Economic Models and Policy Analysis in Higher Education: A Diagrammatic Exposition*

Michael B. Paulsen and Robert K. Toutkoushian

Introduction

Policy analysis is a term that is used very often in education circles and seems to have multiple meanings depending on the background of the person using the phrase and the context in which it is used. Generally speaking, a *policy* is "a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions" (Merriam-Webster Dictionary, 2007), and an *educational policy* is "a specification of principles and actions, related to educational issues, which are followed or which should be followed and which are designed to bring about desired goals" (Trowler, 2003, p. 95). Who are the policy makers in higher education? For the postsecondary setting, policy makers would include entities and individuals who enact these laws and rules, including academic departments, colleges, institutions, and local, state, and national governments. The goal of educational policies is to lead to desired changes in behavior for participants within the education system. For example, a state-level educational policy may be implemented to help increase the percentage of high school students who go on to pursue a postsecondary education. The goal of this policy is to change the behavior of some high school students who may not be likely to attend college following graduation. As another example, an academic department may design policies to increase the quality of instruction given to undergraduate students. Here, the policy maker (academic department administration) is seeking to alter the actions of faculty in such a way that will lead to gains in instructional quality.

Educational policy analysis focuses on how one should evaluate the effectiveness of alternative educational policies when choosing between them. The analysis of policy in higher education—an interdisciplinary field of study—is richly

* The authors would like to thank John Cheslock, Steve DesJardins, Don Hossler and Laura Perna for their helpful comments on earlier drafts of this manuscript. Any errors or omissions, however, are the responsibility of the authors.

J. C. Smart (ed.), *Higher Education: Handbook of Theory and Research*

informed by a diverse set of disciplines including sociology, psychology, political science, history, philosophy and more. One other discipline that has great potential to help us understand the higher education enterprise and to productively inform policy analysis in higher education is *economics*. Non-economists often associate economics with money, profit and other business-related phenomena and often equate economics with professional fields such as business, accounting or finance. Unfortunately, this perspective greatly limits and substantially narrows the view of many non-economists regarding the usefulness of economics for policy analysis in higher education. In terms of both structure and methodology, the discipline of economics is a social and behavioral science and has much more in common with sociology, psychology and political science than with accounting, finance and business fields (Paulsen & Toutkoushian, 2006b; Toutkoushian & Paulsen, 2006).

Economics is comprised of highly generalizable frameworks that are designed to analyze how *incentives* affect the *behavior* of decision makers who are in pursuit of goals. Most higher education policies represent elements of incentive structures—or changes in those incentive structures—that influence the behavior of individuals or institutions. For example, a state need-based grant to a student who is undecided about whether or not to pursue higher education changes the incentive structure this student faces by expanding the student's income *constraint*. For many students, this change in their income constraint will affect their decision-making and change their college-going behavior. This is very important for policy analysis in higher education because there are countless higher education policies that can be readily conceptualized in terms of tangible or intangible elements of incentive structures, and economics provides productive analytical frameworks for understanding, evaluating, and measuring the effectiveness of such policies.

Economists have a unique approach to looking at educational policy issues. They begin by identifying the decision makers for a given problem, the constraints those decision makers face, and the goals and objectives they want to pursue. This information, together with a series of behavioral and simplifying assumptions, is used to develop a conceptual model of the underlying process being studied. Economists then use the model to determine the allocation of resources that lead to the maximization of the goal given the constraints faced by the policy maker. More importantly, the model can shed light on how changes in one or more facets of the problem can affect this point of maximization. This is generally referred to by economists as comparative statics. Comparative statics prove to be very useful for educational policy analysis because they allow the economist to predict how policies might affect the outcome of interest. To economists, the analysis of educational policies is crucial because of the numerous policies that might be enacted to address specific issues, and the limited resources that policy makers have at their disposal to do this. Choosing an ineffective or less effective policy leads to an opportunity cost in that another action could have been taken that would have been more effective at reaching the intended goal.

In this chapter, we seek to provide the reader with a detailed explanation and one substantial illustration of how economists approach educational policy analysis, and how this can be useful for understanding and improving higher education. Our

presentation is primarily intended for those higher education scholars, administrators and practitioners who are not trained in economists. Toward this end, we have minimized our use of mathematical notation and maximized our use of diagrammatic representations of all economic models, with each diagram and model accompanied by substantial and detailed narrative explanation. In the first half of this chapter, we focus on explaining how economists develop and use models in their work, and how economists use these models to examine educational policies. In the second half of this chapter, we explore the use of human capital theory—the theoretical framework from economics that is the most widely-used for the analysis of higher education policies—and a model of the market for investment in higher education to provide a detailed illustration of how economic theories, models, and methods can be and have been applied to educational policies in the realm of student access to postsecondary education. We conclude with a discussion of some of the measurement issues encountered when trying to analyze educational policies and factors such as data limitations and self selection that impose limitations on what can be done to analyze the effectiveness of alternative educational policies.

General Economic Approach to Educational Policy

In this first section, we focus on providing the reader with a general description of the approach that economists use to examine educational policies. This approach can be applied to many different problems within higher education, including student access to higher education, faculty compensation and time allocation, student retention, and educational productivity, to name but a few. We encourage those readers interested in more detailed and in-depth explanations of the general microeconomic concepts, models and methods presented in this chapter to consult some of the fine microeconomic textbooks available at the introductory level—such as Mankiw (2007) or McEachern (2006)—or intermediate-level—such as Pindyck and Rubinfeld (2005) or Frank (2003). Additional explanations of many of these concepts that are directed towards institutional researchers can be found in Toutkoushian and Paulsen (2006).

Economic Models

Economists rely heavily on the use of theoretical models to conduct their work in educational policy. A model by definition is meant to be a simplified depiction of reality, so that one can focus on a few important factors rather than all of the complexities of a given problem. An education model begins by identifying the decision maker of interest (such as a student, faculty member, or administrator), the goal or objective that they are trying to attain, and the constraints that they face in doing so. For example, a model that looks at whether or not students go on to college would

begin by identifying students (and perhaps their families) as the decision maker. The presumed goal of students is to make decisions that will maximize their happiness, or utility. Students face constraints, however, in that they only have limited financial resources to be able to pay for college and limited time to allocate among competing uses of their time. The economic model would be designed to describe in a relatively simple fashion how students allocate their time and income so as to maximize their utility, and what the implications would be for whether or not they choose to go to college. Essentially, a student would opt to go to college if doing so allowed him/her to obtain more lifetime utility than would be true by not going to college.

A typical model might posit that a decision maker such as a student receives utility from different combinations of two goods or services. The utility that individuals receive from these goods and services can and does vary across individuals. This means, for example, that two high school students could receive different amounts of satisfaction from going to college and using their remaining money for other goods and services. The utility from different combinations of goods/services is usually represented graphically in the form of an indifference curve. An indifference curve shows all of the combinations of two goods and services that would give a decision maker the same level of utility, making them "indifferent" between the choices. This is illustrated graphically in Fig. 1, where each indifference curve shows the combinations of two goods (labeled X and Y) that yield the same satisfaction level. Each decision maker is presumed to have an infinite number of such curves, with greater combinations of X and Y yielding more utility. The decision maker would prefer to reach the highest indifference curve possible because in doing so they will have increased their satisfaction.

While the indifference curves represent the goal that the decision maker is trying to achieve (in this case, maximizing utility), there are typically one or more constraints imposed on decision makers that limit the satisfaction they can attain. These are most often in the form of constraints on the amount of financial resources that can be spent, or the amount of time that can be used. A budget constraint is a way of graphically representing the choices available to a decision maker for allocating the resource in question. Figure 1 depicts a typical budget constraint, where the points of intersection on each axis indicate the maximum amount of a good or service that could be consumed if all of the financial resources were spent on that particular commodity. These points are derived by dividing the total financial resources of the decision maker by the price of each good. This also means that the position and slope of the budget line is fully determined by the decision maker's level of financial resources and the prices of the two goods being measured. Any point along the budget constraint is viewed as an efficient use of resources because all of the resources are being expended for goods X and Y. Likewise, all points to the right of the budget constraint are unattainable given the current prices of the goods X and Y and available income.

The problem for the decision maker, from the point of view of an economist, becomes how to maximize their goal or objective given the constraints that they face. This can be seen graphically in Fig. 1. The optimal point, which is referred to

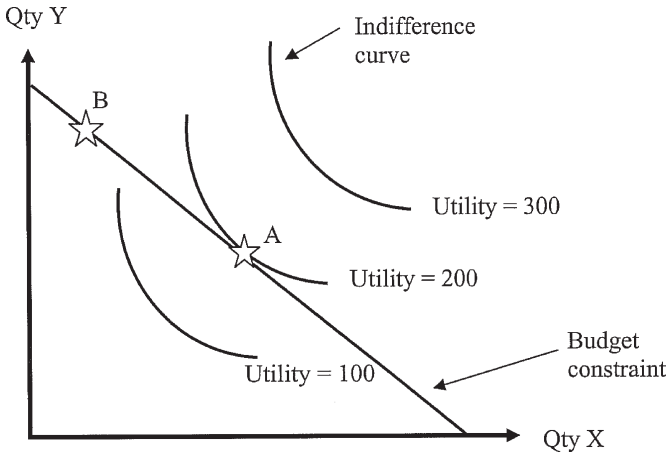

Fig. 1 Optimization

as the equilibrium, is found where the indifference curve is tangent to the budget line (point A). At this point, the decision maker is obtaining as much utility as possible given the level of resources and prices of the two goods or services. Any other point along the budget line, such as point B, would be efficient but result in a lower level of utility to the decision maker. Therefore, the decision maker could become happier by reallocating resources away from good Y and towards good X until point A is reached. While the decision maker would prefer to choose any combination along the indifference curve "utility = 300," as noted earlier these combinations are unattainable with the current level of resources and prices.

Alternatives for Educational Policy

The economist's view of educational policy analysis uses a theoretical model such as the one described above to ask the question: what policy can be enacted that would lead to a desired change in equilibrium? To illustrate, in 2004 62.5% of black non-Hispanic high school graduates and 68.8% of white non-Hispanic high school graduates entered college within 12 months of graduation (National Center for Education Statistics, 2005, Table 181). Policy makers may therefore be interested in understanding why this difference in the college going rates between students of different races has occurred and what might be done to help eliminate the gap. Figure 2 shows how these college-going rates might be expressed using the framework of indifference curves and budget constraints.

This framework also makes clear that the difference in college-going rates must be attributed to one or more of the following three explanations. The first is that white students have a higher preference than black students for education. Thus,

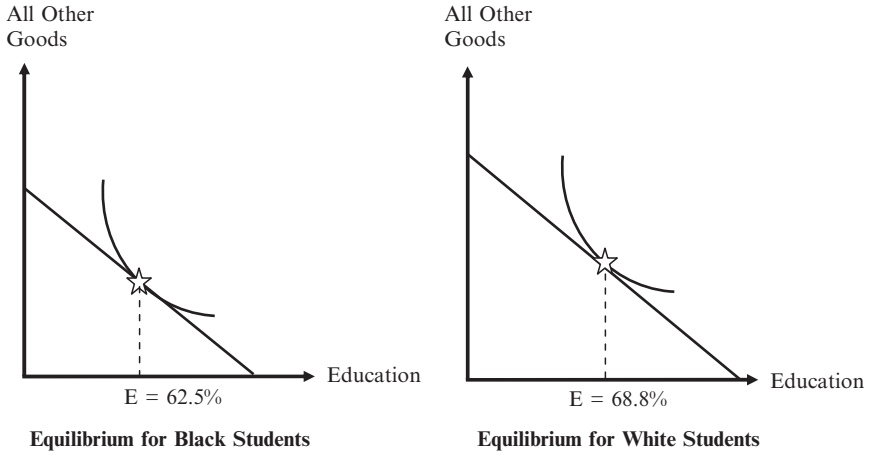

Fig. 2 Different equilibria by race

holding ability to pay constant, white students would be more willing than black students to trade other goods and services for education. If true, then the entire set of indifference curves for white students is shifted more towards education, leading to an equilibrium point that has more consumption of education. This is depicted graphically in Fig. 3. Only the indifference curves for each group that are tangent to the budget line are shown here. It is assumed here that both white and black students have the same exact budget lines, meaning that they have the same levels of financial resources for education and face the same prices for education. Accordingly, the gap in college-going rates is due exclusively to different preferences between the groups for higher education.

A second possible cause for the difference in college-going rates is that on average white students have more financial resources (income, wealth) than black students. As a result, the budget line for white students would be greater than (or to the right of) the budget line for black students, enabling white students to purchase more education and perhaps all other goods than black students. This is shown in Fig. 4. Note that it is assumed here that white and black students have the same indifference curves (i.e., they have the same preferences for education versus all other goods), and they face the same relative prices for education versus all other goods (i.e., their budget constraints are parallel). As a result, the different college-going rates are not due to different preferences for college, but rather different amounts of resources that could be used to pay for college.

Finally, a third potential explanation is that the relative price of education is lower for white students than it is for black students. This would enable white students to purchase more education than black students can purchase given their income. Graphically, this would cause the budget line for white students to pivot outward, and would lead to an equilibrium that contains more education for white students than for black students (Fig. 5). In this figure, we assume that white and

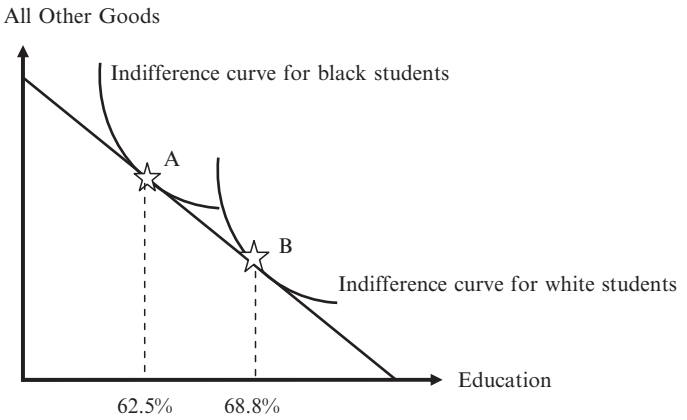

Fig. 3 Effects of different preferences for higher education

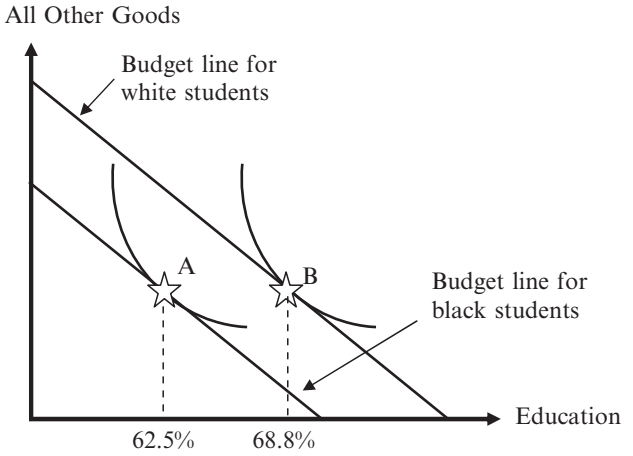

Fig. 4 Effects of different budget constraints for higher education

black students have the same indifference curves and the same amount of financial resources, and therefore the difference in college-going rates is fully attributable to the different prices that they face. Of course, it is also possible that any combination of these three explanations hold at the same time. For example, in comparison to black students, white students could have a higher preference for education and have more financial resources to acquire education.

The focus of economists who study educational policy is not so much with understanding the reasons why decision makers are at a given equilibrium point as it is with designing policies that would lead to desired changes in equilibria. The policy maker's action plan is intended to alter the behavior of decision makers in a particular way, regardless of the reason that the current equilibrium condition has emerged.

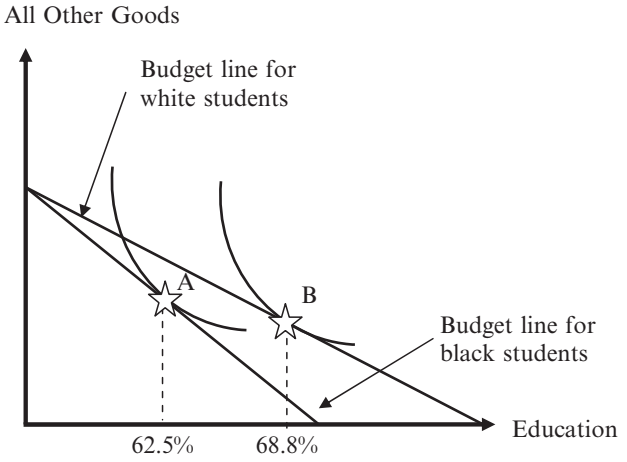

Fig. 5 Effects of different prices for higher education

The framework described here shows that there are three general ways in which an equilibrium can be altered: (1) change the preferences of the decision maker; (2) change the decision maker's level of financial resources; and/or (3) change the relative prices faced by the decision maker. As shown in Figs. 3 through 5, a policy that can accomplish any of these would lead to predicted changes in equilibria.

Returning to the previous example, the difference in college-going rates between white and black students could, in theory, be reduced by either shifting the preferences of black students more towards education, increasing the level of financial resources for black students, or reducing the price of education for black students. Policy makers might attempt to alter preferences by publicizing the advantages of going to college (or the disadvantages of not going to college), or introducing support programs at pre-collegiate levels that would make it more appealing for black students to want to pursue a postsecondary education. In fact, there are many examples of initiatives such as Project Opportunity (College Entrance Examination Board, 1971), the federal TRIO programs, and private initiatives such as I Have a Dream (Fenske et al., 1997) that could be viewed as attempts to shift the indifference curves of black students towards education.

However, among the three options for changing equilibriums, economists usually focus their attention on educational policies that affect the constraints faced by decision makers rather than their preferences. Economists certainly acknowledge that changing preferences could change the equilibrium point, and that preferences of decision makers can and do shift over time. However, this approach is not often used by economists who are involved in educational policy analysis because the field of economics has relatively little to contribute to our understanding of how the preferences of decision makers are formed. This approach is best informed by the work

of the behavioral sciences, such as sociology, psychology, and others that provide insights into how students' preferences are formed.[1] Therefore, economic models typically take preferences as given and develop optimization models that are independent of how they are formed.

Educational policies that alter either the location or slope of the budget line can lead to the same changes in behavior without affecting the preferences of the decision maker. An economist knows with certainty that an income supplement to students will lead to an outward shift in the student's budget line, all else equal. Likewise, a policy such as increased state appropriations to institutions of higher education that reduces the tuition paid by a group of students would cause the budget line for these students to pivot outward. In each case, the policy maker has a high level of control over the magnitude of the change in the constraint that results from the policy. For this reason, these types of policies are often referred to as "policy levers." The identification of such policy levers, and the prediction, analysis, and evaluation of the effects of the use of policy levers constitute the most common applications of economic models to policy analysis.

The economic model of optimal decision making also shows that policies could be implemented that actually force decision makers to choose non-equilibrium positions along their budget constraint. Such policies might include minimum teaching and service loads for faculty, and compulsory attendance for students. In Fig. 6, for example, a student who was free to choose how to allocate her resources between education and all other goods would want to choose a point such as A. However, if policy makers sought to increase the amount of education that she obtained, they could implement a policy requiring students to attend college, increasing her educational attainment to point B. The problem with this policy, from the perspective of the student, is that it has led to a reduction in her utility or satisfaction. The fact that she faces a budget constraint means that the policy has forced her to forego some consumption that would have given her more enjoyment than did the additional education.

In contrast, the policies that alter the decision maker's budget constraint in some way still allow the decision maker the freedom to act as they see fit and to maximize their utility. To shift the budget line, an educational policy maker might advocate plans to provide income supplements to students and their families, or create tax advantages for the families of students that effectively increase their disposable income. The income supplement or tax advantage would cause the entire budget line to shift to the right, enabling students to purchase more education

[1] This is true of traditional economics and economists. However, in the emerging field of behavioral economics, economists explicitly acknowledge and utilize the many natural connections between psychology—particularly cognitive and social psychology—and economic phenomena. Behavioral economists draw extensively on the social, cognitive, motivational, and emotional phenomena in their analysis of individual and group decision-making and in their examination of anomalies in the marketplace. For more information, interested readers should consult the volume by Camerer et al. (2003).

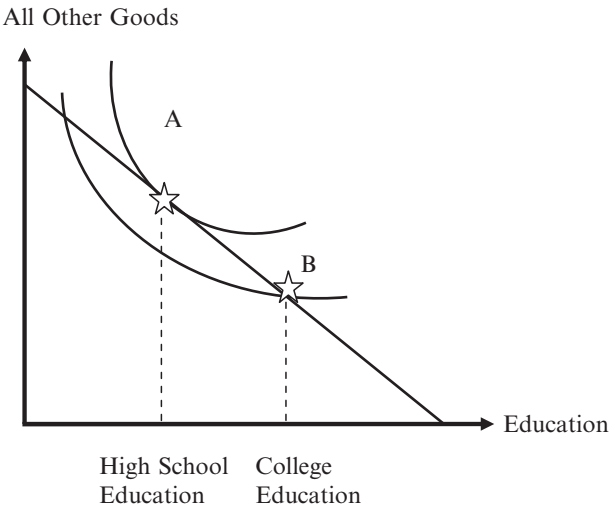

Fig. 6 Effects of choosing a non-equilibrium point

and all other goods. Finally, a policy could be implemented that would instead reduce the price of education. This may be achieved through an explicit price discount made by the institution or a commitment from the institution, state, or other entity to cover a percentage of all education completed by the student. Other examples of price decreases for students would include reductions in the interest rate charged on student loans, and the enactment of reciprocity agreements between states to charge in-state tuition rates to each other's residents.

Another means of affecting the constraints for decision makers is through what are known as in-kind subsidies. Generally speaking, an in-kind subsidy is a benefit that can be used for only a specific purpose. To illustrate, suppose that a state provided low-income students with a $4,000 stipend that could only be used to pay for college. This is similar to a policy that would give low-income students an additional $4,000 in income, except that the income supplement can only be used to purchase education. This would lead to a discontinuous shift in the budget line as shown in Fig. 7. The dashed line (C,A,B) now represents the budget constraint faced by the student. The student can consume up to $4,000 in education without reducing the income available to consume all other goods and services, and therefore this segment of the budget constraint would be a horizontal line. After this point, however, additional dollars spent on education would reduce the amount of income left for purchasing other goods and services. Most forms of financial aid given to students would be characterized as in-kind subsidies because they cover a stipulated amount of the price of education as compared to a percentage discount per credit hour or year.

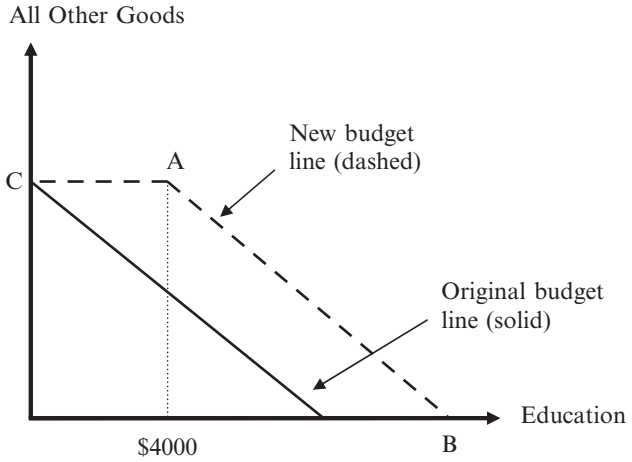

Fig. 7 Effects of $4,000 in-kind subsidy for education

In-kind subsidies such as this may be preferred by some policy makers because the subsidy can only be used for the purpose intended by the donor. In contrast to an in-kind subsidy, a $4,000 income subsidy could be used for many purposes aside from higher education, raising concerns that an income subsidy would be less likely to lead to a desired increase in college attendance. From the perspective of the decision maker, however, an in-kind subsidy is typically less favorable than an equivalent income subsidy. This arises because the possibility exists that a decision maker's new optimum point is along the horizontal segment (C,A), in which case the decision maker would have received more utility with an income subsidy of the same amount. Decision makers who would find new equilibrium points along the segment (A,B), however, are indifferent between receiving an in-kind versus an income subsidy because they would reach the same point regardless of the form of the policy. In this example, the student's family would have spent at least $4,000 on education, and thus can use the subsidy to free up the same amount for spending on other goods and services. Accordingly, the in-kind subsidy functions as an income subsidy for them.

This general approach to policy—targeting action plans towards the constraints faced by decision makers—can be used in a wide range of higher education applications. There are many different decision makers within higher education, each with their own set of objectives and constraints. Academic departments, for example, can be viewed as decision makers because they must choose how to allocate limited faculty to meet its research, teaching, and service commitments. If university policy makers are concerned that faculty in a department are not spending enough time teaching undergraduate students, they may consider a range of action plans that could increase this quantity. The university might achieve this goal through increasing

the budget for an academic unit (a rightward shift in the budget line), thus enabling them to hire more faculty and use them to teach undergraduate students and carry out the other mission aspects of the department. An in-kind subsidy could also be provided to the department by providing them with funding to hire only faculty such as adjunct or clinical faculty who would specialize in teaching. Or the institution could focus on "price" by covering a percentage of the salary for only those faculty who specialize in teaching. All of these policies would be designed to affect the decision maker's constraints in the hopes of changing behavior in a manner intended by the policy maker. These would differ from policies where the institution attempts to shift the department's preferences towards instruction without altering the income or prices that they face.

Faculty members are another example of decision makers in higher education, in that they have some discretion over how they allocate their time between competing activities. In this instance, time and not income is the relevant constraint faced by the decision maker. In Fig. 8 we show an example of the constraint faced by a faculty member between allocating her time between teaching and research. For simplicity, we assume that the individual has a time constraint of 40 hours per week to allocate between these two activities. In equilibrium, she currently spends 15 hours/week in research and 25 hours/week in teaching given her preferences between teaching and research.

The policy maker—in this case, the academic department, the institution, or the state—could design plans that would be intended to entice the faculty member to change her time allocation in ways that are more in line with the preferences of policy makers. Suppose that the department's administration simply asked

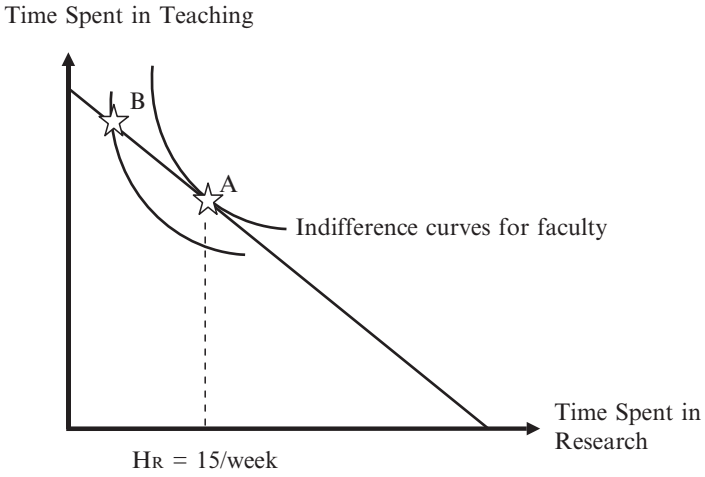

Fig. 8 Depiction of time allocation problem for faculty

the faculty member to increase the amount of time that she spent in teaching. To the individual faculty member, such an increase would be problematic for two reasons. First, it would lead her to choose a time allocation that was not optimal from her point of view. She would have a lower level of utility at point B, for example, than she would at point A, and thus the policy leads to a reduction in utility. Second, due to the time constraint of 40 hours/week, there would be an opportunity cost of increasing her time devoted to teaching because she would have to forego some of her time spent in research activities. Policies aimed at extolling the virtues of teaching would be viewed by economists as attempts to shift her preferences away from research and towards teaching. These policies may or may not be effective in doing so, and the institution would have difficulty determining if the action plan did indeed change preferences in the intended direction.

Alternatively, economists would normally focus on policies that would affect the constraints faced by the faculty member. The department could shift her time constraint outward to the right by reducing her service commitments because she would now have more discretionary time for both teaching and research. However, there is the risk that with the reduced service load, the faculty member would opt to only spend more time in research. If the time release from service was in exchange for the faculty member teaching an additional course, then this would be viewed as an in-kind subsidy because the additional time could not be used for research. Likewise, the department could provide additional teaching assistants to the faculty member, which would reduce the number of hours she needed to teach each course, and thus lower the "price" that she faced for teaching each course. All of these policies could lead to new equilibrium time allocations that may be in the direction intended by policy makers. However, the faculty reward system has a complex structure and institutions do not have full control over the reward system. For example, incentives or rewards related to opportunities for consulting and more attractive positions at other institutions provide extra-institutional sources of rewards for faculty that could mitigate or offset institutional efforts to adjust intra-institutional reward structures to promote desired changes in faculty behavior.

Using Economic Models for Access-Related Policy Analysis in Higher Education

Economic theories, models and their diagrammatic forms give perspective or provide frameworks for policy analysis in higher education. Some of the most prominent examples of such theories or models would include the theory of consumer behavior, human capital theory, the market model of demand and supply—including related concepts such as elasticity of demand—and microeconomic theories of the firm. This section will begin by identifying a specific policy problem or area and

consider some types of "policy levers" that are relevant to the policy problem areas. For example, *access* to higher education is an important and critical policy problem area in higher education, and relevant policy levers would include federal grants and loans for students, state need-based or merit-based grants to students, and state and local appropriations to institutions.

Economic theories and models are the sources economists use to identify policy levers for addressing particular policy problems. For example, if access to higher education is the policy problem, then a key question for economists to ask would be "What policies would rearrange incentives to stimulate behavior by individuals and/or institutions that would promote access to higher education?" Policy levers can arise from federal, state, and institutional levels of policymaking. And the effective policy levers are those that use changes in "incentives" to stimulate changes in individual or institutional behavior that, in turn, promote improvements in a policy problem area like access. For economists, policy analysis is about analyzing how changing specific constraints faced by individuals and institutions alters their behavior and decision-making and moves them from one equilibrium position to another.

In this section we present and examine economic theories and models—in diagrammatic form—to illustrate the usefulness of economic theories and models as frameworks for identifying policy levers and predicting the effects of policy levers—at the federal, state, and institutional levels—on the behavior of individuals and institutions. More specifically, we articulate and illustrate—with diagrams and narrative explanation—how economic models provide a useful theoretical format for policy analysis by identifying policy levers with the potential to change behavior in ways that promote access to, and participation in, higher education. We conceptualize a student's decision about whether or not to attend college—which can be viewed as the first in a sequence of college-going decisions students make (St. John, 2003)—as an "access" decision and we view policies affecting this decision as access policies (Perna, 2006).

Human Capital Theory: A Framework for Analyzing Demand-Side and Supply-Side Policies to Promote Students' Access to and Investment in Higher Education

The most prominent of the theoretical frameworks used by economists and other social scientists to analyze students' college-going decision-making behavior relative to their access to, or participation in, higher education is *human capital theory*. The origins of modern human capital theory are often attributed to the pioneering work of Theodore Schultz (1961) and Gary Becker (1962). However, economists have further developed and refined this theory to the degree that it is now an established branch of labor economics (see, e.g., Ehrenberg & Smith, 2006), it serves as the starting point for many modern studies of investment in education and other forms

of human capital (see, e.g., Avery & Hoxby, 2004), and it constitutes an important component of other theoretical structures in economics such as theories of economic growth and development (see, e.g., Cohn & Geske, 1990).[2]

Human capital theory views students' decisions to attend college as investments in higher education—an important form of human capital. Economists conceptualize human capital as a set of knowledge, skills, attitudes, abilities and talents that, when embodied in individuals, serve to enhance their productive capacities, and can therefore, be rented to employers in exchange for earnings over the life cycle. Investments in higher education—or other forms of human capital such as health care, on-the-job training, or job search—constitute additions to an individual's existing stock of human capital (Becker, 1993; Belfield, 2000; Ehrenberg & Smith, 2006; Johnes, 1993; Thurow, 1970; Woodhall, 1995). Economists view educational investment decision-makers, whether households or individuals, as seeking to maximize their utility subject to budget constraints. In utility functions, human capital investment is typically specified to affect utility directly or indirectly through its effects on other arguments in the utility function such as income or consumption (see, e.g., Becker, 1993; Belfield, 2000; Card, 1999; Checchi, 2006; McMahon, 1984; Thurow, 1970).

One straightforward specification is to assume that students allocate the resources available to them, as defined by their budget constraint, between investments in education and consumption expenditures on all other goods in order to maximize their utility across the life cycle (DesJardins & Toutkoushian, 2005; Paulsen & Toutkoushian, 2006b). This format assumes students engage in "constrained optimization" behavior by seeking to maximize their utility—based on their individual preferences for various combinations of higher education and other goods acquired through investment and consumption decisions—subject to the limits of their time and budget constraints. Human capital theory assumes that students engage in *rational behavior*. In brief, individuals are behaving rationally if each individual makes choices about allocating the resources in their own unique budget constraint between higher education and other goods in ways that

[2] Human capital theory has received consistent empirical support for over 45 years and has provided insightful explanations of individual and institutional behavior, including decisions about investment in higher education. A central tenet of human capital theory is that education increases an individual's productivity, and therefore leads to higher future earnings. Alternative perspectives on the relation between educational attainment and earnings have emerged over the years, such as the screening hypothesis (e.g., Spence, 1973), job competition model (e.g., Thurow, 1975), dual labor market hypothesis (e.g. Doeringer and Piore, 1971), and social class approach (e.g., Bowles and Gintis, 1976). A thorough analysis of these contributions is beyond the scope of this chapter; however, each approach offers an important perspective and should be studied in conjunction with human capital theory.

maximize their utility in accordance with their own unique and subjective preferences (DesJardins & Toutkoushian, 2005; Paulsen & Toutkoushian, 2006b).[3]

Human capital theory assumes that, in order to maximize their utility, when students make college-related investment decisions they compare the expected benefits with the expected costs of college (Carnoy, 1995; Checchi, 2006; Ehrenberg & Smith, 2006; Kaufman & Hotchkiss, 2000; McConnell et al., 2003; McMahon & Wagner, 1982; Paulsen, 2001a; Psacharopoulos, 1973). The earnings differential between college graduates and high school graduates—which continues to increase throughout most of the working life span (Murphy and Welch, 1989, 1992; McMahon & Wagner, 1982)—is quite substantial in magnitude (College Board, 2006a) and constitutes the primary monetary benefit that students expect to receive because of their investment in higher education. The primary monetary costs that students expect to pay for their investment in college include direct, out-of-pocket costs such as tuition and fees, books and supplies, commuting, and incremental living costs, as well as indirect opportunity costs due to the earnings foregone while attending college (Arai, 1998; Becker, 1993; Belfield, 2000; Checchi, 2006; Palacios, 2004).

Figure 9 portrays the most important monetary benefits and costs associated with the college-going investment decision for a recent high school graduate. Two possible earnings streams appear in the figure. The CC line portrays the expected earnings stream for a recent high school graduate who attends college without delay, incurs direct costs while attending college, does not work while attending college, and graduates in four years. This earnings stream is negative during the college years when the student is not working and the direct costs of college are incurred. After college graduation, the CC line continues at a positive level of earnings which rises at a substantial rate throughout the lifespan. The HH line portrays the expected earnings stream for a recent high school graduate who enters the workforce by taking a full-time job instead of going to college. This earnings stream is assumed

[3] The meaning of the rational behavior assumption is very important but it is often misunderstood and applied in ways that are misleadingly restrictive. Each individual's preferences for different combinations of higher education and other goods, or the values she assigns to them, are by definition, highly subjective, idiosyncratic and unique to each individual. Preferences for various combinations of higher education and other goods vary considerably across individuals, because the formation of preferences is uniquely shaped by each individual's distinctive experiences, access to information, values, attitudes, and beliefs, which in turn are influenced by individual differences in home, school and community environments. Budget constraints also vary substantially across individuals, particularly due to differences in incomes and the prices of higher education and other goods and services for different individuals and households. Therefore, *rational behavior* means that two individuals with identical budget constraints would choose different amounts of higher education and other goods if they have different preferences; and two individuals with identical preferences would make different choices because they face different budget constraints. Paulsen and Toutkoushian (2006b) offer a brief, accessible explanation of what economists mean by rational behavior, and DesJardins and Toutkoushian (2005) provide a comprehensive treatment of the subject.

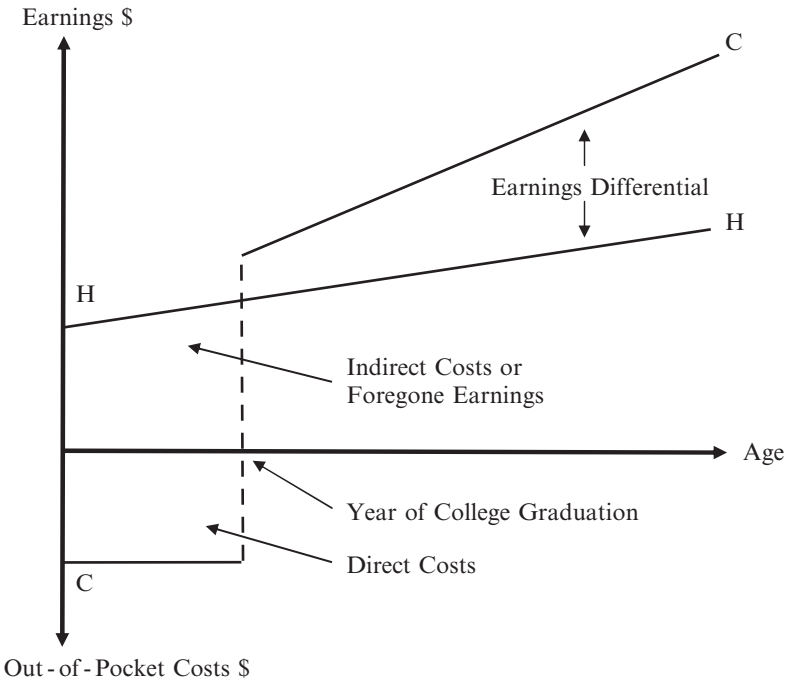

Fig. 9 Benefits, costs and investment in higher education

to start immediately at a positive level and not increase as fast as the CC line over the lifespan.

The most important monetary benefit of college attendance is represented by the *earnings differential*, where the CC line exceeds the HH line by increasing amounts across a typical 43-year post-college work life (i.e., 65–22 = 43 years). In order to acquire these monetary benefits, each student compares them to the expected costs of college attendance. The two most important monetary costs of college are represented as the *direct costs* which comprise the out-of-pocket expenses for tuition and fees, books, commuting, and living costs related to college attendance, and the *indirect costs* or *foregone earnings* which equals the income a college student could have earned by entering the workforce with their high school diploma instead of going to college.

As noted previously, human capital theory assumes that when students decide whether or not to attend college they compare the expected utility of going to college with the expected utility from not going to college. In general, attending college would be perceived as a worthwhile investment when the expected utility from going to college exceeds the expected utility of not going to college. Economists describe the expected utility of each choice as being affected by the costs and benefits of each choice. For higher education, the cost includes the direct and indirect costs of acquiring a higher education, and the benefit is the future

income stream that students expect they will realize if they pursue a postsecondary education.[4] Accordingly, the investment in human capital model usually focuses on the costs and benefits of each choice and not the utility of each choice. Because the comparative statics of the investment in human capital model are the same regardless of whether one examines the costs and benefits of each choice or the utilities of the costs and benefits of each choice, the analysis of educational policies would not be affected by this simplification.

Even this stylized presentation of the human capital model provides a useful general framework for identifying policy levers and predicting the effects of policy levers—at the federal, state, or institutional, levels—on the students' decisions regarding whether or not to participate in college. In broad terms, the human capital model indicates that policies that either decrease the expected costs of college or increase the expected benefits of college would increase the likelihood that a student would choose to attend college. Research on the effects of each of the primary components of expected benefits and expected costs on student enrollment decisions has generated consistent findings in support of the key elements of the human capital model. For example, research has shown that the likelihood that a student will invest in college is positively related to the earnings differential between college and high school graduates (see, e.g., Averett & Burton, 1996; Freeman, 1976; Kane, 1999; Murphy & Welch, 1992; Paulsen & Pogue, 1988; Rouse, 1994; Rumberger, 1984). In addition, research has consistently shown that students' enrollment decisions are negatively related to the direct costs of college attendance, such as tuition and fees, books and living costs (Avery & Hoxby, 2004; Heller, 1997, 1999; Kane, 1995, 1999; Leslie & Brinkman, 1988; McPherson & Schapiro, 1991; Paulsen, 1998, 2000; Paulsen & Pogue, 1988; Paulsen & St. John, 2002; Rouse, 1994). Finally, research has consistently indicated that students' enrollment decisions are also negatively related to the indirect costs or foregone earnings (i.e., opportunity costs) of college (Heller, 1999; Kane, 1995, 1999; Long, 2004; Paulsen, 1990; Rouse, 1994).

A more precise algebraic presentation of the human capital model portrays students' college-going decision-making in terms of the present value method and the internal rate of return method. The expected benefits of higher education accrue and the expected costs are incurred over time, so that attention to the time value of money is important for a more precise derivation and statement of the criterion for identifying a profitable or worthwhile human capital investment decision. Using the present-value approach, a student would view an investment in higher education as profitable when the present discounted value (PDV) of the benefits of college—

[4] In a more complete analysis (see, e.g., McMahon and Wagner, 1982), this model would also include non-monetary costs and benefits as well, such as the psychic costs of college related to the time and effort associated with studying or the improvement in one's health, expansion of one's ability to enjoy non-market activities, and the consumption benefits of the college experience. Any examination of the well-known problems of identification and measurement of non-market costs and benefits, while posing an important challenge in the context of human capital theory, is beyond the scope of this chapter.

expressed in Equation (1) as the earnings differential between college and high school graduates ($E_t^C - E_t^H$)—exceeds the present discounted value (PDV) of the direct costs (C_t), plus the indirect costs or foregone earnings (E_t^H) during college.

$$\sum_{t=5}^{T} \frac{E_t^C - E_t^H}{(1+i)^t} > \sum_{t=1}^{4} \frac{C_t}{(1+i)^t} + \sum_{t=1}^{4} \frac{E_t^H}{(1+i)^t} \qquad \text{(Equation 1)}$$

The symbol (i) in Equation (1) represents the market rate of interest used to discount the value of future streams of costs and benefits, while the symbol (r) in Equation (2) represents the *internal rate of return* on the investment, which equals the interest rate that equates the PDV of the benefits of college and the PDV of the costs of college.

$$\sum_{t=5}^{T} \frac{E_t^C - E_t^H}{(1+r)^t} = \sum_{t=1}^{4} \frac{C_t}{(1+r)^t} + \sum_{t=1}^{4} \frac{E_t^H}{(1+r)^t} \qquad \text{(Equation 2)}$$

Using both the internal rate of return (r) and the market rate of interest (i), the following criterion indicates whether or not an investment in college would be profitable: the investment would be profitable when the internal rate of return (r) exceeds the market rate of interest (i) (Arai, 1998; Carnoy, 1995; Checchi, 2006; Cohn & Geske, 1990; Ehrenberg & Smith, 2006; Johnes, 1993; Kaufman & Hotchkiss, 2000; McConnell et al., 2003; McMahon & Wagner, 1982; Paulsen, 2001a).

This algebraic portrayal of the higher education investment decision in the human capital model provides a more refined framework for identifying policy levers—at the federal, state, institutional, or private levels—that can be used to influence students' decisions regarding whether or not to participate in college. For example, policies that provide subsidies to students—such as financial aid in the form of grants, scholarships, or loans from governmental, institutional or private sources—could serve to expand the budget constraints faced by students by providing them with increased funding to pay for the out-of-pocket or direct costs of college (C_t). Those students who experience such positive changes in their budget constraints would, all else equal, be more likely to choose to attend college and invest more in higher education (see, e.g., Catsiapis, 1987).

Even though the diagrammatic and algebraic portrayals of the human capital models presented above provide useful insights for identifying and predicting the effects of various policy levers on students' decisions about whether or not, and how much, to participate in higher education, there is a more comprehensive, complex and policy-specific diagrammatic presentation of the human capital model that is the most productive and revealing framework for identifying policy levers and predicting the effects of policy levers—at the federal, state, institutional, or private levels—on the students' decisions regarding whether or not to participate in college. This is the model of supply and demand in the market for funds to invest in higher education. It reveals and clarifies, for representative individuals or groups, both broad categories and specific types of policy levers that are available to influence both supply-side and demand-side factors affecting the college-going decision-making of students and their families.

This model of supply and demand in the market for funds to invest in higher education was developed by Nobel laureate Gary Becker (1967, 1975, 1993); Jacob Mincer applied the model in his study of the distribution of labor incomes (1993); and Walter McMahon estimated the coefficients of the equations for the *demand* for investment in higher education and for the *supply* of funds to invest in higher education, in a series of studies, estimating the equations separately for samples of whites, blacks, males, females, and students from all race and gender groupings in the lowest income quartile (1976, 1984, 1991). This comprehensive, theoretically-sound, empirically-supported model is useful for policy analysis in higher education for the following reasons: it serves as a very productive framework for explaining why some students, or groups of students, are more advantaged and others are more disadvantaged in the market for funds to invest in higher education; it provides, for representative individuals or groups, a useful framework for identifying specific types of policy levers—on both the supply-side and the demand-side of the market—that coincide with constraints faced by students and their families when making college-going decisions; and it provides an analytical structure for predicting the effects of policies that change constraints in ways that enable and prompt students to invest in higher education and participate in college.

The notions of *marginalism* and the method of *marginal analysis* are central concepts from microeconomics and constitute important foundational elements for constructing the logic of problems relating to educational policy (Frank, 2003; Paulsen & Toutkoushian, 2006b; Pindyck & Rubinfeld, 2005). For example, human capital theory assumes that when students consider whether or not to invest in an additional unit of education—such as one year, or two years, or four years of college—they compare expected benefits to expected costs in order to make informed and utility-maximizing decisions. Economists view such decision-making challenges as exercises in constrained optimization—i.e., students choosing in ways that will maximize their satisfaction or utility subject to relevant budget and time constraints. Economists view a student's decision regarding whether or not to invest in a college education as decision-making "at the margin." In other words, because marginal is a synonym for "incremental" or "additional," when a student is considering whether or not to invest in an additional unit of education, he or she will compare the "marginal" benefits with the "marginal" costs of such a decision. As long as the marginal benefit of an option exceeds the marginal cost, the decision maker would find it to his or her advantage to pursue the option, and vice versa.

Based on the framework of the human capital model portrayed in Fig. 9, and the precise expression of the investment decision criterion as expressed in Equations (1) and (2), we know that it would be profitable for a student to invest in higher education as long as the internal rate of return (r) exceeds the market rate of interest (i). This investment criterion is completely consistent with marginal analysis, because the internal rate of return (r) reflects the marginal benefit (MB) of an additional unit of investment in higher education in percentage terms (i.e., MB = r), and the market rate of interest (i) represents the marginal cost (MC) of an additional unit of investment in higher education in percentage terms (i.e., MC = i) (see, e.g., Becker, 1993;

McMahon, 1984; Mincer, 1993; Paulsen, 2001a). In the model of supply and demand in the market for funds to invest in higher education constructed below, MB will be defined as the "marginal rate of return" on each additional dollar invested in higher education and the MC will be defined as the "marginal interest cost" for each additional dollar invested in higher education.[5]

The presentation of this model of human capital theory is informed by the original work of Becker (1975, 1993), the applications by Mincer (1993), and the empirical studies of McMahon (1976, 1984, 1991); as well as by the nature of its presentation and explanation in a number of textbooks and related scholarly work in labor economics and the economics of education (see, e.g., Arai, 1998; Card, 1999; Kaufman & Hotchkiss, 2000; McConnell et al., 2003; Paulsen & Smart, 2001). In order to construct the overall framework of the model, the supply side will be presented first, followed by the demand side, and a combination of demand and supply that helps portray the meaning of reaching equilibrium for individuals and groups in the market for funds to invest in higher education. Then, the overall framework is used to identify policy levers that can be used to change constraints faced by students in ways that promote changes in the behavior of individual students or groups of students and increase their likelihood of participation in higher education.

Figure 10 presents the supply of funds in the model of the market for funds to invest in higher education. The supply curve illustrates the dollar amounts ($) of different types of funds available at different levels of marginal interest cost (i) for a representative individual student or group of students. In order to fully illustrate the different quantities and different types of funds available at different levels of marginal interest cost, we use a stair-step format to portray the supply of funds. In subsequent analyses, however, we also present supply of funds curves in their more common and simpler upward-sloping format. For the given supply curve in Fig. 10 (S), $0\$_1$ dollars of "grant" funds are available at zero marginal interest cost (i.e., i = 0). From the perspective of students, grants are the least costly and most desirable source of funds and this "grants" category includes sources of funding referred to as grants, scholarships, and private gifts from federal, state, institutional or private sources—including students' parents. Only a small portion of all students are in a position to finance all the costs of their higher education from zero-marginal-interest-cost grant or gift sources and most of those individuals are students from relatively high-income households. The relative availability of zero-marginal-interest-cost grants is an important source of a substantial amount of segmentation in the market regarding the supply of funds for students. The primary reason for this

[5] The marginal rate of return (r) is the yield or expected net economic payoff to an investment, defined as the "value of the (discounted lifetime) gains due to an individual's education expressed as a percentage of the (discounted) costs to the individual of acquiring that education" (Johnes, 1993, p. 28). The market rate of interest (i)—defined in this model as the marginal interest cost from an additional dollar of investment in higher education—equals "either the rate at which interest income could have been earned if the individual's funds had not been spent on college or the rate at which interest costs would have to be paid to acquire the funds necessary to make the college investment" (Paulsen, 2001a, p. 60).

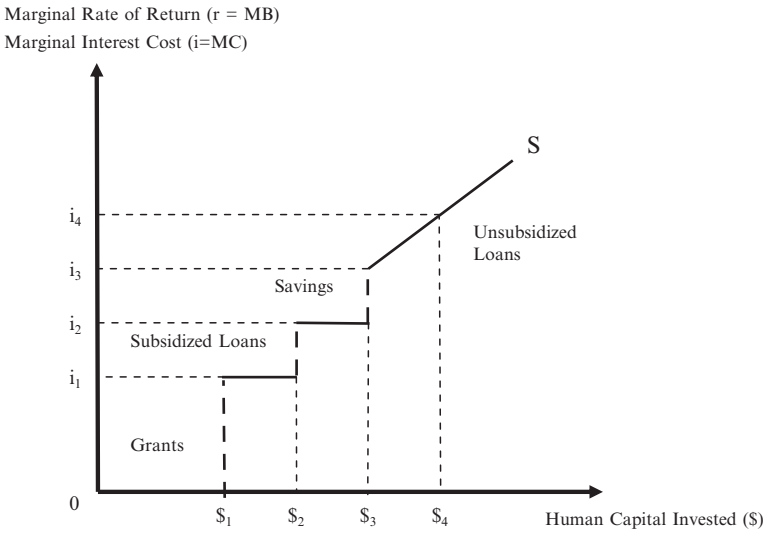

Fig. 10 The supply of funds for investment in higher education

market segmentation is due to the substantial variation in the family incomes and wealth of college-bound students and the concomitant variation in students' receipts of gifts from parents to finance none, some, or all of their higher education. In many instances, policies that result in grants for students from federal, state and institutional sources instead of parental or other family sources—e.g., Pell grants—are intended to address the inequities that arise from this market segmentation due to the unequal distribution of family income and wealth in the nation.

Once funds at a marginal interest cost of zero are exhausted, students must turn to types of funds available at various non-zero marginal interest costs to finance their education. The category of funds with the second-lowest marginal interest cost is subsidized student loans (e.g., subsidized Stafford loans). In Fig. 10, $\$_1\$_2$ dollars of subsidized loans are available at a non-zero marginal interest costs of i_1. Subsidized Stafford loans, along with Pell grants, of course, were designed to increase the availability of zero-or-low-interest-cost funds for low-income students, thereby expanding their budget constraints to enable and promote their participation in higher education (Mumper, 1996; St. John, 1994, 2003). Next, $\$_2\$_3$ dollars of funds are available to students who are able to draw upon their own savings, such as earnings from summer jobs and the like. When students use their own savings to finance college investment, they give up the chance to earn interest income on the balance of those funds in an interest-earning asset, such as a savings account. The marginal interest cost of these funds is the rate at which students forego interest income on their savings, indicated in Fig. 10 as i_2. Finally, once funds from grants, subsidized loans, and savings are exhausted, students turn to unsubsidized loans, avail-

able at increasingly higher marginal interest costs equal to or greater than i_3 or i_4.[6] The shift in federal policy away from grants—with a marginal interest cost of zero—and towards loans with marginal interest costs ranging from a minimum of i_1 to a maximum reaching higher than i_4 has necessarily resulted in an increase in the average marginal interest cost of funds for many students—especially those eligible for federal need-based grants (College Board, 2006b; St. John, 2003).

The demand for investment in higher education is presented in Fig. 11. The demand curve (D) illustrates the relationship between the amounts of dollars invested in higher education ($) and the marginal rate of return (r) on each additional dollar invested in higher education. As explained above, the marginal rate of return equals the internal rate of return (r) from Equation (2). The demand for investment in higher education is downward-sloping for several reasons. For each additional investment a student makes in higher education, the number of years over which the student can benefit from the college-high school earnings differential decreases, the direct (tuition) and indirect (foregone earnings) costs increase, and a student's future earnings and productivity increase at a diminishing rate because additional human capital is being added to limited mental, physical, and temporal capacities of an individual—i.e., the law of diminishing returns in the production of human capital is in effect. This pattern is clearly illustrated in Fig. 11. Reading from the demand curve (D), when the amount invested is only $\$_1$, the marginal rate of return on the last dollar invested equals r_3, but when the amount invested reaches $\$_2$ and $\$_3$, then the marginal rates of return decrease to r_2 and r_1, respectively.

Figure 12 illustrates the equilibrium and optimal level of investment in higher education for a representative individual or group of individuals facing the demand and supply conditions presented in the figure. In order to maximize utility subject to her budget constraint, a student should continue to invest in higher education as long as the marginal rate of return (MB = r) exceeds the marginal interest cost (MC = i) of an additional unit of investment. In Fig. 12, for each amount of dollars invested ($)—i.e., the horizontal coordinate of each point on the demand curve—the marginal rate of return from the last dollar invested (r) is read as the vertical coordinate off the

[6] As indicated, we assume that the decision-making unit in our analysis of the market for investment in higher education is the individual student. But this analysis can also be done using the family, or some combination of the student and the family, as the relevant decision-making unit. The analytical framework is highly generalizable and works equally well with the student or the family as the relevant decision-making unit. However, when the decision-making unit is the family, then one feature of the supply of funds curve must be interpreted differently. When the family is the decision-making unit, then family income and parental contributions to their children's education are no longer viewed as a source of zero-marginal-interest-cost funds. Instead, when a family uses "savings" from its income as a source of funds to pay for higher education, these savings have opportunity costs, and the opportunity costs are measured in terms of the marginal interest rate (i_2 in Fig. 10 above) at which the family's savings could have earned interest income if it had not been spent on investment in higher education (see, e.g., McMahon, 1984).

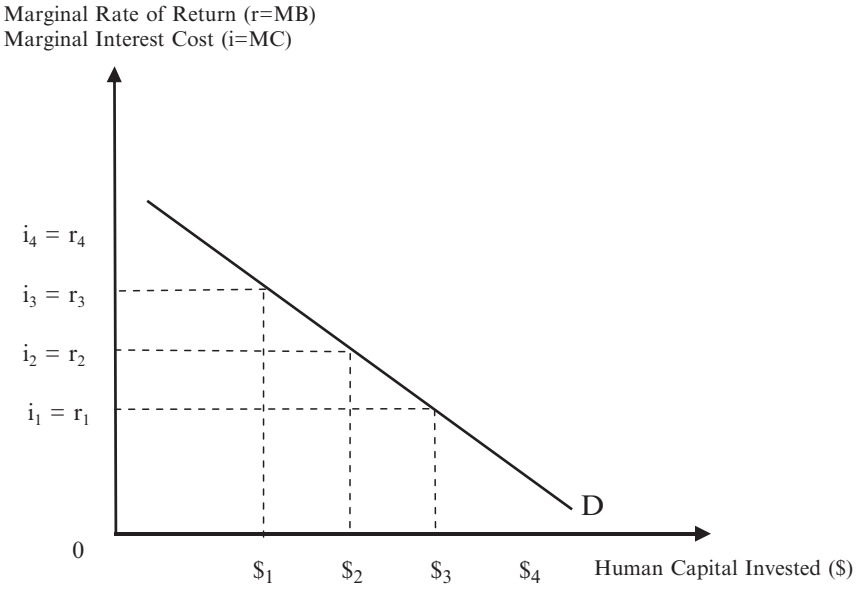

Fig. 11 The demand for investment in higher education

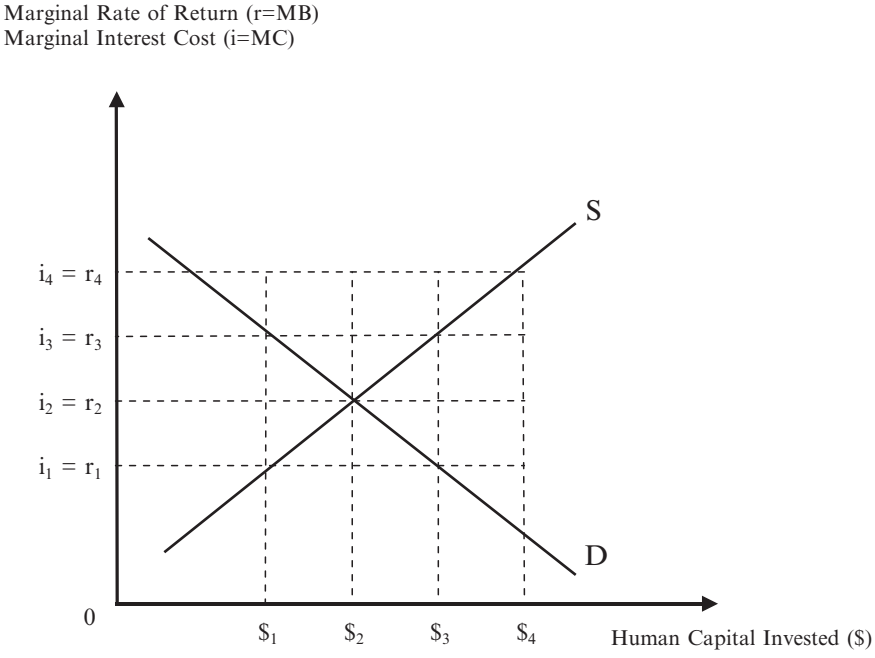

Fig. 12 Supply, demand, and the equilibrium level of investment in higher education

demand curve corresponding to a particular level of investment ($), while the marginal interest cost of the last dollar invested (i) is read as the vertical coordinate off the supply curve corresponding to a particular level of funds for investment ($)—i.e., the horizontal coordinate of each point on the supply curve. As shown in Fig. 12, when the amount invested in higher education equals $\$_1$, the demand curve indicates that the marginal rate of return is r_3, and the supply curve indicates that the marginal interest cost is only i_1. Because r_3 exceeds i_1, increased investment in higher education would clearly be profitable for the student. The marginal rate of return continues to exceed the marginal interest cost of funds until the level of investment reaches $\$_2$, where the marginal rate of return equals the marginal interest cost of funds for the last dollar invested, which means $\$_2$ would be the equilibrium level of investment and the amount of investment that would maximize the student's utility subject to a budget constraint (Arai, 1998; Kaufman & Hotchkiss, 2000; McConnell et al., 2003; McMahon, 1984; Paulsen, 2001a).

Supply, Demand, and Policy Levers in the Market for Funds to Invest in Higher Education

In this section we present specifications for the supply and demand functions that include arguments defining the relevant supply-side or demand-side conditions or constraints faced by representative individuals or groups in the market for investment in higher education. In order to develop the most useful and straightforward specifications for supply and demand functions, the particular supply and demand specifica-tions presented and used in this analytical model are informed by, but not identical to, the original specifications of Becker (1967, 1975, 1993), the specification and empirical estimation of the supply and demand functions by McMahon (1976, 1984, 1991), as well as by additional research on factors influencing the rates of return (see, e.g., Card, 1999) and factors influencing students' likelihood of participation in and/or level of investment in higher education (see, e.g., Ellwood & Kane, 2000).

Using this approach, the supply function in Equation (3) is consistent with Becker's original conceptualization of inter-individual or inter-group differences in supply conditions as representing *constraints* on the "opportunities" students have to access funds for investment in higher education—manifested as differences between supply curves in the marginal interest cost (i) at which various amounts of funds ($) are available (1975, 1993).

Supply Function:

$$S_{\$} = f(i, Y, G, L) \qquad \text{(Equation 3)}$$

Where

i = the marginal interest cost of each additional dollar invested
Y = disposable income of the student's family

G = grants, which includes sources of funding referred to as grants, scholarships, or gifts from federal, state, institutional or private sources
L = loans available to lower and middle income students through a means test

All arguments besides "i" in the supply function represent shift parameters that change the position of the overall supply curve. Therefore, the shift parameters constitute a set of potentially fruitful policy levers that could effectively change supply conditions and constraints in ways that expand students' opportunities to invest in college (i.e., supply-side constraints) and thereby promote access to higher education.

Figure 13 presents two different supply curves in the market for funds to invest in higher education. Each supply curve represents a set of supply conditions or *constraints* faced by a representative individual or group of individuals in the market. These conditions or constraints can make some students more *advantaged* and others more *disadvantaged* in the market for funds to invest in higher education. It is evident from Fig. 13 that the marginal interest costs (i) at which various dollar amounts of funds are available clearly present a more advantaged set of supply conditions or constraints for those individuals or groups who face supply curve S_2 compared to those who face supply curve S_1 in the market for funds to invest in higher education. For example, supply curve S_1 starts with a horizontal portion from 0 to $\$_1$ and continues with a upward-sloping portion from its horizontal intercept at $\$_1$ to S_1, and supply curve S_2 starts with a horizontal portion from 0 to $(\$_3 + \$_4)/2$ and continues with a upward-sloping portion from its horizontal intercept at $(\$_3 + \$_4)/2$ to S_2.

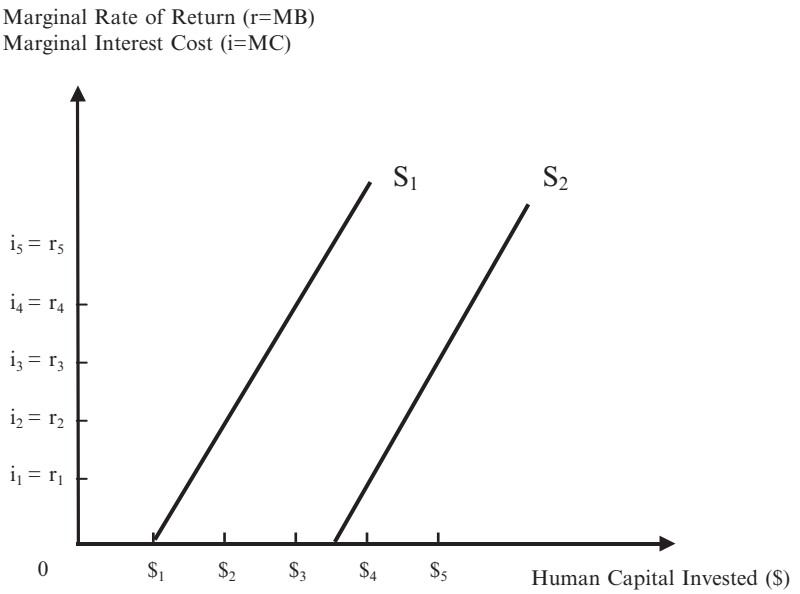

Fig. 13 Supply conditions and advantage and disadvantage in the market for investment in higher education

The horizontal portion of each of the two supply curves, S_1 and S_2, indicates the amount of funds available to a student from zero-interest-cost sources, such as grants, scholarships, and gifts from federal, state, institutional and private sources, including parents.

One of the most prominent determinants of the position of the supply curve of funds to invest in higher education is family income (Y in Equation (3)) and/or wealth (Becker, 1967, 1975, 1993; McMahon, 1976, 1984, 1991). Many students from moderately to very wealthy families have access to zero-interest-cost funding for college from their parents in amounts that are often sufficient to cover a portion, if not all, of the costs of college attendance. More specifically, Ellwood and Kane (2000) estimate that parents of students from the top income quartile pay $4,083 more of their children's college costs at public institutions and $8,420 more at private institutions than those in the lowest income quartile. In terms of the supply curves in Fig. 13, inter-family differences in income and wealth could be responsible for a substantial share of the difference in the horizontal intercepts of S_1 and S_2 and the amounts of zero-interest-cost funds available—i.e., 0 to $\$_1$ versus 0 to $(\$_3 + \$_4)/2$ under the two sets of supply conditions. There is broad support in the literature for the hypothesis that family income has a positive effect on enrollment (Ellwood & Kane, 2000; Hossler et al., 1999; Kane, 1999; Perna, 2000), and that gaps in participation rates between income groups are both substantial and persistent (see, e.g., Mumper & Freeman, 2005; Thomas & Perna, 2004).

We are currently in a period of increasing rather than decreasing gaps in income between higher and lower income classes; therefore equalizing access to higher education—where more investment in higher education leads to greater future income—could be a potentially productive long-term method to achieve a more equal distribution of income. Many economists and other policy analysts have contended that the existence of substantial positive externalities arising from investment in higher education constitutes a compelling rationale to prompt government to intervene in the market for investment in higher education with grants for students that are intended to expand students' budget constraints and promote greater participation and investment in higher education (Baum, 2004; Breneman & Nelson, 1981; Paulsen, 2001b; Paulsen & Toutkoushian, 2006a). The greatest challenge in this regard is based on the ongoing, but only moderately successful, efforts of economists and other policy analysts to identify the nature, and measure the magnitudes, of all the sources of positive externalities due to investment in higher education (Baum & Payea, 2004; Bowen, 1977; Fatima & Paulsen, 2004; Institute for Higher Education Policy, 2005; Paulsen & Fatima, 2007). The primary sources of zero-marginal-interest-cost grants to students have included federal need-based and state need-based grant programs, as well as a rapidly increasing pool of state merit-based grants for all merit-eligible students regardless of need (College Board, 2006b; Heller, 2006; Mumper & Freeman, 2005).

The demand function in Equation (4) is also consistent with Becker's original conceptualization of differences in demand functions as representing constraints on the "capacities" students have to benefit from investments in human capital—manifested as differences between demand curves in the marginal rates of return (r)

for various amounts invested ($) (1967, 1975, 1993). All arguments besides "r" in the demand function represent shift parameters that change the position of the overall demand function. Therefore, the shift parameters constitute a set of potentially fruitful policy levers that could effectively change demand conditions and constraints in ways that expand students' capacities to benefit from those investments (i.e., demand-side constraints), thereby promoting access to higher education.
Demand Function:

$$D_{\$} = f(r, A, FB, SQ) \qquad \text{(Equation 4)}^{7}$$

where

r = the marginal rate of return for each additional dollar invested
A = ability as measured by test scores or school grades
FB = family background, such as parents' education, income, occupation
SQ = school quality measured by indicators of school resources such as pupil-teacher ratios, teacher salaries, or length of school year (see, e.g., Card & Krueger, 1992)

Figure 14 presents two different demand curves in the market for funds to invest in higher education. Each demand curve represents a set of demand conditions or constraints faced by a representative individual or group of individuals in the market. These conditions or constraints can make some students more advantaged and others more disadvantaged in the market for funds to invest in higher education. The marginal rates of return (r) corresponding to various dollar amounts invested in higher education clearly present a more advantaged set of demand conditions or constraints for those individuals or groups who face demand curve D_2 compared to those who face demand curve D_1 in the market for investment in higher education. For example, in Fig. 14, for a representative individual or group whose demand conditions or constrains are portrayed along demand curve D_1, when the amount invested is $\$_2$, the marginal rate of return on the last dollar invested equals only r_2. However, for a representative individual or group whose demand conditions or constrains are portrayed along demand curve D_2, when the same amount is invested ($\$_2$), the marginal rate of return on the last dollar invested is much higher at $(r_4 + r_5)/2$. Similar vertical differences in the marginal rates of return between the two demand curves can be observed for each amount of dollars invested.

One of the most prominent determinants of the rates of return to education, and therefore, the position of the demand curve for investment in higher education is student ability (A in Equation 4) (Arai, 1998; Becker, 1993; Card, 1999; Cipillone,

[7] A careful study of the issues of measurement, specification, endogeneity, and selection bias in the estimation of rates of return to education is beyond the scope of this chapter. We encourage readers to consult the recent reviews of this literature by Ashenfelter and Rouse (2000) and Card (1999). Another specification of the demand for human capital could include an indicator of college quality (see, e.g., Dale and Krueger, 1999; Monks, 2000; Zhang and Thomas, 2005); however, this is not included in Equation (4) because our analysis focuses on the access decision of students regarding whether or not to attend college, but *not* the student choice of which college to attend.

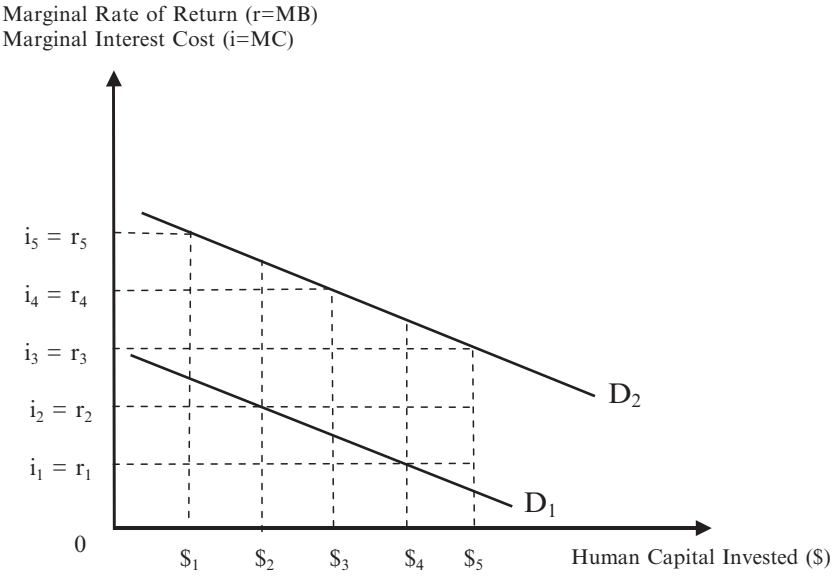

Fig. 14 Demand, advantage and disadvantage in the market for investment in higher education

1995; Leslie & Brinkman, 1988; McMahon, 1976, 1984, 1991; Monks, 2000; Taubman & Wales, 1974; Woodhall, 1995). Students of higher ability tend to have higher rates of return than those of lower ability. Therefore, all else equal, D_2 would illustrate the demand for investment in higher education for students with higher ability and D_1 would represent the demand for investment in higher education for students with lower ability. The positive correlation between ability and earnings has been explained in a number of understandable ways. For example, some economists explain the differences in rates of returns between different demand curves in terms of interpersonal differences in ability, broadly conceived. Becker (1993) explains that higher demand curves represent higher rates of returns because "persons who produce more human capital from a given expenditure [on human capital] have more capacity or 'ability'" (p. 124), and Mincer (1993) concurs that "differences in levels of demand curves represent individual differences in productivities, or abilities" (p. 56). Other economists have argued that an individual's ability is related to a form of initial "pre-school" or "pre-existing" endowment of human capital that can be subsequently used to more productively acquire additional human capital (Cipillone, 1995; Thurow, 1970). Initial endowments of human capital can directly affect the level of education a student attains, the learning that occurs during schooling, and the earnings and rates of return that occur subsequent to that schooling.

Economists and other social scientists have also found measures of family background—particularly parental education, as well as parental income or occupation—to be related, either directly or indirectly through mediating variables,

to rates of return to education and therefore, to the position of the demand curve for investment in higher education (FB in Equation 4) (Behrman et al., 1992; Card, 1999; Jencks, 1972, 1979; Korenman & Winship, 2000; McMahon, 1976, 1984, 1991; Sewell & Hauser, 1976; Taubman & Wales, 1974). Therefore, all else equal, D_2 would illustrate the demand for investment in higher education for students with more advantaged family backgrounds and D_1 would represent the demand for investment in higher education for students with less advantaged family backgrounds.

There are a number of reasons that those from more advantaged family backgrounds tend to have higher rates of return to educational investments. As one example, McMahon (1984) offers this explanation for including mother's education as his measure of family background in his investment demand function: "The hypothesis is that home investments in children, when the mother has more education, raises the IQ or ability of the child…and also, especially if the mother has been to college, shifts the utility function toward greater farsightedness. Both imply larger investment in education." (p. 82). This "farsightedness" of college-educated parents is quite important and refers to the greater likelihood that college-educated parents are well aware of the benefits of college, well-informed about the nature and extent of such benefits and all of the arrangements, resources and efforts that are necessary to acquire them, and therefore place a high value on the benefits of college—most of which would accrue in the future. As a result, college-educated parents would be more willing to forgo present consumption for future benefits from investment in college and accordingly would use a smaller rate to discount future earnings and would expect higher rates of return to investments. When children have the opportunities to inherit or adopt this information and these values, insights, beliefs, and perspectives from their parents, they acquire an early form of human capital—produced in the home or family environment—that can enhance their propensity for educational investment, as well as the productivity and fruitfulness of their investment, both in terms of the quantity and quality of the education they acquire and their subsequent earnings in the job market throughout their careers.

Another important determinant of rates of return, and therefore, the position of the demand curve for investment in higher education is school quality (SQ in Equation 4) (Altonji & Dunn, 1996; Card, 1999; Card & Krueger, 1992, 1996). Students who acquire pre-college education at schools with higher levels of resources—as measured by pupil-teacher ratios, teacher salaries or another indicator of school expenditures per pupil—tend to have higher rates of return than those who attend pre-college schools with fewer resources. Therefore, all else equal, D_2 would illustrate the demand for investment in higher education for students who acquire pre-college education at schools with greater resources and D_1 would represent the demand for investment in higher education for students who acquire pre-college education at schools with fewer resources. According to Card and Krueger (1996), the "most plausible theoretical explanation for a link between school quality and earnings is that—other things being equal—students acquire more skills if they attend higher quality schools (i.e., schools with more generous resources)" (p. 165).

In this section, we examine the ways in which demand and supply curves—for individuals or groups who are advantaged or disadvantaged in the market—interact to generate a variety of possible equilibrium levels of investment under various supply and demand conditions and constraints. Figure 15 combines sets of different supply curves and different demand curves for individuals and/or groups of individuals in the market for funds to invest in higher education. Each supply curve and each demand curve represents a set of supply or demand conditions or constraints faced by a representative individual or group of individuals in the market. These conditions or constraints can make some students more advantaged and others more disadvantaged in the market for funds to invest in higher education. In this context, we can analyze the effects of changes in the shift parameters in the supply and demand functions as policy levers to expand students' constraints and change individual behavior in favor of more investment in higher education, thereby promoting access.

In Fig. 15, we first consider representative individuals or groups of individuals who are relatively less advantaged on both the supply and demand sides of the market. In other words, students who are not from advantaged family backgrounds, do not have high ability endowments, and did not attend high-quality pre-college schools are best portrayed by demand curve D_1. If these students are also not from higher-income families and qualify for only need-based grants with limited purchasing power in terms of covering the direct costs of college, their conditions and constraints are best represented by supply curve S_1. In order to maximize their utility students should invest in units of higher education ($) as long as the marginal

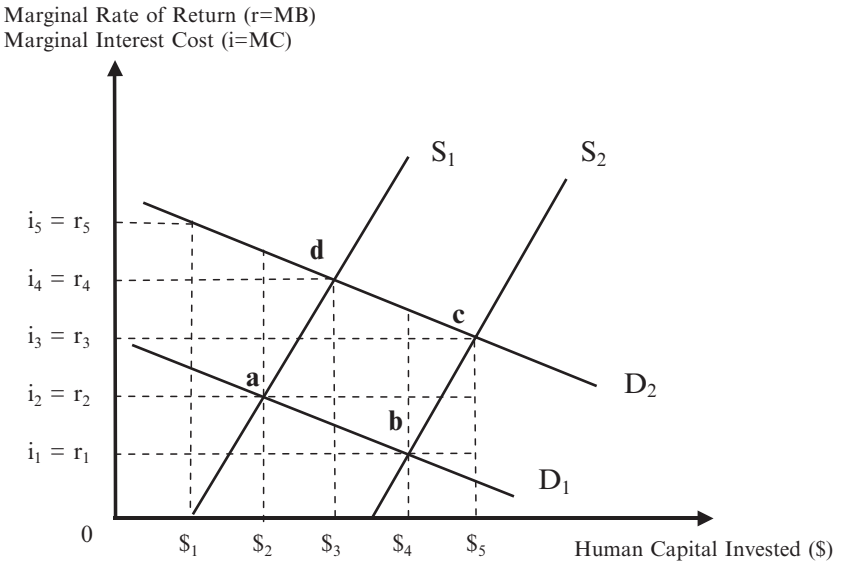

Fig. 15 Supply, demand, advantage and disadvantage in the market for investment in higher education

rate of return exceeds the marginal interest cost of funds required for such investment. For those facing supply and demand conditions S_1 and D_1, investment would be worthwhile for dollar amounts from 0 up to $\$_2$—i.e., $r > i$ until dollars invested reaches $\$_2$ at point "a". All else equal, point "a" is the optimal and equilibrium level of investment in higher education for students with supply and demand constraints S_1 and D_1.

As noted in a previous section, the primary determinant of differences in supply conditions like those represented by S_1 and S_2 is differences in family incomes. And family incomes, of course, are private sources of zero-marginal-interest-cost funds, usually gifts to children, to pay for college. For lower-income students, supply-side policies can help address their relative disadvantage in the supply of funds for investment by providing public sources of zero-marginal-interest-cost funds in the form of federal and state need-based grants. Substantial increases in need-based grants would expand lower-income students' budget constraints, shifting them from a supply constraint indicated by S_1 to one better represented by S_2. Such policies could help address, at least in part, the different availabilities of zero-marginal-interest-cost funds between higher- and lower-income students. If these policy changes move lower-income students from S_1 to S_2 (along D_1), a new equilibrium and optimal level of investment would occur at point "b" where S_2 intersects D_1 and where $\$_4$ dollars are invested in higher education. As illustrated in Fig. 15, for all investment amounts from 0 to $\$_4$ the marginal rate of return exceeds the marginal interest cost of funds, making $\$_4$ the new equilibrium level of investment.

Research indicates that, as predicted by the model, increases in grants are positively related to greater enrollment and investment in higher education (see, e.g., Catsiapis, 1987), and research has demonstrated the positive enrollment effects of need-based grants from federal sources (Leslie & Brinkman, 1988; Manski & Wise, 1983; McPherson & Schapiro, 1991; Dynarski, 2003) and need-based grants from state sources (Ellwood & Kane, 2000; Heller, 1999; Kane, 1999). State merit-based grants have also become popular in recent years and their availability could also help students move from a supply constraint like S_1 to one like S_2. However, increases in these funds would provide additional zero-marginal-interest-cost funds—usually as an entitlement—for students who are merit-eligible regardless of financial need. Nevertheless, research does indicate that merit grant programs also promote greater participation and investment in higher education (see, e.g., Dynarski, 2004).

We next consider representative individuals from lower-income students—who continue to be the focus of our access-based concern—in an initial equilibrium in their investment decision-making at point "b" in Fig. 15, where the optimal, and utility-maximizing, level of investment in higher education is $\$_4$ dollars. In this instance, at point "b" students are relatively less advantaged on the demand side of the market as illustrated by their demand constraints on demand curve D_1, but are relatively more advantaged on the supply side of the market as illustrated by their supply constraints on supply curve S_2. In other words, demand curve D_1 portrays students who do not have high ability endowments, are not from advantaged family backgrounds, and did not attend high-quality pre-college schools. We assume that

the supply-side policies discussed in the previous section were implemented and that the effects of such policies were, as illustrated in Fig. 15, to move the lower-income students—previously in equilibrium at point "a" and facing supply conditions S_1—to point "b" where their new supply constraints are reflected by supply curve S_2. Their somewhat more advantaged supply constraints on S_2 reflect the fact that the supply-side policies (increased grants) discussed in a previous section were effectively implemented and these students have already been the recipients of a substantially increased volume of need-based federal or state grants, and possibly also of some state merit-based grants as well.

As noted in a previous section, the primary determinants of differences in demand conditions—and perceived rates of return to educational investment—like those represented by D_1 and D_2 are differences in students' ability, family background, and pre-college school quality. Each of these determinants of rates of returns—and therefore, of the position of the two demand curves—reveal policy levers that could use demand-side policies to promote changes in the behavior and decision-making of lower-income students that lead to increases in their participation and investment in higher education, thereby addressing the access problem. Although increasing the innate or genetic ability endowments of potential students is not within the grasp of policymakers, policies to promote academic achievement and gains in academic achievement in pre-college schooling do provide accessible policy levers based on demand-side policies in the market for investment in higher education. For example, research on the "achievement model" (see, e.g., Jencks & Phillips, 1999) now provides convincing evidence that academic achievement and gains in academic achievement, as measured by test scores on cognitive tests of knowledge and skills—such as ACT or SAT math, verbal or content area scores—are significantly and positively related to students' subsequent earnings. In other words, this evidence indicates that differences in measured academic achievement or gains in academic achievement in school positively affect the earnings, and therefore, the rates of return on educational investments for students. Academic achievement is, of course, an important predictor of college participation, particularly among lower-income students; and there are many types of pre-college preparation programs that can help improve students' academic achievement (see, e.g., Perna, 2005).

Clearly, changing today's students' family backgrounds so they are more "advantaged," such as by increasing the share of today's students whose parents are college-educated, is not within the grasp of policymakers. However, there are policy levers, based on demand-side policies in the market for investment in higher education, that are available to provide alternative opportunities for today's youth to acquire some of the knowledge, information, values, insights, beliefs, and perspectives about the costs and benefits of college, the preparatory steps and efforts required to get to college and be successful there, that a family background with college-educated parents could provide. Providing adequate funding for the TRIO programs (Fenske et al., 1997) and funding to support state-level efforts like Indiana's highly successful postsecondary encouragement experiment (Hossler & Schmit, 1995) and the COACH mentoring program in Boston's public schools (Avery & Kane, 2004)

serve as excellent examples of such policies.[8] Unlike many of the other policies considered in our analysis, these demand-side policies do not affect, and are not intended to affect, students' financial constraints; instead, they are targeted to influence how students form their college-going preferences, and therefore, their expected rates of return to investments in college.

The third set of policy levers we consider is also based on demand-side policies in the market for investment in higher education. These policies require increased funding to provide more resources in elementary and secondary schools. Most research on the effects of school resources on students' future earnings has identified specific targets for policy, such as raising teacher salaries and lowering pupil-teacher ratios, both of which would enhance school resources and increase the rates of return to schooling for students in the system (Card, 1999, 2001). For example, Card and Krueger (1996) conducted a meta-analysis of a group of studies of the effect of school resources and students' future earnings. They examined 25 estimates of the effect of school resources on earnings and converted them to comparable elasticites. Their findings showed that all estimated elasticities were positive and nearly all were statistically significant.

Each of the three sets of demand-side policies discussed above can help address the relative disadvantage of the lower-income students on whom our analyses is focused, in terms of the demand for investment in higher education, by increasing the rates of return to further schooling for these students. Policies such as those discussed above—i.e., increasing pre-college academic preparation programs, post-secondary encouragement and information dissemination programs, and per-pupil resources in schools—would increase the rates of return to higher education among lower-income students. This would mean that for each amount of dollars invested in higher education, rates of return would be higher than before the policy changes. This is portrayed diagrammatically in terms of a higher demand curve, because a higher demand curve represents an expansion in the demand-side constraints—i.e., constraints on what students' future earnings would be—for lower-income students.

In terms of Fig. 15, students' initial equilibrium position is at point "b" where D_1 and S_2 intersect. But this expansion in the demand-side constraints would shift students from a demand constraint indicated by D_1 to one better represented by D_2. If the demand-side policy changes move these lower-income students from D_1 to D_2 (along S_2), a new equilibrium and optimal level of investment would occur at point "c" where S_2 intersects D_2 and where $\$_5$ dollars are invested in higher education.

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[8] This discussion of the effects of students' family backgrounds, such as their parents' educational attainment, on students' future earnings and rates of return to education is akin to the excellent conceptual and empirical work of sociologists interested in the access problem. A thorough examination of the invaluable contributions of educational sociologists to our understanding of the nature and complexity of the issues of access and equity in college-going is beyond the scope of this chapter. However, we encourage readers to consult the following work to explore this vibrant literature, particularly regarding the constructs of habitus and symbolic capital such as cultural and social capital (Bourdieu, 1977a, b; Bourdieu and Passeron, 1990; Coleman, 1988; Horvat, 2001; Lamont and Lareau, 1988; Massey et al., 2003; McDonough, 1997).

For all investment amounts from 0 to $\$_5$ the marginal rate of return exceeds the marginal interest cost of funds, making $\$_5$ the new equilibrium and utility-maximizing level of investment. The equilibrium level of investment in higher education at the higher level of $\$_5$ is the result of identifying and using policy levers on both the supply-side and the demand-side to implement policies that alter the constraints faced by lower-income students in ways that make them relatively more advantaged in this market, increasing their willingness and ability to invest more in higher education, which directly addresses the access problem.

Research indicates that, as predicted by the model, increases in funding for pre-college academic preparation programs, postsecondary encouragement and information dissemination programs, and per-pupil resources in schools are positively related to greater levels of enrollment and investment in higher education (Card, 1999; Card & Krueger, 1996; Ellwood & Kane, 2000; Hossler & Schmit, 1995; Hossler et al., 1999; Jencks & Phillips, 1999; Perna, 2005; Perna & Titus, 2005).

This economic model of the market for funds to invest in higher education is particularly effective at distinguishing between the effects of various types of policy levers on access to higher education. As an example, we use the model next to compare the effects of increases in the supply of grant funds versus loan funds on the higher education participation and investment decisions of students who differ in how advantaged they are in the market in terms of their expected rates of return to investment in higher education. One supply-side policy that is extensively used to help improve access to higher education is to expand the available supply of non-zero marginal-interest-cost funds such as subsidized student loans. In the previous analysis of the effects of increases in the supply of grants to students, the entire supply of funds curve shifted to the right, because grants constitute a zero-marginal-interest-cost funding. An increase in zero-marginal-interest-cost funding, by definition, shifts the horizontal intercept—i.e., the value of \$ when i = 0—to the right. However, an increase in the supply of non-zero marginal-interest-cost funds does not shift the horizontal intercept; instead it shifts the supply of funds rightward at the appropriate non-zero marginal-interest cost corresponding to the source of increased funds. In the case of an increase in subsidized student loans, the supply curve will shift rightward at the level of the marginal-interest cost of acquiring additional dollars of subsidized student loans.

In order to fully illustrate the effects of an increase in subsidized loans on the supply constraints and investment in higher education, in Fig. 16 we return to the stair-step format (as used in Fig. 10) for presenting the supply of funds curves. Figure 16 presents two supply curves and two demand curves. As explained previously, students who are not from advantaged family backgrounds, do not have high ability endowments, and did not attend high-quality pre-college schools are best portrayed by demand curve D_1 and tend to have lower rates of return on investments in higher education than the more advantaged students facing demand constraints D_2. The initial supply of funds curve (S_1) indicates that $0\$_1$ dollars of grants are available at zero-marginal-interest-cost (0), $\$_1\$_2$ dollars of subsidized loan funds are available at marginal interest cost i_1, $\$_2\$_3$ dollars of savings funds are available at marginal interest cost i_2, and unsubsidized loans are available at marginal

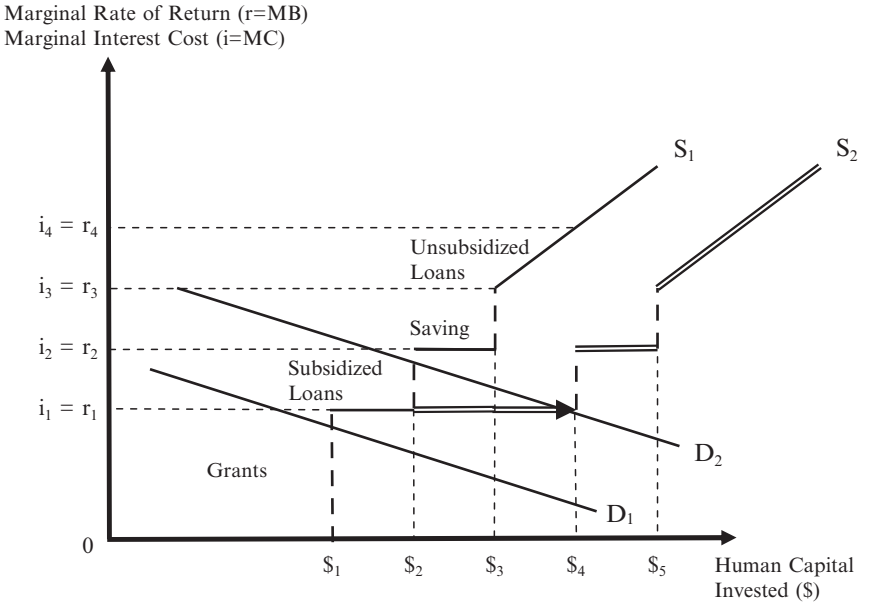

Fig. 16 Supply, demand and investment in higher education: effects of increased supply of subsidized loan funds

interest costs equal to or greater than i_3. It would be worthwhile for students to keep investing dollars in higher education as long as the marginal rate of return equals or exceeds the marginal interest cost of funds. Therefore, faced with the supply constraints represented by supply curve S_1, students with demand constraints represented by D_1 will invest $\$_1$ dollars, while students with demand constraints represented by D_2 will invest $\$_2$ dollars.

Next, consider a supply-side policy change in this context. A substantial increase in available subsidized student loan funds (e.g., subsidized Stafford loans) would result in a shift in the supply of funds from S_1 to S_2. Because there is no change in the quantity of zero-marginal-interest-cost grant funds available, the horizontal intercept of the new supply curve S_2 remains at $\$_1$ dollars, exactly the same as for S_1. The shift in the supply of funds takes place only because of a substantial increase in available subsidized student loan funds. These funds are available at the marginal interest cost of i_1; therefore, the total dollars of these funds available increases from $\$_1\$_2$ dollars with supply S_1 to $\$_1\$_4$ dollars after the shift to supply S_2. The increase in the volume of subsidized student loan funds is represented by the double-lined arrow extending from $\$_2$ to $\$_4$. This increase in loan funds will stimulate greater investment in higher education for some students, but not for others. For students facing demand constraints represented by D_2, the marginal rate of return now exceeds the marginal interest cost of funds for levels of investment up to $\$_4$ dollars, and these students will increase their investment and achieve a new equilibrium and optimal level of investment where S_2 intersects D_2 and where $\$_4$ dollars are invested in higher education. However, students facing the more restrictive demand constraints

represented by D_1 will not increase their investment as a result of the increase in available subsidized student loan funds. For every level of investment beyond $\$_1$, the marginal interest cost of funds exceeds the marginal rate of return on investment. As a result, no increase in investment would be worthwhile for students facing demand D_1.

In Fig. 17, we use stair-step supply of funds curves to more fully illustrate the model's predicted effects of increases in grants funds on investment in higher education. As in Fig. 16, there are two supply curves and two demand curves. Once again, students who are from advantaged family backgrounds, have high ability endowments, and attended high-quality pre-college schools are best portrayed by demand curve D_2 and tend to have higher rates of return on investments in higher education than their less advantaged counterparts facing demand constraints D_1. Given the supply constraints represented by supply curve S_1, the initial equilibrium and optimal level of investment for students with demand constraints represented by D_1 is $\$_1$ dollars, while the initial equilibrium and optimal level of investment for students with the less restrictive demand constraints on D_2 is $\$_2$ dollars.

Next, we assume that a substantial increase in grant funds shifts the supply curve from S_1 to S_2. Because this increase in supply is exclusively due to an increase in zero-marginal-interest-cost grant funds, the shift in supply is represented by a rightward movement in the horizontal intercept of the supply of funds curve, as indicated by the double-line arrow. The horizontal intercept of S_1 was at $\$_1$ dollars of zero-marginal-interest-cost funds, while the horizontal intercept of S_2 is at $\$_3$

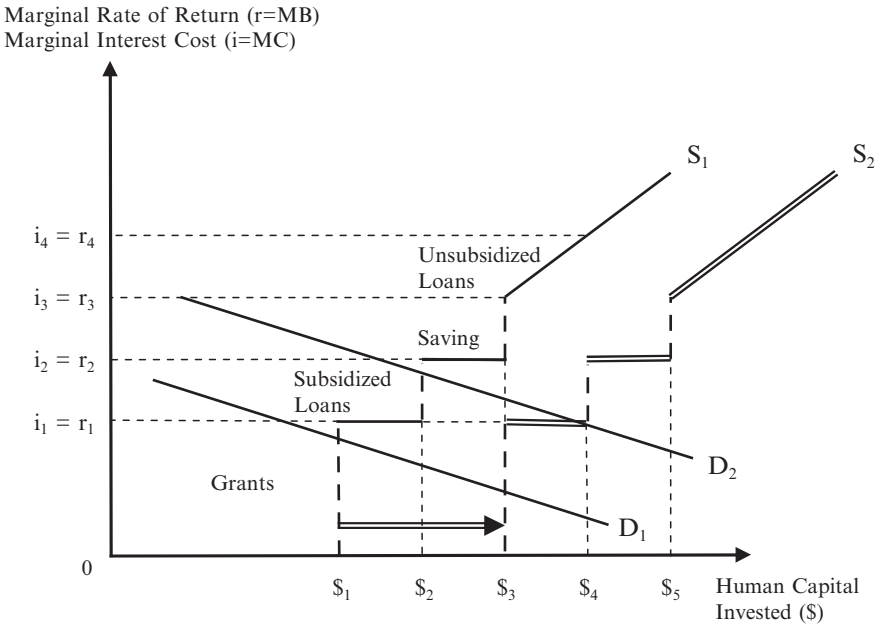

Fig. 17 Supply, demand and investment in higher education: effects of increased supply of grant funds

dollars of zero-marginal-interest-cost funds. The only difference between the two supply of funds curves is that an additional $\$_1\$_3$ funds are now available at zero-marginal-interest cost. The total amount of zero-marginal-interest-cost funds available has increased from $0\$_1$ to $0\$_3$; however, the quantities of each type of the less-desirable non-zero marginal-interest-cost funds (subsidized loans, savings, and unsubsidized loans) available on S_2 are the same as were available on S_1. Unlike the increase in supply due to more subsidized loan funds—which would stimulate investment in higher education for some relatively more advantaged students, but not for some of their less advantaged counterparts—this increase in supply due to more grants will stimulate greater participation and investment in higher education among both more and less advantaged students. More specifically, for students facing demand constraints of D_2, the marginal rate of return now exceeds the marginal interest cost of funds for levels of investment up to $\$_4$ dollars, and these students will increase their investment up to a new equilibrium and optimal level of investment $\$_4$ dollars, where S_2 intersects D_2. In parallel fashion, for students facing demand constraints of D_1, the marginal rate of return now exceeds the marginal interest cost of funds for levels of investment up to $\$_3$ dollars, and these students will increase their investment up to a new equilibrium and optimal level of $\$_3$ dollars, where S_2 intersects D_1.

In summary, an increase in grants—i.e., an increase in zero-marginal-interest-cost funds—increases the horizontal intercept of the supply curve and stimulates more investment in higher education among both students facing relatively more advantaged and students facing relatively less advantaged demand-side conditions or constraints. However, as show in Fig. 16, increases in supply of funds due only to increases in subsidized student loan funds produces an increase in the supply of funds only at the non-zero-marginal-interest costs of i_1. Therefore, this supply-side policy will have different effects on students facing different demand-side constraints. Students who are relatively more advantaged in the market for investment in higher education will increase their investment, while those students who are not from advantaged family backgrounds, do not have high ability endowments, and did not attend high-quality pre-college schools are less likely to find additional investment worthwhile. This analytical result is consistent with existing theory and research. Expansion in subsidized loans is certainly a possible and a popular supply-side policy. However, the subsidy value of loans has been estimated to be only one-half of the subsidy value of grants (Leslie & Brinkman, 1988; McPherson & Schapiro, 1991), and research demonstrates that students' enrollment decisions are more responsive to grant aid than to loan aid (Heller, 1997).

Measuring the Effectiveness of Educational Policies

As the phrase implies, "policy analysis" focuses on how to determine the effectiveness of specific educational policies. This work involves using theory to draw inferences about the likely effect of an educational policy on decision makers, as

described in the previous sections, as well as using inferential methods to test whether specific policies led to the changes that were predicted by theory. This is a crucial part of policy work to economists because an ineffective policy is a wasted opportunity to apply fixed resources to their most highly valued use. Policy makers are always faced with constrained resources that limit the range of things that they can do to help improve education. Accordingly, if a policy was implemented that proved to be ineffective, then the resources could have been used in a more constructive manner and therefore an education stakeholder (students, parents, society) experience losses. It is imperative that educators and policy makers find ways to evaluate the likely impact of their policies when making decisions about them, either prior to or after implementation.

Conceptual models such as those described above are indispensable to economists for conducting this type of work. These models enable researchers to make estimates regarding how specific policies will affect the behavior of the decision maker. Economists refer to these conjectures as comparative statics. The strength of economic analysis and the use of models lies not in their ability to explain how the decision makers arrived at the present equilibrium, but rather in their ability to predict how a change in some facet of the model might affect the equilibrium. Many of these changes can be framed in terms of educational policies. For example, economic models are useful for predicting how an increase in financial aid would affect the number of students choosing to go on to college. The educational policy in this example is to increase financial aid for students, and the theoretical model would show the predicted impact of this policy on the likelihood of targeted students choosing to go to college.

The cornerstone of policy analysis, however, involves finding ways to document whether a specific policy has proven to be effective. This usually takes the form of quantitative studies that look for evidence of relationships between the policy and the actions of the decision maker. A conceptual model serves as a guide to the researcher of the possible factors that should be relevant for inclusion in the quantitative analysis. In the earlier example where policy makers were interested in increasing the rate at which black students go to college, for example, a researcher might conduct a quantitative study to determine if differences across students in their family income level or financial aid affect whether or not they go to college. Thus, the theoretical model of college-going behavior would be useful in identifying the variables that should be used in such a study. Researchers would then have a theoretical basis for focusing on these factors to determine if and how they affect a student's interest in going to college.

There is also a direct connection between comparative statics and the research methods used by economists for educational policy analysis. Multiple regression models and their counterparts such as logistic regression and hierarchical linear modeling (HLM) typically estimate models of the form:

$$Y = X\beta + P\alpha + \varepsilon \qquad \text{(Equation 5)}$$

where

Y = dependent variable of interest

X = set of control variables that the theoretical model suggest might have an impact on Y with weights β
P = policy-related variables that are recommended by the theoretical model with weights α, and
ε = random error term.

The policy variables could be either direct measures of whether the policy was enacted ($P = 1$ if yes, $P = 0$ otherwise), or indirect measures of the policy such as the family income level or amount of higher education spending. The estimated coefficients for the variables in X and P are referred to as partial effects because they show the predicted change in the dependent variable due to a one-unit change in the explanatory variable, holding all other variables constant. Of course, this is precisely what is meant by the notion of comparative statics. Viewed in this way, the estimates for the coefficients (α) can be used to test the theoretical predictions of the effects of specific educational policies on decision makers.

Although the model and description of the approach to educational policy analysis seems straightforward, there are a number of challenges that researchers face when attempting to analyze specific policies. First, researchers always encounter data limitations in their work. These limitations may mean that several key variables that are predicted from the theoretical model to be important for the study cannot be measured. For example, a researcher who is studying the effects of income subsidies on how students make decisions about whether to go to college may have information on family income but not family wealth. Data limitations may also affect the way in which specific factors can be measured and used in an analysis. Surveys of students may, for instance, collect data on family income in groups such as less than $20,000, $20,000 but under $40,000, and so on, and financial aid data on students may be aggregated by purpose (need-based, merit-based). Likewise, the sampling design used in the analysis will impact the surveyed population and hence the degree to which the results can be applied to other settings.

Second, it should be acknowledged that the findings from quantitative studies are probabilistic in nature rather than definitive. This is due to the reliance on drawing samples from larger populations and using the results from the samples to draw inferences about what would have been found had the entire population been examined. This sampling error is inevitable in quantitative studies and is the reason why researchers use predefined significance levels when drawing conclusions about the effects of policies on the actions of decision makers. Data limitations impose yet another source of error into quantitative studies.

Summary and Discussion

In this chapter, we provided an overview of the way in which economists approach the analysis and evaluation of educational policies, and a more complete explanation of how this works with regard to the problem of access to higher education. The focus on using constraints to alter the behavior of decision makers is drawn

from the emphasis on comparative statics in economics and the use of policy levers that provide policy makers with tools that are reliable and testable. At the same time, we point out that educational policy analysts can also draw from other disciplines to target policies on the way that decision makers form preferences. With regard to access to higher education, for example, informing students of the potential benefits and costs of pursuing a higher education should always be an important component of an overall strategy to raise the college-going rate of students. However, these policies are best informed by disciplines such as sociology, psychology, and others that can yield insights into how preferences are formed. This highlights the fact that the solutions to many important policy problems in higher education require a multidisciplinary approach, and economics can make a valuable contribution to research and policy analysis in higher education through its unique theoretical and empirical perspectives on policy problems.

The wide range of entities that are involved with educational policy certainly add to the difficulty of making policies that are effective and efficient in their use of resources. Proposed policies will often be critiqued by students, parents, teachers, administrators, taxpayers, town officials, and state/local politicians, to name a few. To economists, each of these entities have objectives or goals that they are trying to reach, and will consider the likely impact of a policy on how it affects the achievement of their goals. Often policies are not Pareto optimal—i.e., socially efficient—because a policy may benefit one group and harm another. For example, increases in state appropriations to public institutions certainly benefit those students and their families who attend in-state public institutions, but they take funding away from other state uses or from taxpayers if state taxes are raised to increase the appropriations. State appropriations do constitute a potentially effective policy lever. However, because such subsidies are given to institutions and not to students, it is uncertain how much of the appropriations will be used to actually reduce the price charged to students. There are also political considerations to almost any policy proposal, whether they are for elected officials or governing boards of institutions of higher education. These instances highlight the importance of having good, empirically-based information about the likely impacts of educational policies so that deliberations can be more productive.

One area of research that promises to grow in importance with regard to educational policy analysis is the problem of *self-section* in educational policy studies. There are many instances in education where policies such as financial aid or postsecondary encouragement programs are not implemented in a random fashion across decision makers. If decision makers are allowed to choose whether or not they are subjected to an educational policy, and this policy is affected by unobservable characteristics of the decision maker, then the estimated effect of the program will be biased using standard statistical approaches such as regression analysis. The federal government has become a strong advocate for the use of randomized experiments (the so-called “gold standard” for educational research) where a group of subjects are randomly assigned to a specific treatment (policy) and their outcomes are compared to subjects who were not assigned to the treatment (US Department of Education, 2003). The emphasis on randomized experiments in funding decisions

for federal grants has led to concerns among educators who point out that it is very difficult in many situations in education to implement a true randomized experiment. Analysts are therefore often forced to try to infer unbiased effects of policies using data that were generated without a random assignment. A number of approaches have emerged for accomplishing this, including instrumental variables (Heckman, 1979, 1990; Card, 1995), regression discontinuity (Battistin & Rettore, 2002; Hahn et al., 2001), propensity score matching (Heckman et al., 1998; Dehejia & Wahba, 2002), and natural experiments. Each of these approaches has its advantages and disadvantages, and whether one can be applied to a given policy depends on the nature of the policy and the information available to the analyst. This promises to be a topic of growing importance in educational policy analysis as researchers struggle to find better ways of evaluating the true impacts of alternative policies and meet federal requirements for the use of more rigorous research methodologies.

Conclusion

It is a common, but understandable, mistake for individuals who are not trained in economics to associate economics with money, business, profit and related phenomena, and to equate economics with fields of study such as business, finance, or accounting. However, this perspective substantially limits an individual's impression of the usefulness of economics for higher education policy analysis. In this chapter we have tried to explain and illustrate—using diagrams, detailed narration, and minimal mathematical notation—how economists analyze the behavior of individuals, groups and institutions engaged in decision-making processes by identifying the decision makers, considering the goals of the decision makers, and examining the constraints that the decision makers face in pursuit of their preferred goals. Because of its focus on the behavior of individuals, groups and institutions, economics is appropriately viewed as a social and behavioral science (Paulsen & Toutkoushian, 2006b; Toutkoushian & Paulsen, 2006). For example, many higher education policies influence individual behavior by affecting the constraints that student decision-makers face—such as income constraints, information constraints, and time constraints—as they pursue their goals. In this context, economics provides analytical frameworks that are particularly useful for understanding, evaluating, and measuring the effectiveness of higher education policies.

In the first half of this chapter, we explained how economists develop and utilize generalizable models of decision making to analyze higher education policies. In the second half of the chapter, we provided a detailed explanation and illustration of how human capital theory—the most widely-used theoretical framework from the economics of education—and a model of the market for investment in higher education can be and have been applied to the analysis of higher education policies in the policy problem area of student access to postsecondary education. We hope that, in combination, these two major parts of our chapter will serve as a useful introduction to economics for higher education scholars, administrators, and other

practitioners who are not trained in economics, but would like to understand how certain theoretical frameworks and models from the discipline of economics can be effectively used to analyze higher education policy.

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