be verified and tested to determine the sensitivity of the findings to these assumptions. The approach can also be used for measuring the return to different degree levels (associate's, bachelor's, master's, doctoral), and applied to subgroups of students such as by gender, race/ethnicity, and income.

We first review the private benefits and costs from earning a college degree as discussed in Chap. 3, and show how the return to college can be expressed as either the net present value of benefits minus costs, the ratio of benefits to costs, or the internal rate of return. We extend this notion to examine how economists measure the social return to college, where the calculations take into account the added costs and benefits incurred by others in society to support a student's education. We then discuss how the formulas can be applied to different levels of degrees, and illustrate how the aggregate-level studies can be used to capture the private and social benefits for all those who attend college, as opposed to only those students who successfully graduate from college. Throughout this section, the term "degree" can relate to any level of academic degree or education.

Private Return to Graduating College

In Chap. 3, we defined the costs and benefits incurred by students when they earn a college degree. Recall that the present value of costs incurred by a student who takes T^1 years to graduate is written as:

$$C(pri)^g = \sum_{t=1}^{T^1} \frac{P_t - F_t + (1 - tx^{na})(1 - w_t)I_t^{na}}{(1 + i)^{t-1}(1 + z)^{t-1}} \tag{4.1}$$

where all variables and symbols are defined in the same way as in Chap. 3. On the benefit side, the present value of private benefits from earning a college degree are calculated as:

$$B(pri)^g = \sum_{t=T^1+1}^{T} \frac{(1 - tx^g)I_t^g - (1 - tx^{na})I_t^{na}}{(1 + i)^{t-1}(1 + z)^{t-1}} \tag{4.2}$$

Note that the lifetime benefits and costs have been adjusted for inflation (i) and the discount rate (z). The income streams for private benefits and costs should be measured net of taxes because these are the benefits and indirect costs realized by students and their families. It has been suggested that the future income stream also accounts for the possible “option value” that accompanies completing a degree of a certain level, if the degree is a requirement for more advanced degrees. For example, a bachelor’s degree is required for a student to obtain a master’s or doctoral degree. As a result, earning a bachelor’s degree has some added financial benefit by opening up the possibility of even higher earnings if students later obtain more advanced degrees.

The first way in which aggregate-level studies measure the return on a college degree is with the *net present value*. The private net present value from graduating ($NPV(pri)^g$) was defined in Chap. 3 as the difference between the average private benefits and costs for graduates:

$$NPV(pri)^g = B(pri)^g - C(pri)^g \tag{4.3}$$

where benefits and costs are based on data for the average student. When $NPV(pri)^g > 0$, the average private benefits from completing a degree exceed the average private costs. These are referred to as private costs and benefits in that they apply to the person who is consuming the higher education service; namely, students and their families. In addition, these costs and benefits are restricted to those items that can be readily translated into financial terms. The return on postsecondary education in this equation is expressed in units of currency such as dollars, yen, or euros.

The second way in which the return to postsecondary education can be measured in aggregate-level studies is through the *ratio of private benefits to costs*. The ratio of private benefits to costs for graduates ($Ratio(pri)^g$) is defined as:

$$Ratio(pri)^g = B(pri)^g / C(pri)^g \tag{4.4}$$

When this ratio exceeds one, it indicates that the average discounted benefits are larger than the cost. Although this measure uses the same data as the net present value, the ratio is not affected by the units of measurement. If the ratio of benefits to costs in the U.S. is 4.50 and the ratio in Croatia is 3.20, then the ratio metric shows that a unit of currency invested in postsecondary education in the U.S. yields more benefits on average than is true in Croatia.

Finally, it is common for aggregate-level studies of the financial benefits from earning a college degree to express their findings as the *internal rate of return* (IROR). The private internal rate of return for graduates ($\delta(pri)^g$) is the annual rate of return (δ) that is needed to equate the average private benefits and costs, as in:

$$\sum_{t=T^1+1}^{T} \frac{B(pri)_t^g}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(pri)^g)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(pri)_t^g}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(pri)^g)^{t-1}} \tag{4.5}$$

For example, if $\delta = 0.10$, then this means that benefits over the years $t = T^1 + 1,\ldots,T$ would have to rise by 10 % annually to cover the costs incurred over the years $t = 1,..,T^1$. This formula is often referred to as the "full method" for measuring the internal rate of return on education.[11]

To see how these three measures compare to each other, imagine a simple two-period world in which a student goes to college in the first time period and works in the labor market in the second time period. The student incurs $20,000 in costs ($C(pri)^g$) in the first time period, and receives $30,000 more in salary ($B(pri)^g$) in the second time period as a result of having gone to college. In this instance, the private net present value from graduating college ($NPV(pri)^g$) is $30,000–$20,000 = $10,000, and the ratio of private benefits to cost is $30,000/$20,000 = 1.50. The formula for the internal rate of return is simplified in the two-period model to the net present value as a percentage of costs, as in:

$$IROR = \delta(pri)^g = \left(\frac{NPV(pri)^g}{C(pri)^g}\right) \; x \;\; 100 \tag{4.6}$$

which in this example results in a value of 50 %. Moving to a multi-period model greatly complicates the procedure for finding the internal rate of return because costs and benefits are incurred over multiple periods in the future, and an iterative method must be used.[12]

The vast majority of aggregate-level studies appearing in academic journals use the internal rate of return to measure the private financial return to college. The internal rate of return is usually calculated assuming that the discount rate for an individual's time preference is zero (i.e., $z = 0$ %) so that the resulting figure will be comparable to the rates of return published on other assets. Nonetheless, it is possible to calculate the IROR for present-value dollars as well.

In Table 4.2, we demonstrate how these formulas work for a hypothetical 18-year old high school senior who is deciding whether or not to pursue a bachelor's degree. For simplicity, we assume that all financial values such as incomes and

---

[11] See Psacharopoulos and Patrinos (2004) and McMahon (2009). There is also a "shortcut method" that is sometimes used in rates of return studies, where the private internal rate of return is approximated by $\left(\bar{I}^g - \bar{I}^{na}\right)/4\bar{I}^{na}$ (Psacharopoulos, 1981). This is useful in situations where the earnings trajectories over time are flat and the researcher does not have enough data to apply the full method.

[12] Spreadsheet programs and advanced calculators typically have built-in routines that will calculate the internal rate of return. For example, the Excel formula "=IRR(cell1:cellN)" will find the rate of return represented by an array of expenditures and revenues in the range cell1 to cellN.

Table 4.2 Hypothetical illustration of private return to a bachelor's degree vs. high school

Age	After-tax income with bachelor's degree	After-tax income if not attend college	Direct cost	After-tax indirect cost
18	–	–	$3,000	$15,000
19	–	–	$3,000	$15,000
20	–	–	$3,000	$15,000
21	–	–	$3,000	$15,000
22	$31,500	$15,000	–	–
23	$31,500	$15,000	–	–
↕	↕	↕	↕	↕
64	$31,500	$15,000	–	–
65	$31,500	$15,000	–	–
Totals	**$1,386,000**	**$660,000**	**$12,000**	**$60,000**
	Graduates:		**Non-Graduates:**	
	Benefits =	$726,000	Benefits =	$165,000
	Costs =	$72,000	Costs =	$72,000
	NPV =	$654,000	NPV =	$93,000
	Ratio =	10.08	Ratio =	2.29
	IROR =	17.7 %	IROR =	4.0 %

Notes: Values shown in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Bachelor-degree program is assumed to last 4 years. Incomes are high school = $20,000, some college = $25,000, and bachelor's = $42,000. Net price = $3,000/year. Direct cost = $3,000/year, and represents tuition minus grants/scholarships. Tax rate = 25 %. Discount rate = 0 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation

costs rise at the same rate as inflation, the student does not work during college ($w = 0$), and that future dollars are not discounted for time preference ($z = 0$). The student in this example enrolls in a bachelor's degree program for 4 years, and then enters the labor market until age 65. Starting at age 22, she would earn $31,500/year after taxes if she went to college and graduated with a bachelor's degree ($1,386,000 over 44 years in the labor market), $18,750/year if she went to college but did not earn a degree ($825,000 over 44 years), and $15,000/year if she did not go to college ($660,000 over 44 years). As a result, her cumulative private expected income gain from earning a bachelor's degree is $1,386,000–$660,000 = $726,000. In Table 4.2 we assumed that each year of college costs the student $3,000 (tuition and fees minus grants and scholarships), which corresponds roughly to the average net price paid by students who attend public 4-year institutions ($12,000 over 4 years). The student in this example would give up $15,000/year in after-tax income that she could be earning if not in college ($60,000 over 4 years). The resulting total cost of pursuing a bachelor's degree is then $18,000/year or $72,000 over 4 years.

The financial benefit from enrolling in a bachelor's degree program depends on whether the student graduates or not. If she were to earn a bachelor's degree, her private net present value would be the difference between benefits and costs (\$726,000–\$72,000 = \$654,000). The ratio of private benefits to costs is 726,000/72,000 = 10.08, meaning that she receives about \$10 in benefits for every dollar invested in her degree. Her private internal rate of return in this example is then found to be 17.7 %. The financial payoff for the student from going to college is substantially less, however, if she does not earn a bachelor's degree. The same \$72,000 in costs would generate only \$165,000 in added benefits over her lifetime, for a net present value of \$93,000. The ratio of benefits to costs of 2.29 indicates that each dollar of costs results in \$2.29 in benefits. Finally, the private internal rate of return is 4 % if she went to college for four years and did not graduate, which is far below the standard typically used to assess the worthiness of the investment relative to other options.

Social Return to Graduating College

The same general approach can be used to obtain measures of the return to society as a whole when students invest in postsecondary education. Students and their families (private), and other entities such as governments and private donors (public) invest resources to help students go to college. Likewise, both private and public groups hope to receive benefits from their investments. Social costs and benefits are defined as the sum of private and public costs/benefits. On the cost side, the present value of social costs would include all private costs and any additional (public) costs incurred by others in society to support the education of students, as in:

$$C(soc)^g = \sum_{t=1}^{T^1} \frac{P_t - F_t + (1 - w_t)I_t^{na} + G_t}{(1+i)^{t-1}(1+z)^{t-1}} \tag{4.7}$$

Note that pre-tax incomes are used rather than after-tax incomes because tax revenues can be used by society to benefit the public at large, and thus tax revenues foregone are a part of society's cost when students go to college. Furthermore, the variable G_t captures public subsidies that are used to reduce the portion of private cost paid by students. State appropriations to public institutions are one example of a public subsidy because it is hoped that in exchange for appropriations, public colleges and universities charge a lower tuition rate to state residents.

On the benefit side, the present value of social benefits to students would be represented as follows:

$$B(soc)^g = \sum_{t=T^1+1}^{T} \frac{I_t^g - I_t^{na} + E_t^g}{(1+i)^{t-1}(1+z)^{t-1}} \tag{4.8}$$

where incomes are in pre-tax dollars, and E_t^g = added positive externalities or benefits received by the public that are not captured by the tax revenues created by students who graduated from college. These positive externalities may be in the form of reduced health care costs, improved standard of living, and so on. Most studies of the social return to postsecondary education have difficulty measuring these positive externalities and usually omit them from the calculation. As noted by Psacharopoulos and Patrinos (2004, p. 112), "…typical social rate of return estimates are not able to include social benefits." McMahon (2009), however, examines how these types of public benefits may in fact be quantified, and he has found that these public benefits are nearly as large as the private benefits.

The resulting net present value to society (public plus private) from graduating college is the difference between the present value of social benefits and costs:

$$NPV(soc)^g = B(soc)^g - C(soc)^g \tag{4.9}$$

Likewise, the ratio of social benefits to costs from degree completion is calculated as follows:

$$Ratio(soc)^g = B(soc)^g / C(soc)^g \tag{4.10}$$

and the *social internal rate of return* from graduating from college ($\delta(soc)^g$) is the annual rate of return (δ) that is needed to equate the average social benefits and costs in the following equation:

$$\sum_{t=T^1+1}^{T} \frac{B(soc)_t^g}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(soc)^g)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(soc)_t^g}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(soc)^g)^{t-1}} \tag{4.11}$$

In Table 4.3 we continue with the previous example to show how the three measures of social return to higher education could be calculated for a student who pursues a bachelor's degree. Our assumptions in Table 4.3 are similar to those we used in Table 4.2, except that incomes are now measured in pre-tax dollars. As noted above, tax revenues foregone represent costs to society when students go to college; after students graduate, the taxes generated can be used to benefit the public and thus represent additional benefits to society. Following the previous example, the student in this illustration enrolls in a four-year bachelor's degree program and, at age 22, enters the labor market until retirement at age 65. Assuming she graduates with a bachelor's degree, she would earn $42,000/year before taxes

($1,848,000 over 44 years in the labor market). At age 65, her cumulative private expected income gain from earning a bachelor's degree is $1,848,000–$880,000 = $968,000. We also assume that each student produces an additional $E_t = \$8,000$ in public benefits (positive externalities) per year beyond taxes from having gone to college ($352,000 over 44 years).[13] As a result, the lifetime social (private plus public) benefits would be $1.32 million (= $968,000 + $352,000).

We assume that each year of college costs the student $3,000 in net tuition ($12,000 over four years). The student in this example would give up $20,000/year in before-tax income that she could be earning if not in college ($80,000 over 4 years). We also assume that the public pays $G_t = \$10,000$ in annual subsidies for the student's college education ($40,000 over 4 years), which is in line with the average governmental expenditures on student support at public 4-year institutions. Accordingly, the lifetime social (private plus public) costs would be $132,000 (= $12,000 + $80,000 + $40,000).

The resulting social net present value would be the difference between social benefits and costs, which is $1,320,000 – $132,000 = $1,188,000. The ratio of social benefits to cost is then $1,320,000/$132,000 = 10.00, indicating that for every dollar invested by society for students to earn a bachelor's degree, $10 are generated in private and public benefits. Finally, the social internal rate of return from graduating college is found to be 17.5 %. For students who do not graduate, however, the social return to college is much smaller. If the student goes to college for four years but does not earn a bachelor's degree, her social net present value in this example would be $440,000, or about one-third the quantity for graduates. The ratio of benefits to costs for the non-graduate would be 4.33, and the social internal rate of return is 8.4 %. The social benefits may in fact be smaller than this if the non-graduates contribution to the public good is less than the $8,000/year assumed for graduates.

Return to Earning an Associate's Degrees

The approach used by economists to measure the private and social return to an associate's degree is essentially the same as for a bachelor's degree. However, there are a few differences that must be taken into account. Associate-degree programs are usually designed to be two years in length, as opposed to the standard four years for a bachelor-degree program, and thus students would incur fewer direct and indirect costs. The cost savings for an associate's degree are even greater because students at 2-year institutions pay lower prices than do students at most 4-year institutions. The College Board (2012) showed that in the 2012–2013 academic year, the average tuition and fees at public 2-year institutions ($3,130) was less than

[13] As noted previously, this parameter is very difficult to estimate and is often omitted from rate of return studies for this reason. When combined with the added tax revenues from higher education, our choice of $8,000/student is consistent with estimates from McMahon (2009) of the public benefits from higher education.

Table 4.3 Hypothetical illustration of social return to a bachelor's degree vs. high school

Age	Pre-tax income with bachelor's degree	Pre-tax income if not attend college	Public benefits	Direct cost	Pre-tax indirect cost	Public cost
18	–	–	–	$3,000	$20,000	$10,000
19	–	–	–	$3,000	$20,000	$10,000
20	–	–	–	$3,000	$20,000	$10,000
21	–	–	–	$3,000	$20,000	$10,000
22	$42,000	$20,000	$8,000	–	–	–
23	$42,000	$20,000	$8,000	–	–	–
↕	↕	↕	↕	↕	↕	↕
64	$42,000	$20,000	$8,000	–	–	–
65	$42,000	$20,000	$8,000	–	–	–
Totals	**$1,848,000**	**$880,000**	**$352,000**	**$12,000**	**$80,000**	**$40,000**
Graduates:		**Non-graduates:**				
Benefits =	$1,320,000	Benefits =	$572,000			
Costs =	$132,000	Costs =	$132,000			
Net present value =	$1,188,000	Net present value =	$440,000			
Ratio =	10.00	Ratio =	4.33			
IROR =	17.5 %	IROR =	8.4 %			

Notes: Values in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Bachelor-degree program assumed to last four years. Incomes are high school = $20,000, some college = $25,000, and bachelor's = $42,000. Direct cost = $3,000/year, and represents tuition minus grants/scholarships. Public costs = $10,000/year and public benefits = $8,000/year above and beyond taxes. Discount rate = 0 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation

the average grant aid and tax benefits for students ($4,350). Another financial benefit is that students who earn associate's degrees would have more years to spend in the labor market. On the downside, however, the average earnings for associate's degree recipients is lower than the average for individuals with a bachelor's degree, which would then reduce future benefits.[14] The net effect of all of these factors on the return to graduating with an associate's or bachelor's degree depends on the relative size of these factors.

In Table 4.4, we continue with our previous hypothetical example to demonstrate how to calculate the private and social return to earning an associate's degree. The 18-year old student in this example is assumed to enroll in an associate's degree program for two years and then enter the labor market and retire at age 65. Net

[14] As with bachelor's degrees, the earnings with an associate's degree depend on the major chosen by the student. Associate-degree programs in fields such as nursing yield higher earnings than many other programs. The same is true, of course, for bachelor-degree programs. See Tuor and Backes-Gellner (2010) for more discussion.

Table 4.4 Hypothetical illustration of private and social return to an associate's degree vs. high school

Age	Private			Social				
	After-tax income gain with associate's degree	Direct cost	After-tax indirect cost	Pre-tax income gain with associate's degree	Direct cost	Pre-tax indirect cost	Public benefit	Public cost
18	–	$1,000	$15,000	–	$1,000	$20,000	–	$10,000
19	–	$1,000	$15,000	–	$1,000	$20,000	–	$10,000
20	$7,500	–	–	$10,000	–	–	$8,000	–
21	$7,500	–	–	$10,000	–	–	$8,000	–
↕	↕	↕	↕	↕	↕	↕	↕	↕
64	$7,500	–	–	$10,000	–	–	$8,000	–
65	$7,500	–	–	$10,000	–	–	$8,000	–
Totals	**$345,000**	**$2,000**	**$30,000**	**$460,000**	**$2,000**	**$40,000**	**$368,000**	**$20,000**
Private:				**Social:**				
Benefits =		$345,000		Benefits =	$828,000			
Costs =		$32,000		Costs =	$62,000			
Net Present Value =		$313,000		Net Present Value =	$766,000			
Ratio =		10.78		Ratio =	13.35			
IROR =		21.2 %		IROR =	25.7 %			

Notes: Values in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Associate-degree program assumed to last two years. Incomes are high school = \$20,000 and associate's = \$30,000. Direct cost = \$1,000/year, and represents tuition minus grants/scholarships. Public costs = \$10,000/year and public benefits = \$8,000/year above and beyond taxes. Tax rate = 25 %. Discount rate = 0 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation tuition and fees per year are set equal to $1,000 (in recognition of the lower net prices paid by students at 2-year institutions) and the pre-tax income with an associate's degree is set at $30,000/year. As before, we assume that there are $10,000 in social costs per year enrolled and $8,000 in social benefits per year after graduation. Likewise, we use the same discount rate (0 %) and income tax rate (25 %) as in previous examples. The first three columns of figures in Table 4.4 are used to calculate the private return on an associate's degree, and the last five columns pertain to calculating the social return.

In this example, the private net present value over the student's lifetime from earning an associate's degree is $313,000. Although this value is notably lower than the net present value for a bachelor's degree (using similar assumptions), note that the ratio of benefits to costs and the private internal rate of return from earning an associate's degree are higher. The same pattern can be seen when comparing the different measures of social return to graduating with either an associate's or a bachelor's degree. If the values used in the example are reasonable, then it suggests that dollar-for-dollar, investing in an associate's degree yields a better rate of return than investing in a bachelor's degree. However, bachelor-degree recipients would receive a much larger dollar payoff than would associate-degree recipients to their investment. We will return to this issue later in the chapter.

Return to Earning a Graduate Degree

The same basic approach can be used to estimate the financial return on earning a master's or doctoral degree. However, calculating the return to graduate education is also complicated by several issues. First, master-degree programs are usually intended to be two or three years in length, and doctoral-degree programs can take four or more years to complete. Second, acceptance into a graduate program is conditional on earning a bachelor's degree. This means that for a high school graduate to earn a doctoral degree, he or she must first earn a bachelor's degree and a master's degree.[15] Given that not all students who enter bachelor-degree programs graduate, only about two-thirds of students who begin a bachelor's degree will be eligible to pursue a master's degree, and only a fraction of this group will later be able to earn a doctoral degree.

The timing at which students go to graduate school has implications for the return on earning a graduate degree (see Fig. 3.2 in Chap. 3). In particular, because students are older when they enroll in graduate school, there are fewer years over which they can reap financial benefits in the labor market from these degrees. The increased time needed to receive both an undergraduate and graduate degree will

[15] In some instances, a student with a bachelor's degree may be accepted directly into a doctoral-degree program, and then receive a master's degree during the completion of their doctoral degree.

also raise the direct and indirect costs.[16] The indirect costs will rise as the student graduates from each degree program due to the student having better labor market opportunities that must be given up to go to college. For example, when enrolled in a master-degree program, the student gives up the income that could be received from having a bachelor's degree. Finally, the return to graduate education could be measured relative to either a high school education or a bachelor's degree. Both the costs and the benefits from graduate degrees will differ depending on which prior education level is used as the point of reference.

We now continue with our previous example in Table 4.5 to show how to calculate the return to master's degrees. In this example, we focus on the return to earning a master's degree relative to having a high school diploma. The 18-year-old student is now choosing between going to work after high school and going to college for six years to earn a bachelor's degree followed by a master's degree. Note that the indirect costs rise after four years because at this point the student has earned a bachelor's degree and could receive more income than before in the labor market. The student incurs direct and indirect costs for six years, and spends two fewer years (only 42) in the labor market, both of which would tend to reduce the return from graduating with a master's degree. Nonetheless, the dollar costs and benefits are larger for master-degree recipients than for bachelor-degree recipients because of the income gain that accompanies having a master's degree, and the resulting private net present value ($930,000) is nearly 50 % greater than for bachelor-degree holders. However, both the private ratio of benefits to costs (7.60) and the internal rate of return (13.6 %) are smaller for those who complete a master's degree than for those who complete a bachelor's degree. The same pattern holds when comparing the social return from earning a master's degree versus a bachelor's degree.

Finally, Table 4.6 extends the example even further to illustrate how the return on earning a doctoral degree might be calculated. As before, the return from graduating with a doctoral degree is measured relative to a high school diploma. The 18-year-old student is thus deciding whether to spend ten years in pursuit of a doctoral degree (four years for a bachelor's degree, then two years for a master's degree, followed by four more years for a doctoral degree) or go directly into the labor market and bypass college altogether. As a result, the student in this example would spend 10 years in college and 38 years in the labor market. The levels of direct and indirect costs rise considerably in comparison to other degrees due to the longer time spent in college and the rising salaries that could be received in the labor market with each degree earned.

Despite the negative impact on return from having spent more time in college and less time in the labor market, the private net present value from earning a doctoral degree ($1,252,500) is about one-third higher than for a master's degree, twice as large as for a bachelor's degrees, and more than four times as large as for an associate's degree. This is due to the substantial increase in earnings that

[16] Direct costs may be offset in doctoral-degree programs when the student receives a teaching or research assistantship. Such assistantships may also cover a portion of the indirect costs incurred by the student if they receive a stipend from the institution.

Table 4.5 Hypothetical illustration of private and social return to a master's degree vs. high school

	Private:			Social:				
Age	After-tax income gain w/master's degree	Direct cost	After-tax indirect cost	Pre-tax income gain with master's degree	Direct cost	Pre-tax indirect cost	Public benefit	Public cost
18	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
19	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
20	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
21	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
22	–	$3,000	$31,500	–	$3,000	$42,000	–	$10,000
23	–	$3,000	$31,500	–	$3,000	$42,000	–	$10,000
24	$25,500	–	–	$34,000	–	–	$8,000	–
25	$25,500	–	–	$34,000	–	–	$8,000	–
↕	↕	↕	↕	↕	↕	↕	↕	↕
65	$25,500	–	–	$34,000	–	–	$8,000	–
Totals	**$1,071,000**	**$18,000**	**$123,000**	**$1,428,000**	**$18,000**	**$164,000**	**$336,000**	**$60,000**
Private:				**Social:**				
Benefits =		$1,071,000			Benefits =		$1,764,000	
Costs =		$141,000			Costs =		$242,000	
Net present value =		$930,000			Net present value =		$1,522,000	
Ratio =		7.6			Ratio =		7.3	
IROR =		13.6 %			IROR =		13.0 %	

Notes: Values in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Master-degree program assumed to last two years, bachelor'-degree program lasts four years. Incomes are high school = $20,000, bachelor's = $42,000, and master's = $54,000. Direct cost = $3,000/year, and represents tuition minus grants/scholarships. Public costs = $10,000/year and public benefits = $8,000/year above and beyond taxes. Tax rate = 25 %. Discount rate = 0 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation

Table 4.6 Hypothetical illustration of private and social return to a doctoral degree vs. high school

Age	Private: After-tax income gain w/doctoral degree	Private: Direct cost	Private: After-tax indirect cost	Social: Pre-tax income gain with doctoral degree	Social: Direct cost	Social: Pre-tax indirect cost	Social: Public benefit	Social: Public cost
18	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
19	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
20	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
21	–	$3,000	$15,000	–	$3,000	$20,000	–	$10,000
22	–	$3,000	$31,500	–	$3,000	$42,000	–	$10,000
23	–	$3,000	$31,500	–	$3,000	$42,000	–	$10,000
24	–	$3,000	$40,500	–	$3,000	$54,000	–	$10,000
25	–	$3,000	$40,500	–	$3,000	$54,000	–	$10,000
26	–	$3,000	$40,500	–	$3,000	$54,000	–	$10,000
27	–	$3,000	$40,500	–	$3,000	$54,000	–	$10,000
28	$41,250	–	–	$55,000	–	–	$8,000	–
↕	↕	↕	↕	↕	↕	↕	↕	↕
65	$41,250	–	–	$55,000	–	–	$8,000	–
Totals	**$1,567,500**	**$30,000**	**$285,000**	**$2,090,000**	**$30,000**	**$380,000**	**$304,000**	**$100,000**
Private:				**Social:**				
Benefits =		$1,567,500		Benefits =	$2,394,000			
Costs =		$315,000		Costs =	$510,000			
Net present value =		$1,252,500		Net present value =	$1,884,000			
Ratio =		5.0		Ratio =	4.7			
IROR =		9.0 %		IROR =	8.5 %			

Notes: Values in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Doctoral-degree program assumed to last four years, master-degree program two years, and bachelor-degree program four years. Incomes are high school = $20,000, bachelor's = $42,000, master's = $54,000, and doctoral = $75,000. Direct cost = $3,000/year. Public costs = $10,000/year and public benefits = $8,000/year above and beyond taxes. Tax rate = 25 %. Discount rate = 0 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation accompany graduating with a doctoral degree. At the same time, the ratio of benefits to costs (5.0) and the internal rate of return (9.0 %) for doctoral degrees are lower than for associate's, bachelor's, and master's degrees.

All of the figures presented in Tables 4.2, 4.3, 4.4, 4.5, and 4.6 assumed that students do not discount future incomes and costs for the time preference of money. It is likely the case, however, that people prefer having current dollars to future dollars due to the foregone interest on the money. It is also interesting to consider how large is the return to earning a graduate degree conditional on having earned the degree needed for admission. For example, a student who has graduated with a bachelor's degree may want to know whether he or she should enroll in a master's degree program or go into the labor market at that time. A similar calculation would be useful for a student who has received a master's degree and now must decide whether to seek a doctoral degree or find a full-time job.

We consider both of these issues in Table 4.7. The table summarizes the three return metrics for degree completers by level of degree (associate's, bachelor's, master's, doctoral) and point of reference (high school diploma versus next highest degree). We show how the different measures of return would be affected by the choice of discount rate, where we assume either a 0 or 3 % discount rate per year above inflation.

Comparing the top half and bottom half of the rows in Table 4.7 reveals that increasing the discount rate reduces all three measures of private and social return to higher education. For example, the private net present value from earning an associate's degree falls by more than 50 % ($148,870 versus $313,000) when the discount rate rises to 3 % from 0 % per year. Large reductions are also seen for the ratio of benefits to costs and the internal rate of return, and apply to both private and social returns.[17]

Table 4.7 further illustrates that, as expected, the levels of private and social returns to earning graduate degrees are much smaller when compared to the next highest degree as opposed to when they are compared to a high school diploma. Interestingly, the ratios of benefits to costs and the internal rates of return are not dramatically different when the comparison groups were changed. Nonetheless, in this example the level of return to graduate degrees are still sizable in comparison to the next highest degree, suggesting that further investments in graduate education on average have a financial payoff for those who graduate.

The table also shows that when moving across degree levels, the net present values move in the opposite direction as the ratios of benefits to costs and the internal rates of return. Graduate degrees typically have larger dollar payoffs and smaller ratios of benefits to costs and rates of return. This pattern is highlighted in Figure 4.2, where we show the benefits and costs from our examples for the four different postsecondary degree levels relative to a high school diploma (assuming

[17] Keep in mind that economists usually calculate the internal rate of return assuming that the discount rate for time preference is 0 % above inflation because the return can then be directly compared to other investments. Accordingly, the values for the internal rate of return with a 3 % discount rate can be thought of as "adjusted rates of return" that are biased downward relative to other investments.

Table 4.7 Summary of illustrations of private and social return to earning a degree—associate's through doctoral degrees

	Comparison groups					
Measure of return	Associate's vs. high school	Bachelor's vs. high school	Master's vs. high school	Master's vs. bachelor's	Doctor's vs. high school	Doctor's vs. masters
PRIVATE (discount rate = 0 %):						
Net present value	$313,000	$654,000	$930,000	$309,000	$1,252,500	$424,500
Ratio benefits to costs	10.8	10.1	7.6	5.5	5.0	3.4
Internal rate of return	21.2 %	17.7 %	13.6 %	12.2 %	9.0 %	7.6 %
SOCIAL (discount rate = 0 %):						
Net present value	$766,000	$1,188,000	$1,522,000	$730,000	$1,884,000	$834,000
Ratio benefits to costs	13.4	10.0	7.3	7.6	4.7	4.1
Internal rate of return	25.7 %	17.5 %	13.0 %	16.8 %	8.5 %	9.1 %
PRIVATE (discount rate = 3 %):						
Net present value	$148,870	$297,321	$392,020	$139,104	$442,286	$157,650
Ratio benefits to costs	5.7	5.3	4.0	3.0	2.6	2.0
Internal rate of return	17.7 %	14.2 %	10.3 %	8.9 %	5.9 %	4.4 %
SOCIAL (discount rate = 3 %):						
Net present value	$371,872	$539,539	$636,036	$351,823	$648,548	$340,413
Ratio benefits to costs	7.1	5.3	3.9	4.3	2.5	2.3
Internal rate of return	22.1 %	14.1 %	9.7 %	13.4 %	5.3 %	5.9 %

Notes: Values in the table were created for illustrative purpose only and are not based on actual data. Illustration assumes student begins college at age 18 and retires at age 65. Associate-degree and master-degree programs last two years, bachelor-degree and doctoral-degree programs last four years. Incomes are high school = $20,000, some college = $25,000, associate's = $30,000, bachelor's = $42,000, master's = $54,000, and doctoral = $75,000. Direct cost = $3,000/year for all except Associate's (net price = $1,000). Public costs = $10,000/year and public benefits = $8,000/year above and beyond taxes. Tax rate = 25 %. Discount rate = 0 % or 3 %. Incomes, costs, and subsidies are assumed to grow at the rate of inflation

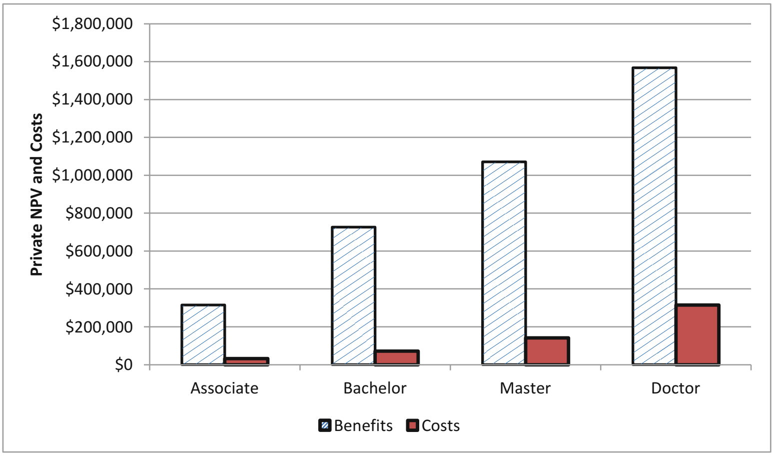


Fig. 4.2 Hypothetical illustration of lifetime private benefits and costs by degree level. *Notes*: Values used in the chart were created for illustrative purpose only and are not based on actual data. Illustration begins with an 18-year old student who retires from the labor market at age 65. All illustrations assume that the earnings by degree level are as follows: high school graduate ($20,000), some college ($25,000), associate's degree ($30,000), bachelor's degree ($25,000), master's degree ($42,000), and doctoral degree ($75,000). Associate- and master-degree programs are assumed to be two years in length. Bachelor- and doctoral-degree programs are assumed to be four years in length. The tax rate was set equal to 25 %, and the discount rate for time preference was set equal to 0 %. The net price for all degree programs except associate's degree is assumed to be $3,000/year, and the net price for associate's degree is assumed to be $1,000/year.

discount rate $z = 0$ %). The first bar in each pair shows the present-value benefits, and the second bar in each group is the present-value costs. The net present value is found as the difference between benefits and costs. Because the gap between benefits and costs rises as the degree level rises, the net present value is highest for doctoral degrees and lowest for associate's degrees. In contrast, the ratio measure and the rate of return measure focus on the relative size of the two bars rather than their differences. When the cost is relatively small, as is true for associate's degrees, then the ratio of benefits to costs and the internal rate of return can be higher even though the net benefits are smaller. This helps to illustrate why degrees with higher percentage payoffs such as associate's degrees may in fact yield lower dollar payoffs than other degrees.

Private and Social Returns to Attending College

The approaches used by economists to measure the return to college focus mainly on those students who went to college and earned a degree. However, as discussed in Chap. 3, a number of students who begin degree programs do not graduate, and on average these students do not fare nearly as well financially as do graduates. This raises the question: How large is the return from postsecondary education for all students who go to college as opposed to only those who graduate? Baum, Ma, and Payea (2010) argued that there are still substantial benefits from attending college even for those students who do not earn a degree. They note: “It is also important not to discount the value of college experience even for those students who do not earn a degree. . .although the payoff for earning a college credential is highest, the median return to each additional year of postsecondary schooling is significant.” (p. 8). The authors, however, do not provide calculations of the financial benefit for those students who attend and do not graduate. Further complicating matters is the fact that students who attend college can drop out or graduate at different points in time. Those who drop out or graduate early would incur fewer direct and indirect costs than other students, holding all else constant.

Because students do not know with certainty at the time they enroll when they will leave the institution, the best that they could do is use expectations to factor the risk of non-completion into their cost/benefit calculations. Recall that we earlier showed how to define the benefits and costs for all students from going to college, which includes graduates and non-graduates. The expected income from attending college can be thought of as a weighted-average of incomes from earning a degree and not earning a degree, where the weights correspond to the probability of completing a degree. Similarly, the expected costs from attending college are found by weighting the actual costs per year by the probability that the student will be enrolled. This probability will reflect the chance that the student either graduates or drops out of college at various points in time.

Once the present-value benefits and costs of attending college have been determined, these can be used to estimate the private and social return for all students from going to college in either net present value,

$$NPV(pri)^a = B(pri)^a - C(pri)^a \tag{4.12}$$

$$NPV(soc)^a = B(soc)^a - C(soc)^a \tag{4.13}$$

ratios of benefits to costs,

$$Ratio(pri)^a = B(pri)^a / C(pri)^a \tag{4.14}$$

$$Ratio(soc)^a = B(soc)^a / C(soc)^a \tag{4.15}$$

or the private and social internal rates of return:

$$\sum_{t=T^1+1}^{T} \frac{B(pri)_t^a}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(pri)^a)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(pri)_t^a}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(pri)^a)^{t-1}} \tag{4.16}$$

$$\sum_{t=T^1+1}^{T} \frac{B(soc)_t^a}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(soc)^a)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(soc)_t^a}{(1+i)^{t-1}(1+z)^{t-1}(1+\delta(soc)^a)^{t-1}} \tag{4.17}$$

As before, the social costs of attending college were obtained by adding public financial support to private costs, and social benefits include any positive externalities generated for the public by all who go to college and not just those who graduate. Because the expected costs and benefits will both be higher for college graduates than they are for all students who go to college, it is not clear *a priori* whether the returns to attending college would be larger or smaller than the returns to graduating from college.

Although there have been a few efforts to measure the return to higher education for those who attended college but did not earn a degree, most studies in the literature focus exclusively on the return to higher education for graduates. In contrast, Toutkoushian, Shafiq, and Trivette (2013) show how the private and social returns to higher education can be measured for graduates, non-graduates, and all students combined. The authors revised the traditional calculation methods used by previous researchers to take into account the expected costs of going to college, the risk of not graduating, the risk of leaving college early (using retention and graduation rates), and incorporating the average earnings for those who enrolled in college but did not earn a bachelor's degree. Overall, they found that while the average net present value for all attendees was notably smaller than for graduates, it was still positive and fairly large. Thus, going to college is still a wise financial investment for the average college student, even after taking into account the risk of not graduating.

Comparisons of Measures of Return to College

Given the three alternatives for measuring the return from postsecondary education, the first question that comes to mind is which of these is "best?" There is some debate among academics and policy makers as to which aggregate-level metric is the most useful. Even though these methods rely on the same basic data and present-value formulas, they each have their advantages and disadvantages.

An advantage of the net present-value statistic is that it shows the level of the expected payout to the student over their lifetime, which has value to the individual. Knowing that earning a bachelor's degree may lead to a gain of $300,000 over one's lifetime, for example, would be useful information to students when making decisions about postsecondary education. However, the level of return does not indicate whether going to college was a better investment than other options. And if the student had to pay $200,000 to get the $300,000 return, then going to college was a worse investment than if he or she only had to pay $30,000 for the same dollar return. Another practical issue that must be addressed is how to choose the discount rate for the net present-value calculation. Often it is simply assumed that the person's discount rate is zero, which would mean that after accounting for inflation, the person is indifferent between a dollar in the future and a dollar in the present. This would, however, lead to an overstatement of the net present value when in fact individuals prefer current to future dollars, as is likely the case. Yet another limitation of the net present-value measure is that the estimates are difficult to compare across time and nations. For example, is a net present value of $300,000 in 1980 bigger or smaller than a net present value of $500,000 in 2013? And how would a net present value of $800,000 US compare to a net present value of 6 million yen? Adjustments for inflation and exchange rates can be made to overcome these issues, but they require work on the part of the analyst to select the right values.

The ratio-of-benefits-to-costs measure of return has an advantage over the net present-value statistic in that it can be compared across time and nations. It does not matter which unit of currency is being used, nor the time at which the study is conducted. On the negative side, though, the ratio measure still requires the economist to choose a discount rate for the person's time preference of money, which is difficult to estimate in practice. Likewise, the ratio of benefits to costs cannot be directly compared to other investments, and thus does not indicate if seeking a higher education degree was a better investment for the student and/or society than other ways in which these resources could have been used.

Finally, the internal-rate-of-return metric is similar to the ratio of benefits to costs in that the units of measure make it comparable across time, levels of education, nations, and subgroups of students (such as males versus females). In addition, the internal rate of return is popular among academics because unlike the other two measures of return, the estimates can be compared to the rates of return on more traditional investments such as stocks and bonds as long as it is assumed that the discount rate for time preference is zero. However, even the internal-rate-of-return metric has its limitations. If future dollars are in fact discounted by students and their families due to a preference for current dollars over future dollars, then the internal rate of return will overstate the person's perceived return on investing in a college education.

Perhaps the most important philosophical issue to consider is which of these measures means the most to students and their families when they make decisions about postsecondary education. In the model of college choice that we presented in Chap. 3, students derive utility from the additional earnings they receive from college because the money can be spent on goods and services that give them satisfaction. Thus a student when faced with two options with the same rate of return but different dollar returns would gain more utility from the option with the larger dollar return. What about the student who must decide whether to pursue an associate's or a bachelor's degree? From the illustration in Table 4.7, the internal rate of return from earning an associate's degree was higher than for a bachelor's degree. Would the student therefore be better off financially if he or she obtained an associate's degree rather than a bachelor's degree? Despite the higher rate of return to an associate's degree, the average level of financial gain and hence lifetime utility is notably smaller than it is for a bachelor's degree. Therefore, the answer depends on which is more important to the student: the *rate* or *level* of return to college.

The preference among many economists for the internal-rate-of-return metric is driven, in part, by the nature of more traditional investments such as stocks and bonds. For these investments, the distinction between the level of return and rate of return on the investment is not as important as it is for higher education. Once an investor knows the rate of return on a stock or bond, the investor can control the level of return by choosing the amount to invest. For example, if an investor expects a 10 % return on every dollar invested in a given stock, then the expected dollar return can be doubled by simply purchasing twice as many shares of stock. The same relationship, however, does not apply to investing in postsecondary education. If a student believed that the internal rate of return to graduating from a given college was 15 %, then the student could not double her lifetime benefit by either going to the Bursar's office and offering to pay double the tuition rate, or enrolling twice at the same institution. The level of return from the investment in postsecondary education is largely determined once the student has selected an institution and major.

Taken together, we believe that there is value for students and policy makers alike in all of these measures of the private return on higher education. The net present value is perhaps most useful for students in helping them make decisions at a specific point in time about whether to go to college, and if so, where to attend. The ratio of benefits to costs and the internal rate of return are important for tracking changes in the lucrativeness from investing in postsecondary education, and comparing the return across nations or subgroups of institutions and students.

Methodological Issues in Aggregate-Level Studies

In the hypothetical examples presented earlier in the chapter, we made a number of simplifying assumptions to help illustrate the logic behind how private and social returns to postsecondary education are estimated. For instance, we assumed that incomes and costs grow at the same rate as inflation so that the lifetime benefits and costs would be relatively straightforward to calculate. We also included an estimate of public benefits ($8,000/year) to our illustration of social return, even though these benefits are very hard in practice to measure. To obtain defensible estimates that could be used in policy and academic settings, however, economists must use more defensible estimates of the components in the benefit and cost formulas. In doing so, there are a number of methodological issues that need to be addressed.

In aggregate-level studies, values for the benefit and cost formulas are chosen that would represent the parameters faced by a typical or representative student. This is often done by setting the parameters equal to the means or medians of variables for designated groups of individuals. For example, to calculate the private cost of going to college, the researcher needs to know the prices charged per year

($P_1,...P_{T1}$), the grants and scholarships received per year ($F_1,...,F_{T1}$), the tax rate that would apply to income if a student did not attend college (tx^{na}), the proportion of income that could be earned while in college (w), the annual rate of inflation (i), the discount rate for time preference (z), and the income that could be earned during college ($I_1^{na}, \ldots, I_{T1}^{na}$). The initial values P_1 and F_1 can be set equal to the average tuition/fee rates and grants received by students. Other factors such as the discount rates that individuals and society apply to future costs and benefits and the net tax rates for individuals, may be difficult to precisely measure, leaving the economist to make assumptions about these rates and perhaps use several different values to determine how sensitive the findings are to the assumed values. It is common, for example, to see a study report estimates based on several discount rates.

Estimating the public subsidies and benefits for higher education poses significant challenges for the economist. On the cost side, the public subsidies would certainly include revenues from government appropriations and financial aid programs that reduce the net prices paid by students. It is not clear, however, which other sources of institutional revenues should also be counted as public subsidies. Some of the revenues received by colleges and universities are earmarked for research and public service rather than instruction, and thus it could be argued that they are not public subsidies meant to encourage students to go to college. Other revenues from auxiliaries such as dormitories and food services are generated from non-instructional services provided to students. In practice, it therefore becomes difficult to determine which revenues should be counted as "public subsidies" to students. Empirical studies often either use all revenues per student, or only appropriations, as the measure of social costs.[18]

It is even more difficult to measure the public or spillover benefits due to higher education. As noted earlier, studies of the social return try to capture the public benefits through the additional tax revenues that are generated due to postsecondary education. However, going to college could lead to a number of other market and non-market public benefits, with the non-market benefits (by definition) being the hardest to convert into monetary equivalents. Accordingly, most studies do not include public benefits in their calculations, or at best they do so only through the additional tax revenues. This omission of benefits and increase in costs helps to explain why aggregate-level studies usually find that the social return to postsecondary education is less than the private return. However, as noted by McMahon (2010, p. 5), "If the estimates of the value of private and social non-market benefits beyond earnings are added to the jobs and earnings benefits as they should be, the evidence becomes overwhelming that the true social rates of return are higher than those typically reported."

Finding the right measures of income to use in return-to-postsecondary-education calculations can be a bit more involved than would seem to be the case at first glance. Income data are typically reported for people in broad age groups such as all

[18] For an excellent discussion of this issue, see Cohn and Geske (1986).

individuals ages 25 and older. This can have an adverse effect on the return calculations because the relative earnings by degree level may change over the person's life cycle. Ideally, the starting value should correspond to the average after-tax income of all individuals at around age 18 when they would be making the decision to enter college. The best that can often be done with available data is to use the average income for all individuals ages 25–34 as the starting place for calculations. And none of these metrics include the value of non-salary benefits that may accompany income.

The income measures should also consider the earnings of all people by degree level, and not only those who are employed. Income statistics produced by the Census Bureau and other organizations frequently report the average earnings for only those people who have been employed full-time within a designated time frame. As a result, the average incomes are higher than the averages for all those with a specific level of educational attainment. This would affect the return to education calculations because unemployment rates tend to be negatively correlated with years of education, meaning that the benefits for all college degree holders are even greater than would be suggested by statistics for only those degree holders who are employed. To take into account the chance that the person will be able to find employment, the researcher can either use an average income measure that includes employed and unemployed individuals within an age group, or weight the average income value for only those who are employed by the probability of being employed.

A more debatable data issue with regard to income is whether the average earnings for college graduates used in the formulas should also reflect the additional income gain that they may receive if they later go on to earn additional academic degrees. A bachelor's degree is a requirement for students to earn a master's degree, and thus it has been argued that a bachelor degree's value should also include the expected benefits from graduate degrees.[19] This can be included in the benefits calculation when the income stream for degree completers includes the incomes for those who went on to earn even higher degrees. Using the average income for all individuals with a bachelor's degree or higher, as opposed to the average earnings for those with only a bachelor's degree, for example, would in theory capture the option value of earning a bachelor's degree. The counterargument, of course, is that if the average income for those with at least a bachelor's degree is used, then some part of the income is due to the graduate degrees and not the bachelor's degree per se.

There are also different measures of earnings that could be used in the cost and benefit formulas. For instance, should the economist use a person's earnings or income as the relevant measure of what is gained from college? Income typically would include a person's salary as well as earnings from other sources, and thus may show a larger financial benefit from college. What is not clear, however, is

[19] This point was raised as far back as Weisbrod (1962). Also see Cunha (2009) and Hwang, Liao, and Huang (2013) for more discussion.

whether income differences from investments and other miscellaneous sources can be attributed to going to college. Household earnings could likewise be used as a measure of earnings.[20]

Another challenge in measuring the return to higher education is how to project future changes in the components of the cost and benefit formulas. The growth rates in future prices, grants, and incomes can be approximated by assuming each grows at a constant rate, such as $P_t = P_1(1 + r_p)^{t-1}$ and using data on the average growth rates in these metrics over specific time spans to project into the future. For factors where such data cannot be obtained, the researcher may simply set their future values equal to the expected rate of inflation as we did in our earlier examples in this chapter.

Projecting future incomes is perhaps the most difficult aspect to be addressed when calculating the return on postsecondary education. The income streams in each category will normally grow over time due to cost of living adjustments in earnings, job promotions, productivity, and so on, and will vary across individuals and colleges attended. Students do not know these future income streams with certainty at the time that they have to make the decision about whether or not to go to college.[21] Salaries by degree levels will vary by occupation as well as constantly-changing labor market conditions. Future salaries will also depend on the student's employer, the region of the country where they choose to live, their academic performance, the institution that they attended, and many other factors.[22] And as individuals gain human capital through their lifetime, this may lead to productivity gains that in turn influence earnings. The effects of productivity gains on benefits can be explicitly modeled or they can be built into the income streams through assumptions about growth over the life cycle.[23]

There are other empirical issues that economists face when trying to calculate the return on graduate degrees. While data on average earnings for those with graduate degrees have been tracked and reported by agencies such as the U.S. Census Bureau for years, the same is not true of other components of the net present-value formula. For example, it is difficult to find data on average financial aid awards to graduate students, particularly for assistantships and fellowships which cover some or all of the direct and indirect costs. Public subsidies for graduate education are hard to isolate because arguably some of the subsidy

[20] The challenge with household income is that it can be difficult to assign the income to one spouse and the education level of a single individual in the household.

[21] Webbink and Hartog (2004), however, found evidence that students can form reasonable expectations of their future income streams.

[22] For example, Monks (2000) found that college graduates' earnings vary by students' race, gender, ability, income, and years of work experience, and by various college characteristics such as institutional selectivity. Interested readers should also see Brewer, Eide, and Ehrenberg (1999), Carnoy (2010), and Dale and Krueger (2002).

[23] See Cohn and Geske (1986) for details.

given for research purposes is in part used to support the training of graduate students. And the general subsidies received by colleges are not broken down in university financial reports into subsidies for undergraduate versus graduate education.

A final complication on the benefit side is that the future income streams for individuals in all education categories are likely to shift downward in retirement. Forecasting precisely how much benefits fall in retirement is very challenging in practice given the wide range of retirement options in place for employees, including government-funded pensions. Nonetheless, people who have earned higher salaries during their time in the labor market should have higher earnings that they can draw upon in retirement. It is therefore common for aggregate-level studies to calculate benefits only up through a person's retirement from the labor market. As a result of this omission, the benefits from such studies will be biased downward.

Findings from Aggregate-Level Studies

There have been numerous studies conducted across the globe to measure the average financial return to higher education. George Psacharopoulos in particular has conducted a number of these studies and has published summaries of the results from studies across time, nations, and level of education.[24] Although many of the return to education studies look at primary and/or secondary education, we focus here on the findings for postsecondary education. Within this group, the most attention has been given to the financial return to completing a bachelor's degree. However, a number of researchers have also measured the return to earning an associate's degree or a graduate degree.

Return to Bachelor's Degrees

There have been a few empirical studies that have measured the level of financial benefits from earning a bachelor's degree. Cohn and Geske (1986), for example, found that the net present value of a bachelor's degree in 1981 was between $60,000 and $329,000, depending on the discount rate chosen. Day and Newburger (2002) estimated that as of 1999 the lifetime financial benefit from a bachelor's degree was $1.1 million for males and $600,000 for females. Similarly, a report by Carnevale, Rose and Cheah (2011) concluded that the lifetime financial benefit in 2009 from having a bachelor's degree was approximately $1 million. It should be noted that

[24] Interested readers are referred to Psacharopoulos (1973, 1981, 1985, 1994, 2008).

Table 4.8 Selected estimates of private and social internal rates of return to bachelor degree completion outside of the United States, 1989

Nation	Measure of internal rate of return	
	Private (%)	Social (%)
Argentina	14.9	7.6
Brazil	28.2	21.4
Chile	20.7	14.0
Colombia	21.7	14.0
Costa Rica	12.9	9.0
Honduras	25.9	18.9
Uruguay	12.8	10.3
Venezuela	11.0	6.2

Notes: Results were taken from Psacharopoulos (1994)

these last two reports did not subtract costs and thus they measure the benefits from college and not the net benefits.[25]

One of the best studies in this category was conducted by Baum, Ma, and Payea (2010). The authors used a 3 % annual discount rate in their calculations and factored in how incomes might change over the person's lifetime. They found that bachelor's degree recipients in 2008 would on average expect to earn about 66 % more than high school diploma holders. This equates to a benefit of approximately $530,000. Although the authors did not subtract costs from these benefit estimates, they further showed that the direct and indirect costs would be lower than benefits and thus there was still a sizable financial payoff to earning a bachelor's degree.[26]

In contrast, the vast majority of aggregate-level studies present their findings in terms of the internal rate of return on investment.[27] Overall, they found that there are double-digit private and social rates of return to completing a bachelor's degree. However, the social rates of return estimates reported in these studies tend to be smaller than the private rates of return due to the omission of social benefits and the overestimate of social costs.[28] To illustrate, Table 4.8 summarizes the main findings from several nations for the year 1989, as reported by Psacharopoulos (1994). Although the internal rates of return to bachelor's degree completion varied considerably across nations, the estimates tended to fall between 10 and 20 % per year. McMahon (2009) provides similar evidence on the private and social rates of return to higher education in OECD countries.

[25] Other limitations with these two studies are that they did not discount benefits, they used incomes for only employed individuals, they ignored taxes, and used average incomes for all workers and not younger workers.

[26] The private benefits in their calculations appear to use pre-tax incomes that would therefore include public as well as private benefits.

[27] Early studies of the private and/or social internal rate of return to higher education include Hansen (1963), Becker (1964), Hanoch (1967), Mincer (1974), and Carnoy and Marenback (1975).

[28] For example, McMahon (2009) used all revenues to measure societal support for higher education. Not only does this total include some revenues that were not used to support student instruction, it also double counts student net tuition payments.

Return to Associate's Degrees

Economists have likewise estimated the financial payoff from earning an associate's degree. Most of these studies focus on the United States due to its relatively large sector of 2-year institutions. In fact, a number of these studies found results that mirror what was shown earlier for the illustration; namely, that the internal rate of return to earning an associate's degree is comparable to, and often higher than, the rate of return from a bachelor's degree. McMahon (2009), for example, reports that for 2000 and 2005 the social internal rates of return for associate's degrees were several percentage points higher than for bachelor's degrees, and exceeded the 10 % threshold. At the same time, the net present value from earning an associate's degree tends to be lower than the net present values for higher degree levels.

Return to Graduate Degrees

Finally, a smaller number of studies have focused on the return to earning a graduate degree.[29] As noted by Cohn and Geske (1990, p. 110), "The economic returns to graduate programs are generally much lower than for bachelor degree programs. . ." For example, Ashenfelter and Mooney (1968) found that in 1958–60 the internal rate of return was 4.8 % for earning a master's degree and between 3.5 and 10.5 % for earning a doctoral degree. This finding is also in line with the results that we presented from the illustrations earlier in this chapter. However, the studies summarized by Cohn and Geske (1990) all relied on the internal rate of return as the sole measure of return. If the level of return from graduate education is significantly higher than the level of return from other degrees, then people may still decide that graduate school is a good investment despite the lower rates of return.

New Estimates of the Return to College

Recall that the return figures shown in Tables 4.2, 4.3, 4.4, 4.5, 4.6, and 4.7 were based on hypothetical data and simplifying assumptions as a way to demonstrate how the formulas work. Accordingly, they should not be interpreted as evidence about the magnitude of the returns to college. In this section, we use more defensible data to provide updated estimates of the average return to earning a bachelor's or associate's degree, as well as the average return for all students from

[29] Among the earliest studies of the return to graduate education are Hanoch (1967), Ashenfelter and Mooney (1968), Bailey and Schotta (1972), Mincer (1974), and McMahon and Wagner (1982).

enrolling in college.[30] The assumptions that we used in the calculations are shown in Table 4.9. We assume that the student begins college at age 18 and attends college for up to 6 years, after which he or she works until age 65. To account for the risk of not graduating and the timing of dropout and graduation, we used data on the average dropout and graduation rates by year for public and private institutions. The costs of going to college were set equal to the average net prices faced by students in each sector, and public support was defined as government support for instructional activities (G_t in Eq. 4.7). We used average total earnings by degree level for all workers ages 25–34 as the first-year incomes. One assumption that departs from the earlier illustrations is that we allowed incomes for college graduates to grow at a faster rate (4.1 % per year) than the incomes for those without a postsecondary degree (2.7 % per year).[31] The student was assumed to work part-time during college, earning 10 % of what he/she could earn if not attending college. Due to data limitations we restricted the average incomes for graduates of public and private institutions to be the same. If in fact graduates of private not-for-profit institutions have higher earnings than graduates of public institutions, then our estimates of the return for private institutions will be biased downward. We also did not include any public benefits in our calculations (i.e., we set $E_t^g = 0$ in Eq. 4.8), aside from those public benefits that are captured through taxes on additional incomes earned due to college.

A summary of the key findings for students seeking a bachelor's degree are presented in Table 4.10. For public and private institutions, we report the return for graduates, non-graduates, and all students combined ("attendees"). We calculated each of the three measures of return to higher education (net present value, ratio of benefits to costs, internal rate of return) for each group, assuming discount rates of either 0 or 3 % per year. We also provide separate estimates of the private and social returns to seeking a bachelor's degree.

The findings show that regardless of the measure used, the financial returns to earning a bachelor's degree are substantial. The net present values are in the general range of $500,000 to $1.2 million for public and private institutions, depending on the discount rate that is used. Similarly, the ratios of benefits to costs ranged from 9.14 to 19.12 for public institutions and 6.02 to 12.59 for private institutions. The private internal rates of return for graduates were also large (19.9 % for public institutions and 15.4 % for private institutions), and comparable in magnitude to findings from earlier studies.

At the other extreme, those who attend college but do not earn a bachelor's degree experience much lower returns from their investment. The private net present values range between $7,000 to $42,000 across both types of institutions, with benefits exceeding costs by ratios of between 1.69 and 3.61 (public) and 1.30

[30] The analysis draws on the methodology presented by Toutkoushian, Shafiq, and Trivette (2013). The reader is directed to this study for more details on the modifications used to the formulas presented in Chaps. 3 and 4.

[31] This assumption draws on the work by Arias and McMahon (2001) who showed that incomes for college graduates rise faster than incomes for non-college graduates.

Table 4.9 Parameters in calculations of return from pursuing a bachelor's degree, 2011

Category	Public institutions (%)	Private not-for-profit institutions (%)
Graduation rate after year 4	37.3	58.4
Graduation rate after year 5	22.3	13.5
Graduation rate after year 6	6.6	3.7
Dropout rate after year 1	22.0	20.5
Dropout rate after year 2	8.0	3.0
Dropout rate after year 3	3.8	1.0
Average tuition and fees	$8,655	$29,056
Percent tuition/fees covered by grants/ scholarships	66.4	54.0
Annual growth rate in net tuition/fees	6.9	0.2
Government instructional support in year 1	$10,682	$3,093
Annual growth rate in government support	0	0
Pre-tax income: BA degree or more	$40,367	$40,367
Pre-tax income: some college, no BA degree	$20,572	$20,572
Pre-tax income: high school diploma	$18,797	$18,797
Income tax rate (all groups)	25.0	25.0
Annual growth in income: BA degree or more	4.1	4.1
Annual growth in income: some college, no degree	2.7	2.7
Annual growth in income: high school diploma	2.7	2.7
Annual rate of inflation	2.4	2.4
Percent time work during college	10.0	10.0

Notes: Table was modified from Toutkoushian, Shafiq, and Trivette (2013). Graduation rates for years 4, 5, and 6 were based on data for full-time, first time freshmen at public and private institutions for the 2004 cohort (Source: *Digest of Education Statistics 2011*). The sum was adjusted upward by a total of 10.2 % to account for transfers who graduate from other institutions (Source: Ewell & Kelly, 2009). The dropout rates after year 1 were taken from the 2006 cohort (*Digest of Education Statistics 2011*). We assumed that all students who did not drop out after year 1 or graduate after years 4, 5, or 6 dropped out in years 2 and 3. Average tuition and fees and the percentage of tuition/fees covered by grants were for the year 2012 (Source: *Trends in College Pricing 2012*). The growth rates in net tuition/fees were set equal to the averages for years 2003–2012 (Source: *Trends in College Pricing 2012*). Estimated government instructional support is defined as federal, state, and local revenues for non-grant activities for 2010 (Source: *Digest of Education Statistics 2012*). Pre-tax median incomes for all workers were obtained from U.S. Census Bureau, Current Population Survey, 2012 Annual Social and Economic Supplement Data. These were adjusted to take into account individuals without earnings and then converted to estimates of post-tax incomes assuming a tax rate of 25 %. Assumptions of income growth rates were based on estimated growth rates for years 1983–1995 (Arias & McMahon, 2001). Annual rate of inflation was set equal to the average percentage increase in the CPI between 2003 and 2012

Table 4.10 Updated estimates of return to pursuing a bachelor's degree in the United States, 2011

Measure of return (Discount rate)	Public institutions			Private not-for-profit institutions		
	Graduates	Non-graduates	All students	Graduates	Non-graduates	All students
Private return						
NPV (0 %)	$1,266,158	$42,286	$826,471	$1,237,700	$38,422	$920,617
Ratio (0 %)	19.12	3.61	17.66	12.59	2.60	12.56
IROR (0 %)	19.9 %	5.4 %	14.1 %	15.4 %	4.3 %	12.3 %
NPV (3 %)	$540,254	$11,413	$336,905	$512,146	$7,297	$365,415
Ratio (3 %)	9.14	1.69	8.08	6.02	1.30	5.76
Social return						
NPV (0 %)	$1,646,998	$43,021	$1,075,768	$1,655,882	$52,819	$1,231,415
Ratio (0 %)	13.26	2.23	12.65	13.11	2.73	13.04
IROR (0 %)	15.6 %	3.2 %	12.0 %	15.8 %	4.6 %	12.6 %
NPV (3 %)	$681,142	$1,975	$423,892	$688,218	$11,312	$491,006
Ratio (3 %)	6.33	1.06	5.77	6.27	1.36	5.99

Notes: Assumed discount rates are shown in parentheses in the first column. *NPV* net present value of discounted benefits minus costs, *Ratio* ratio of discounted benefits to costs, *IROR* internal rate of return (non-discounted benefits and costs). Calculations assume that the student is 18 years old and retires at age 65. Gross private benefits include the gain in post-tax incomes over the person's time in the labor market. Gross social benefits use pre-tax incomes in their calculations. Net benefits subtract the average tuition and fees at 4-year public institutions less average grants and scholarships less government revenues that are used for offsetting instructional costs. It is assumed that the student works part-time during college and earns 10 % of the income that could be earned if working full-time

to 2.60 (private). The resulting internal rates of return (5.4 % for public institutions and 4.3 % for private institutions), while positive, were lower than the common standard of 10 %. When we estimated the average financial return from college for all students, we found that the net present values for public and private institutions were still large but about one-third below the values for only those who graduate from college. Taken together, the private return to college depends on whether a student earns a degree.

Turning to the social returns to postsecondary education, we found that the level of social net benefits were actually higher than the level of private net benefits. This indicates that the additional public benefits from taxes exceed the higher costs due to governmental support for higher education. However, the ratios of social benefits to costs for all students combined were smaller than the ratios of private benefits to costs. Finally, the social internal rate of return for public institutions was still large but smaller than the private internal rate of return. In contrast, the social and private internal rates of return for private institutions were very similar to each other. Keep in mind that due to the omission of positive externalities ($E_t^g = 0$ in Eq. 4.8), the estimates of social return presented here are biased downward.

Individual-Level Studies of the Return to College

The aggregate-level studies are popular because they are relatively straightforward to calculate and interpret. One important limitation of these studies, however, is that they are only valid if students in the two groups being compared (such as high school graduates and bachelor's degree recipients) are on average the same in all other ways that may affect their earnings. Because high school and college graduates may have different attributes that affect earnings, the return to postsecondary education estimates from aggregate-level studies may be incorrect.

To see this, let's assume that a student's income is a function of educational attainment (***ED***) and sets of observable (***X***) and unobservable (***W***) factors, as in:

$$I_j = \boldsymbol{ED_j\gamma} + \boldsymbol{X_j\alpha} + \boldsymbol{W_j\beta} + \varepsilon_j \tag{4.18}$$

where ε = random error term, and symbols in boldface indicate that there could be multiple variables represented by the symbol. The variables in ***X*** may represent factors that can be readily observed by researchers such as years of labor market experience, gender, and so on. The unobservable factors in ***W*** could include a person's innate ability, motivation, attention to detail, reliability, and many other things that are also valued in labor markets (and therefore affect income) but are difficult for researchers to see.

Aggregate-level studies of the return on higher education use the difference in average incomes between college and high school graduates as a measure of the financial benefit from earning a college degree. This average income gap can be broken down into the portion due to college graduates having more education, as well as the gaps between college and high school graduates in their observable and unobservable variables in ***X*** and ***W***:

$$\left(\bar{I}^g - \bar{I}^{na}\right) = \left(\boldsymbol{ED^g} - \boldsymbol{ED^{na}}\right)\boldsymbol{\gamma} + \left(\bar{\boldsymbol{X}}^g - \bar{\boldsymbol{X}}^{na}\right)\boldsymbol{\alpha} + \left(\bar{\boldsymbol{W}}^g - \bar{\boldsymbol{W}}^{na}\right)\boldsymbol{\beta} \tag{4.19}$$

What researchers would ideally like to know is the income gain that is solely due to college graduates having more education than high school graduates, holding all else constant (i.e., $(\boldsymbol{ED^g} - \boldsymbol{ED^{na}})\ \boldsymbol{\gamma}$). However, this quantity will equal the average income gap only when one of the following three conditions is met:(i) the factors in ***X*** and ***W*** have no effect on earnings ($\boldsymbol{\alpha}$, $\boldsymbol{\beta} = 0$); (ii) college and high school graduates have the same average levels of all the factors in question ($\bar{\boldsymbol{X}}^g = \bar{\boldsymbol{X}}^{na}, \bar{\boldsymbol{W}}^g = \bar{\boldsymbol{W}}^{na}$); or (iii) the weighted averages of the differences in observed and unobserved factors cancel each other out ($(\bar{\boldsymbol{X}}^g - \bar{\boldsymbol{X}}^{na})\boldsymbol{\alpha} + (\bar{\boldsymbol{W}}^g - \bar{\boldsymbol{W}}^{na})\boldsymbol{\beta} = 0$).

The first possibility is easy to refute since there are many observable and unobservable factors that theory and research studies suggest have an impact on the earnings of individuals in labor markets. On the second option, we can think of ways in which high school and college graduates likely differ, on average, which may have an impact on their earnings in the labor market. It is not hard to imagine, for example, that college graduates on average performed better in school than those students who did not go to college. Because college can be expensive, it is likewise not surprising to find that college graduates on average come from higher socioeconomic backgrounds than those who do not go to college. If academic ability, socioeconomic status, and other observable and unobservable factors such as these work to the advantage of college graduates, then $\left(\overline{\boldsymbol{X}}^{g} > \overline{\boldsymbol{X}}^{na}\right)$ and $\left(\overline{\boldsymbol{W}}^{g} > \overline{\boldsymbol{W}}^{na}\right)$ and the difference in average incomes between the two groups would overstate the income gain that is only attributable to the student having gone to college. Some researchers such as McMahon (2009), however, counter that the effects of omitted factors such as these on return to education estimates in aggregate-level studies are relatively small.

To remove the effects of observable characteristics of workers from their salaries, economists use data on individuals to estimate "earnings equations" for the individuals using multiple regression analysis. Differences in earnings among students that are due to observable attributes, such as academic performance, can be controlled for in a multiple regression model by adding these variables to the equation. The following regression model specification was initially suggested by Mincer (1958) for this purpose:

$$lnI_j = \boldsymbol{ED_j\gamma} + \boldsymbol{X}_j\boldsymbol{\alpha} + \varepsilon_j \tag{4.20}$$

where $lnI_j =$ log of income for the j-th person. This specification is referred to as a "semilogarithmic" or "Mincerian" earnings equation.[32] In the semilogarithmic model, the coefficients for the variables in ***ED*** represent the approximate percentage differences in predicted earnings between two students with different levels of education but the same observable characteristics in ***X***. When income is measured in units of currency rather than logarithms, the coefficients on the ***ED*** variables capture the average currency (US dollars, euros, etc.) difference due to education. Although these coefficients are commonly referred to in the literature as "returns" on postsecondary education, technically they only reflect income gains since costs are not subtracted from benefits. As a result, the coefficients from these earnings equations cannot be directly compared with estimates of return from aggregate-level studies or for other assets and investments.

The general earnings equation in (4.20) can be used in several ways to measure the financial benefit due to postsecondary education. One approach is to create separate dummy variables for the person's highest degree obtained (such as $HS_j = 1$ if high school, else 0; $AA_j = 1$ if associate's degree and else 0; $BA_j = 1$ if bachelor's

[32] Mincer's use of the natural log of earnings as the dependent variable has since become the most commonly-accepted way to specify earnings equations, and has been used in countless studies. Its use has been justified on the grounds that the distribution of earnings is often skewed to the right and the log transform helps to normalize the dependent variable. In addition, the functional form is appealing in applications where salaries are compounded over time, such as when workers receive a common percentage increase in salary. The discussion in this section, however, would apply equally in situations where actual salary and not the log of salary is used as the dependent variable in the earnings equation.

degree, else 0; $MA_j = 1$ if master's degree, else 0; $PHD_j = 1$ if doctoral degree, else 0), and then add all of these except the first variable in the regression model, along with other relevant observable variables[33]:

$$lnI_j = \gamma_1 AA_j + \gamma_2 BA_j + \gamma_3 MA_j + \gamma_4 PHD_j + \boldsymbol{X_j \alpha} + \varepsilon_j \tag{4.21}$$

The coefficient on the variable BA_j (denoted γ_2), for example, represents the average percentage salary difference between bachelor's degree recipients and high school graduates, holding constant the variables in $\boldsymbol{X}$. This coefficient captures the salary increase due to the combined effect of additional years of education and degree completion. Similar interpretations apply to the coefficients for the variables *AA*, *MA* and *PHD*. The coefficients can be used to estimate the annual dollar benefits from earning each degree by multiplying the coefficients by average earnings.

An alternative approach is to replace the dummy variables for degree level with a single variable for years of education (*YrsED*):

$$lnI_j = \gamma_1 YrsED_j + \boldsymbol{X_j \alpha} + \varepsilon_j \tag{4.22}$$

The coefficient γ_1 represents the average percentage salary increase for each additional year of schooling holding constant the variables in $\boldsymbol{X}$. Because the equation does not contain controls for degree level, the coefficient captures the effect of both degree completion and additional years of education on earnings. Often the years of education variable may include primary and secondary education as well as postsecondary education. The return to graduating college could be estimated by multiplying the assumed duration of the degree program (e.g., 4 years for a bachelor's degree) by the coefficient on the variable *YrsED*. This approach was commonly used in early studies of the return to education because survey data contained information on years of education and not the degrees earned by students.

To determine whether earnings are affected by both years of education and degree completion, the two equations can be combined as follows:

$$lnI_j = \gamma_1 AA_j + \gamma_2 BA_j + \gamma_3 MA_j + \gamma_4 PHD_j + \gamma_5 YrsED_j + \boldsymbol{X_j \alpha} + \varepsilon_j \tag{4.23}$$

Now the coefficients γ_1 to γ_4 represent the average percentage salary premium received by students when they earn a college degree, holding constant years of education and the variables in $\boldsymbol{X}$. Likewise, the coefficient γ_5 denotes the payoff from an added year of education for two students with the same highest degree. The salary model specification in Eq. (4.23) is particularly useful if the researcher wants to determine whether earnings increase in a non-linear fashion with education. If the salary premiums for graduating from college are significant, even after controlling for years of education, then the results would be consistent with what are often

[33] Other degree levels could also be used as the reference category for this purpose.

referred to as "sheepskin effects."[34] The coefficient on the variable *YrsEd* is also useful because it captures the average salary increase for an additional year of college, which indicates the financial benefits to attending college for those who do not graduate. In this way, individual-level studies can measure the benefits obtained for those who attend college but do not graduate.[35]

Many studies have used the semilogarithmic approach to measuring the financial benefits from postsecondary education.[36] Most studies focus on the benefits from earning a bachelor's degree. Overall, they have found that both years of postsecondary education and degree completion have positive effects on a person's earnings. Bitzan (2009), for example, found that each year of education increased earnings by 1.2 to 3.7 %, and that in addition earnings increased by 14 to 20 % when individuals completed their bachelor's degree, indicating a substantial sheepskin, or degree-completion, effect.

Other researchers have used individual-level data to examine the financial benefits from earning an associate's degree. Many of the early studies on this topic focused on specific academic programs such as nursing that were relevant for 2-year institutions. More recently, the question of whether there were financial benefits from earning an associate's degree has taken on new urgency as policy makers began to push for more students to first attend 2-year institutions and then transfer to 4-year institutions as a means to save money. The results have been mixed, however, regarding the magnitude of the financial benefits to earning an associate's degree. Kane and Rouse (1995), for example, found that there was a positive effect on earnings for each year spent by a student at a 2-year institution, but that graduating with an associate's degree only led to higher earnings for women. Jaeger and Page (1996), however, observed larger financial benefits for associate's degree completers in their study.

Dating back to the 1960s, research has also been conducted on the financial benefits to graduate education.[37] Ashenfelter and Mooney (1968), for example, found that years of graduate education had a positive and significant effect on earnings of between \$800 to \$1,000 per year. Their results also showed that graduating with a doctoral degree led to an additional increase in salary, but the same did not hold true for completion of a master's degree. Jaeger and Page (1996) also examined the benefits to graduate degree completion and found that earnings increased relative to having a bachelor's degree.

---

[34] For more explanation and discussion of sheepskin effects, see Belman and Heywood (1991, 1997), Hungerford and Solon (1987), Gullason (1999), Heywood (1994), and Shabbir and Ashraf (2011) and Jaeger and Page (1996).

[35] Another variation on the earnings equations shown here is to use a "spline function" where variables are added to the model to capture years of education above specific threshold values (such as 12 or 16 years). More discussion on the incorporation of risk into rate of return studies can be found in Christiansen, Joensen, and Nielsen (2007), and Hussey and Swinton (2011).

[36] See, for example, Card and Krueger (1992), Heckman and Polachek (1974), Kane and Rouse (1995), Park (2011), and Trostel (2005).

[37] Studies of note include Hanoch (1965) and Ashenfelter and Mooney (1968).

Extensions

There are a number of ways in which the approaches described in this chapter for measuring the return to college can be extended. Beginning with the aggregate-level studies, there may be interest in trying to calculate the average return for subgroups of students. For example, is the return to college different for male and female students, or for black, Hispanic and white students? Policy makers and students are particularly interested in whether the return to college varies by the student's choice of major. Likewise, do the returns to college vary by the type of institution attended, such as public versus private, more selective versus less selective, and so on.

In theory, it is possible to apply the aggregate-level formulas to these subgroups. In practice, however, researchers are often limited in the data that can be used to conduct analyses of subsets of students. Recall, for example, that in our earlier illustration of the return to public and private institutions, we could not take into account the possible income differences between graduates of these institutions due to data limitations. Because most aggregate-level studies rely on income data collected by federal agencies such as the U.S. Department of Labor, average earnings by subgroups of interest to analysts may not exist. In the case of gender and race/ethnicity, however, one can find data on average earnings broken down by these subgroups by age.

There is considerable interest in trying to measure the rates of return to specific colleges and universities using this general methodology. To do this, data would have to be found on the average earnings of those who attended a specific institution. Even if such data could be found, however, applying the equations shown in this chapter to a single institution may provide misleading information on the expected return to attending the institution. First, high school graduates may not be the right comparison group to use for this purpose, especially if the institution in question is fairly selective and prestigious. Along these same lines, the retention and graduation rates for a single institution may not be a good indicator of the "risk" of non-completion that an average student would face if he or she were to enroll because these statistics are based on those who have attended the institution in the past. For example, the 6-year graduation rate for the 2008 cohort of new students attending Stanford was reported in the Common Core dataset as being 95 %. This rate is very high relative to most other postsecondary institutions, and probably reflects the qualifications of the students who attended the institution as much as it does anything that Stanford did to help them succeed. If a student with average academic qualifications were to enroll at Stanford, then the student's likelihood of graduating within 6 years will almost certainly be less than 95 %.

Turning to extensions for the individual-level studies, although the multiple regression approach is an improvement over simply comparing average earnings by degree attainment, it is not without its problems. The incomes in these studies are not discounted for time preference, which would lead to an upward bias in the benefits. Accordingly, the estimates from these studies should be viewed as gross financial benefits with a 0 % discount rate. Another limitation is that individual-level studies typically capture only the private benefits from higher education, and thus do not address the social costs and benefits that may go along with an individual student's education.

Another issue is that an argument can be made that some of the observable factors in $\boldsymbol{X}$ that could be affected by educational attainment should not be used in the salary model. The most obvious example of this is a person's occupation. Many jobs have minimum degree requirements, and thus part of the value of a college degree is reflected in the income effect for different occupations requiring the degree. Therefore, controlling for occupations in the semilogarithmic regression model would lead to a downward bias in the estimated impact of education on earnings.

Economists, noting the fact that earnings increase substantially with degree completion, have examined whether there is also a nonlinear relationship between years of postsecondary education and financial benefits.[38] The results from these studies have been mixed, with some researchers finding that the income gain from an additional year of postsecondary education is relatively constant and others concluding that the gains rise with years of education.

Perhaps the most important—and challenging—limitation of the multiple regression approach in Eq. (4.20) is that some factors such as a person's innate ability to do things and their motivation to succeed cannot be observed by the researcher. These unobservable factors become part of the error term in the regression model (i.e., $\varepsilon_j = \boldsymbol{W}_j\boldsymbol{\beta} + u_j$), where $u_j =$ random error. If the unobservable factors in $\boldsymbol{W}$ are correlated with the educational attainment variables in $\boldsymbol{ED}$, then the coefficients on the education variables will be biased.[39] The same problem, however, would apply to other unobservable variables such as motivation and determination that could also be correlated with educational attainment.

Economists have tried to correct this bias through several different approaches. Some studies relied on an instrumental variables technique to isolate the impact of educational attainment on earnings.[40] To do this, the researcher must find one or more variables that affect educational attainment and yet do not have a direct effect on earnings. In practice, this has proven to be difficult to do because most of the factors that a researcher might posit could influence educational attainment, such as academic ability and socioeconomic status, arguably could also have a direct effect on earnings.

[38] See Card and Krueger (1992), Heckman and Polachek (1974), and Trostel (2005).

[39] Harmon and Walker (1995) provide a summary of the issues surrounding this type of ability bias in return to education studies.

[40] Examples of studies using an instrumental variable approach to estimate returns to education include Card (1993), Angrist and Krueger (1995, 2001), and Heckman and Vytlacil (1998). Readers who are interested in the methodological issues on this topic should see Griliches (1977), Heckman, Lochner, and Todd (2008), Dale and Krueger (2002), and Card (1995).

Due to the challenge in finding suitable instrumental variables, other researchers have relied on alternative estimation methods. For example, Blundell, Dearden, Goodman, and Reed (2000) focused on the earnings for college graduates with the earnings for individuals who had similar likelihoods of going to college but did not do so. Another group of researchers have used longitudinal data on individuals to measure their wage changes after increases in education (Angrist & Newey, 1991; Park, 2011), arguing that the factors in $\boldsymbol{W}$ are held constant for the same individuals over time. Finally, other researchers have addressed this problem by studying twins who make different decisions regarding the quantity and quality of their education.[41] The authors of these studies argue that by studying twins, the average unobservable effects between the two groups of students should be the same or at the least very similar, and therefore regression analysis can remove any remaining differences due to observable characteristics.

Policy Focus

For a number of reasons, higher education policy makers have been interested in finding ways to entice more students to go to college. In Chap. 3, we discussed how financial aid can be used to achieve this goal. By providing students with financial aid, policy makers can reduce the direct cost of going to college and thus increase student aspirations or predisposition to go to college. Note that this policy tries to achieve the goal by raising the financial return to college for students. The increase in aid reduces the present-value costs and in turn increases the net present value, ratio of benefits to costs, and internal rate of return to college. As going to college becomes more profitable for students, comparative statics suggest that there may be some who at the margin change their minds about college and decide to enroll due to financial aid.

Other policy makers believe that the college attendance rate is too low because students do not understand how large the private financial benefits are from going to college. To them, the problem is not that the return to college is too low to make it worthwhile to students, but rather that many students lack sufficient information about the large returns that are available to them if they were to go to college. Aggregate-level studies are therefore used by some as a policy instrument to provide students and their families with information about the financial benefits from going to college. In fact, such studies are often sponsored by entities such as the College Board that have a vested interest in having more students go to college.

A relevant question for policy makers about this approach is the following: Is the information obtained from these studies accurate and relevant for the targeted groups of students they seek to influence? An argument can be made that the findings from aggregate-level studies in particular are biased upward and may

[41] See, for example, Ashenfelter and Krueger (1994).

make going to college appear to be more lucrative than it is. As discussed several times in this chapter, the focus on the return to graduates overlooks the real risk that students incur when they begin college. We have found that the average level of return to attending college is sizable but nonetheless roughly one-third lower than the return received by degree holders. Although the costs of college are typically only a fraction of the lifetime net financial benefits, studies that report the benefits and ignore the costs overstate the financial case for going to college. Of course, a counterargument can be made that the estimates in these studies are biased downward because they do not capture non-market benefits from college or the additional financial benefits people would receive in retirement.

Policy makers need to consider the characteristics of the students they are trying to influence with their policies, and how these characteristics may in turn affect their costs and benefits from college. It is likely the case that students who are not predisposed to go to college would not fare as well as other students if they were to enroll in postsecondary institutions. Students who would not decide to go to college on their own are probably less well prepared academically on average to succeed. As a result, non-college bound students would have a higher risk of dropping out and a lower chance of earning a degree than the "typical student" we used in our calculations in Tables 4.10 and 4.11. Both of these factors will reduce the average financial return that they might anticipate from going to college. As shown earlier in this chapter, for those students who go to college and do not earn a degree, their benefits are only marginally greater than the costs, and may be negative depending on the circumstances of the individual student. Students need to understand that the return estimates presented in policy studies are based on the average returns for those students who have gone to college, and that their expected return could still be positive but will likely be smaller than the values given the most attention by the media.

To be clear, we are not suggesting here that policy makers should discourage more students from going to college. On the contrary, there are certainly many students across the United States and around the world that could benefit substantially from going to college, but would not do so on their own due to their financial circumstances, family situation, lack of knowledge about the benefits and costs of college, and so on. Finding policies that can help these students overcome barriers is certainly a most worthy endeavor. Nonetheless, policy makers should recognize that not every student would necessarily be better off (in terms of money or happiness) if they went to college rather than do something else with their scarce resources of time and money. Economic analysis is all about comparing the costs and benefits of a decision, and these costs and benefits may differ across individuals.

Table 4.11 Updated estimates of return to pursuing an associate's degree at public institutions in the United States, 2011

Return to postsecondary education measure	Graduates	Non-graduates	All students
Private return			
NPV (0 %)	$648,376	$45,320	$252,811
NPV (3 %)	$275,201	$14,796	$104,415
Ratio (0 %)	21.86	3.57	12.37
Ratio (3 %)	10.06	1.85	5.77
IROR (0 %)	21.1 %	6.7 %	14.7 %
Social return			
NPV (0 %)	$842,114	$47,215	$321,178
NPV (3 %)	$345,057	$6,650	$123,555
Ratio (0 %)	14.19	2.29	8.05
Ratio (3 %)	6.53	1.18	3.76
IROR (0 %)	15.6 %	3.9 %	10.8 %

Notes: Assumed discount rates are shown in parentheses in the first column. *NPV* net present value of discounted benefits minus costs, *Ratio* ratio of discounted benefits to costs, *IROR* internal rate of return (non-discounted benefits and costs). Values are only for public institutions. Calculations assume that the student is 18 years old and retires at age 65. Gross private benefits include the gain in post-tax incomes over the person's time in the labor market. Gross social benefits use pre-tax incomes in their calculations. Net benefits subtract the average tuition and fees at 2-year public institutions less average grants and scholarships less government revenues that are used for offsetting instructional costs. It is assumed that the student works part-time during college and earns 10 % of the income that could be earned if working full-time. We assumed that 34.4 % of students graduated by the end of year 3, with all other students dropping out by that time. Average tuition and fees and the percentage of tuition/fees covered by grants were for the year 2012 (Source: *Trends in College Pricing 2012*). Because the average grant exceeded the average tuition and fees, we set the percentage of tuition/fees covered by grants to 100 %

Student Loans and Borrowing

Another policy issue that has received considerable attention in the media is the extent to which students borrow money to pay for college. As we document in Chap. 7, the share of education costs paid by students has risen steadily in the twenty-first century as state funding for higher education has failed to keep pace with costs. According to the National Center for Education Statistics (2014), the percentage of 4th year undergraduates who had taken out loans to finance their college education has increased from 50 % in 1989–1990 to 67 % in 2011–2012. Likewise, the average cumulative loan debt for 4th year undergraduates who have borrowed has risen steadily over time, reaching $26,200 in 2011–2012.[42] The increasing reliance on loans to pay for college has led to calls for policies to be developed that would reduce or even eliminate the need for students to borrow.

[42] Data were taken from the *Digest of Education Statistics 2013*, Table 331.95. Additional analysis of trends in student borrowing can be found in Woo (2013).

Clearly, students would be better off if they could replace loans with scholarships, *ceteris paribus*, because scholarships are a reduction in net price and loans simply defer when the student has to pay the net price. From the model in Chap. 3, a net price reduction is predicted to increase utility by raising the net financial return on going to college. It may even increase utility by making it easier to afford to go to college in instances where students do not have access to loans. Therefore, from the perspective of students, replacing loans with grants is a good policy for them.[43]

There are, however, other issues that need to be addressed before deciding whether this is a good or bad policy. First, if student loans are to be replaced with grants, then how will the grants be funded? If they are state grants, then the monies will have to come from taxpayers. If loans are replaced by institutional grants, then the monies will have to come from other students, as well as private donors, consumers of other institutional services, and so on. The point here is that there are costs involved with a loan reduction policy, and these costs must ultimately be paid by someone. Second, an argument can be made that even though some students may be required to take out loans to pay for college, the evidence strongly suggests that on average the financial benefits more than outweigh the costs of borrowing. Loans were thus envisioned by policy makers as a way of helping students acquire a postsecondary education when they could not afford to pay the direct costs at the time of enrollment.

Third, stories in the media about students with six-digit cumulative loan debt are the exception and not the rule. Most students who attend college borrow much lower amounts to help pay for college. In Table 4.12, we show national data on the annual distribution of loan disbursements for higher education for undergraduate students in the 2011–2012 academic year.[44] The figures in the table represent annual (and not cumulative) borrowing for undergraduates who are freshmen through seniors, and include borrowing by both the student and their parents to pay for college. We report the borrowing amounts separately by type of institution as well as aggregated across the four categories. Overall, it can be seen that roughly four out of every ten undergraduates and their parents did not take out any loans to finance their education in this particular year. Furthermore, the average amount borrowed across the four institution types was $5,209, and 80 % of all students borrowed less than $10,000 per year for college. Even within private, not-for-profit 4-year institutions, only 10 % of undergraduates borrowed more than $20,000 in this year. Interestingly, the table also shows that the vast majority of students in the private for-profit sector took out loans in some amount to help pay college expenses.

[43] More recently, Gonzalez Canché (2014) examined whether cumulative loan debt for bachelor-degree recipients was affected by whether the student initially enrolled at a 2-year or a 4-year institution, and Denison, Fowles, and Moody (2014) examined borrowing frequencies between sectors.

[44] The data were obtained from the National Postsecondary Student Aid Study (NPSAS) for the 2011–2012 academic year. We would like to thank Manuel Gonzalez Canché from the University of Georgia for compiling the statistics shown in this table.

Table 4.12 Annual amount borrowed by undergraduate students and their parents in 2011–2012 from any source

		Public 2-year	Public 4-year	Private nonprofit 4-year	Private for profit	Combined
Percentile distribution	10th	$0	$0	$0	$0	$0
	20th	$0	$0	$0	$2,000	$0
	30th	$0	$0	$0	$4,057	$0
	40th	$0	$0	$4,000	$5,500	$0
	50th	$0	$3,500	$5,500	$7,594	$3,500
	60th	$0	$5,500	$7,500	$9,500	$5,500
	70th	$0	$6,900	$9,500	$9,500	$7,500
	80th	$3,000	$9,500	$12,500	$10,500	$9,500
	90th	$5,500	$12,500	$20,310	$14,500	$12,500
	100th	$21,500	$49,724	$63,017	$69,500	$69,500
	Mean	$1,365	$4,995	$7,769	$7,810	$5,209
	SE	$17	$49	$97	$39	$23

Notes: Data were taken from the National Postsecondary Student Aid Study (NPSAS) for the 2011–2012 academic year, and compiled by Manuel Gonzalez Canché. The data pertain to undergraduate students who were enrolled in the 2011–2012 academic year at one of the institution types shown above. Does not include students who report being enrolled in multiple institution types in this particular year. The figures in the table show amounts borrowed by students and their parents in only this particular year from all sources including federal and state governments, institutions, employers, and private agencies. Figures on private borrowing are self-reported by students

As we discuss in Chaps. 6 and 7, students who enroll at an in-state public institution receive a substantial subsidy through state funding to their institution. The average loan indebtedness statistics reported in the media are often misleading in that they may exclude students who do not borrow to finance their education. If the one-third of non-borrowers are combined with the two-thirds who borrowed, the average cumulative loan indebtedness cited earlier falls from $26,200 to $17,500. A more precise calculation of the distribution of cumulative loan indebtedness is shown in Table 4.13. The data in this table are also taken from the NPSAS survey and show the cumulative loan debt incurred by undergraduate degree recipients in 2011–2012 and their parents. Across the four sectors, the average accumulated loan debt for degree recipients was $16,475, and 90 % of degree recipients borrowed less than $43,000 to help pay for college. Not surprisingly, cumulative loan debt was highest for students graduating from private, nonprofit 4-year institutions where tuition rates are highest. However, even for students in this sector, only 10 % of graduates borrowed more than $70,000 to finance their education. The average cumulative loan indebtedness for graduates of public 4-year institutions ($19,564) and public 2-year institutions ($5,817) were notably smaller than for private institutions, in large part due to their lower net prices.

It is also not clear from the available evidence that the majority of students who take out loans cannot repay them. Woo (2013) reports that as of 2009, nearly three-quarters of students who took out loans were either repaying those loans or no

Table 4.13 Cumulative amount borrowed by undergraduate degree recipients and their parents in 2011–2012 from any source

		Public 2-year	Public 4-year	Private nonprofit 4-year	Private for profit	Combined
Percentile distribution	10th	$0	$0	$0	$1,119	$0
	20th	$0	$0	$0	$6,363	$0
	30th	$0	$0	$7,500	$9,289	$3,500
	40th	$0	$5,500	$15,526	$9,500	$8,000
	50th	$0	$12,616	$23,514	$12,000	$10,000
	60th	$2,026	$20,293	$30,000	$15,000	$13,917
	70th	$5,500	$27,437	$36,960	$19,565	$19,500
	80th	$10,000	$36,536	$47,738	$27,924	$28,218
	90th	$19,000	$50,000	$69,294	$41,341	$42,500
	100th	$131,100	$157,984	$326,936	$197,305	$326,936
	Mean	$5,817	$19,564	$29,834	$17,840	$16,475
	SE	$196	$427	$1,067	$207	$172

Notes: Data were taken from the National Postsecondary Student Aid Study (NPSAS) for the 2011–2012 academic year, and compiled by Manuel Gonzalez Canché. The data only pertain to undergraduate degree recipients (associate and bachelor) in 2011–2012 academic year at one of the institution types shown above. Does not include students who report being enrolled in multiple institution types in this particular year. The figures in the table show cumulative amounts borrowed by students and their parents from all sources including federal and state governments, institutions, employers, and private agencies. Figures on private borrowing are self-reported by students

longer had outstanding debt (i.e., had already repaid their loans). The remaining quarter of students with debt includes those who have legitimate deferments due to continuing education, parental leave, public service, and economic hardship. Even for those students who borrowed above the median amounts for college, their loan payments over a 10-year period would in many instances be comparable to loan payments that they would normally make on a 5-year automobile loan.

This relates to a final point, namely that to an economist students themselves bear some responsibility for the choices that they make as to where to go to college, how much to pay, and whether they have to borrow to pay those costs. Students have options with regard to where to go to college and how much they will have to pay. If a student incurs significant loan debt by enrolling at an expensive private institution where they were not offered grants or scholarships and could have received an arguably comparable education at a more-affordable public institution, then is it up to policy makers to correct the problem? Should policy makers force these students to attend less-expensive colleges?

Final Thoughts

In this chapter, we examined the different methods that economists use to measure the return on investing in human capital through higher education. Economists rely on aggregate- and individual-level approaches to estimating the return on postsecondary education. Each of these approaches has its advantages and disadvantages. Studies can also be divided into private versus social returns, and return for graduates versus all students. Overall, the evidence from countless studies has found that on average there are positive and sizable financial benefits from college, and that they generally outweigh the costs of the investment. This even holds when the risk of dropping out of college is factored into the calculations of private and social returns.

Given the persistent debate within society as to the value of a college education, and the possible effects of changing demographics and economic circumstances on this value, studies of the return on education will likely continue to draw the attention of researchers, policy makers, and students and their families. In particular, more attention is needed from economists as to how to make adjustments in their estimates of the return to college for the effects of unobservable factors that may be leading to biased estimates.

Glossary

Symbol	Definition
Subscript j	Student
Subscript t	Time
P	Price of college (tuition + fees)
F	Financial aid per student (grants and scholarships)
tx^{na}, tx^{g}, tx^{ng}	Income tax rates for not attend college, graduate, and not graduate
W	Proportion of foregone income earned while in college
I^{na}, I^{g}, I^{ng}	Incomes if not attend college, graduate college, and not graduate
i	Annual rate of inflation
z	Annual discount rate for time preference of money
δ	Internal rate of return to college
T1	Years in college
T2	Years until retirement
T	Lifetime
π_t^r	Probability of enrolling in college in year t
π^g	Probability of graduating college
r_p	Rate of growth of future costs and benefits of college
G_t	Public costs of college per year (e.g., state appropriations)
E_t^g	Public benefits (positive externalities) per year beyond the tax revenues created by students who graduate from college

(continued)

Symbol	Definition
$C(pri)_t$	Annual private costs of college
$C(pri)^g$	Cumulative private costs of graduating college
$C(pri)^a$	Cumulative private costs of attending college
$B(pri)^g{}_t$	Annual private benefits of graduating college
$B(pri)^a{}_t$	Annual private benefits of attending college
$B(pri)^g$	Cumulative private benefits of graduating college
$B(pri)^a$	Cumulative private benefits of attending college
$NPV(pri)^g$	Private net present value of graduating college
$NPV(pri)^a$	Private net present value of attending college
$NPV(soc)^g$	Social net present value of graduating college
$NPV(soc)^a$	Social net present value of attending college
$Ratio(pri)^g$	Ratio of private benefits to costs of graduating college
$Ratio(pri)^a$	Ratio of private benefits to costs of attending college
$Ratio(soc)^g$	Ratio of social benefits to costs of graduating college
$Ratio(soc)^a$	Ratio of social benefits to costs of attending college
$IROR(pri)^g$ or $\delta(pri)^g$	Private internal rate of return of graduating college
$IROR(pri)^a$ or $\delta(pri)^a$	Private internal rate of return of attending college
$IROR(soc)^g$ or $\delta(soc)^g$	Social internal rate of return of graduating college
$IROR(soc)^a$ or $\delta(soc)^a$	Social internal rate of return of attending college
ED	Set of variables used to represent educational attainment
X	Set of variables used to represent observable characteristics of students that may influence earnings in the labor market
W	Set of variables used to represent unobservable characteristics of students that may influence earnings in the labor market
lnI	Natural logarithm of income
YrsED	Years of education completed
AA, BA, MA, PHD	Dummy variables for terminal (last) degree earned
γ(gamma)	Average percentage differences in predicted earnings between two students with different levels of education, controlling for other student characteristics
α	Average percentage differences in predicted earnings between two students with different levels of ability, gender or other characteristics controlling for levels of education

References

Angrist, J., & Krueger, A. (1995). Split-sample instrumental variables estimates of the return to schooling. *Journal of Business & Economic Statistics, 13*, 225–235.

Angrist, J., & Krueger, A. (2001). *Instrumental variables and the search for identification: From supply and demand to natural experiments* (No. w8456). Cambridge, MA: National Bureau of Economic Research.

Angrist, J., & Newey, W. (1991). Over-identification tests in earnings functions with fixed effects. *Journal of Business and Economic Statistics, 9*, 317–323.

Arias, O., & McMahon, W. (2001). Dynamic rates of return to education in the U.S. *Economics of Education Review, 20*, 121–138.

Asadullah, M. (2006). Returns to education in Bangladesh. *Education Economics, 14*, 453–468.

Ashenfelter, O., & Krueger, A. (1994). Estimates of the economic return to schooling for a new sample of twins. *American Economic Review, 84*, 1157–1173.

Ashenfelter, O., & Mooney, J. (1968). Graduate education, ability, and earnings. *The Review of Economics and Statistics*, *50*, 78–86.

Ashworth, J. (1997). A waste of time? (Private rates of return to higher education in the 1990s). *Higher Education Quarterly, 51*, 164–188.

Bailey, D., & Schotta, C. (1972). Private and social rates of return to education of academicians. *The American Economic Review*, *62*, 19–31.

Baum, S., Ma, J., & Payea, K. (2010). *Education pays 2010*. New York: The College Board.

Becker, G. (1964). *Human capital: A theoretical and empirical analysis with special reference to education*. Chicago: University of Chicago Press.

Belman, D., & Heywood, J. (1991). Sheepskin effects in the returns to education: An examination of women and minorities. *The Review of Economics and Statistics, 73*, 720–724.

Belman, D., & Heywood, J. (1997). Sheepskin effects by cohort: Implications of job matching in a signaling model. *Oxford Economic Papers, 49*, 623–637.

Benhabib, J., & Spiegel, M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*, 143–174.

Bitzan, J. (2009). Do sheepskin effects help explain racial earnings differences? *Economics of Education Review, 28*, 759–766.

Blumenstyk, G. (2015, September 29). Just half of graduates strongly agree their college education was worth the cost. *Chronicle of Higher Education*. Retrieved December 13, 2015 from http://chronicle.com/article/Just-Half-of-Graduates-Say/233453/

Blundell, R., Dearden, L., Goodman, A., & Reed, H. (2000). The returns to higher education in Britain: evidence from a British cohort. *The Economic Journal*, *110*, 82–99.

Brewer, D., Eide, E., & Ehrenberg, R. (1999). Does it pay to attend an elite private college? Cross-cohort evidence on the effects of college type on earnings. *Journal of Human Resources, 34*, 104–123.

Card, D. (1993). *Using geographic variation in college proximity to estimate the return to schooling* (No. w4483). Cambridge, MA: National Bureau of Economic Research.

Card, D. (1995). Earnings, schooling, and ability revisited. *Research in Labor Economics, 14*, 23–48.

Card, D., & Krueger; A. (1992). Does school quality matter? Returns to education and the characteristics of public schools in the United States. *Journal of Political Economy*, *100*, 1–40.

Carnevale, A., Rose, S., & Cheah, B. (2011, August). *The college payoff: Education, occupation, and lifetime earnings*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Carnevale, A., Jayasundera, T., & Cheah, B. (2012). *The college advantage: Weathering the economic storm*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Carnoy, M. (2010). Race earnings differentials. In D. Brewer & P. McEwan (Eds.), *Economics of education* (pp. 109–118). Amsterdam, The Netherlands: Elsevier.

Carnoy, M., & Marenbach, D. (1975). The return to schooling in the United States, 1939-69. *Journal of Human Resources*, *10*, 312–331.

Christiansen, C., Joensen, J., & Nielsen, H. (2007). The risk-return trade-off in human capital investment. *Labour Economics, 14*, 971–986.

Cohn, E., & Geske, T. (1986). Benefit-cost analysis of investment in higher education. In M. McKeown & K. Alexander (Eds.), *Values in conflict: Funding priorities for higher education* (pp. 183–215). New York: HarperBusiness.

Cohn, E., & Geske, T. (1990). *The economics of education* (3rd ed.). Oxford, UK: Pergamon Press.

Cohn, E., & Hughes, W. (1994). A benefit-cost analysis of investment in college education in the United States: 1969–1985. *Economics of Education Review, 13*, 109–123.

Cunha, F. (2009). Crossing the finish line: A review. *Journal of Human Capital, 3*, 354–378.

Dale, S., & Krueger, A. (2002). Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *The Quarterly Journal of Economics, 117*, 1491–1527.

Day, J., & Newburger, E. (2002). *The big payoff: Educational attainment and synthetic estimates of work-life earnings*. Washington, DC: U.S. Census Bureau.

Denison, D., Fowles, J., & Moody, M. (2014). Borrowing for college: A comparison of public and private, nonprofit institutions of higher education. *Public Budgeting and Finance, 34*, 84–104.

Denny, K., & Harmon, C. (2001). Testing for sheepskin effects in earnings equations: Evidence for five countries. *Applied Economics Letters, 8*, 635–637.

Dupuit, J. (1844). On the measurement of the utility of public works. *International Economic Papers*, *2*, 83-110.

Ewell, P., & Kelly, P. (2009). *State-level completion and transfer rates: Harnessing a new national resource*. Working paper, National Center for Higher Education Management Systems (NCHEMS).

Fain, P. (2012, June 29). College for all? Politicians and pundits ramp up questions about value of degrees. *Inside Higher Education*. Retrieved June 29, 2012 from http://www.insidehighered.com/news/2012/06/29/politicians-and-pundits-ramp-questions-about-value-degrees

Freeman, R. (1971). *The market of college-trained manpower: A study of the economics of career choice*. Cambridge, MA: Harvard University Press.

Freeman, R. (1976). *The overeducated American*. New York: Academic.

Gonzalez Canché, M. (2014). Is the community college a less expensive path toward a bachelor's degree?: Public 2-and 4-year colleges' impact on loan debt. *The Journal of Higher Education, 85*, 723–759.

Griliches, Z. (1977). Estimating the returns to schooling: Some econometric problems. *Econometrica: Journal of the Econometric Society, 45*, 1–22.

Gullason, E. (1999). The stability pattern of sheepskin effects and its implications for the human capital theory – Screening hypothesis debate. *Eastern Economic Journal, 25*, 141–149.

Hanoch, G. (1965). *Personal earnings and investment in schooling*. Doctoral dissertation. Department of Photoduplication, University of Chicago Library.

Hanoch, G. (1967). An economic analysis of earnings and schooling. *Journal of Human Resources*, *2*, 310–329.

Hansen, W. (1963). Total and private rates of return to investing in schooling. *Journal of Political Economy, 71*, 128–140.

Hansen, W., & Weisbrod, B. (1969). *Benefits, costs, and finance of public higher education*. Chicago: Markham Publishing Company.

Harmon, C., & Walker, I. (1995). Estimates of the economic return to schooling in the UK. *American Economic Review, 85*, 1278–1286.

Heckman, J., Lochner, L., & Todd, P. (2008). Earnings functions and rates of return. *Journal of Human Capital, 2*, 1–31.

Heckman, J., & Polachek, S. (1974). Empirical evidence on the functional form of the earnings-schooling relationship. *Journal of the American Statistical Association*, *69*, 350–354.

Heckman, J., & Vytlacil, E. (1998). Instrumental variables methods for the correlated random coefficient model: Estimating the average rate of return to schooling when the return is correlated with schooling. *Journal of Human Resources, 33*, 974–987.

Heywood, J. (1994). How widespread are sheepskin returns to education in the U.S.? *Economics of Education Review, 13*, 227–234.

Hungerford, T., & Solon, G. (1987). Sheepskin effects in the return to education. *The Review of Economics and Statistics, 69*, 175–177.

Hussey, A., & Swinton, O. (2011). Estimating the ex ante expected returns to college. *American Economic Review, 101*, 598–602.

Hwang, W., Liao, S., & Huang, M. (2013). Real option, human capital investment returns and higher educational policy. *Economic Modelling, 31*, 447–452.

Jaeger, D., & Page, M. (1996). Degrees matter: New evidence on sheepskin effects in returns to education. *The Review of Economics and Statistics, 78*, 733–740.

Kane, T., & Rouse, C. (1995). Labor-market returns to two-and four-year college. *The American Economic Review*, *85*, 600–614.

Lederman, D. (2013, January 28). The college grad/employment mismatch. *Inside Higher Education*. Retrieved January 28, 2013 from http://www.insidehighered.com/news/2013/01/28/are-college-graduates-underemployed-and-if-so-why

Lemieux, T. (2006). Postsecondary education and increasing wage inequality. *American Economic Review, 96*, 195–199.

Martel, K. (2015, October 13). Crisis sells: Spinning data into hot headlines. *Inside Higher Education*. Retrieved December 13, 2015 from https://www.insidehighered.com/views/2015

McKean, R. (1958). *Efficiency in government through systems analysis with emphasis on water resource development*. New York: Wiley.

McMahon, W. (1991). Relative returns to human and physical capital in the U.S. and efficient investment strategies. *Economics of Education Review, 10*, 283–296.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: The Johns Hopkins University Press.

McMahon, W. (2010, March). The private and social benefits of higher education: The evidence, their value, and policy implications. *Advancing Higher Education,* 1–12.

McMahon, W., & Wagner, A. (1982). The monetary returns to education as partial social efficiency criteria. In W. McMahon (Ed.), *Financing education: Overcoming inefficiency and inequity* (pp.150–187). Urbana, IL: University of Illinois Press.

Menon, M. (2008). Perceived rates of return to higher education: Further evidence from Cyprus. *Economics of Education Review, 27*, 39–47.

Mincer, J. (1958). Investment in human capital and personal income distribution. *The Journal of Political Economy, 66*, 281–302.

Mincer, J. (1974). *Schooling, experience, and earnings*. New York: National Bureau of Economic Research.

Mishan, E. (1983). *Cost-benefit analysis* (3rd ed.). London: George Allen & Unwin.

Monks, J. (2000). The returns to individual and college characteristics: Evidence from the National Longitudinal Survey of Youth. *Economics of Education Review, 19*, 279–289.

National Center for Education Statistics. (2014). *Digest of education statistics 2013*. Washington, DC: Institute of Education Sciences.

Park, S. (2011). Returning to school for higher returns. *Economics of Education Review, 30*, 1215–1228.

Prest, A., & Turvey, R. (1965). Cost-benefit analysis: A survey. *Economic Journal, 75*, 683–735.

Psacharopoulos, G. (1973). *Returns to education: An international comparison*. Amsterdam, The Netherlands: Elsevier.

Psacharopoulos, G. (1981). Returns to education: An updated international comparison. *Comparative Education, 17*, 321–341.

Psacharopoulos, G. (1985). Returns to education: A further international update and implications. *Journal of Human Resources, 20*, 583–604.

Psacharopoulos, G. (1994). Returns to investment in education: A global update. *World Development, 22*, 1325–1343.

Psacharopoulos, G. (2008). Funding universities for efficiency and equity: Research findings versus petty politics. *Education Economics, 16*, 245–260.

Psacharopoulos, G., & Patrinos, H. (2004). Returns to investment in education: A further update. *Education Economics, 12*, 111–134.

Samuelson, R. (2012, May 27). It's time to drop the college-for-all crusade. *Washington Post*. Retrieved on June 29, 2012 from http://www.washingtonpost.com/opinions/its-time-to-drop-the-college-for-all-crusade/2012/05/27/gJQAzcUGvU_print.html

Schultz, T. (1963). *The economic value of education*. New York: Columbia University Press.

Selingo, J. (2015, September 30). Is college worth the cost? Many recent graduates don't think so. *The Washington Post*. Retrieved December 13, 2015 from https://www.washingtonpost.com/news/grade-point/wp/2015/09/30/is-college-worth-the-cost-many-recent-graduates-dont-think-so/

Shafiq, M. (2007). Household rates of return to education in rural Bangladesh: Accounting for direct costs, child labor, and option value. *Education Economics, 15*, 343–358.

Shabbir, T., & Ashraf, J. (2011). Interpreting sheepskin effects of investment in schooling. *Pakistan Journal of Commerce and Social Sciences, 5*, 202–215.

Tilak, J. (2007). Post-elementary education, poverty and development in India. *International Journal of Educational Development, 27*, 435–445.

Toutkoushian, R., Shafiq, M., & Trivette, M. (2013). Accounting for risk of non-completion in private and social rates of return to higher education. *Journal of Education Finance, 39*, 73–95.

Trostel, P. (2005). Nonlinearity in the return to education. *Journal of Applied Economics, 8*, 191–202.

Tuor, S., & Backes-Gellner, U. (2010). Risk-return trade-offs to different educational paths: Vocational, academic and mixed. *Journal of Economic Studies, 37*, 495–519.

Vedder, R. (2012, June 6). Ditch. . .the college-for-all crusade. *The Chronicle of Higher Education*. Retrieved June 29, 2012 from http://chronicle.com/blogs/innovations/ditch-the-college-for-all-crusade/32661

Webbink, D., & Hartog, J. (2004). Can students predict starting salaries? Yes! *Economics of Education Review*, *23*, 103–113.

Weisbrod, B. (1962). Education and investment in human capital. *Journal of Political Economy, 70*, 106–123.

Williams, W. (2012, June 26). How many college-educated janitors do we need? *Charlotte Observer*. Retrieved June 29, 2012, from http://www.charlotteobserver.com/2012/06/26/3341588/how-many-college-educated-janitors.html

Woo, J. (2013). *Degrees of debt: Student borrowing and loan repayment of bachelor's degree recipients 1 year after graduating: 1994, 2001, and 2009*. National Center for Education Statistics (NCES 2014–011). Washington, DC: Institute of Education Sciences.

Chapter 5
Demand and Supply in Higher Education

Abstract In this chapter, we explain how demand and supply can be applied to higher education markets. We begin by providing some background on the economic concepts of markets, demand, and supply, and review historical data on college enrollments and key determinants of demand. We then build on the college choice model from Chap. 3 to identify the demand for higher education. In this section, we distinguish between individual and market demand, and then turn to the supply side of higher education markets. In the next section, we show how supply and demand are combined to find the market clearing price for higher education services, and the corresponding enrollment level. Following this section, we tackle the notion of elasticity and the various ways in which economists apply elasticity to higher education. In the Extensions to the model section, we briefly look at alternative measures of demand and how economists can use quasi-experimental methods to better measure price sensitivity of demand. Finally, the Policy Focus section discusses state broad-based financial aid programs and the growth of the for-profit industry within higher education.

Introduction

Nearly every year students face an increase in college tuition and fees over the previous year, and yet enrollments at America's colleges and universities continue to rise. Such counterintuitive relationships and even apparent 'mysteries' are all too common in the study of contemporary higher education and they sometimes seem almost impossible to explain. But there are many key economic concepts, theories and models that are particularly effective in providing insight and understanding into these complex patterns as well as their causes and effects. Some of the most productive and useful of these economic concepts and models include those associated with the theories of demand, supply and the marketplace, all of which can be applied in an analysis of higher education markets.

When it comes to higher education, economists are primarily concerned with the study of how scarce resources can be efficiently allocated and how the benefits and costs of college can be equitably distributed among students, schools and the rest of

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_5

society. In the United States and other nations, these processes primarily take place in higher education markets. Economists use the concept of the marketplace or the market to represent those places, processes, arrangements, interactions, institutions and other contexts in which buyers (consumers) and sellers (producers) exchange valuable goods and services. In the marketplace setting, buyers and sellers work together to determine the prices and quantities of goods and services that are exchanged. In higher education markets, the valuable goods and services exchanged are bundles of instructional and related educational services, the buyers are students and their families, and the sellers are colleges and universities. Students and their families are free to make decisions regarding whether to go to college, where to go to college, and how much they would be willing to pay for specific institutions. Similarly, colleges and universities (or their governing bodies) in higher education markets make decisions regarding who to admit, how many students to admit, and what prices to charge. The *market price* of educational services is represented by the equilibrium or market-clearing tuition and fees per academic year and the *market quantity* of educational services is represented by enrollment or the quantity of students enrolled at the market-clearing price. It is in the market context that students and their families give up a portion of their time and money in order to acquire the benefits that they need and want from colleges.

In the marketplace setting, the interactions of buyers and sellers determine the prices and quantities of goods and services that are exchanged. In this context, demand theory explains buyer behavior and supply theory explains seller behavior. Demand theory identifies how various factors influence the choices made by buyers, and supply theory focuses on another set of factors that influence seller behavior. In combination, demand theory and supply theory constitute an economic model of the marketplace, based on the competitive theory of markets, that can explain how various demand-side and supply-side factors help determine the market prices and quantities of the goods and services exchanged.[1] Demand theory, supply theory and the market model can also help explain how changes in factors outside the immediate marketplace, such as changes in the general economy or population demographics, or changes in policies designed by federal, state and local governments, as well as institutions, can impact the behavior of buyers and/or sellers and the prices and quantities of goods and services exchanged.

[1] Competitive market assumptions represent an approximation of behavior in higher education markets, due to some price-setting and supply-side constraints the complicating effects of which are beyond the scope of this chapter and are not thoroughly addressed in this chapter's analyses using the competitive marketplace model. But even though few markets in real life approach the strict conditions required for perfect competition, markets exhibit degrees of competition and therefore, the competitive market model can help explain and predict market behavior and outcomes (e.g., see Belfield, 2000, p. 146; Steinemann, Apgar, & Brown, 2004, p. 52). Or, as Rothschild and White (1995) summarize the case regarding its applicability to the market for higher education: "we have argued that a competitive framework for analysis appears reasonable but that the nonprofit status of universities and the major role of non-tuition funds providers introduce special features into any competitive structure" (pp. 34–35).

In this chapter, we explain how demand and supply can be applied to higher education markets. We begin by providing some background on the economic concepts of markets, demand, and supply, and review historical data on college enrollments and key determinants of demand. We then build on the college choice model from Chap. 3 to identify the demand for higher education. In this section, we distinguish between individual and market demand, and then turn to the supply side of higher education markets. In the next section, we show how supply and demand are combined to find the market clearing price for higher education services, and the corresponding enrollment level. Following this section, we tackle the notion of elasticity and the various ways in which economists apply elasticity to higher education. In the Extensions to the model section, we briefly look at alternative measures of demand and how economists can use quasi-experimental methods to better measure price sensitivity of demand. Finally, the Policy Focus section discusses state broad-based financial aid programs and the growth of the for-profit industry within higher education.

Background

A *market* is where buyers and sellers of goods and services come together to engage in trade. The notion of markets dates back thousands of years as places where humans first began to trade goods and services with each other. Economists describe markets as a means for making decisions about what a society should produce, how goods and services will be distributed, and how much buyers will be charged for goods and services. As technology improved and humans became more mobile, markets became less place-bound. Today, there are numerous examples of markets where transactions occur without buyers and sellers ever meeting in person.

There is a long and rich history behind the development of markets, demand, and supply.[2] Discussions of demand and supply can be traced back to the eighteenth century through the work of Sir James Steuart (1767) and Adam Smith (1776), followed by Ricardo (1817–21). In *Researches Into the Mathematical Principles of the Theory of Wealth* (1838) by Antoine Cournot, these ideas were formalized into what we now know as demand and supply curves.[3] It was not until the publication of Alfred Marshall's classic textbook *Principles of Economics* (1890), however, that supply and demand curves became a staple of economic analysis. We explore the concept of markets in higher education more fully in Chap. 8.

---

[2] An excellent survey of the development of demand and supply curves can be found in Humphrey (1992).

[3] Other economists of note in this early period include Rau (1841), who explained the stability of equilibrium in markets, and Mangoldt (1863), who offered a simple algebraic model of supply, demand, and equilibrium.

As documented by literature reviews on the subject, there have been numerous empirical studies on the demand for postsecondary education.[4] Although the early literature on demand for higher education focused on the United States, many subsequent studies have been conducted around the globe.[5] In general, these studies have focused primarily on two issues: forecasting demand for higher education, and measuring the sensitivity of demand to changes in price. The general conclusion from the literature is that the demand for postsecondary education is relatively unaffected by price changes. Studies of the demand for postsecondary education seek to explain trends in college enrollments, forecast future demand, and understand how students make decisions about whether to go to college, and if so, where to enroll.

The levels of postsecondary enrollment can provide us with some information about how the demand for higher education has changed over time. Table 5.1 provides data on postsecondary enrollments in the United States in selected years from 1870 through 2010. Enrollments are expressed in both actual numbers and as percentages of the total population. During this 140-year period, college enrollments increased dramatically both in numbers and as shares of the total population, with the most rapid increase in enrollments occurring between 1950 and 1980.

Although interesting, this trend raises a number of questions. First, do the data on enrollments reflect demand, supply, or some combination of the two? For example, the enrollment growth after 1980 could reflect an increased interest on the part of students and their families in going to college (demand). But it could also reflect increases in the numbers of spaces made available to students in postsecondary markets (supply). There are a number of other forces at work on demand and supply that may have affected the numbers shown here. The United States experienced an increase in the population following World War II (i.e., the Baby Boom), which has had a rippling effect on the demand for many different goods and services including postsecondary education. This demographic trend can be seen in Figs. 5.1 and 5.2. Figure 5.1 shows how the number of births in the United States has fluctuated from 1960 to 2012. The number of births per year fell from 1960 through much of the 1970s as the larger Baby Boomer cohorts of children were replaced by smaller birth cohorts. Births then steadily increased over the next 15 to 20 years as the Baby Boomers began having children (i.e., the Baby Boomer Echo). The impact of this second wave of increased births is seen in Fig. 5.2, which shows how the number of high school graduates have changed over time. The number of high school graduates in the United States increased in the 1970s and 1980s as the Baby Boomers moved through the K-12 education system, and were eventually replaced by smaller graduating cohorts in the 1990s and early 2000s.

[4] Literature reviews of studies of demand for postsecondary education include Jackson and Weathersby (1975), Radner and Miller (1975), Leslie and Brinkman (1987), W. Becker (1990), Paulsen (1990), Heller (1997), and Ehrenberg (2004).

[5] See, for example, Albert (2000), Canton and de Jong (2004), Fredriksson (1997), and Psacharopoulos and Soumelis (1979).

Table 5.1 Postsecondary enrollments in the United States, 1870–2010

Year	Postsecondary enrollments[a]	U.S. population[b]	Ratio: enrollments to population (%)
1870	52,286	38,558,371	0.14
1880	115,817	50,189,209	0.23
1890	156,756	62,979,766	0.25
1900	237,592	76,094,000	0.31
1910	355,213	92,407,000	0.38
1920	597,880	106,461,000	0.56
1930	1,100,737	123,076,741	0.89
1940	1,494,203	132,122,446	1.13
1950	2,444,900	152,271,417	1.61
1960	3,639,847	180,671,158	2.01
1970	8,004,660	205,052,174	3.90
1980	11,569,899	227,224,681	5.09
1990	13,538,560	249,438,712	5.43
2000	14,791,224	282,171,957	5.24
2010	20,427,711	310,232,863	6.58

Notes
[a]Source is *Digest of Education Statistics 2013*, Table 220
[b]Source is U.S. Census Bureau

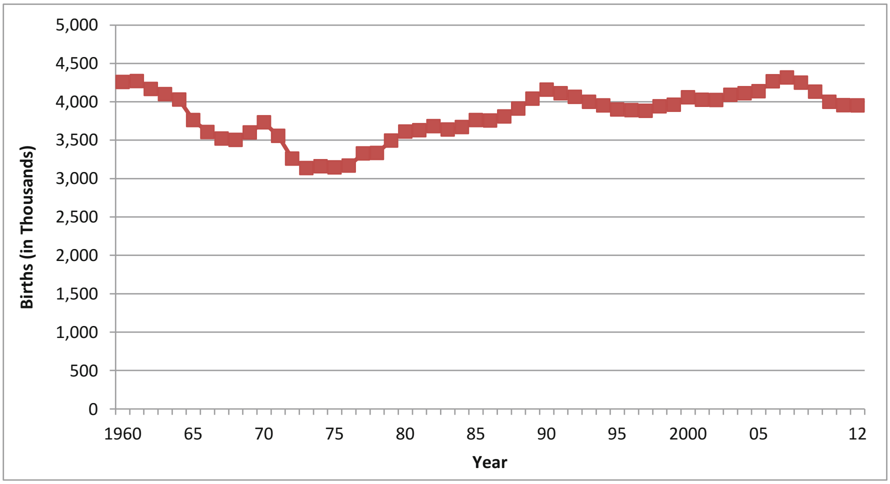


Fig. 5.1 Number of births in the US, 1960 to 2012 (*Source*: U.S. National Center for Health Statistics, Vital Statistics of the United States (http://www.cdc.gov/nchs/nvss.htm))

As will be explained later in this chapter, the demographic changes in the United States are an example of a shift in the demand curve for postsecondary education. Another demand-side change in postsecondary markets is that the G.I. Bill provided financial assistance in the 1940s and 1950s to war veterans to encourage them to go to college. In response, a number of colleges and universities expanded their

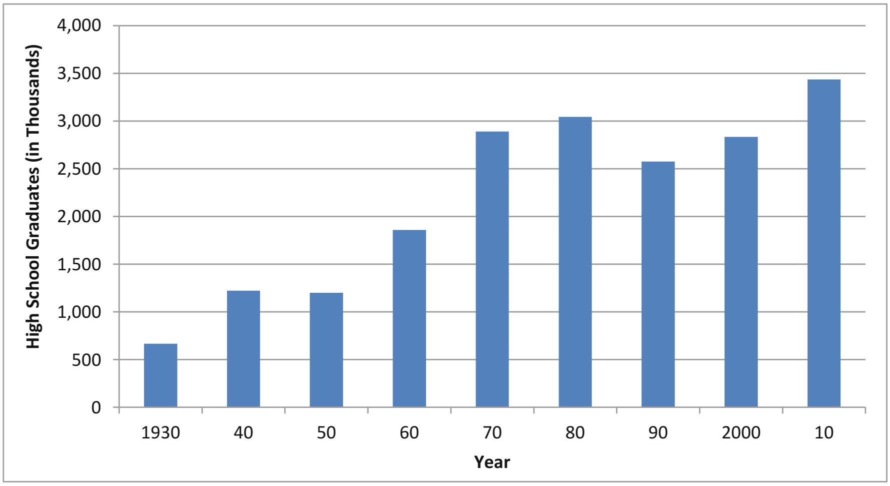


Fig. 5.2 Number of high school graduates in the US, selected years 1930 to 2010. (*Source*: *Digest of Education Statistics 2012*, Table 122)

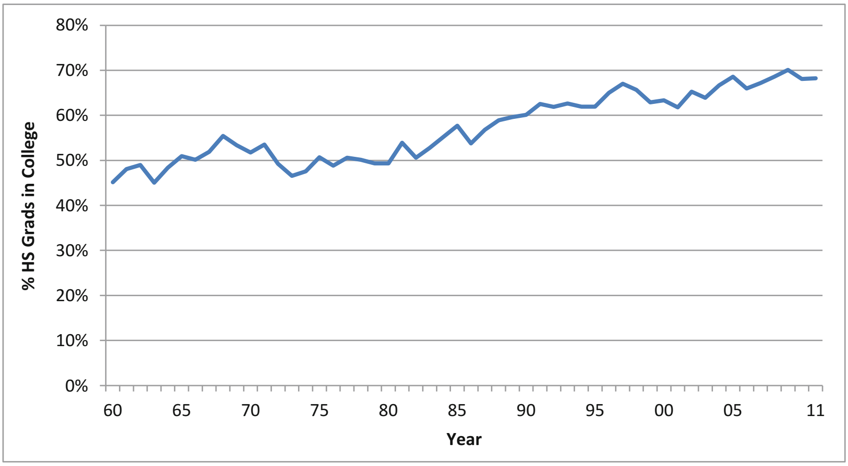


Fig. 5.3 Percent high school graduates enrolled in college, 1960–2011. *Notes*: Data were obtained from National Center for Education Statistics, *Digest of Education Statistics 2012*, Table 210. *Numbers* denote the percentage of recent high school graduates ages 16–24 enrolled in either a 2-year or 4-year institution by October of the year of graduation

campuses and grew in size and scope. Economists use the concepts of demand and supply to explore these and other related questions.

The effect of demographic trends on postsecondary education in the United States was magnified due to an increase in the college participation rate. Figure 5.3 shows the trend in another possible indicator of the demand for higher education: the proportion of recent high school graduates ages 16–24 enrolling in college after

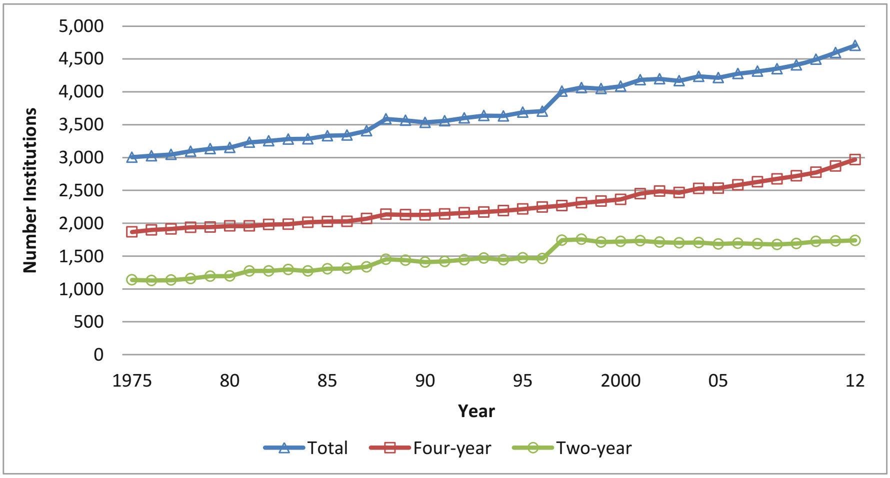


Fig. 5.4 Number of postsecondary institutions in the United States, 1975 to 2012 (*Source*: *Digest of Education Statistics 2013*, Table 279)

graduation. Roughly 50 % of the recent high school graduates enrolled in college between the years 1960 and 1980. Over the next thirty years, however, there was a steady increase in the share of high school graduates going to college, rising to 70 % by 2012.

During the time that demand for postsecondary education was rising, the United States also experienced an increase in the number of suppliers. Figure 5.4 shows how the number of postsecondary institutions has changed over time. It can be seen that there has been a gradual rise in the number of suppliers in postsecondary markets. Therefore, it is not clear whether the postsecondary enrollment growth was driven by increased demand or increased supply.

Demand for Higher Education

A *demand curve* describes the relationship between the price of a good or service and the amount of the good or service that consumers want to purchase. A demand curve can be thought of as a table or schedule showing the quantities of a good or service that consumers would be willing and able to purchase at a series of prices, holding all other factors such as income and the prices of other goods constant. The student's demand curve for postsecondary education is derived through the decisions made that would maximize their utility subject to their budget or income constraint.

To see how the demand curve originates, suppose that a student has to decide how to allocate her income between postsecondary education (*ED*) and a composite variable representing all other goods (*OG*) that she might purchase. The student has

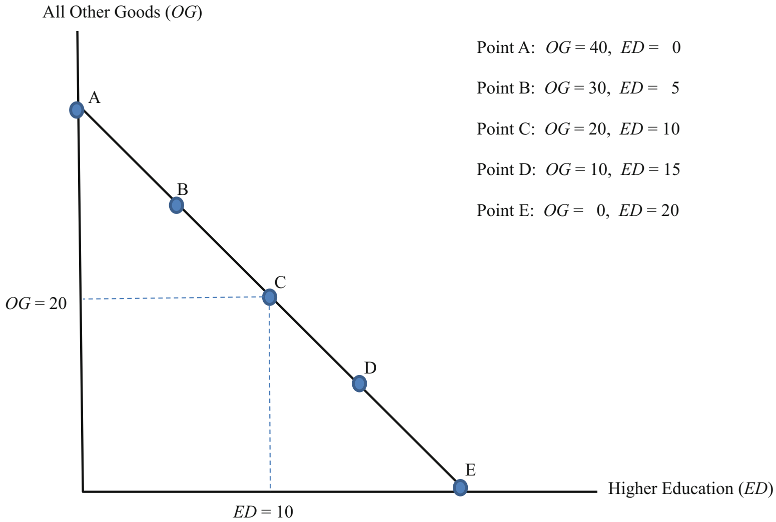


Fig. 5.5 Student's budget constraint. *Notes*: Figure assumes that the student has income of $I =$ \$40,000, the price of each unit of all other goods is $P_{OG} =$ \$1,000 and the price per unit of higher education is $P_{ED} =$ \$2,000

an initial budget line which is determined by her income level (I) and the prices per unit of postsecondary education (P_{ED}) and all other goods (P_{OG}):

$$I = P_{ED}ED + P_{OG}OG \tag{5.1}$$

The budget line for the student is depicted graphically in Fig. 5.5. We assume that the student has an income of $I =$ \$40,000, the price per unit of higher education is $P_{ED} =$ \$2,000 and the price per unit of the composite good is $P_{OG} =$ \$1,000.[6] The five points highlighted in the graph (labeled A through E) represent combinations of higher education and all other goods that the student could afford to purchase given her income. If the student were at point B, for example, then she would spend her entire income on five units of *ED* and 30 units of the composite good *OG*. The slope of the budget line is $-P_{ED}/P_{OG}$ and is the same at all points along the line. The slope can be thought of as the rate at which she is able to trade all other goods to get more postsecondary education. In this example, the slope of the budget line is −\$2,000/ \$1,000 = −2.0, meaning that if she wants to purchase an additional unit of higher education, she has to give up two units of all other goods. Note that the budget line acts as a constraint on what the student can do with regard to higher education and all other goods consumed.

[6] A unit of higher education could represent a course, a credit hour, or a year of education. It is also common to make a simplifying assumption and group all other goods and services into one aggregate good and then focus on the single variable of interest on the X-axis.

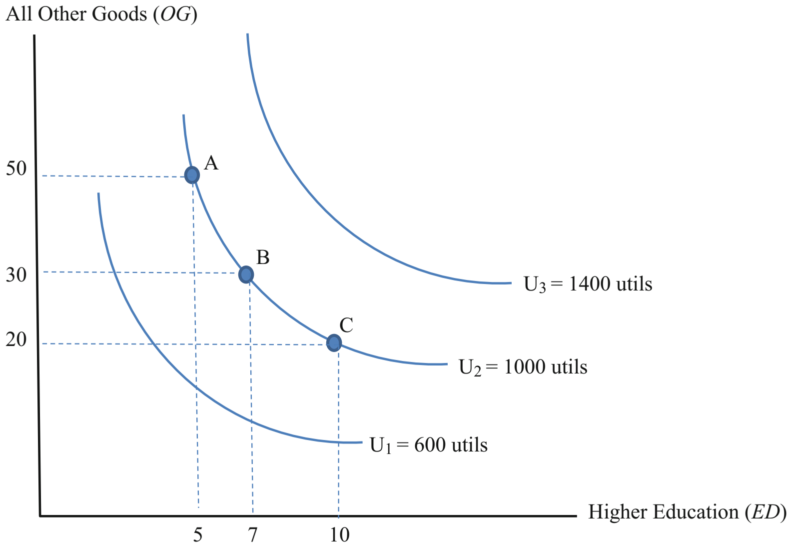


Fig. 5.6 Student's indifference curves for higher education

In the absence of constraints, the student has preferences for goods and services that are represented by indifference curves. For our example, an *indifference curve* shows the various combinations of higher education and all other goods that would give her the same level of utility or happiness. Three of these curves (labeled U_1 to U_3) are shown in Fig. 5.6. The student is assumed to have an infinite number of such indifference curves, with those to the right representing higher levels of utility. All of the combinations along the indifference curve U_3 give the student more utility than any of the combinations on curves U_1 and U_2. Using the indifference curve U_2 as an example, the student would be equally happy with—or indifferent between—the amount of higher education and all other goods at point A (50 units of *OG* and five units of *ED*) and the amount of higher education and all other goods at point B (30 units of *OG* and seven units of *ED*).

The slope of the indifference curve represents the rate at which the student would be willing to trade all other goods for more higher education. Unlike the budget line, indifference curves are not straight lines and as a result, the slope of the indifference curve is not constant and will depend on where the student is along the curve.[7] Going back to Fig. 5.6, if the student were initially at point A and wanted to move to point B, she would be willing to trade 20 units of *OG* to get two additional units of higher education. In moving from point B to C, however, her desired rate of exchange would be 10 units of *OG* for three units of *ED*. The rate of desired

[7] The specific shape of an indifference curve is due in part to the assumption that as the student consumes more of each good or service, her total utility increases at a decreasing rate. This means that there is diminishing marginal utility for both *ED* and *OG*, in that the student gets less and less added value as she consumes more of each good or service.

exchange is different for her at point B than it was at point A because she now has fewer units of *OG* (and is less willing to give them up) and more units of *ED* (and less interested in acquiring more). The slope of the indifference curve at any given point is called the marginal rate of substitution (*MRS*). If we write the student's utility function in a general form such as:

$$U = f(ED, OG) \tag{5.2}$$

then the *MRS* is the ratio of the marginal utilities for higher education and all other goods and can be calculated as:

$$MRS = -(MU_{ED}/MU_{OG}) \tag{5.3}$$

where $MU_{ED} = \partial U/\partial ED =$ marginal utility of higher education, and $MU_{OG} = \partial U/\partial OG =$ marginal utility of all other goods. Over a given range of the indifference curve, the average *MRS* can be estimated by $-\Delta OG/\Delta ED$, where $\Delta OG =$ units change in all other goods, and $\Delta ED =$ units change in higher education.[8] From Fig. 5.6, for example, the average *MRS* between points A and B is approximately $-20/2 = -10$. Note that $(\Delta OG/\Delta ED)$ is nothing more than the rate at which the student would want to exchange *OG* for *ED* without reducing her total level of satisfaction or utility.

The problem facing the student is how much postsecondary education and all other goods should she consume. Her goal in this model is to maximize her utility without exceeding her income. Economists have shown that this point occurs where the slope of the budget line is equal to the marginal rate of substitution, and all income is spent. In Fig. 5.7, this translates into the student choosing to consume $ED = 10$ units of higher education and $OG = 20$ units of everything else (point C). At this point, the rate at which she is willing to trade all other goods to get more higher education is equal to the rate at which she is actually able to do so given her income and the prices of higher education and all other goods. Even though she would prefer other combinations such as point A to point C, she cannot afford them because the combination of *ED* and *OG* at point A exceeds her income. Likewise, although both points C and E are affordable for the student, she would prefer to be at point C because she would get more utility from this combination.

The optimum point can also be found mathematically by combining the student's utility function and budget line into a mathematical function (L) such as the following:

$$L = f(ED, OG) + \tau(I - P_{ED}ED - P_{OG}OG = 0) \tag{5.4}$$

[8] The slope of the indifference curve at a specific point shows the change in one good due to a very small change in the other good. The approximation shown here is actually the slope of a straight line connecting the two points on the indifference curve, which may differ from the slopes of the curve at specific points along this interval.

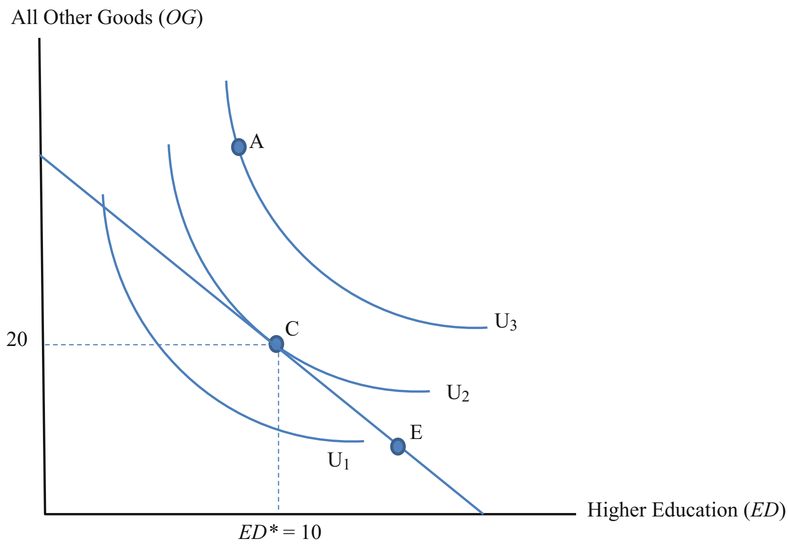


Fig. 5.7 Student's optimization of higher education. *Notes*: Figure assumes that the student has income of $I = \$40{,}000$, the price of each unit of all other goods is $P_{OG} = \$1{,}000$ and the price per unit of higher education is $P_{ED} = \$2{,}000$

where all variables are defined as before.[9] Calculus can then be used to find the values of ED, OG, and τ that maximize the function L.[10] In this model, the resulting utility-maximizing quantity of postsecondary education (denoted ED^*) would be written as a function of the prices per unit of higher education and all other goods, and the student's income level:

$$ED^* = f(P_{ED}, P_{OG}, I) \tag{5.5}$$

Assuming that the function $f(\ )$ relating prices and income to ED was known, the equation could be solved and the resulting optimum amounts of postsecondary education and all other goods would be determined.

The demand curve for higher education is identified (or derived) from this optimization process by observing how the equilibrium quantity of ED changes when the price of higher education changes, holding all else constant. Accordingly, the demand curve is a schedule showing all possible combinations of ED^* and P_{ED}

[9] The equation is referred to as a Lagrangian function where the problem is to optimize a function subject to a constraint. The symbol τ represents the shadow price of income, or the change in the Lagrangian function due to an increase in the income constraint. See the discussion in Chap. 2 for more information.

[10] More precisely, this is done by taking the first partial derivatives of L with respect to each of the three variables, setting the derivatives equal to zero, and then finding the values of ED, OG, and τ that make all of the equations true at the same time. It is common for applications to focus on the optimum quantities of ED and OG and not focus attention on the optimum value for the shadow price parameter.

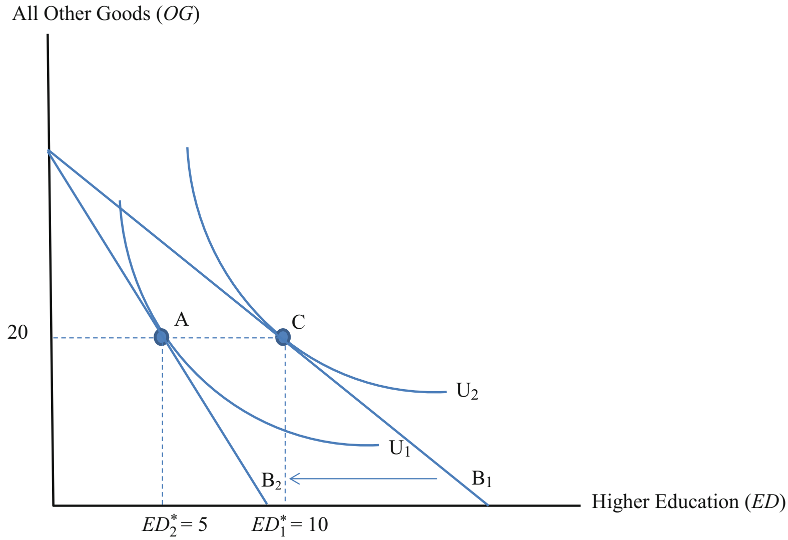


Fig. 5.8 Effects of price increase on student's optimization of higher education. *Notes*: Figure assumes that for the first budget line B_1 the student has income of $I = \$40,000$, the price of each unit of all other goods is $P_{OG} = \$1,000$ and the price per unit of higher education is $P_{ED} = \$2,000$. In the second budget line B_2, the price per unit of higher education increases to $P_{ED} = \$4,000$

that the student would choose at a given income level and price level for all other goods. To see this, suppose that the price of higher education in our example increased from $P_{ED} = \$2,000$ to $P_{ED} = \$4,000$. If we did not change the student's income or the price per unit of all other goods, then the higher education price increase would cause the student's budget line in Fig. 5.8 to pivot inward along the X-axis from point B_1 to B_2. At the higher price for postsecondary education, the student could no longer consume the same amounts of *ED* and *OG* as before because she would exceed her income. Repeating the optimization exercise from before at the new price for higher education would lead her to choose 20 units of *OG* and five units of *ED*. The new equilibrium is shown graphically at point A where the budget line B_2 is tangent to one of her indifference curves.

To find the student's demand curve for higher education, the utility-maximizing exercise shown above would be repeated for a series of prices and the resulting combinations of (ED^*, P_{ED}) would be recorded. The demand curve for postsecondary education is shown graphically in Fig. 5.9 by plotting the prices of higher education on the vertical axis and the quantities of higher education demanded on the horizontal axis.[11] In this example, points A and C correspond to

[11] The convention of placing price on the vertical axis and quantity on the horizontal axis is somewhat unusual. It is common to put the dependent variable on the vertical axis, and yet quantity is described as being dependent on price and not vice-versa. The early depictions of demand and supply, however, had price on the vertical axis and the practice has continued to this day.

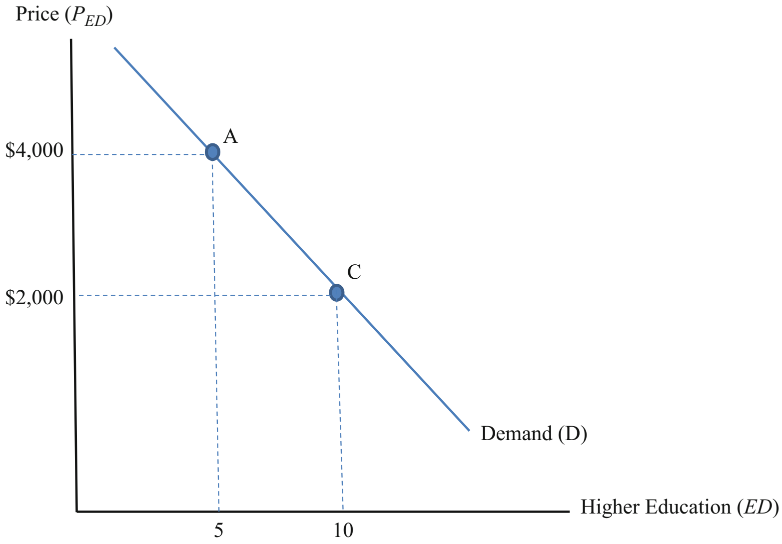


Fig. 5.9 Student demand for higher education

two utility-maximizing combinations of the price of the k-th college and the student's demand for attending the college. At point C, if the price was $2,000 per unit of higher education, then the student would choose ten units of higher education. If the price per unit doubled to $4,000, however, the student would demand only five units of higher education.

It is useful to think of the utility-maximizing amount of higher education shown in Eq. (5.5) as being similar to the latent demand for higher education discussed in Chap. 3. Recall that the student's latent demand for considering the k-th institution was a function of the price of the k-th institution and a series of other factors, as in:

$$a_{jk}^{*} = f\left(I_k^g,\ I_k^{ng}, I^{na}, \pi_k^g, \pi_k^r, T^1, T^r, T, tx^g, tx^{na}, P_k, F_k, w, z, i, Y, X\right) \tag{5.6}$$

If any of these variables were to change, they would also change the latent demand for the k-th college. To express this as a demand function for the k-th institution, we would find the values of a_{jk}^{*} for the student at a series of prices P_k, holding constant all other variables in the equation. This can be written mathematically as follows:

$$a_{jk}^{*} = f\left(P_k \middle| I_k^g,\ I_k^{ng}, I^{na}, \pi_k^g, \pi_k^r, T^1, T^r, T, tx^g, tx^{na}, F_k, w, z, i, Y, X\right) \tag{5.7}$$

where the vertical line "|" indicates that all variables to the right of the line are assumed to be fixed or held constant. A similar approach could, of course, be used for the predisposition for going to college (a_j^{*}) and the demand for applying to a

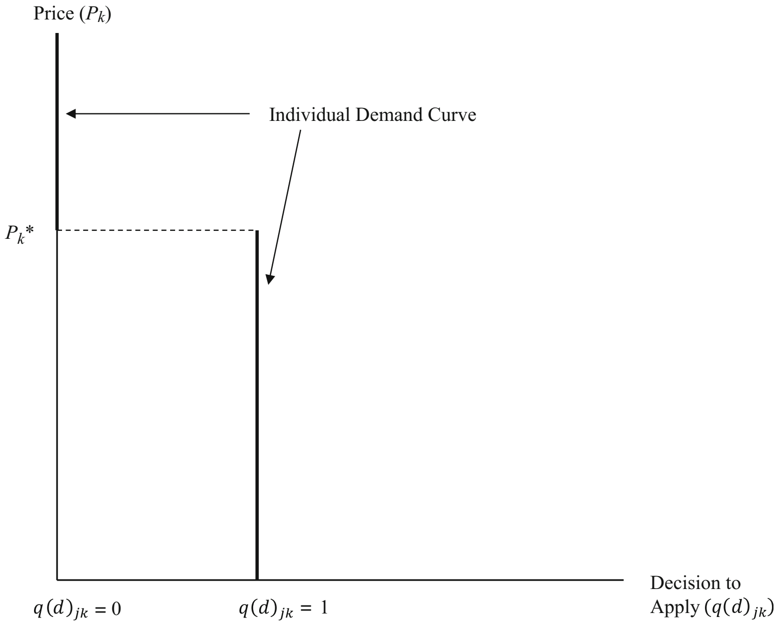


Fig. 5.10 Observable individual student demand for a single institution

specific institution ($q(d)^*_{jk}$). The individual student's unobservable demand curve for applying to the k-th institution can be thought of as the values of $q(d)^*_{jk}$ corresponding to a series of prices ($P_1, \ldots, P_n$), holding constant all other factors that can affect $q(d)^*_{jk}$. The resulting demand curve would be continuous (either a straight line or a curve).

Latent demand curves are useful as a theoretical construct, but they cannot be directly observed. However, due to the dichotomous nature of the application variable (the student either applies or does not apply to the k-th institution), the demand curve that can actually be observed is a discontinuous vertical line that switches from not applying ($q(d)_{jk} = 0$) to applying ($q(d)_{jk} = 1$) once the price of attending college becomes sufficiently low.[12] This is depicted in Fig. 5.10.

We can use this same general approach to find the individual's unobservable and observable demand curves for considering postsecondary education, which correspond to Stage 1 of the five-stage college choice model in Chap. 3. The student's unobservable demand for higher education, for example, are the values of a^*_j that align with a series of prices of higher education holding all else in the demand equation constant. Likewise, the observable demand for higher education would be identified by finding the price P at which the student decides to pursue a college

[12] Because the dependent variable is dichotomous and bounded, one should use an appropriate statistical technique when estimating an individual-level demand curve.

education, and plotting this in a similar way as in Fig. 5.10. Similarly, the same kind of demand curves could be specified for the second stage of the college choice model as to whether to include an institution in the initial choice set. A continuous line/curve is used for the latent demand for considering a specific institution, and the discontinuous vertical line demand curve shows how changes in the price of the k-th college affect whether or not a student actually includes the institution in his or her choice set.

Market Demand for Postsecondary Education

The derivation of the demand curves for higher education shown above focuses on the decisions of a single student. Of course, higher education markets consist of a large number (J) of students, each of whom must decide at what price they decide to go to college, consider an institution, or apply to an institution. The sum of the demands for all students who are faced with these options within a set of competitors represents the market demand. The market demand curve is a schedule showing the numbers of students who would make each of these decisions at a series of prices, holding all else constant. We use $Q(d)_k = \sum_{j=1}^{J} q(d)_{jk}$ to represent the total number of students who applied to the k-th college. The same approach could be used to represent the number of students who decide to include a specific college in their initial choice set, or the number who enrolled at the institution. The market demand curve for the institution is therefore affected by all of the same factors that influence an individual student's demand curve, as well as the number of individuals in the respective market.

We further use $Q(d) = \sum_{k=1}^{K} \sum_{j=1}^{J} q(d)_{jk}$ to denote the aggregate demand for applying to institutions in a market, where the demands for the K institutions in the relevant market are summed to obtain the total. For example, if a researcher were interested in the market for public 4-year universities in Michigan, then $Q(d)$ represents the total demand for the 16 public 4-year universities in the state. Likewise, this construct could be used to find the total demand for initially considering institutions within a given set of competing institutions.[13]

Because students vary in terms of the utilities they attach to college and the components of the expected costs and benefits from attending college, they will have different "tipping points" at which the price becomes low enough that they decide it is in their best interest to either consider college, include an institution in their choice set, or apply to an institution. A simple illustration of this is shown in Fig. 5.11, where we assume that the postsecondary market consists of four students.

[13] There are instances where economists will want to avoid double-counting students for a designated market who have considered or applied to multiple institutions.

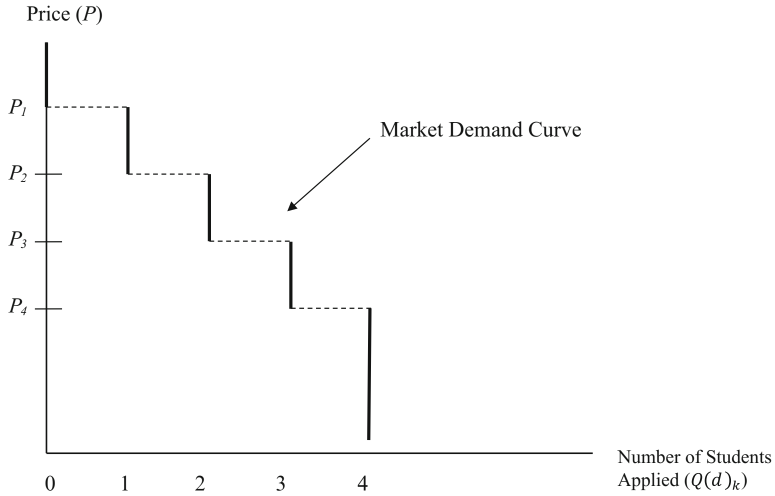


Fig. 5.11 Observable market demand for a single institution

The individual demand curves for the four students are summed to obtain their aggregate demand. In this figure, no student would be willing to apply to the college if they had to pay more than P_1, one student would apply if the price was between P_1 and P_2, two students would apply if the price was between P_2 and P_3, three would apply at prices between P_3 and P_4, and all four students would apply at any price below P_4. The negative relationship between the price of the institution and the quantity demanded is known as the law of demand.

The market demand curve is important for the economics of higher education because price (tuition) and quantity (enrollments) in the relevant market are set by the intersection of market demand and supply as opposed to the demand and supply curves for a single consumer or producer. Because markets typically include a large number of consumers, it is more convenient to depict the market demand curve for higher education by a straight line or a curve (see Fig. 5.6) rather than by the staircase pattern in Fig. 5.11.

Changes in Quantity Demanded

It is important to understand the distinction that economists make between a change in the quantity demanded and an overall change or shift in demand. A *change in quantity demanded* represents a movement from one point on the demand curve to another. The only way in which the quantity of postsecondary education demanded may change is if the price changes and all else is held constant. This is depicted graphically in Fig. 5.12. Point A shows that at the price of $15,000, there would be a total of 8,000 students who would be willing and able to attend the institution. If the

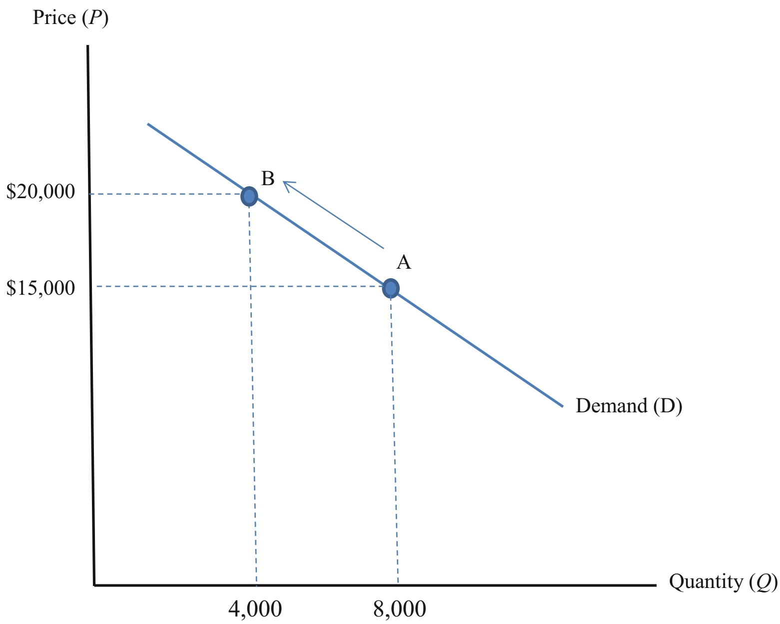


Fig. 5.12 Change in quantity demanded of postsecondary education

institution were to increase its price to $20,000, however, then only 4,000 students would be willing and able to attend. Therefore, the $5,000 price increase led to a *change in quantity demanded* of −4,000 students. The height of the demand curve indicates the maximum price that each student and their family would be willing and able to pay for college. The 4,000th student represented by point B, for example, would pay up to $20,000 to attend this institution, and likewise the 8,000th student would pay a maximum of $15,000.

Changes in Demand

The demand curve shown in Fig. 5.12 is constantly changing position due to forces in the postsecondary education market. When the demand curve moves from one location to another, it is referred to as a *change in demand*. For a change in demand to occur, one of the non-price factors in the demand model would have to change. There are two types of changes in demand: increases in demand and decreases in demand. An increase in demand happens when the demand curve shifts upward and to the right from D_1 to D_2, as shown in Fig. 5.13. As a result of the increase in demand, the quantities demanded at each price would rise. For example, if the price of postsecondary education was $20,000, then at point A along the original demand curve there would be 4,000 students willing and able to attend the institution.

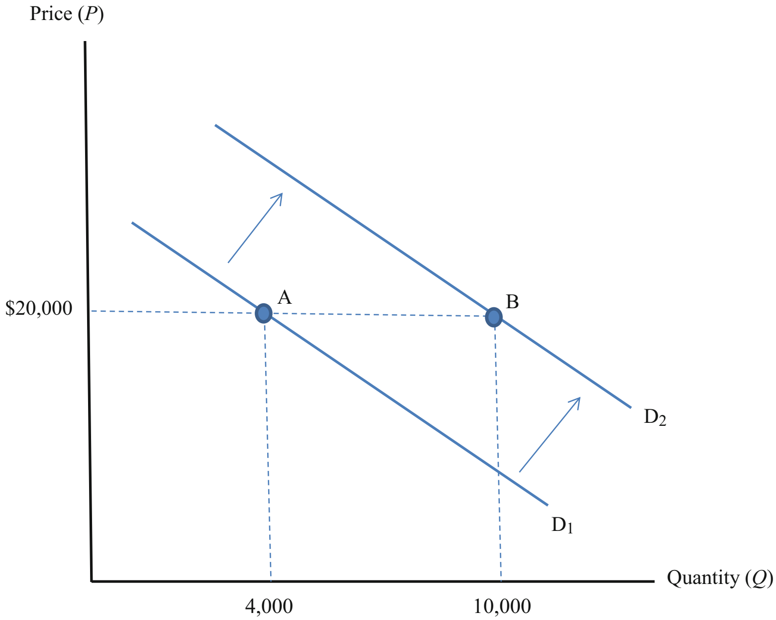


Fig. 5.13 Effect of increase in market demand on quantity

However, if the demand curve shifts upward and to the right to the position D_2, then at the same price there would now be 10,000 students willing and able to attend the institution. The demand curve could also shift downward and to the left, which is referred to as a decrease in demand.

What factors could lead to a change in demand? In general, demand curve shifters would include any variable that was assumed to be held constant when the market demand curve was formed. This would include factors such as the incomes of students and their families, the prices of competing institutions, the consumptive benefits of college, and the number of students in the market. In fact, all of the variables to the right of the conditional line "|" in Eq. (5.7) (and similar demand equations for a_j and $q(d)_{jk}$) are demand curve shifters. How far changes in each variable would shift demand depends on the relationship between each variable and demand.

Of particular interest to economists is the effect of changes in income on the demand curve. Whether changes in income lead to an increase or decrease in demand depends on whether postsecondary education is a normal good or an inferior good. If demand rises when incomes increase, then the postsecondary option being considered is a *normal good*. Likewise, an *inferior good* is one for which increases in income lead to decreases in demand. How income changes affect postsecondary demand depends on the student's initial income level and the type of institution being considered. As incomes rise, students and their families are better able to pay the prices charged by colleges. For example, before any increase in income, a student from a lower-income family may have been unable and unwilling to go to college; however, an increase in income may enable him or her to now consider going to a 2-year college where tuition rates are relatively low. For a middle-income student, an income increase could help him or her afford to go to an in-state 4-year institution instead of a 2-year institution. Upper-income students, on the other hand, may find that an income increase permits them to substitute away from 4-year in-state public institutions and towards out-of-state public institutions or even private institutions where tuition rates are relatively high.

The tuition rates charged by other institutions will have a positive effect on the demand for the institution in question as long as the institutions are viewed as being substitutes for each other. As the tuition rates at competitors rise, holding all else constant, the relative price of going to the college being examined will fall. For example, if Iowa State University were to increase its tuition rate, then this may cause more students to consider attending the University of Iowa because for many students these two institutions are in the same postsecondary market and compete with each other for students. In contrast, tuition increases at a community college in Oregon are unlikely to affect demand for the University of Iowa because they do not compete in the same markets for most students.

To illustrate the effects of income and competitor's price on demand, suppose that the market demand curve for applying to College A is found to be the following:

$$Q(d)_A = 2,000 - 1.5P_A + 0.3P_B + 0.8I \tag{5.8}$$

where $Q(d)_A$ = number of students in the market who apply to college A, P_A = price of college A, P_B = price of a competing College B, and I = average incomes of students and their families. In Table 5.2, the first column shows six different tuition rates that could be charged by College A. When combined with the numbers in the second column, the pairs of values (P_A, $Q(d)_A$) represent points along the initial demand curve when the competitor's price is P_B = \$10,000 and the average incomes of students and their families is I = \$40,000. Due to the negative slope of the demand curve (which is the coefficient -1.5 for the variable P_A in Eq. 5.8), as the price of College A rises by \$100 holding P_B and I constant, applications to College A (quantity demanded) would fall by 150 students. Moving from one row to the next in this table illustrates changes in quantity of postsecondary education demanded because the only factor that changed was the price of College A.

Now, suppose that the average incomes of students and their families (a - non-price factor) were to rise by \$20,000 to a new value of \$60,000, and the price of College B is held constant at P_B = \$10,000. Because the coefficient for average family income (+0.8) is positive, the increase in family incomes will lead to more applications at each of the six prices shown in the table. In this instance, the \$20,000 increase in average incomes will result in 16,000 more applications at each price. As a result, the demand curve for applying to College A would shift upward and to the right and we would say that there has been an increase in demand. The

Table 5.2 Example of change in demand for college A

Price of college A	Quantity of applications ($Q(d)_A$)[a]	If average income rises to \$60,000:[b] Quantity of applications ($Q(d)_A$)	Change in demand	If competitor's price falls to \$6,000:[c] Quantity of applications ($Q(d)_A$)	Change in demand
\$1,000	35,500	51,500	+16,000	34,300	−1,200
\$3,000	32,500	48,500	+16,000	31,300	−1,200
\$5,000	29,500	45,500	+16,000	28,300	−1,200
\$10,000	22,000	38,000	+16,000	20,800	−1,200
\$15,000	14,500	30,500	+16,000	13,300	−1,200
\$20,000	7,000	23,000	+16,000	5,800	−1,200

Notes: Quantity of applications to College A are determined by the demand equation: $Q(d)_A = 2{,}000 - 1.5P_A + 0.3P_B + 0.8I$.

[a]It is assumed that the price of College B is $P_B = \$10{,}000$ and the average income of students and their families is $I = \$40{,}000$

[b]All parameters are the same as in the first equation, except that income is increased to $I = \$60{,}000$

[c]All parameters are the same as in the first equation, except that the price of College B is reduced to $P_B = \$6{,}000$

positive coefficient for income indicates that on average College A is viewed as a normal good by consumers.

Similarly, the last two columns show what would happen if the competing institution lowered its price to $P_B = \$6{,}000$, and average family income was held constant at the original value $I = \$40{,}000$. The fact that the coefficient for the competitor's price (+0.3) is positive shows that the two colleges in question are viewed on average as substitutes in the relevant higher education market. The price reduction for the substitute good reduces the number of applications that College A would receive at each price by 1,200 students. Therefore, the demand for College A has shifted downward and to the left, resulting in a decrease in demand.

There are other variables that may also cause the market demand for postsecondary education to shift. Recall that the market demand curve is the sum of all of the individual-specific demand curves for students in the market. Therefore, as more students enter a given postsecondary market, holding all else constant, it would lead to an increase in demand and vice-versa. For example, in the 1990s and continuing through the first decade (and more) of the twenty-first century, there was an increase in the number of students graduating from high school. The larger graduating classes translated into an increase in demand for higher education. In addition, the demand curve for considering the k-th college (shown in Eq. 5.7) shows that incomes by degree level, time spent in college and the labor market, the probability of graduating, financial aid received, and the other factors on the right-hand side of the equation all impact demand. Revisiting the concept of comparative statics from Chap. 3, one may be able to determine if increases in each factor of interest would be predicted to cause demand to rise or fall.

Supply of Postsecondary Education

The demand curve focused on the decisions made by the consumers of postsecondary education, namely students and their families. These individuals constitute only one half of higher education markets. Postsecondary education markets also consist of a supply side, which represents the entities that make these educational services available to students and their families. Each college must make decisions about the levels and types of services that they want to provide to their market. Although these services could include research, teaching, and/or public service, we focus here on the supply decisions relating to teaching or instruction-related services and how these are reflected in the number of students served.

An important feature of supply decisions in postsecondary markets is the time frame in which price and quantity supplied are determined. Colleges and universities typically decide in the spring what price to charge and how many students to enroll for the following academic year.[14] Therefore, price and quantity are fixed during any specific academic year regardless of changes in factors that could affect supply decisions. Nonetheless, even in non-education markets there is a period of time during which the supplier has a specific price that they charge customers and a specific quantity of the good or service that they are willing and able to sell at that price.

The *supply curves* for institutions in higher education in a given year ("short-run") generally fall into one of two categories, as depicted in Fig. 5.14. The graph on the left shows the short-run supply curve for an institution that would enroll as many students as wish to attend at the stated price. These institutions are often referred to as "open admission institutions." In contrast, the graph on the right illustrates the case where the college has set an enrollment target and will only enroll students up to this limit regardless of price. These institutions where enrollments are fixed can be thought of as "selective admission institutions." Usually, the selective admission institutions are those that benefit from having more applicants who are willing and able to pay the price to attend than the institution has space to accommodate in the short run or that the institution needs to help finance its operations.

Given enough time, however, institutions of higher education can vary the supply of spaces offered to students depending on a range of factors, including the price that they charge. Therefore, the long-run supply curve for the market would be an upward-sloping line or curve showing the relationship between price and quantity of spaces supplied. Microeconomic theory suggests that over a multi-year period the quantity of services supplied by the k-th institution ($Q(s)_k$) will be a function of the price of the service, the price of resources needed to provide services

[14] Of course there are exceptions to this pattern, primarily for 2-year and not-for-profit institutions that may vary pricing and supply decisions from term to term.

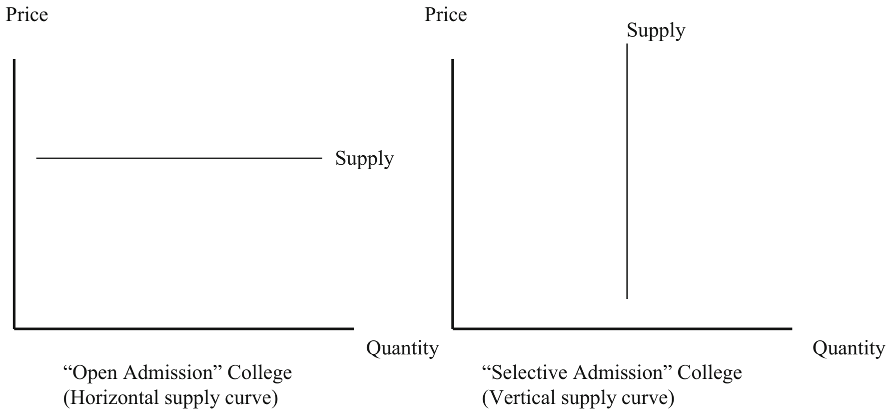


Fig. 5.14 Short-run supply curves for open admission and selective admission institutions

(R), the state of technology for producing services (H), and any governmental and other subsidies received by the institution (G):

$$Q(s)_k = f(P_k, R_k, H_k, G_k) \tag{5.9}$$

The quantity of postsecondary services supplied may be thought of as the number of places that the institution is willing to provide to students. The prices of resources would include things such as salaries and benefits for faculty and staff, and the cost of equipment and services. The state of production technology available would, for example, encompass the student-faculty ratio or use of distance-delivery technology in the provision of college learning experiences. Finally, the subsidies to producers would include state or local government appropriations to public institutions, as well as donative resources acquired by public and private institutions through fund-raising, endowment income, and so on.

Each of these factors on the right-hand side of Eq. (5.9) can have an important influence on the quantity of enrollment places institutions are willing to make available. For example, all else held constant or equal to its current value, a higher price (P) would increase the number of places institutions are willing to provide or supply to students. This is known as the *law of supply*. All else equal, higher salaries for administrators or faculty (R) would lead to decreases in the quantity of enrollment places supplied. Colleges and universities using a larger student-to-faculty ratio or offering a larger share of its coursework via distance technology (H) are more likely than other institutions to have lower per-student costs of production and supply larger quantities of enrollment places, all else held constant. Similarly, all else equal, higher per-student subsidies to help cover the institution's costs of educating students (G) would tend to increase the quantity of enrollment places institutions of higher education are willing to supply.

As with demand, we can talk about the supply for an individual institution or the supply for a group of institutions in the same market. When the focus is on one institution (such as the University of Connecticut), Eq. (5.9) represents the relevant supply equation. In contrast, if one defines a market as the set of institutions that compete with each other for students and resources, such as the set of Ivy League institutions or the set of four-year institutions offering master's degrees in economics, then the relevant supply will be the sum of the supplies for the institutions in this market (i.e., $Q(s) = \sum_{k=1}^{K} Q(s)_k$). The market supply in this case will be affected by all of the factors that influence the supply decisions for each institution, as well as the number of institutions in the market.

Changes in Quantity Supplied

The (long-run) supply curve shows the quantities of students that would be accommodated by institutions in the market at a series of prices, holding all other factors in the supply equation constant. The supply curve can be expressed in algebraic form by rewriting the quantity supplied equation as:

$$Q(s)_k = f\left(P_k \middle| R_k, H_k, G_k\right) \tag{5.10}$$

where the vertical line "|" again denotes that everything to the right of the line is assumed to be held constant. The concept of a supply curve can also be applied to the fourth stage of the college choice model where institutions make decisions about which students to admit, and each of the non-price factors in the equation represent supply curve shifters.

As with demand, economists are careful to distinguish between changes in quantity supplied and changes in supply. When there is a change in the price of the postsecondary option of interest, it leads to a *change in quantity supplied* which is shown as a movement along a given supply curve. This is shown in Fig. 5.15 where a price increase from $15,000 to $20,000 leads to an increase in the number of students that institutions would be willing and able to enroll from 7,000 to 10,000. It is assumed in the chart that none of the other factors that could affect supply have changed. The height of the supply curve indicates the minimum price that colleges would need to receive to supply a given number of spaces to the market. At point A, for example, institutions would need to receive at least $15,000 to entice them to enroll the 7,000th student, and would need even more ($20,000) to enroll the 10,000th student at point B.

Changes in Supply

On the other hand, when one of the non-price factors that can influence supply does indeed change from its current value, it will result in a shift in the entire supply

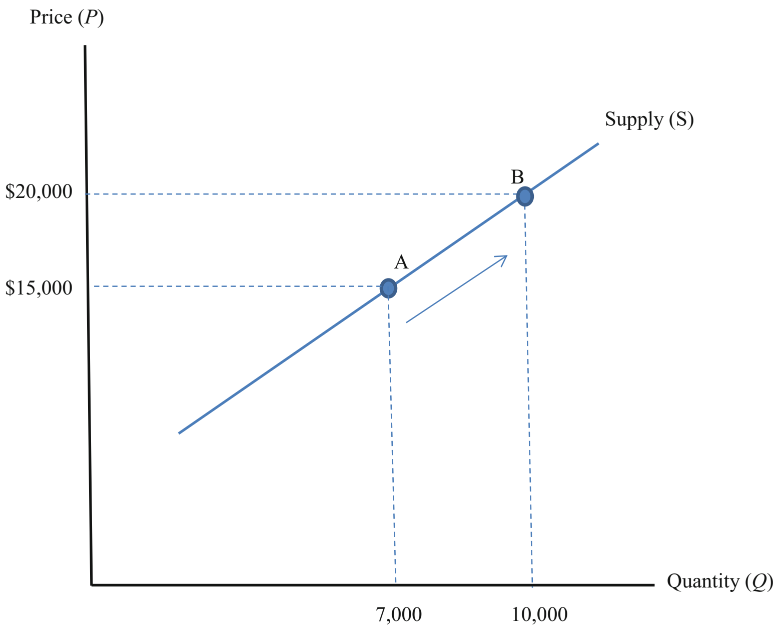


Fig. 5.15 Change in quantity supplied of postsecondary education

curve. This is referred to as a *change in supply*. The supply curve may either shift downward and to the right (increase in supply), or upward and to the left (decrease in supply). When there is a decrease in supply, as shown in Fig. 5.16, the quantities of postsecondary education supplied at each price will fall. To illustrate, suppose that the price of college was \$20,000. According to the original supply curve S_1 there would be $Q(s) = 10{,}000$ spaces made available for students. If something were to change a non-price factor in a way that would lead to a decrease in supply, then the entire curve may move to a new location as denoted by S_2. At the same price as before ($P = \$20{,}000$), only $Q(s) = 5{,}000$ spaces would now be available for students. An increase in supply would lead to the opposite shift in the supply curve.

Equilibrium in Postsecondary Markets

Markets provide a mechanism for setting prices and output for the good or service in question. Economists dating back to Cournot (1838) have stressed that prices and output depend on both demand and supply, in that a market brings together (either physically or virtually) demanders and suppliers of the good or service. The same is true in higher education markets, where demand and supply determine the tuition rate at which the number of students who want to go to college equals the number of

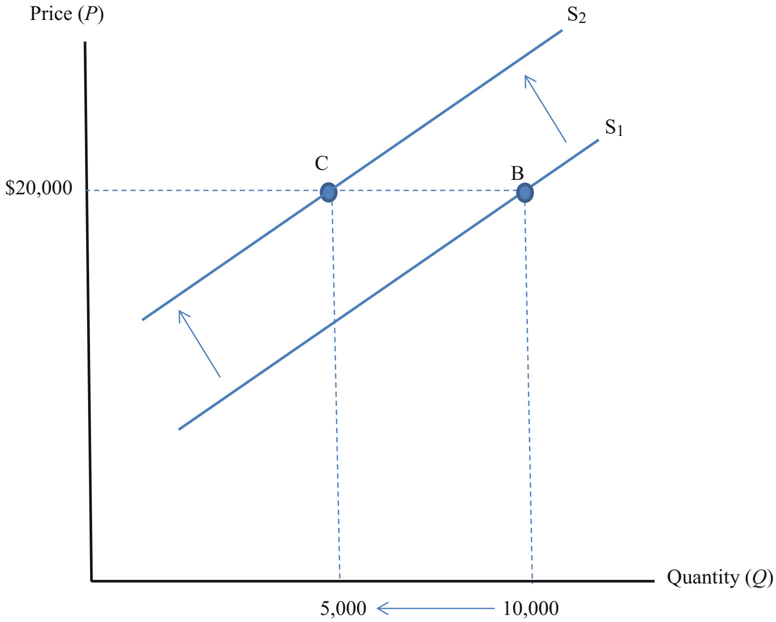


Fig. 5.16 Decrease in supply of postsecondary education

spaces that institutions are willing to provide. The market demand and supply curves can now be combined to find the market-clearing, or equilibrium, price charged for postsecondary education and the number of students who would enroll at this price.

The equilibrium is shown graphically as the point where the market demand and supply curves intersect, as in Fig. 5.17. The market demand and supply curves in this example intersect at point A ($P = \$15{,}000$, $Q = 7{,}000$), meaning that if the price was set equal to $15,000, the number of students who would be willing and able to enroll in college would be the same as the number of spaces institutions would be willing and able to provide. If the price was set above equilibrium (such as $P = \$20{,}000$), then institutions would provide more spaces than students would be willing to fill. This would result in an excess supply of spaces in the market. Institutions would have an incentive to reduce their prices to help fill the empty seats, and thus there would be a downward pressure on prices towards the equilibrium value. The opposite would happen if prices were below equilibrium. In our example, a price of $P = \$10{,}000$ would entice many more students to go to college than institutions would be willing to accommodate, leading to an excess demand in the market. The excess demand would place upward pressure on prices until the equilibrium value is attained. According to Adam Smith, it is as if an "invisible hand" is constantly moving market prices towards equilibrium.

It is helpful to note that both the demanders and suppliers benefit from the equilibrium price. Recall that the height of the demand curve shows the maximum

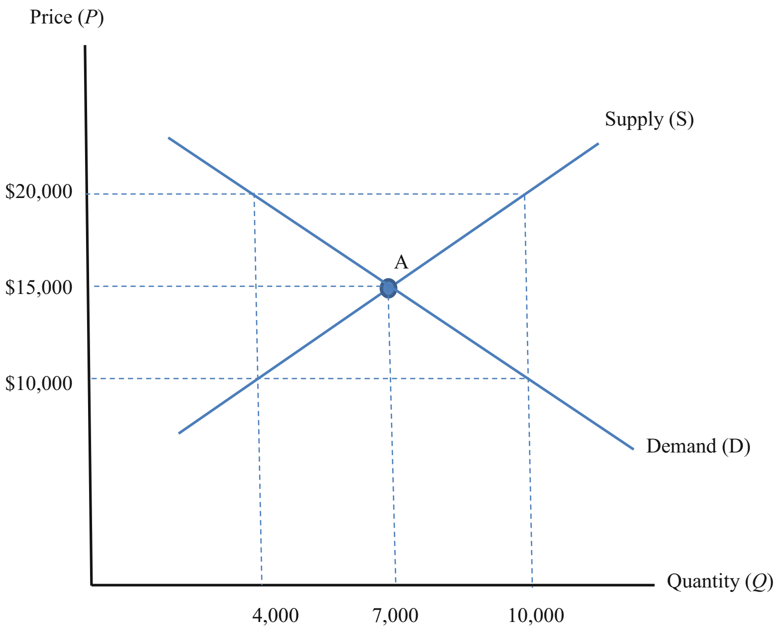


Fig. 5.17 Equilibrium in a postsecondary education market

that each student would be willing to pay for a postsecondary education. Instead of paying their maximum prices, however, students pay the lower equilibrium price and therefore receive a benefit (known as consumer surplus) from the vertical distance above the equilibrium price and below the demand curve. Likewise, suppliers get a benefit from receiving the equilibrium price per student rather than the minimum amounts they require to offer the space. This additional value (known as producer surplus) is the vertical distance above the supply curve and below the equilibrium price.

Changes in Equilibrium

Postsecondary markets are rarely stable or static. Whenever the demand or supply curves in a market shift, they lead to a new equilibrium price and quantity. The many factors that affect demand and supply are constantly changing, creating pressures on prices and output. Of course, the change to a new equilibrium is not instantaneous. Time is required for the impact of the factor to be felt on demanders and/or suppliers, and with multiple shifts occurring at the same time, equilibrium is perhaps best described as a constantly moving target rather than a static point as depicted in Fig. 5.17.

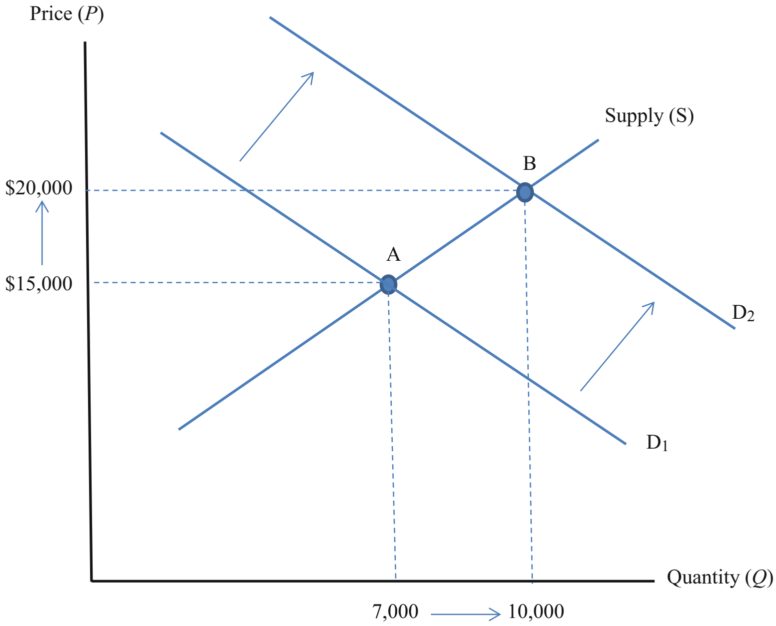


Fig. 5.18 Effect of increase in demand on equilibrium in a postsecondary market

When changes in a non-price demand or supply factor result in a new equilibrium, economists use demand and supply theories to compare the two different states of market equilibrium—one before and one after the market changes. The comparison of different market equilibria before and after such market changes is referred to by economists as comparative statics (see discussion in Chap. 2). Suppose that the postsecondary market in Fig. 5.18 is in equilibrium at point A. At this point, the going rate for postsecondary services is \$15,000 and 7,000 students would be enrolled. If something were to occur that would cause the demand curve to shift upward and to the right, then the increase in demand would lead to a new equilibrium at point B, where the market-clearing price is higher ($P =$ \$20,000) and 10,000 students would enroll. The movement from point A to B would not happen right away, but rather there would be pressure over time for prices to rise. It should be noted that the change in demand shown in Fig. 5.18 leads to a change in quantity supplied because it results in a movement from one point to another along the supply curve.

As another example, suppose that the postsecondary market in Fig. 5.19 experiences an increase in supply due to an improvement in the productivity of faculty. The supply curve moves from its current location at S_1 to a new location at S_2. Due to the increase in supply, the equilibrium price in the market falls and the equilibrium quantity rises. At the equilibrium point B, the new market-clearing price is \$11,000, at which 9,000 students would be willing and able to enroll. The change in supply in this example is also interpreted as a change in quantity demanded because

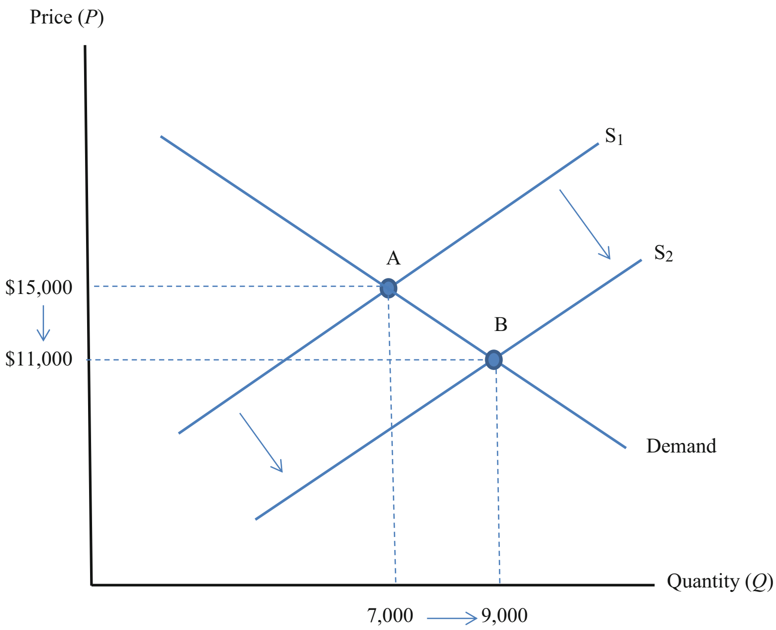


Fig. 5.19 Effect of increase in supply on equilibrium in a postsecondary market

the shifting supply curve leads to a movement along the demand curve which has not changed its position.

Of course, it is entirely possible that both the demand and supply curves will shift at the same time. The resulting effect on price and quantity depends on the relative size of the changes in demand and supply. The concepts of demand, supply, and equilibrium are useful for projecting the direction of change in price and quantity in the postsecondary market due to a specific factor, holding all else constant.

Elasticity Measures in Postsecondary Markets

Economists are often interested in predicting not only the direction, but also the magnitude, of changes in quantity demanded or supplied when another factor changes. There are two basic approaches that can be used for this purpose. The most straightforward way to do this is to measure the unit change in quantity demanded or supplied due to a one-unit increase in the factor of interest. For instance, if the price of going to college increases by $1000, then how many more spaces would colleges supply to the relevant higher education market? These effects are captured by the slopes of the demand and supply curves. Although the slope is easy to interpret, a limitation with this approach is that it is not always clear whether the resulting change in quantity is "large" or "small." If the number of applications to an institution were to fall by 400 due to a \$600 tuition increase, for example, then this would be a big problem for a college that only receives 800 applications each year but a much smaller problem for a public land-grant institution that receives 20,000 or more applications annually.

To address this limitation, economists often focus on the percentage change in quantity that is caused by a percentage change in a specific factor. This concept is referred to in the broadest sense as an *elasticity*. To illustrate, if family incomes were to fall by 10 % due to a recession, then the demand elasticity would be based on the resulting percentage of students who would no longer be willing and able to go to college. The advantage of expressing sensitivity in terms of percentage changes is that the results can be readily compared across different examples since it is not affected by the units of measurement.

There are three general magnitudes of elasticity. When a one percent change in a factor leads to a greater than one percent change in quantity, then quantity is very responsive to the factor and is said to be elastic. Likewise, quantity is inelastic when a one percent change in the factor creates a less than one percent change in quantity. This means that quantity is not greatly influenced by the factor in question. Finally, quantity is unit elastic when a one percent change in the factor results in precisely a one percent change in quantity.

Own-Price Elasticity of Demand

Most often, economists focus on the sensitivity of quantity demanded to changes in the price of the good or service. This is referred to as the *own-price elasticity of demand* ($E(P_k)_d$) and is defined as the ratio of the percentage change in quantity demanded divided by the percentage change in the price of the good or service:

$$E(P_k)_d = \frac{\%\Delta Q(d)_k}{\%\Delta P_k} \tag{5.11}$$

where $\%\Delta Q(d)_k$ = percentage change in quantity demanded of the k-th institution, and $\%\Delta P_k$ = percentage change in the price of institution k. A key assumption of this formula to keep in mind is that all other factors that may affect demand are held constant. The larger the numerator of Eq. (5.11) relative to the denominator, the more elastic or sensitive students and their families are with respect to price changes. Provided that the demand curve has a negative slope, the resulting measures of elasticity will also be negative. Demand will be own-price elastic when $E(P_k)_d < -1$, inelastic when $0 > E(P_k)_d > -1$, and unit elastic when $E(P_k)_d = -1$.

There are a number of factors that can affect the own-price elasticity of demand across a wide range of types of goods and services. Two of the most common determinants of the price elasticity of demand for a product are: (a) the share of household's budgets that a product's price accounts for, and (b) the number and closeness of substitute products available.

The share of income that the price of a product accounts for in household budgets is a very important determinant of elasticity. For example, tissues, paper towels or toothpaste all account for small portions of household budgets; therefore, even fairly large percentage increases in their prices will probably not lead to a large percentage reduction in quantity demanded—in other words, a relatively low own-price elasticity of demand would be expected for such products. On the other hand, products such as houses, new cars, or four years of college are big-ticket items that account for large portions of household budgets. Therefore, all else equal, the own-price elasticity of demand for products and services such as these would be somewhat larger than for services that are only a small portion of a person's budget.

The number and closeness of substitutes for a product available sometimes depends on how the market for a specific product is defined. For example, a 20 % increase in the price of gasoline sold at one station would produce a very large percentage decrease in its quantity demanded, because consumers can easily purchase very close substitutes at other stations. However, a 20 % increase in the price of gasoline at all stations would probably lead to a much smaller percentage decrease in quantity demanded because there are fewer close substitutes available for gasoline. As a result, the demand for 'gasoline' ($Q(d)$) would be more inelastic than the demand for 'gasoline at Station k' ($Q(d)_k$).

There are ready parallels for this in postsecondary markets. If a small private college in the Midwest increased its tuition and fees by 25 %, we could expect a fairly large decrease in quantity demanded at the institution because many Midwestern college-bound students and their families would view other private institutions or one of the 4-year public colleges and universities in the state or region as being very close substitutes. However, if all 4-year institutions in the same region raise their tuition and fees by 25 %, the percentage decrease in quantity demanded would be much smaller because the only close substitutes would be area two-year community colleges and similar institutions of higher education outside of the geographic area. Accordingly, the demand for higher education at any one institution should be more elastic than the demand for higher education at all four-year colleges taken together.

There are other determinants of own-price elasticity of demand that are especially relevant to postsecondary markets. The price sensitivity of students may vary with their family income, in that students from lower-income families are more price responsive than their higher-income peers. This is to be expected because a year of college education—which is a fairly big-ticket item in any household's budget—is by definition an even "bigger" ticket item for lower-income households than it is for higher-income households.[15] Similarly, all else equal, first-generation

[15] A series of reviews of the research on students' own-price elasticity in higher education markets have consistently reported that lower- and lower-middle income students are more price sensitive than their higher-income peers (Heller, 1997; Jackson & Weathersby, 1975; Leslie & Brinkman, 1987; McPherson, 1978; Paulsen, 1998).

students and minority students—who are disproportionately overrepresented among lower-income families, and on average, have lower incomes than their peers—may be more sensitive to price changes (and thus have higher own-price elasticities) than their peers.

We may also find that the own-price elasticity of demand differs by type of institution. For example, it could be the case that the market demand for two-year community colleges is more price elastic than the market demand for 4-year public or private colleges.[16] This is not surprising because community colleges enroll disproportionately large numbers of students who come from lower-income families, and are first-generation college students, minority students, and nontraditional-aged students. At the same time, given that the cost of attendance at 2-year institutions is generally less than at 4-year institutions, the share of household budgets that the price of 2-year colleges accounts for may be lower, and markets for 2-year institutions have fewer suppliers, which may offset some of the effects of student characteristics on own-price elasticity of demand.

In addition to measuring own-price elasticity between two points along a demand curve, economists can talk about whether the entire demand curve is elastic or inelastic. This elasticity is represented graphically by the steepness of the demand curve. When the demand for postsecondary education is more inelastic to its price, the demand curve becomes steeper. Likewise, a relatively flat demand curve depicts a situation where demand is elastic, or more sensitive to price changes. This is shown in Fig. 5.20. The solid demand curve D_1 is relatively steep, indicating that the quantity of higher education demanded does not change very much when the price changes. This would be an example of an inelastic demand curve. Similarly, the second demand curve (D_2) represented by the dashed line is an elastic demand curve because changes in price lead to larger changes in quantity demanded. The own-price elasticity of demand may have important implications for the effects of changes in supply on equilibrium prices in the market. If the demand curve is very inelastic, then changes in supply will lead to larger changes in equilibrium price than would be true if the demand curve were more elastic.

Own-Price Elasticity of Supply

The concept of price elasticity can also be applied to the supply curve. In this instance, the *own-price elasticity of supply* ($E(P_k)_s$) represents the percentage change in quantity supplied due to a percentage change in the price of the good or service:

[16] Heller's (1997) review of research on own-price elasticity of demand reports greater price sensitivity among students at community colleges than their peers at other types of institutions.

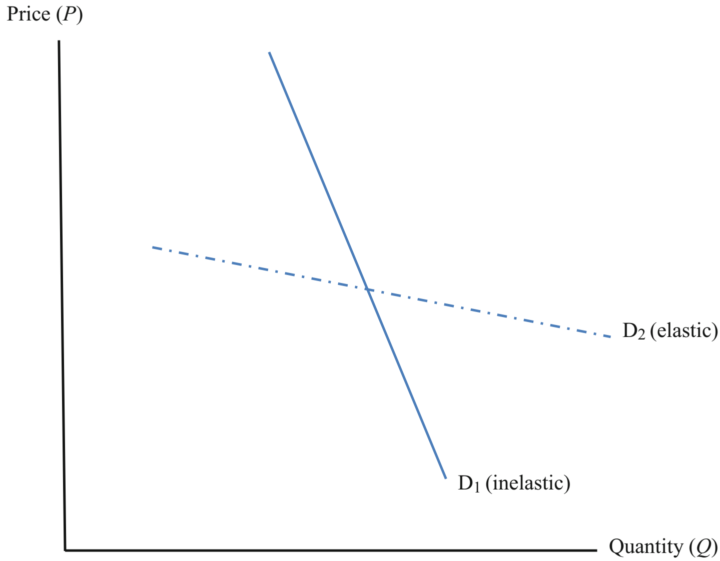


Fig. 5.20 Own price elasticity of market demand curves

$$E(P_k)_s = \frac{\%\Delta Q(s)_k}{\%\Delta P_k} \tag{5.12}$$

where $\%\Delta Q(s)_k$ denotes the percentage change in quantity supplied due to price. As with the formula for the own-price elasticity of demand, it is assumed that all other factors that could affect supply are held constant when calculating the own-price elasticity of supply.

Supply is said to be own-price elastic when a one-percent change in price leads to a more than one percent change in quantity supplied, indicating that supply is very sensitive to price changes. Likewise, supply is inelastic when a one-percent change in price leads to less than one percent change in quantity supplied, and is unit elastic when the percent change in supply is equal to the percent change in price. Because the supply curve is normally upward sloping, however, the own-price elasticities of supply are positive values in contrast to the negative own-price elasticities of demand.

The entire supply curve can also be described as being relatively elastic or inelastic, based on the relative steepness of the curve as shown in Fig. 5.21. The supply curve S_1, for example, is very steep, indicating that changes in price lead to only small changes in the quantity of higher education supplied by institutions. Accordingly, this would be an example of an inelastic supply curve and would apply to institutions that practice selective admissions. On the other hand, the second supply curve (S_2) is very flat, which denotes that price changes lead to large differences in the quantity of higher education supplied. Therefore, the second

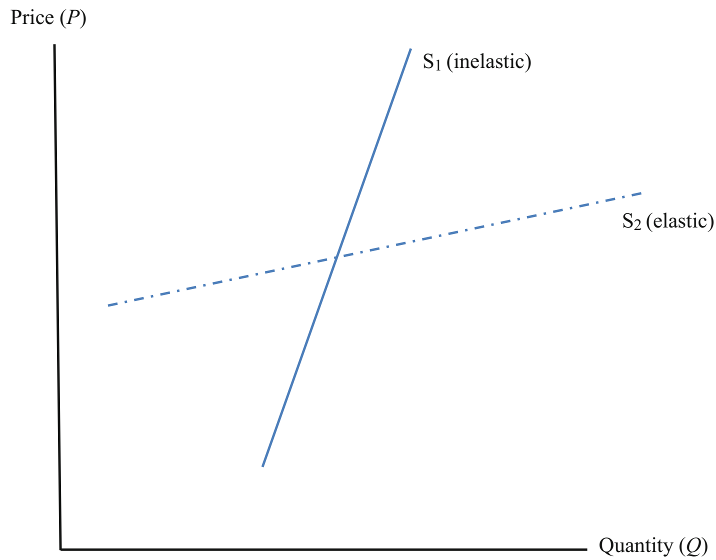


Fig. 5.21 Own price elasticity of market supply curves

supply curve is relatively elastic and corresponds to institutions that practice open admissions.

Cross-Price Elasticity of Demand

The notion of elasticity can be extended to virtually every factor that is part of the demand and supply functions for higher education. In these instances, elasticity measures the percentage shift in the demand or supply curve (as opposed to a movement along a demand or supply curve) due to a percentage change in a designated factor. For example, if the demand for higher education experienced only a very small shift when the consumptive benefits from going to college increase, then demand would be said to be relatively inelastic with regard to changes in consumptive benefits.

Economists focus most of their attention on two of the non-price elasticities as they pertain to the demand curve. The first of these is the *cross-price elasticity of demand*, which represents the percentage change in the demand for one postsecondary option due to a one percent change in the price of another option. In its most general form, the cross-price elasticity of demand is written as follows:

$$E(P_{k,l})_d = \frac{\%\Delta Q(d)_k}{\%\Delta P_l} \tag{5.13}$$

where $E(P_{k,l})\ _d =$ cross-price elasticity of demand for the k-th option due to a change in price for the l-th option, and $\Delta\%P_l =$ percent change in the price of the l-th option. The options in the formula can be individual institutions, such as $k =$ University of New Hampshire and $l =$ Plymouth State University, or groups of institutions such as $k =$ 4-year public institutions and $l =$ 4-year private institutions. It is assumed here that the price of the k-th option, family income, and all other demand curve shifters are held constant when calculating the cross-price elasticity of demand.

The cross-price elasticity of demand is used to determine whether two goods or services are substitutes or complements for each other. Two services are substitutes if consumers can use them in place of each other. Putting football rivalries aside, the University of Alabama (k) and Auburn University (l) are likely viewed as substitutes for each other by many students in the state of Alabama. The notion of substitutes can also be applied to groups of institutions, such as 2-year (k) versus 4-year (l) institutions, or in-state public (k) versus out-of-state public (l) institutions. If two goods or services are in fact substitutes, then as the price of one option increases, it should lead to increases in the demand for the other option. This translates into a positive value for the cross-price elasticity of demand. Furthermore, as the size of the cross-price elasticity of demand rises, the two services are said to be closer substitutes for each other. Accordingly, one might expect to find that Indiana University of Pennsylvania has a higher cross-price elasticity of demand with Clarion University of Pennsylvania than it does with Beijing Normal University in China because relatively few students are likely to include both Beijing Normal University and Indiana University of Pennsylvania in their choice sets.

It is also possible to measure the cross-price elasticity for complementary higher education services. Two services are referred to as complements for each other if they are often consumed at the same time. One clear example of complementarities in higher education is between instruction and non-instructional activities. Students pay tuition to cover instructional expenses, and usually incur additional mandatory fees for a variety of things such as student activities, health care, bus services, computing, and so on. In this sense, these extra services are consumed by students at the same time as their instruction. Room and board is another example of a complementary service to higher education instruction. When students go to college, they often have to also pay for (and thus "consume") living expenses. If two services are complements of each other, then an increase in the price of one service would lead to a decrease in the consumption of the other service because it is now more expensive to consume both services at the same time. An economist would therefore predict that increases in mandatory fees or in room-and-board charges would reduce the quantity of instructional services demanded by students, and vice-versa.[17] As before, the larger the cross price elasticity of demand becomes, the stronger complements the two services are said to be for each other.

Income Elasticity of Demand

Finally, the last form of elasticity that is commonly addressed by economists is the *income elasticity of demand*. This represents the sensitivity of demand to changes in income:

$$E(I)_d = \frac{\%\Delta Q(d)}{\%\Delta I} \tag{5.14}$$

where $E(I)_d$ = income elasticity of demand, and $\%\Delta I$ = percent change in income, and as before it is assumed that all other factors that affect demand are held constant. Income elasticity of demand is important to economists for two main reasons. First, the ability to pay for goods and services, as reflected through income, is a factor in many models of consumer demand, including the demand for higher education. Second, government policies often involve income subsidies to lower-income individuals, and thus it would be useful for policy makers to know the magnitude of the effect of an income subsidy on consumers. The income subsidy can take different forms, including tax breaks that are given to families with children in college. The income elasticity of demand can in theory be positive or negative, depending on whether the good or service is a normal or an inferior good. If the good or service is a normal good, then the income elasticity of demand in Eq. (5.14) will be positive, and vice-versa when the good or service is an inferior good.

The concept of income elasticity of demand can be very informative for examining postsecondary markets. Consider the case of students who are attending 2-year (community) colleges. Typically, these institutions charge lower tuition than do 4-year institutions, and tend to attract more interest from students in lower-income families. If students at 2-year institutions were to experience an increase in income, however, they would be better able to afford to enroll at 4-year institutions and some may switch. At the same time, an increase in incomes for the general population may lead some students who previously could not afford to go to even a 2-year college to now be able to do so. For them, the increase in income leads to an increased demand for 2-year institutions. The net or average effect of an income increase would therefore represent whether 2-year institutions are thought of as a normal or inferior good in the higher education marketplace. In

[17] Alternatively, if an economist defines "price" as the full cost of attendance (tuition, fees, room and board), then an increase in room and board is a movement along the demand curve and not a shift in the demand curve.

contrast, institutions at the top end of the pricing distribution are most likely normal goods because an increase in incomes does not enable students to substitute towards more expensive options.

Issues in Measuring Elasticity

Although the concept of elasticity is relatively straightforward, in practice it can be very challenging to measure. There are two general approaches that economists use to measure elasticity, and each approach has its advantages and disadvantages. The first way to estimate elasticity is to calculate the percentage changes in the factors in question between two specific points in time. This may be done using the midpoint formula for the own-price elasticity of demand as follows:

$$E(P_k)_d = \frac{\left(\frac{Q(d)_2 - Q(d)_1}{\overline{Q}(d)}\right)}{\left(\frac{P_2 - P_1}{\overline{P}}\right)} \tag{5.15}$$

where $\overline{P}$ = midpoint of prices P_1 and P_2 at points 1 and 2, and $\overline{Q}$ = midpoint of quantities $Q(d)_1$ and $Q(d)_2$ at points 1 and 2.[18] Along any given demand curve, the own-price elasticity of demand could change depending on the shape of the curve and the points selected. While we focus on own-price elasticity of demand here, keep in mind that the same approach could be applied to the other three forms of elasticity covered in this chapter.

The main advantage of the midpoint formula for measuring elasticity is that it is easy to understand and calculate when given the appropriate numbers. To illustrate, suppose that points A (P_A = \$8,000, $Q(d)_A$ = 3,000) and B (P_B = \$10,000, $Q(d)_B$ = 2,200) represent two combinations of price and quantity demanded along the demand curve for a college. The own-price elasticity of demand using the midpoint formula would therefore be:

$$E(P_k)_d = \frac{\left(\frac{2,200 - 3,000}{2,600}\right)}{\left(\frac{\$10,000 - \$8,000}{\$9,000}\right)} = \frac{-0.308}{0.222} = -1.39 \tag{5.16}$$

In this example, as the price increased by 22.2 % there was a 30.8 % reduction in quantity demanded, and thus the demand curve is on average own-price elastic between these two points.

Although the midpoint formula appears to be relatively simple, in practice it can be very difficult to apply to postsecondary markets. The problem arises because

[18] The midpoint formula is useful for ensuring that the percentage change in quantity and price will be the same regardless of whether it is calculated moving from point 1 to 2 or from point 2 to 1.

demand and supply are affected not only by the price of the good or service in question, but also by a range of other demand and supply shifters. Recall that the definitions for elasticity assume that all factors other than the ones being examined are held constant. This assumption is more likely to be true in markets where prices change over short periods of time. In local markets for gasoline, for example, it would be hard to attribute any change in sales from one day to the next to a change in consumer incomes, preferences for gasoline, or population changes in the community. However, even in this example, competing stations may change their prices as well and have an influence on the station's sales. A relatively unique feature of postsecondary markets is that price of the service is usually held fixed for an entire year. The large amount of time between price changes increases the chance that other demand and supply factors may have also changed in the interim and affect the quantity demanded or supplied.

Let's use data for the University of Georgia as an illustration of the difficulty in measuring elasticity through the midpoint formula. Suppose that an economist wanted to calculate own price and income elasticities for the university between 2011 and 2012. The first two columns in Table 5.3 show statistics for these 2 years on the numbers of Georgia residents applying to, being accepted by, and enrolling at the University, the inflation-adjusted prices charged to resident students, and the per-capita incomes of Georgia residents. The third column contains the midpoints for each variable, and the fourth column shows the resulting percentage changes in each factor from 2011 to 2012.

Between 2011 and 2012, the price faced by students for attending the University of Georgia increased by only 0.4 %. During the same period, resident applications and enrollments moved in opposite directions, with applications rising by 3.9 % and enrollments falling by 11.8 %. As discussed in Chap. 3, however, neither applications nor enrollments are pure measures of demand because enrollments are affected by the supply decisions of the university, and applications may also be restricted to a lesser extent by supply due to concerns among students about their chances of being admitted. The price of attendance is likewise open to interpretation. The price shown here includes gross tuition, mandatory fees, room and board, and personal expenses. Arguments could be made for only focusing on tuition, or tuition plus mandatory fees, or tuition net of grants and scholarships as the appropriate measure of price. Finally, there are multiple ways of defining income for the purpose of calculating income elasticity. Incomes could be restricted to individuals who are in age groups that are most likely to attend college, or could be measured as per-capita income, median income, or household income for the state.

Putting aside for the moment these measurement questions, the resulting estimates of elasticity still may not be accurate. Using the midpoint formula, the own-price elasticity of demand (where demand = applications) from 2011 to 2012 for the University of Georgia is +10.7. The value suggests that a 1 % increase in price leads to more than a 10 % increase in applications. The elasticity estimate is puzzling because it is positive and thus does not conform to the law of demand, and demand appears to be extremely sensitive to price. On the other hand, if enrollments were instead used to measure demand, the same price change is associated with a

Table 5.3 Illustration of elasticity calculations for the University of Georgia, 2011 to 2012

Factor	2011	2012	Midpoint	% change from 2011 to 2012
Applications	11,952	12,428	12,190	+3.9 %
Acceptances	7,989	7,282	7,636	−9.3 %
Enrollments	4,876	4,332	4,604	−11.8 %
Resident price	$21,172	$21,250	$21,211	+0.4 %
Income	$24,097	$24,321	$24,209	+0.9 %
	If Demand is Represented by:			
Elasticities	**Applications**	**Enrollments**		
Own price demand =	+10.7	−32.3		
Income =	+2.5	−0.1		

Notes: Data on cost of attendance, applications, acceptances, and enrollments for Georgia residents were supplied by the Office of Institutional Research, University of Georgia. Data on per-capital income were obtained from the Census Bureau. Both the resident price and per-capital income are expressed in inflation-adjusted 2012 dollars. Resident price includes tuition, mandatory fees, room and board, and personal expenses

large decrease in enrollments (elasticity = −32.3). A strict interpretation of this value would conclude that demand is highly own-price elastic.

Neither estimate, however, is an accurate measure of the own-price elasticity of demand because the change in applications and enrollments between 2011 and 2012 could have been affected by a number of factors in addition to price. For example, the University of Georgia reduced the number of acceptances by 9.3 % between 2011 and 2012, and thus the drop in enrollments reflects the supply decisions of the institution as well as demand decisions of students. Any number of other things could have also changed between 2011 and 2012 that may have shifted the demand curve and thus affect applications as well, such as the incomes of students and their families, the prices of other institutions, financial aid offers, application fees, and non-financial attributes of the institution. The same problem occurs when calculating the income elasticity of demand. The estimated income elasticity of demand shown in Table 5.3 suggests that the University of Georgia is a normal good when applications are used and neither a normal nor inferior good when enrollments are used to represent demand. Yet we know from the data in the table that the University of Georgia's price changed over this time period, and other demand factors aside from income could have changed as well.

To avoid some of the problems with the midpoint method, another approach to measuring elasticity is to estimate the demand equation with a multiple regression model. The demand equation for the k-th postsecondary option may be written in general form as follows:

$$lnQ(d)_k = \alpha + \beta_k lnP_k + \beta_l lnP_l + \gamma lnI + \boldsymbol{X\delta} + \varepsilon \qquad (5.17)$$

where ln = natural log transformation, P_k = price of k-th institution, P_l = price of l-th institution, I = family income or wealth, and $\boldsymbol{X}$ = set of other factors that may shift demand. The advantage of using this special functional form (known as the "double log" specification) is that the coefficients for the variables P_k, I, and P_l are interpreted as elasticities. For example, the coefficient β_k shows the percentage change in the demand for postsecondary option k due to a one percent change in the price of the k-th option, holding all other variables in the equation constant. Likewise, the coefficients β_l and γ show the percentage changes in the demand for postsecondary option k due to a one-percent change in the price of the l-th institution or a one-percent change in family income or wealth, respectively, holding all other variables in the equation constant. The double-log demand curve is appealing to researchers because it has the same elasticity at any point along the curve. Of course, if the true functional form for the demand curve is not a double-log function, then the elasticity measures will be incorrect.

The early demand studies in economics mainly focused on forecasting changes in demand for postsecondary education, and thus used time-series data. With time-series data, the researcher can observe whether changes in tuition and fees are correlated with changes in the share of population going to college:

$$\ln\left(\frac{Q(d)_t}{POP_t}\right) = \alpha_0 + \alpha_1 \ln P_t + \gamma \ln I_t + \ln \mathbf{X_t \delta} + \varepsilon_t \tag{5.18}$$

where $Q(d)_t$ / POP_t = share of the designated population enrolling in year t, P = tuition and fees, I = income or ability to pay for college, and $\boldsymbol{X}$ = set of other characteristics that may affect demand for college and change over time, such as the unemployment rate and the characteristics of the student population. The demand equation can be estimated for all institutions combined or for designated groups such as all 4-year public institutions.

Among the first studies of demand for postsecondary education of this type was conducted by Campbell and Siegel (1967). They used this approach (in double-log form) to determine how disposable income and tuition affected the proportion of high school graduates ages 18–24 enrolling in college in selected years from 1927 to 1963. They found that demand was own-price inelastic ($E(P_k)_{\mathrm{d}} = -0.44$) and that postsecondary education was a normal good ($E(I) = 1.20$).

Despite its advantages, there are still several challenges that have to be addressed when trying to estimate the demand Eq. in (5.18). To determine how changes in prices, incomes, and other factors affect demand and supply, data must be obtained over multiple time periods. Since these factors are generally held constant for an entire year and these variables are rarely tracked prior to the 1970s, it would be difficult to find enough data to reliably estimate the demand equation using time-series data. In fact, the regression model reported in the 1967 study by Campbell and Siegel relied on only nine observations.

In a cross-sectional study, data are used on individual students or groups of students to examine how prices and other factors influence their postsecondary choices. The demand equation for groups of students might be written as:

$$ln\left(Q(d)_k/POP\right) = \alpha_0 + \alpha_1 lnP_k + \boldsymbol{lnP\beta} + \gamma lnI_k + \boldsymbol{X\delta} + \varepsilon_k \tag{5.19}$$

where $Q(d)_k$ / POP = share of the designated population enrolling in the k-th institution, and $\boldsymbol{P}$ = vector of prices at all institutions that compete with the k-th institution for students. The main challenge with this approach is that the prices would be the same for all students in the market. In this instance, the researcher can try to find other variables that are related to price but vary across students. Hoenack (1967), for example, used the distance from a student's home to the institution in question as a measure of price, asserting that as distance increases the cost of attendance will also increase. Spies (1973) and others used another approach in cross-sectional studies by replacing price in Eq. (5.19) with a variable for price as a share of income (***P/I***). The argument made by Spies is that dividing by income introduces variability in the price variable and reflects the "price" to the individual student for attending the institution.

The demand equation could likewise be estimated using data on individual students at one point in time. The dependent variable in this type of study is a dichotomous choice variable representing whether or not a student considered/applied/enrolled at the institution. The advantage in estimating a cross-sectional model is that the economist can greatly increase the sample size needed for statistical purposes. Students and their families will vary in terms of their incomes, enabling the analyst to measure the income elasticity of demand. However, at any one point in time the price of the k-th postsecondary option will be the same for all students. This presents a problem because there is no variation in the price of the service, and variation is needed to find the own-price elasticity of demand. One way to address this problem is to replace the price variable with a variable for the amount of financial aid received, as in:

$$q(d)_{jk} = \alpha_0 + \alpha_1 F_{jk} + \gamma I_j + \boldsymbol{X_j\delta} + \varepsilon_j \tag{5.20}$$

where $q(d)_{jk}$ = individual demand for the k-th institution, and F_{jk} = amount of financial aid offered to the j-th student by the k-th institution. Because financial aid reduces the net price paid by students, the coefficient α_1 represents the sensitivity of demand to price (and $\alpha_1 > 0$ indicates that the demand curve is downward-sloping).

The challenges of inadequate variation in price and insufficient observations for meaningful estimation can be addressed by combining time-series data on price and enrollment demand for multiple institutions. This can be done by creating a panel dataset characterized by both year-to-year variation and college-to-college variation in price and enrollment demanded, while controlling for the effects of other relevant variables. For example, Paulsen and Pogue (1988) used a fixed effects, covariance model to estimate a market demand equation by pooling data on 64 small private 4-year colleges (in Iowa and Illinois) over a 16-year period. Using a double-log specification and controlling for other relevant factors, they found that the own-price elasticity of demand for this group of institutions was −0.17.

Extensions

Alternative Measures of Demand

There have been numerous studies on the demand for postsecondary education. These studies vary in terms of how they measure demand, supply, and prices. While the majority of economic studies have used enrollments as a measure of demand, this can be problematic because the enrollment decision is affected by both the demand from students and the supply from institutions (see Chap. 3). In some instances, however, enrollment figures can be reasonably interpreted as demand. If the institution being examined is an open-admission institution, then any change in enrollments by definition is due to changes in demand and not supply. Or if the postsecondary option being examined is at an aggregate level (such as enrollments in any college or in 4-year colleges), then changes in enrollments most likely are due to changes in demand and not supply because most students with a predisposition to college could find some place to enroll. On the other hand, if an institution has a fixed supply of spaces and more applicants than they can accommodate, then changes in enrollments for this institution most often reflect changes in supply and not demand.

Some researchers have turned to alternative measures of demand to avoid the identification and interpretation problem with enrollments. These studies try to find measures that correspond with the third stage of the student choice model in Chap. 3, where students form their initial demands for attending an institution. The dependent variables in these studies may represent the number of applications received by an institution.[19] Researchers have also used the number of students having their SAT or ACT scores sent to an institution as an indicator of whether a student included a college in his or her choice set.[20] Depending on data availability, researchers could use other measures of early interest as well, such as campus visits, requests for information, or application for financial aid. The advantage of using these measures is that they are not as affected as other measures of demand by the number of spaces made available by an institution.

---

[19] See, for example, studies by Savoca (1990), DesJardins, Dundar, and Hendel (1999), and DesJardins, Ahlburg, and McCall (2006).

[20] See, for example, studies by Toutkoushian (2001a, 2001b). Note that these studies correspond to the second stage of the college choice model in Chap. 2.

Quasi-Experimental Methods

As we have noted, there are limitations with the demand models that we have described in this chapter that make it difficult for researchers to obtain good estimates of price and income elasticities. In large part, the limitations are due to the fact that economists must rely on observational data rather than construct experiments. In an environment where prices, incomes, and financial aid can all change at the same time, economists cannot easily hold all else constant and thus the demand measures on the left-hand side of the equation are potentially affected by many different factors.

Another problem in empirical work on this topic is that in most instances the receipt and level of financial aid is not an exogenous variable. Financial aid is not awarded at random; instead, aid is given to students on the basis of financial need, academic merit, and other criteria. The effect of financial aid on demand is further complicated by the fact that in order to receive financial aid, students must seek it out. It is likely that those students who were active in looking for aid are somehow different from other students. In particular, if students who were more determined to succeed and go to college were more likely than others to receive financial aid, then the estimated effect of receiving aid in equations such as (5.20) could in fact reflect these other factors and not the aid itself.

Economists have tried to address these difficult issues by using an array of methods known generally as "quasi-experimental methods." These methods include such techniques as regression discontinuity, two-stage least squares, difference-in-difference, and natural experiments.[21] The goal of these types of studies is to reduce the potential bias from self-selection and unobservable factors on the estimated impact of selected variables on postsecondary demand. The specific quasi-experimental approach that economists use in this research depends on the problem at hand and the type of data that are available.

In a regression discontinuity approach, the goal is to determine if the demand for postsecondary education is the same for students who face different prices but otherwise have very similar characteristics. This method can be used for financial aid programs when the award is based on a quantifiable factor such as family income. For example, the federal Pell Grant is awarded to students who are eligible for free lunch, which is determined through family income. A regression discontinuity study of the Pell Grant program might then compare the demand for postsecondary education for students with family incomes within ± $5,000 of the cutoff for free lunch eligibility. The same approach could be applied to merit-based

[21] It is well beyond the scope of this book to provide details on the different quasi-experimental techniques that economists have used to examine issues in postsecondary education and related topics. We highly recommend the book *Methods Matter* by Murnane and Willett (2011) for an overview of these techniques, as well as studies by Thistlethwaite and Campbell (1960), Lee and Lemieux (2010), Imbens and Angrist (1994), McCall and Bielby (2012), Reynolds and DesJardins (2009).

aid programs when the award is determined by criteria such as a student's grade point average in high school or SAT score.

Another quasi-experimental method that has been used in postsecondary research is known as two-stage least squares (or instrumental variables). This technique attempts to reduce the bias in the effect of financial aid due to unobservable factors by finding one or more factors (called "instrumental variables") that help predict receipt of financial aid but do not directly affect the demand for postsecondary education. The equation predicting whether a student receives aid is then estimated simultaneously with the demand equation, and provided that certain conditions are met, the resulting estimates of the effect of aid on demand will be unbiased.[22] Despite the fact that two-stage least squares has been used in countless studies of education, in practice the conditions for unbiasedness can be hard to satisfy. The economist must convince the reader that there is at least one variable that can predict receipt of financial aid and yet not have a direct effect on the demand for postsecondary education. Unfortunately, most of the variables that might be considered as good predictors of financial aid—such as family income and academic performance—would also be thought of as demand curve shifters, and thus would not be good instrumental variables.

Other quasi-experimental approaches fall under the heading of what are called "natural experiments." This phrase relates to situations where an entity imposes a policy that leads to a change in price or financial aid that was not anticipated by most students and their families. The economist can then compare the demand for postsecondary education prior to and following the policy change to see if the resulting change in price or aid had an effect on student behavior. These types of studies are particularly useful for federal or state financial aid programs where the government makes changes in the amount of the award or the criteria for receiving the award.

Policy Focus

In this section on higher education policy, we show how demand, supply, and comparative statics can be used to analyze two different policy applications to higher education: (1) the growth in state broad-based merit aid programs, and (2) the rise of the private for-profit sector in higher education.

[22] See Imbens and Angrist (1994) for an excellent discussion of the conditions needed to apply the instrumental variable technique.

State Broad-Based Merit Aid

Prior to 1993, state financial support for postsecondary education was primarily in the form of appropriations to designated institutions and need-based financial aid to students. Although some states gave additional funding to students in recognition of their academic performance, the number of students benefiting from this merit aid was small. In 1993, however, the state of Georgia introduced the first large scale—or broad-based—merit aid program known as the HOPE ("Helping Outstanding Pupils Educationally") scholarship. The HOPE scholarship was intended to provide financial assistance for college to large numbers of students who met the award criteria, which in Georgia was to have a high school GPA of 3.00 or higher. By 2010, approximately one-third of all states in the United States had implemented similar broad-based merit-aid grant programs (Dynarski, 2004; Toutkoushian & Hillman, 2012).

Broad-based merit aid programs provide state grants to students that in turn would reduce the net price that they pay for attending specific colleges. The amounts of the grants ranged from full tuition at public four-year in-state institutions down to smaller amounts often expressed as either a designated dollar amount or a specific percentage of the public four-year tuition. The intent of these programs is to provide a financial incentive for students to perform better in high school and college, and to stay in their state of residence for their postsecondary education and hence reduce concerns about "brain drain" to other states.

Figure 5.22 illustrates how the introduction of a broad-based state merit-grant program would be predicted to affect the overall market for higher education. Point A represents the initial market equilibrium. It corresponds to the point where the initial demand curve (D_1) intersects the supply curve (S) at tuition price P_1 and a quantity enrolled of Q_1. The introduction of a broad-based grant program would lead to an increase in demand for higher education among students from the state. The vertical distance between the old (D_1) and new (D_2) demand curves represents the size of the grant to each student. The increase in demand is represented by an upward shift. The new market equilibrium is represented by point B, which indicates the point where the new demand curve (D_2) intersects the initial (and unchanged) supply curve (S). All else equal, this results in a higher quantity of student enrollment Q_2 and higher tuition price P_2. This is the outcome of a process that increases subsidies to student consumers in the higher education market of interest. As a result, the merit aid program should lead to increased enrollments in higher education.

The merit aid program would also be predicted to have interesting effects on specific institutions. In particular, some institutions may benefit more than others from the broad-based merit aid program. For a student to receive a state broad-based merit aid award, he or she is must attend an institution that is designated by the granting state. Usually, states require grant recipients to enroll at an in-state public institution, or a public/private institution located within the state boundaries. Accordingly, the shift in the demand curve for an in-state institution would reflect a

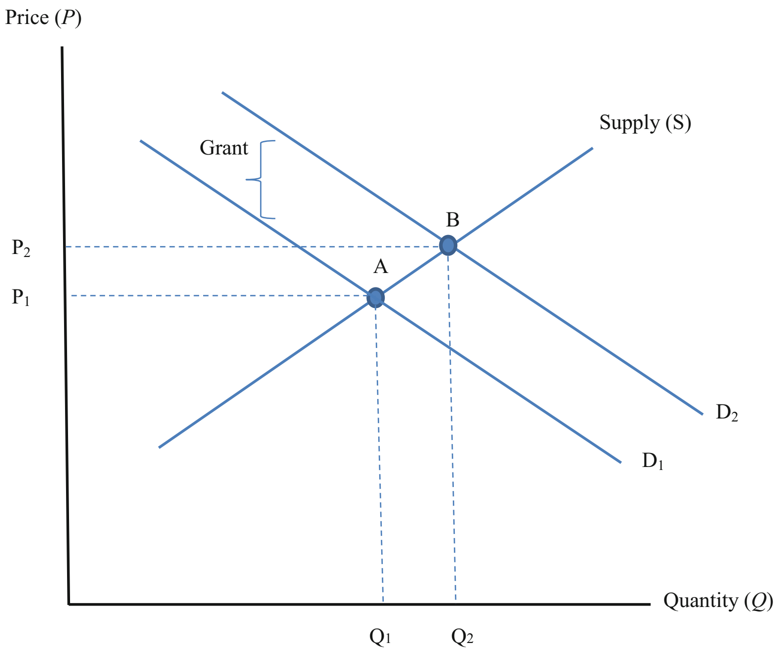


Fig. 5.22 Effect of state broad-based grant on overall postsecondary education market

larger benefit from the merit aid grant because students are overall more likely to go to college, and the price of an in-state college has become substantially lower relative to out-of-state options. The situation is quite different for an institution where the grant cannot be used, such as an out-of-state institution. In this case, the state grant represents a price decrease for one or more of the out-of-state institution's competitors, which would cause the out-of-state institution's demand curve to decrease.

Growth of For-Profit Higher Education Sector

One of the more remarkable trends in the postsecondary education industry in recent years has been the significant growth in the private for-profit sector. Table 5.4 shows how the number of postsecondary institutions by sector in the United States has changed from the 1970s through 2012. In the 1970s, virtually all private institutions were not-for-profit in nature. Although the number of private not-for-profit institutions has remained fairly steady over the next 40 years, for-profit institutions grew from 55 in 1976 to 1,451 by 2012.

Such a substantial increase in the number of private for-profit institutions in the United States raises interesting questions about how the growth will impact

Table 5.4 Number of postsecondary education providers by sector, 1976 to 2012

Year	Public	Private Not-for-profit	Private For-profit	Private for-profit share of total (%)
1976–1977	1,455	1,536	55	1.8
1986–1987	1,533	1,635	238	7.0
1996–1997	1,702	1,693	614	15.3
2006–2007	1,688	1,640	986	22.9
2012–2013	1,623	1,652	1,451	30.7

Source: Digest of Education Statistics 2013, Table 317. Data include 2-year and 4-year institutions and their branch campuses

postsecondary education markets. Economists would argue that this represents an increase in the number of suppliers in markets. This change would cause the market supply curve to shift to the right, which should put downward pressure on prices and increase the number of students who can receive postsecondary services.

Curiously, the 40-year period where the market supply curve shifted to the right was also marked by tuition increases that generally outpaced inflation. What happened? One possible explanation is that there were other demand factors (e.g., increasing earnings of college graduates, increasing financial aid to students) and supply factors (e.g., reduced state appropriations, rising prices of resources such as administrators, staff, and faculty) that also changed during this period that put upward pressure on market prices. In other words, the ceteris paribus assumption likely does not hold in this case, and the price changes cannot be solely attributed to the growth in the for-profit sector.

Another possible explanation is that the growth in the for-profit sector had different effects across the various postsecondary markets. Most of the for-profit providers do not offer graduate degrees, and thus the shift in the supply curve for graduate markets has been relatively small. Likewise, for-profit institutions operate mainly in markets for older and non-traditional students, and thus the growth did not have a substantial effect on the prices and enrollment decisions of traditional-aged students. Taken together, it is not surprising that the substantial increase in the for-profit sector has not led to lower prices for postsecondary education.

Final Thoughts

In this chapter, we focused on how the economic concepts of demand, supply, elasticity, and markets can be applied to postsecondary education. The demand curve is the result of the decisions made by individuals who must allocate their time and income constraint among competing uses, typically education and all other goods and services. Demand is posited to be affected by the utility from the net benefits (both market and non-market) of going to college, students' ability to pay, and personal characteristics that may shape preferences. The supply side is driven by the opportunities available to suppliers (colleges and universities), the cost of doing business, and the goals/objectives of the supplier.

The own-price elasticity of demand is defined as the percentage change in quantity demanded divided by the percentage change in price. The share of the budget that higher education accounts for is often quite substantial. As a result, students from lower-income families tend to be more sensitive to price changes than their higher-income counterparts. Because students who are first-generation, under-represented-minority, part-time, and non-traditional-aged are disproportionately overrepresented among lower-income students, they are also, on average, more price sensitive.

It is important to define the market of interest before beginning a study of supply and demand. Equilibria in postsecondary markets are moving targets, in that the market demand and supply curves are in constant flux due to changes in various forces in the marketplace. In this sense, demanders and suppliers in each postsecondary market can be thought of as moving towards a new equilibrium, rather than resting at a final equilibrium price and quantity as depicted in a typical supply/demand graph.

Glossary

Symbol	Definition
I	Income
P_{ED}	Price per unit of higher education
ED	Number of units of higher education consumed
ED^*	Utility-maximizing number of units of higher education consumed
P_{OG}	Price per unit of composite ‘all other goods’
OG	Number of units of composite ‘all other goods’ consumed
$U()$	Utility function or indifference curve
$f()$	Function symbol
MRS	Marginal rate of substitution
MU	Marginal utility
Δ	Change symbol (“delta”)
L	Lagrangian function
$\tau(tau)$	Shadow price of income in Lagrangian function
$\boldsymbol{a}_{jk}^{*}$	Latent demand for considering the k-th institution
P_k	Price of the k-th institution
$\vert$	Conditional symbol
$\boldsymbol{a}_{j}^{*}$	Latent demand for considering college
$\boldsymbol{q}(\boldsymbol{d})_{jk}^{*}$	Latent demand for applying to the k-th institution
$Q(d)_k$	Number of students who apply to the k-th institution
$Q(s)_k$	Number of spaces supplied by the k-th institution
R_k	Price of resources needed by the k-th institution to supply services

(continued)

Symbol	Definition
H_k	State of technology for k-th institution for supplying services
G_k	Subsidies to the k-th institution from government and other sources
$Q(d)$	Market demand
$Q(s)$	Market supply
D	Demand curve
S	Supply curve
$\boldsymbol{E(P_k)_d}$	Own-price elasticity of demand
$\boldsymbol{\%\Delta Q(d)_k}$	Percentage change in quantity demanded
$\%\Delta P_k$	Percentage change in price of k-th institution
$\boldsymbol{E(P_k)_s}$	Own-price elasticity of supply
$\boldsymbol{\%\Delta Q(s)_k}$	Percentage change in quantity supplied
$\boldsymbol{E(P_{k,l})_d}$	Cross price elasticity of demand
$E(I)_d$	Income elasticity of demand
$\%\Delta I$	Percentage change in income
$\boldsymbol{\overline{P}}$	Midpoint of prices for elasticity formula
$\boldsymbol{\overline{Q}(d)}$	Midpoint of quantity demanded for elasticity formula
$\boldsymbol{\overline{Q}(s)}$	Midpoint of quantity supplied for elasticity formula
$Ln(\ )$	Natural log function
β_k	Coefficient estimating own-price elasticity of demand
β_l	Coefficient estimating cross-price elasticity of demand
γ	Coefficient estimating income elasticity of demand

References

Albert, C. (2000). Higher education demand in Spain: The influence of labour market signals and family background. *Higher Education, 40*, 147–162.

Becker, W. (1990). The demand for higher education. In S. Hoenack & E. Collins (Eds.), *The economics of American universities* (pp. 155–188). New York: State University of New York Press.

Belfield, C. (2000). *Economic principles for education: Theory and evidence*. Cheltenham, UK: Edward Elgar.

Campbell, R., & Siegel, B. (1967). The demand for higher education in the United States, 1919–1964. *American Economic Review, 57*, 482–494.

Canton, E., & de Jong, F. (2004). The demand for higher education in The Netherlands, 1950–1999. *Economics of Education Review, 24*, 651–663.

Cournot, A. (1838). *Researches into the mathematical principles* of *the theory of wealth* (Trans. N. Bacon). New York: Macmillan, 1929; reprinted, New York: Augustus Kelley, 1971.

DesJardins, S., Ahlburg, D., & McCall, B. (2006). An integrated model of application, admission, enrollment, and financial aid. *Journal of Higher Education, 77*, 381–429.

DesJardins, S., Dundar, H., & Hendel, D. (1999). Modeling the college application decision process in a land-grant university. *Economics of Education Review, 18*, 117–132.

Dynarski, S. (2004). The new merit aid. In C. Hoxby (Ed.), *College choices: The economics of where to go, when to go, and how to pay for it* (pp. 63–97). Chicago: The University of Chicago Press.

Ehrenberg, R. (2004). Econometric studies of higher education. *Journal of Econometrics, 121*, 19–37.
Fredriksson, P. (1997). Economic incentives and the demand for higher education. *The Scandinavian Journal of Economics, 99*, 129–142.
Heller, D. (1997). Student price response in higher education: An update of Leslie and Brinkman. *Journal of Higher Education, 68*, 624–659.
Hoenack, S. (1967). *Private demand for higher education in California*. Unpublished Ph. D. dissertation, University of California, Berkeley.
Humphrey, T. (1992). Marshallian cross diagrams and their uses before Alfred Marshall: The origins of supply and demand geometry. *Economic Review*, March/April, 3–23.
Imbens, G., & Angrist, J. (1994). Identification and estimation of local average treatment effects. *Econometrica, 62*, 467–475.
Jackson, G., & Weathersby, G. (1975). Individual demand for higher education: A review and analysis of recent empirical studies. *The Journal of Higher Education, 46*, 623–652.
Lee, D., & Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature, 48*, 281–355.
Leslie, L., & Brinkman, P. (1987). Student price response in higher education. *Journal of Higher Education, 58*, 181–204.
Mangoldt, H. (1863). The exchange ratio of goods (Trans. E. Henderson from *Grundriss der Volkswirtschaftlehre*). Stuttgart: Engelhorn. In *International economic papers*, no. 11, 32–59. London: Macmillan, 1962.
Marshall, A. (1890). *Principles of economics* (Vol. I). London: Macmillan.
McCall, B., & Bielby, R. (2012). Regression discontinuity design: Recent developments and a guide to practice for researchers in higher education. In J. Smart & M. Paulsen (Eds.), *Higher education: Handbook of theory and research* (Vol. 27, pp. 249–290). Dordrecht, The Netherlands: Springer.
McPherson, M. (1978). The demand for higher education. In D. Breneman & C. Finn (Eds.), *Public policy and private higher education* (pp. 143–196). Washington, DC: The Brookings Institute.
Murnane, R., & Willett, J. (2011). *Methods matter: Improving causal inference in educational and social science research*. New York: Oxford University Press.
Paulsen, M. (1990). *College choice: Understanding student enrollment behavior* (ASHE Higher Education Report Series). Washington, DC: The George Washington University.
Paulsen, M. (1998). Recent research on the economics of attending college: Returns to investment and responsiveness to price. *Research in Higher Education, 39*, 471–489.
Paulsen, M., & Pogue, T. (1988). Higher education enrollment: The interaction of labor market conditions, curriculum, and selectivity. *Economics of Education Review, 7*, 275–290.
Psacharopoulos, G., & Soumelis, C. (1979). A quantitative analysis of the demand for higher education. *Higher Education, 8*, 159–177.
Radner, R., & Miller, L. (1975). *Demand and supply in U.S. higher education*. New York: McGraw-Hill.
Rau, K. (1841). *Grundsatze der volkswirtschaftslehre*, 4th edn. Heidelberg.
Reynolds, C., & DesJardins, S. (2009). The use of matching methods in higher education research: Answering whether attendance at a two-year institution results in differences in educational attainment. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 24, pp. 47–104). Dordrecht, The Netherlands: Springer.
Ricardo, D. (1921). *The first six chapters of the principles of political economy and taxation of David Ricardo, 1817*. London: Macmillan.
Rothschild, M., & White, L. (1995). The analytics of the pricing of higher education and other services in which the customers are inputs. *Journal of Political Economy, 103*(3), 573–586.
Savoca, E. (1990). Another look at the demand for higher education: Measuring the price sensitivity of the decision to apply to college. *Economics of Education Review, 9*, 123–134.
Smith, A. (2004). *The wealth of nations (1776)*. New York: Barnes & Noble Publishing, Inc.

Steinemann, A., Apgar, H., & Brown, W. (2004). *Microeconomics for public decisions*. Cincinnati, OH: South-Western College Publishing.
Steuart, J. (1767). *An inquiry into the principles of political economy: Being an essay on the science of domestic policy in free nations* (Vol. 2). London: Millar & Cadell.
Thistlethwaite, D., & Campbell, D. (1960). Regression-discontinuity analysis: An alternative to the ex post facto experiment. *Journal of Educational Psychology, 51*, 309–317.
Toutkoushian, R. (2001a). Changes in the demand for public land-grant universities: The use of panel datasets. *Research in Higher Education, 42*, 679–707.
Toutkoushian, R. (2001b). Do parental income and educational attainment affect the initial choices of New Hampshire's college-bound students? *Economics of Education Review, 20*, 245–262.
Toutkoushian, R., & Hillman, N. (2012). The impact of state appropriations and grants on access to higher education and state outmigration. *The Review of Higher Education, 36*, 51–90.

Chapter 6
The Role of Government in Higher Education

Abstract In this chapter, we explore the economic justifications for the role of government in supporting postsecondary education. Although many refer to education (particularly public education) as a public good, the teaching function of colleges and universities does not meet the economists' definition of a public good. Perhaps the only product from postsecondary education that may be thought of as a public good is basic research. Instead, the economic rationale for governmental financial support of postsecondary education rests on the argument that students produce positive externalities when they go to college. We will outline the main economic concepts behind public goods and externalities, and show how they relate to governmental support for higher education. We also provide an extension of the model of public choice, and consider two higher education policy issues with regard to the appropriate level of state support for higher education and the debate between need-based and merit-based financial aid.

Introduction

Every economy has to answer questions about what will be produced, how much will be produced, and how will it be distributed. Economic theories and concepts dating back to Adam Smith and others have asserted that in most situations, decisions about these issues are best left to competitive markets. In a sense, markets are the ultimate form of democracy in that buyers and sellers "vote" with their dollars and resources on how to answer these fundamental questions. If a society is producing too many DVD players, for example, then the actions of consumers and producers will cause the supply and demand curves in the DVD market to shift, which in turn will reallocate resources away from DVD player production and towards something else that is collectively deemed more valuable. These changes are made without any form of central coordination among actors in the economy, but rather through the supply decisions of firms and the purchasing choices of consumers in markets.

An important aspect of markets that is not often given sufficient attention is that the decisions of buyers and sellers are presumed to be made purely on the basis of

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_6

their self-interest. Consumers choose what to buy and how much to buy according to the utility or value they think they would get from their purchases. Accordingly, buyers are not concerned with how their purchasing decisions might affect others in society. Likewise, sellers make decisions about what and how much to sell based on how they alone will benefit. Also note that both the buyer and the seller each get something of value from the voluntary exchange of goods and services that occurs in competitive markets. Through the pursuit of self-interest on the part of buyers and sellers, however, markets enable resources to be distributed in the optimum way for individuals and society, and therefore self-interested decision making benefits society as a whole.

As discussed in Chap. 3, students make decisions about whether or not to go to college based on their perceptions of the costs and benefits they face in doing so. Students are presumed to consider only those benefits that they will personally receive, which are the private (internal) market and non-market benefits that they get from going to college. Understandably, they may not take into account how their decision to go to college will affect others in society such as their neighbors and residents of their state and nation. The private benefits from going to college—such as increased lifetime human capital, earnings, and consumptive benefits—are fully captured by the students themselves, and therefore, these private benefits are naturally internalized by students and used in their decisions about postsecondary education.[1]

The interactions of buyers and sellers in a competitive marketplace can help the economy move toward an efficient allocation of scarce resources and determine what should be produced and in what amounts. However, there are a number of well-known instances or conditions when the private market alone may not lead to the optimum allocation of resources from society's point of view. In these situations, it is said that a *market failure* has occurred. For example, if consumers cannot be prevented from using a good or service if they do not pay for it, then they will have an incentive to use the good/service without paying. The problem with this, of course, is that if too many consumers reach the same conclusion, then how will the good or service be provided? This is the "free rider problem" that must be addressed with goods and services that economists refer to as public goods. An example of a public good is national defense because specific individuals cannot be excluded from benefiting from the service, and the use by one individual does not diminish anyone else's use of the service.

Another form of possible market failure arises when the consumption of a good or service creates benefits or costs for others not involved in the trade. This leads to what economists call an *externality*.[2] An externality can be bad, as in the case of

[1] See, for example, McMahon (2009), Paulsen and Fatima (2007), and Paulsen and Toutkoushian (2006).

[2] Selected studies of interest on externalities due to education include Baum, Ma, and Payea (2013), Bowen (1977), Institute for Higher Education Policy (1998, 2005, 2012), Leslie and Brinkman (1988), McMahon (2009), Paulsen and Fatima (2007), and Wolfe and Haveman (2002).

cigarette smoking where second-hand smoke may harm others around them; this harm would constitute a *negative externality*. Or the consumption of a good or service may impart benefits to others, in which case it is referred to as a *positive externality*. It is often asserted that education produces positive externalities in that when people acquire more education, others around them benefit as well in financial and non-financial ways. In fact, the social rates of return discussed in Chap. 4 reflect both the private and public (non-private) benefits from postsecondary education.

The problem with goods and services that create externalities is that according to the traditional model of market behavior, consumers do not take into account how their actions affect others when deciding what to consume and how much to consume. If this is true, then those things which lead to negative externalities will end up being overproduced from society's perspective, and likewise goods/services that create positive externalities will be underproduced. In the case of higher education, this means that if college produces positive externalities, then under the classical model assumptions a purely competitive market—if left to its own accord—would provide college education to too few students.

In both instances of market failure—for public goods and those goods/services which lead to positive externalities—an argument can be made that governments should intervene in these markets to help achieve more socially-desirable outcomes. For public goods, this intervention typically takes the form of the government requiring individuals to contribute to their production through taxation. Consumers are not given the choice whether or not to pay for the service.[3] In contrast, governments intervene in a different way in markets where the good or service leads to positive externalities. Rather than require people to fund production of the good, the government uses financial subsidies to individuals or suppliers to entice students in the market to make different choices. In this way, decisions in the competitive market are still made by individuals and suppliers based on their perceived self-interest, and yet the resulting production outcomes are more consistent with broader societal goals and objectives.

In this chapter, we explore the economic justifications for the role of government in supporting postsecondary education. Although many refer to education (particularly public education) as a public good, the teaching function of colleges and universities does not meet the economists' definition of a public good. Perhaps the only product from postsecondary education that may be thought of as a public good is basic research. Instead, the economic rationale for governmental financial support of postsecondary education rests on the argument that students produce positive externalities when they go to college. We will outline the main economic concepts behind public goods and externalities, and show how they relate to governmental support for higher education. We also provide an extension of the

[3] Of course, taxpayers do have some say in the matter through their voting behavior. If citizens collectively feel that the taxes imposed on them to support a good/service are too high, then they could pressure their legislators to lower taxes or vote to replace them with other legislators who better support their preferences.

model of public choice, and consider two higher education policy issues with regard to the appropriate level of state support for higher education and the debate between need-based and merit-based financial aid.

Background

Concepts and theories from public sector economics and welfare economics provide the primary rationale for government intervention in competitive markets. Welfare economics and public sector economics contain ideas and theories that constitute a useful analytical framework with tools for examining the role of public policy in higher education markets. This analytical framework provides a model for how to examine and evaluate:

- the private benefits to students as consumers due to economic activity in markets for higher education;
- the private benefits to institutions as producers due to economic activity in markets for higher education;
- the external benefits to society—i.e., received by those third-party beneficiaries of the market, even though they're not direct participants in the market—due to economic activity in markets for higher education;
- the rationale for government intervention in higher education markets in the presence of external benefits;
- the relationships between private benefits to students and institutions and external benefits to society;
- the optimum level of investment in higher education;
- the effects of government intervention and policy on market dynamics, student and institutional behavior, and the level of students' investment in higher education;
- the costs of the government policy;
- the effects of government intervention and policy on 'welfare gains'—i.e., gains in society's well-being or welfare;

The phrase *public good* has a very specific meaning in economics. It is defined as a good or service that is both non-excludable and non-rival in nature. Something is said to be non-excludable if the supplier cannot easily prevent some individuals from using the good or service. Likewise, a good or service is non-rival if its use by one person does not diminish another person's ability to derive value from the same good or service. Examples of public goods are national defense, lighthouses, and fireworks displays, since they would seem to meet both of these criteria.

The notion of public goods dates back many centuries, emerging from the need of societies to provide security to its members. The protection of citizens, in the form of armies and police or guards, for example, is difficult to apply to only a portion of a state's or nation's population. As large-scale health epidemics such as the Black Plague began to threaten societies, the need increased for other public goods and services such as medical facilities to protect the general public. In fact, as a society becomes more complex, the demand for public goods will likely grow as well. The problem is that if citizens cannot be excluded from benefiting from the service, then they have little incentive to pay for it. Accordingly, governments must intervene in the market to compel or require citizens to contribute to the provision of the service.

Despite the fact that societies have had to address problems with public goods for a long time, the economic analysis of public goods is a relatively recent phenomenon. Paul Samuelson is largely credited with being the first to articulate the economic issues with public goods in his 1954 article "The pure theory of public expenditure." Other economists such as Musgrave (1939), however, had also previously discussed issues relating to collective goods that may be thought of as public goods.

In addition, another set of economists have expanded the concepts of goods beyond the simple public / private dichotomy. This work recognizes that public and private goods are but two extremes along a continuum of options depending on the degree of excludability and rivalry that characterized the good or service. It has been argued that there are actually four categories of goods and services:

- Private Goods = Excludable and Rival
- Club Goods = Excludable and Non-rival
- Common Goods = Non-Excludable and Rival
- Public Goods = Non-excludable and Non-rival

Club goods, for example, are those goods and services that are shared by a certain number of individuals. The supplier can limit the number of people using the good or service (and hence they are excludable), but among those who do consume the good, there is no rivalry in consumption. An example of a club good might be a neighborhood swimming pool. More importantly for our purposes, it has been argued that a college or university could also be thought of as a club good.[4] On the other hand, natural resources such as forests and lakes are described as common goods because it is difficult to prevent some individuals from using them (non-excludable), but if left unchecked the use of the resource by some may diminish others' ability to use the same resource.

The notion of externalities dates back to the work on neo-classical economic theory by Henry Sidgwick (1887), Alfred Marshall (1890), and later Arthur Pigou (1920). An externality is a spillover benefit or cost that occurs when a good or service is exchanged in competitive markets. Much of the literature on this topic has focused on problems where the consumption of a good or service imposed harm on a third party ("negative externality"). Frequently-used examples of negative externalities include air and water pollution and second-hand smoke from cigarettes. The

[4] James Buchanan (1965) is largely credited with popularizing the analysis of club goods, though other early contributors also include Tiebout (1956), Wiseman (1957), and Olsen (1965). For more discussion of club goods, see Sandler and Tschirhart (1980, 1997) and Cornes and Sandler (1996).

problem with negative externalities from an economic perspective is that the cost imposed on the third party is not taken into account by the buyers and sellers when they engage in trade. As a result, more of the good or service is produced than would be socially optimal. Although positive externalities have received less attention from researchers, they also create problems in competitive markets. In this instance, the spillover benefit that a third party would receive from the transaction is not taken into account by the buyers and sellers, and less of the good/service is produced than would be socially desired.

Public Goods and Externalities in Education

In policy and academic circles, education (particularly public education) at various levels is often referred to as a public good. However, in the absence of government intervention, the education of students does not meet the strict non-excludability and non-rivalry requirements of the definition of public good favored by economists.[5] Primary and secondary education in the United States is sometimes considered to be non-excludable because there are laws requiring communities to offer education services to all students in their area, and laws that students must go to school until they reach a certain age. If left to their own devices, though, education suppliers could prevent individuals from taking advantage of their services. There is nothing inherent about education that would make it impossible to prevent some from consuming it. In fact, even today a person could not simply walk in off the street and into a classroom and receive the service without permission. In addition, schools and colleges can exclude individuals from consuming education services through expulsion.

Likewise, it has been said that education is non-rival because all students in the class can receive education services regardless of whether other students are also in the classroom. However, there is some degree of rivalry in education if we focus on the quality of education received rather than simply access to services. Because learning depends in part on the interaction between students and instructors, changes in the size of classrooms may affect the amount of learning that students receive. For example, if one student continually asks questions in class, then the consumption of education by this student has a rivalry effect on other students in the same class who have less time to ask their own questions.

On the other hand, an argument could be made that the knowledge produced from basic research at colleges and universities is a public good. The research knowledge in this sense is not patented or produced exclusively for an organization or entity. For example, research that is conducted by faculty members and disseminated through books and journals would be considered basic research. The knowledge from basic research is non-excludable because once the findings have been published, it is very difficult to prevent others from reading it and benefiting from

[5] For a good discussion of this, see Grace (1989).

it. In addition, basic research is non-rival in that the use of it by one person does not prevent another person from also using it.[6]

Without some form of market intervention, the free rider problem would present a significant threat to basic research. Given that it can take substantial time and resources to conduct research and there is a risk that the research will not be successful, then there is an incentive for individuals and institutions to simply let others produce research and then use the results from their work. However, if everyone reached the same decision, then too little basic research would be produced for society. The government therefore chooses to intervene in competitive education markets and provide support for basic research through federally-funded research grants. The funds for these research grants, of course, come from individuals through taxes, and in this way the government compels individuals to contribute to the provision of this public good.

Turning to externalities, a stronger case can be made that there are positive externalities associated with the teaching activities of colleges and universities. As noted earlier, there have been many empirical studies that have sought to determine whether education produces positive benefits for others. As an example, Lochner and Moretti (2004) examined whether increases in educational attainment resulted in reductions in incarceration rates, which then would have positive benefits for communities. States and governments often look to education as a means for increasing economic growth and raising the standard of living in their region. Due to the connection between education and earnings (see Chap. 4), increases in education result in greater tax contributions to governments, that in turn can be used to benefit others. In fact, when people say that education is a "public good," what they most likely mean is that education produces external benefits for the public at large.

Externalities may also come into play in the classroom. Colleges that have highly-selective admissions believe that by increasing the quality of students at their institutions, they can provide students with a richer learning environment. In a sense, they feel that such "peer effects" create positive externalities in instruction. If a student asks thoughtful questions in class, then it may not only benefit the student who asked the question but others in the class as well. Of course, it is equally possible that students who are disruptive in class or take up too much instructional time with questions and comments that are not productive will impose negative externalities on other students in the classroom.

A number of scholars have reviewed the literature on the nature and extent of public benefits from higher education. Researchers have concluded that when

[6] However, knowledge may have some degree of excludability because a reader must have access to the journal or book where the research has been published, and libraries have limited selections of publications. And if the local library only has one copy of a given book or journal, then the use of that publication by one person precludes another from using it for a designated period of time. For more discussion on this topic, see Stiglitz (1999).

students go to college, it results in economic, health, and social benefits for others.[7] The economic spillover benefits for society may include higher tax contributions which are then used to provide services for the public, enhanced economic growth, reduced unemployment, and a higher quality workforce. Some of the health benefits that emerge from higher education are reductions in second-hand smoke (due to lower cigarette consumption among college-educated people) and increased blood donations. Finally, there is also a range of possible social benefits for the public from college, such as improved civic participation, increased donations to charities, greater rates of volunteerism, reduced crime rates, and increased racial tolerance.

A major challenge associated with determining the share of the total benefits of higher education that are public versus private is the inherent difficulty in measuring these benefits—especially the external (or public) benefits. One of the most comprehensive efforts to measure the various benefits of higher education, with a particular emphasis on the value of public benefits, is Walter McMahon's book, *The Private and Social Benefits of Higher Education: Higher Learning, Greater Good* (2009). Building on the work of many other scholars in this area, McMahon tackles the conceptual and measurement challenges posed by this task. He statistically analyzes both time series and cross section data for not only the United States but also for many other developed and developing nations. Through this approach, McMahon (2009) estimates the benefits of higher education, including the contributions of higher education to social benefit externalities across a wide range of general areas. Based on his work, he concludes that the public benefits of higher education are roughly similar in size to the private benefits from higher education. Accordingly, he argues that substantial financial support from the government for postsecondary education is warranted.

Positive Externalities and Higher Education

We now explain how the presence of positive externalities affects the pricing and output in postsecondary education markets. In particular, we will show that when there are positive externalities created by higher education, competitive markets will not produce enough education from the perspective of society. Although we focus here on the positive externalities created by education, keep in mind that there may also be negative externalities produced by higher education that would result in the opposite effect.[8]

[7] For examples of reviews of research on public benefits, see Baum et al. (2013), Bowen (1977), Institute for Higher Education Policy (1998, 2005, 2012), and Leslie and Brinkman (1988).

[8] Possible examples of negative externalities from higher education include disturbances due to underage drinking, excessive noise, increased crime, and traffic congestion.

Consumer and Producer Surplus

To begin the discussion of how positive externalities affect education markets, it is helpful to first consider the concepts of consumer and producer surplus.[9] These represent the surplus or extra benefits for buyers and sellers that are generated when they engage in voluntary trade with each other in markets. *Consumer surplus* is the total benefit that consumers receive by participating in the competitive marketplace and was introduced in Chap. 3. Graphically, it represents the difference between the maximum price consumers are willing to pay for a product—which is indicated by the height of the demand curve at each quantity demanded—and the equilibrium price they actually pay. Similarly, *producer surplus* measures the total excess benefit that suppliers obtain when they sell their goods and services in the competitive marketplace. Producer surplus represents the difference between the equilibrium price that producers actually receive and the minimum price they need to cover costs—which is indicated by the height of the supply curve at each quantity supplied.

These two concepts are depicted in Fig. 6.1, where point A corresponds to the market equilibrium at tuition price P_{pri} and quantity Q_{pri}. The subscript '*pri*' is used to denote that the equilibrium price and quantity are based on the decisions of students and their families in higher education markets. These values are found where the private demand curve (D_{pri}) intersects the market supply curve (S). Consumer surplus is depicted by the area of the triangle BAP_{pri}. This triangle corresponds exactly to the area above the market tuition price P_{pri} and below the private demand curve. When interpreting consumer surplus, it is important to remember that the aggregate value consumers obtain from their participation in the market is based entirely on the private or internal benefits they receive. In higher education markets, the students and their families are consumers and they gain private benefits from completing an academic year of college. The external or public benefits of postsecondary education accrue to other members of society and are not part of consumer surplus.

Likewise, producer surplus is represented by the area of the triangle $P_{pri}AC$. This triangle corresponds to the area below price P_{pri} and above the supply curve S. Keep in mind that the aggregate value that producers acquire from their participation in higher education markets represents private benefits that institutions receive due to their sale of their services. Therefore, any public benefits that accrue to society in general due to the educational services provided by colleges and universities are likewise not part of producer surplus.

[9] For more details on consumer and producer surplus, see Nicholson and Snyder (2010) and Pindyck and Rubinfeld (2009).

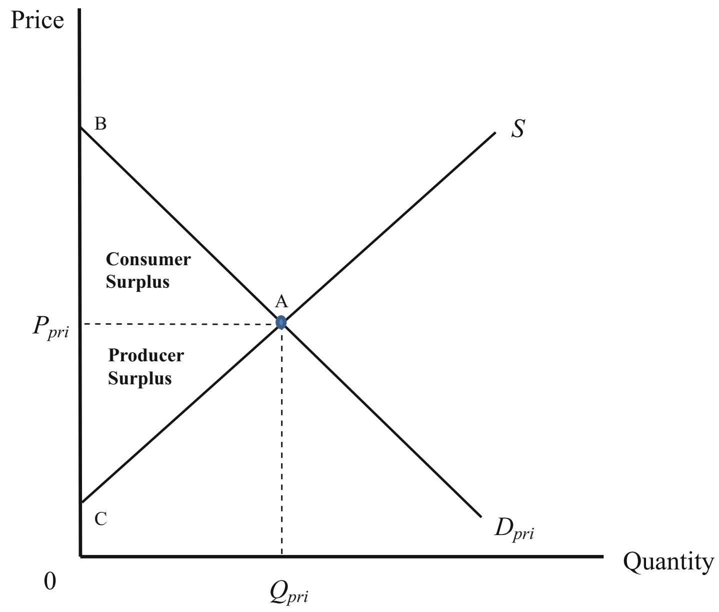


Fig. 6.1 Consumer and Producer Surplus in Higher Education Markets

Positive Externalities

Research suggests that higher education may generate a number of positive externalities or public benefits. These are benefits that are received by third-party members of society who do not actively participate in higher education markets. However, the direct participants in the market—students and institutions—do not think about these benefits when they are engaged in transactions. That is, students only look at their private benefits when deciding whether or not, and how much, to invest in higher education; while institutions consider only their private benefits when making decisions about how many and which students to admit. The public benefits of higher education are ignored by students and institutions, yet these same benefits are of great value and in high demand by society.

Once we introduce the possibility of public benefits into the competitive market model, it leads to a situation where the market without government intervention would provide too little of the good or service from the perspective of society. In our example, the amount of higher education produced by a competitive market would fall short of the socially-optimal level. Public sector economic theory refers to this as a *market failure* due to the presence of positive externalities. In Fig. 6.2, point A still represents the competitive market equilibrium for consumers without considering external benefits. The value that society places on the public benefits arising from each student enrolled in college is denoted by the line D_{pub}, which for simplicity is assumed to be the same for all students (i.e., a horizontal line). Total

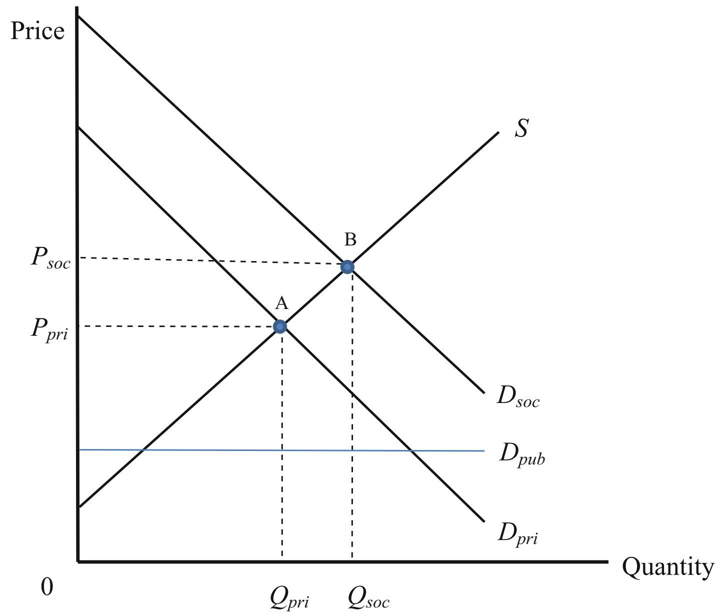


Fig. 6.2 Private and social demand in higher education markets

social demand for higher education is represented by D_{soc}, which is the sum of public and private demand ($D_{soc} = D_{pri} + D_{pub}$).

Equilibrium from the point of view of society occurs where the social demand curve intersects the market supply curve (Point B). Because D_{soc} reflects the combined values of both the private benefits valued by students and the public benefits valued by third-party members of society, the socially-optimal amount of higher education occurs when Q_{soc} students enroll in college. Technically, the difference between quantity enrolled Q_{pri} and Q_{soc} indicates the quantity of educational services that would be underproduced from society's perspective in a competitive market for higher education, when only the private benefits of college were considered.

Government Intervention and Externalities

If the voluntary choices of students and institutions in competitive markets result in less higher education being consumed by students than is desired by society, then the government may try to do something to address this problem. There are several options available for government intervention, each of which will have varying costs and benefits and different impacts on consumers, producers, and the public. This is important because economists assert that every decision maker—even a government—should take into account the costs and benefits of their actions when choosing a strategy.

In general, the government options can be grouped into demand-side and supply-side interventions. Demand-side interventions are government subsidies to consumers that cause the demand curve to shift outward to the right. Similarly, supply-side interventions are subsidies given to suppliers which lead to a rightward shift in the market supply curve. In each instance, the new equilibrium quantity of postsecondary education in the market will be higher and hopefully equal to the socially-optimal quantity. We now use welfare economics and public sector economics to examine these government intervention options.

To begin, it is helpful to define two additional concepts that are used in this analysis. The first concept is *social surplus*, which represents the sum of the surplus values for consumers, producers, and the public that occurs due to transactions in markets. The social surplus is found by adding together the consumer surplus, producer surplus, and the positive externalities realized by the public. The second concept defined here is *welfare gain*. The welfare gain denotes the change in social surplus that occurs when there is a change in the market. It is hoped that when the government intervenes in a competitive market, the various entities affected are better off due to the intervention. Of course, the welfare gain would also have to take into account the cost to society of the government intervention. These concepts can be illustrated with diagrammatic analysis using the framework developed and applied here.[10]

In Fig. 6.3, point A represents the initial competitive market equilibrium for consumers without considering external benefits. Now, let's assume that the government intervenes in higher education markets by providing all students with a grant or subsidy equal to $P_{soc} - P_0$ dollars. This is a demand-side intervention because the subsidy is given to student consumers. In this illustration, the subsidy to students is equal to the public benefit shown earlier. As a result, the private demand curve shifts upward and to the right from $D_{pri,1}$ to $D_{pri,2}$. If the subsidy equals the public benefits, then the new private demand curve will be the same as the social demand curve. This raises the equilibrium price to P_{soc}, but reduces the net price paid by students from P_{pri} to P_0. As a result, the surplus value for students (consumer surplus) increases by the dark shaded area $P_{pri}AHP_0$ because those students who previously enrolled in college now receive more benefits from paying a lower price, and the $Q_{soc} - Q_{pri}$ additional students who enroll due to the subsidy likewise receive some benefits. Colleges and universities also gain from the subsidy because the new equilibrium price that they receive (P_{soc}) is higher than the old equilibrium price, and more students enroll in college than before the subsidy. The increase in producer surplus is represented in Fig. 6.3 by the light-shaded area $P_{soc}BAP_{pri}$. Finally, there is a gain to third parties from government intervention because more students enroll in college, and each new student generates public

[10] For example, see Boardman et al. (2001), Gramlich (1998), Hyman (2008), and Weimer and Vining (2005).

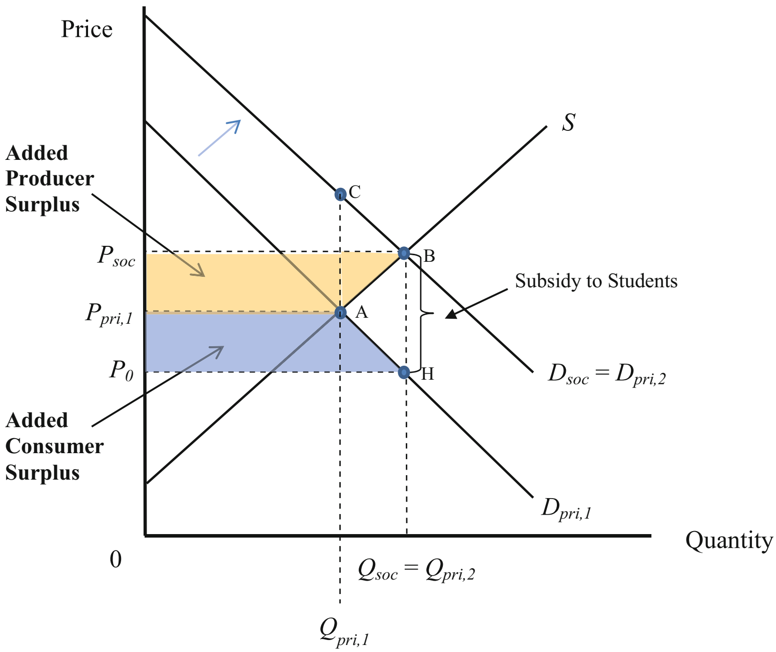


Fig. 6.3 Demand-side government intervention in higher education markets

benefits. The increase in public benefits in Fig. 6.3 is shown as either the change in enrollments times the public benefit per student $((Q_{soc} - Q_{pri}) * (P_{soc} - P_0))$, or the area *ACBH*.

The change in social surplus due to the subsidy equals the sum of the change in consumer surplus, producer surplus, and public surplus. The welfare gain from the government grant is defined as the change in social surplus before and after the grant, minus the cost to the government from the policy. Because the government provides a subsidy to every student in the market, the cost of the subsidy is represented by the rectangular area $P_{soc}BHP_0$. Given that the change in the social surplus exceeds the cost of the program, the welfare gain from the grant is positive, corresponding to area *ABH*. This indicates that the total benefits of the grant outweigh the cost of the grant program.

Another way in which the government can intervene in postsecondary markets is by giving a financial subsidy to colleges and universities, as shown in Fig, 6.4. This policy is directed at the supply side of the market. The financial subsidy enables institutions to offer spaces to students at lower prices, which translates into a rightward shift of the market supply curve from S_1 to S_2. The vertical distance between the old and new supply curve is the amount of per-student subsidy to institutions. Equilibrium in the market is still determined by where the private demand curve intersects the market supply curve, which now occurs at point C. As a result, more students would want to go to college due to the subsidy given to

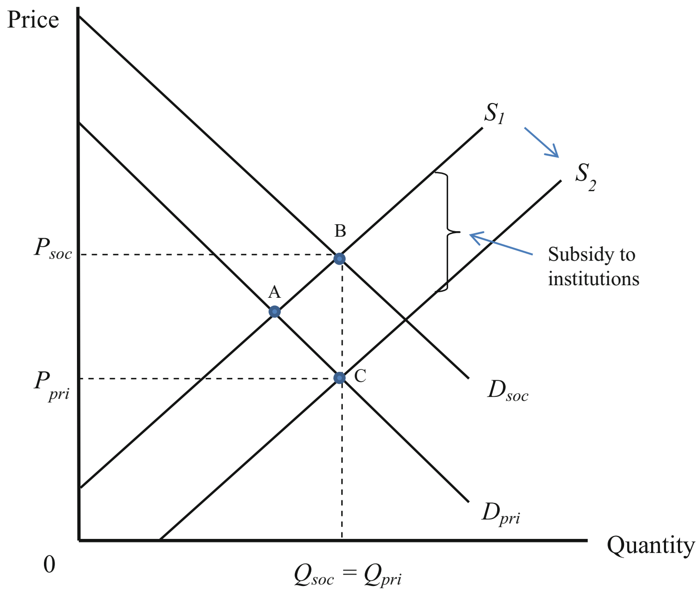


Fig. 6.4 Supply-side government intervention in higher education markets

colleges. In theory, there is a subsidy level that would lead to the exact increase in enrollments needed from the perspective of society (i.e., $Q_{pri} = Q_{pub}$).

Marginal Cost and Benefit Analysis of Government Intervention

In the preceding discussion, government intervention in higher education markets is viewed as a good thing because the net addition of surplus value to society exceeds the cost. It is important to note, however, that in this scenario the government considers the surplus values received by consumers, producers, and the public as benefits to them. An argument can be made, however, that government should be concerned with only the public benefits and public costs when evaluating policy options. In this instance, the government would want to compare the cost it incurs from the subsidy to the public benefits due to the subsidy. From Fig. 6.3, it seems clear that providing a uniform subsidy to all students is not a cost-efficient strategy for the government. The cost of the subsidy to the government exceeds the gain in public surplus because the first Q_{pri} students who receive the grant would have gone to college without the subsidy. Therefore, the government expenditure did not lead the first Q_{pri} students to change their behavior, and society would have received their public benefits without the policy.

Another way to examine the different options available to governments for intervening in higher education markets is through marginal cost and benefit analysis. There are many situations where economists posit that a decision maker should take into account the cost and benefit of an action when deciding on a course of action. In their most general forms, the marginal benefit represents the change in total benefits from an action, while the marginal cost denotes the change in total costs from an action. Given suitable assumptions about marginal costs and benefits (usually that marginal benefits fall and marginal costs rise), the decision maker would find it to be in his or her best interest to pursue the action up to the point where the marginal benefit equals the marginal cost.

It is important to distinguish between who is receiving the benefits and incurring the costs. Marginal private benefits (*MPB*) denotes the change in benefits received by the consumer, which in our case is the student. In contrast, the marginal social benefit (*MSB*) is the increased benefits received by both the consumer and others in society. On the cost side, the marginal social cost (*MSC*) represents the change in costs incurred by the student and others in society. Finally, the marginal private cost (*MPC*) is the additional cost incurred by only the student and not the rest of society from higher education.

We now use these concepts to examine in more detail the impact of governmental policies on the decisions of students. Let's begin in Fig. 6.5 with the case where all costs of going to college are borne by the student. Figure 6.5 looks very similar to Fig. 6.2, except that the demand and supply curves are replaced by marginal benefit and marginal cost curves for students, and the vertical axis measures marginal costs and benefits rather than price. To make the presentation parallel with the supply / demand discussion earlier, we assume here that the marginal

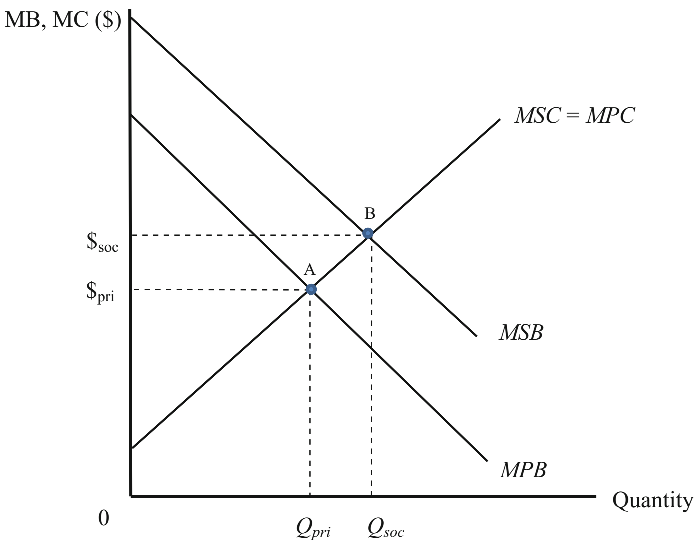


Fig. 6.5 Private and social marginal costs and benefits from higher education

private and social costs rise as more students go to college. If the government does not provide any subsidy to students or institutions for higher education, as in Fig. 6.5, then the marginal private cost curve will be the same as the marginal social cost curve.

There are also two marginal benefit lines to consider. The line *MPB* denotes the marginal private benefit for each student from going to college. As before, we assume that different students receive different marginal benefits from going to college, where the benefits include everything discussed in Chaps. 3 and 4 and converted to dollars. Finally, the line *MSB* shows the marginal social benefit from each student going to college. A simplifying assumption is made that each student in this example generates the same public benefit or externality when they go to college, and thus the two lines are parallel.

Students in postsecondary markets are assumed to make their decisions about college based on a comparison of the marginal private benefits and costs that they face (a behavioral assumption). As a result, without government intervention of some kind, students would want to go to college as long as $MPB > MPC$. The resulting equilibrium would occur at point A and the first Q_{pri} students would opt to go to college because their private benefits exceed their costs. For all remaining students, it would not be in their personal interest to go to college because their marginal private costs exceed their marginal private benefits. From society's point of view, however, students should enroll in college as long as the marginal social benefit exceeds the marginal social cost. The socially-optimal point is at B where $MSB = MSC$. The problem facing the government is how to entice the additional $(Q_{soc} - Q_{pri})$ students who should go to college to do so, even though it is not in their personal best interest.

This concept can also be illustrated with a hypothetical example. Consider the following five students in Table 6.1. Each student has estimated the benefit and cost they would personally face if they went to college, and the corresponding difference (net private benefit). For example, student A feels that she would receive a $30,000 benefit per year from going to college, and that it would cost her $15,000 to do so. As a result, she would receive a $15,000 net private benefit. In contrast, student E would expect only a $14,000 private benefit from college and incur a $31,000 cost, leading to a $17,000 net loss if he attended college. If these students based their willingness to attend college solely on whether the net private benefit is positive, then only the first two students (A and B) would decide to go to college without government intervention in this example.

In Table 6.2, we return to the same five students and assume that each would create $10,000 in public benefits for others (i.e., positive externalities) if they were to go to college. Accordingly, the marginal social benefits for each student are shown in the third column. On the cost side, the marginal private cost is the same as the marginal social cost when there are no subsidies for higher education (in other words, the marginal public cost is zero). From society's perspective, a student should go to college as long as the marginal social benefit exceeds the marginal social cost. This would mean that the first four students in the list (A through D)

Table 6.1 Hypothetical example of marginal private costs and benefits for five students

Student	Marginal private benefit (*MPB*)	Marginal private cost (*MPC*)	Net private benefit	Will student want to attend college?
A	\$30,000	\$15,000	\$15,000	Yes
B	\$26,000	\$19,000	\$7,000	Yes
C	\$22,000	\$23,000	−\$1,000	No
D	\$18,000	\$27,000	−\$9,000	No
E	\$14,000	\$31,000	−\$17,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Net private benefit = marginal private benefit—marginal private cost. Student is assumed to want to attend college provided that the net private benefit is positive

Table 6.2 Hypothetical example of marginal social costs and benefits for five students

	Marginal benefit			Marginal cost				
Student	Private	Public	Social	Private	Public	Social	Net social benefit	Should attend college for society?
A	\$30,000	\$10,000	\$40,000	\$15,000	\$0	\$15,000	\$25,000	Yes
B	\$26,000	\$10,000	\$36,000	\$19,000	\$0	\$19,000	\$17,000	Yes
C	\$22,000	\$10,000	\$32,000	\$23,000	\$0	\$23,000	\$9,000	Yes
D	\$18,000	\$10,000	\$28,000	\$27,000	\$0	\$27,000	\$1,000	Yes
E	\$14,000	\$10,000	\$24,000	\$31,000	\$0	\$31,000	−\$7,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Marginal public benefit = benefits from each student (in dollars) to the government from higher education. Marginal public cost = costs incurred by the government for each student's education (government subsidy). Net social benefit = marginal social benefit—marginal social cost. Student should attend college for society provided the net social benefit is positive. Illustration assumed that each student generates \$10,000 in benefits to the public, and that all postsecondary education costs are incurred by the student

should go to college. However, because students base their decisions solely on their private costs and benefits, only the first two students would do so.

There are several approaches that the government could use to entice students C and D to go to college. Using marginal cost/benefit analysis, each of these approaches focuses on reducing the marginal private cost paid by students, regardless of whether the subsidy is given to the student or the institution. The government's objective is to lower the price paid by students in such a way that some of them will switch from having negative to positive net private benefits, and therefore decide to go to college.

Uniform Subsidies

The first intervention option is a uniform subsidy, where all students are offered the same reduction in marginal private cost. A uniform subsidy could be supply-side in the form of funding given to institutions that reduce prices for groups of students by the same amount. The subsidy could also be a demand-side intervention if the government were to give all students in a given category the same amount of financial aid. The effect of a uniform subsidy is depicted in Fig. 6.6, where the marginal private cost curve shifts downward and to the right by a constant amount. The new equilibrium point where the marginal private benefit equals the marginal private cost occurs at point C, which corresponds to the socially-optimal enrollment level Q_{soc} identified earlier.

To see how this would look in our illustration, in Table 6.3 let's assume that each of the five students is offered a $10,000 scholarship from the government that can only be used for going to college. Because the dollar subsidy is the same for everyone, it is a uniform subsidy. The fourth column of figures shows the new marginal private costs for students if they went to college and the fifth column contains the net private benefits. From this column, it can be seen that students A through D would now all have net private benefits that are positive, and thus the students who choose to attend college are the same as the students that society would say should go to college. Note that the marginal social costs are not affected by the subsidy, because the added cost to the public is offset by the lower cost paid by students.

The example most familiar to readers of a uniform subsidy is state appropriations. In principle, state funding to public institutions is in turn used to reduce the

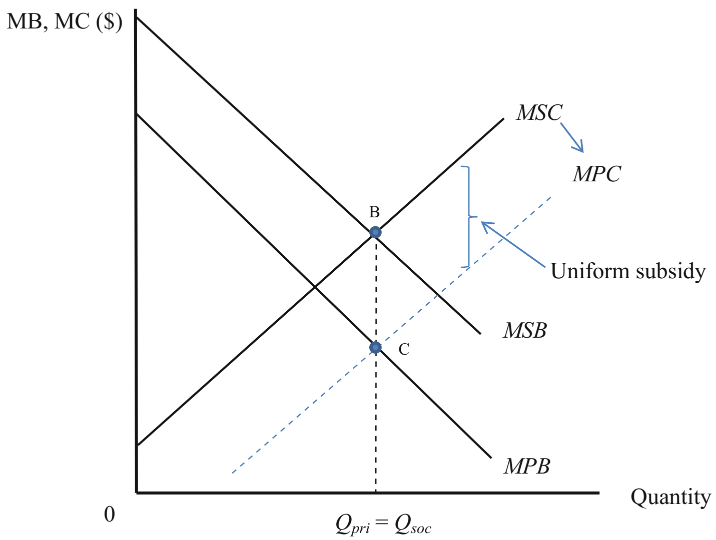


Fig. 6.6 Effects of uniform government subsidy on marginal costs and benefits

Table 6.3 Hypothetical example of uniform subsidy on private marginal costs and benefits for five students

Student	Marginal private benefit (MPB)	Marginal social cost (MSC)	Government subsidy	Marginal private cost (MPC)	Net private benefit	Will student want to attend college?
A	$30,000	$15,000	$10,000	$5,000	$25,000	Yes
B	$26,000	$19,000	$10,000	$9,000	$17,000	Yes
C	$22,000	$23,000	$10,000	$13,000	$9,000	Yes
D	$18,000	$27,000	$10,000	$17,000	$1,000	Yes
E	$14,000	$31,000	$10,000	$21,000	−$7,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Marginal public benefit = benefits from each student (in dollars) to the government from higher education. Marginal public cost = costs incurred by the government for each student's education (government subsidy). Net private benefit = marginal private benefit—marginal private cost. Net social benefit = marginal social benefit—marginal social cost. Illustration assumed that each student generates $10,000 in benefits to the public, and that the government subsidy is set equal to $10,000 per student

price they charge to all state residents by the same amount, regardless of their ability to pay, their academic performance, or any other criteria. Broad-based state financial aid programs are another form of uniform subsidy when all students who meet the merit criteria receive the same scholarship or grant. Indiana's Twenty-first Century Scholars program, for example, provides qualifying students from Indiana with a grant sufficient to cover the in-state tuition and fees at public institutions within the state's boundaries. Likewise, Georgia's HOPE scholarship awards in-state students who qualify for the scholarship with funding to cover 90 % of the tuition at 4-year, in-state public institutions.[11]

The uniform subsidy has the appeal of being relatively easy to implement because each student receives the same subsidy, and the government does not have to determine the criteria for how much subsidy to award individual students. One downside to the uniform subsidy is that it may result in aid being given to some students who would have gone to college without it. In this sense, it might be argued that for some students the subsidy was unnecessary and therefore a bad use of public funds. Recall that in Table 6.3, $20,000 in subsidies were given to students A and B and yet they would have gone to college even without the subsidy.

[11] The grant awards may differ slightly across students depending on which institution they choose to attend. Nonetheless, all students in the eligible group are offered the same net price reduction for the same institutions. And it should be noted that the subsidies in this example exclude out-of-state students and thus are not uniform for all students.

Non-uniform Subsidies

Due to concerns with uniform subsidies, a government might instead consider using a non-uniform subsidy, where the level of subsidy varies across students. Typically, non-uniform subsidies are designed so that smaller subsidies are given to those who are the most likely to go to college, and larger subsidies for those who are the least likely to go to college.

There are a number of different options for implementing a non-uniform subsidy. One way in which this might be done is shown in Fig. 6.7. The size of the subsidy per student is represented by the vertical distance between the marginal social cost and the marginal private cost lines. Note that the shift in the *MPC* curve is not uniform or parallel, in that the gap increases along with *MPC*. In theory, the subsidies could be distributed in such a way that the new equilibrium enrollment level after the subsidy is the same as the socially-optimal level determined earlier. The appeal of this approach is that the students who would have gone to college anyway receive smaller subsidies than in a uniform subsidy approach, and more subsidies can be given to those students with greater need.

Returning to our illustration, in Table 6.4 let's assume that the government replaces the uniform subsidy of $10,000/student with a non-uniform subsidy that ranges from $1,000/student to $13,000/student. Furthermore, the subsidy is structured so that students with higher marginal private costs are offered larger subsidies. In this example, student A only receives a $1,000 subsidy instead of the $10,000 uniform subsidy, but she would still want to go to college because the net private benefit is positive. Although student C receives a smaller subsidy than in

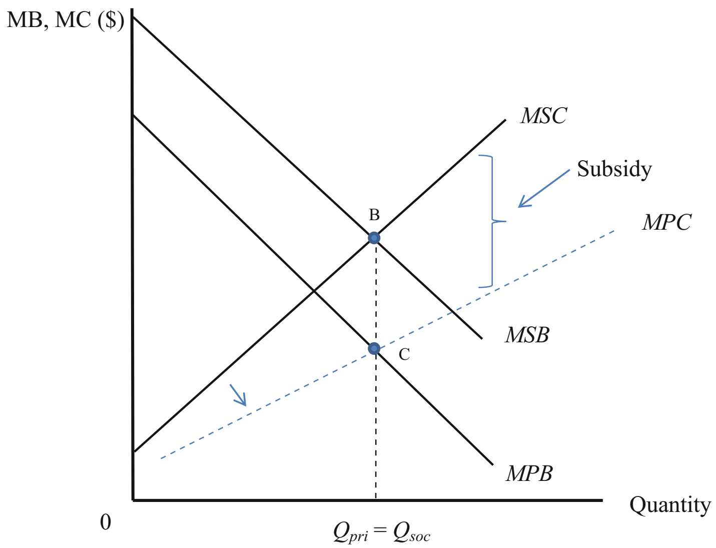


Fig. 6.7 Effects of non-uniform subsidy on private marginal costs from higher education

Table 6.4 Hypothetical example of non-uniform subsidy on marginal cost and benefits for five students

Student	Marginal private benefit (*MPB*)	Marginal social cost (*MSC*)	Government subsidy	Marginal private cost (*MPC*)	Net private benefit	Will student want to attend college?
A	$30,000	$15,000	$1,000	$14,000	$16,000	Yes
B	$26,000	$19,000	$4,000	$15,000	$11,000	Yes
C	$22,000	$23,000	$7,000	$16,000	$ 6,000	Yes
D	$18,000	$27,000	$10,000	$17,000	$1,000	Yes
E	$14,000	$31,000	$13,000	$18,000	−$4,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Marginal public benefit = benefits from each student (in dollars) to the government from higher education. Marginal public cost = costs incurred by the government for each student's education (government subsidy). Net private benefit = marginal private benefit—marginal private cost. Net social benefit = marginal social benefit—marginal social cost. Illustration assumed that each student generates $10,000 in benefits to the public, and that the government subsidy increases along with marginal social cost

the previous example, it is sufficient to change the student's mind about going to college. An interesting case in this example is student E, who is offered a $13,000 subsidy even though the public benefit to society would be only $10,000 if he decided to enroll in college. In fact, society would have lost value if this particular student had chosen to enroll in college.

Non-uniform subsidies occur most often in the form of need-based financial aid, where the level of financial aid is set higher for students who are less able to afford to go to college and thus less likely to enroll. The main challenge with implementing this approach is how to determine the right relationship between marginal private cost and the level of subsidy. There are many different values that we could have used in Table 6.4, for example, and the wrong choice could lead to either too many or too few students going to college. To illustrate, if student E had been offered an $18,000 grant, then he would have wanted to attend college even though the net public benefit from doing so would be negative.

Alternatively, non-uniform subsidies could be given in such a way that the marginal cost of going to college does not exceed a designated level. This is shown graphically in Fig. 6.8, where the government provides a subsidy to each student so that the marginal private cost does not exceed a certain value (labeled 'Cap' in Fig. 6.8). The new marginal private cost curve faced by students is the same as the original marginal private cost curve up to point A, after which the line pivots and becomes horizontal, representing constant marginal private cost. The government will then make up the difference between the student's *MPC* and society's *MSC*.

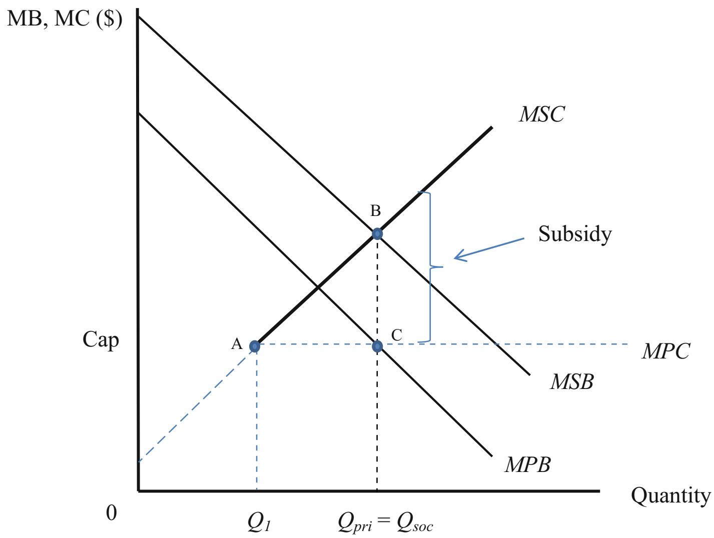


Fig. 6.8 Effect of subsidy capping private marginal cost of higher education

In our illustration, suppose that the government gave each student a subsidy sufficient to ensure that the student did not have to pay more than $17,000 for college. Table 6.5 shows that the first student (A) would not receive any subsidy because her marginal private cost was already less than $17,000. The subsidies offered to students B through E increased with their marginal private cost to the point where the new marginal private cost for each of them equaled $17,000. In this scenario, students A and B would continue to want to go college, and students C and D would now find that it is also in their financial interest to do so as well. The last student E, despite the larger subsidy, would not attend college because his marginal private cost still exceeds the marginal private benefit.

The federal need-based financial aid system in the United States is an example of this type of governmental approach to subsidies. Students who apply for federal need-based aid must complete the Free Application for Federal Student Aid (FAFSA). The data are then used to calculate the student's expected family contribution, which can be thought of as the portion of costs that the student and their family should in theory be able to afford. The remaining difference between price of attendance and expected family contribution is the student's unmet need. In theory, the government would then provide financial aid in an amount to cover the unmet need.[12] As with the previous non-uniform aid example, an advantage of this approach is that less government money is given to students who would have gone to college without the subsidy. The difficulty, however, is determining how to set the appropriate subsidy level for each student.

[12] In practice, the government may not meet all of the unmet need through the FAFSA calculation. The federal subsidy may also include loans which must be repaid by the student in the future.

Table 6.5 Hypothetical example of subsidy capping marginal cost for five students

Student	Marginal private benefit (*MPB*)	Marginal social cost (*MSC*)	Government subsidy	Marginal private cost (*MPC*)	Net private benefit	Will student want to attend college?
A	$30,000	$15,000	$ 0	$15,000	$15,000	Yes
B	$26,000	$19,000	$2,000	$17,000	$9,000	Yes
C	$22,000	$23,000	$6,000	$17,000	$5,000	Yes
D	$18,000	$27,000	$10,000	$17,000	$1,000	Yes
E	$14,000	$31,000	$14,000	$17,000	−$3,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Marginal public benefit = benefits from each student (in dollars) to the government from higher education. Marginal public cost = costs incurred by the government for each student's education (government subsidy). Net private benefit = marginal private benefit—marginal private cost. Net social benefit = marginal social benefit—marginal social cost. Illustration assumed that each student generates $10,000 in benefits to the public, and that the government subsidy is set so that the marginal private cost does not exceed $17,000

Finally, the most cost-effective non-uniform subsidy approach for the government would be to provide funding to only those students for whom MSB > MPC > MPB and limit the subsidies to the amounts needed to make their net private benefits positive. Returning to the numerical illustration in Table 6.6, suppose that the government implemented a targeted subsidy where they only provided subsidies to students C and D. Furthermore, the subsidies were set at levels that are just high enough to lead to positive net private benefits for these two students, which would then entice them to want to go to college. Student C would still change his or her mind about going to college even though the subsidy is much lower in this case than it was in the prior two illustrations.

In Table 6.7, we provide a comparison of costs and benefits to the government for these four different approaches to higher education subsidies. The first column shows the gain in public benefits that occur due to subsidies. In each case, the numbers were chosen so that two students (C and D) who did not attend college prior to the subsidy changed their minds and decided to go to college after the subsidies. Because each student generated $10,000 in public benefits, the total benefit from each policy was $20,000. The second column of figures provides the cost of the subsidies to the government. Note that costs are not incurred for those students who do not go to college. For the uniform subsidy, the total cost to the government is $40,000 because four students who were offered the subsidy enrolled in college. It can be seen that the uniform subsidy approach is the most expensive option of the four shown here in this illustration. The last column contains the net benefit to the government, defined as the benefit minus cost. For these examples, the targeted subsidies are the most cost efficient because fewer subsidies are given to those students who would have gone to college without them. What is not shown here, however, are the implementation costs with each option. These costs are likely

Table 6.6 Hypothetical example of targeted grants on marginal cost and benefits for five students

		Before subsidy		After Subsidy			
Student	Marginal benefit (private)	Marginal cost (social)	Marginal cost (private)	Government subsidy	Marginal cost (private)	Net private benefit	Will student want to attend college?
A	$30,000	$15,000	$15,000	$0	$15,000	$15,000	Yes
B	$26,000	$19,000	$19,000	$0	$19,000	$7,000	Yes
C	$22,000	$23,000	$23,000	$2,000	$21,000	$1,000	Yes
D	$18,000	$27,000	$27,000	$10,000	$17,000	$1,000	Yes
E	$14,000	$31,000	$31,000	$0	$31,000	−$17,000	No

Notes: Marginal private benefit includes the financial and non-financial benefits received by the student from college, converted to dollars. Marginal private cost includes the financial and non-financial costs incurred by the student from college, converted to dollars. Marginal public benefit = benefits from each student (in dollars) to the government from higher education. Marginal public cost = costs incurred by the government for each student's education (government subsidy). Net private benefit = marginal private benefit—marginal private cost. Net social benefit = marginal social benefit—marginal social cost. Illustration assumed that each student generates $10,000 in benefits to the public, and that the government is only given to two students (C and D) in amounts needed to make their net private benefits equal $1,000

Table 6.7 Comparison of costs and benefits from hypothetical examples

Government policy	Public benefits	Cost to the government	Benefit minus cost
Uniform subsidy	$20,000	$40,000	−$20,000
Non-uniform subsidy	$20,000	$22,000	−$2,000
Cap on marginal private cost	$20,000	$18,000	+$2,000
Targeted grant	$20,000	$12,000	+$8,000

to be higher for non-uniform policies, which lowers their net benefit. We return to this issue in the Policy Focus section of the chapter.

Extensions

Up to this point in the chapter, we have focused on the idea that when students go to college, they produce spillover benefits for the public at large and that government intervention could be used to help entice more students to go to college for the good of society. What we have not yet discussed is what happens to these spillover benefits once they are produced, and should it matter to governments. In this extension, we argue that both the production and retention of public benefits shape governmental higher education subsidy policies.

To see why the retention of public benefits is important, note that the spillover benefits from college are not likely to be evenly distributed over the population. Economic positive externalities from higher education, such as an improved standard of living and higher tax collections, will be more highly concentrated in the community, state, and nation where the student resides. A person who moves to Iowa City, Iowa with a Bachelor's degree in finance, for example, may create financial benefits on others living in the town of Iowa City, Johnson county, and the state of Iowa, but would have very minimal financial impacts on communities in New Hampshire. Similarly, the non-financial positive externalities from higher education such as improved civic participation, lower crime rates, and so on, also would occur most often in the area close to where the individual lives.[13] It is likely the case that most of the positive externalities created by going to college follow the student to wherever he/she resides.

As a result, governments may be worried that some of the public benefits that they financed go to help people in other jurisdictions. This concern is particularly true at the state level in the United States because students can easily move from one state to another and take their positive externalities with them. Of course, the same problem could occur at the national level; however, it is typically more difficult for individuals in the United States to move across national borders, and thus less risk that a nation's higher education subsidy will instead be used to benefit another nation. Incidentally,

[13] An interesting discussion of this topic can be found in Moretti (2012).

this risk is higher in many other parts of the world. The creation of the European Union and the Bologna Process, for example, has made it easier for students from one country in the region to study and live in other countries in the same region. And given the substantial numbers of students who come to the United States from other nations to study, there is understandable concern from the home countries that they will experience "brain drain" if the students do not return following graduation from college. Accordingly, the positive externalities from a nation's higher education system may end up being captured by other nations.

One way in which governments try to keep a greater share of the public benefits that they finance is by requiring that the subsidy be used at an institution within the jurisdiction of the government (Toutkoushian & Hillman, 2012). Such restrictions apply to state appropriations because in order to receive the subsidy in the form of lower in-state tuition rates, a student has to attend an institution in the state. This means that the student (normally) lives within the state during college, and thus most of the positive externalities that are created during their postsecondary education stay within the state. Similar restrictions are usually placed by states on the use of non-uniform subsidies such as need-based and merit-based aid programs. As noted earlier in this chapter, Indiana's Twenty-first Century Scholars program requires scholarship recipients to attend an in-state institution. State policy makers also hope that by tying the subsidy to attending an in-state institution, students who use the subsidies may be more likely to live in the state following graduation, thus providing even more positive externalities to the state. There is always the risk that a student may move to another state or nation and take their spillover benefits with them. Of course, this is offset to some degree by the benefit states receive when college-educated individuals from other states and nations move into their state. From a state's perspective, attracting college-educated workers from other places is a benefit because it can derive positive externalities from the mover's higher education without having to pay for it.

Many states share similar concerns and preferences that their own state's citizens will be the beneficiaries of the positive externalities generated by state subsidies to their public institutions. In 2014, the Iowa Board of Regents approved a new performance-based funding (PBF) formula for allocating state appropriations among its several public universities. The most distinctive feature of the PBF formula is that the plan bases 60 % of each year's allocation of state funding on each university's enrollment of in-state students (http://www.regents.iowa.gov/). This policy is consistent with the assumption that positive externalities generated by in-state students are more likely than those generated by out-of-state students to stay in the state.

Policy Focus

We now consider two examples of policy relating to government intervention in higher education markets. The first example focuses on the philosophical approach used by states to financially support higher education for its citizens. The debate centers around whether it is better to keep prices low for everyone ("low-tuition / low-aid") or allow for higher prices and corresponding higher levels of financial support for designated students ("high-tuition / high-aid"). The second policy example is the debate around the proper share of social costs for higher education that should be borne by the government.

High-Tuition/High-Aid vs. Low-Tuition/Low-Aid

As discussed in this chapter, there are a number of different ways in which states may choose to intervene in higher education markets. States must decide how much total support to give, whether to give the support to students, institutions, or both, and how to distribute the support among various entities. Most of the approaches used by states for financially supporting their public 4-year systems can be arranged into two broad policy categories: (a) low-tuition / low-aid model, and (b) high-tuition / high-aid model. Although some states still espouse commitments to low tuition at its public 4-year institutions, many students now face systems of public 4-year institutions in which a much higher tuition rate than in the past has become the norm. A growing number of states must wrestle with evolving high-tuition, public, 4-year systems and engage in efforts to provide either need-based or merit-based grants to students, with an eye toward addressing the accessibility of their public 4-year institutions in light of their rapidly-rising tuition price tags.

These two approaches rely on different philosophies regarding the best way for states to financially subsidize their higher education systems. In the low-tuition / low-aid model, the notion is that charging a relatively low tuition rate for in-state students will encourage more to go to college, and will treat all citizens in a similar manner. These states rely more heavily on uniform subsidies to institutions and/or students. In contrast, the proponents of the high-tuition/high-aid model argue that the best approach for encouraging college-going behavior among citizens is to direct more financial subsidies to those students who are least able to pay. By using non-uniform subsidies, these states can in theory produce more positive externalities for the state at a lower cost.

Although the potential effectiveness of the high-tuition, high-aid policy approach sounds promising when practiced under ideal circumstances, scholars have observed that thus far, some states' experiences with such policies have revealed challenges with efforts to coordinate and implement broad-based aid programs.[14] It is also interesting to note that despite the potential efficiency arguments in favor of using non-uniform and targeted subsidies, more than 90 % of state government subsidies in the United States are uniform subsidies in the form of block grants to institutions.

[14] See Hearn, Griswold, and Marine (1996), Johnstone (1993), and Toutkoushian and Shafiq (2010) for more discussion of these implementation challenges.

There are several explanations that may help us understand this disconnect between theory and practice. First, governments face different costs of implementing approaches to higher education subsidies. It is easiest—and thus less expensive—for a government to simply provide a block grant subsidy to institutions than implement a non-uniform subsidy because fewer procedures must be put in place to figure out how to distribute the subsidies. In contrast, to implement a non-uniform subsidy program the government would have to develop more extensive procedures for figuring out how much money to give specific students. Resources (time and money) are needed to review each student's financial information and then determine how much subsidy is required to change each student's mind about going to college. Because this information is unobservable to government policy makers, they must use proxy variables that are thought to be related to the amount of subsidy needed. Such proxy variables might include family income, number of family members in college, academic ability, race/ethnicity, and so on. The gathering, processing, and verification of this information is a costly activity that would reduce the net financial benefit for the public from a targeted (non-uniform) subsidy program.

There are political considerations that also help explain the popularity of uniform state subsidies for higher education. According to the median-voter model of political behavior, politicians will act in ways to try and appease the average, or median, voter within their jurisdiction. As a result, policies that provide benefits to more voters would tend to receive more political support than other policies. In higher education, state appropriations provide benefits to a large number of students and their families, whereas targeted need-based financial aid programs would tend to help fewer individuals. This means that if a state government attempted to replace block grant appropriations that benefit many students with larger and targeted need-based financial aid for fewer students, this policy would likely encounter political resistance from more constituents than would support the change. The political difficulties of changing subsidy policy may be even greater if it is true that the families who would receive need-based aid are less politically active than the larger population of college-going students who benefit from state block grants to institutions.

In addition, public colleges and universities themselves may be resistant to changing the structure of governmental support for higher education away from block grant subsidies to institutions. State appropriations represent a relatively stable source of revenue that helps these institutions with financial planning, whereas replacing block grants with student-based aid would introduce more variability into its revenue streams. As a result, public colleges and universities on the whole would be likely to put pressure on legislative bodies to maintain the current subsidy structure over a non-uniform and targeted subsidy program.

Sharing the Cost of Higher Education

Finally, we return to perhaps the most important and vexing policy question on this topic: who should pay what portions of the social costs of delivering higher education services? Based on the benefits-received principle of equity that is part of public sector economics, the answer is: "Each party who benefits should pay a portion of the cost". In the case of postsecondary education, if there are positive externalities created when students go to college, then both the student and society benefit to some degree from the service and each should share the financial burden.

However, there is a longstanding debate about the relative size of benefits received by private individuals and the public at large when students acquire postsecondary education.[15] Better and more accurate estimates of the value of public external benefits are essential to moving this debate forward. In the first decade of the 2000s, the ongoing—and largely *de facto*—privatization of the public sector of higher education is one vivid indication that even though society and policy makers in general understand that the value of private benefits to students is substantial, neither society nor policy makers have yet reached agreement about exactly how large these benefits are, and what their relative shares of financial support should be.

In theory, if half of the total (social) benefits from higher education accrue to students and the other half is in the form of spillover benefits to the public, then the benefits received principle would dictate that higher education costs should be divided equally between students and governments. In practice, however, it is hard to determine the "right" shares of costs that should be borne by these two parties because it is very difficult to measure the public and private benefits due to students going to college. Recall from Chap. 4 that there are numerous challenges with trying to quantify the private and social financial benefits from college. As a result, higher education policy makers cannot pin down with any measure of precision the correct shares of costs that should be paid by individuals and governments.

The lack of sufficient information about public and private benefits from higher education has contributed to the debate in the United States about how much governmental financial support for higher education is needed. The funding of higher education in the United States has been steadily shifting over time from public to private sources. Slow growth (or in some cases actual reductions) in state appropriations per student to public institutions, in combination with growth in the costs to institutions of educating their students, has led to large yearly increases in tuition. The College Board (2012) reports that for public doctoral-granting institutions, for example, net tuition as a percentage of total expenditures has increased from 37 % in 1999–2000 to 53 % by 2009–2010. Similar increases were reported for other public colleges and universities as well. At the same time, although the level of state funding for public institutions has usually increased each year, the share of total revenues from state funding has fallen steadily over time.[16]

[15] More details on this debate can be found in Carnegie Commission (1973), Johnstone and Marcucci (2010), and McMahon (2009).

[16] Toutkoushian (2001), for example, documents that between 1975 and 1995, state appropriations as a percentage of net education and general revenues fell from 57 to 47 %. Similarly, the College Board (2012) has shown that from the 1980s through 2012, state appropriations grew at a slower rate than enrollments and total revenues.

Those who feel that most of the benefits from higher education are private and not public would argue that this trend is appropriate, while others would argue that the opposite is true. The debate is particularly relevant for Europe, where students often pay small or zero amounts of tuition and fees for higher education. But is this the right mix of funding? An argument can be made that if some of the benefits from college are captured only by the student, then it would be more socially efficient and equitable to have the student pay a portion of the cost of their education.

And it should be understood that higher education can never be truly "free" even if no tuition is charged to the student. There is still a social cost of higher education that must be paid by someone, otherwise the service could not be provided. Government subsidies are paid through taxes that are levied against citizens, businesses, and other entities. In essence, these entities end up paying for the free education of others. If the public benefits from higher education are very large, then one would argue in favor of a mix of funding more heavily tilted towards the government. The debate as to what is the right mix will certainly continue as long as academics have difficulty measuring the private and social benefits form higher education.

Final Thoughts

Free and competitive markets are the cornerstone of much of microeconomic theory. Nonetheless, economists have identified situations under which an unfettered market may not lead to the socially-optimum allocation of goods and resources in the economy. This argument is often made about higher education, in that there is the belief that not only do students themselves benefit when they go to college, but so do those around them. If this is true, and if students only base their postsecondary decisions on the private costs and benefits that they face, then the market system would lead to too few people enrolling in college from the perspective of society.

In this instance, it may be justifiable for the government to intervene in the competitive market. This intervention takes the form of financial incentives that reduce the cost paid by students. The hope is that by reducing the net price to the student, there will be some at the margin who would then decide that it is now in their best interest to go to college because their private benefit exceeds the new cost. We outlined how governments may provide these subsidies in either a uniform or non-uniform manner, and discussed some of the implementation and political issues that governments must address when choosing an appropriate strategy.

Glossary

Symbol	Definition
P_{pri}	Equilibrium price based on private demand
Q_{pri}	Equilibrium quantity based on private demand
D_{pri}	Private market demand curve
S	Market supply curve
D_{pub}	Public market demand curve
D_{soc}	Social market demand curve
P_{soc}	Equilibrium price based on social demand
Q_{soc}	Equilibrium quantity based on social demand
MPB	Marginal private benefit
MPC	Marginal private cost
MSB	Marginal social benefit
MSC	Marginal social cost

References

Baum, S., Ma, J., & Payea, K. (2013). *Education pays 2013: The benefits of higher education for individuals and society*. New York: The College Board.

Boardman, A., Greenberg, D., Vining, A., & Weimer, D. (2001). *Cost-benefit analysis: Concepts and practice*. Upper Saddle River, NJ: Pearson-Prentice Hall.

Bowen, H. (1977). *Investment in learning: The individual and social value of American higher education*. San Francisco: Jossey-Bass.

Buchanan, J. (1965). An economic theory of clubs. *Economica, 32*, 1–14.

Carnegie Foundation for the Advancement of Teaching. (1973). *Higher education: Who pays? Who benefits? Who should pay?* New York: McGraw-Hill.

College Board. (2012). *Trends in college pricing 2012*. New York: The College Board.

Cornes, R., & Sandler, T. (1996). *The theory of externalities, public goods and club goods* (2nd ed.). Cambridge, UK: Cambridge University Press.

Grace, G. (1989). Education: Commodity or public good? *British Journal of Educational Studies, 37*, 207–221.

Gramlich, E. (1998). *A guide to benefit-cost analysis*. Prospect Heights, IL: Waveland Press.

Hearn, J., Griswold, C., & Marine, G. (1996). Region, resources, and reason: A contextual analysis of state tuition and student aid policies. *Research in Higher Education, 37*, 241–278.

Hyman, D. (2008). *Public finance: A contemporary application of theory to policy*. Mason, OH: Thomson-Southwestern.

Institute for Higher Education Policy. (1998). *Reaping the benefits: Defining the public and private value of going to college*. Washington, DC: Institute for Higher Education Policy.

Institute for Higher Education Policy. (2005). *The investment payoff: A 50-state analysis of the public and private benefits of higher education*. Washington, DC: Institute for Higher Education Policy.

Institute for Higher Education Policy. (2012). *The investment payoff: Reassessing and supporting efforts to maximize the benefits of higher education for underserved populations*. Washington, DC: Institute for Higher Education Policy.

Johnstone, B. (1993). *The high-tuition—high-aid model of public higher education finance: The case against*. Albany, NY: State University of New York, for National Association of System Heads.

Johnstone, B., & Marcucci, P. (2010). *Financing higher education worldwide: Who pays? Who should pay?* Baltimore, MD: The Johns Hopkins University Press.

Leslie, L., & Brinkman, P. (1988). *The economic value of higher education*. New York: Macmillan.

Lochner, L., & Moretti, E. (2004). The effect of education on crime: Evidence from prison inmates, arrests, and self-reports. *American Economic Review, 94*, 155–189.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: The Johns Hopkins University Press.

Marshall, A. (1890). *Principles of economics, Book X* (7th ed.). London: Macmillan.

Moretti, E. (2012). *The new geography of jobs*. New York: Houghton Mifflin Harcourt Publishing Company.

Musgrave, R. (1939). The voluntary exchange theory of public economy. *The Quarterly Journal of Economics, 53*, 213–237.

Nicholson, W., & Snyder, C. (2010). *Microeconomic theory: Basic principles and extensions* (10th ed.). Mason, OH: Thomson-Southwestern.

Olsen, M. (1965). *The logic of collective action*. Cambridge, UK: Harvard University Press.

Paulsen, M., & Fatima, N. (2007). Higher education and growth in state workforce productivity, 1980–2000: Evidence on the public benefits of college education. In P. B. Richards (Ed.), *Global issues in higher education* (pp. 37–56). New York: Nova Publishers.

Paulsen, M., & Toutkoushian, R. (2006). Overview of economic concepts, models and methods for institutional research. In R. Toutkoushian & M. Paulsen (Eds.), *Applying economics to institutional research* (New Directions for Institutional Research, no. 132, pp. 5–24). San Francisco, CA: Jossey-Bass Inc.

Pigou, A. (1920). *The economics of welfare*. London: Macmillan.

Pindyck, R., & Rubinfeld, D. (2009). *Microeconomics* (7th ed.). Upper Saddle River, NJ: Pearson-Prentice Hall.

Samuelson, P. (1954). The pure theory of public expenditure. *The Review of Economics and Statistics, 36*, 387–389.

Sandler, T., & Tschirhart, J. (1980). The economic theory of clubs: An evaluative survey. *Journal of Economic Literature, 18*, 1481–1521.

Sandler, T., & Tschirhart, J. (1997). Club theory: Thirty years later. *Public Choice, 93*, 335–355.

Sidgwick, H. (1887). *Principles of political economy*. New York: Macmillan.

Stiglitz, J. (1999). Knowledge as a global public good. In I. Kaul, I. Grunberg, & M. Stern (Eds.), *Global public goods: International cooperation in the 21st century* (pp. 308–325). New York: Oxford University Press.

Tiebout, C. (1956). A pure theory of local expenditures. *Journal of Political Economy, 64*, 416–424.

Toutkoushian, R. (2001). Trends in revenues and expenditures in public and private higher education. In M. Paulsen & J. Smart (Eds.), *The finance of higher education: Theory, research, policy & practice* (pp. 11–38). New York: Agathon Press.

Toutkoushian, R., & Hillman, N. (2012). The impact of state appropriations and grants on access to higher education and state outmigration. *The Review of Higher Education, 36*, 51–90.

Toutkoushian, R., & Shafiq, N. (2010). Should states use appropriations or need-based financial aid to support higher education? *Research in Higher Education, 51*, 40–64.

Weimer, D., & Vining, A. (2005). *Policy analysis: Concepts and practice* (4th ed.). Upper Saddle River, NJ: Pearson-Prentice Hall.

Wiseman, J. (1957). The theory of public utility price – An empty box. *Oxford Economic Papers, 9*, 56–74.

Wolfe, B., & Haveman, R. (2002). Social and nonmarket benefits from education in an advanced economy. Conference series; [Proceedings]. *Federal Reserve Bank of Boston, 47*, 97–142.

Chapter 7
Higher Education Revenues and Expenditures

Abstract In this chapter, we look at the revenues and expenditures for postsecondary institutions. As in prior chapters, we begin this chapter by providing some background information on the early work that economists have done to examine organizational finances, and its eventual application to colleges and universities. We then turn to the ways in which economists analyze revenues for organizations, and how this relates to the revenues that are received by colleges and universities. Building on Chap. 5, we highlight the important role that subsidies play in funding the operations of institutions of higher education. From there, we examine the expenditure side of the ledger and how economists look at the cost structure for organizations and how this relates to colleges and universities. In the extension to this model, we focus on how some institutions assign revenues and costs to academic units within the institution using what is referred to as a decentralized budgeting process. Finally, we conclude the chapter with a policy discussion of decisions to close or merge postsecondary institutions and the connection to finances.

Introduction

In the first half of this book, we examined the demand side of higher education markets. The focus of these earlier chapters was on the ways in which individuals and society participate in and benefit from postsecondary education. As explained in Chap. 5, however, postsecondary markets need both demanders and suppliers to set prices and allocate services. In the next two chapters we focus on the economic dimensions of the supply side of higher education markets; namely, how do colleges and universities operate? Although our discussion of suppliers will center on postsecondary institutions, other entities can also be thought of as suppliers of postsecondary education. In the United States, for example, decisions about the number, type, missions, and locations of postsecondary providers are made by state governments, university systems, postsecondary education commissions, and coordinating boards. Internationally, the same decisions are often made at the national level. Accordingly, these entities are also suppliers of higher education services.

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_7

When economists look at how organizations behave, they consider several questions: (1) Where does the organization get its money? (2) How does the organization spend its money? (3) What goal or objective is the organization trying to achieve? And (4) How does the organization compete with other organizations for customers and resources? These fundamental questions apply to not-for-profit organizations such as hospitals, churches, and universities as much as they do to for-profit corporations. The generality of these concepts extends well beyond the examples found in economics textbooks that primarily focus on privately-run companies and assume that the goal of the company is to maximize profits. Even though most postsecondary institutions are not-for-profit organizations, they still need to be concerned with how to finance their operations, and whether their resources are being used in such a way that it will help them best achieve their goals subject to the constraints they face.[1]

In the next two chapters, we tackle these questions with regard to institutions that operate in higher education markets. Specifically, in Chap. 7 we look at the revenues and expenditures for postsecondary institutions, and then in Chap. 8 we address how colleges and universities operate and compete in markets for students, faculty, and other resources. As in prior chapters, we begin this chapter by providing some background information on the early work that economists have done to examine organizational finances, and its eventual application to colleges and universities. We then turn to the ways in which economists analyze revenues for organizations, and how this relates to the revenues that are received by colleges and universities. Building on Chap. 6, we highlight the important role that subsidies play in funding the operations of institutions of higher education. From there, we examine the expenditure side of the ledger and how economists look at the cost structure for organizations and how this relates to colleges and universities.[2] In the extension to this model, we focus on how some institutions assign revenues and costs to academic units within the institution using what is referred to as a decentralized budgeting process. Finally, we conclude the chapter with a policy discussion of decisions to close or merge postsecondary institutions and the connection to finances.

[1] Some of the important books that have been written on higher education finance issues include H. Bowen (1980), McPherson, Schapiro, and Winston (1993), Clotfelter (1996), Paulsen and Smart (2001), Ehrenberg (2006), and Weisbrod, Ballou, and Asch (2008).

[2] Throughout this chapter, we use the terms "expenditure" and "cost" interchangeably to refer to the monies spent by postsecondary institutions for the delivery of services. These terms should not be confused with the costs/expenditures incurred by students and their families to go to college, nor the cost/expenditures of federal and state governments to help support higher education.

Background

Firms and businesses have existed for a long time, dating back to the shift away from agrarian societies and towards the mass production of goods through the Industrial Revolution in the eighteenth century. With the Industrial Revolution and the pioneering work of Adam Smith and his contemporaries, academics began to pay attention to these organizations and how they behave in markets. Much of this early work centered on firms at the market or industry level, and the role of the market supply curve in helping to determine equilibrium prices and output. Economists in the nineteenth century developed the notion of a supply curve to represent how the price received affects firms' decisions about the quantity of output to produce.[3] Of particular note are the contributions of Mangoldt (1863) who examined how costs affect the shape of the firm's supply curve and introduced the concept of economies and diseconomies of scale.

The early twentieth century work by economists featured a renewed interest in the behavior of individual firms as opposed to an entire market.[4] Ronald Coase (1937), for example, examined the notion of transaction costs for firms. He argued that the existence and size of firms is related to the transaction costs that they may incur (internal) and that can occur outside of the firm (external). Another important avenue of work involved expanding the traditional concept of a firm to organizations that produce multiple outputs. Such multi-product firms face particular challenges such as how to allocate fixed resources across the various outputs. As noted by Pfouts (1961, p. 651): "…within the firm, each product is competing with all of the firm's other products for the use of available fixed resources. Therefore the multi-product firm cannot legitimately be regarded as a collection of single-product firms."[5] It is easy to see the importance of this analogy to colleges and universities, many of which are also multi-product firms delivering instructional, research, and public service outputs.

Economists presumed that, as is true for any decision maker, firms seek to make the best of their situation. For the majority of cases, the behavioral assumption was made that firms attempt to maximize their profits. The notion of profit-maximizing behavior has become a staple of economic analysis of the firm, and used to describe

[3] Early discussions of supply can be found in the work of Adam Smith (1776). Cournot (1838) is credited with being the first to introduce a supply curve to represent the schedule of quantities of output that would be supplied at different prices. The supply curve was later enhanced by Rau (1841) and most notably Mangoldt (1863). An excellent analysis of the history of supply curves can be found in Humphrey (1996).

[4] Readers who are interested in more details about the evolution of economic thinking with regard to the firm are referred to the works by Berle and Means (1933), P. Hall (1987), R. Hall and Hitch (1939), Putterman (1998), Kroszner and Putterman (2009), Williamson (1971), and Moss (1984).

[5] As cited by Pfouts (1961), the concept of multi-product firms can be traced back to Hicks (1946), Weldon (1948), Clemens (1951–52), and Bailey (1954). Other important studies from economics of multi-product firms include Teece (1982) and Panzar and Willig (1977).

the actions of firms across different market structures. It was not until the 1970s that economists began to regularly study other types of organizations where profit maximization was not the goal and assuming a profit motive was not the best way to understand their behavior. A number of not-for-profit organizations, including churches, public schools and hospitals, are not owned by shareholders and therefore do not distribute profits to them. Economists have since examined the behavior of not-for-profit organizations, and showed that many microeconomic principles could likewise be applied to organizations in these settings.[6] In a nutshell, economics posits that every decision maker, be it an individual consumer, an organization, or a government, tries to make the best out of its situation given its limited resources. Not-for-profit organizations still have goals and objectives as would firms in the for-profit world, with the only differences being that the goals/objectives are more diverse and less well defined for not-for-profit organizations. And not-for-profit organizations still have to ensure that their revenues are sufficient to cover their expenses so that they may stay in business. In fact, in many instances not-for-profit institutions are permitted and even encouraged to bring in more revenues than expenditures. Accordingly, having an understanding of where colleges get their money (and the forces behind these revenue streams), and how they spend their money, is essential to understanding their behavior and success in markets.

Economic Analysis of Revenues

There are three measures of revenues that are commonly used by economists when examining organizations. The first of these is *total revenue* (TR), which represents the monies received by an organization for its operations. When all of a firm's revenues come through the sale of one specific good or service, its total revenue is simply the quantity of output sold (Q) times the equilibrium price per unit (P):

$$TR = P \times Q \tag{7.1}$$

This is shown graphically in Fig. 7.1, where for simplicity we assume that a college faces a linear demand curve for spaces. In this example, if the college charged a tuition rate (P) of \$24,000 for each student, then 10,000 students (Q) would be willing and able to enroll at that price. As a result, if this was the college's only source of revenue then its total revenue would be \$24,000 × 10,000 = \$240 million.

[6] Among the first economic studies of the non-profit sector was the Newhouse's (1969) study of hospitals. Additional studies of note in the economic literature on not-for-profit organizations include Hansmann (1987), Weisbrod (2009), James (1983), Steinberg and Gray (1993), P. Hall (1987), Steinberg (2003), and Easley and O'Hara (1983).

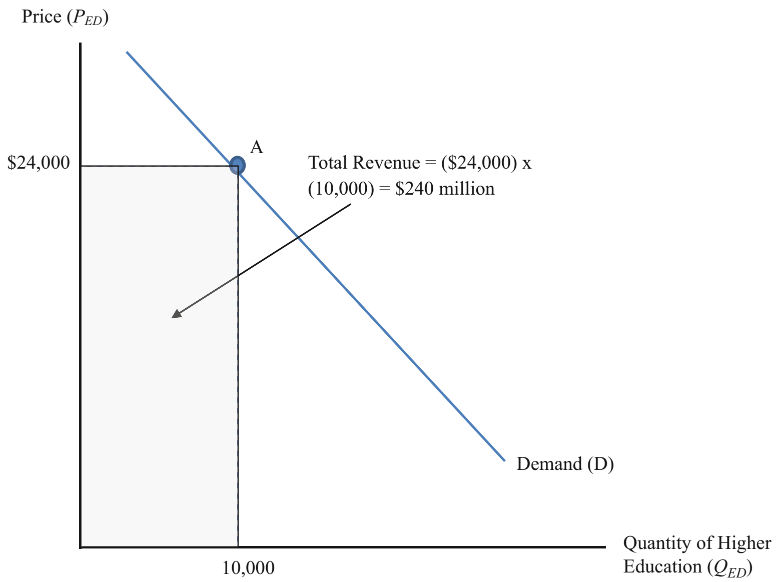


Fig. 7.1 Total revenue and demand

Of course, this simple formula does not fully capture the ways in which most postsecondary institutions generate revenue. In particular, institutions often charge different prices to different groups of students. When firms do this, it is referred to as price discrimination. Despite its name, price discrimination does not always imply illegal or inappropriate behavior on the part of the organization with regard to pricing. The most notable example of price discrimination in higher education is that public institutions charge a higher tuition rate to out-of-state students than they do to in-state students. In addition, colleges may give more financial aid to students from lower-income families or students with better academic qualifications, which also results in different groups of students paying different prices. If a firm sells its product to K different customers at different prices, then the total revenue formula can be generalized as:

$$TR = \sum_{k=1}^{K} P_k x Q_k \tag{7.2}$$

where P_k = price charged to the k-th group of customers and Q_k = quantity or output of the good or service sold to the k-th group.

This total revenue formula for postsecondary institutions also must be expanded to account for other revenues that they receive. Tuition and fees are only a fraction of the revenues taken in by a college or university. Colleges not only receive money from students and their families, but also from national, state, and local governments, private donors, merchandise sales, and other entities. Winston (1999) treats all of these non-student revenues as subsidies. These can be added to the total revenue calculation as follows:

$$TR = \sum_{k=1}^{K} P_k x Q_k + G \tag{7.3}$$

where G represents revenues or subsidies from all sources other than students and their families for tuition and fees.

A second key revenue term used by economists is a*verage revenue* (*AR*). This is defined as the ratio of total revenue to the output of the organization:

$$AR = TR/Q = TR/\sum_{k=1}^{K} Q_k \tag{7.4}$$

Note that the average revenue takes into account the prices charged to different groups of customers, as well as subsidies received by the organization. In addition, whenever the organization receives subsidies ($G > 0$), the average revenue will overstate the amount of funding brought into the organization solely from the sale of goods and services to customers. The average revenue metric is most useful in situations where Q is a meaningful measure of the total output of the organization. If the firm only produces one good or service, then Q obviously represents the total number of units produced. Or when the firm makes several goods or services that are similar in nature, the sum of the different units produced can often be treated as an approximation of the total output of the organization.

In postsecondary education, it is common to use the number of students enrolled as a measure of output, and then calculate average revenue by dividing total revenue by enrollments. However, this practice can be misleading due to the nature of postsecondary institutions. As noted earlier, colleges are multi-product firms that provide services to various customers in the areas of teaching, research, and public service. The quantities of services supplied in each of these three broad areas cannot be easily summed to obtain an aggregate measure of an institution's total output. To illustrate, suppose that in a given academic year a postsecondary institution enrolled 2000 students, published 100 articles in academic journals, and participated in 30 public service initiatives for the state. How should these quantities be added together to represent the total output of the institution? Dividing total revenues from all activities by the number of students by definition leads to an overstatement of revenues per student because some portion of revenues was not provided by them, and some revenues were intended for other purposes.

The issue of how to define and measure the total output of a college becomes even more difficult when we look at productivity within each of these categories. In teaching, a college may provide educational services to undergraduate and graduate students, or chemistry and history majors, and yet the resources used for instruction for each group are quite different. This problem is most pronounced in the area of research, where the output of faculty members includes patents, books, articles in peer-reviewed journals, and even creative works and artistic performances. As a result,

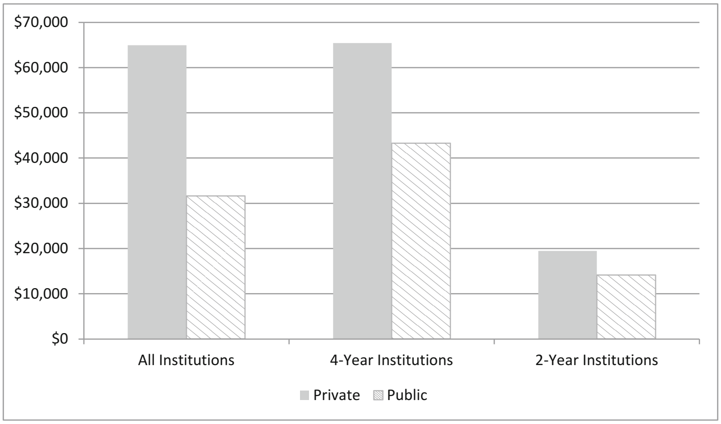


Fig. 7.2 Average revenue per student by type of institution, 2010–2011 (*Notes*: Data were obtained from the Digest of Education Statistics 2012, Tables 401 and 405. Statistics were derived by dividing total revenues from all sources by the number of full-time equivalent students)

there are a variety of ways to define average revenue, depending on which output measure is divided into total revenue. None of these should be strictly interpreted as the average amount of funding received for any one particular output measure.

With these caveats in mind, in Fig. 7.2 we provide data on the average revenue *per student* for public and private institutions by level of institution in 2010–2011. It can be seen that the average revenue per student for all private institutions ($64,924) was more than double the amount for all public institutions ($31,627). Some of this difference is due to the higher concentration of 2-year institutions in the public sector, whereas almost all private not-for-profit institutions award bachelor degrees. Nonetheless, there is still a sizable gap in the average revenues per student between private and public 4-year institutions ($65,412 for private and $43,275 for public).

The average revenues per student for each sector mask substantial differences in revenues within the sectors based on the mission of the institution. To illustrate, in Fig. 7.3 we report the average revenues per student for private not-for-profit, 4-year institutions in 2010–2011 broken down by institutional categories developed by the Carnegie Commission. In 2005 the Carnegie Commission placed 4-year institutions into one of five categories, where the categories represent estimates of the level of research activity at the institution: (1) Very High Research; (2) High Research; (3) Doctoral; (4) Master's; and (5) Bachelor's.[7] The differences in average revenue per student across these five groups of institutions are striking. Private institutions in the most research-intensive category have an average revenue per student of $213,162, which is more than four times greater than the next research-intensive category ($50,543). Interestingly, the average revenue per student at 4-year private

[7] Details on the 2005 Carnegie classifications of postsecondary institution can be found at http://classifications.carnegiefoundation.org/resources/.

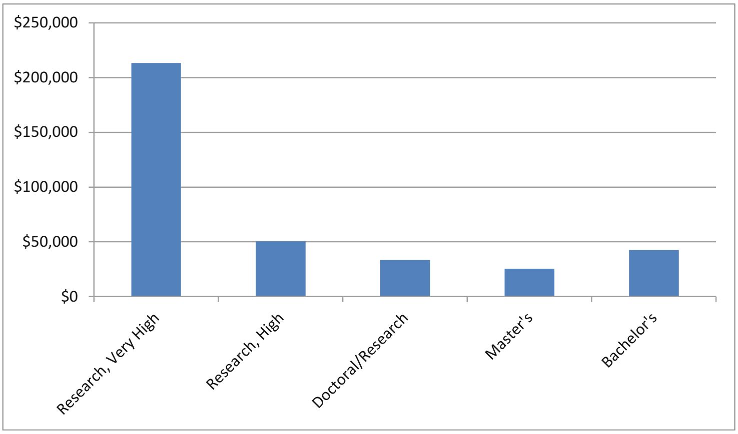


Fig. 7.3 Average revenues per student by type of 4-year private institution, 2010–2011 (*Notes:* Data were obtained from the *Digest of Education Statistics 2012*, Table 406. Statistics were derived by dividing total revenues from all sources by the number of full-time equivalent students. Private institutions were categorized according to the level of research activity as determined by the 2005 Carnegie Classification system http://classifications.carnegiefoundation.org/resources/. Data only include 4-year private not-for-profit institutions)

bachelor institutions ($42,502) is greater than the averages for doctoral ($33,509) and master's ($25,508) institutions. These differences reflect the fact that some private bachelor-level institutions are prestigious, highly-selective liberal arts institutions that are relatively well funded for their degree level. At the same time, these large figures do not suggest that institutions have this much revenue at their disposal solely for the teaching of students.

The average revenues per student for institutions can fluctuate from year to year as both the levels of resources and enrollments change. Figure 7.4 shows the trend in average revenues per student for 4-year public and private institutions from 2005–2006 to 2010–2011. The trend line for public institutions is relatively flat, indicating that average revenues per student are fairly stable over time. In contrast, the average revenues for private institutions fluctuated wildly over this 6-year period. Particularly notable is that between 2006–2007 and 2008–2009 average revenues per student for private institutions fell from $69,048 to $23,798, and then rebounded to $56,310 the following year. The variability in average revenues for public and private institutions is affected by the stability in the sources of revenues that each receives, and private institutions depend more heavily than do their public counterparts on volatile revenue streams from investments and donations. We will return to this topic later in the chapter.

The final measure of revenue that economists frequently use is marginal revenue. M*arginal revenue* (*MR*) is defined as the change in total revenue when the organization produces an additional unit of output. When given a mathematical function for total revenue, marginal revenue is found by taking first partial

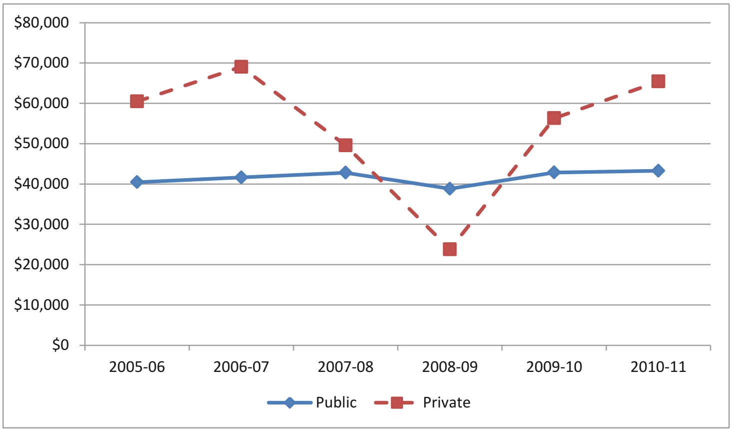


Fig. 7.4 Average revenues per student by type of institution, 2005–2006 to 2010–2011 (*Notes:* Data were obtained from the Digest of Education Statistics 2012, Tables 401 and 405. Statistics were derived by dividing total revenues from all sources by the number of full-time equivalent students, and all figures are expressed in constant dollars (2011–2012 base year). Data for 4-year public institutions for 2006–2007 were not available and were estimated using linear interpolation between adjoining years)

derivative with respect to output (i.e., $MR_k = \partial TR_k / \partial Q_k$). Marginal revenue can vary depending on the shape of the demand curve and where the firm is operating in relation to its demand curve when output rises. There is a connection between total revenue and own-price elasticity of demand for a linear demand curve (also see the discussion of elasticity in Chap. 5). In general, two things happen to total revenue when an organization lowers its price. First, the firm loses revenue because it now receives less money for each unit of output sold. At the same time, the firm gains revenue because it sells more units of output at the lower price. The resulting change in total revenue – marginal revenue – depends on the relative size of these two effects. Along a linear demand curve such as shown in Fig. 7.1, when prices are high the firm is operating in the elastic portion of the demand curve. For these firms, price reductions lead to increases in total revenue because the gain in revenue from selling more output more than offsets the loss in revenue from lowering the price. As the firm continues to lower its price and move downward along its linear demand curve, however, the change in total revenue will fall and become negative. Eventually, a further reduction in price causes the firm to lose more money than it can make up by selling its output to more customers. If demand is non-linear, then the relationship between price and total revenue depends on the specific functional form of the demand curve.

The connection between total revenue and own-price elasticity of demand is depicted in Table 7.1, where the institution is considering six different prices that it might charge students at points along its market demand curve. Because all students in this illustration are charged the same price and there are no other sources of

Table 7.1 Illustration of total revenue and own-price elasticity of demand

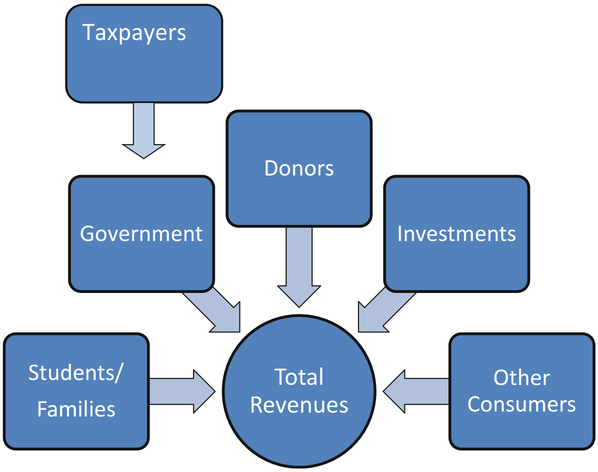
Point	Price	Quantity demanded	Tuition revenue	Change in tuition revenue	Own-price elasticity of demand
A	\$24,000	10,000	\$240 million	–	–
B	\$20,000	18,000	\$360 million	+\$120 million	−3.14
C	\$16,000	26,000	\$416 million	+\$56 million	−1.64
D	\$12,000	34,000	\$408 million	−\$8 million	−0.93
E	\$8000	42,000	\$336 million	−\$72 million	−0.53
F	\$4000	50,000	\$200 million	−\$136 million	−0.26

revenue for the institution, price is equal to average revenue. For simplicity we assume that the demand curve is linear (i.e., each \$4,000 reduction in price leads to an additional 8,000 students who would be willing and able to attend the institution). As the institution initially lowers its price from \$24,000 to \$20,000, it gains \$120 million in total revenue because the lost revenue from lowering its price (−\$4,000 × 10,000 = −\$40 million) is more than made up for by the added revenue from enrolling more students (+\$20,000 × 8,000 = +\$160 million). As the college continues to reduce its price and move down along its demand curve, however, the change in total revenue becomes smaller and smaller and eventually turns negative. Moving to the last column, it can be seen that whenever the own-price elasticity is between 0 and −1.00 (meaning demand is own-price inelastic), total revenue would fall if the price were cut even more.

The concept of tuition elasticity is very important to colleges when they make decisions about what tuition rate to charge students each year. If a college does not have a good sense of where it falls along the student demand curve, then it does not know whether raising tuition rates next year will cause tuition revenue to increase or decrease. The situation is further complicated by the fact that public institutions compete in separate markets for resident and non-resident students. Given that tuition rates at public institutions are much higher for non-resident students than for resident students, a uniform increase in price for both groups may lead to a lower gain or even a loss in tuition revenue from non-resident students relative to resident students.

Higher Education Subsidization Most firms in the for-profit world rely almost exclusively on their customers to provide funding to the organization. Firms sell their goods and services in product markets, and the price customers pay covers the full cost of production plus a markup for enough profit to keep the firm in business. The theoretical appeal of this approach to pricing is that the benefits in most for-profit markets are private in nature and thus pricing is consistent with the benefits received principle.

Fig. 7.5 Depiction of revenue sources for postsecondary institutions



In contrast, postsecondary institutions receive money from many different entities. We depict the general funding situation for postsecondary institutions in Fig. 7.5. The revenues for colleges and universities come from five main sources. Economists view these sources of funding as individuals or organizations that each have demand functions for specific types or quantities of higher education services that they want. The first and most obvious source of revenue is students and their families. Students give money to colleges in exchange for instructional and consumptive services, as well as for complementary services such as room and board and miscellaneous fees. The second source of revenue is government, where this can be defined at the federal, state, and local levels. As discussed in Chap. 6, governments give money to colleges primarily in exchange for reduced prices charged to state residents at public institutions, as well as to help colleges engage in research activities, and support selected projects that provide public service benefits. The third general source of funding for colleges and universities is donations. Donors include individuals, private foundations, and others who provide money to colleges to help support the overall mission, fund scholarships, and make infrastructure improvements. Fourth, institutions receive funding from their investments, mostly in the form of earnings on their endowments. Finally, the last source of funding is individuals who give financial support to institutions in exchange for non-instructional services provided by postsecondary institutions. Examples of these services include ticket sales to athletic and cultural events, sales of university merchandise, and medical services at institution-sponsored medical facilities.

We can make three important observations from Fig. 7.5. First, the primary consumers of postsecondary educational services – students and their families – are responsible for only a portion of an institution's total revenues. Although the burden for paying for college has been steadily shifting towards students over time, there is still a substantial amount of subsidization occurring in postsecondary education. Nearly four out of every five dollars received by 4-year public institutions, for example, are from sources other than the tuition and fees from students and their families. However, not all of these dollars are given to postsecondary institutions in exchange for instruction. Second, almost all of the funding for postsecondary institutions is in one way or another supplied by individuals. This even applies to government funding for colleges because the money is obtained from citizens through taxation. The burden for paying for the delivery of postsecondary services is shared among multiple groups of individuals, and the relevant question to ask is not should students have to pay for college, but how much of the cost should be paid by students and others in society.[8] And third, postsecondary institutions must rely on a range of entities to fund their operations. Whereas firms in for-profit markets can concentrate on pleasing their customers, postsecondary institutions must also be concerned with appealing to government officials, alumni, local residents, and fans of their athletic teams, as well as fluctuations in financial markets.

Gordon Winston (1997, 1999) offered a simple but useful framework for understanding how subsidies affect prices in higher education. He grouped revenues for colleges and universities into two broad categories: subsidized and unsubsidized revenues. Unsubsidized revenues represent monies obtained directly from students and their families, and subsidized revenues represent all other forms of financial support. In the case of a typical for-profit firm, all of its revenues would be considered unsubsidized.[9] Winston further articulated that these subsidies play an important role in the prices charged to students in postsecondary markets. He argued that in the for-profit world, average prices are set equal to the cost of producing a unit of output (AC) plus a per-unit markup to cover the normal level of profit needed to keep the supplier in business. Therefore the consumer pays the full cost of producing the good or service plus a little extra. In postsecondary markets, however, Winston asserted that the pricing equation should be thought of as average cost minus subsidies per unit.

We now combine the traditional notion of pricing with Winston's formulation into one general expression that can be used to represent average prices in most types of organizations, including colleges and universities:

$$\overline{P} = AC + \pi/Q - G/Q \tag{7.5}$$

where $\overline{P}$ = average price, π/Q = profit per unit of output, and G/Q = subsidy per unit of output. For most firms in the private sector that seek to maximize profits, the profit per unit of output is positive and the last term in the equation drops out because they do not receive subsidies ($G/Q = 0$). In contrast, public postsecondary

[8] A complicating factor in pinning down the total amount paid by students and their families is that they pay directly for services through their tuition and fees, and also indirectly as taxpayers whose payments are used by governments to support postsecondary education. They may also make charitable donations to the institution, and consume other postsecondary services.

[9] Of course there are exceptions to this rule. Some companies in the for-profit world receive subsidies from the government, for example, as a means to help make them more competitive with international competitors (e.g., automakers) or to ensure the survival of the industry.

institutions and many private institutions receive substantial subsidies from various entities ($G/Q > 0$), and even not-for-profit institutions may have excess revenues ($\pi/Q > 0$).

We can derive two powerful implications from this simple equation. It shows that unlike for-profit markets, in postsecondary markets students do not pay the full cost of their education unless the subsidy (e.g., government appropriations or private donations) is zero. Another important implication of Winston's model is that prices are affected by both higher education costs *and* subsidies. In the for-profit world, as long as profit margins are relatively constant, rising costs of production lead to price increases because the consumer pays the full cost of the service. Changes in prices therefore go hand-in-hand with changes in production cost. However, in postsecondary education, price increases can occur when the costs of production rise, when subsidies fall, or when both happen at the same time.

Sources of Revenues In the United States, the federal government requires postsecondary institutions to annually report information on their revenues according to specific categories. The revenue categories have changed over time, such as in 2002 when the categories for public institutions were modified.[10] As noted earlier in this chapter, the revenues for colleges and universities can be grouped according to source. Monies are given to institutions for various purposes, such as to purchase instructional services, support postsecondary research, encourage service to the general public, and to purchase non-instructional goods and services. These categorizations are not mutually exclusive. For example, state governments give money to colleges in large part to reduce the tuition rates charged to resident students, but also to encourage the research and public service activities of postsecondary institutions that benefit the state.

In Table 7.2 we show the major sources of revenue for all public institutions in 2010–2011, as well as sources of revenues broken down by 2-year and 4-year status. In this particular year, public institutions received $323 billion in revenues, with about 80 % of the total going to 4-year institutions. Slightly less than half (46 %) of all public institution revenues were obtained from governments at various levels. Comparing the sectors, 2-year institutions rely more heavily than do 4-year institutions on federal, state, and local governments to fund their operations. Note that less than one-fifth of total revenues for all public institutions are obtained directly from students and their families from net tuition and fees.

In Table 7.3, we report similar revenue breakdowns for private not-for-profit institutions in 2010–2011. Given that there are relatively few 2-year private institutions, we only show the figures for all 2- and 4-year private institutions combined.

---

[10] The reporting standards for public institutions are determined by the Governmental Accounting Standards Board (GASB, http://www.gasb.org), and the standards for private institutions are under the jurisdiction of the Financial Accounting Standards Board (FASB, http://www.fasb.org). Institutions are required to report financial data by designated categories to the federal government annually through the Integrated Postsecondary Education Data System (IPEDS). Details on the revenue categories can be found at: http://www.nces.ed.gov/IPEDS/.

Table 7.2 Revenues by source for public institutions, 2010–2011

Revenue source	All public		4-year public		2-year public	
	Total ($Billions)	Percent (%)	Total ($Billions)	Percent	Total ($Billions)	Percent (%)
Net tuition and fees[a]	60.2	19	51.0	19	9.2	16
Federal government[b]	56.1	17	41.3	16	14.8	26
State government[b]	73.4	23	56.8	21	16.7	29
Local government[b,c]	20.3	6	10.1	4	10.2	18
Private gifts	6.3	2	6.1	2	0.2	0
Auxiliary	23.6	7	21.5	8	2.1	4
Investment income	14.2	4	13.8	5	0.4	1
Hospitals	31.1	10	31.1	12	0.0	0
All other[d]	38.5	12	34.2	13	4.3	7
Total	**323.8**	**100**	**265.9**	**100**	**57.9**	**100**

Notes: Data obtained from *Digest of Education Statistics 2012*, Table 401. Revenue categories defined by GASB 34/35
[a]Net tuition and fees = tuition and fee receipts minus discounts and allowances
[b]Government funding includes operating grants and contracts, appropriations, and nonoperating grants
[c]Local government revenue also includes private grants and contracts
[d]Includes other nonoperating revenues, capital appropriations, capital grants and gifts, additions to endowment, and other income

Table 7.3 Revenues by source for private not-for-profit institutions, 2010–2011

Revenue source	Total ($ Billions)	Percent (%)
Net tuition and fees[a]	$60.0	29
Federal government[b]	$24.3	12
State government[b]	$1.7	1
Local government[b,c]	$0.5	0
Private gifts, grants & contracts	$22.1	11
Investment return	$53.6	26
Educational activities	$5.0	2
Enterprises	$14.8	7
Hospitals	$17.5	8
Other	$7.7	4
Total	**$207.2**	**100**

Notes: Data obtained from *Digest of Education Statistics 2012*, Table 406. Revenue categories defined by FASB. Data include 2-year and 4-year private not-for-profit institutions
[a]Net tuition and fees = tuition and fee receipts net of allowances
[b]Government funding includes grants, contracts, and appropriations
[c]Local government revenue does not include private grants and contracts

Table 7.4 Average revenues per student by source and type of institution, 2010–2011

	Average revenue/student		Share of average revenue	
Revenue source	Public	Private	Public (%)	Private (%)
Net tuition and fees	$8,302	$18,867	19	29
Federal government	$6,728	$7,686	16	12
State government	$9,240	$536	21	1
Investment return	$2,241	$16,958	5	26
All other revenues	$16,764	$21,365	39	33
Total	**$43,275**	**$65,412**	**100**	**100**

Notes: Data obtained from *Digest of Education Statistics 2012*, Tables 401 and 405. All figures are expressed in constant dollars (2011–2012). Data include only 4-year not-for-profit institutions

The specific revenue categories for public and private institutions are not the same due to the different rules set by their respective accounting standards boards. Collectively, private not-for-profit institutions received more than $200 billion in revenues for the year 2010–2011. As shown by these figures, even private colleges and universities are highly subsidized organizations. Although private institutions are more dependent than are public institutions on net tuition revenue, less than 30 % of all their revenues come directly from students and their families. Not surprisingly, private institutions receive very little funding from state governments, but they depend more heavily than do public institutions on donations and the return on financial investments to subsidize their operations.

To provide a more direct comparison of the average revenues per student by source for public and private institutions, in Table 7.4 we grouped revenues into five broad categories: net tuition and fees, federal government, state government, investment return, and all other sources. On average, private institutions have higher average revenues than do public institutions in each aggregate category except for state government. Particularly striking is the high reliance of private institutions on revenues from their investments.

Let's now look in more detail at the major revenue categories for colleges and universities. The first category of interest is net tuition revenue, which is defined as gross tuition and fee revenues minus any financial aid given to students from the institution. Financial aid is treated as a price discount to students in data reported to the federal government, and students at the same institution can pay different net prices for the same service. Another important source of variation in net prices for public institutions is the different tuition rates charged to resident and non-resident students. At most 4-year public institutions, non-resident students are charged sticker prices that are two to three times as high as the in-state tuition rates. The dollar figure reported to the federal government is the total net tuition dollars; it does not distinguish between the revenue collected from resident and non-resident students.

Behind this revenue source are students and their families, who form demand functions for the bundle of postsecondary services they will consume (see Chap. 5). These demanders compare the benefits and costs of enrolling when making a college-going decision. Accordingly, to attract net tuition and fee revenues institutions have to be aware of the market demand curve from students and their families for their institution. Recall from Fig. 7.1 that the consumer's demand curve is assumed to be downward-sloping, in that holding all else constant price increases by the institution would lead to reductions in the quantity of instructional services demanded. Depending on where the institution's price is along the market demand curve, raising tuition rates could either increase or reduce net tuition revenue. Further complicating matters is that it is very difficult for an institution to determine its location along the market demand curve.

Federal (or national) governments provide funding for postsecondary education in one of two forms. The first is to give money to colleges and universities to support their research missions. Research dollars are awarded to faculty and their institutions through grants administered by agencies such as the National Science Foundation, National Institute of Health, and the Institute for Education Sciences. The grant process can be very competitive, and the funding offsets designated research expenditures reported by the institution for sponsored research projects. The second way in which federal governments support postsecondary education is by giving financial subsidies to students to help reduce the net price they pay for college. In the United States the largest federal aid program is Pell Grants given to students from lower-income families. The federal government also helps students by providing subsidized loans at below-market interest rates. Taken together, the federal government helps sponsor both the teaching and research missions of postsecondary institutions through its funding. In this sense, the federal government is another demander of postsecondary services. The federal government must compare the costs of supporting higher education (i.e., funding levels) with the benefits it expects to receive in the form of positive externalities and public goods (see Chap. 6).

In contrast to federal governments, state governments provide most of their financial assistance for postsecondary education directly to institutions in the form of block grants or appropriations. States expect public colleges to use some or all of the appropriation to lower the tuition rate for residents of the state. Other funding is given directly to students to help reduce the net prices that they pay for college. Funding to students – typically in the form of state grants – is given on the basis of either financial need or academic performance or merit. Although there has been a gradual trend towards shifting funding away from institutions and towards students, about 92 cents of every state dollar for higher education is distributed to institutions as appropriations. Finally, states may give some monies to colleges to help cover the cost of public service work that benefits the state. As with the federal government, state governments are demanders of postsecondary services and compare their funding to the positive externalities they expect to derive from this support (see Chap. 6).

The financial support for postsecondary institutions from local governments is relatively small, which is different than primary and secondary education where local communities often give substantial amounts of funding to their schools. However, in some states the local communities provide funding for the 2-year institutions within their jurisdiction. The greater local support for 2-year versus 4-year institutions is consistent with the idea that local communities derive more positive externalities from 2-year institutions because they are attended by local citizens while living at home. Therefore local governments are demanders of postsecondary education due to their interest in generating positive externalities and public service benefits for their communities through their support of higher education.

Economists view all levels of government as entities that use economic principles to make decisions about the level of financial support they give to postsecondary education.[11] In this way of thinking, the decision rule for a government unit is to distribute its scarce resources (revenues collected from citizens and businesses through taxation) so as to maximize the well-being of citizens under its jurisdiction. Spending on postsecondary education, as with any other purpose, has an opportunity cost because the money that the government gives to colleges, students or faculty researchers could have been used for other purposes such as primary and secondary education, roads, health care, public assistance programs, and so on. Viewed in this way, government decisions at the margin are not about whether there are added benefits to citizens from spending more money on postsecondary education. Most observers would agree that as government spending on higher education increases, so will the benefits for students and the public at large. The relevant question to an economist is: do the benefits of increased government spending on higher education outweigh the costs? If, for example, a $50 million increase in state appropriations led to a $20 million gain in public benefits in the state, then the increased funding would not be a worthwhile investment of funds, even though some members of society would have been better off with the increased funding.

Private funding to postsecondary education captures revenues given to institutions for several purposes. The majority of private funding is in the form of charitable donations from alumni, foundations, other individuals, and corporations. The funding is often used to build up an institution's endowment, fund construction projects on campus, pay for scholarships for students, or cover expenses associated with research and public service projects. As shown earlier in this chapter, private colleges and universities in particular rely heavily on private donors to help finance their operations.

[11] Many studies in economics and political science rely on the median voter model to explain legislative behavior (see, for example, Comanor, 1976; Ahmed & Greene, 2000; Holcombe, 1989). Median voter theory posits that legislators vote in accordance with the preferences of the average, or median, voter within their jurisdiction. The model can be traced back to the work of Hotelling (1929), Black (1948), and Downs (1957). Studies of the median voter model applied to education include Borcherding and Deacon (1972), Lovell (1978), Bergstrom, Rubinfeld, and Shapiro (1982), Holcombe (1980), Toutkoushian and Hollis (1998), and Corcoran and Evans (2010). Alternatively, some researchers have relied on competing interest group theory (G. Becker, 1983, 1985) to explain how the size of groups such as senior citizens and corrections have a disproportionate influence on the behavior of legislators.

Of course private donors and philanthropic organizations are also economic decision makers that have to allocate their scarce resources to best achieve their goals and objectives. They have their own demand functions for postsecondary education services, and must weigh the costs of donating to colleges against the benefits that they hope to receive in return. In the case of alumni and other individuals, they first decide how to spread their income and wealth between donations and all other things, and if they opt to donate some portion to organizations, they choose the organizations that will best help them achieve their goals.[12] Philanthropic organizations such as private foundations also must make tough choices about how to spread their scarce financial resources among potential beneficiaries. Accordingly, anything that affects the total resources of donors will in turn likely affect whether they donate, and if so, how much they donate. Because private donations fluctuate with the health of the economy, they are sometimes difficult to forecast for planning purposes at the institutional level.

There are several types of benefits derived by donors from giving money to colleges and universities. First, there are tax advantages that individuals receive when they donate money to postsecondary institutions. Second, individuals may receive a series of other benefits (or perks) when they donate to colleges, such as tickets to and preferential seating at sporting events. Some donors also benefit due to the prestige that they receive when their donation is recognized by others. This is seen in particular when donations are used to create a scholarship, endowed professorship, or building where the donor's name is used.

Postsecondary institutions take monies that they receive in donations and store a portion of them in the form of an endowment. In 2011, the total endowments held by colleges and universities in the United States had reached $416 billion, led by Harvard University with $32 billion.[13] Postsecondary institutions invest a portion of their endowments in stocks, bonds, and other securities, and the earnings on these investments are then categorized as revenue from investment income. In many cases, the amount spent from the endowment is from the investment earnings on the endowment so that the institution can protect the principal. Institutions with larger endowments are therefore capable of generating more revenues than other institutions to spend on their day-to-day operations. However, these revenues can fluctuate wildly from year to year depending on how well investments such as stocks and bonds have fared in financial markets. The recession in the United States in 2008–2009 led to substantial reductions in the

[12] Much of the literature on charitable giving has focused on whether public subsidies discourage or crowd out private giving to organizations. Studies of note that have examined the determinants of donations include Bergstrom, Blume, and Varian (1986), Okten and Weisbrod (2000), Payne (2001), Cheslock and Gianneschi (2008), Gottfried (2008), and Heutel (2014).

[13] Source: *Digest of Education Statistics 2012*, Table 411.

level of endowments and their returns.[14] Furthermore, a portion of an institution's endowment may be restricted in that it can only be used for specific purposes. This reduces the flexibility of an institution to use monies in ways that it feels are most beneficial in achieving its goals and objectives.

Auxiliary revenues are monies received by institutions for a variety of non-instructional goods and services that they offer. These revenues include room and board charges for students who live in on-campus housing, ticket sales to athletic and cultural events at the institution, and sales of university merchandise. Some of these goods and services are sold to students, and other goods and services are sold to alumni, campus visitors, and the general public. Behind auxiliary revenues are a range of individuals who each have demand functions for the specific postsecondary services that they want to use. Students and their families focus on auxiliaries such as on-campus housing, food services, and athletic facilities. Likewise, visitors to campus weigh the costs of the auxiliaries they use – such as athletic events, artistic performances, and institution merchandise – relative to the perceived benefits of each.

Finally, institutions receive revenues from the operation of hospitals and medical facilities, and non-operating revenues for capital projects and other sources. These revenue sources also depend on demanders for postsecondary services, such as patients who may want to use the medical facilities at a university hospital or clinic.

Trends in Revenue by Source As noted earlier in this chapter, due to differences in the accounting rules used for public and private institutions it is difficult to obtain comparable data on revenues for long periods of time. Nonetheless, several important trends can be discerned from the available data. The first trend is that there has been substantial growth in revenues for higher education over time. From the 1960s through the mid-1990s, total revenues rose at annual rates between 6 and 14 % prior to adjusting for inflation.[15] Of course, much of this growth was in response to rising college enrollments during this period. However, even after accounting for the growth in students and inflation from 1974–1975 to 1994–1995, average revenues rose annually by about 2 % points per year. Revenues have continued to increase for higher education in the early twenty-first century, although at a slower pace than what was seen in earlier years. At private not-for-profit institutions, for example, total revenues increased from $82 billion in 2000–2001 to $207 billion in 2010–2011 which, after adjusting for inflation and the growth in students, represents a 50 % increase. Between 2005–2006 and 2010–2011 – a period that included the Great Recession of 2008–2009 – public institutions still saw total revenues go from $246 billion to $324 billion, which is a 5.5 % increase over the 5-year period after adjusting for enrollment growth and inflation.

[14] Brown, Dimmock, and Weisbenner (2015) studied the effects of both supply-side and demand-side factors on charitable donations to institutions of higher education. In addition, their study focused on the years before and during the Great Recession of the late 2000s. As part of their study, they examined the effects of the business cycle and fluctuations in the health of the economy on charitable donations to institutions of higher education.

[15] Statistics in this section pertaining to the years prior to 1995 were obtained from Toutkoushian (2001). Likewise, the College Board (2014) is the source for statistics in years after 1995.

A second important trend for postsecondary revenues is the relative decline in state appropriations as a revenue source. From 1974–1975 to 1984–1985, state funding increased faster than inflation and enrollment growth and represented close to 60 % of all revenues for public institutions. Over the next decade, however, the share of total revenues from state funding fell to the point where by the mid-1990s state appropriations represented less than half of total revenues for public institutions. More recently, after adjusting for inflation, total state funding has declined from $88.7 billion in 2007–2008 to $72.0 billion in 2012–2013. Adjusted for inflation and expressed on a per-student basis, state funding has experienced a steady decline over a 25-year period, going from a high of $9,980 in 1987–1988 to $6,646 in 2012–2013.

As state funding has stagnated, educational expenditures have continued to rise even after adjusting for inflation and the number of students being served. This has placed pressure on public institutions to rely more heavily on non-governmental sources of revenue to balance their budgets. Not surprisingly, tuition and fee revenue has become a larger portion of total revenues at many institutions. Both public and private not-for-profit institutions experienced a seven to eight percentage point increase in the share of total revenues coming from net tuition and fees between 1974–1975 and 1994–1995. This trend has continued since this time; the College Board (2014) estimates that between 1993–1994 and 2013–2014, net tuition and fees at 4-year public and private not-for-profit institutions have risen by 53 % and 22 % respectively, even after adjusting for inflation.

The final trend of note is that institutions in both the public and private sectors have increasingly turned to donations as a way to help cover the rising costs of their operations. Revenues from private gifts, grants and contracts were the fastest growing source of funds for public institutions between 1974–1975 and 1994–1995. One of the challenges that institutions face with regard to this revenue source is that it can be highly volatile. During the 2008–2009 recession in the United States, for example, many private institutions experienced sizable losses in revenues from private sources. This can be seen in Table 7.5, where we report the average revenues by source for 4-year private institutions from 2000–2001 to 2010–2011. The trends for net tuition and fees, federal funding, and all other revenues are relatively stable over this 10-year period. In contrast, the average revenue from private gifts, grants and contracts exhibited cyclical variation consistent with changes in the US economy. Most notable during this period was the dramatic changes in average revenues from investments, with the values fluctuating from a high of $21,045 in 2006 to a low of -$22,080 in 2008.

Economic Analysis of Expenditures

As any college president, chief financial officer, dean, or department chair will attest, it is very expensive to operate a postsecondary institution. The National Center for Education Statistics (2012) reports that in 2010–2011, the average ratios

Table 7.5 Trends in average revenues per student by source for private institutions, 2000–2010

Year	Net tuition and fees	Federal funding	Private gifts, grants and contracts	Investment return	All other revenues	Total revenues
2000	$15,720	$6715	$7961	−$1808	$12,660	$41,248
2001	$16,168	$7138	$7430	−$3159	$13,132	$40,708
2002	$16,461	$7598	$6572	$4269	$13,393	$48,292
2003	$16,809	$8004	$6918	$13,488	$13,377	$58,596
2004	$17,125	$8150	$6925	$12,590	$13,192	$57,982
2005	$17,400	$7738	$7212	$14,008	$13,687	$60,045
2006	$17,873	$7601	$7601	$21,045	$14,532	$68,654
2007	$17,965	$7154	$7433	$2283	$14,472	$49,308
2008	$18,470	$7230	$6077	−$22,080	$14,054	$23,751
2009	$18,716	$7610	$5984	$9440	$14,273	$56,024
2010	$18,812	$7624	$6924	$16,783	$14,782	$64,924

Notes: Data were obtained from *Digest of Education Statistics* (2012), Table 405. Values represent revenues per full-time equivalent student in constant dollars (base year = 2012). All other revenues include state funding, local funding, sales and services, auxiliaries, and hospitals

of expenditures (or costs) to students at 4-year, degree-granting institutions were approximately $37,500 for public institutions and $47,800 for private not-for-profit institutions. The large average cost figures and the fact that the growth in higher education expenditures usually outpaces inflation sometimes raise concerns among supporters of higher education that colleges are inefficient organizations.[16] Because education is a very labor-intensive service, there are fewer opportunities for colleges to save money by finding substitutes for labor. As a result, higher education costs would be expected to rise at a faster rate than costs in other industries. This phenomenon has sometimes been referred to as a "cost disease."[17]

But do these statistics mean that 4-year public institutions really spend an average of $37,500/year to educate a student? In short, the answer is no. Colleges

[16] The Higher Education Price Index (HEPI) was developed by Ken Halstead as a way to track changes in the cost of delivering higher education services (Halstead, 1991). The HEPI is based on the average prices in a market basket of goods and services that are typically purchased by institutions of higher education each year. Some of the items in the market basket are personnel compensation, fringe benefits, utilities, supplies and materials, contracted services such as data processing, library acquisitions, and other items purchased for current operations. The index is explained and maintained by the Commonfund Institute (https://www.commonfund.org/CommonfundInstitute/HEPI/Pages/default.aspx).

[17] The cost disease argument can be traced back to Baumol and W. Bowen (1966). They initially applied the idea to a string quartet, arguing that the production of this service requires a certain amount of labor inputs for which substitutes cannot be easily found. In subsequent work, Baumol and others have applied this notion to education and debated whether or not it is appropriate (Baumol & Blackman, 1995; Baumol, 1996; W. Bowen, 2013; Cowen, 1996; Wellman, 2010; Martin, 2011).

are multi-product firms, and thus some portion of spending is for research, public service, and other non-instructional goods and services. Further complicating matters is that an institution's teaching, research, and public service activities may be complementary, such as when a faculty member uses her research to improve her teaching. Therefore, even if we could isolate the expenditures in these three categories by function, we would still not have a completely accurate picture of the amount spent on instruction. Colleges also spend monies on activities such as academic support, student services, and administration that are not direct classroom expenses but nonetheless contribute to their teaching mission.

Fixed and Variable Costs Economists separate the total costs for a firm (TC) into two categories: fixed costs (FC) and variable costs (VC). Simply put, *fixed costs* are those that the organization would incur regardless of the amount of output produced. This means that fixed costs do not change when the organization produces more or less output. In contrast, *variable costs* do change in proportion to the firm's output. For example, the monthly rent for a bicycle repair store would be a fixed cost in the short run because the rent is the same regardless of how many bicycles were serviced in a month, whereas the materials and labor used to repair each bicycle are variable costs. Given enough time, however, all costs incurred by an organization can vary. Returning to the bicycle repair store, if the business continues to service more bicycles than it can accommodate in its current location, the owner could move the company to a larger building with possibly higher fixed costs. The period of time during which at least one item of expenditure is held fixed is known as the organization's *short run*. Note that under this definition, the short run is not a specific period of time such as three months, and the short run will likely vary by type of organization.

There are several major challenges that economists face when trying to classify postsecondary costs as either fixed or variable. First, some fixed costs that are necessary for providing postsecondary services (such as the cost of buildings) are not reflected in annual expenditure data reported to the federal government or audited financial statements. Another difficulty is that many postsecondary costs fall somewhere between the extremes of fixed and variable costs. To see this, consider the category of instructional costs. Although instructional costs should in general increase with the number of students taught, enrolling a few additional students can usually be done with little or no added instructional cost to the institution. Likewise, colleges can vary the delivery of instruction in ways that could lower instructional costs as enrollments rise, such as by replacing tenure-eligible (and more expensive) faculty with adjunct faculty and/or graduate assistants. As another example, college administration is often viewed as a fixed cost because each institution needs only one president, one chief financial officer, and so on regardless of size. However, as the size and complexity of an institution increases, it may add vice presidents, provosts, and other "mid-level managers," and thus drive up total administrative costs. Therefore, many postsecondary costs are actually somewhere between being unambiguously-fixed and unambiguously-variable costs.

Average and Marginal Costs Average and marginal costs are central to the way economists examine the cost structure and behavior of all types of organizations. *Average cost* (AC) is defined as the ratio of total expenditures to output:

$$AC = TC/\sum_{k=1}^{K} Q_k \tag{7.6}$$

The concept of average cost can be applied to both fixed and variable costs, with average fixed costs (AFC) equaling fixed costs divided by output and average variable cost (AVC) being defined as variable costs divided by output. Because total cost equals the sum of fixed and variable costs, it must be true that $AC = AFC + AVC$. When data on costs per type of output are available, these quantities can be applied to multi-product firms as well, where AC_k denotes the average cost of producing the k-th product.

One of the challenges of examining multi-product firm expenditures is determining how to assign fixed costs to the different outputs produced. For example, how much of the salary for the chief financial officer at Comcast should be applied to the cost of providing cable services versus internet services for its customers? Similar difficulties arise in postsecondary markets when trying to distribute administrative and support costs to academic programs.

In Table 7.6, the middle column shows the average costs per student at not-for-profit institutions, broken down by sector (public vs. private) and degree level (2-year vs. 4-year) in 2010–2011. The first column contains the average revenues per student for each type of institution, and the last column reports the difference between average revenues and average costs as reported to the federal government through IPEDS. It is interesting to note that on average the reported revenues exceed expenses even for not-for-profit institutions. Technically, not-for-profit institutions are allowed to have excess revenues in a given year, and in fact may be encouraged to budget for excess revenues so as to ensure that they will be able to cover expenses in the event of an unanticipated increase in expenditures or decline in revenues.[18]

The concept of *marginal cost* refers to the change in costs incurred by an organization as it increases its output (or $MC_k = \partial TC_k/\partial Q_k$). Over large ranges of output, marginal cost may be lower than average cost because fixed costs do not change when more output is produced. The marginal cost for the bicycle repair shop described earlier would include the cost of supplies and labor needed to fix an additional bicycle, after already accounting for the costs needed to service all of the

[18] Technically, the "not-for-profit" status of an institution means that the college or university may not distribute excess revenues to shareholders as a for-profit firm or organization would do (Hansmann, 1986). There are other reasons why revenues may exceed expenditures for not-for-profit institutions. The expenditures reported to the federal government through the annual IPEDS collection rely on GASB reporting rules, which may not cover all relevant spending in a given year. Other expenses and revenues may be carried over from one year to the next, which adds additional variation to reported financial data.

Table 7.6 Average revenues and costs per student for not-for-profit institutions, 2010–2011

Category	Average revenue	Average cost	Excess average revenue
Public			
All	\$31,627	\$27,656	+\$3,971
4-year	\$43,275	\$37,497	+\$5,778
2-year	\$14,140	\$12,761	+\$1,379
Private			
All	\$64,924	\$47,779	+\$17,145
4-year	\$65,412	\$48,094	+\$17,318
2-year	\$19,468	\$18,392	+\$1,076

Notes: Data were obtained from the Digest of Education Statistics 2012, Tables 401, 405, 412, and 414. Data only include degree-granting institutions in the United States at the bachelor's level and higher that participate in Title IV financial aid programs. Total revenues and costs are divided by full-time equivalent (FTE) enrollments to obtain average revenue and average cost estimates. Dollar figures are expressed in 2011–2012 dollars

bicycles that were previously fixed. In the case of postsecondary education, the marginal cost of teaching an additional student includes the incremental cost for instructors, materials, academic and institutional support, and so on.

The distinction between average and marginal costs is a significant one. In many instances marginal costs can be substantially lower than average costs, and this can have important implications for policy making. To illustrate, if a college has space available in existing classes for an additional student, then enrolling the student would not lead to large increases in expenditures. Suppose that the college would receive \$8,000/year in tuition and fees from a new student, and the average cost per student is \$36,000. The institution might conclude – incorrectly – that it would be a bad financial decision to enroll the additional student because it would lose money as a result – i.e., additional or marginal revenue of \$8,000 is much less than average cost of \$36,000. However, the additional or marginal revenue (\$8,000) should be compared to the marginal cost, not the average cost, of the additional student, where the marginal cost of this student is very likely to be well below \$8,000. In this case, the institution would actually gain net revenues (i.e., MR > MC) by enrolling the additional student.

As with postsecondary revenues, it is common practice to use enrollments as a proxy measure for output and then interpret average costs as being the average cost for educating a student. However, if a university spends money on research activities that are unrelated to its teaching activities, then including these expenditures in average cost calculations will overstate the amount spent by the institution solely on educating students. Another limitation of using enrollments as the only measure of output in average and marginal cost calculations is that the number of students taught does not capture the quality of teaching services provided. If two institutions A and B enrolled the same number of students, and students at institution B experienced larger gains in learning as a result of their education, then ideally this should be reflected in the productivity of each institution. This problem is fundamental to higher education because it is very difficult to measure the quality of educational services and how much students have learned during their time at the institution, and yet the quality of teaching services and learning outcomes are central to any meaningful discussions about the productivity and efficiency of postsecondary institutions. Furthermore, if institution B produced the larger student gains by spending more money than did institution A on its teaching mission, then in the absence of measures of the quality of learning institution B would appear to be less cost efficient because its expenditures per student are higher.

Categories of Expenditures The total costs for institutions of higher education can be broken down into a number of categories.[19] The largest single expenditure category for public institutions is instructional services, which includes the salaries and benefits for faculty as well as other direct instructional costs. However, the reported instructional expenses are not accurate measures of the total amounts spent by colleges and universities on their teaching function. Some of the salaries paid to faculty are actually intended to support their research and public service activities, and therefore, including all faculty salaries in instruction will overstate the amount of resources spent on this activity. On the other hand, some of the spending in other categories such as academic support and student services are meant to support the teaching mission of the institution even though they are not direct classroom expenditures; and therefore, excluding the amounts of academic support and student services that support teaching services from reported instructional expenditures will understate the amount of resources spent on this activity. An argument can also be made that some portion of spending on research, public services, and other activities at an institution enhance the quality of instructional services received by students and therefore should also be counted as instruction.

The category for research expenditures consists mainly of spending on externally-funded research projects. If a faculty member receives a grant from the federal government to conduct research on a particular topic, then the revenues from the grant appear on the federal revenue line of their budget and the expenditures from the grant are counted as research expenditures. Some institutions will also apply a portion of faculty salaries and benefits to the research expenditure category to reflect costs incurred from non-sponsored research activities. Similarly, public service expenditures typically include the costs incurred by an institution from specific activities that provide benefits to those outside of the institution (such as cooperative extension services). Both the research and public service lines likely understate the true costs incurred for these aspects of institution's mission.

Academic support is defined as the expenses incurred by the institution to support its teaching, research, and public service missions. Student services are directed to activities such as the registrar and admissions offices, and although they are not classroom expenditures per se, they should arguably be included as part of the total cost of the teaching mission of an institution. The academic support line is

[19] More detailed descriptions of the various expenditure categories can be found on the NCES website for IPEDS.

Table 7.7 Total and average costs at 2-year public institutions by category, 2010–2011

Expenditure category	Total cost ($ Billions)	Average cost/student	% of total
Instruction	$19.32	$4405	34.5
Research	$0.02	$5	0.0
Public service	$0.79	$180	1.4
Academic support	$3.73	$849	6.7
Student services	$4.58	$1045	8.2
Institutional support	$6.76	$1542	12.1
O&M of plant	$4.72	$1077	8.4
Depreciation	$2.30	$523	4.1
Scholarships & fellowships	$7.72	$1761	13.8
Auxiliary enterprises	$2.46	$562	4.4
Hospitals	$0.00	$0	0.0
Independent operations	$0.00	$0	0.0
Interest	$1.16	$264	2.1
Other	$2.40	$548	4.3
Total expenditures	**$55.95**	**$12,761**	**100**

Notes: Data are obtained from Digest of Education Statistics (2012), Table 412. All figures are converted to constant (2011–2012) dollars

a bit more difficult to assign to one aspect of an institution's mission because some portion of academic support costs – e.g., library expenditures – are incurred for research, public service, and instruction. Institutional support is the category that captures the cost for administrative and professional staff needed to operate an institution. Ideally these costs need to be apportioned across the different functions of the institution as well.

The operation and maintenance (O&M) of plant expenditure line of the budget reflects costs incurred by an institution for providing maintenance and service to the buildings and grounds for each institution. Scholarship and fellowship expenditures are defined as the total scholarship and fellowships given to students by the institution. Prior to changes in accounting rules for public institutions, this category included all scholarships and fellowships as an expense rather than a price discount. However, in recent years, just as net tuition revenue (i.e., sticker price tuition net of institutional scholarships and fellowships) is reported as a revenue category, tuition and fee discounts – i.e., expenditures on scholarships and fellowships – are now removed from the calculation of expenditures. Finally, auxiliary enterprises include the expenses incurred from self-supporting operations at an institution that provide services to students and faculty, such as residence halls, food services, and recreational facilities.

In Tables 7.7, 7.8 and 7.9 we calculate the total costs, average costs, and percentages of total costs by category for 2-year public, 4-year public, and 4-year private institutions in 2010–2011. Although the average spending per student on instruction is highest in dollars for 4-year private institutions, instruction as a share of total expenditures is actually larger for 2-year public institutions (34.5 %). Four-year public and private institutions have reported average spending per student on

Table 7.8 Total and average costs at 4-year public institutions by category, 2010–2011

Expenditure category	Total cost ($ Billions)	Average cost/student	% of total
Instruction	$62.39	$9401	25.1
Research	$30.20	$4550	12.1
Public service	$11.43	$1722	4.6
Academic support	$16.18	$2438	6.5
Student services	$9.38	$1413	3.8
Institutional support	$17.80	$2682	7.2
O&M of plant	$14.68	$2212	5.9
Depreciation	$13.57	$2045	5.5
Scholarships & fellowships	$10.40	$1567	4.2
Auxiliary enterprises	$19.89	$2997	8.0
Hospitals	$28.71	$4327	11.5
Independent operations	$1.18	$179	0.5
Interest	$4.63	$698	1.9
Other	$8.40	$1266	3.4
Total expenditures	**$248.83**	**$37,497**	**100**

Notes: Data are obtained from Digest of Education Statistics (2012), Table 412. All figures are converted to constant (2011–2012) dollars

Table 7.9 Total and average costs for 4-year private institutions by category, 2010–2011

Expenditure category	Total cost ($ Billions)	Average cost/student	% of total
Instruction	$51.15	$15,568	32.6
Research	$17.89	$5444	11.4
Public service	$2.32	$706	1.5
Academic support	$14.01	$4264	8.9
Student services	$12.60	$3834	8.0
Institutional support	$20.82	$6339	13.3
Auxiliary enterprises	$14.88	$4529	9.5
Net grant aid to students	$0.79	$242	0.5
Hospitals	$14.66	$4461	9.3
Independent operations	$5.54	$1684	3.5
Other	$2.33	$707	1.5
Total expenditures	**$156.98**	**$47,779**	**100**

Note: All dollar figures are in 2011–2012 dollars

research between $4,500 and $5,500, and as noted earlier this likely understates the true financial costs of research. Private 4-year institutions also have relatively high levels of spending on functions such as academic support, student services, and institutional support.

Economies of Scale and Scope The concept of economies and diseconomies of scale has received considerable attention from economists across a wide range of

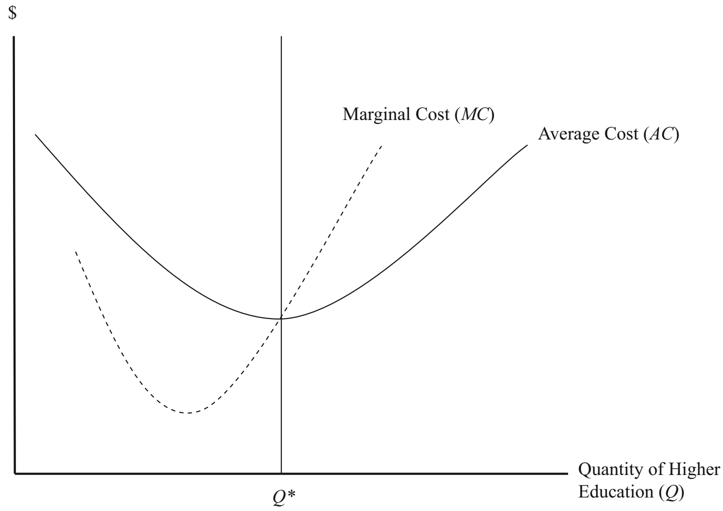


Fig. 7.6 Depiction of average and marginal cost of higher education

industries.[20] Stated briefly, *economies of scale* occur when the cost per unit of output falls as an organization produces more output. The shape and position of the average and marginal cost curves yield important information about the organization's cost structure and whether economies of scale are present. Economies and diseconomies of scale are represented graphically by quadratic (or "U-shaped") average and marginal cost curves as shown in Fig. 7.6. At first, average costs fall as more output is produced because fixed costs such as the president's salary are spread over more units of output (such as students), and the institution learns how to better utilize its resources to produce output through specialization. In addition, as a college grows it can increase the size of selected classes and find less expensive ways to teach students. A large public university, for example, may teach popular courses such as introductory accounting in large lecture halls holding hundreds of students. Even after factoring in the added cost of teaching assistants in these classes, the cost per student would be lower than if the students were divided into smaller classes taught by tenured professors. Of course, opportunities for small colleges to achieve such economies of scale would be more limited, and they would be unlikely to be able to deliver instruction at such a low cost per student.

At some point, however, as output continues to increase the average cost reductions from spreading out fixed costs may be outweighed by the additional costs needed to coordinate activities across the organization and other inefficiencies. In the case of higher education, cost inefficiencies may appear when institutions grow beyond a specific size as it finds it necessary to reorganize itself into

[20] Early thought about economies of scale can be traced back to Adam Smith's (1776) discussion of productivity gains that could be achieved through the division of labor. Other early studies of note include Marshall (1890), Moore (1959), and Ferguson (1969).

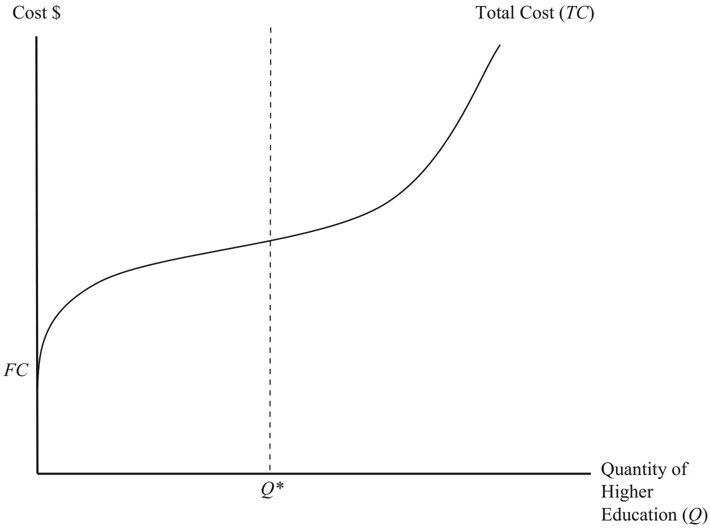


Fig. 7.7 Depiction of cubic total cost curve of higher education

separate collegiate units within the institution, each with its own infrastructure and corresponding costs. Furthermore, as institutions are broken into separate colleges, the need arises to increase spending to coordinate activities across collegiate units within the university, and collegiate units may add administrative and support infrastructure to help manage their operations. Taken together, there may be a point at which average and marginal costs will begin to rise along with output.

When changes in output result in reductions in average cost, it is said that the firm is experiencing economies of scale. Likewise, diseconomies of scale occur when costs per unit rise as output changes. The output level Q^* in Fig. 7.6 denotes the point where average costs are minimized. Given the way the two curves are defined, the marginal cost curve must cross the average cost curve at its minimum point.

Similarly, Fig. 7.7 shows the total cost curve for an institution with both economies and diseconomies of scale. For the marginal cost curve to be quadratic and exhibit economies and diseconomies of scale, the total cost curve should be a cubic function of output because $MC = \partial TC/\partial Q$.

In theory, the cost function is obtained by finding the input levels that minimize expenditures subject to a given level of production and technology. In the case of postsecondary education, the total cost curve would show the least expensive way that a college could produce different combinations of teaching, research, and public service outputs.[21] For multi-product firms such as colleges and universities, it is also possible that additional cost savings can be achieved by the joint

[21] Excellent discussions of the application of cost functions to higher education can be found in Brinkman and Leslie (1986) and Brinkman (1990).

production of outputs. When this happens, it is referred to as *economies of scope* or ray economies. One example of economies of scope occurs when a professor uses her research to improve the content and quality of the classes that she teaches.

Do economies and diseconomies of scale and scope exist in higher education? On the face of it, there seems to be good reason for believing that they do. Given that some costs are clearly fixed in nature and even some variable costs do not change for smaller changes in enrollments, at least over a certain range of institutional size average costs should fall as enrollments rise. It is also true that large universities typically are organized into colleges within the institution, each with its own administrative and support functions. As institutions become larger and more decentralized, it becomes more difficult to engage in planning and thus time and money must be spent on coordinating activities across campus, which might eventually lead to increases in average costs.

There have been a number of statistical studies that have estimated total and average cost functions for higher education, and tested for the presence of economies of scale or scope. The cost functions for this purpose can be written in their most general forms as follows:

$$AC = f(\boldsymbol{Q}, \boldsymbol{X}) \tag{7.7}$$

$$TC = g(\boldsymbol{Q}, \boldsymbol{Z}) \tag{7.8}$$

where AC and TC are defined as before, $\boldsymbol{Q}$ = set of output variables, $\boldsymbol{X}$ = set of non-output factors that affect average costs, $\boldsymbol{Z}$ = set of non-output factors that affect total cost, and $f(\,)$ and $g(\,)$ are mathematical functions showing how these factors relate to average and total costs. Empirical studies differ in the set of institutions examined (such as only public 4-year institutions, or institutions in select Carnegie classifications), the non-output variables that may affect costs, the assumed functional form of the cost equation, and the manner in which they account for the multi-product nature of postsecondary institutions. Because institutions of higher education produce several types of output, it is common to choose variables for $\boldsymbol{Q}$ that represent outputs in the different areas of activities for institutions. Most studies in the literature, for example, use undergraduate enrollments, graduate enrollments, and research revenues as proxies for outputs in undergraduate instruction, graduate instruction, and research respectively. Economists may then enter these variables in different forms to capture the non-linear relationships that are predicted between outputs and total or average costs.

To illustrate, one way to estimate a cost function that is consistent with economies and diseconomies of scale is to specify that total costs are cubic functions of output as in:

$$TC = \alpha_0 + \alpha_1 Q_U + \alpha_2 Q_U^2 + \alpha_3 Q_U^3 + \boldsymbol{Q_G}'\boldsymbol{\gamma} + \boldsymbol{Q_R}'\boldsymbol{\delta} + \boldsymbol{Z}'\boldsymbol{\beta} + \varepsilon \tag{7.9}$$

where $\left(Q_U, Q_U^2, Q_U^3\right)$ = three variables for undergraduate enrollments, $\boldsymbol{Q_G}'$ = a set of three output variables for graduate enrollments $\left(Q_G, Q_G^2, Q_G^3\right)$, $\boldsymbol{Q_R}'$ = a set of three output variables for research expenditures $\left(Q_R, Q_R^2, Q_R^3\right)$, and $\boldsymbol{Z}'$ = a set of other factors that may shift the total cost curve. The marginal cost function is then found by taking the first derivative of the total cost function with respect to the output measure of interest. For example, the marginal cost curve for undergraduate instruction would be written as:

$$MC_U = \partial TC/\partial Q_U = \alpha_1 + 2\alpha_2 Q_U + 3\alpha_3 Q_U^2 \tag{7.10}$$

Expressed in this way, the marginal cost curve for undergraduate education is a U-shaped curve, provided that the coefficient α_3 is positive.

Similarly, the average cost function can be estimated by specifying average costs as a function of undergraduate enrollments and their enrollments squared $\left(Q_U, Q_U^2\right)$, graduate enrollments and squared enrollments $\left(Q_G, Q_G^2\right)$, and research revenues and squared revenues $\left(Q_R, Q_R^2\right)$. Average costs may also be affected by other factors (***X***) such as the research intensity of the institution, graduate enrollments, the mix of disciplines, and geographic location:

$$AC = \alpha_0 + \alpha_1 Q_U + \alpha_2 Q_U^2 + \alpha_3 Q_G + \alpha_4 Q_G^2 + \alpha_5 Q_R + \alpha_6 Q_R^2 + \boldsymbol{X}'\boldsymbol{\beta} + \varepsilon \tag{7.11}$$

If the coefficients on the squared enrollments variables $(\alpha_2, \alpha_4, \alpha_6)$ are positive, then this is evidence that average costs at first fall with output and then increase, which is consistent with the notion of economies and diseconomies of scale. The output level at which average cost is minimized (denoted Q^*) can then be found by taking the partial derivative of Eq. (7.11) with respect to the output measure of interest, setting the resulting function equal to zero, and solving for Q. In the case of undergraduate enrollments:

$$\partial AC/\partial Q_U = 0;\ Q_U^* = -\alpha_1/2\alpha_2 \tag{7.12}$$

Economies of scope can be captured in cost functions by interacting the different output variables with each other and determining if the interaction terms are statistically significant. When the coefficients for the interaction variables are negative and significant, they provide evidence that costs are lower when the institution produces these outputs at the same time, which implies that there are economies of scope.

Economists have also used other statistical approaches for specifying the total cost function for multi-product firms such as colleges and universities. The translog production function is a popular alternative to the equations shown above because it is a generalized version of the Cobb-Douglas production function which is frequently used in economic applications.[22] Other economists have used a flexible form production function that is similar to the total cost curve shown in Eq. (7.9) except that it includes dichotomous variables for the presence of outputs, and

---

[22] In the translog production function (see, for example deGroot, McMahon, & Volkwein, 1991), the log of total cost is regressed against the log of outputs, log of squared outputs, and the interactions of log of outputs with each other.

researchers sometimes have entered the outputs in quadratic rather than cubic form.[23] Economies and diseconomies of scale are examined in these models by first estimating the average increment in total cost (*AIC*) due to the j-th output:

$$AIC = \left(TC - TC_{j-1}\right)/Q_j \tag{7.13}$$

where $TC_{j\text{-}1}$ = total cost of producing all but the *j*-th output, which is found using the coefficients from the estimated total cost function. The ratio of *AIC* to the marginal cost of the *j*-th output is then used to determine if there are economies or diseconomies of scale for the output in question. When the ratio is greater than one, it indicates that, at the current output level, average incremental costs are greater than marginal costs and thus economies of scale may be achieved by increasing output. Regardless of the statistical approach chosen, however, the objective of the analysis is the same: to isolate the impact of enrollments and other factors on the cost of providing higher education services.

The findings from the majority of studies on this topic support the notion of economies of scale in higher education. In one such study, Toutkoushian (1999) assembled data on more than 800 4-year institutions and estimated both average cost and total cost functions for higher education. The results showed that many of the expected relationships held, in that average costs rise with the ratio of faculty to students and the research intensity of the institution. It was also found that there were economies of scale in higher education for enrollment levels up to approximately 24,400 students. Given that the vast majority of 4-year public institutions are smaller than this, the findings suggest that higher education services could be delivered at a lower total cost if smaller institutions were merged into fewer but larger institutions. Although such a policy may reduce total costs across the postsecondary system, it may not be in the best interest of students or faculty members. Instead, as institutions become larger they may be less able to fulfill their unique missions and provide the desired services to their constituents. Using a similar methodology but a different set of institutions, Laband and Lentz (2004) found economies of scale up to about 16,000 students.

There are, however, some caveats with regard to empirical studies of economies of scale and scope in higher education. Because the statistical functions relate actual, and not minimum, expenditures to outputs, the resulting cost functions may not represent the minimum amounts that need to be spent to produce certain services. This is important because it is debatable whether colleges and universities seek to minimize the cost of providing a given level of services. Howard Bowen

[23] The flexible fixed cost function draws on the pioneering work of Baumol, Panzar, and Willig (1982). Studies of note that have used this approach in higher education applications include Cohn, Rhine, and Santos (1989), Koshal and Koshal (1995, 1999), and Laband and Lentz (2003). Interestingly, some of the flexible fixed cost studies that have received attention in the literature (e.g., Cohn et al., 1989; Koshal & Koshal, 1999; Laband & Lentz, 2003; Sav, 2004) used a quadratic total cost function. As noted by Laband and Lentz (2004, p.434): "To represent the classic textbook cost function that can show (dis)economies of scale, we estimated a total cost function that included squared and cubic measures of the three outputs in the model." Other studies of note include Getz, Siegfried, and Zhang (1991), James (1978), and Lenton (2008).

(1980), for example, argues that colleges operate and act as revenue maximizers and then spend most, if not all, of the revenue they receive. An equally important challenge is that the output measures – such as undergraduate enrollment – used in postsecondary cost functions may not be the best representations of output, especially because they do not capture the quality of the services being delivered. Finally, the expenditure data omits many fixed costs that were originally incurred for facilities and are needed to provide services.

Extensions

Thus far, we have focused on total revenues and expenditures at the institutional level, and how they are categorized by sources and uses of funds. However, it is also important to consider how revenues and expenditures are allocated to academic and non-academic units within an institution. The data on revenues and expenditures that an institution reports to the federal government are totals for the institution and are not broken down by academic and administrative departments. From an organizational perspective, a postsecondary institution can be thought of as a federation of smaller subgroups that are defined by academic disciplines. Institutions are often divided into schools or colleges, such as the school of business or education. These collegiate units can be further broken down into academic departments, such as the economics department within the school of business.

The way institutions of higher education make production decisions about their educational services is somewhat different from what happens in most other types of organizations. In a typical company, the top leaders are responsible for deciding what will be produced, how much will be produced, and how it will be produced. In contrast, in colleges and universities, decentralized units usually make these decisions. For example, faculty members at the departmental level decide what research to conduct and what courses to teach. The collegiate unit and university administration then provides oversight and coordination for the academic units. Of course students who are pursuing an undergraduate degree in a specific major must also take classes outside of their major department, and therefore the production process for instruction is not wholly contained within a single department. The sociology department, for example, not only provides educational services to students majoring in sociology, but also to other students who take one or more sociology courses as part of their general education requirements or electives.

Another important difference in the operations of postsecondary institutions and private businesses relates to the financial responsibility of units within the organization. If a for-profit firm produces multiple products, then each product is evaluated based on how much it costs to produce it and how much revenue it brings into the organization through sales. If a product line is not profitable, then the firm has a clear incentive to find ways to reduce costs and/or bring in more revenue, or divert resources to another more profitable product. In higher education, however, some departments generate positive net revenues for the institution, while in other departments the cost of their operations exceeds the revenue that they bring in. Furthermore, when the costs for academic units are paid by the institution's central administration, there is less incentive for the units to reduce costs or generate additional revenues.

In a traditional university budgeting process, the institution's central administration makes decisions on an annual basis as to how much money to allocate to each department and support unit. Unrestricted revenues from net tuition and fees, state appropriations, donations, and other sources flow into the university and are then distributed among academic units to cover their planned expenditures for the year. So how does an institution determine how much funding to give to different academic units? In a traditional budgeting process, revenues are not typically distributed on the basis of any set formula or indicators such as the number of students enrolled, but in theory depend on the change in revenues at the institutional level and the perceived needs of each academic unit. If the business school were to experience a 10 % increase in enrollments, however, there is no guarantee that funding from a university's central administration will rise by 10 % in response.

The traditional budgeting system has the advantages of being fairly straightforward to operate and imposes fewer demands on academic units, but it has its limitations. One limitation is that the revenues assigned to academic units may not align with how much money each unit actually generates for the institution. In postsecondary education there is a high degree of cross-subsidization between and within academic units. In particular, departments that are more costly to operate are subsidized by other units that have lower costs of production, even though both units bring in similar amounts of per-student revenues because of the common practice of setting uniform tuition rates across majors. Laboratory science departments, for instance, typically have higher costs than do humanities departments because expensive equipment that is essential in the laboratory is usually not needed in the humanities to teach students or conduct research. Variations in faculty salaries across academic units is another common reason for cross-subsidization between academic units. The institution must compete in separate labor markets for faculty by discipline and the costs of recruiting and retaining engineering faculty exceeds the costs for philosophy faculty (see Chap. 9). Postsecondary costs also vary by the level of students. Class sizes are usually smaller for juniors and seniors than they are for freshmen and sophomores, which means that the cost of educating students who are closer to graduation is higher than the cost of educating newer students. And graduate education tends to be more expensive than undergraduate education due to even smaller class sizes and the greater emphasis of research in the training of graduate students.[24]

[24] These relationships have been consistently demonstrated by economists as a result of estimating cost functions, as described in a previous section of this chapter. For example, Paulsen (1989) estimated the coefficients of instructional cost functions for small private, not-for-profit colleges, finding that many of these same factors create differences in instructional costs even at small private colleges. More specifically, results indicated that instructional costs were greater for upper-level undergraduates compared to lower-level undergraduates, for graduate students relative to undergraduate students; and instructional costs were directly affected by differences in faculty salaries as well as differences in student-faculty ratios.

Another concern with traditional budgeting practices in higher education is that academic units do not have much control over their resources. Each academic department is dependent on the central administration to recognize its need and value to the institution and fund it accordingly. Units that generate more money for the institution than they receive from the administrative allocation may view the current system as being unfair. The lack of connection between performance and funding could lead to a situation where there are no incentives for faculty and departments to do things such as expand enrollments that would help the institution increase revenues.[25] Likewise, because the institution covers the planned expenses for each unit, there is little reason for the unit to become more cost efficient. If a department were able to consolidate support services and reduce expenditures by $40,000, for example, then under a traditional budgeting process the department would not be permitted to use this cost savings for other needs in their own department; in fact, the administration may even reward the department by reducing its budget by $40,000 for the following year.

Decentralized budgeting has been offered by some as an alternative model to address these shortcomings. Although decentralized budgeting systems are most often referred to as responsibility centered management (RCM), institutions have used a variety of names for this process including value centered management (University of Michigan), resource management model (Iowa State University), and incentives for managed growth (University of Minnesota). Decentralized budgeting has been used by a number of private institutions and is increasingly being adopted by public institutions as well.[26] In a decentralized budgeting system, academic units referred to as "responsibility centers" are given the revenue that they generate for the institution, and they must use it to cover their unit's expenses. Typically, schools and colleges within an institution are defined as the responsibility centers; however, academic departments could also be used for this purpose. If the expenses exceed revenues for a responsibility center, then it must make cuts in its spending or generate additional revenue to achieve a balance.

There are many variations of decentralized budgeting systems and no two systems are exactly alike. At some institutions, all revenues are first distributed to the responsibility centers and then the academic units are taxed to fund university-level expenses for things such as central administration, academic support, and the library. In other decentralized budgeting systems, instead of taxing academic units some portion of revenues is kept by the central administration to pay for

[25] This problem is referred to by economists as the principal-agent problem (Arrow, 1969; Grossman & Hart, 1983; Harris & Raviv, 1978; Lane & Kivisto, 2008; Liefner, 2003; Rees, 1985; Ross, 1973).

[26] Indiana University is often credited with being the first public institution to adopt a decentralized budgeting approach (Whalen, 1991). Other academics who have contributed to the study and analysis of decentralized budgeting systems include Brinkman (1993), Priest, Becker, Hossler, and St. John (2002), Strauss and Curry (2002), Strauss, Curry, and Whalen (1996), Toutkoushian and Danielson (2002), Hearn, Lewis, Kallsen, Holdsworth, and Jones (2006), Massy (1996), and Lopez (2006).

university-level expenses. Revenues may all be allocated on the same basis (such as per-student or per-credit hour), or different formulas may be used for different revenue streams (such as tuition revenue and state appropriations).

There are several appealing aspects of using a decentralized budgeting system over a more traditional budgeting process. In decentralized budgeting, academic units have more control over their operations by having the freedom to do things that will bring in more revenues and enable them to deliver better services. Another advantage of decentralized budgeting is that the university's budgeting process becomes more transparent to all parties at the institution because specific formulas are used to distribute revenues and all units are aware of the formulas. A third advantage is that academic units have a financial incentive to do things that would reduce spending and increase revenue to improve their bottom line and in turn help the entire university. And finally, by taxing academic units for administrative and central services, the decentralized budgeting system provides checks and balances on spending in these areas which may be viewed by some as less relevant for the production of teaching, research and public service outputs of the institution.

At the same time, there are some potential disadvantages with decentralized budgeting systems. It might be argued that designating the school/college as the responsibility center does not provide enough incentives for departments and faculty within departments to change their behavior in meaningful ways that are desired by the institution. Even when an institution uses decentralized budgeting, a responsibility center may continue to use a traditional budgeting process to allocate revenues and expenses for departments within the school and not apply the same formulas down to academic departments within the responsibility center. In this instance, a department may not see the benefits to them of expanding enrollments or reducing costs and thus may be reluctant to make changes that would benefit the college. Similarly, professors within a department may not be willing to, say, teach more students and thus generate more money for the college if the additional money would not come back to the person when salaries are set for the coming year.

There are also concerns that decentralized budgeting will increase competition among academic units because students who switch majors will take their dollars with them to the new department. If most of the competition for students is within the institution rather than between institutions, then the decentralized budgeting system would not increase the amount of revenues flowing into the institution as a whole, but would instead simply redistribute existing revenues across units.[27]

[27] Studies that have examined the impact of decentralized budgeting systems on institutions include McBride, Neiman, and Johnson (2000), Toutkoushian and Danielson (2002), and Hearn et al. (2006).

Policy Focus

In the for-profit world, companies are always at risk of going out of business. If the owners of the business could use their resources in alternative ways that would generate more profits, then it is in their best interest to close the business and perhaps start a new one. To illustrate, companies such as Radio Shack, Staples, and Sears have had to close a number of stores since the beginning of the twenty-first century. The risk of going out of business can be very high for small companies and/or companies that are new entrants into a market.

Closures of institutions of higher education do not happen as frequently as they do in many for-profit industries. However, the risk still exists that an institution may be forced to close its doors. According to a 2015 survey of college business officers, 19 % of respondents indicated that they felt that their institution might have to close within the coming decade.[28] Similarly, the National Center for Education Statistics reported that between 2012–2013 and 2014–2015, there were 91 fewer private for-profit institutions in higher education, driven in large part by sharp declines in enrollments and the resulting financial pressures.[29] Most of the other institutions that have closed in recent years are for-profit institutions and/or very small, tuition-dependent private institutions, such as Gunstock College, Lewis College, Campbell Normal University, Alexander College, Atlanta University, Mount Lebanon University, and Tacoma Catholic College.[30] The risk of closure is not isolated to the for-profit sector. In March 2015, for example, Sweet Briar College announced that due to financial pressures it would be discontinuing services. Although the decision was subsequently reversed when alumni were able to raise enough funds to keep the institution open, the announcement was the source of much discussion and consternation within higher education.

A more frequent occurrence in higher education is when campuses within a system close or merge with each other. An institution with campuses at several locations may decide to discontinue services at one or more locations. In 2008, for example, the Community College of Denver closed three of its campuses (East, North, and Southwest CCD), and in 2012 the University of Phoenix announced that it was closing 115 of its campuses around the United States. The governing body of a system of public institutions may likewise opt to combine or merge several institutions into one larger institution. In 2012, the Technical College System of Georgia decided to merge two of its institutions (Central Georgia Technical College

---

[28] The survey was conducted by Inside Higher Education and can be downloaded from their website at https://www.insidehighered.com/system/files/media/IHE_Business%20Officers_Survey%202015%20final.pdf

[29] See the NCES report by Ginder, Kelly-Reid, and Mann (2015) for more details and statistics.

[30] Studies of note on the factors that influence campus closings include Hoenack and Roemer (1981) and Porter and Ramirez (2009). A list of college closings in recent years can be found at http://www.ehow.com/info_7965391_list-closed-universities.html.

and Middle Georgia Technical College), and in 2013 the University System of Georgia voted on mergers for eight of the institutions within its jurisdiction.

From an economic perspective, the decision to close and/or merge an institution depends heavily on its financial viability. For-profit institutions are clearly at the greatest risk for closure given that the owners are constantly evaluating the profitability of using their resources for keeping the institution open versus doing other things. As discussed in this chapter, however, even not-for-profit institutions need to ensure that they can raise enough revenue to at least cover expenses. Private institutions that are relatively small, less selective in admissions, and not significantly engaged in research may have concerns about their financial viability, especially because they are often highly tuition dependent. Nonetheless, public institutions also are at risk of closure or merger despite the subsidy that they receive from state governments.

Behind policy decisions about campus closures and in particular mergers are the notions of fixed costs and economies of scale. Policy makers often advocate for merging campuses or institutions as a way to deliver educational services at a lower cost per student. This would occur because the new (merged) institution will be larger and could take advantage of economies of scale. These advantages are thought to arise due to the reduction in fixed costs. For example, the argument goes that since an institution only needs one president, by merging two institutions the new institution can save on this expense. The same argument would apply to other aspects of running a college or university for which there are fixed expenses. Likewise, the merged institution could potentially offer larger classes to students, which in turn would lead to further reductions in per-student costs, and leverage its larger size to purchase goods and services at lower prices.

It is an open question, however, whether cost savings are realized when institutions merge and how large they might be. As discussed previously, administrative costs are not unambiguously fixed because administrative duties tend to rise with the size and complexity of an institution, and thus when colleges merge the new institution may replace one of the presidents with a vice president. This would lead to a predicted cost savings, but not as large as would be the case with only one employee doing the job. The tenure system also reduces the flexibility of the new institution to eliminate faculty positions as a way of saving money when campuses are merged. Finally, it is often the case that when institutions are merged they are not moved to a new location but rather continue operating at their existing locations under a new name. This limits the ability of the new institution to take advantage of economies of scale by, say, combining departments or administrative units into one building, or finding new space that could be used more efficiently for the merged institution. And of course there are costs involved when merging institutions that need to be considered as well. These costs may include new signage, stationery, and promotional materials, restructuring costs, costs to communicate the change to students, and so on. Taken together, mergers may lead to some cost savings but the magnitude of these savings could be much lower than thought by the policy makers who advocated for them.

Final Thoughts

Economists view a college or university as simply another type of decision maker that faces the same basic economic problem of how to make the best out of its situation given the constraints that it faces. Institutions are constrained in the revenues that they have at their disposal, and behind almost every revenue source are other economic decision makers with demand functions for the postsecondary services that are of most interest to them. Institutions are also similar to firms in the for-profit world in that they have human resources (students, faculty, staff) that they can use to help fulfill their missions. These revenue and human resource constraints are not independent; finances affect the quantity and quality of human resources that can be employed by an institution. For example, colleges with more money at their disposal can hire more and better faculty, give more financial aid to attract better students, and so forth. Higher education production is therefore intertwined with finances, and the incentives for institutions are such that they actively work to attract more revenues to fund their operations.

At the same time, policy makers and the general public are becoming increasingly critical of the way in which higher education finances play out. They have observed tuition rates that have grown at rates exceeding inflation for a long period of time, spending levels that seem very high when expressed as spending-per-student ratios, and yet policy makers have insufficient evidence that the rising prices and spending in higher education have translated into greater benefits and outcomes. It is in this context that institutions of higher education also face pressure to demonstrate that they are efficiently using their financial resources, holding down tuition increases, and pleasing various constituents. In the next chapter, we will continue to explore how institutions behave in academic markets in light of these constraints and pressures.

Glossary

Symbol	Definition
TR	Total revenue
P_k	Price of k-th higher education output
Q_k	Quantity of k-th higher education output
G	Government subsidy to higher education
AR	Average revenue
MR	Marginal revenue
$\overline{P}$	Average price
π/Q	Profit per unit of output
TC	Total cost
FC	Fixed cost
VC	Variable cost

(continued)

Symbol	Definition
AC	Average cost
AFC	Average fixed cost
AVC	Average variable cost
MC	Marginal cost
f(), g()	Functions
X	Non-output variables that affect average cost
Z	Non-output variables that affect total cost
AIC	Average increment in total cost

References

Ahmed, S., & Greene, K. (2000). Is the median voter a clear-cut winner?: Comparing the median voter theory and competing theories in explaining local government spending. *Public Choice, 105*, 207–230.

Arrow, K. (1969). The organization of economic activity: Issues pertinent to the choice of market versus nonmarket allocation. *The Analysis and Evaluation of Public Expenditure: The PPB System, 1*, 59–73.

Bailey, M. (1954). Price and output determination by a firm selling related products. *American Economic Review, 44*, 82–93.

Baumol, W. (1996). Children of performing arts, the economic dilemma: The climbing costs of health care and education. *Journal of Cultural Economics, 20*, 183–206.

Baumol, W., & Blackman, S. (1995). How to think about rising college costs. *Planning for Higher Education, 23*, 1–7.

Baumol, W., & Bowen, W. (1966). *Performing arts: The economic dilemma*. New York: Twentieth Century Fund.

Baumol, W., Panzar, J., & Willig, D. (1982). *Contestable markets and the theory of industry structure*. New York: Harcourt and Brace Jovanovich.

Becker, G. (1983). A theory of competition among pressure groups for political influence. *The Quarterly Journal of Economics, 98*, 371–400.

Becker, G. (1985). Public policies, pressure groups, and dead weight costs. *Journal of Public Economics, 28*, 329–347.

Bergstrom, T., Blume, L., & Varian, H. (1986). On the private provision of public goods. *Journal of Public Economics, 29*, 25–49.

Bergstrom, T., Rubinfeld, D., & Shapiro, P. (1982). Micro-based estimates of demand functions for local school expenditures. *Econometrica, 50*, 1183–1205.

Berle, A., & Means, G. (1933). *The modern corporation and private property*. New York: Macmillan.

Black, D. (1948). On the rationale of group decision-making. *Journal of Political Economy, 56*, 23–34.

Borcherding, T., & Deacon, R. (1972). The demand for the services of non-federal governments. *The American Economic Review, 62*, 891–901.

Bowen, H. (1980). *The costs of higher education*. San Francisco: Jossey-Bass Publishers.

Bowen, W. (2013). *Higher education in the digital age*. Princeton, NJ: Princeton University Press.

Brinkman, P. (1990). Higher education cost functions. In S. Hoenack & E. Collins (Eds.), *The economics of American universities: Management, operations, and fiscal environment*. New York: State University of New York Press.

Brinkman, P. (1993). Responsibility center budgeting: An approach to decentralized management for institutions of higher education. *Planning for Higher Education, 21*, 49–51.

Brinkman, P., & Leslie, L. (1986). Economies of scale in higher education: Sixty years of research. *Review of Higher Education, 10*, 1–28.

Brown, J., Dimmock, S., & Weisbenner, S. (2015). The supply of and demand for charitable donations to higher education. In J. Brown & C. Hoxby (Eds.), *How the financial crisis and Great Recession affected higher education*. Chicago: The University of Chicago Press.

Cheslock, J., & Gianneschi, M. (2008). Replacing state appropriations with alternative revenue sources: The case of voluntary support. *The Journal of Higher Education, 79*, 208–229.

Clemens, E. (1951–52). Price discrimination and the multi-product firm. *Review of Economic Studies*, *19*, 1–11.

Clotfelter, C. (1996). *Buying the best: Cost escalation in elite higher education*. Princeton, NJ: Princeton University Press.

Coase, R. (1937). The nature of the firm. *Economica, 4*, 386–405.

Cohn, E., Rhine, S., & Santos, M. (1989). Institutions of higher education as multi-product firms: Economies of scale and scope. *The Review of Economics and Statistics, 71*, 284–290.

College Board. (2014). *Trends in college pricing 2013*. Washington, DC: The College Board. Retrieved 8/1/14, from http://www.trends.collegeboard.org

Comanor, W. (1976). The median voter rule and the theory of political choice. *Journal of Public Economics, 5*, 169–177.

Corcoran, S., & Evans, W. (2010). *Income inequality, the median voter, and the support for public education* (No. w16097). Cambridge, MA: National Bureau of Economic Research.

Cournot, A. (1838). *Researches into the mathematical principles of the theory of wealth* (N. Bacon, Trans.). New York: Macmillan, 1929.

Cowen, T. (1996). Why I do not believe in the cost-disease. *Journal of Cultural Economics, 20*, 207–214.

deGroot, H., McMahon, W., & Volkwein, J. (1991). The cost structure of American research universities. *The Review of Economics and Statistics, 73*, 424–431.

Downs, A. (1957). *An economic theory of democracy*. New York: Harper Collins.

Easley, D., & O'Hara, M. (1983). The economic role of the nonprofit firm. *The Bell Journal of Economics, 14*, 531–538.

Ehrenberg, R. (Ed.). (2006). *What's happening to public higher education? The shifting financial burden*. Baltimore: The Johns Hopkins University Press.

Ferguson, C. (1969). *The neoclassical theory of production & distribution*. London: Cambridge University Press.

Getz, M., Siegfried, J., & Zhang, H. (1991). Estimating economies of scale in higher education. *Economics Letters, 37*, 203–208.

Ginder, S., Kelly-Reid, J., & Mann, F. (2015). *Postsecondary institutions and cost of attendance in 2014–15; degrees and other awards conferred, 2013–14; and 12-month enrollment, 2013–14* (NCES 2015–097). Washington, DC: National Center for Education Statistics, Institute of Education Sciences.

Gottfried, M. (2008). College crowd-in: How private donations positively affect alumni giving. *International Journal of Educational Advancement, 8*, 51–70.

Grossman, S., & Hart, O. (1983). An analysis of the principal-agent problem. *Econometrica, 51*, 7–45.

Hall, P. (1987). A historical overview of the private nonprofit sector. In W. Powell (Ed.), *The nonprofit sector: A research handbook* (pp. 341–361). New Haven, CT: Yale University Press.

Hall, R., & Hitch, C. (1939). Price theory and business behavior. *Oxford Economic Papers, 2*, 12–45.

Halstead, K. (1991). *Higher education revenues and expenditures: A study of institutional costs*. Washington, DC: Research Associates of Washington.

Hansmann, H. (1987). Economic theories of nonprofit organization. In W. Powell (Ed.), *The nonprofit sector: A research handbook* (pp. 27–42). New Haven, CT: Yale University Press.

Hansmann, H. (1986). The role of nonprofit enterprise. In S. Rose-Ackerman (Ed.), *The economics of nonprofit institutions* (pp. 57–84). New York: Oxford University Press.

Harris, M., & Raviv, A. (1978). Some results on incentive contracts with applications to education and employment, health insurance, and law enforcement. *The American Economic Review, 68*, 20–30.

Hearn, J., Lewis, D., Kallsen, L., Holdsworth, J., & Jones, L. (2006). "Incentives for Managed Growth": A case study of incentives-based planning and budgeting in a large public research university. *The Journal of Higher Education, 77*, 286–316.

Heutel, G. (2014). Crowding out and crowding in of private donations and government grants. *Public Finance Review, 42*, 143–175.

Hicks, J. (1946). *Value and capital* (2nd ed.). Oxford: Oxford University Press.

Hoenack, S., & Roemer, J. (1981). Evaluating college campus closings for the 1980s: A case application of an optimization model. *Research in Higher Education, 15*, 49–68.

Holcombe, R. (1980). An empirical test of the median voter model. *Economic Inquiry, 18*, 260–275.

Holcombe, R. (1989). The median voter model in public choice theory. *Public Choice, 61*, 115–125.

Hotelling, H. (1929). Stability in competition. *The Economic Journal, 39*, 41–57.

Humphrey, T. (1996). Marshallian cross diagrams and their uses before Alfred Marshall: The origins of supply and demand geometry. In J. Woord (Ed.), *Alfred Marshall: Critical assessments. Second series*. New York: Routledge.

James, E. (1978). Product mix and cost disaggregation: A reinterpretation of the economics of higher education. *Journal of Human Resources, 13*, 157–186.

James, E. (1983). How nonprofits grow: A model. *Journal of Policy Analysis and Management, 2*, 350–365.

Koshal, R., & Koshal, M. (1995). Quality and economies of scale in higher education. *Applied Economics, 27*, 773–778.

Koshal, R., & Koshal, M. (1999). Economies of scale and scope in higher education: A case of comprehensive universities. *Economics of Education Review, 18*, 269–277.

Kroszner, R., & Putterman, L. (Eds.). (2009). *The economic nature of the firm: A reader* (3rd ed.). Cambridge, UK: Cambridge University Press.

Laband, D., & Lentz, B. (2003). New estimates of economies of scale and scope in higher education. *Southern Economic Journal, 70*, 172–183.

Laband, D., & Lentz, B. (2004). Do costs differ between for-profit and not-for-profit producers of higher education? *Research in Higher Education, 45*, 429–441.

Lane, J., & Kivisto, J. (2008). Interests, information, and incentives in higher education: Principal-agent theory and its potential applications to the study of higher education governance. In *Higher education: Handbook of theory and research* (Vol. 23, pp. 141–179). Dordrecht, The Netherlands: Springer.

Lenton, P. (2008). The cost structure of higher education in further education colleges in England. *Economics of Education Review, 27*, 471–482.

Liefner, I. (2003). Funding, resource allocation, and performance in higher education systems. *Higher Education, 46*, 469–489.

López, M. (2006). Towards decentralized and goal-oriented models of institutional resource allocation: The Spanish case. *Higher Education, 51*, 589–617.

Lovell, M. (1978). Spending for education: The exercise of public choice. *The Review of Economics and Statistics, 60*, 487–495.

Mangoldt, H. (1863). The exchange ratio of goods. (E. Henderson, Trans.) *Grundriss der volkswirtschaftslehre*, Stuttgart: Engelhorn. In *International economic papers*, No. 11, (pp. 32–59). London: Macmillan, 1962.

Marshall, A. (1890). *Principles of economics* (Vol. 1). London: Macmillan.

Martin, R. (2011). *The college cost disease: Higher cost and lower quality*. Northampton, MA: Edward Elgar Publishing.

Massy, W. (Ed.). (1996). *Resource allocation in higher education*. Ann Arbor, MI: University of Michigan Press.

McBride, A., Neiman, S., & Johnson, J. (2000). Responsibility-centered management: A 10-year nursing assessment. *Journal of Professional Nursing, 16*, 201–209.

McPherson, M., Schapiro, M., & Winston, G. (1993). *Paying the piper: Productivity, incentives, and financing in U.S. higher education*. Ann Arbor, MI: The University of Michigan Press.

Moore, F. (1959). Economies of scale: Some statistical evidence. *Quarterly Journal of Economics, 73*, 232–245.

Moss, S. (1984). The history of the theory of the firm from Marshall to Robinson and Chamberlin: The source of positivism in economics. *Economica, 51*, 307–318.

National Center for Education Statistics. (2012). *Digest of education statistics 2012*. Washington, DC: Institute of Education Sciences.

Newhouse, J. (1969). *Toward a theory of non-profit institutions: An economic model of a hospital* (No. RAND-P-4022). Santa Monica, CA: RAND Corporation.

Okten, C., & Weisbrod, B. (2000). Determinants of donations in private nonprofit markets. *Journal of Public Economics, 75*, 255–272.

Panzar, J., & Willig, R. (1977). Economies of scale in multi-output production. *The Quarterly Journal of Economics, 91*, 481–493.

Paulsen, M. (1989). Estimating instructional cost functions at small independent colleges. *Journal of Education Finance, 15*, 53–66.

Paulsen, M., & Smart, J. (Eds.). (2001). *The finance of higher education: Theory, research, policy & practice*. New York: Agathon Press.

Payne, A. (2001). Measuring the effect of federal research funding on private donations at research universities: Is federal research funding more than a substitute for private donations? *International Tax and Public Finance, 8*, 731–751.

Pfouts, R. (1961). The theory of cost and production in the multi-product firm. *Econometrica, 29*, 650–658.

Porter, S., & Ramirez, T. (2009). *Why do colleges fail? An analysis of college and university closings and mergers, 1975–2005*. Paper presented at the meeting of the American Educational Research Association, San Diego, CA.

Priest, D., Becker, W., Hossler, D., & St. John, E. (Eds.). (2002). *Incentive-based budgeting systems in public universities*. Northampton, MA: Edward Elgar.

Putterman, L. (1998). *The economic nature of the firm*. Cambridge, UK: Cambridge University Press.

Rau, K. (1841). *Grundsätze der volkswirthschaftslehre* (4th ed.). Heidelberg, Germany: C.F. Winter.

Rees, R. (1985). The theory of principal and agent part i. *Bulletin of Economic Research, 37*, 3–26.

Ross, S. (1973). The economic theory of agency: The principal's problem. *The American Economic Review, 63*, 134–139.

Sav, G. (2004). Higher education costs and scale and scope economies. *Applied Economics, 36*, 607–614.

Smith, A. (1776). *The wealth of nations*. London: Methuen & Co., Ltd.

Steinberg, R. (2003). Economic theories of nonprofit organizations. In H. Anheier & A. Ben-Nur (Eds.), *The study of nonprofit enterprise: Theories and approaches* (pp. 277–309). New York: Kluwer Academic Publishers.

Steinberg, R., & Gray, B. (1993). "The role of nonprofit enterprise" in 1993: Hansmann revisited. *Nonprofit and Voluntary Sector Quarterly, 22*, 297–316.

Strauss, J., Curry, J., & Whalen, E. (1996). Revenue responsibility budgeting. In W. Massy (Ed.), *Resource allocation in higher education* (pp. 163–190). Ann Arbor, MI: University of Michigan Press.

Strauss, J., & Curry, J. (2002). *Responsibility center management: Lessons from 25 years of decentralized management*. National Association of College and University Business Officials, PO Box 362, Annapolis Junction, MD 20701-0362.

Teece, D. (1982). Towards an economic theory of the multiproduct firm. *Journal of Economic Behavior and Organization, 3*, 39–63.
Toutkoushian, R. (1999). The value of cost functions for policymaking and institutional research. *Research in Higher Education, 40*, 1–16.
Toutkoushian, R. (2001). Trends in revenues and expenditures in public and private higher education. In M. Paulsen & J. Smart (Eds.), *The finance of higher education: Theory, research, policy & practice* (pp. 11–38). New York: Agathon Press.
Toutkoushian, R., & Danielson, C. (2002). Using performance indicators to evaluate decentralized budgeting systems and institutional performance. In D. Priest, W. Becker, D. Hossler, & E. St. John (Eds.), *Incentive-based budgeting systems in public universities* (pp. 205–226). Northampton, MA: Edward Elgar Publishing.
Toutkoushian, R., & Hollis, P. (1998). Using panel data to examine legislative demand for higher education. *Education Economics, 6*, 141–157.
Weisbrod, B. (2009). *The nonprofit economy*. Cambridge, MA: Harvard University Press.
Weisbrod, B., Ballou, J., & Asch, E. (2008). *Mission and money: Understanding the university*. Cambridge, MA: Cambridge University Press.
Weldon, J. (1948). The multi-product firm. *Canadian Journal of Economics and Political Science, 14*, 176–190.
Wellman, J. (2010). Improving data to tackle the higher education "cost disease". *Planning for Higher Education, 38*, 25–37.
Whalen, E. (1991). *Responsibility center budgeting: An approach to decentralized management for institutions of higher education*. Bloomington, IN: Indiana University Press.
Williamson, O. (1971). Profit, growth and sales maximization. In G. Archibald (Ed.), *The theory of the firm*. London: Penguin.
Winston, G. (1997). Why can't a college be more like a firm? *Change, 29*, 32–38.
Winston, G. (1999). Subsidies, hierarchy and peers: The awkward economics of higher education. *The Journal of Economic Perspectives, 13*, 13–36.

Chapter 8
Competition and Production in Higher Education

Abstract In this chapter, we focus on the behavior of colleges and universities in the markets for students. We begin by providing some background information on the pioneering work of economists on production, competition, and market structures. We then turn to the alternative goals and objectives that have been offered for postsecondary institutions. Unlike typical industries where the behavioral assumption is made that the organization is trying to maximize profits, postsecondary institutions have been described by economists as striving to maximize a range of things such as revenues, utility, prestige, or discretionary budgets. In the next section of the chapter we review the different structures that economists commonly use to describe product markets, and how postsecondary markets compare to these models. Following the discussion of market structures, we turn to the topic of competition in postsecondary education. Despite the impression that competition is something new to higher education, in fact colleges have a long history of competing with each other in ways that extend beyond athletics. In postsecondary education, colleges engage in price and non-price competition for students. The next topic that we cover is education production. Economists use a production function or model to describe how organizations convert inputs into outputs to work towards their goals. We believe that the production function analogy holds quite well for a number of reasons, and yet we will discuss some of the important differences in the production function between the typical for-profit sector and higher education that complicate the comparison. In the Extensions section, we discuss how online and distance education may affect the markets in which colleges and universities compete. Finally, in the Policy Focus section, we examine how states use funding formulas to distribute appropriations to public institutions and impact their behavior.

Introduction

In Chap. 7, we focused on where colleges and universities get their money and how they spend it. The way in which postsecondary institutions are funded is quite different from what happens to organizations in the for-profit world in that the

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_8

services of colleges and universities in both the public and private sectors are highly subsidized by government, donors, and others. Nonetheless, even though the majority of institutions are classified as being not-for-profit, they still need to raise enough revenue to cover their costs and remain in business. Accordingly, decisions must be made about what they have to do to succeed.

In this chapter, we use an economic lens to consider in more detail how colleges and universities behave in postsecondary markets. Firms in the for-profit world compete with each other for customers, employees, and the resources that they need to provide goods and services. These firms must decide how to best convert inputs into outputs to help achieve their goals and objectives. This is the type of problem that can be addressed by economics: how a decision maker uses scarce resources to help achieve its goals. The same problem applies to higher education, where colleges compete with each other for students, faculty, staff, research grants, state appropriations, private donations, athletics, and so on. Postsecondary institutions must likewise figure out how to use their scarce resources to help work towards their goals and objectives.

Here we will focus primarily on the behavior of colleges and universities in the markets for students. We begin by providing some background information on the pioneering work of economists on production, competition, and market structures. We then turn to the alternative goals and objectives that have been offered for postsecondary institutions. Unlike typical industries where the behavioral assumption is made that the organization is trying to maximize profits, postsecondary institutions have been described by economists as striving to maximize a range of things such as revenues, utility, prestige, or discretionary budgets.

In the next section of the chapter we review the different structures that economists commonly use to describe product markets, and how postsecondary markets compare to these models. As is true with for-profit firms, colleges and universities operate in many different markets for customers and compete in multiple markets at the same time. However, most postsecondary markets do not align neatly with the classic textbook definitions of market structures used by economists.

Following the discussion of market structures, we turn to the topic of competition in postsecondary education. Despite the impression that competition is something new to higher education, in fact colleges have a long history of competing with each other in ways that extend beyond athletics. The competition for students—especially academically talented students—can be fierce. One way in which firms compete for customers is by lowering their price. In postsecondary education, colleges engage in price competition not only through their posted tuition and fees, but also by how much financial aid the institution gives to students to reduce the net prices that they pay. Colleges compete for students through non-price mechanisms as well. These include improving the quality of education, which in turn raises the financial benefits to students from attending the institution, or through adding amenities and other services and attributes that increase consumptive benefits for students. Economists refer to this second form of competition as product differentiation, where the supplier alters the good/service to make it more appealing to consumers.

The next topic that we cover in this chapter is education production. Economists use a production function or model to describe how organizations convert inputs into outputs to work towards their goals. For example, an automobile manufacturer takes rubber, glass, steel and other raw materials (inputs), and runs them through an assembly line (production process) to produce automobiles (outputs). The output is then sold to consumers to help achieve the company's goal of maximizing profits. Can this same analogy be used to describe how colleges and universities operate? We believe that the analogy holds quite well for a number of reasons, and yet we will discuss some of the important differences in the production model between the typical for-profit sector and higher education that complicate the comparison. Sometimes this process is shown as a mathematical equation such as the widely-used Cobb-Douglas production function. Other times production is depicted as a more general relationship between inputs, production process, outputs, and goals/objectives.

In the Extensions section, we discuss how online and distance education may affect the markets in which colleges and universities compete. Will these institutional practices come to dominate postsecondary markets? Which groups of customers will find distance education to be the most appealing? Finally, in the Policy Focus section, we examine how states use funding formulas to distribute appropriations to public institutions and impact their behavior. For example, we consider how using peer funding formulas may help colleges remain competitive with other institutions, and how performance funding formulas may enhance the productivity of a states' institutions of higher education. We will argue that despite good intentions, performance funding systems may have a limited impact on the efficiency of production in higher education due to some of the unique facets of how colleges convert inputs into outputs and how these systems are implemented.

Background

As with many economic topics covered in this book, the origin of the study of how firms behave dates back to the eighteenth century as economists began to address questions relating to the mass production of goods and services. Early economists focused on how firms use land, labor, capital, and raw materials to produce goods and services. Because this work centered on for-profit firms and businesses, economists usually assumed that the goal of these organizations was to maximize profits, and developed models to identify how much output should be produced to achieve this goal subject to their constraints.

Once a firm has chosen how much output to produce, it must figure out the best way to actually make the output. Economists use the concept of a production function to describe this process. In a production function, a firm converts inputs into outputs through its designated production process. The resulting production function shows the maximum output that an organization can produce with given resources, assuming that any technical inefficiencies have been addressed. As early as the eighteenth century, economists such as Turgot and Malthus described relationships between resources and output that followed assumptions about how the marginal productivity of labor and capital change as output is expanded.[1] More formal mathematical versions of production functions were later introduced by a number of economists.[2]

The notion of competition among firms was first articulated by economists in the eighteenth century. In *The Wealth of Nations*, Adam Smith discussed how sellers compete with each other on the basis of price, and that market pressures would lead sellers to lower their price when they have excess output. However, other academics who predate Smith likewise contributed to our current understanding of competition among firms.[3] If you were to open any principles-level economics textbook, you would find several chapters devoted to the four following market structures: perfect competition, monopoly, oligopoly, and monopolistic competition. The structure of a market is important for understanding how firms compete with each other for customers. Adam Smith and his contemporaries observed that markets with many sellers tended to have lower prices than did markets with fewer sellers. This work led to the notion of a perfectly-competitive market in which there are a very large number of firms, each of which produces a small share of total output.[4] Despite what its name suggests, firms in a perfectly-competitive market do not really compete with each other because each individual firm has no control over the market price and takes the market price as given. In addition, all firms in a perfectly competitive market produce a homogenous product, so that consumers view each firm's output as identical.

In the late nineteenth century, it became clear to economists that the model of perfect competition was not a sufficient description for how actual markets operate. The concept of perfect competition is more useful as a theoretical construct than it is a model for real markets. At the opposite extreme from perfect competition is the market model known as monopoly. The term monopoly dates back more than two centuries to Aristotle, who used it to describe the market for olive presses at the

[1] A. R. J. Turgot (1767) is largely credited with being the first to describe how a firm's total output can be modeled as a function of inputs based on assumptions about the marginal productivity and cross-productivity of inputs. Malthus (1798) later extended this notion to a logarithmic relationship between inputs and output. Excellent reviews of the early economic literature on production can be found in Humphrey (1997) and Mishra (2007).

[2] See von Thunen (1863), Cobb and Douglas (1928), Christensen, Jorgenson, and Lau (1972), and Uzawa (1962).

[3] Among the early economists who examined competition among sellers are Steuart (1767), Turgot (1767), Hume (1955), and Cantillon (1755). For more details of the early economic literature on competition, see Monroe (1948), Schumpeter (1954), Stigler (1957), McNulty (1967), and Moss (1984).

[4] The model of perfect competition can be traced to the work of Cournot (1929). Readers who are interested in how the concept of perfect competition developed are referred to Hayek (1948), Stigler (1957), and McNulty (1967).

time. Interest in monopolies increased in the late nineteenth century as important industries began to be taken over by large firms or trusts such as Standard Oil. In a monopolistic market, there is only one supplier or seller. The firm therefore has no direct competitors, and thus its price becomes the market price by definition. To combat problems associated with monopolies and highly-concentrated industries, the United States enacted legislation to ensure that firms did not have too much monopoly power to control prices and output in designated markets.[5] Because very few actual markets have only one seller, however, the monopoly model is likewise viewed as more of a theoretical construct than a description of real markets.

By the twentieth century, in an attempt to find models of markets that were more realistic, economists turned their attention to options that fall somewhere in between the two extremes of perfect competition and monopoly. The first of these is monopolistic competition. In a monopolistically-competitive market there are many sellers, low barriers to entry and exit, and yet firms produce goods are services that are heterogeneous, meaning that they can differ from each other.[6] In this model, firms can compete with each other in ways other than simply lowering their price. If McDonald's wanted to sell more hamburgers, for example, not only could they reduce their price, they could also improve the quality of their hamburgers, or use advertising to make them more desirable among consumers.

Finally, economists developed models of markets where there were relatively few sellers—but more than one—of a particular good or service. In these markets, which have come to be known as oligopolies, sellers have market power but are greatly affected by the actions of others in the market. This interdependence among sellers is a key feature of oligopoly, and led to the introduction of game theory to explain how firms operate in these markets. The origins of the oligopoly model date back to Cournot.[7] If the good or service being sold is relatively homogeneous (such as gasoline or cement), then firms compete with each other mainly through the prices they charge. However, if instead of each firm cutting its price to increase market share they could agree or collude to keep prices higher, then they would all potentially benefit from the arrangement. The OPEC oil cartel is perhaps the most famous example of this type of collusion in an oligopolistic market, and the aforementioned antitrust legislation was targeted at preventing such behavior by sellers.

[5] Key pieces of antitrust legislation in the United States include the Sherman Act of 1890 and the Clayton Act of 1914.

[6] The concept of monopolistic competition traces back to the pioneering work of Chamberlin (1933) and Robinson (1933). Discussions of monopolistic competition and its evolution can be found in Chamberlin (1961), Keppler (1994) and Hart (1979).

[7] Readers who are interested in the development of oligopoly and game theory are referred to Stigler (1950), Schumpeter (1954), Shapiro (1989), Puu and Sushko (2002), Edgeworth (1889), Bertrand (1883), and Nash (1950, 1951).

Goals and Objectives of Postsecondary Institutions

All organizations need to make decisions about how they will operate. Economic reasoning is based on the notion that each decision maker—be it a firm or an individual—seeks to make the best of its situation given the constraints that it faces. This holds true regardless of the specific goal or objective of the decision maker. Note that this definition is very general and says nothing about what that goal or objective should be.

To move beyond such a general statement, we must make a behavioral assumption about the goal or objective colleges and universities are trying to achieve. For traditional firms and businesses, economists usually assume that their goal is to maximize profits. This follows from the fact that for-profit organizations are owned by shareholders and are expected to distribute excess earnings (profits) to shareholders. If potential shareholders look for the investment with the highest financial payoff, then it follows that firms will seek to maximize profits and hence the amounts of profit they can distribute to shareholders.

Economists have shown that a firm will produce output up to the point where the additional revenue from the last unit of output produced (*marginal revenue*) equals the additional cost incurred from producing the last unit of output (*marginal cost*) to maximize profits. This is depicted in Fig. 8.1 for the simple case where there is a U-shaped marginal cost curve as described in Chap. 7, and a linear marginal revenue curve that falls with output.[8] The profit-maximizing output level (Q_E) and equilibrium price (P_E) are found where the marginal revenue and marginal cost curves intersect. To see why this level of output maximizes profits, consider two other levels of output (Q_A and Q_B). If the firm were producing fewer units than Q_E (such as Q_A), then there are ($Q_E - Q_A$) units of output not being made even though doing so would increase profits because MR > MC. Accordingly, the firm would have an incentive to increase output up to Q_E. Likewise, the opposite would occur if the firm were making too much output, such as Q_B. Now the firm is producing ($Q_B - Q_E$) units of output even though it costs the firm more money to make them than it receives in sales revenues (MC > MR). Profits could therefore be increased by reducing output to the equilibrium level Q_E.

---

[8] The marginal revenue curve will be linear and downward-sloping when the demand curve (i.e., the average revenue curve) is also linear and downward-sloping. Both are derived from the total revenue function. The relationships between total, marginal and average revenue functions can be readily defined mathematically as follows:

$$TR = \alpha_1 Q - Q^2$$
$$MR = \partial TR / \partial Q = \alpha_1 - 2Q$$
$$AR = TR/Q = \alpha_1 - Q$$

The U-shaped marginal cost curve follows from the assumption that there are economies and diseconomies of scale in the provision of services. However, the same basic results discussed here also hold for other situations where the marginal revenue and/or marginal cost curves have different shapes.

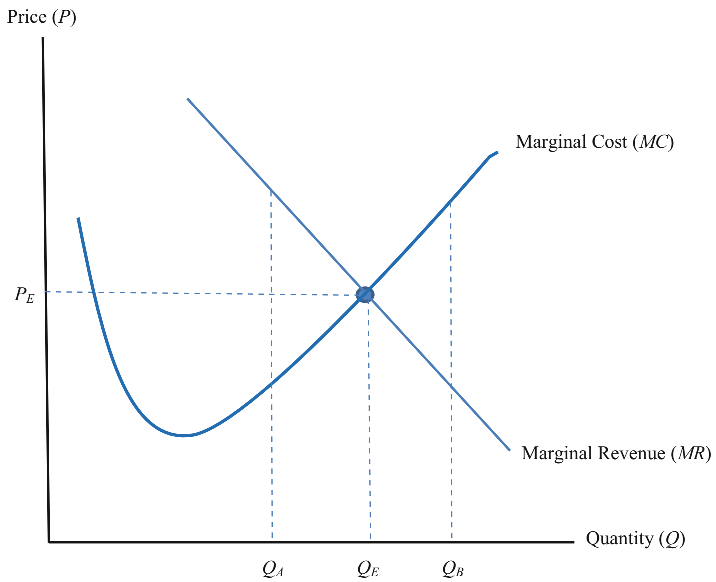


Fig. 8.1 Profit-maximizing output for a firm

Does the goal of profit maximization apply to colleges and universities? Not-for-profit colleges and universities do not have shareholders and they do not exist solely to make money for those shareholders. The ultimate goal of postsecondary institutions, in its broadest sense, is to maximize the production and distribution of knowledge subject to their constraints. Because the teaching activities of an institution relate to the distribution of knowledge, and the research activities of an institution relate to the production of knowledge, there can also be complementarities between these in that research may help with knowledge dissemination and teaching may help with knowledge production. The relative emphasis that an institution places on the production (research) and distribution (teaching and learning) of knowledge depends on its mission, with bachelor- and associate-level institutions focusing almost solely on knowledge dissemination and doctoral- and master-level institutions being involved in both dimensions. As a result, even though postsecondary institutions sometimes behave in ways consistent with organizations in pursuit of profits, for colleges and universities, profit maximization is at best a means towards another end and not an end in and of itself.

Whereas most observers would agree that postsecondary institutions seek to maximize knowledge production and dissemination, there is considerable disagreement about how they operate and what motivates them to work towards this goal. A number of researchers have simply treated colleges and universities as profit maximizers. They argue that not-for-profit postsecondary institutions are permitted to earn and keep excess revenues, and prudent budget managers will seek to earn and retain some profit, or excess revenue, to cover higher-than-anticipated expenditures. Economists such as Rothschild and White have used the profit maximization assumption to model the behavior of colleges and universities, and other economists have argued that postsecondary institutions seek to maximize their discretionary budget, which is similar to the standard assumption of profit maximization.[9] For example, Paulsen developed a model in which he argued that postsecondary institutions seek to maximize their revenue that remains after subtracting an institution's expenditures for producing services plus other expenses for marketing and fundraising.

At the same time, there are arguments against the profit maximizing assumption as the best description of the incentive that motivates postsecondary behavior. Many institutions practice selective admissions rather than enroll students up to the point where marginal revenue equals marginal cost. These institutions deliberately forego profit and revenue in exchange for deciding which subset of potential students they will serve. This is particularly true of institutions with excess capacity in classrooms and dormitories because the marginal costs of educating additional students may be much lower than the marginal revenue they would bring into the college if they were admitted and enrolled.

Other economists have introduced alternatives to the pursuit of profit as the incentive that primarily motivates the actions of postsecondary institutions. One of the most popular theories of institutional behavior was developed by Howard Bowen.[10] His theory, which has come to be known as the "revenue theory of costs," holds that institutions raise as much revenue as they can and then spend all the revenue they raise. This theory aligns with much of the observed activities of institutions where they aggressively seek out revenues from students, governments, and other entities, and then increase spending in response to having received more revenues. Note that this theory is distinct from profit maximization where the organization is concerned not with the level of revenues, but with the revenues that are left over after covering expenses. Bowen's theory also helps explain the phenomenon of rising costs in higher education.[11]

Although Bowen's theory has been cited frequently and has some appealing attributes, there are limitations with it as well. As is true of the discretionary budget model, it is not clear that maximizing revenues is the ultimate goal of institutions instead of being the means to achieve another goal. We also see many instances where institutions could raise more revenues than they currently do, by charging students higher tuition or by expanding enrollments when there is excess demand, and yet they choose to not do this. And institutions may not always put revenues back into their operations and drive up expenditures, but rather use some portion to lower the prices charged to students.

---

[9] See Rothschild and White (1995). The discretionary budget model is described in detail by Paulsen (2000). His model builds on the work of Migue and Belanger (1974), Niskanen (1975) and Blais and Dion (1991).

[10] See Bowen (1980) for more details.

[11] In this framework, costs rise as non-discretionary revenues rise, leading to what Winston (1999) referred to as a positional arms race among colleges and universities for financial resources. Interested readers are also referred to Clotfelter (1996) for more discussion.

Finally, others have asserted that institutions attempt to maximize utility or prestige rather than profit or revenue. Garvin, for example, developed a conceptual model of postsecondary institutions with the assumption that universities attempt to maximize utility.[12] Likewise, a number of studies have relied on the assumption that institutions seek to maximize their prestige or reputation.

Each of the alternatives offers some useful insights into the actions of colleges and universities, and yet each on its own does not fully explain the college and university behavior that we observe in postsecondary markets. One way to look at this is that colleges operate differently depending on the markets in which they compete. It might be argued that there are two extreme groups of institutions: prestige maximizers and revenue maximizers. At one extreme are institutions that seek to achieve their ultimate goals by maximizing their prestige or reputation (see Fig. 8.2). For them, prestige and reputation in academia is driven by the quality of the students who are enrolled at the institution. To get more high-ability students to enroll, an institution can either improve the quality of services offered, and/or reduce the price charged to high-ability students. This is largely achieved through subsidies, which are revenues obtained from all non-student sources (see discussion in Chap. 7). We present this model in Fig. 8.2, where we represent the process of institutional behavior as circular in order to show that institutions that are successful at raising their prestige can use their gains to attract even more subsidies and continue the cycle.

Institutions within this group believe that by maximizing prestige/reputation, they can better achieve their ultimate goals of producing and disseminating knowledge. Colleges with more prestige and financial resources can use this to hire better faculty and provide a better infrastructure for producing research. Likewise, by becoming more selective in admissions these institutions hope to provide a better learning environment for students through peer effects.

A hypothetical illustration of the role of subsidies in pricing is shown in Fig. 8.3. In this example, the equilibrium tuition rate ($30,000) and enrollment level (5,000) are found where quantity demanded equals quantity supplied. Therefore, the institution needs $150 million in revenue to cover its expenses for educating 5,000 students. Suppose now that the institution receives $50 million in subsidies from sources such as state governments or private donations. If the institution distributed the subsidy evenly across all students, then it would only have to charge students $20,000/year to attend. At this lower price, there would now be 8,000 students who are willing and able to enroll given the position of the market demand curve for enrollment at the institution. If the institution still wants to enroll the same number of students as before, then it would have an excess demand of 3,000 students and only enroll 63 % of those who apply for admission. Note that as the subsidy level

[12] Other economists who assumed that the goal of postsecondary institutions is to maximize utility or prestige include James (1978, 1990) and Winston (1999). Epple, Romano, and Sieg (2006) posited that the goal of postsecondary institutions is to maximize the quality of experiences for students. For further discussion see Garvin (1980), James (1990), Winston (1999), and Melguizo and Strober (2007).

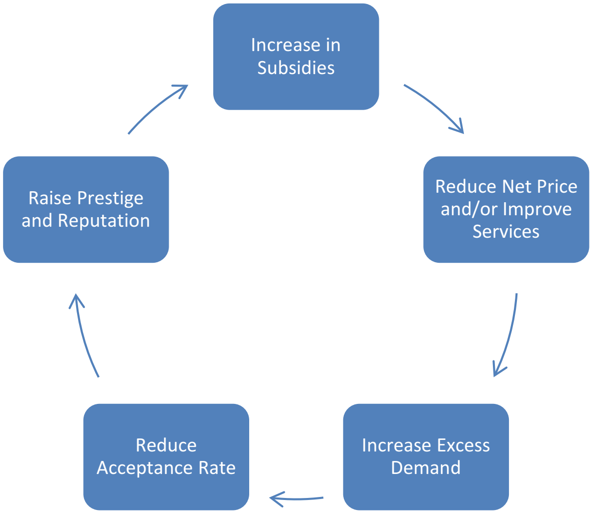


Fig. 8.2 Model of prestige-seeking behavior of selective higher education institutions

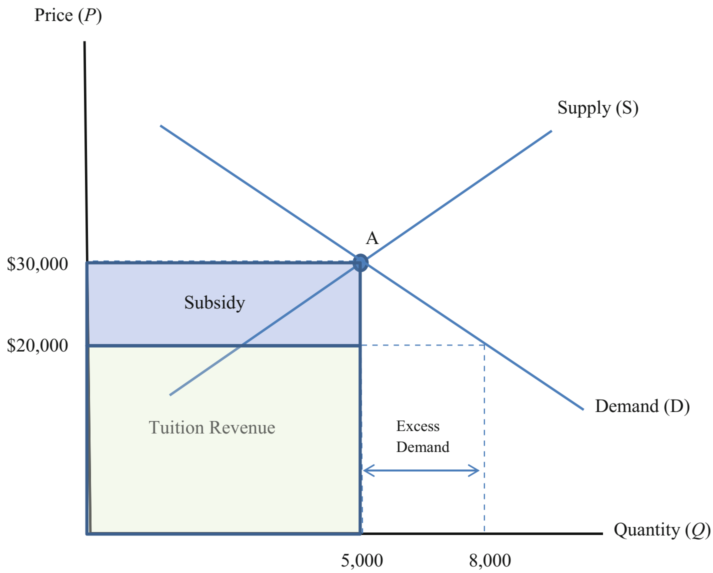


Fig. 8.3 Using subsidies for price reduction

increases, all else held constant, the price charged to students falls and the excess demand for the institution rises. As excess demand rises, the college would be more selective as to which students they admit, and thus increase the average academic qualifications of the incoming class and in turn the college's reputation and prestige.

Instead of using the subsidy to lower prices, the college could do as Bowen suggests and use the additional revenue to improve the production process and the quality of services. Institutions that have added resources are able to hire more and better faculty, improve research facilities, reduce class sizes, expand support services, and offer amenities that enhance the overall experience of students. Imagine that an institution uses all of its subsidy to improve services rather than reduce prices, as shown in Fig. 8.4. The investment of subsidies in improving services results in a leftward shift in the institution's supply curve since it is now more expensive to deliver the same quantity of instructional services as before. Students are still charged a tuition rate of $30,000 and yet receive $40,000 worth of services. As a result, the market demand curve will shift to the right and there will be an excess demand at the prior equilibrium price of $30,000. Regardless of how subsidies are used, however, they would be predicted to increase demand for the institution, which in turn raises prestige and reputation. In practice, of course, institutions could also use its subsidy for both price reduction and quality improvements.

This description of institutional behavior combines attributes of many of the previously offered theories in this area. The explicit goal of prestige maximization is consistent with others who have argued that the goal of postsecondary institutions is not to simply raise as much money as it can, and it aligns with the well-known assumption of utility maximization in economics (where utility is derived from prestige). Institutions in this model are also interested in raising revenues, but focus on acquiring subsidies as opposed to total revenue as in Bowen's model or discretionary revenue as in Paulsen's model.

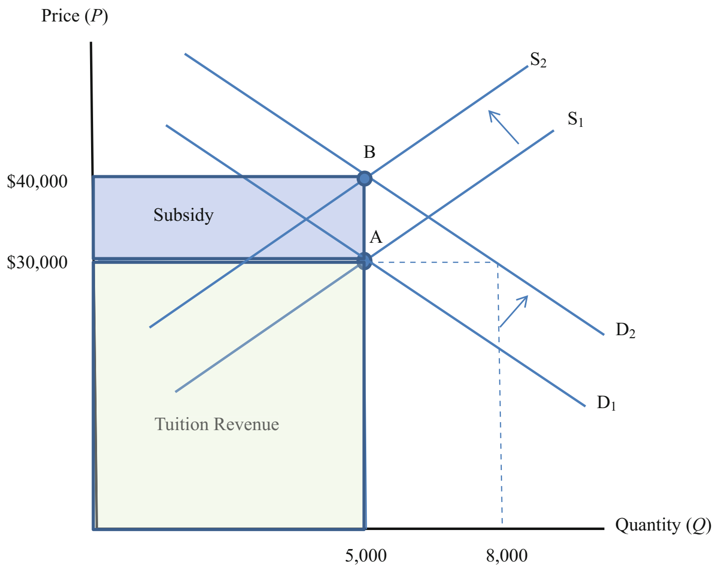


Fig. 8.4 Using subsidies for quality enhancement

The framework that we outlined above is a useful model for 4-year institutions that practice some degree of selectivity in admissions and strive to maximize their prestige or reputation. There are other institutions, however, for which this model does not apply. Many colleges admit the vast majority of applicants and do not use selectivity as a means to enhance prestige. Similarly, they are not heavily engaged in research and thus do not work to secure research funding. These institutions tend to be very dependent on tuition revenue to finance their operations. This description would apply to 2-year institutions as well as many less-selective 4-year institutions. For these institutions, Bowen's revenue theory of costs is perhaps a better description of their behavior, although these schools do often use subsidies to reduce prices as well as drive up costs.

Finally, there are institutions that fall somewhere between these two extremes. These institutions (mainly bachelor-level) practice some degree of selective admissions, and yet do not directly compete with the most selective/prestigious institutions in the industry for students. Likewise, these institutions may produce knowledge through research, but are not as heavily engaged in this activity as are doctoral-granting institutions. Institutions that fall into this category may include 4-year institutions with minimal involvement in graduate education. These institutions face particularly difficult challenges because of the high level of resources needed to compete with highly-selective schools that have invested heavily in research production.

Postsecondary Education Markets

Of course, if there are multiple colleges and universities trying to maximize their prestige or revenues at the same time, then the actions of one will affect the ability of others to do the same. For example, if one institution becomes successful at raising subsidies and using them to build excess demand, then this institution is taking away money, high-ability students and/or faculty from other institutions. This interdependence among sellers highlights the fact that in seeking to achieve their goals, institutions have to compete with each other in markets for students, faculty, research grants, and other resources used in production.

The higher education industry is made up of a number of separate markets. Markets are first defined by the degree that the student is seeking. There are separate markets for associate's degrees, bachelor's degrees, master's degrees, and doctoral degrees as depicted in Table 8.1. For most students, these degrees are viewed as distinct products that cannot be substituted for one another. There are instances, however, where students may be considering more than one degree level. A recent high school graduate, for example, may be interested in pursuing either an associate's or bachelor's degree. Likewise, at the graduate level some students may choose between enrolling in a master's or doctoral degree program.

Within each degree level, postsecondary markets are further defined with regard to academic discipline or major. This is particularly true at the graduate level

Table 8.1 Characteristics of U.S. markets for instructional services by degree level

Characteristic	Associate's degree	Bachelor's degree	Master's degree	Doctoral degree
Geographic Scope of Markets	Within commuting distance of a student's home	National for high-ability students; Regional for other students; Separate markets in public IHE for in-state and out-of-state students	National for high-ability students; Regional for non-traditional students	National for the majority of traditional students; Regional for non-traditional students
Focus of Service	Instruction	Instruction	Instruction and some research	Instruction and substantial research
Breadth of Service	Take courses in a range of subjects plus major	Take courses in a range of subjects plus major	Take courses in one field of study	Take courses in one field of study
Bundling of Service	Instruction, academic and support services; some extracurricular and locational	Substantial bundling of instruction, academic and support services, many extracurricular and locational	Some bundling of instruction, academic and support services; some extracurriculars and locational	Some bundling of instruction, academic and support services; some extracurriculars and locational
Homogeneity of Service	Some heterogeneity: Service varies by courses in program, quality of courses	Considerable heterogeneity: Service varies by program content, course quality, non-classroom attributes, prestige of degree	Some heterogeneity: less variation in degree content, still have variations in prestige from supplier	Some heterogeneity: less variation in degree content, still have variations in prestige from supplier
Barriers to Entry	Fixed costs and government regulation, lower barriers than for BA, MA, PhD	Fixed costs and government regulation; higher barriers than AA due to costs of non-classroom attributes	Fixed costs and government regulation; lower barriers than BA. Incur fixed and variable costs for research	Some barriers from fixed costs and government regulation. Incur added fixed and variable costs for research
Student Characteristics	Lower academic ability; looking for career preparation and skills	Substantial variation in student academic ability; looking for general knowledge as well as career preparation	Above-average academic ability; looking for general knowledge as well as career preparation	High academic ability; looking for general knowledge as well as career preparation

Notes: Table adapted from Becker and Toutkoushian (2013, p. 357) because graduate students take most if not all of their courses within a single academic department. We might therefore talk about markets of providers of bachelor's degrees in mechanical engineering, or markets for doctoral degrees in sociology. This is similar to how other multi-product firms operate, where they may produce multiple goods and services targeted towards different customers.

Markets for instructional services may be further defined in terms of additional characteristics. The geographic span of a market depends on how far individuals are willing to travel to consume the good or service in question. Markets for products such as gasoline and groceries tend to be small in geographic span in that people tend to purchase and use these things within commuting distance of where they live. A person living in Blacksburg, VA, for example, is unlikely to drive to Jupiter, FL to fill up her car with gasoline even if the price per gallon in Jupiter, FL were notably lower. The geographic span of postsecondary markets varies by the student and the degree level being pursued. Some students—particularly working adults—are place-bound due to work and family constraints and thus seek to attend college while living at home. Other students are more mobile and yet may limit their choice to institutions within their home state or region, whereas other students would be willing and able to attend college anywhere within the nation or even the world.

Postsecondary markets also depend on the academic qualifications of students. Because institutions only supply services to students who meet their admission requirements, higher-ability students may consider a larger set of institutions than do lower-ability students. Institutions may segment demand for their services according to student ability and offer merit-based financial aid to entice more higher-ability students to enroll, especially because of the role that student qualifications play in institutional rankings and prestige.

Market Structures

In the textbook description of market structures, economists focus on the following attributes of markets: barriers to entry or exit, homogeneity of the good or service, and the number of suppliers. How the four main market models compare on these attributes is summarized in Table 8.2. Barriers to entry refer to how easily new suppliers can join the market. These barriers may be due to factors such as government regulations or the level of resources needed to start a new business and be competitive with existing suppliers. Homogeneity of the good or service is when consumers view the good or service sold as identical across suppliers. Perfectly-competitive markets are those in which there are a large number of firms, there are no barriers to entry or exit, and the product sold is the same (homogeneous) across sellers. At the other extreme, a monopoly is a market with only one seller, and there are large barriers to entry and exit. In between these extremes, a monopolistically-competitive market has many sellers, low barriers to entry and exit, but the good or service sold varies across suppliers (heterogeneous).

Table 8.2 Attributes of common market structures

Attribute	Perfect competition	Monopolistic competition	Oligopoly	Monopoly
Number of suppliers	Many	Many	Few	One
Barriers to entry	None	Small	Large	Very large
Barriers to exit	None	Small	Large	Very large
Type of good or service	Homogeneous	Heterogeneous	Homogeneous	n/a

Finally, an oligopoly is usually characterized as having a small number of sellers, large barriers to entry and exit, and the product is fairly homogeneous.[13]

The structure of a market has implications for how sellers compete for customers and resources. In general, suppliers have two options for competing with each other: (1) provide a better good or service to consumers, or (2) reduce the price of their good or service. When firms operate in a perfectly-competitive or oligopolistic market, they cannot differentiate their products because customers view the good or service as being the same regardless of where they buy it. Oligopolistic markets have relatively few suppliers, and thus there is an incentive for firms to work together (or collude) so that they can avoid reducing prices and can enhance or sustain their profits. Firms in a monopolistically-competitive market, on the other hand, can compete in both ways for customers. A firm can either make substantive changes in its good or service in ways that would be more appealing to customers, or they can reduce the price, or both.

So what type of structure best describes markets for students in higher education? To answer this question, it is helpful to first look at the overall characteristics of postsecondary markets. In Table 8.1 we summarized the attributes that are typical of markets at the associate, bachelor, master, and doctoral degree levels.[14] Beginning with associate's-degree markets, because students usually live at home while attending 2-year institutions, the geographic span of these markets is defined to be within commuting distance for students. Thus, in most areas there will only be a handful of 2-year institutions from which to choose. The service itself can vary from institution to institution depending on what courses are offered, who is teaching the course, and what consumptive services are offered to students. There are barriers to entry and exit from the market because it takes time and money to establish a college. However, the startup costs for a 2-year college are not as high as for a typical 4-year college given that the infrastructure costs are generally smaller and fewer consumptive benefits are offered to students. Accordingly,

[13] Economists have also developed versions of oligopoly in which sellers produce heterogeneous goods and services (see Kuenne, 1992). However, the usual case is to consider a market with only a few large sellers whose products are viewed as being very similar to each other.

[14] See Becker and Toutkoushian (2013) for a more detailed discussion of these issues.

associate's-degree markets tend to look like a combination of oligopoly and monopolistic competition.

Turning to bachelor's-degree markets, the number of sellers is relatively high due to the fact that traditional-aged students typically move to where the institution is located to consume the services. As a result, geography is less of a constraint on student choice in bachelor's-degree markets than it is in associate's-degree markets. Nonetheless, many students prefer to attend institutions in some proximity to where their families reside. We tend to see students from northeastern states, for example, being more interested in attending colleges and universities located in the northeastern portion of the United States. The services provided by bachelor's-level colleges are very heterogeneous. Not only will students find differences across colleges due to courses, instructors, and degree requirements, but the consumptive benefits can vary greatly from institution to institution. Because students usually live at or near the institution, 4-year colleges offer more consumptive benefits than do 2-year institutions, and these consumptive benefits take on greater importance for students when choosing among providers. There are moderate to large barriers to entry in bachelor's-degree markets due to the infrastructure (buildings, administration, etc.) that must be created when starting a college, as well as any state rules or regulations that must be met. Accordingly, many bachelor's-degree markets tend to be closer to monopolistic competition than any of the other major structures.

However, there are instances where specific segments of bachelor's-degree markets have relatively few suppliers and function more like an oligopoly with a heterogeneous service. An example of this might be markets defined by in-state public institutions. Smaller states such as New Hampshire or lower-population-density states like Iowa, for example, have only a few public institutions offering bachelor's degrees, and thus students who have limited their choice set to in-state public institutions (perhaps due to price and/or proximity to home) have a small number of suppliers from which to choose. Likewise, the market for very highly-selective and prestigious institutions is fairly small due to the difficulty in attaining such status. As an illustration, in the 1980s the ten Ivy League institutions were alleged to have engaged in collusion due to making agreements in semi-public meetings on their financial aid offers to students with certain characteristics such as grades and SAT or ACT scores.[15]

Turning to master's-degree markets, their geographic span tends to be larger than for bachelor's-degree markets because graduate students are more mobile than undergraduates and there are fewer suppliers of master's degrees within each subject area. The service is heterogeneous because not all master's programs offer the same courses and have the same instructors, but the service is more homogeneous than undergraduate education in that students take most of their courses within their home department and may be less interested in the consumptive benefits they receive from going to college. The barriers to entry for master's

[15] For more details on this antitrust case, see Barro (1991), Salop and White (1991), Carlton, Bamberger, and Epstein (1995), and Austin (2006).

markets are higher than for undergraduate education due to the higher per-student costs of providing master's-level education and training, which not only includes smaller class sizes but also some emphasis on research productivity. Therefore these markets also look like a blend between monopolistic competition and oligopoly, but are closer to oligopoly than is true for bachelor's-degree markets.

Finally, doctoral-degree markets are the largest in geographic span. These markets tend to have the fewest number of suppliers due to the high barriers to entry caused by the added expense and difficulty of starting and operating a doctoral-degree program. To start a doctoral program in history, for example, an institution would have to find revenues to cover the expenses of adding new classes, assisting students, allocating time for faculty to engage in more research, and hiring faculty who have the skills to produce research. The service is still viewed as heterogeneous by consumers; however, students take most, if not all, of their courses within their major department and in general are less interested in the consumptive benefits of their education than is true for a typical undergraduate student. As a result, doctoral markets are closer to oligopoly than other market structures except that there is still some degree of product differentiation.

Competition in Postsecondary Markets

Every college or university in the United States faces competition for students, faculty, and resources. This is true of the most prestigious institutions as well as open-access community colleges. In many for-profit markets, when firms compete with each other they try to maximize profits and capture as large of a share of their market as possible. Postsecondary markets are a bit different, however, in that most suppliers do not try to maximize profits nor do they strive to serve as many customers as possible. In this section, we explore competition in higher education in more detail and discuss what it means for institutional behavior and for students.

Measuring Market Competition

Economists use several measures to quantify the extent of competition within an industry or market. The first measure is known as the concentration ratio (CR), which represents the proportion of sales or revenues received by the largest *n* firms in an industry:

$$CR_n = \sum_{j=1}^{n} R_j / R_N \tag{8.1}$$

Table 8.3 Concentration ratios for selected industries, 2007

Industry	Number of firms in ratio			
	n = 4	n = 8	n = 20	n = 50
Hydroelectric Power Generation (%)	47	70	90	99
Air Transportation (%)	46	68	82	91
Electric Power Generation (%)	21	36	60	84
Tire Dealers (%)	31	40	44	49
Transportation & Warehousing (%)	17	25	35	43
New Car Dealers (%)	6	8	10	13

Notes: The concentration ratio represents the percentage of total industry sales and receipts for the largest subset (4, 8, 20, and 50) of firms. Ratios were obtained from the U.S. Census Bureau (https://www.census.gov/econ/concentration.html)

where N = total number of firms in the industry, n = number of largest firms of interest, R_j = revenue or sales for the j-th firm, and $R_N = \sum_{j=1}^{N} R_j$ = total sales in the industry. Concentration ratios are usually calculated for $n = 4$, 8, 20, or 50. The concentration ratio by definition is bounded between 0 and 1, with $CR_n = 1$ indicating that the industry is a monopoly. As the concentration ratio becomes smaller, the industry is said to be more competitive in that less total revenue is concentrated within the n largest firms. As a rule of thumb, four-firm concentration ratios above 0.50 are sometimes used by economists as evidence that the market is too heavily dominated by a few firms. Table 8.3 provides concentration ratios for selected industries for 2007 as calculated by the U.S. Census Bureau. The data show that the hydroelectric power generation industry is highly concentrated, with close to half of all sales going to the largest four firms and almost all sales distributed among the top 50 firms. In contrast, the new car dealers industry is not highly concentrated; only 6 % of sales go to the four largest sellers and 13 % of sales for the 50 largest firms.

A second measure of market competition is known as the Herfindahl Index. The Herfindahl Index (HI) is very similar to the concentration ratio except that it is calculated as the sum of the squared market shares and only for the 50 largest firms in the industry:

$$HI_{50} = \sum_{j=1}^{50} \left(R_j/R_N\right)^2 \tag{8.2}$$

where HI_{50} = Herfindahl Index for the 50 largest firms. The Herfindahl Index is also bounded between 0 and 1, with larger values suggesting there is less competition in the market and in the limit $HI_{50} = 1$ when there is only one firm.[16] The advantage of

[16] The Herfindahl Index could be calculated on a 0–1 scale or a 0–10,000 scale depending on the units of measure for market shares. For example, a firm with a 5 % market share would have a value of 5 rather than 0.05. In this instance, the rescaled Herfindahl Index is bounded between 0 and 10,000.

Table 8.4 Concentration ratios for 4-year, not-for-profit institutions, 2012–2013

Metric	Number of institutions in ratio			
	n = 4	n = 8	n = 20	n = 50
Endowment (%)	20.9	29.0	44.3	59.1
Total Revenues (%)	5.8	10.6	21.8	38.8
Credit Hours: Graduate (%)	4.2	7.5	14.9	27.7
Credit Hours: Undergraduate (%)	2.1	3.9	8.8	18.3

Notes: The concentration ratio represents the percentage of total industry sales and receipts for the largest subset (4, 8, 20, and 50) of institutions. Endowment is the value at the end of the 2012–2013 year. Total revenues include revenues from all sources. Data were obtained from IPEDS for the 2012–2013 academic year. The industry is defined here as the set of all 4-year, not-for-profit (public or private) degree-granting institutions in the United States (n = 2,280). Concentration ratios were calculated by the authors

the Herfindahl Index over the concentration ratio is that the Herfindahl Index places more weight on the market shares for the largest firms in the market.

To examine the extent of competition in the higher education industry, we calculated the concentration ratios for all 4-year, not-for-profit institutions in the U.S. for 2012–2013. The results are presented in Table 8.4. We show the concentration ratios for four different metrics relating to markets: endowments, total revenues, graduate credit hours, and undergraduate credit hours. The first two are measures of the financial resources of an institution, and the last two focus on the number of customers served by an institution. Overall the 4-year higher education industry is not very concentrated with regard to either revenues or students. Only 18 % of undergraduate credit hours, for example, are produced by the 50 largest colleges and universities. The postsecondary industry is more concentrated with regard to revenues/endowments than with students, but the ratios are still smaller than what is typically found in oligopolistic markets. For example, about 21 % of endowments are held by the four largest institutions, and the top 50 institutions have 59 % of industry-wide endowments.

Market concentration statistics can also be used to determine how the level of competition is changing within an industry over time. In Table 8.5 we calculate the concentration ratios and Herfindahl Index values for the same group of institutions in 1990 and 2012. The first three columns pertain to the four-firm concentration ratios, and the last three are for the 50-firm concentration ratios and Herfindahl Indexes. Beginning with endowments, we see that during this period there was a slight increase in concentration among the top four institutions, but not for the top 50 institutions. Revenues, on the other hand, have become more highly concentrated across the board over this period but still remain low relative to many private industries. In contrast, students are becoming less concentrated among the largest institutions over time.

Table 8.5 Changes in higher education concentration ratios and Herfindahl Indexes, 1990–2012

	Top 4 institutions:			Top 50 institutions:		
Metric	1990	2012	Change	1990	2012	Change
Concentration ratios						
Endowment (%)	19.0	20.9	1.9	59.9	59.1	−0.9
Total Revenues (%)	4.7	5.8	1.1	34.2	38.8	4.6
Credit Hours: Graduate (%)	4.4	4.2	−0.2	30.9	27.7	−3.2
Credit Hours: Undergraduate	2.7	2.1	−0.6	19.9	18.3	−1.6
Herfindahl Index:						
Endowment	n/a	n/a	n/a	0.0154	0.0161	0.0007
Total Revenues	n/a	n/a	n/a	0.0026	0.0035	0.0009
Credit Hours: Graduate	n/a	n/a	n/a	0.0021	0.0017	−0.0004
Credit Hours: Undergraduate	n/a	n/a	n/a	0.0009	0.0007	−0.0002

Notes: The concentration ratio represents the percentage of total industry sales and receipts for the largest subset (4, 50) of institutions. The Herfindahl index represents the sum of squared market shares for the 50 largest institutions. Endowment is the value at the end of the 2012–2013 year. Total revenues include revenues from all sources. Data were obtained from IPEDS for the years 1990–1991 and 2012–2013 academic year, except for credit hours which were taken from 1991 to 1992. The industry is defined here as the set of all 4-year, not-for-profit (public or private) degree-granting institutions in the United States (n = 2,280). Concentration ratios and Herfindahl indexes were calculated by the authors

Price Competition

When we think about how sellers compete for customers, the first thing that comes to mind is price. We see this play out in local markets for gasoline, for example, where stations change their prices on a weekly if not daily basis in an effort to win the business of customers from other stations in the area. In the case of gasoline stations, the prices are posted so that consumers can see what each competitor in the vicinity is charging, and the product for a given octane level is largely viewed by consumers as being homogeneous. Another example of price competition is the airline industry. Customers who are looking to fly from Philadelphia to Minneapolis on a particular day can use internet search engines such as CheapAir and Travelocity to compare rates among airlines. If Delta Airlines decided that it wanted to increase revenues in this market, and demand for air travel was elastic at the current price, then by lowering its price the airline may be able to sell more tickets and increase its total revenue.

Colleges and universities likewise compete with each other on the basis of the prices they charge to students. As long as there is a downward-sloping demand curve for an institution's services, reducing price (holding all else constant) is predicted to increase the quantity of services demanded by students. Because the services provided by colleges are not homogeneous, an institution can charge a higher price than its competitors and still find students who are willing and able to enroll as long as they believe the bundle of services they would receive are better. Many institutions also practice some degree of selective admissions and/or place caps on how many students they will enroll. Therefore, within markets we typically observe students attending a range of institutions with varying prices instead of everyone matriculating at the single college with the lowest price.

Institutions pay close attention to how their posted tuition rate (or sticker price) compares to other competitors. Early in the college search process, students use these posted rates as indicators of what it will cost to attend each institution. In setting tuition and fees for the coming year, colleges may be concerned that if their price is high relative to peers, it would discourage too many students from applying. By using subsidies to reduce the posted tuition rate as in Fig. 8.2, institutions can increase their excess demand and become more selective in terms of whom they admit. Accordingly, colleges must decide how much of their subsidies to use for price reduction and how much to reinvest back into the institution to improve services. Price competition within academe is a bit different from price competition in many other markets, however, in that suppliers only change their prices once each year. Prices are usually set in the spring or summer for the upcoming academic year, and consumers only purchase the bundle of services at designated times of the year.

The pricing of educational services is particularly tricky for public institutions due to the need to segment their market between students who are citizens of the institution's state ("resident" or "in-state") or citizens of other states ("non-resident" or "out-of-state"). The posted tuition rates for out-of-state students at public institutions can be considerably higher than the rates for in-state students. Table 8.6 illustrates this for the thirteen public institutions in the Big10 conference for academic year 2014–2015. The first two columns show the tuition and required fees for resident and non-resident students, respectively. In the third column, we report the dollar gaps in tuition and fees between the two groups of students, and finally the last column contains the gaps in percentage terms. The data show that each public institution charges higher tuition and fee rates to non-resident students than they do to resident students, with the dollar gaps ranging from a low of \$7,250 (University of Minnesota) to a high of \$28,420 (University of Michigan). On average, the tuition and fee gap between resident and non-resident students is about \$17,000 to \$18,000.

The reason behind such large gaps in tuition rates is that public institutions use some portion of their subsidy from the state to lower the prices charged to in-state students in recognition of their role as state-supported institutions. This is depicted in Fig. 8.5, where a public institution uniformly distributes the state subsidy for all in-state students. The first Q_{NR} students represent non-resident students who are charged a sticker price of $P_{NR} = \$30{,}000$. The remaining $Q_R = Q - Q_{NR}$ students are state residents, and are charged a lower price $P_R = \$10{,}000$. In this case, the lower price is made possible by the state subsidy being evenly distributed only among state residents.

Table 8.6 Tuition and required fees for resident and non-resident students at Public Big10 Institutions, AY2014-15

Institution	Resident	Non-resident	Gap ($)	Gap (%)
Pennsylvania State University	$17,502	$30,452	$12,950	74
University of Illinois	$15,602	$30,228	$14,626	94
Rutgers University	$13,813	$28,591	$14,778	107
University of Minnesota	$13,560	$20,810	$7,250	53
University of Michigan	$13,486	$41,906	$28,420	211
Michigan State University	$13,200	$34,965	$21,765	165
University of Wisconsin	$10,410	$26,660	$16,250	156
Indiana University	$10,388	$33,241	$22,853	220
Ohio State University	$10,037	$26,537	$16,500	164
Purdue University	$10,002	$28,804	$18,802	188
University of Maryland	$9,428	$29,721	$20,293	215
University of Iowa	$8,079	$27,409	$19,330	239
University of Nebraska	$8,070	$21,990	$13,920	172
Mean =	**$11,814**	**$29,332**	**$17,518**	**148**
Median =	**$10,410**	**$28,804**	**$18,394**	**177**

Notes: Tuition and requires fees are for new students. Original source of data: AAUDE Survey of Academic Year Tuition & Required Fees. Data were obtained from the Academic Planning and Institutional Research Office, University of Wisconsin (https://apir.wisc.edu/tuitionandfees/2014_Big10_Tuition_Comparison.pdf)

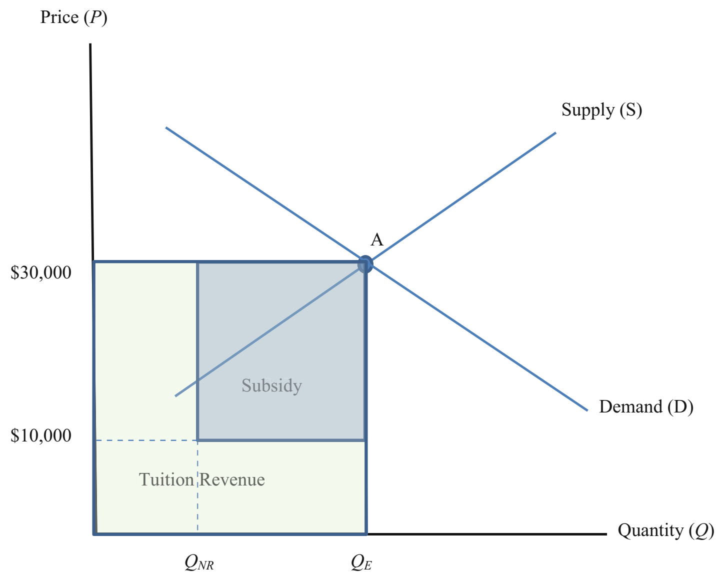


Fig. 8.5 Differential pricing for resident and non-resident students

Another important feature of pricing in academia is that price competition also occurs between institutions through financial aid. The net price charged to students is defined here as the sticker price minus any grants and scholarships awarded to the student. Institutional aid thus functions as a price discount for students, in much the same way that coupons lower the net price that consumers pay at the grocery store for selected items. The economics of tuition discounting applies the microeconomic theory of price discrimination to analyze the institutional pricing and grant-awarding behavior of colleges and universities. David Breneman developed the most widely-used tuition discounting model as part of his economic theory of the private college.[17] These price discounts are given to students for a variety of reasons, including financial need, academic merit or performance, and other attributes important to an institution's goals and objectives such as being an athlete or playing in the marching band. From the institution's perspective, tuition discounting is a widely-used enrollment management strategy that helps institutions to reach their enrollment goals, increase their net tuition revenue, and enhance the quality and diversity of their student body.[18]

Tuition discounting has a long history, but came into more modern use by private colleges and universities during the late 1970s and 1980s, and its use accelerated substantially in the 1990s when tuition inflation became more problematic and the purchasing power of Pell grants continued to diminish.[19] Furthermore, in the context of shrinking state appropriations in the 1990s and 2000s, public universities increasingly adopted tuition discounting practices.[20] The extent of price discounting in higher education is fairly substantial, at least in comparison to many other industries. At 4-year public institutions in 2014–2015, for example, although students faced average tuition and fees (sticker prices) of $9,140, on average they only paid roughly one-third of this amount ($3,030) as the average net price after subtracting grants and scholarships. Likewise, students attending private 4-year institutions paid an average net price of $12,360 after taking into account grant aid, as compared to an average listed or sticker price of $31,230.[21]

The practice of posting high tuition rates and then offering grants and scholarships to offset a large portion of tuition and fees is referred to as a "high price / high aid" strategy. There are several reasons why some colleges prefer this strategy to a

[17] For a more complete diagrammatic and mathematical presentation of all elements of his model, see Breneman (1994). For a statistical test and validation of the model see Breneman, Doti, and Lapovsky (2001).

[18] Interested readers are referred to Baum, Lapovsky, and Ma (2010) and Davis (2003) for more details.

[19] Discussions of the evolution of tuition discounting can be found in Davis (2003), McPherson and Schapiro (2006), and Redd (2000).

[20] See Baum and Lapovsky (2006), Baum et al. (2010), and Hillman (2012).

[21] These statistics were obtained from *Trends in College Pricing 2014*. Washington, DC: The College Board.

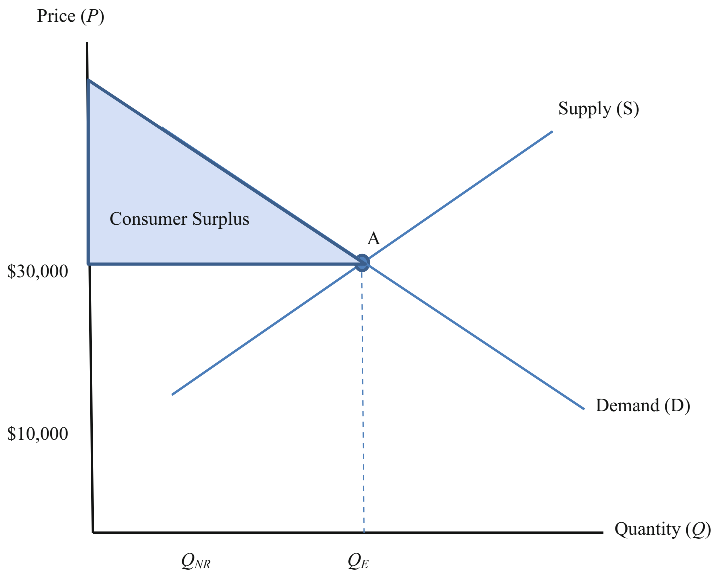


Fig. 8.6 Consumer surplus

low price / low aid strategy where institutions keep tuition rates low but do not offer many price discounts to students. First, the institution may be trying to increase total revenue by capturing some portion of consumer surplus. Recall from Chap. 5 that the market demand curve reflects the various reservation prices at which students would be willing and able to consider attending a given institution. The height of the market demand curve shows the maximum tuition rate that a student would be willing to pay. In perfect price discrimination, the college would charge each student their maximum amounts, and thus fully capture the consumer surplus which is shown graphically in Fig. 8.6.

The difficulty with trying to implement this strategy, however, is that institutions do not have precise knowledge of these maximums for each student. In this situation, the institution may have to divide students into multiple categories and offer different net prices to each of these groups of students based on selected student characteristics and informed estimates of their maximum willingness to pay.

An argument can also be made that a high tuition / high aid strategy is not only more lucrative for institutions but is also more equitable for students than a low tuition /low aid strategy because fewer subsidies are given to those who can afford to pay the full price, and the extra money can be redistributed to those students with greater need.[22] Finally, through a high tuition / high aid strategy, an institution could use the extra revenue to attract interest from more high-ability students who

[22] See, for example, Hansen and Weisbrod (1969), Hearn and Longanecker (1985), Hoenack (1971), and Toutkoushian and Shafiq (2010).

in turn raise the college's prestige and reputation. In large part, institutions use financial aid to affect not only the number of students applying to the institution, but also the types of students who apply. If the underlying goal of many institutions is to maximize their prestige and reputation, then this can be achieved by using financial aid to alter the characteristics of the students who enroll. To illustrate, if an institution were to hold enrollments constant but replace 100 lower-ability students with an equal number of higher-ability students, for example, then it should be able to enhance its prestige and reputation. To do this, the institution may selectively target more financial aid to high-ability students, and increase demand for the institution to the point where they are more likely to apply and enroll if admitted.[23] From this perspective, selective colleges and universities are turning away from need-based aid and towards merit aid in reaction to how the composition of the student body affects rankings and reputation.

Non-price Competition

The fact that colleges provide heterogeneous services to students means that they can compete with each other in ways other than through price. An institution with a relatively high net price may nonetheless be able to attract interest from students if they can convince them that the higher price is more than offset by the higher quality of the service. Postsecondary institutions can differentiate their services in several ways. The first is by doing things that improve the financial benefits that students can expect if they attend the institution. As noted in Chap. 4, improving an institution's graduation rate raises the expected benefits for students if they enroll. Likewise, colleges that become more prestigious would be in higher demand due to the possible signaling effect of postsecondary education. One of the challenges with this type of competition, however, is that it is hard for a college to demonstrate to consumers that the financial payoff is indeed larger than for its competitors. It is not surprising, therefore, to see recruiting brochures highlight graduates who have gone on to have successful careers, in that this gives prospective students the impression that there are sizable market benefits if they attend the institution. Similarly, spending more money on things that are related to the production of educational services may also send signals to students that the quality of education is better. Institutions do this by hiring renowned faculty members, building new classroom and laboratory facilities, and so on.

Colleges can also distinguish their services from competitors by focusing on the non-market, or consumptive, aspects of what they provide to students. During their time in college, students not only benefit from the classes that they take but also

[23] For example, in a recent study, Leeds and DesJardins (2015) found that The University of Iowa's National Scholars Awards have successfully increased the probability of enrollment among high-ability non-resident students.

from the academic support and student services at the institution. Students gain utility from participating in extracurricular clubs and activities, attending sporting events and concerts, walking across a campus with attractive grounds and buildings, and using non-instructional facilities on campus such as student unions and recreation centers. Although empirical evidence is lacking on how important these consumptive benefits are to students, colleges spend considerable sums of money on providing them and highlighting them in recruiting materials. In fact, many institutions may find it preferable to compete more on consumptive benefits than on educational quality because such benefits are easier to produce and show to consumers in the market.

Postsecondary Production Functions

In its simplest form, a production function shows how a firm translates inputs into outputs to achieve its goals, as depicted in Fig. 8.7. The raw materials are the inputs used by the firm. The firm then uses its factors of production—land, labor and capital—to transform the inputs into outputs. The production process describes the way in which the organization makes this happen. The process depends not only on the quantity and quality of factors of production, but also on the technology used to do the work. Let's take the simple example of a coffee shop. The inputs used by the shop include things such as the coffee beans, sweeteners, milk, cups, and other supplies that go into making the final product: a cup of coffee. The factors of production consist of the machines, employees, and store that are used by the company to turn the inputs into output. The production process describes how employees should use the machines and facilities to produce a cup of coffee.

The time needed to make outputs from inputs naturally varies with the good or service. It could take a coffee shop only a few minutes to transform the beans and other supplies into the final cup of coffee sold to a customer. Medical services, on the other hand, may require months or years to transform sick patients into healthy patients. Finally, the ultimate goal of the coffee shop is not to make coffee per se, but rather to earn a profit. Transforming inputs into output thus becomes a means for the firm to reach its goal rather than being an end in itself.

Can the same framework be applied to postsecondary institutions? There are a number of reasons why the production function analogy seems to work for colleges and universities. Students (e.g., new high school graduates) and their pre-college characteristics are the inputs or raw materials used for instruction. The production process includes the employees of the college (faculty, administrative staff, professional staff, support staff), the equipment and supplies needed to provide services to students, the curriculum and content of courses, and the institution's physical

Fig. 8.7 Depiction of production function in postsecondary education

facilities. A college's output from instruction is the same student—now more learned and developed—who leaves the institution before or after graduation. Therefore, a college's production process for knowledge distribution is much like any other business in that it transforms inputs (students when they first enroll) into outputs (students when they leave the institution).

There have been numerous studies in the primary and secondary education literature where economists and other academics have sought to quantify the effects of inputs and production processes on output. These studies have found, for example, that student characteristics have a large effect on output measures of schools such as graduation rates and the percentage of students passing state exams. In contrast, many of these studies have failed to find evidence that changes in the education production process lead to significant changes in output. In his periodic reviews of the literature since the 1980s, Hanushek has shown that relatively few studies have found that spending per student and teacher/student ratios have positive and significant effects on school outputs.[24]

Turning to postsecondary education, Astin was among the first to introduce an "input-process-output" (or I-P-O) model to describe how colleges and universities convert inputs into outputs.[25] There have since been many studies in higher education that have sought to examine how entering student characteristics (inputs) and institutional characteristics (process) affect outputs such as student graduation from college.[26]

Although the general concept of a production function makes sense for higher education, there are a number of difficulties in applying the production function model to the postsecondary sector. First, colleges and universities have multiple goals and objectives that they are trying to achieve. These objectives are described in an institution's mission statement, and include goals relating to research, teaching, and service. For example, the mission statement for the University of Georgia includes goals such as "prepare the University community and the state for full participation in the global society of the twenty-first century," and "promote high levels of student achievement."[27] Similarly, the mission statement for the University of Iowa includes declarations such as "advance scholarly and creative endeavor through leading-edge research and artistic production" and "enhance undergraduate, graduate, and professional education, health care, and other services provided to the people of Iowa, the nation, and the world."[28] However, these goals are very difficult to quantify and measure, which presents challenges for efforts to determine how efficiently institutions are using their resources to achieve these goals and whether specific policies and initiatives are leading to improvements.

---

[24] See, for example, Hanushek (1986, 1997, 2003).

[25] See Astin (1970a, 1970b).

[26] See, for example, Pascarella and Terenzini (2005).

[27] The complete mission statement for the University of Georgia can be found at http://www.uga.edu/profile/mission/.

[28] The complete mission statement for the University of Iowa can be found at https://provost.uiowa.edu/ui-academic-mission.

Second, the postsecondary education production process can be quite lengthy, with institutions requiring a number of years to produce graduates out of new students. And of course the ultimate goal of postsecondary institutions is not to simply graduate students, but rather to help students acquire knowledge and skills that will provide benefits to them and to society at large. These ultimate outcomes may not be fully observed for many years following the student's completion of a degree. Given the difficulty of tracking students over long periods of time, and measuring outcomes that often defy quantification, it is not surprising that we see policy makers and researchers rely on metrics such as graduation rates because they are observable over a shorter time span.

Another challenge with applying the production model to higher education is that colleges and universities do not fully control the quality and quantity of inputs. In the case of the coffee shop, the company can replace lower-quality coffee beans with higher-quality coffee beans if it feels that this will improve their product and in turn help increase profits. Colleges and universities, however, cannot exercise the same level of control over the inputs they use. Although postsecondary institutions select which students to educate through their admissions processes, they can only choose from among those who apply for admission. To see why this matters, suppose that New Mexico State University decides that it wants its graduation rate to be comparable to the graduation rate at Princeton University, and to do that it would need to enroll more higher-ability students. If its applicant pool only contains a limited number of students with SAT/ACT scores that are comparable to Princeton's, however, then there is only so much that the university can do in the short run—or even the long run—to achieve this goal.

A fourth distinguishing feature of higher education production is that the inputs (students) are also part of the production process. New students cannot be passively transformed into educated students; the education production process requires active participation and effort from students. This is quite different from most other industries where the inputs have no say in whether they are converted into outputs (imagine a tree having to agree to be made into a coffee table, for example). This feature of higher education is important because it means that failure to achieve a certain quality or quantity of output with specific inputs may be due to problems with the institution's production process, or insufficient effort on the part of students to participate in production, or some combination. There are similar analogies to education, such as with medical services in that patients have to follow the advice from their doctors in order for the services to be effective. Nonetheless, this is a key distinction between the way in which output is produced in higher education and in much of the for-profit world.

Furthermore, not only are students inputs into and participants in their own education in the production process, but students contribute to the quality of the education of their peers. These "peer effects" constitute another noteworthy feature of the higher education production process.[29] A customer-input technology is a

[29] See, for example, Winston (1999).

central feature of postsecondary production, and the quality of an individual student's education is related to the quality of other students—i.e., that student's peers. Another way to view this is that even though higher-ability students do have to pay for their education, institutions also pay these students via scholarships that reduce net price. Accordingly, these scholarships represent compensation for the positive peer effects that students contribute to the education of other students.[30]

Finally, the pursuit of one goal may help or hinder the pursuit of other goals (teaching versus research goals, for example), and inputs and production processes are often used to pursue multiple goals at the same time. This is particularly true for graduate education. Graduate students are not only inputs into, and active participants in, their own learning and part of their own production process, but they are also part of the production processes for research (through work with faculty on research projects) and undergraduate learning (by serving as teaching and graduate assistants). Taken together, these issues make it very hard to identify how colleges use their resources to achieve any particular goal or objective.

Mathematical Production Functions

In empirical and theoretical studies, economists find it useful to represent the production function as a mathematical equation. The production function could be expressed in a general form such as:

$$Q = f(L, K) \tag{8.3}$$

where Q denotes output of the firm, L = labor, K = capital, and the function $f(L, K)$ represents how labor and capital are used in the production process to create output from inputs. The production function is meant to illustrate the maximum output that a firm can produce with given inputs; however, in practice the function is often estimated where Q denotes actual and not optimal output.

A special type of production function that has been frequently used in economics is the Cobb-Douglas production function.[31] This function is written as follows:

[30] See, for example, Rothschild and White (1995).

[31] The Cobb-Douglas production function is most often attributed to the work of Paul Douglas and Charles Cobb in 1928. Among the appealing features of this production function are that it allows for increasing, decreasing, or constant returns to scale, and it exhibits diminishing marginal returns to scale for each factor of production. Interestingly, the production function developed by von Thunen in the mid nineteenth century is the same as the more widely-cited Cobb-Douglas function which was developed 65 years later in 1928. Humphrey (1997) shows the equivalence between von Thunen's production function and the Cobb-Douglas production function. Other economists of note who developed versions of the Cobb-Douglas production function include Wicksteed (1894) and Wicksell (1893). Readers who are interested in more details on the development and use of the Cobb-Douglas production function are referred to Douglas (1976) and Filipe and Adams (2005).

$$Q = AL^{\alpha}K^{1-\alpha} \text{ or } lnQ = lnA + \alpha lnL + (1-\alpha)lnK \tag{8.4}$$

where A = level of technology, and α and $(1-\alpha)$ are parameters to be estimated. The Cobb-Douglas production function has a number of appealing mathematical features for economic applications. One of these features is that the function shows that more output is typically produced when the firm uses a combination of labor and capital, as opposed to all labor or all capital. This makes sense because, for example, a company that spent all of its resources on machines and none on labor would have a hard time producing output. The Cobb-Douglas function also exhibits constant returns to scale, the elasticity of substitution between the production inputs is constant and equal to one, and the income shares going to labor and capital are constant. The Cobb-Douglas function was later extended to the set of production functions where the elasticity of substitution was constant but not restricted to equal one. These are referred to as constant-elasticity-of-substitution (CES) production functions.[32]

An even more generalized version of the Cobb-Douglas production function that is used for education production models is the translog production function. The translog production function is written as follows:

$$lnQ = lnA + \sum_{j=1}^{3} \alpha_j lnZ_j + \frac{1}{2} \sum_{j=1}^{3} \sum_{i=1}^{3} \beta_j lnZ_j lnZ_i \tag{8.5}$$

where the Z variables represent labor, capital, and raw materials. This function is similar to the Cobb-Douglas function when written in logarithmic form but allows for interaction and non-linear effects among the resources. The extension is important because it does not restrict the inputs to have the same rates of substitution, and it provides a mechanism to examine how other inputs such as supplies and raw materials are also used in production.[33]

There are several difficulties, however, in applying production functions to colleges and universities. The first challenge is that colleges and universities produce multiple outputs in the areas of teaching, research, and service. Furthermore, the outputs draw on many of the same inputs, and the outputs in one area may affect the outputs in another area. This may happen, for example, when a faculty member's research is used to improve his or her teaching. Typically, researchers will limit their production functions to a single output, or instead try to capture the interrelationships among outputs by estimating a multi-product cost function (see Chap. 7). Finally, another difficulty is that higher education outputs are very

[32] The CES production function was introduced by Arrow, Chenery, Minhas, and Solow (1961). For more details on the CES production function, see Uzawa (1962), Christensen, Jorgenson, and Lau (1972) and Miller (2008).

[33] The translog production function can be traced back to the work of Kmenta (1967), Christensen et al. (1972) and Berndt and Christensen (1973). More details on the translog production function can be found in Boisvert (1982).

difficult to quantify. The postsecondary sector does not rely on standardized tests to assess student learning, and therefore postsecondary education production functions rely on a limited set of metrics that can be measured such as numbers of degrees awarded. We will return to some of these limitations later in this chapter when we discuss performance funding models in the policy application section.

Extensions

The production model that we have discussed here focuses on traditional students and residential or "bricks and mortar" postsecondary institutions. In this model, students are assumed to be recent high school graduates who move to wherever the college is located to consume the services provided. These students are most often thought of as enrolled full-time and interested in the consumptive benefits of higher education as well as how college may help them gain human capital which is later rewarded in the labor market. On the supply side, institutions occupy large physical spaces and deliver services through face-to-face instruction according to a specific day/time schedule. This model is a good description for most of the higher education industry throughout the twentieth century and still applies today to a large segment of postsecondary providers and consumers of services.

By the turn of the twenty-first century, however, we began to see important changes occur within the postsecondary industry. Increasing numbers of non-traditional-aged students started looking to colleges and universities to update their skills to help them keep pace with economic changes happening across the globe. Due to family and/or work constraints, however, many of these consumers were limited in how far they could travel to take college courses and how many other things they could give up to acquire more education. At the same time, advances in technology gave postsecondary institutions the potential to deliver services to consumers at multiple locations. Not only is it possible today to send course material over large distances, but students can interact with instructors and each other in ways that are similar to what would take place in a traditional classroom. We refer to these types of instructional modes as distance or online education.

It is important, however, to note that not all distance education classes and programs are the same. Within the general category of online education there are a wide range of models in use. Some online courses are very similar to traditional face-to-face classes in that the content is delivered only at specific times and follows the regular academic calendar. For example, an online version of an introductory statistics class may be held in the fall semester with lectures or discussions taking place each week at a designated day and time. Other online courses rely on a "blended delivery" of material where some course sessions occur face-to-face and others take place online. At the other extreme, massive open online courses (MOOCs) are free, non-credit online courses offered by a number of institutions where students can view the course material at any time from virtually any place and progress at their own speed. In between these extremes are online courses that are offered a number of times each year, and students may have some flexibility in terms of when they need to meet.

There are a range of technologies that can be used for delivering distance education courses. In some instances, online content is administered via one-way instruction where students view content but cannot interact with the instructor or with each other. Although course materials can be provided in a cost-efficient manner through one-way instruction, it may not be as effective as other options for helping students learn. To address this concern, other technology can be used to permit students to interact with faculty and with each other through two-way instruction, thus better replicating a face-to-face classroom environment. Finally, there are a number of platform options for online courses, including Blackboard, EdX, Coursera, and so on that have made it easier for instructors to develop distance education materials and improve access to these materials for students.

Some proponents of distance education claim that improvements in technology will radically transform higher education as we know it. Kevin Carey, for example, argues in his 2015 book *The End of College* that technological advances will lead us to a future higher education industry consisting of an online "University of Everywhere" along with a small number of traditional campus-based institutions. Because online classes do not have the same requirements as traditional classes for physical facilities and auxiliary services, and online classes can in theory accommodate large numbers of students, the argument goes that the per-student cost of distance education courses will be much lower than for face-to-face instruction. If these cost savings could be passed along to students, then online education could help address concerns about high student charges and the rising share of postsecondary costs being paid by students. Likewise, colleges and universities could use online education to reduce tuition rates, giving online suppliers a competitive advantage in postsecondary markets.

Another appealing facet of distance education is that it enables students to acquire human capital from an institution without having to reside within commuting distance of it. The hope among advocates is that by breaking the connection between location and learning, online education will improve access to postsecondary education, especially for segments of the student population that are less mobile due to family, economic, or other constraints. In theory, distance education can help students learn when they want and where they want, as opposed to having to conform to a fixed production schedule as outlined by a traditional university.

Despite all of these compelling arguments in favor of distance education, from an economist's perspective there are a number of reasons why it may not lead to the dramatic changes in postsecondary education markets that some have forecasted. First, online education courses may be more appealing to certain segments of the college student market than it is to others. It is likely the case that the demand for distance education will be greater among non-traditional aged students who are place-bound due to family and work commitments. These students cannot simply pick up and move to where a college is located. Likewise, non-traditional aged students could be more time-bound than other students with regard to when they can and cannot take classes. Students who work full time may prefer to take classes in the evenings and weekends. Finally, older students on average may be less interested in the consumptive benefits of college than are their younger peers. Living at home while taking classes online may not appeal to many 18-year olds who want the full college experience of attending football games, making friends, becoming more mature, attending parties, participating in extracurricular activities, and so on. Taken together, technological advances in distance education should have a greater impact on markets for non-traditional aged students than it will on recent high school graduates, but for a large segment of the student market we predict that the impact would be negligible.

A second issue is that the true costs of delivering distance education are non-trivial and may not be all that much lower than for traditional face-to-face classes. Online classes—even "free" MOOCs—still require the use of scarce resources such as faculty and staff time to create, manage and implement. There will be added technology costs associated with online courses to cover the expenses associated with maintaining the platform used for classes and fixing problems that may arise in connectivity, etc. The developmental cost of online courses is also likely to be higher than for traditional classes because of the fixed costs needed to make online instructional materials in addition to course content.

And not all traditional instruction is expensive. In fact, some face-to-face classes, particularly large classes at the lower-division level that entail considerable "one way" delivery of information through lectures, can be taught in a relatively cost-effective manner. It is common at large institutions to see introductory courses in accounting, for example, taught in rooms that can accommodate several hundred students at a time. Even after factoring in the cost of breakout sessions and graduate assistants, on a per-student basis the cost of the course can be more reasonable than in other instances. Other classes may rely on graduate students, lecturers, and adjunct faculty—who are less expensive than full-time, tenure-eligible faculty—to provide instruction. And the cost of traditional classes may appear to be higher than they really are due to the fact that accounting practices in higher education do not break out spending by function. Some of what is counted as "instructional spending" is perhaps due to spending for research, public service, and auxiliary services.

Another issue is that there is substantial debate as to whether distance education is as effective as traditional education in helping students learn. Online classes must deal with the problem of how to facilitate student interactions with the instructor as well as with each other because individuals are not in the same physical location while taking the course. How do students ask questions in an online course? Can students hear questions and comments posed by their classmates and thus benefit from peer effects? Technological advances have made it possible for online courses to handle this in a variety of ways. Some platforms have the capacity for students to send questions via keyboard entry or by phone. More advanced platforms enable faculty and students to see and hear each other in real time using two-way audio/video connectivity. However, the more design modifications that are made to make an online course "similar" to a face-to-face course, the more expensive the online course becomes and the less likely that the course can be delivered effectively to large numbers of students where the economies of scale are greatest. It would be very difficult, for example, to effectively teach an online course via two-way audio/video to hundreds of students at the same time. An open question for researchers is: does this matter for student learning? If it does, then the cost savings from distance education may come at the expense of reductions in knowledge dissemination (i.e., learning outcomes).

The assessment of student performance and learning is difficult in any educational environment, but is perhaps even more challenging to do in many distance education courses. Online educators have to deal with the logistical issues of how to assess student performance and ensure that the work submitted was done by the student and not by someone else. In a face-to-face classroom the instructor can more fully control the testing environment or assessment context for students.

There are also broader issues of importance with regard to the use of distance education as a substitute for face-to-face instruction. An online education program is a different bundle of services than a traditional face-to-face academic program. By definition, online providers focus on instruction and do not produce research and public service outputs. If traditional institutions were replaced with online institutions, then it may have a negative impact on the quantity and quality of both research and public service produced by the postsecondary industry. In fact, one of the reasons that online education can appear to be less expensive than face-to-face instruction is due to the narrower focus of the bundle of services. The omission of research may negatively impact both student learning as well as the public benefits to society at large, especially if it is believed that there are complementarities between the teaching, research, and service activities of colleges and universities. Students taking online classes also miss out on a number of consumptive benefits of going to a residential college. If these benefits are important for the intellectual and social development of students, then there are real opportunity costs attached to replacing face-to-face instruction with online education.

Finally, there will be a fair number of colleges and universities that will not be interested in using technology to capture a larger share of their market. As we discussed earlier in this chapter, many institutions seek to raise their prestige or reputation as opposed to maximizing profits from customers. Part of an institution's prestige comes from the selectivity imposed with regard to which students are allowed to consume their educational services. Institutions such as Harvard, Princeton, and Stanford could easily teach more students than they currently do, and yet they instead choose to impose enrollment caps. The concern for colleges and universities such as these is that expanding enrollments via distance education may work against their ultimate goal. Online education may therefore be more appealing to open-admissions institutions where student selectivity is not an important issue, or to those institutions that are struggling to meet their enrollment and revenue targets.

Taken together, although distance education has affected and will continue to affect the postsecondary industry, we believe that its impacts will most likely be felt in certain segments of the student and institutional populations. Many aspects of distance education seem to align with the demands of non-traditional aged students. For traditional colleges and students, we may see an increased use of flipped classrooms and other forms of blended delivery of courses in a campus setting. Rather than attend lectures several times each week, students may combine online instructional materials with less frequent face-to-face meetings in small breakout sessions for discussions with instructors and with each other. In many ways, this is similar to how institutions use textbooks as a supplement to, but not a complete replacement for, instruction. Colleges can still provide students with the benefits of a residential college experience and yet capture some limited cost savings.

Policy Focus

States provide substantial financial support to public institutions of higher education through appropriations to designated institutions and financial aid to students who meet specific criteria. More than 90 % of all state funding is distributed as appropriations, which are essentially block grants to public institutions to help support their operations. State appropriation decisions are made annually or biannually as part of the budget-setting process. In all cases, however, the state acts as an economic decision maker that must weigh the costs of appropriating money to postsecondary institutions and students against the expected benefits from doing so, as well as consider the competing costs and benefits of supporting other items in the state budget related to such things as transportation, corrections, K-12 education, and senior citizens.

States use a variety of approaches to determine how much funding they should give to institutions. In some states higher education is simply a line item in the state budget and appropriation decisions are not set according to any formula or explicit criteria. Appropriation increases or decreases may be influenced by information such as the anticipated change in college enrollments, the tax revenues collected by the state, and any special needs of institutions that are passed along to the legislature through lobbying and other efforts. There is no requirement, however, that state funding must be affected by these factors in specific ways.

At the other extreme, a majority of states use funding formulas to make or inform decisions about the level of financial support to provide to colleges and universities. One of the purposes of funding formulas is to make appropriation decisions less subject to political considerations within the state; however, politics still plays a large role in the final appropriation. There are decisions that states have to make with regard to how to implement any funding formula and these decisions are not invulnerable to the political process. In some states funding formulas are used only in an advisory capacity, meaning that the state is not bound by law to provide the full level of funding derived from these formulas. This is particularly relevant when states do not have enough money to fully fund the recommended appropriations from the funding formula. In these instances, the funding formula acts as a means to establish how much funding should be given to institutions based on the relative needs of each institution.

There are three main types of funding formulas used for postsecondary institutions in the United States: (1) planned expenditure formulas; (2) peer funding formulas; and (3) performance funding formulas.[34] These approaches have different goals and objectives, and from a policy perspective each has its pros and cons. In this section, we discuss the nature and function of each of these types of funding formulas, as well as how funding formulas may or may not contribute to either helping a state's public institutions to compete in markets and/or motivate them to become more efficient in their production of graduates and other outputs.

Early adopters of funding formulas relied mostly on the planned expenditure approach, where appropriations were set equal to the funding needed by colleges and universities to run their operations in an ideal world. In a very simple example, if a state's funding formula dictates that each institution needs \$6,000 per student in state support to provide services and an institution enrolls 14,000 students, then the level of state subsidy for the institution would be \$6,000 $\times$ 14,000 = \$84 million. To obtain the per-student funding figure, the state relies on a series of formulas that estimate how much funding an institution needs to efficiently deliver teaching, research, and public services. No two states using this approach are alike in the precise way that they estimate the funding needed by public institutions.

We now illustrate how a simple planned expenditure funding formula works for instructional services. In this approach, the state begins by estimating the number of faculty members needed given the enrollment level of the institution. Suppose that a college had 8,000 students and the state specified that on average a faculty member at the college should be able to serve 80 students. In this instance, the funding formula would calculate that 100 faculty members (8,000/80) are needed for instructional purposes. When combined with an assumption as to what it should cost to hire a faculty member, this gives rise to an estimate of the total funds needed by the institution for faculty. If the funding formula stipulates that on average each faculty should cost \$80,000, then the institution would need \$80,000 $\times$ 100 = \$8 million to cover planned faculty expenses. Similar types of calculations are then included in the funding formula for other cost components of higher education (e.g., student services or institutional support), which when added together result in total planned expenditures. If the institution in our example had total planned expenditures of \$14 million (\$8 million for faculty and \$6 million for everything else), and expects to receive \$9 million in net tuition and fees from students and from sources other than the state, then the state funding formula would recommend a funding level of \$14 million $-$ \$9 million = \$5 million.

It is important to note that the planned expenditure approach may not provide enough funding to colleges to cover all of their current expenses. Rather, the intent

[34] There are many different ways to classify states by the funding mechanisms that they use (Layzell & McKeown, 1992). According to a report produced by MGT of America, in 2006 there were 26 states using "funding formulas" driven by enrollments, 14 states using "benchmark or peer funding," and 11 states using "performance funding".

is for the state to allocate resources for institutions to meet their expenses if they are operating efficiently. The reason states do this is that it gives institutions an incentive to limit their costs. Returning to our previous example, recall that the funding formula was based on the assumption that the institution needs \$8 million to hire 100 faculty members at an average salary of \$80,000 each. If the institution actually employed 110 faculty members, or paid them an average salary of \$90,000, then it would have to figure out how to fund the difference. This would mean raising revenues from other sources and/or cutting expenditures. Of course, for the planned expenditure approach to be implemented, the state must select parameters such as the appropriate ratio of students to faculty and the average salary for faculty. In practice, these parameters may not be based on rigorous analyses of the efficient production values, and may simply be chosen for political expedience or to stay within the state's budget. If the planned expenditure funding formula does motivate or force institutions to cut costs, institutions have to be very thoughtful and careful about where and how the cuts are made in order to generate meaningful gains in institutional efficiency. Unfortunately, it is possible that, depending on where the reductions in expenditures are made, the cost-cutting may come at the expense of slower student progress toward course-completion targets, decreases in retention rates, and eventually reductions in 2-year, 4-year or 6-year graduation rates or even lower job placement rates. If these, and kindred consequences, occur, then the required cost-cutting may be described as leading to deceptive rather than meaningful gains in efficiency.

Let's now look at how the benchmark or peer funding formula works. In this approach, the state provides funding based on the amount needed to make an institution competitive with designated peer institutions. The funding formula works as follows: A set of peer or comparator institutions is chosen for each public institution in the state. For each institution in the peer set, the state obtains data on the total revenues they receive from designated sources per student, and then ranks the peer institutions from high to low on revenues received. The state then identifies a target along the distribution for each of its peer institutions (such as the 50th percentile) and the funding formula calculates how much state funding would be needed to reach this target. A hypothetical example of this is shown in Table 8.7, where a public institution with 20,000 students has ten peers labeled A through J. The column of figures shows the revenue received from state appropriations and tuition per student for each institution. Suppose that the state wants to fund its institution so that it is at the middle (50th percentile) of its peers. This means that the institution needs \$15,500 per student from state appropriations and tuition revenue, for a total of $\$15,500 \times 20,000 = \$310$ million. If the state anticipates that the institution can raise \$200 million from tuition if it charged \$10,000 per student, then it would need to provide the institution with \$110 million in state appropriations to reach the \$310 million target. Alternatively, if the state's goal were to fund its institution at the 75th percentile of its peers, the state would need to supply the institution with \$155 million in appropriations.

There are two main advantages to the peer funding formula model. The first is that under this approach each institution will have enough financial resources to be

Table 8.7 Hypothetical illustration of peer funding formula model for public institutions

Peers	Tuition + State Funding/FTE			
A	\$20,000			
B	\$19,000			
C	\$18,000			
D	\$17,000			
E	\$16,000			
F	\$15,000			
G	\$14,500			
H	\$14,000			
I	\$13,500			
J	\$13,000			
Target percentile	Revenue/FTE for target	Total revenue	Tuition funding	State funding needed
50th =	\$15,500	\$310,000,000	\$200,000,000	\$110,000,000
75th =	\$17,750	\$355,000,000	\$200,000,000	\$155,000,000

competitive with peer institutions in its respective market. This is quite different than what occurs under the planned expenditure approach, where the funding formula does not take into account what is happening to funding for competitors in other states. Another advantage of the peer funding formula approach is its simplicity. The state does not have to figure out what ratios and parameters would be needed to represent an efficient production of higher education services.

At the same time, the peer funding formula approach is not without its limitations. This model requires the state to identify a set of peers for each institution, and the choice of peers can have a large effect on required funding. Selecting the right institutions for this purpose can be difficult in practice given the wide number and diversity of institutions from which to choose. The state also has to set an appropriate target for funding (such as the 50th percentile), and the higher the target, the larger the projected level of state funding needed to reach the target. There is no consensus as to what is the "right" target, and the final decision may be influenced by political and financial considerations at the state level. Finally, the peer funding mechanism provides less encouragement than other funding formula methods for institutions to be efficient in their use of resources.

The last funding formula approach is known generally as performance funding. The use of performance funding in higher education has a long and uneven history. In the United States, a number of states developed performance funding systems where only a small portion of revenues were appropriated to public institutions on the basis of their performance on a series of metrics such as graduation rates.[35]

[35] A number of researchers have focused on this first wave of performance funding systems, including Massy (1996), Layzell (1999), Alexander (2000), Burke (2002), Liefner (2003), and McLendon, Hearn, and Deaton (2006).

Performance funding is not restricted to the United States, however, and a number of nations use this approach to allocate funding to institutions.[36] There has been a renewed interest in performance funding in the United States following Tennessee's development in 2010 of a system where all appropriations for public institutions are assigned based on specific performance metrics. Since that time, other states have followed suit and have created similar performance funding systems.[37] The heightened interest in performance funding is also in response to college graduation rates that are perceived by some to be too low. As of 2014, roughly half of all states were allocating some portion of their revenues based on designated performance metrics such as degrees awarded.

To illustrate, here is how a performance funding model works: The state designates a series of J outcome measures $O_1, \ldots, O_J$ for which institutions will receive funding from the state. In Tennessee, the outcome metrics include such things as the number of students completing 24 credit hours, the number of bachelor and associate degrees awarded, the 6-year graduation rate, and the amount of research and service dollars received. Each outcome measure is assigned a scale weight (s_j) that is used to convert all of the metrics to the same units of measurement and scale. For example, in a given year a research university may receive $2 million in research grants, award 3,000 bachelor degrees, and 200 doctoral degrees. These outputs should not be simply added together because they are measured in different units and on different scales. For example, without some adjustment the research grant outcomes would be 10,000 times greater than the doctoral degree outcome. Accordingly, Tennessee's performance funding formula assigns a scale weight of 1/20,000 for research and service dollars, 1/1 for bachelor degrees, and 20/1 for doctoral degrees.

The next step in a performance funding model is to weight the scaled data to reflect the priorities of the state for performance. These priority weights $w_{1k}, \ldots, w_{Jk}$ can vary by institution as well as by outcome measure to take into account the different missions of institutions. In Tennessee, for example, a research-oriented institution such as the University of Tennessee at Knoxville has a priority weight of 0.10 (or 10 %) for the number of doctorate degrees awarded, whereas the performance weight for the same metric for a teaching-focused institution such as Austin Peay State University is 0 %. The performance weights for each institution must sum to one, so that smaller weights for one outcome must be offset by larger weights for another outcome.

The scale and performance weights are then used to calculate the total weighted outcomes for the k-th institution (WO_k), as represented by the following equation:

---

[36] Studies of performance funding outside of the United States include Jongbloed (2001), Jongbloed and Vossensteyn (2001), Butler (2003), and Orr, Jaeger and Schwartzenberger (2007).

[37] The differences between the earlier interest of some states in performance funding—where a small portion of funding was based on performance measures—and the renewed, more expansive and widespread interest in performance funding have been referred to as PF 1.0 and PF 2.0, respectively (Dougherty & Reddy, 2013).

$$WO_k = \sum_{j=1}^{J} w_{jk} s_j O_{jk} \tag{8.6}$$

To obtain the level of state funding for each institution, the total weighted outcomes are then multiplied by a measure of the average faculty salaries ($\overline{Y}$) and then added to supplemental state funding for designated operations (g_k) such as a medical school or research project:

$$G_k = WO_k \overline{Y} + g_k \tag{8.7}$$

Table 8.8 illustrates how a performance funding model might work for a hypothetical research-oriented institution. The first column shows the ten outcome measures selected by the state for its performance funding model. The second column contains the values of the outcome measures for this hypothetical institution. In the third and fourth columns, we provide the actual scale and performance weights used by Tennessee for each of these metrics that would apply to a research institution similar to the University of Tennessee at Knoxville. The fifth column shows the resulting weighted outcomes for each measure using the formula shown in equation (7.6). At the bottom of the table, the sum of the figures in the last column denotes the total weighted outcomes (3210). When multiplied by an assumed average salary figure of $50,000, we obtain a funding subtotal of $160.5 million. Finally, if the institution were also designated to receive $4 million in additional state spending for maintenance and operations, utilities, equipment and other performance funding, the state would provide $164.5 million for this institution.

There are a number of appealing aspects to a performance funding formula approach to state funding. Performance funding formulas explicitly connect funding to an institution's outputs and productivity, including indicators of student progress toward course-credit threshholds, year-to-year retention rates, degrees awarded, graduation rates, as well as job placement rates. By tying funding to outcomes rather than inputs, a performance funding system increases the attention given by institutions to how they help students succeed once they have enrolled. Second, higher education policy makers further believe that by allocating a large portion of revenues on the basis of designated performance indicators, public institutions are more likely to respond to the policy because the financial benefits for doing so (and costs for not doing so) are greater. Finally, the funding system is more transparent than in many other types of models, allowing institutions to see what they can do to secure more state funding for their operations and, in a sense, have some control over their destinies.

At the same time, there are some concerns with using a performance-based funding system for public institutions. Each state must choose an appropriate set of outcome measures to use in their funding system, and there are problems associated with almost any outcome metric that could be chosen. For example, the metrics associated with graduation rates, credit hours earned and degrees awarded are

Table 8.8 Hypothetical illustration of performance funding model

Outcome measure	Data	Scale weight	Performance weight	Weighted outcome
Students earning 24 credit hours	4,000	1	0.02	80
Students earning 48 credit hours	3,500	1	0.03	105
Students earning 72 credit hours	3,000	1	0.05	150
Bachelor degrees awarded	2,500	1	0.15	375
Masters degrees awarded	1,000	3.33	0.15	500
Doctoral degrees awarded	300	20	0.1	600
Research and service dollars received	$120 million	0.00005	0.15	900
Transfers out with 12 credit hours	1000	1	0.05	50
Degrees awarded per 100 students	20	50	0.1	100
Six-year graduation rate	70	25	0.2	350
Total weighted outcomes	3,210			
Average faculty salary	$50,000			
Subtotal	$160,500,000			
Plus supplemental operations funding	$4,000,000			
Grand total funding	$164,500,000			

Note: Data are for a hypothetical institution

potentially influenced as much by students' pre-college academic ability and the effort put forth by students, as they are by anything that the institution does to help them progress through their education. The performance-funding model is implicitly based on the assumption that colleges and universities can fully control the production of these outcomes and that by providing the right financial incentives the state can get institutions to produce these outcomes. However, even if a college does all of the right things to help students succeed, some students may not put forth the effort required and as a result the institution may appear to be "underperforming."

There are also some possible unintended consequences that could arise from targeting outcome measures such as these. If there is a connection between student success and student preparation and ability, then public institutions may be less willing to enroll students who are not as well prepared to succeed in college. Such a shift would adversely affect first-generation college students, students from lower socioeconomic families, and students from traditionally underrepresented racial/ethnic groups. In addition, institutions may be encouraged under a performance funding system to place less stringent demands on students to complete courses and degree programs in return for securing more state funding.

Another concern with performance funding systems such as Tennessee's is that it is not clear what weights should be used for scaling and performance. The purpose of the scale weights is to convert the starting values for the differently-scaled outcome measures to something of a similar and comparable scale and size, and yet arguments can be made for larger or smaller scale weights for any specific factor. Likewise, the performance weights are in general chosen to reflect the different missions of the institutions being funded and the priorities of the state, but the precise numbers used could arguably be lower or higher than what would be mission-consistent for any given outcome. Why, for example, should an institution's graduation rate be worth exactly ten times the value of the number of students earning 24 credit hours? The decision about what weights to use is very important because it affects the incentives placed on institutions, and the resulting allocations of state monies.

Finally, policy makers need to understand that even if institutions respond to the incentives in the performance funding system, it will likely take time before the institutional changes translate into increased outputs in the designated areas. Degree programs, for example, are anywhere from two to four years in duration, and thus improvements made in student recruitment, advising, and academic support for new students may not result in increases in degrees awarded until these students have made their way through the academic pipeline. Researchers and policy makers who do not take this implementation lag into account may incorrectly conclude that the policy is not working if they do not see immediate improvements in outcomes.[38] Taken together, performance-based funding models face a number of challenges that could potentially reduce their effectiveness in bringing about the changes desired by policy makers.

Final Thoughts

Understanding why colleges and universities behave the way that they do has puzzled stakeholders for a long time. On the one hand, institutions are organizations much like any other firm and they have to be concerned with doing whatever is needed to stay in business. Furthermore, a college does not operate in a vacuum; they must compete for customers and resources much as is true in the for-profit sector. And yet on the other hand, colleges and universities are somewhat different: goals are neither well defined nor easily measurable, and the organization does not have complete control over the production process.

Even though the behavior of institutions of higher education is complex, this chapter has addressed many important ways in which economic concepts can provide substantial insights that enhance our understanding of the institutional behavior of postsecondary institutions. In particular, we have focused on the nature

[38] See Tandberg and Hillman (2014) and Hillman, Tandberg, and Gross (2014).

and extent of competition in the higher education marketplace, as well as the multiple ways in which economic concepts help explain how colleges and universities can effectively utilize competitive strategies in both the price and non-price domains of competition.

The production function for higher education institutions is also complex; however, this chapter focused on many economic concepts that deepen our understanding of those complexities. Using a customer-input technology, with peer effects, makes the production process of colleges and universities unusual, but still understandable and amenable to economic analysis. However, so far, in spite of plausible theories about how performance funding may affect institutional productivity (e.g., degree production or graduation rates) due to new incentive structures, research has yielded mixed findings about these effects.[39] However, potential limitations of such studies include issues and questions related to the data, program design, policy implementation, policy context, principal-agent factors, implementation lags, and more in complex state political environments. We expect, and look forward to, ongoing research in this area, especially because of the increasing privatization and accountability movements, as well as the widespread college completion agendas, that motivate and help fund studies about the effects of performance funding on institutional productivity.

Glossary

Symbol	Definition
TR	Total revenue
Q	Quantity of output
MR	Marginal revenue
AR	Average revenue
CR	Concentration ratio
R_j	Revenues for the j-th largest firm in an industry
HI	Herfindahl Index
P_R	Price for resident (in-state) students
P_{NR}	Price for non-resident (out-of-state) students
Q_R	Quantity of resident students
Q_{NR}	Quantity of non-resident students
L	Quantity of labor
K	Quantity of capital
Z_j	Production input of j-th type (labor, capital, raw materials)
O_{jk}	Output of the j-th type for the k-th institution for performance funding models
WO_k	Weighted total outcomes for the k-th institution

(continued)

[39] See, for example, Dougherty and Reddy (2013), Tandberg and Hillman (2014), and Hillman et al. (2014).

Symbol	Definition
w_{jk}	Priority weight for the j-th output and k-th institution
s_j	Scale weight for j-th output in performance funding models
G_k	Total government funding for the k-th institution
$\overline{Y}$	Average faculty salary
g_k	Supplemental government funding for designated operations

References

Alexander, F. (2000). The changing face of accountability: Monitoring and assessing institutional performance in higher education. *Journal of Higher Education, 71*, 411–431.

Arrow, K., Chenery, H., Minhas, B., & Solow, R. (1961). Capital-labor substitution and economic efficiency. *Review of Economics and Statistics, 63*, 225–250.

Astin, A. (1970a). The methodology of research on college impact (I). *Sociology of Education, 43*, 223–254.

Astin, A. (1970b). The methodology of research on college impact (II). *Sociology of Education, 43*, 437–450.

Austin, A. (2006). Ivy league price-fixing: conflict from the intersection of education and commerce. *Journal of Civil Rights and Economic Development, 21*, 1–52.

Barro, R. (1991, August 27). Let's play monopoly. *Wall Street Journal*, A12.

Baum, S., & Lapovsky, L. (2006). *Tuition discounting: Not just a private college practice*. New York: The College Board.

Baum, S., Lapovsky, L., & Ma, J. (2010). *Tuition discounting: Institutional aid patterns at public and private colleges and universities, 2000–01 to 2008–09*. New York: The College Board.

Becker, W., & Toutkoushian, R. (2013). On the meaning of markets in higher education. In M. Paulsen (Ed.), *Higher education: Handbook of theory and research* (Vol. XXVIII, pp. 323–376). London: Springer.

Berndt, E., & Christensen, L. (1973). The translog function and the substitution of equipment, structures, and labor in U.S. manufacturing 1929–68. *Journal of Econometrics, 1*, 81–114.

Bertrand, J. (1883). Book review of theorie mathematique de la richesse sociale and of recherches sur les principles mathematiques de la theorie des richesses. *Journal de Savants, 67*, 499–508.

Blais, A., & Dion, S. (Eds.). (1991). *The budget-maximizing bureaucrat: Appraisals and evidence*. Pittsburgh, PA: University of Pittsburgh Press.

Boisvert, R. (1982). *The translog production function: Its properties, its several interpretations and estimation problems* (Working paper). Department of Agricultural Economics, Cornell University, Ithaca, NY. File retrieved at: http://dyson.cornell.edu/research/researchpdf/rb/1982/Cornell-Dyson-rb8228.pdf

Bowen, H. (1980). *The costs of higher education*. San Francisco: Jossey-Bass.

Breneman, D. (1994). *Liberal arts colleges: Thriving, surviving, or endangered?* Washington, DC: The Brookings Institution.

Breneman, D., Doti, J., & Lapovsky, L. (2001). Financing private colleges and universities: The role of tuition discounting. In M. Paulsen & J. Smart (Eds.), *The finance of higher education: Theory research, policy & practice* (pp. 461–479). New York: Agathon Press.

Burke, J. (2002). *Funding public colleges and universities for performance*. New York: SUNY Press.

Butler, L. (2003). Explaining Australia's increased share of ISI publications—The effects of a funding formula based on publication counts. *Research Policy, 32*, 143–155.

Cantillon, R. (1755). *An essay on economic theory*. Edited with English translation and other material by H. Higgs. London: Macmillan, 1931.

Carey, K. (2015). *The end of college: Creating the future of learning and the university of everywhere*. New York: Riverhead Books.

Carlton, D., Bamberger, G., & Epstein, R. (1995). *Antitrust and higher education: was there a conspiracy to restrict financial aid?* (No. w4998). National Bureau of Economic Research.

Chamberlin, E. (1933). *The theory of monopolistic competition*. Cambridge, MA: Harvard University Press.

Chamberlin, E. (1961). The origin and early development of monopolistic competition theory. *The Quarterly Journal of Economics, 75*, 515–543.

Christensen, L., Jorgenson, D., & Lau, L. (1972). Transcendental logarithmic production frontiers. *Review of Economics and Statistics, 54*, 28–42.

Clotfelter, C. (1996). *Buying the best: Cost escalation in elite higher education*. Princeton, NJ: Princeton University Press.

Cobb, C., & Douglas, P. (1928). A theory of production. *American Economic Review, 18*, 139–165.

College Board. (2015). *Trends in college pricing 2014*. Washington, DC: The College Board.

Cournot, A. (1838). *Researches into the mathematical principles of the theory of wealth* (Nathaniel T. Bacon, Trans.). New York: Macmillan Co. (1929).

Davis, J. (2003). *Unintended consequences of tuition discounting*. Indianapolis, IN: Lumina Foundation.

Dougherty, K., & Reddy, V. (2013). *Performance funding for higher education: What are the mechanisms? What are the impacts?* (ASHE Higher Education Report, Vol. 39). San Francisco: Wiley.

Douglas, P. (1976). The Cobb-Douglas production function once again: Its history, its testing, and some new empirical values. *Journal of Political Economy, 84*, 903–916.

Edgeworth, F. (1889). *The pure theory of monopoly*. Reprinted in Collected Papers relating to Political Economy 1925 (Vol. 1). London: Macmillan.

Epple, D., Romano, R., & Sieg, H. (2006). Admission, tuition, and financial aid policies in the market for higher education. *Econometrica, 74*(4), 885–928.

Filipe, J., & Adams, G. (2005). The estimation of the Cobb-Douglas function: A retrospective view. *Eastern Economic Journal, 31*, 427–445.

Garvin, D. (1980). *The economics of university behavior*. New York: Academic.

Hansen, W., & Weisbrod, B. (1969). The distribution of costs and direct benefits of public higher education: The case of California. *Journal of Human Resources, 4*, 176–191.

Hanushek, E. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature, 24*, 1141–1177.

Hanushek, E. (1997). Assessing the effects of school resources on student performance: An update. *Educational Evaluation and Policy Analysis, 19*, 141–164.

Hanushek, E. (2003). The failure of input-based schooling policies. *The Economic Journal, 113*, 64–98.

Hart, O. (1979). Monopolist competition in a large economy with differentiated commodities. *Review of Economic Studies, 142*, 1–30.

Hayek, F. (1948). *Individualism and economic order*. Chicago: University of Chicago Press.

Hearn, J., & Longanecker, D. (1985). Enrollment effects of alternative postsecondary pricing policies. *Journal of Higher Education, 56*, 485–508.

Hillman, N. (2012). Tuition discounting for revenue management. *Research in Higher Education, 53*, 263–281.

Hillman, N., Tandberg, D., & Gross, J. (2014). Performance funding in higher education: Do financial incentives impact college completions? *The Journal of Higher Education, 85*(6), 826–857.

Hoenack, S. (1971). The efficient allocation of subsidies to college students. *The American Economic Review, 61*, 302–311.

Hume, D. (1955). *Writings on economics.* In E. Rotwein (Ed.). Madison, WI: University of Wisconsin Press.

Humphrey, T. (1997). Algebraic production functions and their uses before Cobb-Douglas. *Economic Quarterly, 83*, 51–83.

James, E. (1978). Product mix and cost disaggregation: A reinterpretation of the economics of higher education. *Journal of Human Resources, 13*, 157–186.

James, E. (1990). Decision processes and priorities in higher education. In S. Hoenack & E. Collins (Eds.), *The economics of American universities* (pp. 77–106). Albany, NY: State University of New York Press.

Jongbloed, B. (2001). *Performance-based funding in higher education: An international survey*. Clayton, Australia: CEET, Monash University.

Jongbloed, B., & Vossensteyn, H. (2001). Keeping up performances: An international survey of performance-based funding in higher education. *Journal of Higher Education Policy and Management, 23*, 127–145.

Keppler, J. (1994). *Monopolistic competition theory: Origins, results, and implications*. Baltimore, MD: Johns Hopkins University Press.

Kmenta, J. (1967). On estimation of the CES production function. *International Economic Review, 8*, 180–189.

Kuenne, R. (1992). *The economics of oligopolistic competition: Price and nonprice rivalry*. Cambridge, MA: Blackwell Publishers.

Layzell, D. (1999). Linking performance to funding outcomes at the state level for public institutions of higher education: Past, present, and future. *Research in Higher Education, 40*, 233–246.

Layzell, D., & McKeown, M. (1992). *State funding formulas for higher education: Trends and issues*. Paper presented at the annual meeting of the Association for the Study of Higher Education. ERIC # ED352892. Retrieved 7/23/15 from http://files.eric.ed.gov/fulltext/ED352892.pdf

Leeds, D., & DesJardins, S. (2015). The effect of merit aid on enrollment: A regression discontinuity analysis of Iowa's National Scholars Award. *Research in Higher Education, 55*. Advance online publication. doi:10.1007/s11162-014-9359-2

Liefner, I. (2003). Funding, resource allocation, and performance in higher education systems. *Higher Education, 46*, 469–489.

Malthus, T. (1798). *An essay on the principle of population*, 1st edn. London.

Massy, W. (Ed.). (1996). *Resource allocation in higher education*. Ann Arbor, MI: University of Michigan Press.

McLendon, M., Hearn, J., & Deaton, R. (2006). Called to account: Analyzing the origins and spread of state performance-accountability policies for higher education. *Education Evaluation and Policy Analysis, 28*, 124.

McNulty, P. (1967). A note on the history of perfect competition. *Journal of Political Economy, 75*, 395–399.

McPherson, M., & Schapiro, M. (2006). Watch what we do (and not what we say): How student aid awards vary with financial need and academic merit. In M. McPherson & M. Schapiro (Eds.), *College access: Opportunity or privilege?* (pp. 40–73). New York: The College Board.

Melguizo, T., & Strober, M. (2007). Faculty salaries and the maximization of prestige. *Research in Higher Education, 48*, 633–668.

MGT of America. (2006). *Funding formula use in higher education*. Retrieved 12 July, 2015 from http://www.hawaii.edu/act188/docs/MGTAmer-funding_forumula_use.pdf

Migue, J., & Belanger, G. (1974). Towards a general theory of managerial discretion. *Public Choice, 17*, 27–47.

Miller, E. (2008). *An assessment of CES and Cobb-Douglas production functions* (Working paper). Washington, DC: Congressional Budget Office.

Mishra, A. (2007). *A brief history of production functions*. MPRA Paper No. 5254. Retrieved http://mpra.ub.uni-muenchen.de/5254/

Monroe, A. (1948). *Early economic thought*. Cambridge, MA: Harvard University Press.

Moss, S. (1984). The history of the theory of the firm from Marshall to Robinson and Chamberlin: The source of positivism in economics. *Economica, 51*, 307–318.

Nash, J. (1950). Equilibrium points in n-person games. *Proceedings of the National Academy of Sciences*, *36*, 48–49.

Nash, J. (1951). Non-cooperative games. *The Annals of Mathematics, 54*, 286–295.

Niskanen, W. (1975). Bureaucrats and politicians. *Journal of Law and Economics, 18*, 617–643.

Orr, D., Jaeger, M., & Schwarzenberger, A. (2007). Performance-based funding as an instrument of competition in German higher education. *Journal of Higher Education Policy and Management, 29*, 3–23.

Pascarella, E., & Terenzini, P. (2005). *How college impacts students*. San Francisco: Jossey-Bass.

Paulsen, M. (2000). Economic perspectives on rising college tuition: A theoretical and empirical exploration. In J. Smart (Ed.), *Higher education: Handbook of theory & research* (Vol. XV, pp. 39–104). New York: Agathon Press.

Puu, T., & Sushko, I. (Eds.). (2002). *Oligopoly dynamics: Models and tools*. Berlin/Heidelberg/New York: Springer Science & Business Media.

Redd, K. (2000). *Discounting toward disaster: Tuition discounting, college finances, and enrollment of low-income undergraduates*. Indianapolis, IN: USA Group Foundation.

Robinson, J. (1933). *The economics of imperfect competition*. London: Macmillan.

Rothschild, M., & White, L. (1995). The analytics of the pricing of higher education and other services in which the customers are inputs. *Journal of Political Economy, 103*, 573–586.

Salop, S., & White, L. (1991). Policy watch: Antitrust goes to college. *The Journal of Economic Perspectives, 5*(3), 193–202.

Schumpeter, J. (1954). *History of economic analysis*. New York: Oxford University Press.

Shapiro, C. (1989). Theories of oligopoly behavior. *Handbook of Industrial Organization, 1*, 329–414.

Steuart, J. (1767). *An inquiry into the principles of political economy* (2 vols). London: A. Millar & T. Cadell.

Stigler, G. (1950). Monopoly and oligopoly by merger. *The American Economic Review, 40*, 23–34.

Stigler, G. (1957). Perfect competition, historically contemplated. *The Journal of Political Economy, 65*, 1–17.

Tandberg, D., & Hillman, N. (2014). State higher education performance funding: Data, outcomes and policy implications. *Journal of Education Finance, 39*, 222–243.

Thunen, J. (1863). *Der isolierte Staat in Beziehung auf Landwirthschaft und Nationalokonomie*. 3 vols. Jena (Germany): Fischer, 1930. Volume 2: Der *naturgemasse Arbeitslohn und dessen Verhdltnis zum Zinsfuss und zur Landrente* (1850— 1863). Volume 3: *Grundsdtze zur Bestimmung der Bodenrente, der vorteilhaftesten Umtriebszeit und des Wertes der Holzbestdnde von verschiedenem Alter fiir Kieferwaldungen* (1863). A partial translation of Volume 2 as "The Natural Wage and Its Relation to the Rate of Interest and to Economic Rent" is included in B. W. Dempsey, *The Frontier Wage: The Economic Organization of Free Agents,* published by the Loyola University Press, Chicago, 1960.

Toutkoushian, R., & Shafiq, M. (2010). A conceptual analysis of state support for higher education: Appropriations versus need-based financial aid. *Research in Higher Education, 51*, 40–64.

Turgot, A. (1767). Observations sur le memoire de M. de Saint-Peravy, Limoges. In E. daire, ea., Oevres de Turgot, Paris, 1844, pp. 414–433. Translated as Observations on a paper by Saint-Peravy on the subject of indirect taxation, in P. D. Groenewegen, The Economics of A.R.J. Turgot, The Hague, 1977, pp. 43–95.

Uzawa, H. (1962). Production functions with constant elasticity of substitution. *Review of Economic Studies, 9*, 291–299.

Wicksell, K. (1893). *Uber wert, capital, und rente, jena, Germany*. G. Fisher. Translated by S. H. Frowein as value, capital, and rent. London: Allen & Unwin. Reprinted, New York: Augustus M. Kelley, 1970.

Wicksteed, P. (1894). *An essay on the co-ordination of the laws of distribution*. London: Macmillan & Co. At http://cepa.newschool.edu/het/texts/wicksteed/wickess.pdf

Winston, G. (1999). Subsidies, hierarchy and peers: The awkward economics of higher education. *The Journal of Economic Perspectives, 13*, 13–36.

Chapter 9
Labor Economics and Higher Education

Abstract In this chapter, we show how labor economics can be useful in gaining a better understanding of the economic status of the academic profession. Although it is common to make reference to "the academic labor market for faculty" as if it were a single market, in fact academia should be viewed as having a series of interrelated, yet separate, labor markets for faculty in each field/discipline. We begin by presenting some background information on labor economics and it connection to higher education. We then turn to the macro-level view of academic labor markets, by first outlining the issues that affect the demand for faculty labor by institutions, and then the supply of faculty labor by individuals. When these two forces are combined, they determine the going wage rate for faculty within a field and the number of individuals who will be employed. The next part of the chapter discusses the micro-level view of academic labor markets through the notion of human capital as it relates to faculty, and then uses this framework to explore some of the reasons why faculty pay and employment status varies across individuals. In the Extension section, we examine economic issues surrounding the use of non-tenure-track faculty in higher education. Finally, the Policy Focus addresses the economic issues and implications of how faculty use social media in their work.

Introduction

The many individuals who make up the faculty in the American higher education industry are extremely diverse in their backgrounds, professional expertise, interests, and motivations for becoming faculty members. They do, however, share the fact that each of them is employed by an institution of higher education and has a personal incentive to learn about the various aspects of their conditions of employment. Accordingly, the academy has long been interested in understanding the economic status of the academic profession and how it is changing. The American Association of University Professors (AAUP), for example, regularly collects data

This chapter is an updated version of a chapter that originally appeared in *Higher education: Handbook of theory and research* (Toutkoushian, R. (2003), What can labor economics tell us about the earnings and employment prospects for faculty? In J. Smart (Ed.), *Higher education: Handbook of theory and research, volume XVIII* (pp. 263–321). The Netherlands: Kluwer Academic Publishers).

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_9

from colleges and universities on faculty compensation and reports their findings to their membership.

From an economist's perspective, the conditions of employment for faculty—compensation, fringe benefits, length of appointment, and responsibilities—are influenced by a number of important factors relating to the demand for higher education services and the supply of qualified individuals for faculty positions. Some of these factors, such as the state of the economy, the demand for postsecondary education among high school graduates and federal support for university research, can affect faculty in many different disciplines. Other factors, such as changes in the external (non-academic) labor markets available to individuals with faculty qualifications and variations in the demand for specific fields, also contribute to observed differences in the conditions of employment across disciplines.

The academic profession has seen a number of profound changes that have had an impact on academic labor markets for faculty. The emergence of part-time faculty as a significant source of labor raises questions not only about the effects of their increasing use in higher education, but also on how part-time faculty are being treated by institutions with respect to their level of pay and benefits.[1] Population swings due to the "baby boom" of the 1950s and the more recent "baby boomer echo" of the 1980s have had—and will continue to have—significant effects on labor markets and the demand for higher education services.[2] Likewise, legislation in the United States has also influenced academic labor markets for faculty. The introduction of the GI Bill following World War II opened the doors to higher education for significant numbers of Americans. Other legislation, such as the Equal Pay Act of 1964, has helped to focus attention on the conditions of employment for women as well as faculty from underrepresented race/ethnicity groups, and fueled the increase in college participation rates among these groups of students.

Many questions exist among faculty with regard to the status of their profession: Will more professors be needed in the coming years, and if so, in which areas? Is faculty pay likely to rise significantly in the future? Why do professors in some fields such as Information Sciences earn more than faculty in other disciplines, and what may happen to these differences in the coming years? Are women and minority faculty members treated fairly in academe, and if not, what can be done to improve their treatment? How have factors such as faculty mobility and the growth of dual couples in academe affected faculty job security and pay? Why do faculty salaries vary by individuals within the same field? Why do salaries change over time?

[1] Studies of note regarding part-time faculty include Tuckman (1976), Tuckman and Pickerill (1988), Gappa and Leslie (1993), Roueche, Roueche, and Milliron (1996), Barker (1998), Ehrenberg and Zhang (2005a, 2005b), Toutkoushian and Bellas (2003), and Schuster and Finkelstein (2006).

[2] See Radner and Miller (1975), Welch (1979), Stapleton (1989), and Schoenfeld (1993).

In this chapter, we show how labor economics can be useful in gaining a better understanding of the economic status of the academic profession. Economists have generally looked at academic labor market issues from both a "macro-level" and "micro-level" perspective. The macro-level view is useful for explaining changes in the average wages and employment patterns for faculty in academic labor markets, and why they vary across specific fields. Although it is common to make reference to "the academic labor market for faculty" as if it were a single market, in fact academia should be viewed as having a series of interrelated, yet separate, labor markets for faculty in each field/discipline. Economists use the tools of supply and demand to show how wages and employment levels are determined in a labor market, why they vary across markets, and why they change over time.

As in previous chapters of this book, we begin by presenting some background information on labor economics and it connection to higher education. We then turn to the macro-level view of academic labor markets, by first outlining the issues that affect the demand for faculty labor by institutions, and then the supply of faculty labor by individuals. When these two forces are combined, they determine the going wage rate for faculty within a field and the number of individuals who will be employed. The next part of the chapter discusses the micro-level view of academic labor markets through the notion of human capital as it relates to faculty, and then uses this framework to explore some of the reasons why faculty pay and employment status varies across individuals.[3] In the Extension section, we examine economic issues surrounding the use of non-tenure-track faculty in higher education. Finally, the Policy Focus addresses the economic implications of how faculty use social media in their work.

Background

Labor has been a subject of inquiry in the field of economics dating back to its beginnings.[4] Together with land and capital, labor is viewed as one of the three essential factors of production. The importance of labor in the origins of economics is reflected in the title of the first section of Adam Smith's classic *The Wealth of Nations* (1776): "Of the causes of improvement in the productive power of labor and of the order according to which its produce is naturally distributed among the different ranks of the people." In *The Wealth of Nations*, Smith explores concepts such as the division of labor, the wages paid to laborers, and the connections

[3] Labor economics textbooks by Ehrenberg and Smith (2008) and Cahuc and Zylberberg (2004) provide thorough descriptions of the theories and techniques used by economists to understand and analyze labor markets. The reader who is interested in more detailed explanations of general microeconomic concepts such as supply and demand may find it useful to review a principles-level (introductory) textbook on microeconomics such as McEachern (2008).

[4] An excellent review of the progression of the field of labor economics can be found in McNulty (1980).

between wages, employment, and profit. The role of labor in the economy at this time was particularly important as economies transformed from agrarian based to industrial production.

It was not until the early twentieth century, however, before labor economics began to develop into a subfield with its own body of literature. The growth of interest in labor among economists at this time is in part a reflection of the issues of the day. Much of the focus of economists on labor addressed perceived problems with competitive labor markets. The Industrial Revolution had brought with it concerns over a variety of labor issues, including poor working conditions and wages, which subsequently led to organized labor. By the 1930s, the Great Depression introduced unemployment as an issue of concern in the United States among economists.[5]

In the macro-level view of academic labor markets for faculty, all faculty members within a market are essentially treated as though they possessed similar characteristics. However, casual observation of the faculty in any field will reveal notable differences in the type of work that professors do, the quality of their work, and how much they are paid. Why do some faculty members earn more than others within specific labor markets? The micro-level view addresses issues such as why earnings and employment conditions differ across individuals within each specific academic labor market. To explain variations in salaries and employment, economists rely on the theory of human capital. According to the theory of human capital, faculty members have different quantities of skills and attributes ("human capital") that affect their productivity. When colleges and universities reward faculty based on their human capital or productivity, it leads to differences in wages across individuals.[6]

Entire books have been devoted to the macro-level or micro-level views of academic labor markets.[7] Rather than attempt a comprehensive analysis of one of these views, in this chapter we provide an overview of both the macro-level and micro-level perspectives on academic labor markets, and how economics can be used to better understand selected aspects of academic labor markets. The economist's perspective will not explain every variation observed in average faculty salaries over time nor every difference in how much individuals are paid within fields. Nonetheless, the models discussed in this chapter will be helpful in understanding many of the phenomena observed in the academic labor markets for faculty, answering some of the questions posed earlier, and informing the develop-

[5] Discussions of the problems faced by labor during the early twentieth century can be found in Commons (1905), Hicks (1932), Lester (1941), and Watkins (1929).

[6] Readers may find it helpful to revisit Chap. 3, where we discussed human capital in more detail.

[7] Studies of macro-level view of labor markets include Caplow and McGee (1958), Freeman (1971, 1975, 1976), Gordon (1974), Radner and Miller (1975), Cartter (1976), Bowen and Schuster (1986), and Bowen and Sosa (1989). Likewise, micro-level studies of note include Breneman and Youn (1988), Gappa and Leslie (1993), Ferber and Loeb (1997), Creamer (1998), and Schuster and Finkelstein (2006).

ment and implementation of effective policies and practices impacting the salaries, employment, and conditions of employment among members of the academic profession.

Academic Labor Markets

A labor market can be described as the place where buyers and sellers of labor come together to work out mutually beneficial arrangements for employment and compensation.[8] Labor markets are usually organized according to occupations, and may also vary with regard to geographical area. Each labor market consists of two sets of decision makers: (1) firms, who are the buyers, or demanders, of labor, and (2) individuals, who are the sellers, or suppliers, of labor.

The academic labor market for faculty refers to the buying and selling of faculty labor for use by a set of competing colleges and universities. In academic labor markets for faculty, therefore, colleges and universities are the buyers (demanders) of faculty labor, while individuals with the necessary skills for faculty work are the sellers (suppliers) of faculty labor. Note that the suppliers of faculty labor will include some individuals who are not currently employed as faculty, but have the required qualifications to work as faculty. Academic labor markets also vary in geographic scope depending on whether the type of position to be filled is part-time or full-time. The markets for full-time, tenure-eligible faculty are generally national in scope, whereas the labor markets for part-time and adjunct faculty tend to be regional or local. Colleges hire faculty across a wide range of disciplines, and each has its own academic labor market. This description certainly makes sense from the point of view of potential suppliers of faculty labor, who are only qualified to teach and engage in research in a handful of fields, and on the demand side because each academic department is charged with the responsibility for hiring faculty only in their own field.

At the same time, while separate academic labor markets exist for faculty in different disciplines, they are not truly independent from one another. First, there are factors that are shared by the academic labor markets for different fields. For example, financial constraints at the institution, changing economic conditions, and shifts in student demand for postsecondary education will affect the demand for faculty in many different disciplines at the same time. Likewise, many decisions about the employment conditions of faculty, such as salary increases, tenure decisions, and so on, are often made at the institutional, rather than departmental, level.

[8] Good sources of information about the economic foundations of labor markets include McEachern (2008), Cahuc and Zylberberg (2004), Ehrenberg and Smith (2008), Radner and Miller (1975), Cartter (1976), and Bowen and Sosa (1989).

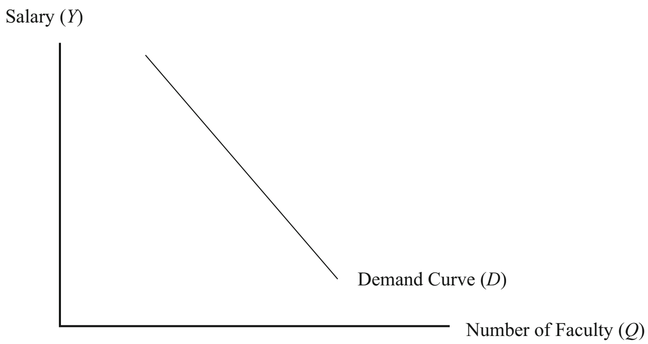


Fig. 9.1 The market demand curve for faculty labor

Labor Demand for Faculty

The demand curve for any type of labor shows the quantities of workers within a labor market that firms would want to employ at a series of wage rates. This curve is assumed to be downward-sloping, indicating that holding all else constant, employers would be willing and able to hire more workers as the price of labor (i.e., salary/wage rate) declines and vice-versa. A typical market demand curve for faculty labor is shown in Fig. 9.1:

In the traditional theory of the firm, the demand curve for labor follows from the decisions made by firms about the quantities of inputs that they will use to produce output. According to this model, firms choose the level of output that will maximize profits, and at the same time select the least expensive way to make this output. If this were not true, then the firm could (by definition) increase its profits by finding a way to produce the same output at a lower cost. As the price of labor rises, firms would have an incentive to substitute other inputs for labor to the extent that it is possible, and thus would want to use less labor as the wage rate rises. The steepness of the demand curve reflects how sensitive the quantity of labor demanded is to changes in the wage rate; when the curve is very steep (or inelastic), then firms do not substitute away from labor as the wage rate rises. Each firm in the labor market is assumed to have such a demand curve for labor, and when these are added together, they yield the market demand curve for labor in Fig. 9.1.

The same general notion of a demand curve for labor can be applied to academic labor markets for faculty, where the "firm" is a college or university, faculty members are "labor," and the "wage rate" is the amount paid to faculty per unit of work, typically represented by their annual salary.[9] The market demand curve for

[9] Faculty members also receive compensation in the form of fringe benefits, such as contributions to retirement accounts, coverage for medical and dental services, and tuition discounts for themselves and possibly their families. For the purposes of this chapter, most of the discussion relating to compensation will refer to salary. Likewise, the terms "salary," "wage," and "compensation" will be used interchangeably throughout the chapter unless noted otherwise.

faculty within a specific field is obtained by adding together the demand curves for faculty in the same field/discipline across colleges and universities. As the annual cost to institutions of employing faculty rises, holding all else constant, they would have an incentive to use fewer full-time faculty to produce their targeted outputs in the areas of teaching, research, and public service.

Labor Supply of Faculty

The labor supply curve describes how much labor qualified individuals would be willing and able to supply to a given market at various wage rates. The curve is assumed to be upward-sloping to indicate that when the wage rate rises, people would be willing to increase the amount of time that they allocate away from other things and towards working for pay. Increases in the market supply of labor can be realized if either currently-employed workers choose to work more hours, and/or potential workers who are not currently in the labor force choose to enter the labor force, either full-time or part-time. The market supply curve for faculty in the academic labor market is depicted below in Fig. 9.2:

According to labor economic models, the market labor supply curve is derived from the actions of individuals. These models assume that people receive utility or satisfaction from the income that they earn from working for pay, and from the time that they spend in all other activities, generally referred to as "leisure."[10] In their attempt to maximize satisfaction, individuals choose how to allocate their time between working for pay and leisure. This is depicted in Fig. 9.3, where the horizontal axis represents the hours spent in leisure activities (T_L) and the vertical axis captures the income earned from working for pay. Assuming that the hourly wage rate (w) is constant, the vertical axis also represents the number of hours spent working (T_w). The time constraint is therefore written as $T = T_w + T_L$. Note that the constraint line looks the same as the budget line discussed in Chap. 5 for students. In fact, both are examples of constraints on the decision maker representing the scare resource (time or money) that limits what the decision maker can do.

The economic problem for the faculty member is how to best allocate her time between working for pay and leisure so as to maximize her utility. The person is assumed to receive utility from spending time in leisure, and also from the income earned from spending time working for pay (i.e, $U = U(wT_w, T_L)$). The shape of the indifference curves shows that as a professor reallocates time away from leisure and towards working for pay, she gives up some utility from spending less time outside

[10] The term "leisure" is a convention used by economists, and is a composite construct encompassing all uses of time that do not involve working for pay. Leisure may therefore include many activities such as housework, child rearing, sleeping, and volunteer work that are not traditionally viewed as leisurely activities.

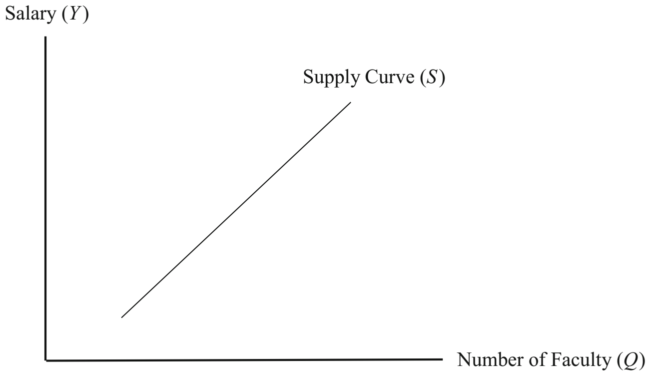


Fig. 9.2 The market supply curve of faculty labor

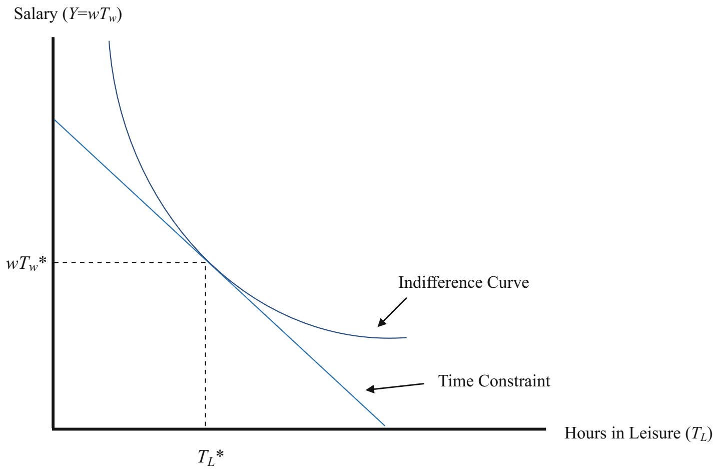


Fig. 9.3 Labor supply decision of an individual faculty member

of work but gains utility from making more money and being able to purchase more goods and services that also give her utility. The optimum time allocation for the individual is found where the time constraint line is tangent to her indifference curve. The faculty member's labor supply curve is then derived by observing how the optimal time spent working for pay changes as the wage rate changes, holding all else constant.

The presumption is that only those individuals who are qualified (able to) for work in the labor market are included in a market's labor supply. Each person in the labor market possesses a supply curve showing how wages would affect the amount of time that he or she would be willing to allocate to working for pay, and the market supply curve is the sum of these individual supply curves.

Applying this notion to academic labor markets, the supply curve shows the relationship between a person's compensation and the amount of labor that he or she is willing to supply to colleges and universities. The nature of faculty work means that a relatively high level of education or human capital is required for someone to be considered as a potential supplier of labor in an academic labor market. Although the set of individuals possessing a Ph.D. or equivalent academic/professional degree in a given field would most surely be considered potential suppliers of faculty labor, individuals with only a high school diploma would be unlikely to meet the job requirements for faculty work and thus would not normally be considered potential suppliers of faculty labor. Between these two extremes, however, individuals may possibly be considered part of the faculty labor supply depending on the fields in which they received their degrees, the type of position they are seeking, and where they want to work. For example, the requirements for part-time, non-tenure eligible faculty positions are generally lower than for full-time, tenure-eligible positions. Likewise, the educational requirements for faculty will likely differ between 2-year and 4-year institutions, between academic and vocational tracks in 2-year institutions, as well as between research-intensive and teaching-intensive 4-year colleges and universities. Taken together, an individual may be considered to be part of the labor supply for some, but not all, of the existing academic labor markets for faculty.

To see why the labor supply curve for faculty is assumed to be upward-sloping, one has to understand what are known as the substitution and income effects of wage increases. First, as faculty salaries rise, the opportunity cost of spending more time in non-work activities rises because he or she would have to give up more income than before. As a result, faculty members will tend to reallocate time away from leisure activities and towards faculty work as their salaries increase. This is known as the *substitution effect*. Likewise, as faculty salaries rise, a person could choose to work fewer hours and still earn the same amount of income as before. This is known as the *income effect*, and will lead faculty members to reduce their supply of labor. Note that the substitution and income effects work in opposite directions. When the substitution effect outweighs the income effect, the labor supply curve will be upward-sloping, and because it is usually assumed that this is the case for faculty members on average, the labor supply curve is typically drawn as upward-sloping.[11,12]

The market labor supply curve for faculty shows how the number of individuals who would be willing and able to work as professors varies with the wage rate.

[11] Some economists have argued in favor of a backward-bending labor supply curve (see Ehrenberg & Smith, 2008; Pindyck & Rubinfeld, 1989). In this instance, the substitution effect of wage increases outweighs the income effect up to a certain point, after which further wage increases lead to a reduction in labor supply.

[12] One complicating factor is that many faculty members are paid on an annual rather than an hourly basis. Since their earnings would not necessarily change as they work more or fewer hours, the labor supply curve for an individual faculty member may be relatively steep. Nonetheless, the predictions of the model described here would still apply to the market, because changes in the salaries for faculty will lead some individuals to enter or leave the academic labor market.

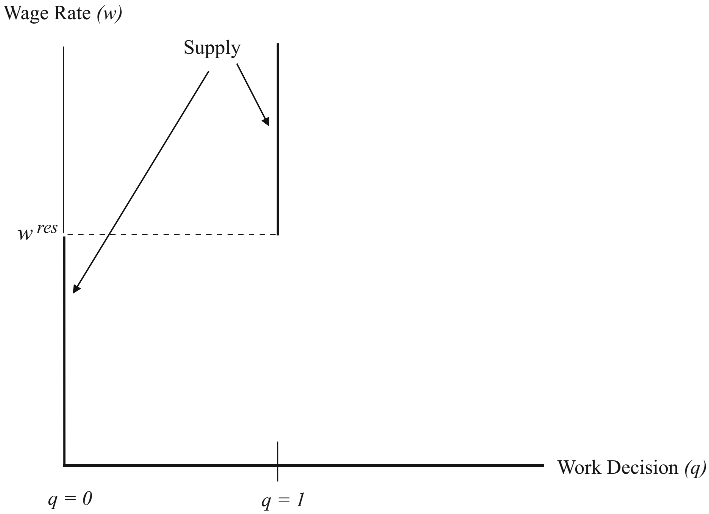


Fig. 9.4 Reservation wage for individual faculty member

In Fig. 9.4 we focus on how an individual's decision whether to work is affected by the wage rate. Each person is presumed to have a latent (unobservable) intent to work (q^*) which is affected by the wage rate and a series of other supply factors. All that can be observed, however, is whether the person works ($q = 1$) or does not work ($q = 0$). The individual's labor supply curve shows the connection between the wage rate and whether or not the person works. When the wage rate is too low, the person would not work; however, once the wage rate exceeds a particular value (w^{res}), the person decides to go to work. This rate is referred to by economists as the reservation wage. Accordingly, the person's curve showing whether he or she would supply labor is represented by two vertical lines connected at the reservation wage. The reservation wage will differ across individuals, and as a result the market supply curve also shows the number of people willing to work at various reservation wages. Note that the discussion of latent supply and reservation wage is very similar to the discussion in Chap. 5 about a student's latent and observable demand for higher education.

Equilibrium Wages and Employment of Faculty

The equilibrium, or market-clearing, wage rate in an academic labor market is found at the point where the market demand for faculty in the field and the market supply of faculty intersect, as shown in Fig. 9.5:

The value Y^* represents the equilibrium salary, or the salary at which the number of faculty demanded by colleges and universities in a specific field equals the quantity of individuals who are willing and able to be employed as faculty, and

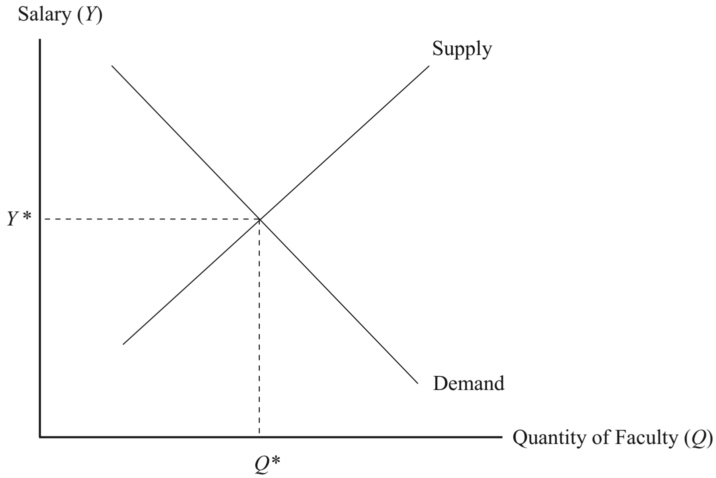


Fig. 9.5 Equilibrium salary and employment in an academic labor market

$Q*$ denotes the equilibrium employment level. The point of intersection is referred to as an equilibrium because the economic model presumes that when salaries are temporarily above or below this level, market forces (or Adam Smith's "invisible hand") will cause salaries and employment levels to move towards these values. When salaries are above $Y*$ there will be an excess supply of faculty in that there are more individuals who are willing and able to work as faculty at the prevailing salary level than institutions of higher education are willing to hire. This excess supply will lead some potential faculty members to reduce their salary demands in order to secure employment, and this process would continue until the average salary falls to $Y*$. Likewise, if faculty salaries were below equilibrium, there would be an excess demand for faculty in that colleges and universities would want to employ more faculty at this salary level than they can find. In response, some institutions would raise faculty salary offers to attract qualified individuals from other labor markets, and this would continue until average faculty salaries reach $Y*$.

This faculty labor market model is based on several simplifying assumptions that may not completely apply to academic labor markets. First, it is presumed that the suppliers and demanders each have perfect information about the salaries and employment opportunities in the labor market. Even though individuals who are applying for faculty positions may have some sense of the salaries that are available to people with their specific skills and qualifications, they are unlikely to know the full range of employment options and salaries available to them, and this knowledge will vary across individuals. Second, the ability of the market to move to a new equilibrium can be hindered by the presence of artificial constraints acting on either the suppliers or demanders. In labor markets, it is usually more difficult for salaries to adjust downward than upward. Both of these concerns apply to many external labor markets as well as academic labor markets. The tenure system and the presence of faculty labor unions impose additional constraints on academic labor markets in that it becomes more difficult for colleges and universities to vary their desired level of salaries and employment in response to external forces such as shifts in student demand for particular majors.

Changes in Faculty Salaries and Employment Levels

The labor demand/supply framework can be used to show some of the reasons why salary and employment levels change over time within academic labor markets. Both the demand curve for faculty and the supply curve of faculty can shift to the left or to the right depending on a number of different factors. Whenever one or more of these curves shift, it could result in a new equilibrium point, and thus shifts in the labor demand and/or labor supply curve lead to changes in faculty salaries and/or employment. Figure 9.6 illustrates, for example, that when the demand curve for faculty labor increases, or shifts to the right, it will lead to higher equilibrium salaries (Y_2) and employment levels (Q_2):

Similarly, Fig. 9.7 shows how an increase in the supply of labor will lead to a decrease in equilibrium salaries and an increase in employment levels:

Either the labor demand curve or the labor supply curve can shift to the left (decrease) or to the right (increase), or both curves may shift at the same time. Therefore, there are eight different combinations of shifts in the demand and supply curves for faculty labor (including no shift).

Although shifts in either curve would result in a new equilibrium, time may be required for the new equilibrium to be reached. In fact, if one shift is followed by another shift in demand or supply, the first of the two new equilibrium points may never be reached. In the event that both curves shift at the same time, either the

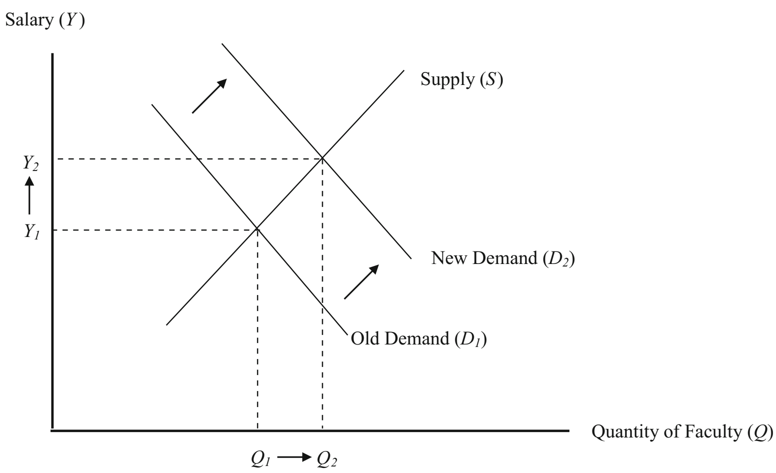


Fig. 9.6 Effects of a shift in the demand for faculty labor on equilibrium

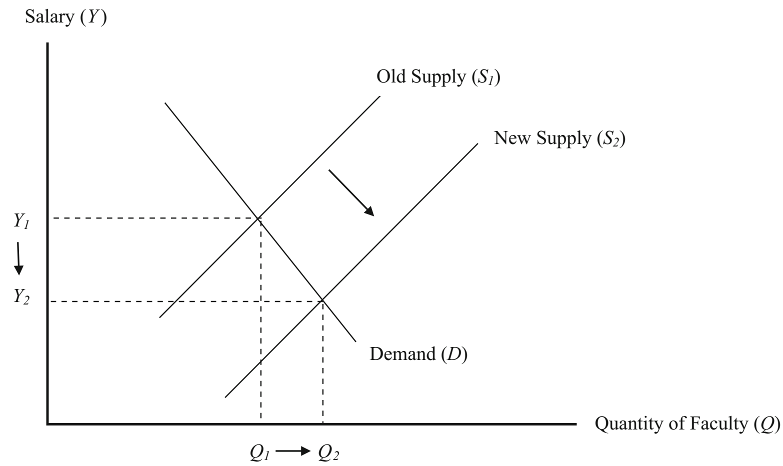


Fig. 9.7 Effects of a shift in the supply of faculty labor on equilibrium

salary or employment change is not known *a priori* because the change depends on the relative magnitudes of the shifts in demand and supply and the steepness of each curve.

Shifts in the Demand for Faculty

The demand curve for labor can shift to the left or to the right when there are changes in the following factors: (1) changes in the price of other inputs used in production; (2) the demand for the good/service produced; (3) the productivity of workers; and (4) the number of employing firms in the labor market. Applying this notion to the demand for faculty by colleges and universities, the market demand curve for faculty within a field can be affected by the following factors:

- The price of other inputs used to provide educational services
- The demand for higher education services
- Faculty productivity
- The number of postsecondary education providers

The price of other inputs used to provide educational services. Colleges and universities employ a range of inputs in addition to faculty, such as students, computers, and administrators, to produce their desired outputs in the areas of teaching, research, and public service. These inputs can be grouped according to whether they are substitutes for faculty labor or complements of faculty labor. A substitute input is one that can perform many of the same functions as faculty. In the case of full-time faculty, labor substitutes would include graduate students and non-tenure eligible faculty such as adjunct faculty and lecturers. Technology also introduces a number of different substitutes for faculty labor, through means such as educational courses delivered over the Internet, videotaped lectures, and interactive textbooks. Complementary inputs to faculty labor are those things that faculty use to help them produce outputs in the areas of teaching, research, and public service. Examples of labor complements include class materials such as textbooks and study guides, computing software and hardware, and classroom and laboratory space.

According to the model of labor demand, an increase in the price of a substitute for faculty labor would lead colleges and universities to use more faculty labor and less of the input with the higher wage/price. Graphically, this is represented by a rightward shift in the demand curve for faculty labor. The opposite effect occurs when there is an increase in the price of an input that is a complement for faculty labor; this will cause the demand curve for faculty to shift to the left since the total cost of using faculty labor has risen.[13]

The demand for higher education services. The demand for any type of labor is a derived demand in the sense that the demand for the good or service being produced creates the demand for labor. The same holds true for academic labor markets for faculty, where teaching, research, and public service are the higher education services produced by faculty labor. Therefore, anything that will cause the demand curve for higher education services to shift to the left or the right will result in a similar shift in the demand for labor. Clearly, the primary "demanders" of higher education services are undergraduate and graduate students who purchase teaching services from colleges and universities. However, the same applies to the demand for research and public services. When the demand for higher education rises, so will the demand for faculty, and vice-versa.

The demand for higher education among students has fluctuated over time for many different reasons.[14] Because high school graduates have traditionally been the largest group of purchasers of higher education teaching services, demographic changes in the number of high school graduates provide an important source of variations in student demand for higher education. Student demand for higher education has also been influenced by the state of the economy, in that the demand for college tends to rise in bad economic times since individuals would be giving up less income—due to there being fewer and lower-paying jobs in the economy—by enrolling in college. This means that the opportunity cost of going to college has fallen. Likewise, as the private benefits—for example, higher salaries and better working conditions—of a college education increase, it is expected that more students would have an interest in pursuing a postsecondary education and thus shift the demand for higher education services, and hence faculty, to the right. Another segment of the population that demands higher education services is non-traditional students. Over time, there has been an incredible growth in the

[13] Researchers who have examined the relationship between the demand for educators and the price of other inputs include Dresch (1975), Tuckman and Katz (1981), Tuckman and Chang (1986), and Gyimah-Brempong and Gyapong (1992).

[14] Excellent surveys of the literature on factors affecting student demand for higher education are provided by Radner and Miller (1975), Cohn and Morgan (1978), Becker (1990), Paulsen (1990), and Clotfelter (1991).

market for adult and continuing education, which has also placed upward pressure on the demand for faculty labor, particularly at 2-year institutions that serve more non-traditional-aged students.

Finally, the private sector and various levels of government also place demands on higher education for the goods and services that it produces. Private industry relies on the research conducted by colleges and universities, and many firms use college graduates as labor inputs into their production processes. As the demands for their goods and services change, so will their demand for university research and college graduates, and hence the demand for faculty. Federal, state, and local governments are also significant demanders of higher education services in the areas of teaching, research, and public service. Governments provide support to higher education for the public benefits of university research, to achieve social goals such as greater higher education participation among underrepresented segments of society, and to meet specific state needs in areas such as agriculture, medicine, and teacher training. In addition, governments provide support for higher education to help increase the positive externalities that are generated when the level of education rises (see Chap. 6).

Faculty productivity. Colleges and universities can increase their output by either employing more faculty members or raising the productivity level of their existing faculty. According to the labor demand model, as faculty become more productive, colleges and universities could set higher enrollment or research output targets and thus employ more faculty members. Some researchers have argued, however, that since higher education is a very labor-intensive industry, there are few opportunities for dramatic changes in worker productivity.[15] At the same time, it is possible that advances in information technology, particularly technology that serves as a complement to faculty labor, have led to more recent gains in the productivity of faculty.

The number of postsecondary education providers. The market demand curve for faculty labor within a field is the sum of all of the faculty demand curves at individual colleges and universities. Therefore, if the number of colleges and universities were to increase, then the market demand for faculty would also increase and shift to the right. The recent growth in distance education and the emergence of more non-traditional postsecondary education providers have resulted in an increase the market demand for faculty labor.

Shifts in the Supply of Faculty

As with the demand curve, the labor supply curve can also shift to the left or right depending on factors such as: (1) the wage rates available to workers in alternative/competing labor markets; (2) an individual's preference for working for pay versus leisure activities; (3) the non-labor income available to workers; and (4) the number

[15] Relevant studies include Baumol and Bowen (1966), Baumol and Blackman (1995), and Fairweather (1995).

of individuals who have the necessary qualifications to find employment in the given labor market. Increases in the wages paid in competing labor markets will lead to a reduction in the labor supply curve since the higher wages will entice some people presently employed in the labor market to switch to the alternative labor market. If people's preference for working for pay versus leisure increases, then this would shift the labor supply curve to the right. Increases in income/wealth that a person receives from non-labor activities (such as inheritances and the earnings of family members) would cause the labor supply curve to shift to the left. Finally, increases in the number of people who could potentially enter the labor market would cause the labor supply curve to shift to the right.

Applying this framework to academic labor markets for faculty shows that the labor supply curve for faculty can shift to the left or right depending on several factors such as the following:

- The wage rates available to faculty in non-academic labor markets
- Faculty preferences for working for pay versus leisure
- The non-labor income of faculty members
- The number of individuals with the necessary qualifications for faculty work

The wage rates available to faculty in non-academic labor markets. People who have the skills and qualifications to be employed as faculty can often find employment in a number of different labor markets outside of academe. Whereas all faculty members have the minimum qualifications for some type of employment outside of academe, the range of alternative labor markets for faculty and the salaries that they offer vary widely by discipline. For example, faculty in areas such as Business, Finance, Engineering, and Computer Science can readily apply their skills in the corporate sector, and the salaries in these fields are often quite high relative to other fields. At the other extreme, there are fewer lucrative competing labor markets for faculty in many fields within the humanities and social science disciplines such as History, English, and Philosophy.

As the salaries in competing labor markets rise, holding all else constant, it will cause some faculty members to leave the academic profession and thus reduce the market supply of labor. Changes in the salaries available to faculty in competing labor markets will also result in changes in the equilibrium salaries in the corresponding academic labor markets. For example, increases in the salaries for computer scientists in the private sector during the 1990s certainly contributed to the shortage of computer science faculty at the time, and increased the salaries for those computer scientists who remained in academe.

Faculty preferences for working for pay versus leisure. Over time, an individual's preferences for work and leisure activities are subject to change. These preferences differ across individuals, and can vary systematically by demographic and socio-economic factors. For example, descriptive statistics reveal that women are more likely than men to be employed part-time in academe, and even among full-time faculty men on average work more hours per week than do women.[16] One

[16] See Kirshstein, Matheson, Jing, and Zimbler (1997) and Bellas and Toutkoushian (1999).

possible explanation for these differences is that female faculty on average may devote more time than their male counterparts to family obligations such as raising children. Similar differences in the preference for working for pay versus leisure may be found for faculty in different age categories. Taken together, the rising gender participation rate in the labor force and the gradual aging of the faculty could have implications for the future market supply curve of faculty labor.

The non-labor income of faculty members. If faculty members find that their income from non-labor activities increases, then they could work fewer hours and still earn the same amount of money as before. The labor supply model would predict that as a result they would reduce their labor supply. Thus, increases in non-labor income would be expected to cause the supply curve to shift to the left and vice-versa. A major source of non-labor income, from the point of view of faculty members, is the earnings of their spouses. Toutkoushian and Bellas (2003) found, for example, that a faculty member's preference for working part-time rather than full-time increased along with their other household income. Since men generally have higher earnings than women, it is not surprising to find that women on average have higher levels of non-labor income than do men.

The number of individuals with the necessary qualifications for faculty work. Finally, changes in the number of individuals who have the skills and qualifications for faculty employment will also cause the labor supply curve to shift. Indeed, this is the most frequent cause of shifts in labor supply in academia, as evidenced by the fact that faculty and administrators pay close attention to changes in the number of newly-minted PhD's in their respective fields. As noted earlier, however, many individuals with master's degrees and, in some instances even bachelor's degrees, would also be qualified for faculty employment, depending on the sector and type of position desired.

Historical Changes in Academic Labor Markets

Many economists and higher education researchers have used the labor supply/demand framework to better understand changes that have occurred in the academic labor markets for faculty.[17] In the following section we review some of the major trends that have affected the demand for faculty labor and the supply of faculty labor in the United States.

[17] Interestd readers are referred to Caplow and McGee (1958), Cartter (1966a, 1966b), Freeman (1971, 1975, 1976), Gordon (1974), Farber (1975), Radner and Miller (1975), Hansen, Weisbrod, and Strauss (1978), Roemer and Schnitz (1982), Bowen and Schuster (1985, 1986), Youn (1988), Bowen and Sosa (1989), Stapleton (1989), and Ehrenberg and Zhang (2005a).

Shifts in Demand for Faculty Labor

Because the demand for faculty is largely derived from the demand for postsecondary education among students, much of the early work in this area focused on the effects of demographic changes on the demand for higher education and the subsequent supply of new Ph.D.s. In Chap. 5, we discussed how demographic trends in the United States affected the demand for higher education. Given the magnitude of the demographic changes brought on by the baby boom, it is not surprising that the dominant discussion of the 1960s and early 1970s revolved around the effects of demographic trends on the demand for faculty, and the number of new Ph.D.s, and hence supply of faculty. Some of the most important early research in this area was conducted by Allan Cartter in the 1960s and 1970s.[18] He developed models to examine how demographic trends and research and development spending affect the demand for Ph.D.'s, which in turn produced changes in salaries and employment opportunities for faculty that lead to market responses in the form of changes in the quantity of faculty labor supplied.

In a series of related studies, Richard Freeman extended Cartter's approach by arguing in favor of a cyclical relationship between faculty salaries and the demand for new Ph.D.s.[19] Freeman's model, which has become known as the "cobweb model," shows how faculty salaries, employment, and Ph.D. output affect each other over time and are balanced in the long run. According to the cobweb model, if faculty salaries were to rise, it would lead to an increase in the future supply of faculty because the higher wage rate would entice more individuals to pursue an academic career. However, the increased supply of labor will shift the labor supply curve for faculty to the right, and thus depress future wages and eventually lead to a decline in future employment.[20] An illustration of the resulting cyclical patterns in employment levels and salaries are depicted below in Fig. 9.8. The time lag arises from the fact that students require time to observe the wage change, and then complete the education and training necessary for employment as faculty in the labor market.

Freeman's 1976 book *The Overeducated American* received a significant amount of attention for its dire predictions for the academic labor market. Freeman warned that the supply of faculty would fall during the late 1970s and early

---

[18] Carrter (1966a, 1966b, 1971, 1974, 1976).

[19] Freeman (1971, 1975, 1976).

[20] Freeman's (1975) model is referred to as a "cobweb model" because the relationship between wages and employment implies that this is a recursive system. Freeman shows that if current employment is a function of lagged wages:

$$S = aW(-1)$$

where $S =$ employment and $W(-1) =$ lagged wages, and future wages are a function of current employment, as in:

$$W(+1) = bS$$

then the employment equation can be written as a recursive equation $S = abS(-1)$. Also see Ehrenberg and Smith (2008).

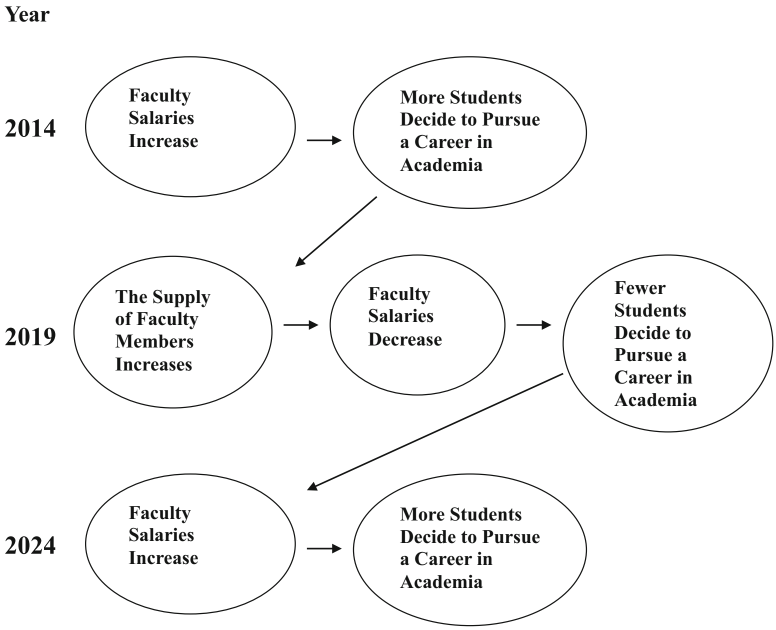


Fig. 9.8 Hypothetical depiction of Freeman's Cobweb Model applied to an academic labor market

1980s because declining wages in academia would reduce the incentive for people to pursue a Ph.D. and subsequently seek employment as faculty. A variation of the cobweb model introduced by Bowen and Sosa (1989) predicted that the ratio of supply to demand for faculty would drop through the first decade of the twenty-first century.

While demographic trends over time have resulted in increases in the demand for higher education, and hence faculty, societal forces have also contributed to a rising demand for postsecondary education among high school graduates over time. The passage of the GI Bill following World War II opened the doors to colleges and universities for many individuals who might not have otherwise pursued a postsecondary education. The rising college participation rate also had a rippling effect on academe in that it helped to raise the educational expectations of parents for their children. The Equal Pay Act of 1964 and related legislation on affirmative action issues, along with expanding employment options for women, have contributed to a rising demand for a college education among women. Federal and institutional financial aid programs have been introduced to lower the net cost of attending college for students from lower-income families. Finally, changes in the general labor market have increased the importance of having a postsecondary education for finding employment in many fields, and increased the need for continuing education among the adult population. A summary of selected trends in demand factors, postsecondary enrollments, college-going rates, and degrees awarded from the 1950s through the 2000s are shown in Table 9.1:

Table 9.1 Trends in births, high school graduates, college enrollments and degrees awarded, selected years 1949–1950 to 2009–2010

Category	1949–1950	1959–1960	1969–1970	1979–1980	1989–1990	1999–2000	2009–2010
Births per 1,000 people	24.1	23.7	18.4	15.9	16.7	14.5	13.5
High school graduates	1,200,000	1,858,000	2,889,000	3,043,000	2,586,000	2,833,000	3,434,672
College participation rate	n/a	45.1 %	53.3 %	49.3 %	59.6 %	62.9 %	70.1 %
Postsecondary enrollments	2,444,900	3,639,847	8,004,660	11,569,899	13,538,560	14,849,691	20,427,711
Bachelor degrees awarded	432,058	392,440	792,316	929,417	1,051,344	1,237,875	1,650,014

Sources: Birth data were obtained from the National Center for Health Statistics. All other data were obtained from the *Digest of Education Statistics 2012*

The third row of Table 9.1 shows that the proportion of high school graduates (public and private schools) who attended college has increased substantially over the past 40 years, rising from 45 % of high school graduates in 1959–1960 to 70 % in 2009–2010. When combined with the demographic trends in the first two rows, it resulted in a rightward shift in the demand curve for higher education among high school graduates. The effects of this shift can be seen in the rising number of students enrolled in postsecondary institutions from 1959–1960 to 2009–2010. It is important to note that even as the number of high school graduates declined during the 1980s, college enrollments continued to rise, in large part due to the increased demand among high school graduates for a college education and also due to the rising demand for postsecondary education among non-traditional students. The number of postsecondary degrees awarded has likewise increased over time due to the shifting demographic trends and greater preference for college among high school graduates. Because college-going rates had remained fairly constant during the 1960s and 1970s, it is not surprising that researchers at the time did not incorporate increases in the college-going rates of students into their projections for academic labor markets.

With regard to other possible sources of change in the demand for faculty labor, the evidence is less uniform and likely to have had a smaller impact on the academic labor market. Data from the National Center for Education Statistics (2010) reveal that federal appropriations to colleges and universities increased nearly eight-fold between 1949–1950 and 1969–1970, far outpacing the rate of inflation; however, the rate of growth since 1970 has been much lower. The number of degree-granting 4-year postsecondary institutions from the 1950s to the 2000s has more than doubled. The more recent growth of for-profit providers of higher education had also contributed to this increase. Much of these gains are due to the rising demand for higher education described earlier.[21] Bowen and Sosa (1989) used the age distribution of faculty to estimate the "replacement demand for faculty" and incorporate this into their projections for the academic labor market. They observed that since 1977 there has been a gradual shifting of the age distribution of faculty, which in the future would lead to greater demand for faculty among colleges and universities. The repeal of policies mandating that faculty retire at age 65, however, has reduced (but not eliminated) the urgent need for colleges and universities to replace retiring faculty.

[21] A small portion of the change is also due to changes in data collection practices at the National Center for Education Statistics. Prior to 1974–1975, branch campuses were not counted separately by the federal government. It is estimated that the separation of branch campuses increased the total institution count by approximately 7 %.

Shifts in Supply of Faculty Labor

Some of the demographic and social trends discussed earlier would not only cause the demand for faculty labor to increase, but also eventually lead to an increase in the supply of faculty as larger numbers of students complete advanced degrees and seek employment in academic labor markets. A further source of change in the supply of faculty labor has been the gradual ratcheting upward of educational aspirations of employers and of individuals. This can be seen in Table 9.2, where data are shown on the number of degrees awarded by level in the United States in selected years:

From 1949–1950 to 2009–2010, there has been a significant rise in the number of degrees awarded at all four levels. Part of this increase is due to demographic and social forces that resulted in greater numbers of high school students going to college. However, when expressed as shares of total degrees awarded, it can be seen that the level of educational aspirations have also risen for college students over time. In 1949–1950, for example, about 12 % of all postsecondary degrees awarded were at the master's level, and only 1 % were at the doctorate level. By 2009–2010, however, almost 21 % of the degrees awarded were master's degrees and 5 % were doctoral degrees. Taken together, these figures suggest that the potential supply of faculty in the aggregate has increased considerably over the past 60 years.

Changes in Salaries and Employment

If both the demand for faculty and the supply of faculty have increased in the United States over time, then the supply/demand model would predict that faculty employment would rise and that salaries may have increased or decreased, depending on the magnitude of the shifts in each of these curves. The limited national data that exists generally supports this view. Figure 9.9 shows trends in faculty employment from 1950 through 2010:

There has been almost a six-fold increase in the number of people employed as faculty from 1950 to 2010. At the same time, the data collected by the AAUP has shown that real wages for the average academic today are not much different from what they were in the mid-1980s.[22] A more detailed look at faculty salaries by year reveals that salaries, after adjusting for inflation, fell during the 1970s in large part due to the extremely high rates of inflation that characterized the decade. Average faculty salaries then increased modestly during the 1980s and have kept pace with inflation in the 1990s. Interestingly, 2009–2010 was the first year since 1996–1997 when faculty salaries did not grow as fast as inflation. With regard to earlier years, Roemer and Schnitz (1982) found that faculty salaries grew at a 3.8 % annual

[22] Statistics were taken from Curtis and Thornton (2014).

Table 9.2 Trends in the number of degrees awarded by level in the United States, selected years

Number of degrees	1949–1950	1959–1960	1969–1970	1979–1980	1989–1990	1999–2000	2009–2010
Associate	n/a	n/a	206,023	400,910	455,102	564,933	849,452
Bachelor	432,058	392,440	792,316	929,417	1,051,344	1,237,875	1,650,014
Master	58,183	74,435	213,589	305,196	330,152	463,185	693,025
Doctor	6,420	9,829	59,486	95,631	103,508	118,736	158,558
Total	496,661	476,704	1,271,414	1,731,154	1,940,106	2,384,729	3,351,049
Market shares	1949–1950	1959–1960	1969–1970	1979–1980	1989–1990	1999–2000	2009–2010
% Associate	n/a	n/a	16 %	23 %	23 %	24 %	25 %
% Bachelor	87 %	82 %	62 %	54 %	54 %	52 %	49 %
% Master	12 %	16 %	17 %	18 %	17 %	19 %	21 %
% Doctor	1 %	2 %	5 %	6 %	5 %	5 %	5 %
Percent change by decade	1949–1950	1959–1960	1969–1970	1979–1980	1989–1990	1999–2000	2009–2010
Associate	n/a	n/a	n/a	95 %	14 %	24 %	50 %
Bachelor	n/a	−9 %	102 %	17 %	13 %	18 %	33 %
Master	n/a	28 %	187 %	43 %	8 %	40 %	50 %
Doctor	n/a	53 %	505 %	61 %	8 %	15 %	34 %

Source: National Center for Education Statistics, *Digest of Education Statistics 2012*, Table 310. Doctor's degrees include first professional degrees such as M. D., D.D.S., and Law

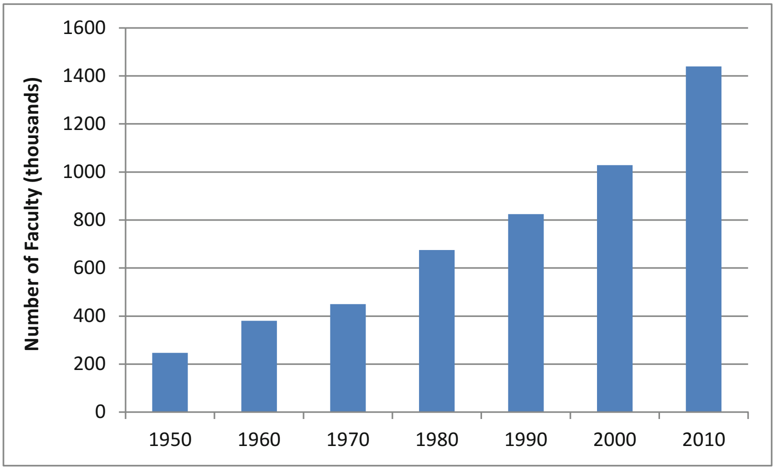


Fig. 9.9 Trends in faculty employment, selected years (*Source*: Digest of Education Statistics 2012)

average between 1957–1958 and 1967–1968, a period described by Farber (1975) as one during which the number of faculty in academic labor markets could not keep pace with the demand for such faculty. Roemer and Schnitz also reported that faculty salaries grew at a much slower pace between 1967–1968 and 1972–1973, and that they decreased relative to salaries in other professional occupations. Bowen and Schuster (1985) likewise observed that from 1970 to 1985, faculty salaries declined by 19 % (after adjusting for inflation), while the real salaries of other occupational groups rose by 3 % for the same period.

The growth in aggregate employment levels shown in Fig. 9.9, however, masks two important trends within higher education. The first trend is that there has been substantial growth in the number of faculty positions held by women, which has grown from 25 % of faculty positions in 1950 to nearly half (47 %) by 2010. The second important trend is that institutions have increased their reliance on part-time faculty over time. According to data compiled by the AAUP, from the mid 1970s through 2011 the growth in positions for full-time, tenure-eligible faculty (+23 %) is considerably lower than the increase in the number of positions for part-time faculty (+286 %) and full-time, non-tenure eligible faculty (+259 %).[23]

Academic Labor Market Differences by Field

The preceding discussion has focused on the academic labor market in its most aggregate form. As noted in the Introduction, however, it is more proper to think of

[23] See Curtis and Thornton (2014).

academia as consisting of a series of separate, yet interrelated, labor markets for faculty in each specific field or discipline. The shifts in the demand for higher education due to demographic trends and societal factors would have increased the demand for faculty somewhat in most every field, because students have to take courses in a wide range of subjects outside of their intended major. Nonetheless, shifts in preferences among college-bound students for specific academic majors, as well as changes in the demands from governments and private industry for particular educational services, will have greater impacts on some fields than on others. The relative supplies of faculty across fields may have changed over time due to changes in the internal and external labor markets. Table 9.3 shows how the number of doctoral degrees awarded has changed over time for selected fields/disciplines:

From Table 9.3, it can be seen that overall there has been a 152 % increase in the number of doctoral degrees awarded between 1970 and 2011. Almost all disciplines experienced considerable growth in the number of doctoral degrees awarded since the 1970s. The largest growth in absolute numbers of doctoral degrees was in the health professions and law, while information sciences, theology, and architecture had the largest percentage growth rates. Although these new doctoral-degree recipients are part of the potential labor supplies of faculty for their respective fields, it is important to keep in mind that the changes over time may also reflect changes in the labor market opportunities for individuals outside of academia. As noted earlier, doctoral-degree recipients can choose to work in academe, the private sector, or the non-academic public sector. When the wages in external labor markets change, they could also have an influence on the number of students who decide to pursue an advanced degree and then seek employment in non-academic industries. For example, the 7 % increase in the number of doctoral-degree recipients in Engineering during the 1980s could be due in part to an increased demand for Ph.D. engineers in the private sector.

Faculty Pay

Up to this point, we have treated faculty members as being identical to each other. Nonetheless, faculty members within each field have a diverse set of characteristics that could affect their labor market outcomes. As a result, the level of faculty pay varies substantially both across and within institutions. Table 9.4 shows how the average level of faculty pay in 2013–2014 differs by the type of institution. In general, faculty salaries are higher in more research intensive institutions, as reflected in the highest degree awarded.

The figures shown in Table 9.4 are averages for all academic disciplines at an institution. Accordingly, some faculty members earn substantially more or less than these averages because they work in separate academic labor markets. And within each academic labor market, there are even more variations in the qualifications, performance, salaries, and employment conditions for individual faculty members. Differences in the labor market opportunities available to faculty outside

Table 9.3 Changes in the number of doctorate degrees awarded by field between 1970 and 2010, selected years

Field	1970–1971	1980–1981	1990–1991	2000–2001	2010–2011	Change: 1970–2010	
						Gain	% Gain
Health professions	15,988	29,595	29,842	39,019	60,153	44,165	276 %
Law	17,441	36,391	38,035	38,190	44,877	27,436	157 %
Engineering	3,687	2,598	5,316	5,485	8,369	4,682	127 %
Biological sciences	3,603	3,640	4,152	5,225	7,693	4,090	114 %
Psychology	2,144	3,576	3,932	5,091	5,851	3,707	173 %
Education	6,041	7,279	6,189	6,284	9,623	3,582	59 %
Theology	312	1,273	1,076	1,461	2,374	2,062	661 %
Business	774	808	1,185	1,180	2,286	1,512	195 %
Information sciences	128	252	676	768	1,588	1,460	1141 %
Performing arts	621	654	838	1,167	1,646	1,025	165 %
Physical sciences	4,324	3,105	4,248	3,968	5,295	971	22 %
Social science	3,660	3,122	3,012	3,930	4,390	730	20 %
Public administration	174	362	430	574	851	677	389 %
Interdisciplinary	101	236	306	512	660	559	553 %
Communications	145	171	259	368	577	432	298 %
Mathematics	1,199	728	978	997	1,586	387	32 %
Philosophy	555	411	464	600	805	250	45 %
Architecture	36	93	135	153	205	169	469 %
Agriculture	1,086	1,067	1,185	1,127	1,246	160	15 %
Cultural studies	143	161	159	216	278	135	94 %
Foreign languages	1,084	931	889	1,078	1,158	74	7 %
English	1,554	1,040	1,056	1,330	1,344	−210	−14 %
All others	198	523	1,185	862	910	712	360 %
Total	**64,998**	**98,016**	**105,547**	**119,585**	**163,765**	**98,767**	**152 %**

Source: *Digest of Education Statistics 2012*, Table 315

Table 9.4 Average faculty salary by type of institution, 2013–2014

Institution type	Public	Private—independent	Private—religiously affiliated	All combined
Doctoral	\$91,918	\$125,592	\$100,252	\$98,902
Master's	\$70,683	\$81,919	\$73,494	\$73,057
Bachelor's	\$67,328	\$82,031	\$64,688	\$72,505
Associate's	\$61,199	–	–	\$61,038
All Combined	\$82,605	\$103,202	\$76,379	\$86,293

Notes: Data were obtained from Curtis, J., & Thornton, S. (2014). Losing focus: The annual report on the economic status of the profession, 2013–2014. *Academe*, *March/April*, 4–38, Survey Report Table 4. The figures are for all academic ranks combined. Data were not reported separately for private institutions at the associate's level due to insufficient number of observations; however, their values are included in the totals for this category

of academe may help explain why faculty in Finance departments on average earn more than faculty in History departments, for example, but this view alone does not explain why some individual professors in History earn more than others in the same discipline.

The micro-level view of labor markets can be used to examine differences in the employment conditions of individuals within, as opposed to across, labor markets. In this section we will explore some of the reasons that variations are found in the earnings and employment prospects of individuals within fields. Economists turn to the theory of human capital to understand why the salaries and employment decisions/opportunities for faculty differ within labor markets. In this section, we will briefly review the theory of human capital and how it relates to labor markets for faculty.

To understand the theory of human capital and its connection to labor, one must first understand how a college or university's demand function for faculty is obtained. Labor economists define the *marginal productivity of labor* (MP_L) as being the additional output produced by an additional worker. In the case of faculty, this would represent the combined change in teaching, research, and public service outputs that a college or university can produce due to employing an additional faculty member. When the change in output due to an additional worker is converted to the change in revenue brought into the organization, it is referred to as the *marginal revenue product of labor* (denoted MRP_L). The marginal revenue product of labor is defined as the marginal product of labor times the marginal revenue of output produced (i.e., $MRP_L = MP_L * MR$). Accordingly, if a new faculty member enabled the college to enroll 40 more students, and each student brought in \$2,000 to the college, then for this faculty member $MP_L = 40$, $MR = \$2{,}000$, and $MRP_L = (40)(\$2{,}000) = \$80{,}000$.

Recall from Chap. 8 that economists posit that to maximize profits, firms should produce output up to the point where the revenue from the last unit of output produced ("marginal revenue" or *MR*) is equal to the cost of the last unit produced ("marginal cost" or *MC*). If marginal revenue is not equal to marginal cost at the current level of output being produced, then the organization could increase profits by adjusting its output level accordingly. This profit-maximizing rule can also be expressed in terms of the revenues and costs associated with labor. Essentially, the firm can maximize profits by hiring labor up to the point where the marginal revenue product of labor is equal to the *marginal factor cost of labor*. Since one can think of the worker's salary and benefits as the marginal factor cost to the firm of employing another worker, this rule asserts that the firm will hire a worker as long as the amount of additional money that the person brings into the organization exceeds his or her compensation.[24]

Applying this framework to postsecondary institutions, however, presents some challenges. As we discussed in Chaps. 7 and 8 of this book, the profit-maximization rule does not adequately describe the behavior of colleges and universities. Nonetheless, because most institutions are very conscious of ensuring that they have sufficient revenues to cover costs and in many situations seek excess revenue, they would be reluctant to hire faculty when the additional costs of doing so are greater than the benefits to the institution. Second, although the marginal cost of employing a faculty member is a relatively straightforward calculation, it is much more difficult to measure the true marginal revenue product of a faculty member. Faculty members typically work to produce outputs in the areas of teaching, research, and public service, and most of these outputs are very difficult to measure. Even if it were possible to measure the additional output in each area attributed to each faculty member, attaching dollar values to each of these outputs would be equally challenging.[25] Perhaps the best that institutions can do is to derive rough measures of the relative productivity of faculty, and use this information in setting salary levels for individuals. In this instance, salaries and productivity would still be positively correlated, and hence the human capital model can provide useful predictions for the academic labor market.

Human Capital and Faculty

What is "human capital," and how does it relate to faculty salaries? Human capital refers to the collective attributes and endowments possessed by an individual that in turn affects his or her productivity in the labor market. The theory holds that, all else held constant, an individual who has more human capital would be able to produce more output per hour of work than another individual with less human capital. To see the connection between human capital and the salaries of workers, recall that in the economist's model of labor demand organizations use labor up to the point where the marginal revenue product of labor is equal to the person's salary. Since

---

[24] The true marginal cost of employing an additional worker would have to salary as well as fringe benefit and other non-salary costs.

[25] More discussion of these and related issues can be found in Fairweather (2005) and Melguizo and Strober (2007).

marginal revenue product is calculated as the additional output produced by the worker times the additional revenue received by the organization for each additional unit of output, workers who are more productive would have higher MRP_L's, and thus would command higher salaries in competitive labor markets. Therefore, the theory of human capital presumes that workers with more human capital will, on average, earn more than other workers.

It is useful to think of workers as having two types (or sources) of human capital: acquired human capital and endowed human capital. Acquired human capital includes those skills and talents that an individual can obtain through their education, training, and experience in the labor market. The time that students spend in college is viewed by economists as an investment in their human capital, because going to college leads to increases in human capital and productivity that in turn enable them to earn higher salaries. Likewise, a person's human capital rises as they gain experience in the labor market since they will acquire skills and knowledge that will also enable them to be more productive workers. As a result, workers with more education, training, and/or experience would be predicted to earn more than other workers.

Endowed human capital, on the other hand, refers to a person's natural ability and talent that affect the amount of output that he or she is able to produce in a given labor market. This source of human capital might include factors such as the person's innate intelligence, physical strength, and personal motivation. Endowed human capital would thus encompass all of those factors that affect a person's work productivity but cannot be increased through any investment on the part of the individual. Another way of looking at this is that endowed human capital are those variations across individuals in their productivity that remain after taking into account differences in their acquired human capital through education, training, and experience in the labor market. The connections between human capital, productivity, and earnings are depicted graphically in Fig. 9.10.

In academic labor markets, faculty members can have large variations in their levels of acquired and endowed human capital. Faculty members as a whole hold many different highest degrees in academe, including doctoral degrees, first professional degrees, master's degrees, and others. The National Center for Education Statistics (2010) reported that in the Fall of 2003, 60 % of full-time instructional faculty held a doctoral degree, 26 % held a master's degree as their highest degree, and 8 % held a professional degree. Likewise, faculty members within most any academic department differ from each other with regard to their years of experience in academe, the quality of their training, their natural ability to perform their teaching, research, and public service duties, their areas of specialization, and their motivation and drive to succeed.

Many researchers have investigated whether human capital and other factors influence faculty productivity.[26] Most of these studies focused their attention on

[26] Recommended readings include Bayer and Fogler (1966), Astin and Davis (1985), Lawrence and Blackburn (1986), Diamond (1984), Fox (1992), Creamer (1998), and Bellas and Toutkoushian (1999).

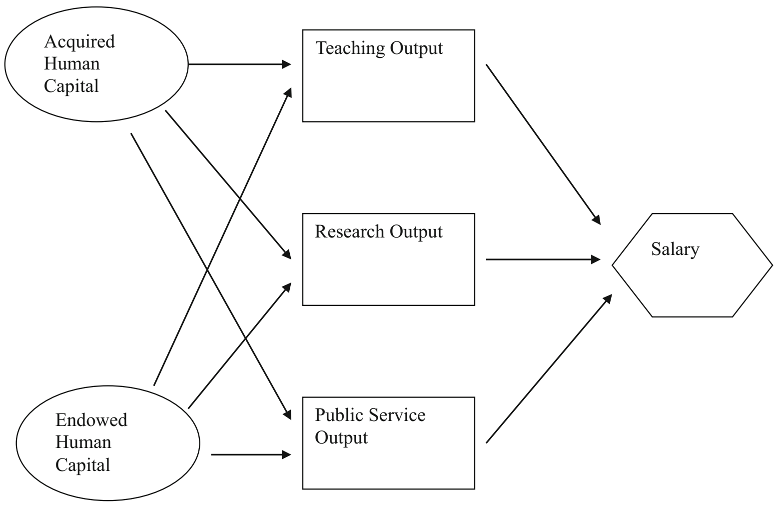


Fig. 9.10 Diagram of the relationship between human capital, productivity, and earnings of faculty

explaining research productivity differences across faculty members, due in part to the inherent difficulty in defining and measuring teaching and public service outputs. It should be noted, however, that even though it is possible to quantify research output measures such as the number of scholarly publications, citations, and sponsored research dollars, these are also imperfect representations of research productivity.

One theory that has been frequently used to explain the connection between a faculty member's age/experience and productivity is the "life-cycle hypothesis".[27] According to this theory, a faculty member's productivity will at first increase as he/she ages and acquires human capital. Eventually, however, a person's endowed human capital will decline with age, leading to decreases in productivity. Therefore, over a person's lifetime, the life-cycle theory would predict a quadratic relationship between age/experience and research productivity as shown in Fig. 9.11.

There is a substantial body of literature that has presented evidence on the effects of human capital measures on the research productivity of faculty.[28] This literature has generally favored the life-cycle hypothesis as one explanation for productivity—and hence salary—variations across faculty members. For example, Bayer and

[27] The life-cycle hypothesis can be traced back to the mid 1970s (Becker, 1975; Tuckman, 1976). A sampling of other studies that have also examined this hypothesis include Over (1982), Lawrence and Blackburn (1988), Levin and Stephan (1991), Goodwin and Sauer (1995), and Tien and Blackburn (1996).

[28] Examples of studies on this topic not cited earlier include Cole and Cole (1967), Hansen, Weisbrod, and Strauss (1978), Hogan (1981), Fox (1983), Bellas (1997), and Porter and Umbach (2001).

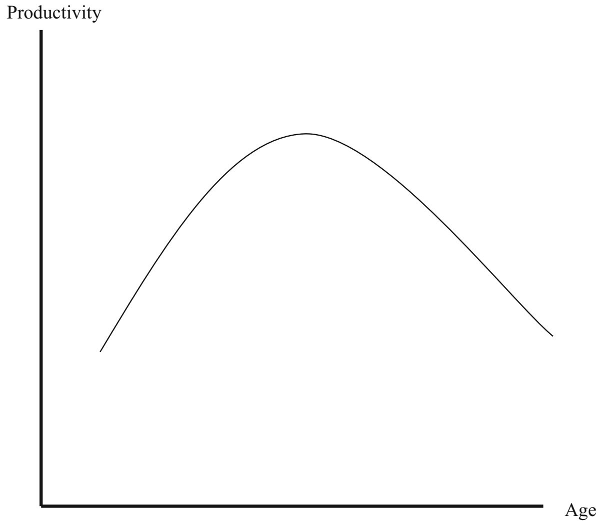


Fig. 9.11 Graphical depiction of the life-cycle hypothesis

Fogler (1966) presented evidence that the number of citations that a faculty member receives to his or her research is correlated with the quality of the person's graduate education. Furthermore, Toutkoushian (1994) showed that faculty with higher levels of educational attainment, and higher quality of graduate training—as measured by the reputation of their graduate program—were more likely to be highly cited within their department.

Determinants of Faculty Pay

As shown in Fig. 9.10, the connection between human capital and faculty compensation follows from the effects of human capital on productivity, which in turn influences pay. Rather than attempt to measure faculty productivity in each area of their work and determine if and how human capital attributes affect productivity, other analysts have examined the connection between human capital and faculty compensation. If faculty compensation is determined in part by an individual's productivity in teaching, research, and public service, then salaries should be correlated with productivity. Human capital theory would thus predict that faculty with more acquired and endowed human capital would, on average, have higher salaries than other faculty.

There is an equally large body of literature that has examined the impact of human capital and other factors on faculty salaries.[29] Most of the published studies

[29] See Loeb and Ferber (1971), Koch and Chizmar (1973), Katz (1973), Ferber (1974), Johnson and Stafford (1974), Hammermesh, Johnson, and Weisbrod (1982), Hirsch and Leppel (1982), Megdal and Ransom (1985), Barbezat (1987, 1989, 1991), Ransom and Megdal (1993), Toutkoushian (1998a, 1998b), Toutkoushian, Bellas, and Moore (2007), Toutkoushian and Conley (2005), Melguizo and Strober (2007), Umbach (2007), and Barbezat and Hughes (2005).

on the determinants of faculty pay have been motivated by the desire to determine if there are pay differences for individual faculty based on their gender after taking into account differences in human capital and field/discipline. The standard approach used to explain variations in faculty salaries is multiple regression analysis. The main advantage of multiple regression analysis is that it allows the researcher to isolate the effects of each factor on faculty salaries after controlling for the effects of all other factors in the model.

Faculty salary studies can be conducted using either cross-section data on faculty at one institution, or a nationwide sample of faculty in a given year. Regardless of whether institutional or national data are used, the researcher will almost always attempt to control for a faculty member's years of experience and educational attainment, under the assumption that these are human capital measures and thus would be expected to contribute to pay differences across individuals. Although faculty salary studies based on national data will often use the same variables as institution-specific studies, the national studies also tend to add controls for the type of institution where the faculty member works, and the geographic location of the institution. Furthermore, because national studies of faculty salaries rely on survey data and institution-specific studies utilize data from personnel files at the institution, national studies can capture information about faculty, most notably their prior work experience and research accomplishments, that are not usually collected and stored in a college's personnel database. The institution-specific and national salary models generally explain between 40 and 80 % of variations in individual salaries as due to differences in acquired human capital, field/discipline, and personal factors.

There is very strong evidence supporting many of the predictions of the human capital model about faculty salaries. The aforementioned studies of faculty compensation have consistently shown that faculty salaries increase along with years of experience in academe and educational attainment; these factors are now used in virtually every empirical study of faculty compensation. Ransom and Megdal (1993), for example, analyzed data for a national sample of faculty in 1984. They found that after taking into account a faculty member's gender, type of academic appointment, and experience level, individuals with doctoral degrees earned approximately 24 % more than faculty with bachelor's degrees. Similar results were reported for professional degrees. Their results also showed that years of experience had a positive and significant effect on salaries after controlling for the same factors in the salary model.

Despite its potential importance in determining faculty salaries, research productivity is not controlled for in many institutional studies because this information is rarely accessible to the researcher through institutional databases. A number of studies have examined the effect of research productivity on earnings, and found that faculty with higher levels of research productivity have higher salaries than faculty who are less productive in research.[30] When research output is not directly

[30] See, for example, Barbezat (1991), Ransom and Megdal (1993), Toutkoushian (1994, 1998a), and Fairweather (2005).

controlled for in the salary model, however, a portion of the effects are usually captured by human capital factors in the salary model, such as experience and educational attainment, as well as other outcome variables such as academic rank. The finding that human capital differences explain some of the variations in faculty compensation when research productivity is not controlled for is consistent with the notion that this is due to the effects of human capital on productivity.

Non-Human Capital Differences in Faculty Pay

Although human capital theory is a useful tool for explaining some of the variations in salaries across individuals, it does not capture all of the pay differences observed in academic labor markets. There are some anomalies in the expected relationships between particular human capital factors and compensation. This is particularly true when examining the effects of experience on earnings. Equally contrary to the predictions of the labor supply/demand model is the fact that some faculty may experience pay differences due to personal attributes such as gender and race/ethnicity that should have no relationship to their human capital or true marginal productivity.

Despite the fact that empirical studies have generally supported the hypothesis that faculty salaries increase at a decreasing rate with years of experience, a number of researchers have presented evidence that challenge this notion. It has been suggested that over time, there has been a narrowing of the pay gap between younger and older faculty in some fields, and that in extreme cases younger faculty are paid more than experienced faculty. This phenomenon is referred to as "salary compression" or "salary inversion" and is often attributed to an institution's failure to make salary adjustments for established faculty when salaries in the external labor markets change.[31] To date, the results from these studies have been mixed, due in part to differences in the methodologies used to measure salary compression. Many of these studies simply compare average salaries for faculty in different age groups without controlling for the effects of other human capital attributes on pay. Toutkoushian (1998c) developed a five-step procedure for measuring salary compression, and showed that at the institution being studied there was no difference between the actual salaries of younger faculty and the salaries that they would be predicted to earn if paid according to the same salary model as more experienced faculty. Twigg, Valentine, and Elias (2002), however, concluded that after using a similar approach, there was evidence of salary compression at a different institution.

[31] Key studies of salary compression include Dooley (1986), Dworkin (1990), McCulley and Downey (1993), Huseman, McHone, and Rungeling (1996), Toutkoushian (1998c), and Twigg, Valentine, and Elias (2002).

Other researchers have investigated a related question—whether faculty with more seniority at a college or university are paid less than other faculty after taking into account their total years of experience.[32] Ransom (1993), for example, found that a faculty member's salary decreased with each additional year of seniority at his or her institution, after controlling for total experience in the field. Ransom referred to this phenomenon as "monopsonistic discrimination" in which colleges and universities discriminate against faculty members who are less mobile by paying them lower salaries.

An alternative to the monopsonistic discrimination explanation offered by Lazear (1986) is that faculty members who are less productive are, on average, less mobile and therefore the fact that faculty with more seniority may have lower salaries reflects these productivity differences. In this instance, the findings observed by Ransom (1993) would be quite consistent with the predictions of human capital theory. Clearly, more work is needed to better isolate all of the ways in which experience influences pay for individuals in the academic labor market for faculty.

Perhaps the most attention in the literature on faculty compensation has been directed at the question of whether female faculty members are paid less than their comparable male counterparts.[33] Studies of gender equity in pay are often motivated by observed differences in the average salaries of male and female professors. For example, Table 9.5 provides a comparison of the average salaries for male and female faculty in 2013–2014 broken down by type of institution and academic rank. Across all institution types and ranks, on average male faculty were found to earn 24 % more than female faculty. The average pay gaps become smaller, however, when comparisons are made of male and female faculty within the same rank. Likewise, the gender pay gaps are found to be greatest at doctoral institutions, and smallest at associate institutions.

These types of statistics are often cited as evidence of pay discrimination in academe; however, there may be differences in the average human capital characteristics of male and female faculty members that could explain some or all of these average pay differences. According to the standard economic models of labor markets outlined here, any pay differences between equally-qualified men and women should not be sustainable in a general labor market because male and female workers are substitute forms of labor for each other.[34] To illustrate, suppose that a male and female faculty member at a particular college are equally productive, and yet the woman receives a lower salary than the man due to an institution's

[32] See Lazear (1986), Ransom (1993), Hallock (1995), Boal and Ransom (1997), Barbezat and Donihue (1998), Moore, Newman, and Turnbull (1998), and Barbezat and Hughes (2005).

[33] See, for example, Ferber (1974), Gordon, Morton, and Braden (1974), Megdal and Ransom (1985), Barbezat (1987, 1989, 1991), Bellas (1992), Ransom and Megdal (1993), and Umbach (2007).

[34] See Becker (1957), and Darity and Mason (1998). As noted by Darity and Mason (1998, p. 81): "Standard neoclassical competitive models are forced by their own assumptions to the conclusion that discrimination can only be temporary."

Table 9.5 Average faculty salary by gender, 2013–2014

Institution type and faculty rank	Male	Female	$ Gap	% Gap
All institutions and all ranks	$94,174	$75,874	$18,300	24.1 %
All institutions—professor	$123,899	$108,031	$15,868	14.7 %
All institutions—associate professor	$84,507	$78,723	$5,784	7.3 %
All institutions—assistant professor	$72,780	$66,991	$5,789	8.6 %
Doctoral institutions—all ranks	$108,101	$84,654	$23,447	27.7 %
Master institutions—all ranks	$77,354	$68,248	$9,106	13.3 %
Bachelor institutions—all ranks	$75,873	$68,605	$7,268	10.6 %
Associate institutions—all ranks	$62,302	$59,919	$2,383	4.0 %

Notes: Data were obtained from Curtis, J., & Thornton, S. (2014). Losing focus: The annual report on the economic status of the profession, 2013–14. *Academe*, *March/April*, 4–38, Survey Report Table 5

preference for male faculty members. In terms of the relationship between salaries and productivity, discrimination implies that the college either pays a wage premium to male faculty:

$$w_m = MRP_m + d_m \tag{9.1}$$

where d_m = wage premium for males, or pays a wage discount to female faculty:

$$w_f = MRP_f - d_f \tag{9.2}$$

However, such a practice would be inconsistent with the assumption that organizations are concerned with their revenues and expenses and compete with each other for resources, because an organization could increase its profitability by substituting less-expensive female labor for more-expensive male labor and produce the same amount of output as before. If a sufficient number of non-discriminating firms replace males with females, it would raise the wages of women and lower the salaries of men up to the point where they are equal.[35] Under this model, in the absence of a sufficient number of non-discriminating firms, employers actually reduce profits when they choose to engage in discrimination.

Of course, one of the challenges of measuring pay discrimination in academe is that, on average, female faculty members have less human capital than do male faculty members, and thus these human capital differences could account for some or all of the observed average wage differences between men and women. To compare the earnings between men and women with similar qualifications, it is necessary to first control for pay differences for faculty due to measurable human capital and other relevant factors. This can be accomplished through an earnings equation such as that originally proposed by Mincer (1958):

[35] As noted by Becker (1971) and reiterated by Holzer and Neumark (2000), this result holds provided that there are a sufficient number of firms that do not discriminate, and that product markets are either perfectly competitive or at a minimum allow new firms to enter the market.

$$\ln Y_i = \alpha_0 + \alpha_1 ED_i + \alpha_2 EXP_i + \sum_{j=1}^{J} \beta_j X_{ij} + \delta G_i + \varepsilon_i \tag{9.3}$$

where lnY = natural log of salary, ED = educational attainment, EXP = years of experience, X_1 to X_J = other variables such as academic field that are thought to affect salaries, and $G = 1$ if female and 0 if male. The coefficient on the gender variable (δ) represents the average predicted pay difference between male and female faculty members who have the same level of educational attainment, experience, and other variables X_1 to X_J. If the estimated coefficient δ is statistically less than zero, then it provides evidence that female faculty on average are paid less than comparable male faculty. This could reflect either inequitable treatment of women or gender differences in other variables that are not in the salary model but affect salary. As a result, it is common to refer to this coefficient as the unexplained wage gap and not discrimination per se. The approach shown here is referred to as the single-equation model because data for male and female faculty are combined into one equation, and the dichotomous variable for gender captures their unexplained pay difference.[36]

In contrast to the predictions of the human capital model, empirical studies have consistently found that female faculty members are paid less than male faculty even after taking into account salary differences due to human capital and field/discipline. One possible explanation for the gender pay gap is that salary differences reflect the effects of productivity that are not captured in the salary model due to data limitations. However, most studies that have controlled for research productivity measures have found that women in academe still earn less than men after controlling for differences in research.

Extensions

When we normally think of faculty, an image comes to mind of a person who is employed in a tenure-track position and works full time at one institution. This person began his or her career as an assistant professor in a tenure-eligible position. After a period of time, the person applied for promotion to the rank of associate professor. If promoted, the person may eventually apply for promotion to the highest rank of full professor. When a faculty member is granted tenure (usually when they have been promoted to associate professor), he or she is virtually assured of having a job for life unless extreme circumstances arise. The professor engages in a range of teaching, research, and service activities appropriate for his or her

[36] Researchers also use a number of multiple-equation methods to measure the unexplained wage gap. For more details on these approaches, see Oaxaca (1973), Neumark (1988), and Toutkoushian and Hoffman (2002).

institution, and is paid an annual salary that typically ranges between \$40,000 and \$150,000.

A significant and growing number of faculty members in academic labor markets, however, work in jobs that do not fit this description. Some individuals are employed in academic positions where they work full time but are not eligible for tenure. Other faculty members are hired on a part-time basis to teach one or two classes per year, and may teach classes at multiple institutions or have full time jobs inside or outside of academia to earn a living. They are usually paid by the course at rates that are only a small fraction of what full-time, tenured faculty in the same field receive on a per-course basis. And they tend to focus exclusively on teaching and are rarely involved in research and service activities. For ease of exposition we refer to all of these individuals collectively as non-tenure track faculty.

The growing reliance by institutions on non-tenure track faculty has naturally raised questions about the impacts of this shift on higher education. One concern is that the increased use of non-tenure track faculty could increase the service burden on tenure-track faculty and possibly lead to reductions in the overall research productivity of an institution.[37] Another issue is that their working conditions and pay may be substantially worse than for their tenure-track counterparts.[38] The National Education Association (1988, p. 27), for example, describes the "misuse and abuse of part-time, temporary, and non-tenure-track faculty. . .[as] one of the most serious problems confronting American higher education." However, other researchers have shown that there can be a variety of reasons for being employed in non-tenure track positions. Although some individuals may feel forced into taking a non-tenure track position because they could not find a tenure-track job, for others this is a voluntary choice as a means to supplement their income, fulfill a desire to teach on an occasional basis, or simply to remain active in academic life.

Labor economics can be used to help understand why some individuals are employed in non-tenure track positions, and why this may vary by factors such as a person's gender or family status. The labor markets for non-tenure track faculty are much like the labor markets for tenure-track faculty, in that wages and employment levels are determined by both the supply of individuals willing and able to take these positions as well as the demand for people to fill these positions. Tenure-track faculty are more likely than non-tenure track faculty to be asked to engage in activities such as research and teaching graduate courses that would require higher levels of education and training. In contrast, non-tenure track faculty members are typically hired to teach undergraduate courses. Therefore, fewer individuals will be expected to have the necessary qualifications to serve as tenure-track faculty members, and the demand for individuals to fill non-tenure track positions will be influenced by the education and training level of the individual. The demand for

---

[37] See Tuckman and Pickerill (1988), Gappa and Leslie (1993, 1996), and Roemer and Schnitz (1982).

[38] See Gappa and Leslie (1993), Roueche, Roueche, and Milliron (1996), and Barker (1998).

non-tenure track faculty will also vary by field/discipline, since they can be more effectively used to teach courses in particular fields, as well as by type of institution.

Turning to the supply side of the market, recall from Fig. 9.4 that the labor supply decision of an individual depends on his or her preference for working for pay versus other uses of time. For each added hour that a worker spends in leisure, he or she must forego the income that could have been earned had the person spent the time working for pay.[39] According to the labor supply model, individuals will choose the optimal combination of time spent in work and in leisure at the point where their indifference curve is tangent to their time constraint line.

What factors might account for the fact that some faculty are more willing than others to work as non-tenure track faculty? The first possible explanation is that some faculty members simply have a greater preference for leisure versus working for pay in academe. It is possible that some people with a higher preference for leisure than the income from working would maximize their utility by choosing to work fewer hours. Each person is rational according to the economist's way of thinking, since each is allocating their time in such a way as to maximize their satisfaction or utility. A person's family status—whether they are married and whether they have young children at home—may contribute to different preferences for work versus leisure because the (opportunity) cost of working increases along with family obligations. A person's gender may also play a role in his or her preference for work versus leisure, in that women have traditionally borne the greater share of family responsibilities.[40] Furthermore, if the salaries for men are higher than the salaries for women, this may contribute to gender differences in the amounts of time that faculty allocate to working for pay in academe.

Toutkoushian and Bellas (2003) investigated how supply-side and demand-side factors influence the probability that a person prefers part-time employment in academe, and how these factors explain the higher concentration of women in part-time positions (51 % of all female faculty at the time occupied part-time positions, while 38 % of male faculty were employed part-time in academe). They found that individuals with family responsibilities were more likely than other faculty to prefer part-time employment, women were 6 % more likely than men to prefer part-time employment, and middle-aged faculty were least likely to prefer part-time employment. In addition, their analysis shows that the supply-side and demand-side factors they considered account for most of the gender difference in part-time employment. The aforementioned supply-side factors explained only a small portion of the gender difference in part-time employment, while demand-side factors such as educational attainment, experience, field, and institution type accounted for the remainder.

[39] Even though faculty members in tenure-track positions are not typically paid "by the hour," there are still ways in which time spent in leisure could be used to increase their income, and more time spent working may lead to higher salaries in the future.

[40] See Goldin (1990), Connelly (1992), and Pencavel (1998).

With regard to the relative compensation of part-time and full-time faculty, Toutkoushian and Bellas compared the earnings per hour of work for these two groups of faculty. They observed that part-time faculty received institutional salaries that were approximately 60 % less per hour of work than for full-time faculty; however, part-time faculty earned slightly more than their full-time counterparts per hour of work after comparing all sources of income. Part-time faculty members were also found to be as satisfied as full-time faculty with their overall academic jobs and level of compensation. Although this does not prove that all part-time faculty members are treated equitably, it calls into question the common perception that on average most part-time faculty are unfairly compensated by their employing institution. At the same time, Toutkoushian and Bellas reported that part-time faculty members were significantly less satisfied than full-time faculty members with their level of benefits.

Policy Focus

Although faculty work has always consisted of a combination of research, teaching, and service, the ways in which this work is done has changed dramatically over time. These changes have been driven, in part, by technological advances that have affected all three dimensions of faculty work. Professors can now deliver content to students using websites and tools such as Powerpoint and smartboards instead of chalk and slate. Data can be analyzed quickly and efficiently using desktop and laptop computers as opposed to large mainframe machines. And one- and two-way audio and video technology make it easier for faculty to distribute their work across vast distances in ways that were not possible in the twentieth century.

In addition, an array of new technologies has evolved over time that faculty can use to communicate with each other and outside audiences. Websites are a way for a faculty member to establish an "internet presence" and disseminate information about themselves and their research, teaching, and service activities to others who logged onto their website. Weblogs, or "blogs" as they have come to be known, are other vehicles for academics to express their views on a wide range of topics. Other delivery mechanisms such as Twitter allow researchers to comment on events of the day and communicate with large numbers of individuals who subscribe to their online content feeds. And even social media applications such as Facebook are means for faculty to communicate and distribute information about their work to the outside world.

Collectively, we refer to these mechanisms here as "social media," but acknowledge that the specific mechanisms vary in how they work, their intended audiences, and that not all media are used by faculty for "social" purposes. Social media represents an important change in how faculty members can do their work. Prior to these technological developments, faculty had to rely on peer-reviewed / juried publication outlets such as academic journals and books—or perhaps opinion pieces or letters to the editor in print newspapers and magazines—if they wanted to communicate their thoughts and ideas to wider audiences. The ability to disseminate views was not under the complete control of the faculty member; the "demander" of content (e.g., the publisher) dictated whether the person's views would be distributed. Although these options still exist today and are important mechanisms for a faculty member's career development, academics can opt to bypass this system in favor of blogs, tweets, and website postings that are wholly "supply driven." There is no quality control mechanism in place or means to evaluate the validity of the information being distributed. In fact, mediums such as Twitter implicitly discourage such evaluation by limiting a person's posting to a maximum of 140 characters, leaving little space for the writer to justify and explain his or her point of view.

In general, there are few policies regarding the proper use of social media for faculty. The policies that do exist have focused on the issue of freedom of speech. Nonetheless, a handful of high-profile cases have arisen in academia in recent years over the way in which faculty members have used social media to espouse their views on a variety of topics related and sometimes unrelated to their work. Our goal in this policy discussion is not to evaluate the merits of any of these specific cases; rather, we focus on the economic dimensions of social media for faculty work. In particular, we discuss the opportunity costs of using social media and how its use relates to faculty productivity.

Economists argue that every decision has opportunity costs attached to it. Once a decision maker does something, the person (or organization) foregoes doing something else with their limited resources. This is the essence of the economic problem for virtually any situation. In the case of faculty work, the scarce resource is time. Professors only have so many hours in their day, days in their week, weeks in their year, and years in their career in which to teach students, conduct research, and engage in service activities. By definition, more time spent in any of these activities means less time available for the other activities. Accordingly, if a faculty member's time is divided between time spent using social media and time spent in all other work-related activities, then the opportunity cost of time spent using social media is the lost time that could have been spent on other aspects of the person's job.

Calculating the true opportunity cost of time spent in social media is complicated, however, because there are many different ways in which a professor may use social media. Time spent online in activities that are not related to work, such as posting personal pictures on Facebook or tweeting about current events unrelated to one's faculty position, clearly have the highest opportunity costs. Such time is truly lost time from a work perspective because the scarce resource (time) was not used to pursue any of the outcomes from faculty work for which the person is being paid.

At the same time, an argument can be made that certain types of online activities are in fact connected to a faculty member's work. For example, a blog posting from an astronomy professor about what was learned from a satellite visiting a planet in our solar system might be viewed as contributing to the person's teaching activities (if distributed to students) or public service (if the general public reads about it). Likewise, disseminating news stories on the faculty member's areas of expertise via Twitter to followers has a public service and perhaps teaching component to it. Furthermore, there are instances where online communications may enhance a faculty member's research if he or she interacts with others through it and comes up with new ideas that are later integrated into the person's scholarly endeavors. In all of these examples, time spent using social media is not completely "lost time" because there are some work-related benefits to it.

It is equally important to note that higher education reward systems are still highly focused on traditional output measures for faculty. Tenure and promotion decisions, as well as annual reviews, tend to give more weight toward publications in books and peer-reviewed journals than they do blog postings and tweets. This weighting reflects the fact that juried publications have gone through a peer review process, and thus have a measure of academic quality assurance attached to them. In contrast, posting a blog entry about a faculty member's thoughts on a state's proposal for free tuition at community colleges, for example, does not have the same information value to those who must assess the faculty member's productivity and quality of work. Although policy makers may be interested in social media information because it can be more readily understood than journal articles, tenure and promotion committees more highly value research products that have been fully vetted by their peers.

In the end, the evaluation of the appropriate use of social media is much like any other tool at the disposal of the individual faculty member. Critical questions must be asked about whether the online activity contributes to the person's teaching, research, and service functions, and if so, how does it do this. Furthermore, the faculty member needs to ensure an appropriate balance among all three activities (with the balance being determined, in part, by where the faculty member is employed). Even if it is argued that the person's participation in social media enhances his or her public service activities and visibility to others, the person may be spending so much time online that the opportunity costs for research and teaching exceed what is gained by having an extensive online presence. This is particularly important for younger faculty members who have not yet received tenure because their opportunity costs of spending too much time using social media are very high.

Final Thoughts

In this chapter, we have attempted to provide an overview of the macro-level and micro-level views of the academic labor market for faculty, and explain how the tools and techniques used in labor economics can be used to help understand the functioning of the academic labor market. The concepts of supply and demand have proven to be very useful in this regard, showing (for example) how demographic trends can contribute to faculty salaries and employment levels. The human capital framework has also been heavily used to measure wage variations across individual faculty members, and test for evidence of pay disparities by gender, race, age, and other factors after taking into account the impacts of human capital measures on earnings.

The strength of academic labor markets for faculty lie in the quality of the individuals who elect to pursue a career in academia. High-quality faculty members are needed for the research that they produce and for the knowledge that they impart to students, which will ultimately have a bearing on their future contributions to the economy. The models presented here show how compensation plays an important role in attracting high-quality individuals to the academic profession. The gradual shifting of the financing of higher education from government sources to individuals, however, raises concerns about whether academe will be able to secure the resources necessary to raise faculty salaries so that academic institutions remain competitive with external labor markets.

The models developed by labor economists have proven to be useful in understanding many of the major changes that have occurred in the academic labor market. More importantly, these tools and concepts should continue to be useful to faculty, administrators, and students in making educated predictions about where the academic labor market is heading and why it is changing. It is also hoped that by comparing the predictions of theories with real outcomes and experiences for faculty in higher education, new models and theories may emerge to better understand the academic labor market for faculty.

Glossary

Symbol	Definition
T	Time
T_w	Time spent at working for pay
T_L	Time spent not working for pay (leisure)
w	Wage rate per hour
w^{res}	Reservation wage
Q	Quantity of faculty
Y	Salary or income of faculty
S	Employment level in cobweb model
$W(-1)$	Lagged wages in cobweb model
MP_L	Marginal productivity of labor
MRP_L	Marginal revenue product of labor
w_m	Wage rate for males
w_f	Wage rate for females
d_m	Wage premium for males
d_f	Wage discount for females
ED	Years of education
EXP	Years of labor market experience
X	Other factors that affect faculty salaries
G	Dichotomous variable for gender

References

Astin, A., & Davis, D. (1985). Research productivity across the life and career cycles: Facilitator and barriers for women. Reprinted in J. Glazer, E. Bensimon, & B. Townsend (Eds.), (1993), *Women in Higher Education: A Feminist Perspective*. Needham Heights, MA: ASHE Reader Series, Ginn Press.

Barbezat, D. (1987). Salary differentials by sex in the academic labor market. *Journal of Human Resources, 22*, 443–455.

Barbezat, D. (1989). Affirmative action in higher education: have two decades altered salary differentials by sex and race? *Research in Labor Economics, 10*, 107–156.

Barbezat, D. (1991). Updating estimates of male–female salary differentials in the academic labor market. *Economics Letters, 36*, 191–195.

Barbezat, D., & Donihue, M. (1998). Do faculty salaries rise with job seniority? *Economics Letters, 58*, 239–244.

Barbezat, D., & Hughes, J. (2005). Salary structure effects and the gender pay gap in academia. *Research in Higher Education, 46*, 621–640.

Barker, K. (1998). Toiling for piece-rates and accumulating deficits: Contingent work in higher education. In K. Barker & K. Christensen (Eds.), *Contingent Work: American employment relations in transition*. Ithaca, NY: ILR Press.

Baumol, W., & Bowen, W. (1966). *Performing arts: The economic Dilemma*. New York: Twentieth Century Fund.

Baumol, W., & Blackman, S. (1995). How to think about rising college costs. *Planning for Higher Education, 23*, 1–7.

Bayer, A., & Fogler, J. (1966). Some correlates of a citation measure of productivity in science. *Sociology of Education, 39*, 381–390.

Becker, G. (1957). *The economics of discrimination*. Chicago: University of Chicago Press.

Becker, G. (1971). *The economics of discrimination* (2nd ed.). Chicago: University of Chicago Press.

Becker, G. (1975). *Human capital* (2nd ed.). New York: National Bureau of Economic Research.

Becker, W. (1990). The demand for higher education. In S. Hoenack & E. Collins (Eds.), *The economics of American universities*. New York: State University of New York Press.

Bellas, M. (1992). The effects of marital status and wives' employment on the salaries of faculty men: The (house) wife bonus. *Gender and Society, 6*, 609–622.

Bellas, M. (1997). The scholarly productivity of academic couples. In M. Ferber & J. Loeb (Eds.), *Academic couples: Problems and promises*. Urbana/Chicago: University of Illinois Press.

Bellas, M., & Toutkoushian, R. (1999). Faculty time allocations and research productivity: Gender, race and family effects. *The Review of Higher Education, 22*, 367–390.

Boal, W., & Ransom, M. (1997). Monopsony in the academic labor market. *Journal of Economic Literature, 35*, 86–112.

Bowen, H., & Schuster, J. (1985). Outlook for the academic profession. *Academe,* September–October 9–15.

Bowen, H., & Schuster, J. (1986). *American professors: A national resource imperiled*. New York: Oxford University Press.

Bowen, H., & Sosa, J. (1989). *Prospects for faculty in the arts and sciences*. Princeton, NJ: Princeton University Press.

Breneman, D., & Youn, T. (Eds.). (1988). *Academic labor markets and careers*. New York: The Falmer Press.

Cahuc, P., & Zylberberg, A. (2004). *Labor economics*. Boston: The MIT Press.

Caplow, T., & McGee, R. (1958). *The academic marketplace*. New York: Basic Books.

Cartter, A. (1966a). The supply and demand for college teachers. *Journal of Human Resources, 2*, 22–37.

Cartter, A. (1966b). *An assessment of quality in education*. Washington, DC: American Council on Education.

Cartter, A. (1971). Scientific manpower for 1970–1980. *Science, 172*, 132–140.

Cartter, A. (1974). The academic labor market. In M. Gordon (Ed.), *Higher education and the labor market*. New York: McGraw-Hill.

Cartter, A. (1976). *Ph.D.s and the academic labor market*. New York: McGraw-Hill.

Clotfelter, C. (1991). Explaining the demand. In C. Clotfelter (Ed.), *Economic challenges in higher education*. Chicago: The University of Chicago Press.

Cohn, E., & Morgan, J. (1978). The demand for higher education: A survey of recent studies. *Higher Education Review, 1*, 18–30.

Cole, S., & Cole, J. (1967). Scientific output and recognition: A study in the operation of the reward system in science. *American Sociological Review, 32*, 377–390.

Commons, J. (1905). *Trade unionism and labor problems*. New York: Augustus M. Kelley Publishers.

Connelly, R. (1992). The effect of child care costs on married women's labor force participation. *Review of Economics and Statistics, 74*, 83–90.

Creamer, E. (1998). *Assessing faculty publication productivity: Issues of equity* (ASHE-ERIC Higher Education Report 26, No. 2). Washington, DC: George Washington University.

Curtis, J., & Thornton, S. (2014). Losing focus: The annual report on the economic status of the profession, 2013–14. *Academe*, March/April, 4–38.

Darity, W., & Mason, P. (1998). Evidence on discrimination in employment: Codes of color, codes of gender. *Journal of Economic Perspectives, 12*, 63–90.

Diamond, A. (1984). An economic model of the life-cycle research productivity of scientists. *Scientometrics, 6*, 189–196.

Dooley, M. (1986). The overeducated Canadian? Changes in the relationship among earnings, education, and age for Canadian men: 1971–81. *Canadian Journal of Economics, 19*, 142–159.

Dresch, S. (1975). Demography, technology, and higher education: Toward a formal model of educational adaptation. *Journal of Political Economy, 83*, 535–569.

Dworkin, A. (1990). The salary structure of sociology departments. *American Sociologist, 21*, 48–59.

Ehrenberg, R., & Smith, R. (2008). *Modern labor economics* (10th ed.). Reading, MA: Addison Wesley.

Ehrenberg, R., & Zhang, L. (2005a). The changing nature of faculty employment. In R. Clark & J. Ma (Eds.), *Recruitment, retention, and retirement in higher education: Building and managing the faculty of the future* (pp. 32–52). Northampton, MA: Edward Elgar Publishing.

Ehrenberg, R., & Zhang, L. (2005b). Do tenured and tenure-track faculty matter? *The Journal of Human Resources, 60*, 647–659.

Fairweather, J. (1995). Myths and realities of academic labor markets. *Economics of Education Review, 14*, 179–192.

Fairweather, J. (2005). Beyond the rhetoric: Trends in the relative value of teaching and research in faculty salaries. *The Journal of Higher Education, 76*, 401–422.

Farber, S. (1975). A labor shortage model applied to the migration of college professors. *Journal of Human Resources, 10*, 482–499.

Ferber, M. (1974). Professors, performance, and rewards. *Industrial Relations, 13*, 69–77.

Ferber, M., & Loeb, J. (Eds.). (1997). *Academic couples: Problems and promises*. Urbana/Chicago: University of Illinois Press.

Fox, M. (1983). Publication productivity among scientists: A critical review. *Social Studies of Science, 13*, 285–305.

Fox, M. (1992). Research, teaching, and publication productivity: Mutuality versus competition in academia. *Sociology of Education, 65*, 293–305.

Freeman, R. (1971). *The market for college-trained manpower: A study in the economics of career choice*. Cambridge, MA: Harvard University Press.

Freeman, R. (1975). Supply and salary adjustments to the changing science manpower market: Physics, 1948–1973. *American Economic Review, 65*, 27–39.

Freeman, R. (1976). *The overeducated American*. New York: Academic.

Gappa, J., & Leslie, D. (1993). *The invisible faculty: Improving the status of part-timers in higher education*. San Francisco: Jossey-Bass.

Gappa, J., & Leslie, D. (1996). *Two faculties or one? The conundrum of part-timers in a bifurcated work force*. Washington, DC: American Association for Higher Education. Inquiry No. 6.

Goldin, C. (1990). *Understanding the gender gap*. New York: Oxford University Press.

Goodwin, T., & Sauer, R. (1995). Life cycle productivity in academic research: Evidence from cumulative publication histories of academic economists. *Southern Economic Journal*, *61*, 728–743.

Gordon, N. (1974). *Higher education and the labor market*. New York: McGraw-Hill.

Gordon, N., Morton, T., & Braden, I. (1974). Faculty salaries: Is there discrimination by sex, race, and discipline? *American Economic Review, 64*, 419–427.

Gyimah-Brempong, K., & Gyapong, A. (1992). Elasticities of factor substitution in the production of education. *Economics of Education Review, 11*, 205–217.

Hallock, K. (1995). Seniority and monopsony in the academic labor market: Comment. *American Economic Review, 85*, 654–657.

Hammermesh, D., Johnson, G., & Weisbrod, B. (1982). Scholarship, citations, and salaries: Economic rewards in economics. *Southern Economic Journal, 49*, 472–481.

Hansen, W., Weisbrod, B., & Strauss, R. (1978). Modeling the earnings and research productivity of academic economists. *Journal of Political Economy, 86*, 729–741.

Hicks, J. (1932). *The theory of wages* (2nd ed.). London: Macmillan.

Hirsch, B., & Leppel, K. (1982). Sex discrimination in faculty salaries: Evidence form a historically women's university. *American Economic Review, 72*, 829–835.

Hogan, T. (1981). Faculty research activity and the quality of graduate training. *Journal of Human Resources, 61*, 400–415.

Holzer, H., & Neumark, D. (2000). Assessing affirmative action. *Journal of Economic Literature, 38*, 483–568.

Huseman, R., McHone, W., & Rungeling, B. (1996). Academic salary compression: A productivity model as a remedy. *Public Personnel Management, 25*, 453–465.

Johnson, G., & Stafford, F. (1974). Lifetime earnings in a professional labor market: academic economists. *Journal of Political Economy*, *82*, 549–569.

Katz, D. (1973). Faculty salaries, rates of promotion, and productivity at a larger university. *American Economic Review, 63*, 469–477.

Kirshstein, R., Matheson, N., Jing, Z., & Zimbler, L. (1997). *Instructional faculty and staff in higher education institutions: Fall 1987 and Fall 1992*. Washington, DC: National Center for Education Statistics (NCES 97–470).

Koch, J., & Chizmar, J. (1973). The influence of teaching and other factors upon absolute salaries and salary increments at Illinois State University. *Journal of Economic Education*, *5*, 27–34.

Lawrence, J., & Blackburn, R. (1986). Aging and the quality of faculty job performance. *Review of Educational Research, 56*, 265–290.

Lawrence, J., & Blackburn, R. (1988). Age as a predictor of faculty productivity: Three conceptual approaches. *Journal of Higher Education, 59*, 22–38.

Lazear, E. (1986). Raids and offer matching. *Research in Labor Economics, 8*, 141–165.

Lester, R. (1941). *Economics of labor*. New York: The Macmillan Company.

Levin, S., & Stephan, P. (1991). Research productivity over the life cycle: Evidence for academic scientists. *American Economic Review, 81*, 114–132.

Loeb, J., & Ferber, M. (1971). Sex as predictive of salary and status on a university faculty. *Journal of Educational Measurement, 8*, 235–244.

McCulley, W., & Downey, R. (1993). Salary compression in faculty salaries: Identification of a suppressor effect. *Educational and Psychological Measurement, 53*, 79–86.

McEachern, W. (2008). *Economics: A contemporary introduction* (8th ed.). Florence, KY: Cengage Learning.

McNulty, P. (1980). *The origins and development of labor economics: A chapter in the history of social thought*. Cambridge, MA: The MIT Press.

Megdal, S., & Ransom, M. (1985). Longitudinal changes in salary at a large public university: What response to equal pay legislation? *American Economic Review, 75*, 271–274.

Melguizo, T., & Strober, M. (2007). Faculty salaries and the maximization of prestige. *Research in Higher Education, 48*, 633–668.
Mincer, J. (1958). Investment in human capital and personal income distribution. *The Journal of Political Economy, 66*, 281–302.
Moore, W., Newman, R., & Turnbull, G. (1998). Do academic salaries decline with seniority? *Journal of Labor Economics, 16*, 352–366.
National Center for Education Statistics. (2010). *Digest of education statistics: 2009* (NCES 2010–013). Washington, DC: U.S. Department of Education.
National Education Association. (1988). The National Education Association's report and recommendations on part-time, temporary and nontenure track faculty appointments. *Exposure, 26*, 27–34.
Neumark, D. (1988). Employers' discriminatory behavior and the estimation of wage discrimination. *Journal of Human Resources, 23*, 279–297.
Oaxaca, R. (1973). Male–female wage differentials in urban labor markets. *International Economic Review, 14*, 693–709.
Over, R. (1982). Does research productivity decline with age? *Higher Education, 11*, 511–520.
Paulsen, M. (1990). *College choice: Understanding student enrollment behavior*. ASHE-ERIC Higher Education Report No. 6. Washington, DC: School of Education and Human Development, George Washington University.
Pencavel, J. (1998). The market work behavior and wages of women: 1975–94. *Journal of Human Resources, 33*, 771–804.
Pindyck, R., & Rubinfeld, D. (1989). *Microeconomics*. New York: Macmillan.
Porter, S., & Umbach, P. (2001). Analyzing faculty workload using multilevel modeling. *Research in Higher Education, 42*, 171–196.
Radner, R., & Miller, L. (1975). *Demand and supply in U.S. higher education*. New York: McGraw-Hill.
Ransom, M. (1993). Seniority and monopsony in the academic labor market. *American Economic Review, 83*, 221–233.
Ransom, M., & Megdal, S. (1993). Sex differences in the academic labor market in the affirmative action era. *Economics of Education Review, 12*, 21–43.Roemer, R., and Schnitz, J. (1982). Academic employment as day labor: The dual labor market in higher education. *The Journal of Higher Education*, *53*, 514-531.
Roemer, R., & Schnitz, J. (1982). Academic employment as day labor: The dual labor market in higher education. The Journal of Higher Education, 53, 514–531.
Roueche, J., Roueche, S., & Milliron, M. (1996). *In the company of strangers: Part-time faculty in American community colleges*. Washington, DC: Community College Press.
Schoenfeld, C. (1993). The retirees are coming—Or are they? *CUPA Journal,* Fall, 1–6.
Schuster, J., & Finkelstein, M. (2006). *The American faculty: The restructuring of academic work and careers*. Baltimore, MD: The Johns Hopkins University Press.
Smith, A. (1776). *The wealth of nations*. London: Methuen & Co., Ltd.
Stapleton, D. (1989). Cohort size and the academic labor market. *Journal of Human Resources, 24*, 221–252.
Tien, F., & Blackburn, R. (1996). Faculty rank system, research motivation, and faculty research productivity: Measurement refinement and theory testing. *Journal of Higher Education, 67*, 2–22.
Toutkoushian, R. (1994). Using citations to measure sex discrimination in faculty salaries. *The Review of Higher Education, 18*, 61–82.
Toutkoushian, R. (1998a). Sex matters less for younger faculty: Evidence of disaggregate pay disparities from the 1988 and 1993 NCES surveys. *Economics of Education Review, 17*, 55–71.
Toutkoushian, R. (1998b). Racial and marital status differences in faculty pay. *Journal of Higher Education, 69*, 513–541.
Toutkoushian, R. (1998c). Using regression analysis to determine if faculty salaries are overly compressed. *Research in Higher Education, 39*, 87–100.

Toutkoushian, R. (2003). What can labor economics tell us about the earnings and employment prospects for faculty? In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XVIII, pp. 263–321). Dordrecht, The Netherlands: Kluwer Academic Publishing.

Toutkoushian, R., & Bellas, M. (2003). The effects of part-time employment and gender on faculty earnings and satisfaction: Evidence from the NSOPF:93. *The Journal of Higher Education, 74*, 172–195.

Toutkoushian, R., Bellas, M., & Moore, J. (2007). The interaction effects of gender, race, and marital status on faculty salaries. *The Journal of Higher Education, 78*, 572–601.

Toutkoushian, R., & Conley, V. (2005). Progress for women in academe, but inequities persist: Evidence from NSOPF:99. *Research in Higher Education*, *46*, 1–28.

Toutkoushian, R., & Hoffman, E. (2002). Alternatives for measuring the unexplained wage gap. *New Directions for Institutional Research, 115*, 71–90.

Tuckman, H. (1976). *Publication, teaching, and the academic reward structure*. Lexington, MA: Lexington Press.

Tuckman, H., & Katz, D. (1981). Estimation of relative elasticities of substitution and relative compensation for part-time faculty. *Economics of Education Review, 1*, 359–366.

Tuckman, H., & Chang, C. (1986). Own-price and cross elasticities of demand for college faculty. *Southern Economic Journal, 52*, 735–744.

Tuckman, H., & Pickerill, K. (1988). Part-time faculty and part-time academic careers. In D. Breneman & T. Youn (Eds.), *Academic labor markets and careers*. New York: Falmer Press.

Twigg, N., Valentine, S., & Elias, R. (2002). A comparison of salary compression models and pay allocation in academia over time. *The Review of Higher Education*, *26*, 81–96.

Umbach, P. (2007). Gender equity in the academic labor market: An analysis of academic disciplines. *Research in Higher Education, 48*, 169–192.

Watkins, G. (1929). *Labor problems*. New York: Thomas Y. Crowell Company.

Welch, F. (1979). Effects of cohort size on earnings: The baby boom babies' financial bust. *Journal of Political Economy, 87*, S65–S98.

Youn, T. (1988). Studies of academic markets and careers: An historical view. In D. Breneman & T. Youn (Eds.), *Academic labor markets and careers*. New York: The Falmer Press.

Chapter 10
Current and Emerging Research on Economics of Higher Education

Abstract In this concluding chapter, we briefly revisit each of the topical areas in the economics of higher education that we have covered in Chaps. 3, 4, 5, 6, 7, 8, and 9 of this book. Our purpose here is not to summarize the content of those chapters. Instead, for each broad topical area or chapter, we introduce and examine a subtopic that has been the focus of more *recent* and *current* economic research in each subject. Current research is the best indicator of future research. Therefore, by considering representative examples of recent research on a subtopic related to each chapter of the book, we hope to illustrate future directions toward which economic research has recently been, or is now, moving in each of the broad areas.

Each chapter of this book applies economic concepts, theories and models to the study of higher education. The first chapter provides an overview of economic reasoning. It introduces the economic concepts and methods that underlie how economists think and how they do their work. In particular, the chapter examines those economic concepts, models and methods that are most essential to an understanding of the economic models of optimal decision making. Economists use models of optimal decision making to study and analyze the behavior of individuals and institutions in pursuit of their goals and objectives subject to multiple constraints in the context of higher education.

In this concluding chapter, we briefly revisit each of the topical areas in the economics of higher education that we have covered in Chaps. 3, 4, 5, 6, 7, 8, and 9 of this book. Our purpose here is not to summarize the content of those chapters. Instead, for each broad topical area or chapter, we introduce and examine a subtopic that has been the focus of more *recent* and *current* economic research in each subject. Current research is the best indicator of future research. Therefore, by considering representative examples of recent research on a subtopic related to each chapter of the book, we hope to illustrate future directions toward which economic research has recently been, or is now, moving in each of the broad areas.

The topics that we have covered in Chaps. 2, 3, 4, 5, 6, 7, 8, and 9 of this book were arranged into two distinct groups. Chapters 2, 3, 4, 5, and 6 applied economics to analyze how and why students and society participate in higher education. In brief, students and society participate in higher education because investment in higher education—i.e., investment in human capital—yields a profitable return, which reflects the relative private benefits and private costs of attending college in general

R.K. Toutkoushian, M.B. Paulsen, *Economics of Higher Education*,
DOI 10.1007/978-94-017-7506-9_10

or choosing to attend a specific college, which in turn, motivates students to participate as part of the demand for enrollment in higher education. Finally, these students' investments in higher education may also generate public benefits (positive externalities) that accrue to others and motivate society to seek the provision of a greater amount of investment in higher education than students would choose based on their private benefits alone. So, in combination, this group of chapters (Chaps. 2, 3, 4, 5, and 6) particularly focused on the "demand" side of the higher education marketplace.

On the other hand, Chaps. 7, 8, and 9 applied economics to analyze the supply side of higher education markets. We drew on concepts and models from the microeconomic theory of the firm to study how institutions behave or operate in the marketplace. In Chap. 7, we used revenue theory to analyze institutional behaviors related to the question "where does the money come from" that enables colleges and universities to effectively operate. And we focused on cost theory to analyze institutional behaviors related to the question "where does the money go" when colleges and universities allocate their budgets in ways that pay their bills and cover the costs of providing educational services.

In Chap. 8 we used economic concepts and models to analyze those institutional behaviors that relate to markets, competition, and production. We relied on microeconomic theories of market structures to analyze how colleges and universities compete with each other for students and for non-tuition resources, such as subsidies, including private donations or government appropriations. We then applied microeconomic concepts to analyze how colleges and universities engage in both price and non-price competition. Finally, we used the production function to model how institutions process inputs into valued educational outputs for student consumers, and extended the model to analyze the potential impact of online and distance education on students and institutions in the marketplace.

In Chap. 9, we took the concepts, theories and models of labor economics to study the wages and employment of faculty in the academic labor market. Both labor supply and labor demand models offer a good deal of explanatory power about a wide range of characteristics and outcomes of faculty labor markets. We used the economic models of demand and supply in faculty labor markets to examine how individual, institutional, disciplinary, environmental and other factors explain variations in salaries and employment across individual faculty members. These markets are the source of faculty, an essential resource in institutional provision of the educational products that student consumers demand. So, in combination, this group of chapters (Chaps. 7, 8, and 9) particularly focused on the "supply" side of the higher education marketplace.

Research on Investment in Human Capital and College Choice

Economists view going to college as an investment in human capital. These investments result in both benefits and costs to students and to society. Human capital theory serves as an economic model of optimal decision making in which students compare the expected benefits and costs of a possible investment in higher education. The framework of human capital theory enables economists to better explain and predict the process and outcome of students in pursuit of an optimal investment decision in higher education. As explained in some detail in Chap. 2, the topical terrain of research in the economics of higher education first expanded into those areas of interest that were the most clearly grounded in, and connected to, human capital theory.

Today, economic researchers continue to rely heavily on human capital theory to explain the postsecondary decisions of students. In their book *The Race between Education and Technology*, economists Goldin and Katz (2008) refer to the twentieth century as the "human capital century". To explain this appellation, they assert, and empirically demonstrate, that America's investment in education—at high school, college and post-baccalaureate levels—played a very prominent role in the remarkable growth of the economy and in America's international leadership in the educational attainment of its citizenry and workforce in the twentieth century. They make further use of the construct of human capital to explain how the human capital century was really "a tale in two parts" (p. 42).

From 1900 to the 1970s, America's record of investment in human capital through education established the nation as the world's leader in educational attainment in terms of the numbers of students going to college and earning degrees at various levels. However, after unparalleled advancement in educational attainment in the first three-quarters of the twentieth century, during the final quarter, rates of educational attainment in the US began to level off and even declined for some subgroups, and showed no growth, or slow growth, at best. During this period, rates of educational attainment at both high school and college levels plateaued. Beginning in the 1970s, and aided in part by a sustained period of slower growth in the numbers of college graduates, rates of return to human capital investments in college degrees increased substantially and reached historically-high levels on into the twenty-first century (Goldin & Katz, 2008). During this period, rates of college participation or enrollment have, and continue to, respond favorably to the rising rates of return to investment in college.

The study of college choice behavior—i.e., examining how various factors affect students' decisions about whether or not to attend college, which college to attend, and whether or not to persist at that college—continues as a vibrant focus of current research. One development in recent college-choice research that is attracting a growing number of researchers is captured in the concept of *undermatching*. Undermatching is said to occur when low-income, but high-achieving, students do not apply to a more selective college or university for which they are academically qualified and are likely to be admitted, and in which they would have similar academic qualifications as their peers (Bowen, Chingos, & McPherson, 2009). Because these selective colleges and universities often have substantial resources per student, high persistence and graduation rates, very favorable college outcomes, and often provide lower net prices than less selective institutions because of the more substantial financial resources they have to devote to institutional grants, there is concern that students who undermatch are missing out on potential benefits which may also spill over to society.

Two broad patterns of application behavior have been observed in recent economic research in this area. Hoxby and Avery (2013) observed that the actions of high-achieving students varies substantially according to whether or not the student is from a low- or high-income background. In particular, the behavior of low-income, high-achieving students is typically quite different from that of their equally high-achieving but high-income counterparts. High-income high-achieving students tend to follow the standard high school counselor's advice and apply to some colleges that would be likely matches for their academic qualifications, some schools whose average student test scores might be a bit beyond their own academic credentials (overmatches), and some safety schools where students average test scores are a bit below their own scores (undermatches). When high-achieving low-income students make college-choice decisions that are similar to their high-income counterparts, Hoxby and Avery refer to their behavior as "achievement-typical." However, when high-achieving low-income students only apply to colleges where average test scores are less than their own academic credentials, their behavior is called "income-typical" because they act in ways that are consistent with their income level and not their academic achievement.

Recent research indicates that undermatching is a pervasive occurrence. In addition, the most consistent results indicate that the likelihood of student undermatching behavior increases significantly for lower-income students, first-generation students and rural students (i.e., such students are more isolated and dispersed).[1] One particularly noteworthy effort of economists' recent work has been the administration of an intervention—on a national scale—that targeted high-achieving low-income students (Hoxby & Turner, 2013). The "ECO-Intervention" included such elements as providing students in the treatment group with carefully-crafted information on the application process, information about the actual net prices of colleges, and a no-paperwork-needed waiver of application fees. The successful effects of the intervention are impressive: the college-going behaviors of high-achieving low-income students in the treatment group changed. The intervention resulted in less undermatching behavior due to students submitting more applications overall, more applications and admissions to more selective colleges and universities, greater use of application fee waivers, as well as actual enrollment in more selective institutions. These advances are quite promising and economic research in the area of college choice continues to expand and deepen. What is not clear, however, is why some low-income, high-ability students do not apply to more selective institutions, and whether changing their behavior is truly in the best interest of the student. As noted in Chap. 3, students are thought to base their college decisions on expected utility, which encompasses a range of financial and consumptive benefits and their own unique preferences. It is possible that many students who exhibit "undermatching" behavior are actually making rational decisions in their selection of institutions that are consistent with their preferences by choosing to apply to colleges where they feel that they will be happiest and most successful.

[1] For example, see Belasco and Trivette (2015), Bowen et al. (2009), Hoxby and Avery (2013), Roderick, Nagaoka, Coca, and Moeller (2009, April), and Smith, Pender, and Howell (2013).

Research on Rates of Return to Higher Education

During the late 1950s and early 1960s, when economists successfully established human capital theory as the foundational theory for the field of economics of education, they were also developing methodologies for the estimation of rates of return to investments in higher education. Since that time, economists have continued to be very interested in estimating rates of return to education, as evidenced by the vast literature that has been created via economists' increasingly sophisticated methodological efforts to validly estimate these returns.[2] In their thorough analysis of the role of investment in education in the growth of the American economy through the twentieth century and into the early twenty-first century, Goldin and Katz (2008) estimated that by 2005, the rate of return to 1 year of college ranged from 13 to 14 %. As the authors indicate, these estimates are historically high, and therefore, have been and continue to be attractive to students making college-going decisions. A more recent review of research on returns to education reports that returns in the United States range from about 6 to 14 %—a range that is inclusive of Goldin and Katz's estimates of 13–14 %—depending on variations in use of samples and methodologies (Gunderson & Oreopoulos, 2010). And as described in Chap. 4, Toutkoushian, Shafiq, and Trivette (2013) recently showed how to adjust aggregate-level estimates of the return to college for the risk of non-completion, and found that while the average returns for all college-goers were lower than in prior estimates for only college graduates, they were still substantial.

In recent years, many voices, from President Obama to policy analysts and scholars, have expressed a resurgence of interest in the potential benefits of providing free tuition at public 2-year colleges.[3] At the same time, scholars who recognize and emphasize the value of community college education have expressed concern that some economists and other social scientists have suggested that undermatched students should have attended a more selective college—i.e., a 4-year college—rather than a community college.[4] In order to more fully examine and estimate the labor market outcomes of community college education, economists have conducted a series of key studies related to the estimation of returns to sub-baccalaureate education—including credits and credentials.[5] One characteristic of a number of these recent studies is that the researchers are taking advantage of

[2] See Card (1999) for a comprehensive review of much of this literature, with a special focus on analysis of the variety of methodological approaches to the estimation of returns on investment in education.

[3] President Obama recently proposed a version of this plan. See the Mangan and Supiano (2015) article on "The Players Who Influenced Obama's Free-College Plan" on *Inside Higher Education*, January 11, 2015. This article provides some information about the proposal, along with the origins of the ideas in the plan.

[4] For example, see Belfield and Bailey's explanation of this concern (2011, p. 47).

[5] See, for example, Bahr (2014), Belfield and Bailey (2011), Cellini and Chaudhary (2014), Dadgar and Weiss (2012), Jepsen, Troske, and Coomes (2014), and Liu, Belfied, and Trimble (2014).

new large state-level datasets consisting of administrative data on students and institutions that have become available in several states including Kentucky, North Carolina, Texas, and Washington State.[6]

In general, findings from these latest studies of the labor market returns to credentials and credits from sub-baccalaureate education are consistent with those of earlier studies, as reviewed by Belfield and Bailey (2011). These studies typically assess labor market outcomes in terms of estimated earnings gains associated with completion of a credential (i.e., associate's degrees and certificates) or completion of credits at community colleges. Research has consistently shown that investments in associate's degrees yield significant and substantial earnings gains compared to high school graduates, averaging 13% for men and 22% for women, albeit returns vary substantially across different fields of study. Almost all studies have found that earnings gains are higher for women than men, regardless of the credential earned or the field of study. Students attending community colleges, without earning a credential, still experience average earnings gains of 9% and 10% for men and women, respectively. In general, earnings gains are greatest for associates degrees and certificates earned in quantitative and/or vocational-technical fields, such as health-related fields (especially nursing), accounting, engineering, computing, transportation, and protective services.

As noted above, the patterns of findings from these latest studies estimating earning gains from credentials and credits earned at community colleges are quite consistent with those of earlier studies. However, in many previous studies, more limited data required that researchers often estimate only returns to associate's degrees. One new and distinctive characteristic of the recent spate of new state-level studies is that the more detailed data available to these researchers has made it possible for them to obtain robust estimates of earnings gains for many community college certificate programs, in addition to the returns to associate's degrees like those produced in previous studies.[7] As a result, one consistent and noteworthy finding of these new studies is that the earnings gains from long-term certificate programs—like those for most associate's degrees—are also substantial and statistically significant. In general, the labor market returns to investment in community college certificate programs follow patterns similar to those seen in the returns from associate's degrees—e.g., earnings gains are consistently higher for women than men, and they are greatest for certificates earned in the types of quantitative and/or vocational-technical fields like those listed above. However, it is important for policy makers to focus on both the level and rate of return to these certificates, and take into account the risk of non-completion when measuring the return for all students who began such programs.

---

[6] For example, for a study using data on Kentucky see Jepsen et al. (2014), for North Carolina see Liu et al. (2014), for Texas see Andrews, Li, and Lovenheim (2012), and for Washington State see Dadgar and Weiss (2012).

[7] The new state-level datasets provide some additional benefits for researchers. For example, as Liu et al. (2014) explain, another "important distinction between these newer studies and earlier studies is that the newer studies make comparisons within the sample of postsecondary students and not between postsecondary students and high school graduates who never attended college" (p. 44).

Research on Demand and Supply for Higher Education

The early studies of the demand for higher education—i.e., enrollment demand—used national, state and institutional data on a variety of environmental and institutional variables in order to explain and predict enrollment demand, as well as to estimate the effects of environmental and institutional variables on that enrollment demand.[8] Economists have continued to study the effects of such factors on enrollment demand well into the twenty-first century. Recently, the "Great Recession" in the decade of the late 2000s and early 2010s created shocks to, or changes in, many factors that can affect enrollment demand at the institutional, state or national levels. The Great Recession was different in many ways from the more common cycles of contraction and expansion in the economy. As a result, economists have recently conducted a series of studies that test the various elements of the theories of demand (and supply), assess their explanatory power in application to enrollment demand, and estimate the effects of various factors on enrollment demand—and its determinants—during the Great Recession.[9]

In recessionary periods, economic theory predicts that higher unemployment rates result in reduced foregone earnings—a large component of the costs of college—which, in turn, leads to increases in demand for higher education. At the same time, potential college students have less taxable income and falling home values during a recession, both of which tend to reduce subsidies (i.e., state appropriations) to public institutions that typically respond by raising tuition to help generate revenue to offset declining state subsidies. In combination, the lower household incomes and the rising tuition lead to decreases in enrollment demand. The net effect on enrollment demand of these positive and negative forces depends on the relative magnitudes of the opposing effects. All of these factors are present, and ordinarily play themselves out, in any recessionary phase of a business cycle.

However, the Great Recession is distinguishable from ordinary recessions in a number of important ways (Long, 2015). First, both the costs of college and the debt levels of students were already at historically high levels prior to the onset of this recession. Second, loans to students played a far larger role than they had in any prior recession. Third, the Great Recession occurred just as institutions of higher education were about to experience the demographic shock of the largest graduating cohort of high school students. By itself, an increase in the number of high school graduates would tend to increase enrollment demand. Thus, the characteristics that distinguish the Great Recession from other prior recessions engender even more forces with opposing effects on enrollment demand.

[8] Most of these early studies of the demand for higher education (enrollment demand) occurred in the 1970s and 1980s. These studies were well reviewed in Becker (1990) and Paulsen (1990).

[9] Some examples of economists' research on the effects of the Great Recession on higher education enrollment include the following: Brown and Hoxby (2015), Long (2015), Barr and Turner (2013) and Barr and Turner (2015).

In Long's (2015) study of the effects of the Great Recession on college enrollment, she examines multiple characteristics of enrollment growth as well as the effects on factors that influence enrollment growth. For her analysis, she distinguished between states according to how severely they were affected by the recession. In particular, she identified states with the most substantial increases in unemployment and decreases in housing values as the most severely affected by the recession. Overall, college enrollment increased during the period; however, enrollment increased the most in states that were the most negatively affected by the recession. Separating the effects on full-time versus part-time enrollment revealed that while full-time enrollment levels were somewhat lower during the recession, part-time enrollment grew substantially across all states during the recession. While white student enrollment showed modest increases overall, white enrollment decreased somewhat in states most severely affected during the recession. On the other hand, minority student enrollment grew substantially in states that were impacted the most by the recession. Completion of certificates and degrees increased during this time, and less-than-1-year certificates grew the most. However, in states hit hardest by the recession, longer-term certificates, associate's and bachelor's degrees all increased. Both gross and net tuition went up over this period, increasing significantly faster in states most affected by the recession. While the percentage of students receiving Pell grants increased in states most severely affected, the average amount received decreased across all states during the recession.

A study by Barr and Turner (2013) complements the findings from Long's study in several ways. For example, the largest share of the increased enrollment during the Great Recession, or specifically between 2007 and 2010, occurred at community colleges (32 %). The next largest increase was at for-profit colleges (30 %), the third largest was at public 4-year colleges and universities (27.4 %) and finally, only about 10% of the increase in enrollment was at private non-profit institutions. During the Great Recession, the American Recovery and Reinvestment Act provided generous increases in funding for the Pell grant. The Pell grant is "countercyclical" in the sense that during a recession more students and families become eligible to receive a Pell grant. This effect was greater than usual during the Great Recession and Barr and Turner assert that this effect, and the generous increase in Pell grant funding, help explain the large increase in college enrollment among low-income students during the Great Recession. As state appropriations decreased during (and after) the recession, public institutions had to look to alternative revenue sources. One of these sources is out-of-state students. Therefore, it is noteworthy that enrollment of out-of-state students increased from 2007 to 2010 by 15 % at flagship public universities and 20 % at other public research universities.

Finally, in another study of the effects of the Great Recession on college enrollment, Barr and Turner (2015) examine the effects of the duration of unemployment insurance (UI) available for displaced workers on college enrollment. They find that each "additional 10 weeks of UI benefits increase enrollment likelihoods by around 1.8 percentage points, or by about 20 %" (p. 63). Not surprisingly, most of this growth occurs in two-year colleges.

As part of studying the many effects of the Great Recession, economists have been learning more about the various ways in which the worst recession since the 1930s has affected, and is affecting, colleges and universities and the overall higher education marketplace. We expect that both the severity and the complexity of conditions associated with the Great Recession will continue to motivate and direct economists in their areas of focus for research on the determinants of college enrollment demand.

Research on Positive Externalities and Government Intervention

American citizens long ago committed themselves to a belief that all of society—i.e., both students and the public—benefit from a high school education. This commitment can be assessed by noting that American citizens have been willing to sufficiently tax themselves so that every individual is guaranteed a public education from kindergarten through high school at no direct charge to the student. This commitment expresses a strong belief in substantial public benefits of an education through high school. Even at the postsecondary level, until recent years, citizens have been willing to sufficiently tax themselves so that a very large portion of the tuition that students would otherwise have to pay to attend public colleges and universities could likewise be covered by subsidies to public institutions.

Nevertheless, in recent decades, many contributors to public rhetoric have increasingly asserted that the benefits of investments in higher education are mostly private—i.e., they accrue primarily to the student who gets the education. During and since the Great Recession in the late 2000s, on average, states have reduced subsidies to their public institutions to the point that college students and their families are now responsible for paying the majority of the costs of attending an in-state public institution themselves. This is understandable, in part, because the private benefits (and costs) of college are much easier to identity and calculate, and they have been much more widely studied and publicized, than the public benefits of college investments. Nevertheless, the substantial and continuing decreases in states' relative investments in the higher education of their citizens have contributed, at least in part, to a new wave of interest among economists in examining the costs and benefits of higher education—with a special focus on, or at least greater attention to—the public or external benefits of higher education.[10]

In one of a series of related studies, Trostel (2010) focused on estimating the fiscal benefits of public investment in college education. This is quite a worthwhile

[10] For example, see Baum, Ma, and Payea (2013), Damon and Glewwe (2011), Institute for Higher Education Policy (2013), McMahon (2006, 2009, 2010), Paulsen and Fatima (2007) and Trostel (2010).

way to investigate the return to public investment in higher education, especially because from a fiscal perspective, one can more readily identify and quantify the public or external benefits and costs. The fiscal benefits of public investment in higher education can be broadly identified as the two sources of expansion of the government budget or public coffers that result from public investments in the college education of citizens. First, college graduates pay much more in taxes than high school graduates, and thereby, generate considerably more tax revenue available for government spending on public services. Second, government expenditures on various social programs, such as corrections or Medicaid, are much less for college graduates than for high school graduates. The contributions that college graduates make to the public coffers—in both increased tax revenues and reduced government expenditures—constitute unambiguous external benefits to investment in higher education.

Using data for the fiscal year 2005, Trostel was able to estimate the public fiscal cost of investment and compare that to estimates of the fiscal contributions to public coffers from college graduates. He separated the federal from the state and local fiscal benefits. This is an important step, because it clearly reveals the fact that most of the fiscal benefits that results from these public investments—as identified above—accrue to the federal government, while most of the fiscal cost of public investment in bachelor's degrees occurs at the state level. Therefore, the fiscal rate of return to federal investment in higher education is greater than that for states; however, the overall estimate of the average *fiscal rate of return* to public investment in higher education is 10 %.

Of special interest is Trostel's detailed effort to estimate the many sources of reductions in government expenditures on public services due to the increasing share of the populace with college degrees. These include decreased public expenditures on Medicare, Social Security, Medicaid, corrections, unemployment insurance, workmen's compensation, public healthcare, and other public assistance—such as food stamps, school lunches, housing subsidies, childcare assistance, energy assistance, and transportation assistance. The first two of these—Medicare and Social Security—are among the largest components and the complex effects of investment in additional college graduates on these two programs are noteworthy. On the one hand, because college graduates have longer average lifespans than high school graduates, they may collect benefits from both of these programs for more years (i.e., greater fiscal costs). However, college graduates also pay taxes at higher rates and for more years, have significantly less health problems, and they retire and begin collecting benefits from both these programs at more advanced ages (i.e., greater fiscal benefits). Ultimately, for each additional bachelor's degree, the present values of fiscal benefits exceed those of fiscal costs so that the result is a significant net saving for government. Only the *direct* fiscal effects of increased tax revenues and decreased expenditures on public services are considered. The *indirect* effects of higher education investment on economic growth, which in turn, affects tax revenues and government spending, are not considered in this analysis. This means that the reported rates of return in this study are likely to be underestimates of the true returns to such investments.

In a related study, Damon and Glewwe (2011), also using data for fiscal year 2005, conducted a study to estimate the private and public benefits due to the subsidies the state provides to Minnesota's public universities. In order to make some of their important estimates, the authors assumed that without the state subsidies, public institutions would have to raise their tuition to levels commensurate with those of Minnesota's private colleges in order to acquire sufficient revenue to replace that provided by the public subsidies. As a result, what they call non-marginal students would either pay the higher tuition and stay at Minnesota's public colleges or attend a private college—i.e., their educational levels would not change—while those they call marginal students require the subsidies to pursue their college degrees and in the face of higher tuition, their educational attainment levels would decrease. This potential loss of marginal students is an important mechanism for assessing the private and public benefits that would occur as a result of the public subsidies to public universities in Minnesota.

After estimating the real economic costs of the subsidies to public universities, Damon and Glewwe examined each component of the private and public benefits related to the public investment in subsidies. For example, they estimate that the subsidies will induce the marginal students to pursue their educational attainment plans to complete college degrees and earn higher wages (private benefits), while these additional college-educated individuals in the workforce will generate spillover or external benefits to the public through interaction with less-educated workers (public benefits). In addition, college graduates have lower unemployment rates than high school graduates (private benefits), are more civically engaged, and have lower government expenditures on crime and incarceration (public benefits). After all estimates are summed and compared, results indicate that the total value of the public plus private benefits of the public subsidies to public institutions exceed the economic cost of the subsidies by a substantial margin—whether using the "conservative" or "very conservative" assumptions about benefits. The challenge with this type of work, however, is how to isolate the benefits that are due to the causal impacts of higher education rather than the average characteristics of college students per se.

Research on Higher Education Revenues and Expenditures

Between 2007–2008 and 2013–2014, state funding for public colleges and universities, per full-time equivalent student, decreased by an average of 23 % across the United States. This is a relatively recent part of a long-term downward trend in state appropriations to higher education that began in the 1980s. During the 10-year period from 2001–2002 to 2010–2011 the percentage of institutional revenues from state funding decreased from 44 % to 27 % for public doctoral universities and 55 % to 35 % at public master's universities (College Board, 2014). Public institutions have understandably come to view cuts in state funding as the norm. Obviously, public universities—and all public institutions—have had to find ways to replace these substantial losses in revenues. Public institutions have used a variety of ways to replace lost state funding with alternative revenue sources. Some examples include increases in published (sticker) prices and net prices, increases in private voluntary support, increases in tuition discounting, and increases in out-of-state enrollment (Brown & Hoxby, 2015; Cheslock & Gianneschi, 2008; College Board, 2014; Hillman, 2012; McKeown-Moak & Mullin, 2014; Zhang, 2007).

Many public universities—and public flagship universities in particular—have engaged in a strategic focus on the tuition-revenue-generating potential of out-of-state students; and this practice has been an important focus of recent economic research.[11] In their study of nonresident freshmen enrollment demand, Jaquette and Curs (2015) found that state appropriations are negatively and significantly related to nonresident enrollment, while controlling for a wide range of appropriate covariates. Moreover, they found that a one-percent decrease in state funding was associated with a .46% increase in nonresident enrollment at public research universities; and a .50 % increase in nonresident enrollment at research-extensive universities in particular. The authors assert that these findings indicate that reductions in state appropriations "compel" public universities—and especially public research universities—to increase their nonresident enrollment as an effective tuition-revenue-generating strategy.

The tuition-revenue-generating effectiveness of nonresident enrollment strategies is quite understandable, especially in light of recent estimates of the price-elasticity of nonresident enrollment. Zhang (2007) found that nonresident enrollment, across all public four-year institutions, was inversely related to nonresident tuition and inelastic; while at public research universities in particular, nonresident enrollment was not responsive to, and not significantly related to, changes in nonresident tuition. Similarly, Winters (2012) found that nonresident enrollment was not responsive to, and not significantly related to, changes in nonresident tuition at either flagship or non-flagship public universities. Moreover, Adkisson and Peach (2008) found that nonresident enrollment at public land grant universities was directly related to nonresident tuition and was elastic.[12]

[11] For example, see Adkisson and Peach (2008), Canche (2014), Jaquette and Curs (2015), Jaquette, Curs, and Posselt (in press), Leeds and DesJardins (2015), Winters (2012), and Zhang (2007).

[12] The finding of a positive relationship between nonresident tuition and nonresident enrollment (Adkisson & Peach, 2008) is counter-theoretical to price theory. Nevertheless, a number of plausible explanations of this result for nonresident enrollment demand have been proposed (e.g., see Zhang, 2007). One possible explanation is that some nonresident students may view price as an indicator or signal of quality and respond favorably to higher quality in their enrollment decision-making. Another plausible explanation is that nonresident students are more likely to enroll for reasons other than the published nonresident tuition level. In support of this, Leeds and DesJardins (2015) have found that nonresident students who have sufficiently high academic scores to qualify for the University of Iowa's National Scholars Awards (NSA)—for which only nonresident students are eligible—are significantly more likely to enroll than their peers who did not receive the NSA. Moreover, analysis of subgroup behavior showed that minorities were more responsive in their enrollment to NSA receipt than their white counterparts.

There are three possibilities to explain how institutions can use the nonresident student market to increase revenues. First, when nonresident enrollment is inversely related to nonresident tuition and is inelastic, then for a given percentage increase in nonresident tuition, nonresident enrollment decreases by a smaller percentage, resulting in an increase in tuition revenue from nonresident students. Second, when nonresident enrollment is not significantly related to nonresident tuition, then for a given percentage increase in nonresident tuition, nonresident enrollment would be unchanged, which also results in an increase in tuition revenue. Finally, when nonresident enrollment is directly related to nonresident tuition and elastic, then for a given percentage increase in nonresident tuition, nonresident enrollment increases by a larger percentage, resulting in an even more substantial increase in tuition revenue from nonresident students.[13]

Research on Higher Education Competition and Production

It is not just rates of enrollment, but also the transformation of enrollment rates into more productive rates of degree completion, that ultimately determines the supply of college-educated workers in the labor force (Turner, 2004). Finding ways to convert more enrollments into degrees is a very important part of the investment in higher education. Many economists and other policy researchers have often focused on explaining rates of enrollment—an important step in an investment in higher education. Unfortunately, until recently, economists had been paying far less attention to explaining rates of educational attainment (i.e., degree completion) and the process by which students and colleges, in varying policy contexts, transform college enrollment into college completion. The outcome of this process is college and university *production* of degrees.

Fortunately, in recent years, research in the economics of higher education has begun to pay a good deal more attention to the determinants of college completion, and therefore, a further expansion in America's investment in the human capital of its workforce and citizenry. One noteworthy example of this development can be seen in the book by Bowen et al. (2009), the primary focus of which is research on college completion, as reflected in book's title, *Crossing the Finish Line: Completing College at America's Public Universities*. A growing number of recent studies have continued and expanded this focus on college completion. There are at least two broad categories of possible determinants of college completion. One category includes demand-side factors, such as insufficient academic preparation or inadequate financial access for college completion. Another category includes

[13] There are, however, some unintended consequences of strategically pursuing greater tuition revenues via recruitment of nonresident enrollment. In particular, Jaquette et al. (in press) have found that when public research universities increase their proportion of nonresident enrollment, the growth in nonresident students is negatively related to the proportions of low-income and underrepresented minority student enrollment.

supply-side factors, such as resources per student available at institutions. Potential determinants of decreased educational attainment (college completion) also reflect the stratification of opportunities by SES and race/ethnicity on the demand side and the stratification of resources by institutional type on the supply side. These and other related factors are analyzed in this newly-focused, expanding literature.[14]

Even though rising labor market returns to college have yielded sustained growth in college enrollment in recent decades, rates of college completion have definitely not experienced commensurate growth; in fact, rates of educational attainment have plateaued. Using national datasets—NLS:72 for the high school class of 1972 and NELS:88 for the class of 1992—to examine college completion rates across different cohorts, a recent study by Bound, Lovenheim, and Turner (2010a, 2010b) yielded several interesting findings. For example, both lower levels of student academic preparation (e.g., lower math test scores) and reduced institutional resources per student (e.g., manifested in higher student-faculty ratios) have contributed to the reduced college completion rates. Increases in enrollment of students with lower levels of college academic preparation contributes to lower completion rates. Decreases in college completion rates are primarily concentrated in public colleges and universities outside the most selective public institutions. Increases in enrollment at these institutions, when unaccompanied by commensurate increases in public funding (i.e., subsidies), reduces the level of resources per student, which contributes to lower rates of college completion.[15] Reductions in college completion rates are greater among men than women.

Other economists have been concentrating on an institutional or state production function in which the inputs are transformed into the production of bachelor's (and other) degrees.[16] For example, categories of institutional expenditure—such as instruction, academic support, student services, research, etc.—represent the inputs (e.g., instructional expenditures = quantity of faculty x average compensation) in the production of degrees. In this context, Webber (2012) recently found that expenditures on student services have the most substantial effect on degree production for students with below-median ACT/SAT scores; while instructional expenditures have the greatest effect on degree production for students with above-median scores. In addition, instructional expenditures have a greater effect on students in STEM fields than those in non-STEM fields. Using a state-level perspective and state-level data, Titus (2009) found that state appropriations and state need-based aid for students are significantly and positively related to bachelor's degree production; while states' non-need-based aid to students have no

[14] For example, see Bound and Turner (2007), Bound, Lovenheim, and Turner (2010a, 2010b), Bowen et al. (2009), Goldin and Katz (2008), Titus (2009), Webber (2012), Webber and Ehrenberg (2010).

[15] In an earlier study, Bound and Turner (2007) refer to this phenomenon as the "cohort crowding" effect. They explain that "within public institutions, those that expand to meet population-related shifts in demand may face reductions in resources per student, further reducing attainment of enrolled students" (p. 896).

[16] See, for example, Titus (2009), Webber (2012) and Webber and Ehrenberg (2010).

significant effect on a state's degree production. This last finding of non-significance is important because about one-third of the states have implemented large merit-based aid programs in the past 20 years.

Research on Labor Issues for Faculty

Research on faculty issues in general has waned in the early part of the twenty-first century. This decline can be traced back to the decision by the Institute of Education Sciences (IES) to discontinue the National Study of Postsecondary Faculty (NSOPF). NSOPF was first administered in 1988, with additional surveys of new cross sections of faculty taking place in 1993, 1998, and 2004. These surveys provided economists and other researchers with a rich source of nationally-representative data on the personal and work characteristics of faculty, their activities and levels of satisfaction with their work, and their compensation. The many studies that were published using these data enabled researchers to make inferences to the national pool of faculty, and examine many different issues relating to labor economics as described in Chap. 9. However, IES has not administered NSOPF since the 2004 iteration, which has left a gap of more than a decade without new information on the labor market experiences of faculty. Academics who have continued to work on labor issues in higher education have had to do so using institutional-, system-, or state-level data on individual faculty when available, or rely on aggregate-level data on faculty from sources such as IPEDS and the AAUP. Accordingly, there is less research currently being conducted on faculty issues than has been true in the past.

Nonetheless, research is still taking place on labor market issues in higher education. An example of this work is a recent study by Rippner and Toutkoushian (2015), in which the authors examine the changes in the levels of pay for faculty who work at private versus public institutions. As documented by the AAUP, the average pay for faculty at private not-for-profit institutions is significantly higher than it is at public institutions. Table 9.4 in Chap. 9 showed that on average faculty are paid more in private institutions than they are in public institutions. The average pay gap for professors is particularly large at doctoral-granting institutions ($33,674), but still exceeds $10,000 even at less research-intensive colleges and universities.

Interestingly, faculty members in public institutions have not always been at a pay disadvantage relative to their peers at private institutions. In fact, the AAUP has shown that prior to the 1980s average faculty salaries were very similar across the two sectors.[17] In 1980–1981, for example, the average salaries for full professors at public institutions were 91 %, 99 %, and 103 % of the average salaries for full professors at private independent institutions in doctoral, master's, and bachelor's

[17] See Curtis and Thornton (2014) and Rippner and Toutkoushian (2015).

institutions respectively. By 2010–2011, however, these ratios had fallen to 75 %, 84 %, and 89 %, respectively. The declines in relative pay at public institutions appear to have been fairly consistent from 1980 through 2010.

Two important policy questions emerge from these observations. The first question is: what could have caused such a rapid decline in relative pay for faculty at public institutions? Labor economics would suggest that factors that have shifted the supply and/or demand curves in the two sectors could be partially to blame. For example, if the age distribution of faculty at private institutions has increased more than it has at public institutions, then some of the decline could be attributed to the fact that faculty in private institutions are now older, have more human capital, and thus merit higher salaries. Another possibility is that public institutions have directed more of their compensation to faculty in the form of medical and retirement benefits. Finally, the different levels of pay could simply reflect differences in the financial health of institutions. If private institutions have fared better than public institutions in raising revenues, then some of the financial gains may have been passed along to faculty.

Rippner and Toutkoushian explored the factors that influence relative pay for faculty in public and private institutions. In cross-sectional models, they found that the large pay disadvantage for faculty in public research institutions relative to private research institutions was largely explained by faculty, student, and institutional characteristics. However, the same factors had no effect on the relative public/private pay difference at master's institutions, and that faculty in public liberal arts (bachelor's) institutions earned more than their peers after controlling for these same factors. Therefore, the public/private pay gap is not uniform across the sectors and not fully explained by financial differences between institutions. Additionally, they looked at changes in average faculty pay between 2001 and 2011, and found that only a fraction of the higher rate of growth in faculty salaries at private institutions during this period could be explained by faculty, student, and institutional characteristics. The evidence clearly suggests that faculty jobs are becoming more lucrative in the private sector over time.

This leads to a second, and perhaps more important, policy question: what will this mean for the future of public higher education? If faculty pay continues to rise faster in the private sector than the public sector, then models of labor economics would suggest that private institutions will be able to hire and retain more higher-quality faculty than will public institutions. Such a trend could have profound effects on public higher education by possibly reducing the quality of teaching and research services. It could lead to a two-tiered system where some students would have to settle for a lower-quality education at public institutions. Likewise, the pay trend could lead to more research dollars flowing to private institutions, which means that fewer research activities would be carried out in the public sector.

Final, Final Thoughts

As evidenced by the studies discussed in this chapter, the economics of higher education is a growing and constantly-evolving area of study. Changes in what is studied and how it is done depend in part on data availability. The development of longitudinal and nationally-representative surveys of students has contributed significantly to our collective understanding of how students make choices about college and the costs and benefits of those choices. Likewise, national efforts to collect data from institutions through IPEDS has not only assisted researchers but also policy makers and practitioners who wish to study issues such as pricing, costs, and enrollments for specific purposes.

Research within the economics of higher education has also been enhanced by improvements in the collection of tools and analytical techniques that economists can bring to bear on important issues in higher education. Technological improvements in computers and computing software have made it possible for more researchers to apply very sophisticated statistical techniques to higher education data. Desktop computers today can estimate models in a fraction of the time that it would have previously taken for large mainframe computers to do the same task. And the software is increasingly user-friendly, opening the door to quantitative analysis in the field to a larger group of faculty, students, and policy analysts.

Similarly, economists have introduced a range of quantitative methods into the analysis of higher education issues, such as panel data techniques and quasi-experimental methods. These advances have gradually started to shift the type of work that is being done in the field of higher education. In particular, the increased use of quasi-experimental methods is particularly important given that many of the problems and issues that we face in higher education can be affected by the self-selection of decision makers. For example, choices about whether or not to go to college can be influenced by unobservable attributes of students (such as their motivation to succeed), and failure to try to take this into account may lead to incorrect conclusions and poor policy recommendations.

The formal study of the economics of higher education recently celebrated its 60th anniversary dating back to the pioneering work of economists including Gary Becker, W. Lee Hansen, Jacob Mincer, Theodore Schultz, and Burton Weisbrod that we have acknowledged earlier in this book. Other notable economists such as Sandy Baum, William Becker, Howard Bowen, David Breneman, Charles Clotfelter, Elchanan Cohn, Ronald Ehrenberg, Marianne Ferber, Stephen Hoenack, Larry Leslie, Lucie Lapovsky, Walter McMahon, Michael McPherson, Ronald Oaxaca, George Psacharopoulos, Michael Ransom, Morton Schapiro, John Siegfried, Paula Stephan, Joseph Stiglitz, Gordon Winston, and many others too numerous to list here, have built on this work and applied it to higher education in ways that perhaps could not have been envisioned 60 years ago when economists began to examine human capital formation and its connection to higher education.

We look for the study of the economics of higher education to grow in size and complexity in the future. Today, a new generation of economists including Thomas

Bailey, Debra Barbezat, Eric Bettinger, John Bound, Paul Brinkman, Celeste Carruthers, John Cheslock, Christopher Cornwell, Brad Curs, Susan Dynarski, Caroline Hoxby, Brian Jacob, Thomas Kane, Gregory Kienzl, Bridget Long, Brian McCall, Tatiana Melguizo, David Mustard, Leslie Stratton, Marvin Titus, Philip Trostel, Sarah Turner, John Winters, Liang Zhang, and many, many others are continuing to work on a wide range of higher education issues and introduce new (economics-oriented) approaches to research to the field of higher education. In addition, much of the work that falls under the heading of "economics of higher education" is being done by academics who were not formally trained as economists. Non-economists can often bring to the table a deeper understanding of the nuances of how higher education works, that can then be combined with the intellectual framework and techniques used by economists to study important issues. The ultimate success of this work depends in part on how well integrated economic reasoning becomes among academics in the larger field of higher education. We hope that our book is a step forward at bridging this gap and strengthening these connections.

References

Adkisson, R. V., & Peach, J. T. (2008). Non-resident enrollments and non-resident tuition at land grant colleges and universities. *Education Economics, 16*(1), 75–88.

Andrews, R., Li, J., & Lovenheim, M. (2012). Heterogeneous paths through college: Detailed patterns and relationships with graduation and earnings. *Economics of Education Review, 42*, 93–108.

Bahr, P. R. (2014). *The labor market return in earnings to community college credits and credentials in California*. Ann Arbor, MI: Center for the Study of Higher and Postsecondary Education, School of Education, University of Michigan. Retrieved from http://www.soe.umich.edu/people/profile/peter_riley_bahr/

Barr, A., & Turner, S. (2013). Expanding enrollments and contracting state budgets: The effect of the Great Recession on higher education. *Annals of the American Academy of Political and Social Science, 650*, 168–193.

Barr, A., & Turner, S. (2015). Out of work and into a job: Labor market policies and college enrollment during the Great Recession. *Journal of Public Economics, 124*, 63–73.

Baum, S., Ma, J., & Payea, K. (2013). *Education pays 2013*. New York: The College Board.

Becker, W. (1990). The demand for higher education. In S. Hoenach & E. Collins (Eds.), *The economics of American universities* (pp. 155–188). Albany, NY: State University of New York Press.

Belasco, A., & Trivette, M. (2015). Aiming low: Estimating the scope and predictors of postsecondary undermatch. *The Journal of Higher Education, 86*(2), 233–263.

Belfield, C., & Bailey, T. (2011). The benefits of attending community college: A review of the evidence. *Community College Review, 39*, 46–68.

Bound, J., Lovenheim, M., & Turner, S. (2010a). *Increasing time to baccalaureate degree in the United States* (Working Paper No. 15892). Cambridge, MA: National Bureau of Economic Research.

Bound, J., Lovenheim, M., & Turner, S. (2010b). Why have college completion rates declined? An analysis of changing student preparation and collegiate resources. *American Economic Journal: Applied Economics, 2*, 129–157.

Bound, J., & Turner, S. (2007). Cohort crowding: How resources affect collegiate attainment. *Journal of Public Economics, 91*, 877–899.

Bowen, W., Chingos, M., & McPherson, M. (2009). *Crossing the finish line: Completing college at America's public universities*. Princeton, NJ: Princeton University Press.

Brown, J., & Hoxby, C. (Eds.). (2015). *How the financial crisis and Great Recession affected higher education*. Chicago: University of Chicago Press.

Card, D. (1999). The causal effect of education on earnings. In O. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (Vol. 3A). Amsterdam, The Netherlands: Elsevier.

Cellini, S., & Chaudhary, L. (2014). The labor market returns to a for-profit college education. *Economics of Education Review, 43*, 125–140.

Cheslock, J., & Gianneschi, M. (2008). Replacing state appropriations with alternative revenue sources: The case of voluntary support. *Journal of Higher Education, 79*, 208–229.

College Board. (2014). *Trends in college pricing, 2014*. Washington, DC: The College Board.

Curtis, J., & Thornton, S. (2014, March–April). Losing focus: The annual report of the economic status of the profession. *Academe*, 4–38.

Dadgar, M., & Weiss, M. (2012). *Labor market returns to sub-baccalaureate credentials: How much does a community college degree or certificate pay?* (Community College Research Center Working Paper No. 45). New York: Teacher's College, Columbia University.

Damon, A., & Glewwe, P. (2011). Valuing the benefits of the education provided by public universities: A case study of Minnesota. *Economics of Education Review, 30*, 1242–1261.

Goldin, C., & Katz, L. (2008). *The race between education and technology*. Cambridge, MA: Harvard University Press.

Canche, M. (2014). Localized competition in the non-resident student market. *Economics of Education Review, 43*, 21–35.

Gunderson, M., & Oreopoulos, P. (2010). Returns to education in developed countries. In D. Brewer & P. McEwan (Eds.), *Economics of education* (pp. 37–43). San Diego, CA: Academic Press/Elsevier.

Hillman, N. (2012). Tuition discounting for revenue management. *Research in Higher Education, 53*, 263–281.

Hoxby, C., & Avery, C. (2013). *The missing "one-offs": The hidden supply of high-achieving, low income students*. Cambridge, MA: National Bureau of Economic Research.

Hoxby, C., & Turner, S. (2013). *Expanding college opportunities for high-achieving, low Income students* (SIEPR Discussion Paper No. 12-014). Stanford, CA: Stanford Institute for Economic Policy Research.

Institute for Higher Education Policy. (2013). *The investment payoff: Reassessing and supporting efforts to maximize the benefits of higher education for underserved populations*. Washington, DC: Institute for Higher Education Policy.

Jaquette, O., & Curs, B. R. (2015). Creating the out-of-state university: Do public universities increase nonresident freshman enrollment in response to declining state appropriations? *Research in Higher Education, 56*(6), 535–565.

Jaquette, O., Curs, B., & Posselt, J. (in press). Tuition rich, mission poor: Nonresident enrollment growth and the socioeconomic and racial composition of public research universities. *The Journal of Higher Education.*

Jepsen, C., Troske, K., & Coomes, P. (2014). The labor market returns to community college degrees, diplomas and certificates. *Journal of Labor Economics, 32*, 95–121.

Leeds, D. M., & DesJardins, S. (2015). The effect of merit aid on enrollment: A regression discontinuity analysis of Iowa's National Scholars Award. *Research in Higher Education*. doi:10.1007/s11162-014-9359-2.

Liu, V., Belfied, C., & Trimble, M. (2014). The medium-term labor market returns to community college awards: Evidence from North Carolina. *Economics of Education Review, 44*, 42–55.

Long, B. (2015). The financial crisis and college enrollment: How have students and their families responded? In J. Brown & C. Hoxby (Eds.), *How the financial crisis and Great Recession affected higher education* (pp. 209–233). Chicago: University of Chicago Press.

McKeown-Moak, M., & Mullin, C. (2014). *Higher education finance research: Policy, politics, and practice*. Charlotte, NC: Information Age Publishing, Inc.

McMahon, W. (2006). Education finance policy: Financing the non-market and social benefits. *Journal of Education Finance, 32*, 264–284.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: Johns Hopkins University Press.

McMahon, W. (2010). The external benefits of education. In D. Brewer & P. McEwan (Eds.), *Economics of education* (pp. 68–79). San Diego, CA: Academic Press/Elsevier.

Mangan, K., & Supiano, B. (2015). The players who influenced Obama's free-college plan. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/The-Players-Who-Influenced/151145/

Paulsen, M. B. (1990). *College choice: Understanding student enrollment behavior*. ASHE Higher Education Report Series. Washington, DC: The George Washington University

Paulsen, M. B., & Fatima, N. (2007). Higher education and growth in state workforce productivity, 1980–2000: Evidence on the public benefits of college education. In P. B. Richards (Ed.), *Global issues in higher education* (pp. 37–56). New York: Nova Science Publishers, Inc.

Rippner, J., & Toutkoushian, R. (2015). The 'big bang' in public and private faculty salaries. *Journal of Education Finance, 41*, 103–123.

Roderick, M., Nagaoka, J., Coca, V., & Moeller, E. (2009). *From high school to the future: Making hard work pay off*. Chicago: Consortium on Chicago School Research.

Smith, J., Pender, M., & Howell, J. (2013). The full extent of student-college academic undermatch. *Economics of Education Review, 32*, 247–261.

Titus, M. (2009). The production of bachelor's degrees and financial aspects of state higher education policy: A dynamic analysis. *The Journal of Higher Education, 80*, 339–468.

Toutkoushian, R., Shafiq, M., & Trivette, M. (2013). Accounting for risk of non-completion in private and social rates of return to higher education. *Journal of Education Finance, 39*, 73–95.

Trostel, P. (2010). The fiscal impacts of college attainment. *Research in Higher Education, 51*, 220–247.

Turner, S. (2004). Going to college and finishing college: Explaining different educational outcomes. In C. Hoxby (Ed.), *College choices: The economics of where to go, when to go, and how to pay for it* (pp. 13–61). Chicago: University of Chicago Press.

Webber, D. (2012). Expenditures and postsecondary graduation: An investigation using individual-level data from the state of Ohio. *Economics of Education Review, 31*, 615–618.

Webber, D., & Ehrenberg, R. (2010). Do expenditures other than instructional expenditures affect graduation and persistence rates in American higher education? *Economics of Education Review, 29*(6), 947–958.

Winters, J. V. (2012). Cohort crowding and nonresident college enrollment. *Economics of Education Review, 31*, 30–40.

Zhang, L. (2007). Nonresident enrollment demand in public higher education: An analysis at national, state, and institutional levels. *The Review of Higher Education, 31*, 1–25.