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Going to College and Finishing College
Explaining Different Educational Outcomes

Sarah E. Turner

More students are attending college than ever before and the labor market rewards to completing a college degree have increased appreciably over the last quarter century. Yet, the rise in the incentives for collegiate completion has not been accompanied by an increase in the share of students making the transition from college enrollment to college completion.[1] Among individuals aged twenty-three in 1970, 23 percent of high school graduates had completed a BA degree, while about 51 percent had enrolled in college for some period since high school graduation. For the same age group in 1999, the share of high school graduates who had enrolled in college at some point rose substantially, to 67 percent, while the share receiving a BA degree rose only slightly, to 24 percent of the cohort. Thus, for college participants measured in their early twenties, completion rates fell by more than 25 percent over this interval. Completion rates measured at older ages are closer to stagnant, implying an overall increase in the time to degree.

It is the combination of collegiate attainment and time to degree that determines the overall supply of workers with college-level skills. The time it takes to complete a degree is an important economic variable in its own

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1. This analysis will concentrate on the link between college enrollment and BA degree attainment; this is not to suggest that attaining a BA degree is the only collegiate credential relevant in the labor market. Data from the Beginning Postsecondary Students longitudinal survey indicate that five years after initial enrollment at four-year institutions, 2.9 percent of students received certificates, 4.2 percent of students received the associate degree and 53.3 percent of students received the BA degree; among students beginning at community colleges, 13.8 percent of students received a vocational certificate, 18.6 percent of students received the associate degree, and 6.1 percent of students received the BA degree within this time frame.

right. Delay in degree attainment implicitly lowers the supply of skilled workers to the economy. Moreover, even if individuals receive some consumption benefit by extending their time in college beyond the four-year norm, the public cost is sizable given the high degree of subsidy from state and federal sources. Implicitly, the opportunity cost of extended time to degree (in the absence of perfect elasticity of supply in the collegiate market) is that other students may be denied college opportunities.

That a college education is more important now than ever is certainly cliché, though it is borne out by the overall increase in the college wage premium. The value of a college degree in the labor force has increased substantially, rising from a premium over a high school degree of about 40 percent in 1980 to over 65 percent two decades later.[2] Reduced growth in the supply of college-educated workers may hamper long-term increases in productivity while also increasing the degree of inequality in earnings. How the higher education market transforms student enrollment into collegiate attainment, including degrees conferred, is fundamental to understanding the determinants of the supply of college-educated workers.

It is surprising that collegiate attainment and time to degree have not received more attention. With few exceptions, recent discussions in policy circles have focused on questions related to *access,* loosely defined as the extent to which individuals from different circumstances enroll in college, to the near exclusion of questions of attainment. Emphasis on vaguely defined notions of "collegiate access and affordability" in public discourse has diverted attention from the monitoring of outcomes, such as courses completed and degrees awarded. Enrollment rates are, of course, an important measure of college entry, but they do not provide a measure of the degree to which students and colleges are able to transfer time and resources to completed courses, years of attainment, or degrees earned. These outcomes are measures of human capital acquired and, while necessarily somewhat inexact, they are indicators of the addition to the stock of skills available to the labor force. Degree and credit outcomes register that a student completed a certain path of study with proficiency, while enrollment measures indicate only transitory participation. That the economic return to a BA degree has risen more rapidly than the premium afforded to "some college" is but one indication of the importance of degree attainment.

It is important to ask why many education analysts (including economists) focus on the enrollment measure, which is an indicator of potential investment, rather than on degrees or credits, which measure additions to

2. Here, I am citing the raw percentage difference between earnings of college graduates and earnings of high school graduates. These earnings differences include not only the return to college education but also the return to unmeasured ability and skills associated with self-selection into college. If the return to unmeasured ability and skills has risen over the past few decades, as some evidence suggests it has, the change in the raw earnings difference overstates the change in the return to college education.

human capital stock.[3] One explanation is that enrollment is simply much easier to track than outcomes, such as credits earned.

Yet enrollment per se does not capture how individuals, along with colleges and universities, convert "participation" to outcomes such as BA degrees or course credits. That there may be substantial increases over time in the relative enrollment among individuals from poor families or racial minorities need not imply a narrowing in the difference between these groups in collegiate attainment. It is these differences in attainment, not in enrollment, that ultimately affect the distribution of earnings.

The objective of this analysis is to document the changing relationship between college enrollment and college completion, to assess the factors responsible for these shifts, and to consider their implications. In doing so, this analysis sets a new direction for higher education research by documenting the gap between enrollment rates and completions and identifying the universe of possible explanations. The first section considers the measurement of college enrollment and college completion, focusing on the intersection of results from a range of different data sources. The second section sets out a basic framework for analysis, starting with the human capital investment model, and outlines explanations for why individuals who begin college do not complete it or complete it in an extended period of time. In the third section, I provide empirical evidence distinguishing the explanatory role of these various factors. The concluding section summarizes the challenges for future research, as well as suggesting some implications for policy and data collection.

If there is one overriding policy conclusion, it is that the traditional focus of economists and policy analysts on the paired concepts of "enrollment" and "access" is insufficient to insure the supply of college-educated workers needed to meet demand, to reduce income inequality, and to narrow intergenerational differences in education and earnings.

Explaining why completion rates have decreased for those in their early twenties and why time to degree has increased rests on understanding the decisions of individuals to invest in college beyond their initial enrollment. Of particular concern is whether characteristics of today's marginal students, those who might not have started college in previous periods, are systematically different in terms of income or achievement from students beginning college in previous years. Changes over time in the academic preparedness of the marginal student may also reduce completion and in-

3. That "access to college" is more likely to be emphasized in the policy dialogue than attainment is more than an impressionistic claim. A search of *The Chronicle of Higher Education* identifies eighty-four stories since August 1998 with exact matches to the phrases "collegiate access" or "access to college" or "college access." Searching over the same time period for references to "collegiate attainment" or "college completion" or "degree attainment" resulted in only fourteen matches. In the legislative arena, a search of all federal bills in the 107th through the 105th congressional sessions produced forty-two references to "college access" or "access to college," relative to twelve references to "college completion" or "degree attainment."

crease time to degree. Financial constraints, combined with imperfect access to capital markets, are one demand-side force potentially reducing completion and extending time to degree. Because policy implications associated with credit constraints are dramatically different than those associated with selection effects, considerable care is warranted in distinguishing empirically between these two. Beyond demand-side factors, expansion on the supply-side of the market has been dominated by growth of community colleges and institutions with relatively low resources per student; as such, these institutions are able to contribute less to college completion than are institutions with greater resources per student or more upper-level courses. Public policies, including federal programs such as Pell grants and direct state appropriations to higher education, are not well-targeted and often do not increase opportunities for academically well-prepared students to complete four-year programs.

1.1 The Relationship Between College Enrollment and Collegiate Attainment

The measurement of college enrollment, college participation, and college completion is fundamental to this analysis, but the definition of these variables is often given too little attention. First, college enrollment is inherently a flow variable, representing the number of students participating at a given educational level at a single point in time. College enrollment can be measured from data tabulated by colleges and universities (in which case the age of the enrolled students is often unknown) or it can be tabulated through survey data, including the census, the Current Population Survey (CPS), or other sources, capturing what an individual is doing at a specific point in time. Collegiate attainment is, on the other hand, a stock variable—measuring the sum of education acquired by a given point in time. The metric for measuring collegiate attainment includes measures of credits, years completed, or degrees awarded; implicitly, the defining feature of these variables is that they are nonrevocable.[4] The most general stock measure is "college participation," indicating that an individual completed at least some college.[5]

4. Human capital or skills may depreciate, but measured educational attainment does not decrease for an individual with age. Implicitly, when using microdata, collegiate attainment is always truncated at a given age, as an individual can always receive more education, but the level will never decrease.

5. The measure of "some college" follows directly from the data available for the 1970 to 2000 period. Ideally, we would have more direct measures of attainment, such as the fraction of the population receiving three years of college. A coding change in large surveys, including the CPS and census, which shifts the educational attainment question from years of attainment to specified degree attainment, makes the comparison particularly difficult. The most ambiguous category in the new scheme is "Some college, no degree," which might include any level of attainment from dropping out in the first semester to completing three years at a four-year institution.

In this paper, college completion is used to denote the receipt of a four-year baccalaureate degree, though one might identify other types of completion in the undergraduate pipeline, such as receiving the associate degree. Linking initial college enrollment and degree receipt is time to degree. Following the rather considerable literature analyzing time to degree at the PhD level, total time to degree is the gross difference between data at BA completion and initial enrollment, while the net measured or elapsed time to degree captures the calendar period in which a student is enrolled. For any birth cohort, time to degree is an inherently truncated variable as students continue to receive degrees at late ages. Calculation of time to degree from microdata may follow two approaches. First, longitudinal data, such as the National Longitudinal Survey of Youth (NLSY), record the year of degree receipt. Alternatively, repeated cross sections, such as the CPS, afford the opportunity to examine how the educational attainment of a birth cohort changes over time.

In each year, recent high school graduates form the "basic" pool of potential college students, and the fraction of these students who enter college define the "traditional" college enrollment rate. Shown in figure 1.1, the enrollment rate of this group surged in the late 1960s (for men, partly

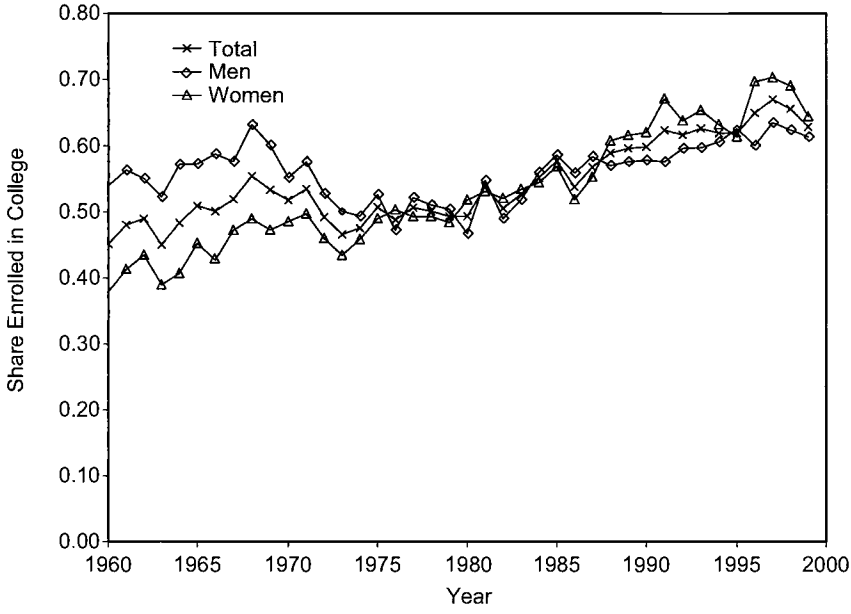


Fig. 1.1 College enrollment of recent high school graduates

Sources: U.S. Department of Labor (various years), with data tabulated from the October CPS.

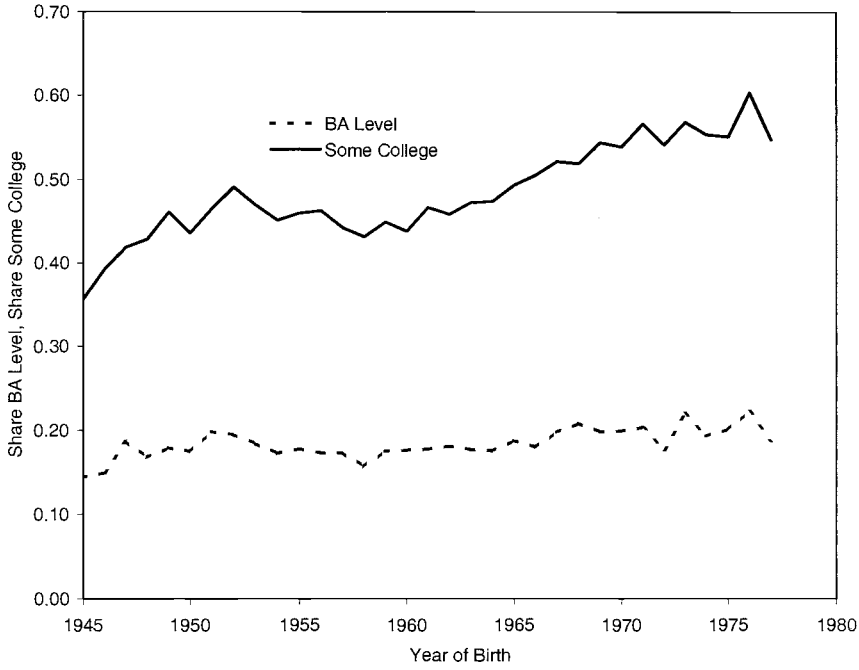
Note: Includes individuals aged sixteen–twenty-four graduating from high school in the preceding twelve months.

in response to the Vietnam war), and it then stagnated in the 1970s.[6] Between the late 1960s and the mid-1970s, enrollment rates for men and women converged, with the relative decline in enrollment more muted for women than for men over this interval. Since 1980, the rise in the enrollment rate of recent high school graduates has been consistent, and the enrollment rate is now near 65 percent, relative to about 50 percent in 1980.

Collegiate attainment is a function of both initial enrollment rates and the transition of the cohort through the education pipeline. Collegiate attainment, measured for a cohort, is also inherently a truncated variable. A birth cohort measured at age thirty will have had more of an opportunity to acquire education than a birth cohort measured at age twenty-three. Yet the timing of educational attainment is also an economic variable, as individuals acquiring education at relatively young ages will have more years to accrue the returns to the skills they have acquired. By near tautology, increased college enrollment rates of recent high school graduates translate to increases in the fraction of a cohort attaining some college.

Figure 1.2 presents a snapshot of the educational attainment of young adults and shows the proportion completing college and the proportion with any collegiate participation at the age of twenty-three from 1968 to 2000. (The data are presented for birth cohorts from 1945 to 1977, which is analogous to the 1968 to 2000 years of observation.) While participation rises in much the same pattern visible in figure 1.1, the change in the proportion with a college degree is far more muted. There is little visible rise in the share completing college in the birth cohorts born after 1960, in spite of the quite visible increase in participation. Overall, the average annual increase in the college participation rate is 1.1 percent, while the increase in college completion is a more modest 0.7 percent. Beyond the aggregate picture, the data suggest three distinct regimes, with the latest period marking the most substantial divergence between enrollment rates and completion rates. First, for the early cohorts born between 1945 and 1952 (equivalently the children of the baby boom and the college students of the Vietnam era), college enrollment rates and college completion rates both increased sharply for cohorts measured at age twenty-three, with college completion increasing by about 35 percent and college enrollment by about 37 percent over this interval. A reversal followed, with absolute declines in enrollment and completion between the 1952 and 1958 cohorts (those cohorts aged twenty-three between 1975 and 1981), and the relative decline in college completion (about 13 percent) was somewhat larger than the relative decline in enrollment rates (about 18 percent). Then, from the 1958 cohort on, college enrollment increased markedly, surpassing the

6. Card and Lemieux (2001) find that educational deferments effectively raised college enrollment and completion for men likely to be at risk of conscription during the Vietnam War. Card and Lemieux (2001) find that draft avoidance raised college attendance rates 4–6 percentage points for men in the late 1960s.



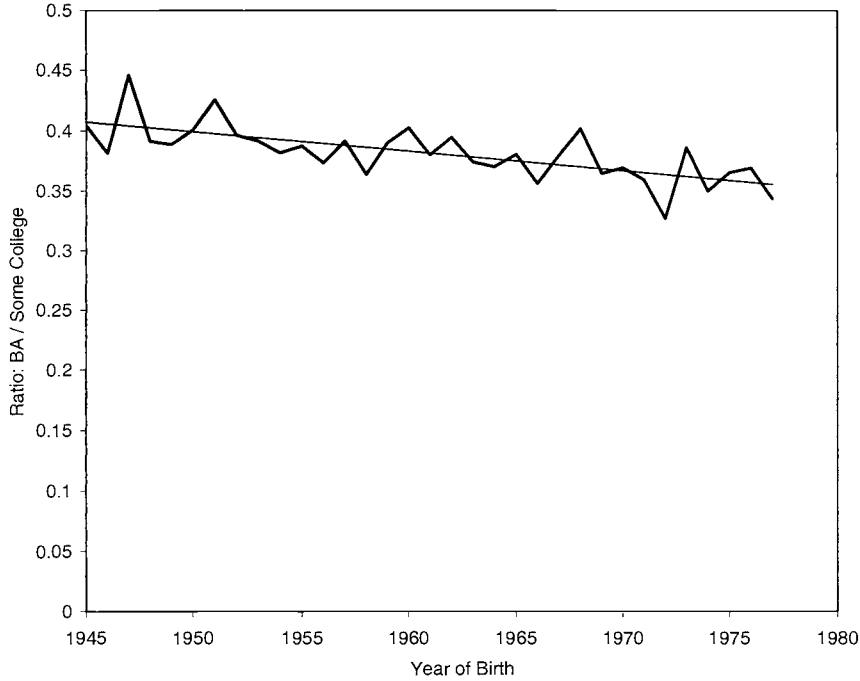


Fig. 1.2 College participation and completion by age twenty-three
Source: Author's tabulations from the October CPS.
Note: See appendix A for detail.

1952 local maximum by 10 percentage points by the time those born in the late 1970s reached the age of twenty-three.

Thinking about the difference between enrollment rates and completion rates as a difference in levels conveys much of the same information and also illustrates the widening gap between enrollment rates and completion in recent birth cohorts. Among those born in 1957 and aged twenty-three in 1980, the expected difference between enrollment and BA completion among high school graduates was about 27 percentage points; by 2000, the gap was 36 percentage points for the cohort aged twenty-three (born in 1977). It follows that the college completion rate (the share of those with some college receiving a degree) decreased from nearly 40 percent to about 34 percent, with this trend shown in the bottom panel of figure 1.2.[7]

Turning to the same trends in college participation and completion for demographic subgroups, figure 1.3 shows the trends for men and women and figure 1.4 shows the trends for blacks and whites. Gains in college participation are marked for blacks, rising at an average annual rate of 2.5 percent, though these gains are not replicated in the completion measure. Men and women display about the same modest overall decline in completion rates, but for men this is against a backdrop of stagnant college participation, while college participation has been rising for women. For each subgroup, completion rates decline over the entire interval, though the decent is strikingly larger for blacks than for those in other ethnic groups.

The observation of individuals at age twenty-three is a truncated picture of completion; changes in time to degree and the age structure of enrollment also need to be considered. To provide a firmer understanding of how these measures of collegiate attainment change over time, figure 1.5 shows college completion and college enrollment over time for different age levels. Most striking is the divergence between the top panel, showing participation, and the bottom panel, showing completion. For the most part, students who will participate in the collegiate system have had at least some college by age twenty-two, as the share recording *some college* for each birth cohort at this age is nearly identical to the share with *some college* for age thirty. It is in the bottom panel showing college completion where we see substantial divergence by time and by age. For all cohorts there are gains in BA completion by age, but these differences become particularly pronounced after the 1955 birth cohort, where the share of twenty-two-year-olds with a BA degree actually declines while degree receipt increases at older ages, particularly over twenty-five. That few of the students beyond age twenty-two are new participants provides an indication that

7. Define CG as the overall graduation rate (college graduates/population) and SC as the college participation rate (some college/population). The completion rate, or probability of graduation conditional on enrollment, is CR = CG/SC. It follows that the difference between the graduation rate and the participation rate is SC – CG = SC(1 – CR) and thus widens with either an increase in college attendance or a decrease in the completion rate.

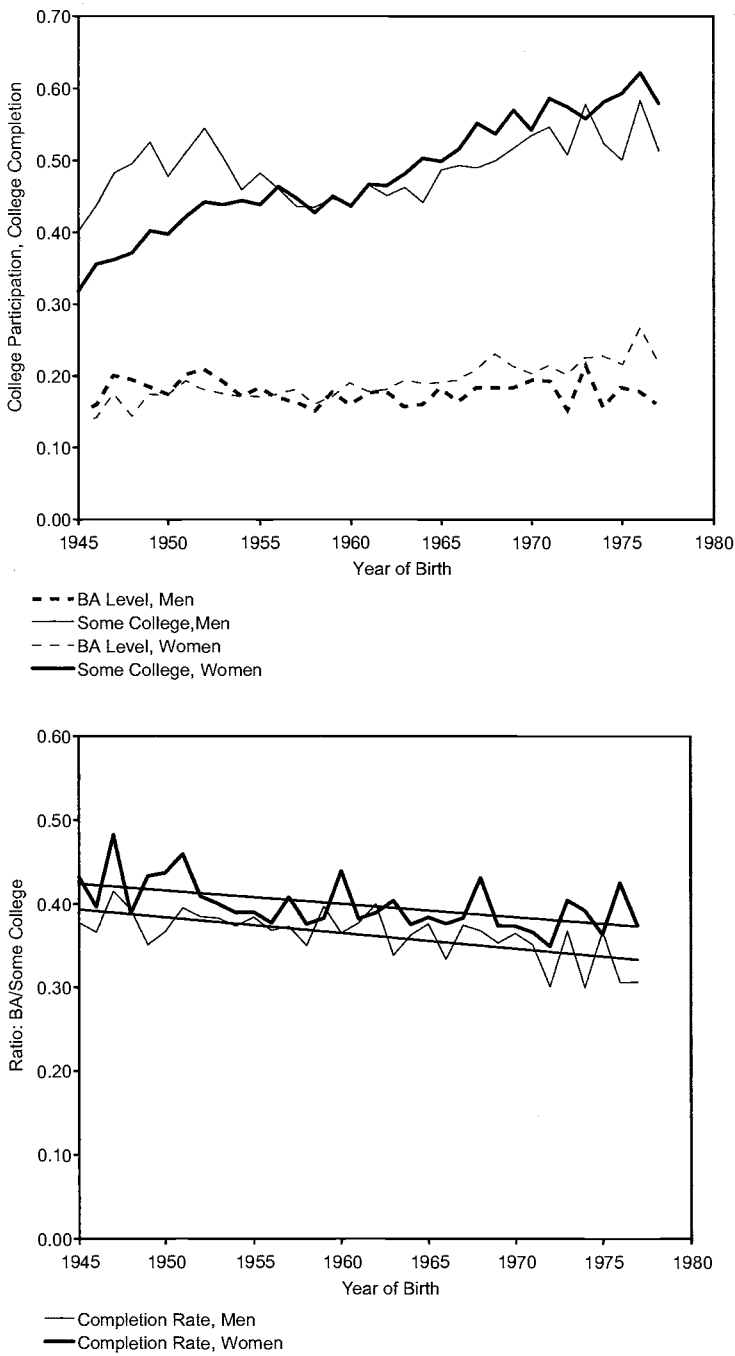


Fig. 1.3 College participation and completion by age twenty-three and sex, 1968–2000

Source: Author's tabulations from the October CPS.

Note: See appendix A for detail.

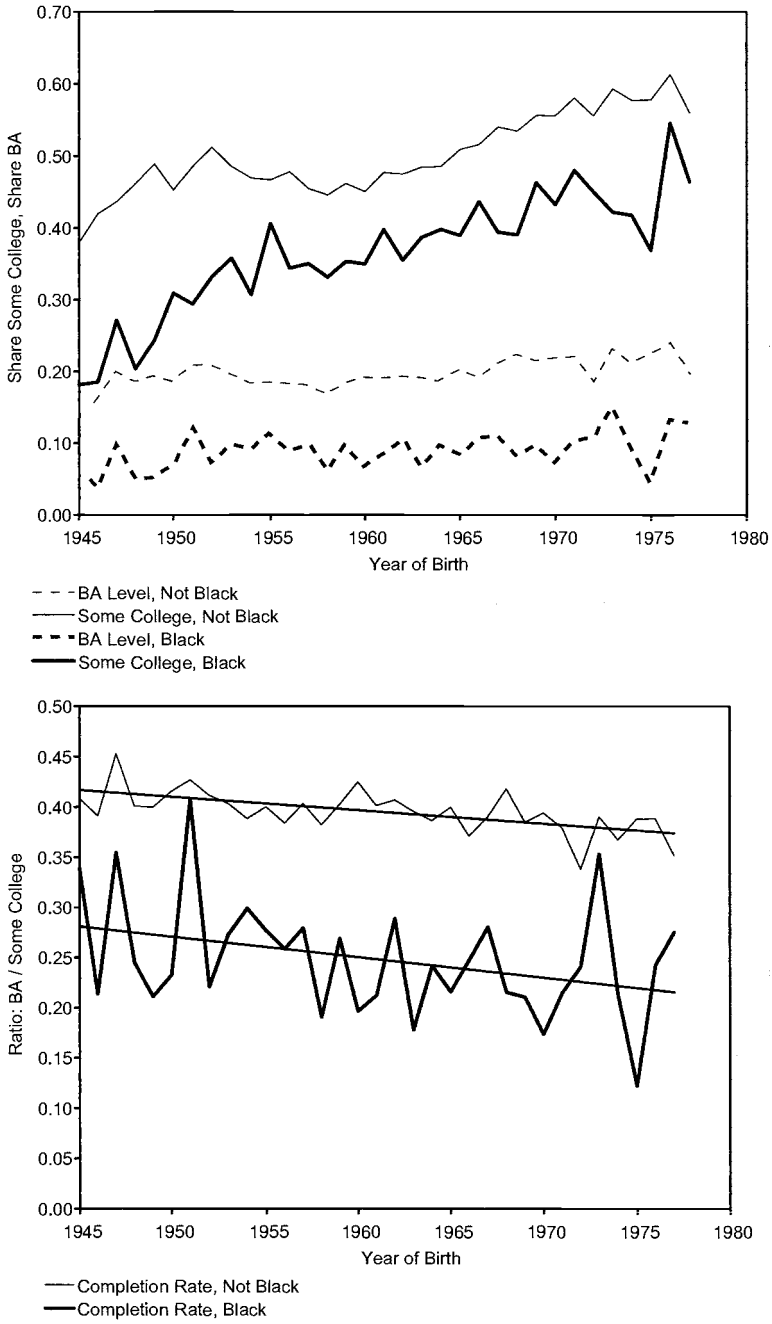
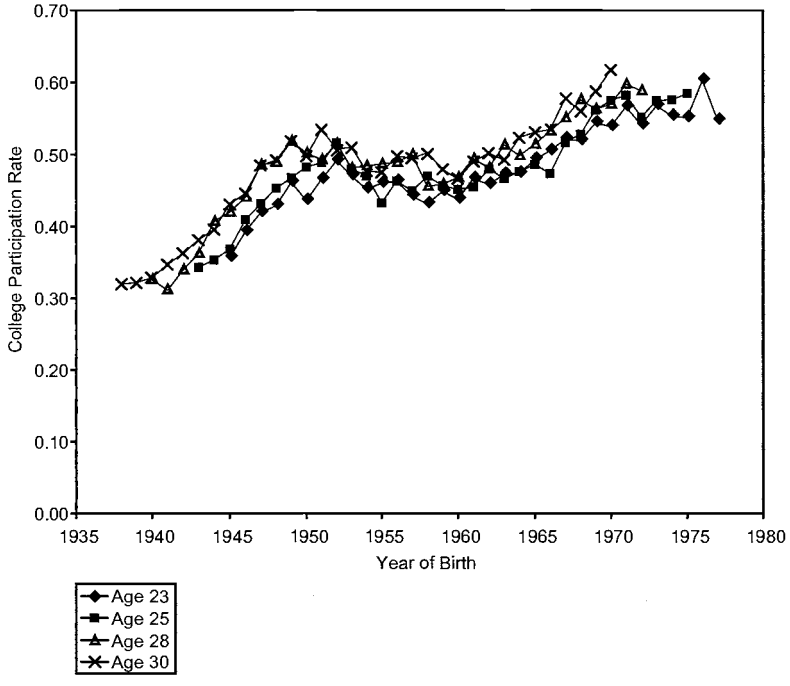


Fig. 1.4 College participation and completion by age twenty-three and race, 1968–2000

Source: Author's tabulations from the October CPS.

Note: See appendix A for detail.



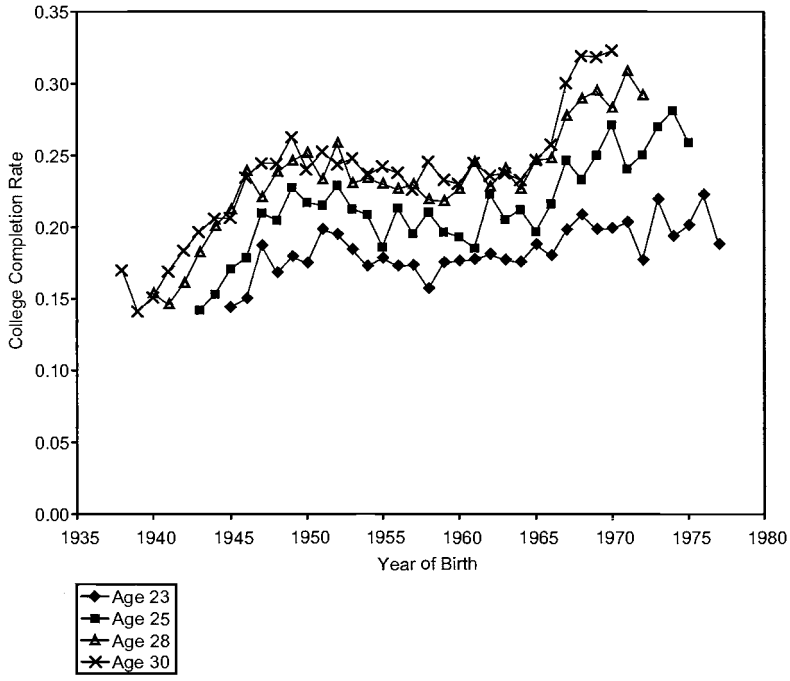


Fig. 1.5 College completion and enrollment by age

Source: Author's tabulations using the October CPS, 1968–2000.

Note: See appendix A for detail.

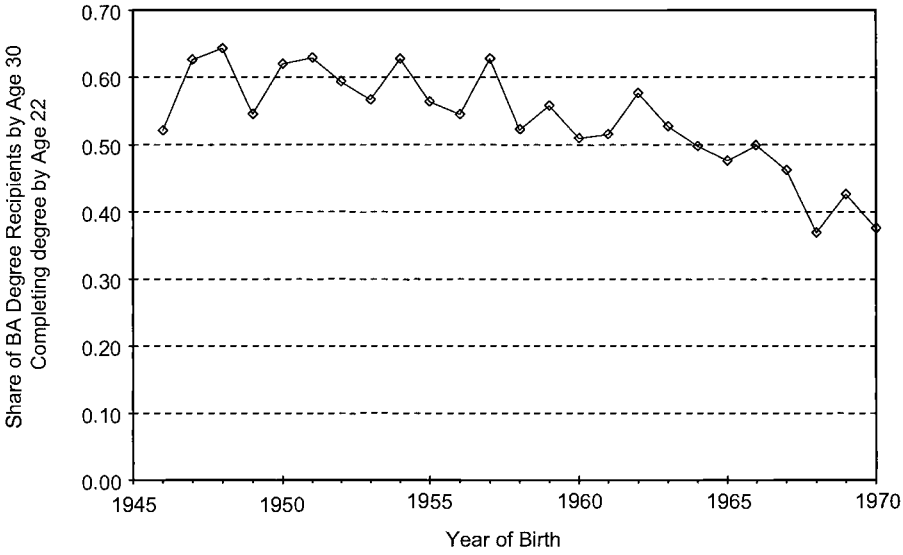


Fig. 1.6 Time to BA by year of birth, share of BA degree recipients completing by age twenty-two

Source: Author's tabulations using the October CPS, 1968–2000.

Notes: Individual weights are employed. See appendix A for detail.

either the duration of enrollment required to receive a BA has increased or more students complete their degrees after a series of spells of discontinuous study. Thus, for students receiving BA degrees between ages twenty-eight and thirty, the total time to degree likely exceeds ten years.

Unambiguously, the expected time to BA completion has increased in recent decades. Because the CPS enables us to trace birth cohorts and their educational attainment over an extended horizon, data on completion rates by age traces out the profile of time to degree. Figure 1.6 shows the trend in the proportion of degree recipients by age thirty receiving degrees by age twenty-two. While this trend is quite flat through the 1955 birth cohort, it declines in subsequent cohorts, reflecting the relatively high incidence of degrees awarded to individuals in their late twenties in the most recent years.[8]

Taking observed collegiate attainment by age at face value, table 1.1

8. A concern is that measured changes in degree completion may capture "education inflation" rather than degree attainment. One reader suggested that respondents might feel more self-conscious about not yet having completed by age twenty-eight than by age twenty-three. Tabulations from the NLSY showing year-to-year changes in educational attainment for those not enrolled in the prior period help to address this question. If recording errors were random, about the same share of people would report losing a year as the share reporting gaining a year. While about 0.004 of those aged thirty reported a year less of education attainment, more than 0.03 reported an increase in attainment without a corresponding record of enrollment. Still, to argue that the observed trend is tied to reporting issues requires a hypothesis about why this behavior has changed over time.

Table 1.1 **Average Annual Rates of Increase in College Completion and College Participation, 1968–2000**

	All			
	Share BA Degree (1)	Share Some College (2)	Ratio BA/Some College (3)	Difference Some College – BA (4)
Age 23	0.007	0.011	–0.004	0.013
	(0.002)	(0.001)	(0.001)	(0.001)
Age 25	0.012	0.012	0.000	0.011
	(0.002)	(0.001)	(0.001)	(0.001)
Age 28	0.014	0.014	0.001	0.013
	(0.002)	(0.002)	(0.001)	(0.002)
Age 30	0.016	0.015	0.001	0.014
	(0.002)	(0.002)	(0.001)	(0.002)

	White				Black			
	Share BA Degree (1)	Share Some College (2)	Ratio BA/Some College (3)	Difference Some College – BA (4)	Share BA Degree (5)	Share Some College (6)	Ratio BA/Some College (7)	Difference Some College – BA (8)
Age 23	0.007	0.011	–0.003	0.013	0.016	0.025	–0.008	0.027
	(0.002)	(0.001)	(0.001)	(0.001)	(0.006)	(0.003)	(0.004)	(0.003)
Age 25	0.013	0.011	0.002	0.010	0.019	0.030	–0.010	0.035
	(0.002)	(0.001)	(0.001)	(0.001)	(0.005)	(0.004)	(0.004)	(0.005)
Age 28	0.014	0.014	0.000	0.013	0.026	0.025	0.001	0.025
	(0.002)	(0.002)	(0.001)	(0.002)	(0.006)	(0.003)	(0.004)	(0.004)
Age 30	0.016	0.015	0.001	0.014	0.029	0.031	–0.002	0.033
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)

	Men				Women			
	Share BA Degree (1)	Share Some College (2)	Ratio BA/Some College (3)	Difference Some College – BA (4)	Share BA Degree (5)	Share Some College (6)	Ratio BA/Some College (7)	Difference Some College – BA (8)
Age 23	–0.001	0.005	–0.005	0.007	0.013	0.017	–0.004	0.019
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Age 25	0.004	0.005	0.000	0.005	0.020	0.019	0.001	0.018
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Age 28	0.005	0.005	0.000	0.005	0.025	0.023	0.002	0.022
	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Age 30	0.006	0.007	–0.001	0.009	0.028	0.024	0.004	0.020
	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)

Notes: Data are from author's tabulations using the October CPS, 1968–2000. In each equation, the dependent variable is the log of the variable indicated in the column heading, and the coefficient estimate corresponds to the year of observation. Individual weights are employed, and standard errors (in parentheses) are corrected for heteroskedasticity.

brings the trends over time together with the presentation of the average annual rates of change in college participation, BA completion, the ratio of BA completion to participation, and the absolute difference between participation and completion over the more than three decades between 1968 and 2000 for a range of ages and demographic classifications. Focusing first on the completion rate conditional on enrollment measured at age twenty-three produces the consistent result of a declining completion rate, with this decline somewhat larger for blacks than for other groups. The completion rate declined significantly, while the absolute difference between participation and completion rose appreciably.

This analysis demonstrates several related, yet distinct, changes in the pattern of collegiate participation and attainment. First, the rate at which college participation is transformed into degree completion (the completion rate) has decreased over time when outcomes for those in their early twenties are examined. This divergence is particularly large for black Americans. Second, when attainment is examined at somewhat older ages, the completion rate has been largely stagnant.

Ideally, we should be able to offer more evidence (even if just descriptive) about the link between family circumstances and the outcome of college completion; however, the absence of good measures of parental resources (and education) and precollegiate achievement in sources like the CPS and the census limits what we can do. Other longitudinal microdata sets such as High School and Beyond, NELS, and NLSY allow for tabulations of college going by family income and student achievement at different points in time, though differences among these surveys lead to something less than a true time series. Secondary tabulations (notably Ellwood and Kane [2000] and Carneiro, Heckman, and Manoli [2002]) illustrate a narrowing of the difference in college enrollment by family income for high-achieving students. For the high school class of 1980, high-income students in the top tertile of the achievement distribution were 26 percentage points, or 61 percent, more likely to attend college than their peers from the low-income quartile; for the high school class graduating in 1992, enrollment rates rose across the board, though disproportionately for low-income, high-achieving students, and the gap narrowed to 23 percentage points, or 31 percent. For low-achieving students, the difference in enrollment by family income rises in both absolute and relative terms over this interval.[9] Thus, it is plainly too simplistic to make sweeping statements about "collegiate access" changing by family income.[10]

9. In her congressional testimony, Hoxby (2000) makes similar calculations, with more narrowly defined achievement ranges (quintiles rather than tertiles), and finds that the narrowing of the gap is particularly pronounced at the top of the achievement distribution.

10. For example, the report *Access Denied* (Advisory Committee on Student Financial Assistance 2001, 12) makes the broad claim that "the current generation of low income young Americans today face diminished educational and economic opportunity as a result of lack

1.2 Explaining College Completion and Extended Time to Degree

Increases in the return to a college degree provide a prima facie motivation for the expectation that we would observe increases in college completion and reductions in time to degree. That such a response is not apparent—and, in fact, the data on completion rates and time to degree point in the opposite direction as demonstrated in the prior section—suggests the need for broad examination of the explanations for why individuals who begin college do not complete it or extend the time to degree completion well beyond the four-year norm. This section begins with a review of the college investment decision and then turns to the discussion of the reasons why this type of framework is likely to be inadequate.

1.2.1 Framework and Its Failure

In considering the potential explanations for college attrition and extended time to degree, we begin with the basic human capital investment problem. Key parameters include the expected wage-schooling locus and the expected costs of additional attainment at the individual level. In general, attending college bears many similarities to other investment decisions, like buying a car or a piece of machinery at a firm. Potential students weigh the benefits from collegiate choices with the costs. Benefits include higher earnings over the remaining working years and whatever consumption utility (or disutility!) is associated with the educational experience. Costs include the direct costs of college and foregone earnings. While tuition costs receive most of the attention in the popular press, it is the foregone earnings that typically form the largest share of college costs.

Typically—and in very general form—economists model the college choice as individuals (i) choosing among the range of collegiate options (both school quality [j] and attainment [s]) to maximize lifetime utility, with a numeraire reflecting the option of no college. Individuals are likely to differ in a number of dimensions including expected returns from particular collegiate options, the available set of choices, and earnings independent of further educational attainment. The choice set varies with both institutional admissions decisions and factors potentially unrelated to economic returns, such as distance to a college or state of residence.

Assuming full information about earnings and the nature of the college

of access to a college education." Similarly, an editorial in the *New York Times* (2002, 14) makes the sweeping statement, "The dearth of student aid for lower-income families is discouraging the neediest from applying to college at all and driving them toward low-paying jobs that keep them at the very margins of society. These are ominous developments at a time when a college diploma has become the ticket for admission into the new economy and a basic requirement for a middle-class life. The most alarming figures show that the college attendance gap between high-income and low-income Americans has widened and that about a quarter of high-achieving low-income students fail to go to college at all."

experience, individuals must choose the length of the program and the college or university to attend to maximize utility. To simplify, we can frame the question as a financial investment decision, with individuals choosing the length of enrollment (s) and the particular college program (j) in order to maximize the lifetime value of earnings.

$$\text{Choose } s, j \text{ to maximize} \sum_{t=s+1}^{T} \frac{Y_{sji}}{(1+r)^t} - \sum_{t=1}^{s} \frac{F_j}{(1+r)^t} - \sum_{t=1}^{T} \frac{Y_{0i}}{(1+r)^t},$$

where Y_{sji} is the annual earnings for individual i attending institution j for s years, Y_{0i} is the annual expected earnings with no further education, and F is the level of direct college costs.[11] Implicitly, this specification assumes no limitations in credit markets, with individuals able to borrow and lend at the market rate r.

Taken at face value, this simple formulation leads to a number of important predictions. First, increases in the return to education should lead to growth in both enrollment and attainment, though the relative magnitude of these changes will depend on the relative numbers at each margin.[12] Second, individuals who make collegiate investments will invest more in the initial periods rather than in later years. Early investment provides more years over which to accrue the benefits.[13] Further, individuals choosing to invest in college will generally choose immediate and continuous en-

11. Discrete time discounting, payments at the end of each period, and the assumption of fixed annual payments are assumed for expositional simplicity. Adding appropriate timing of payments (tuition at the start of the period) and growth of earnings of the life cycle does not change the substantive implications.

12. It is typical to focus on expected individual earnings as a function of schooling (S_i), ability (A_i), and a random error term (ε_i), such as $y_{it} = \beta_t S_i + \gamma_t A_i + \varepsilon_{it}$ (Griliches 1977; Taber 2001). In this case, β can be thought of as the return to education at time t, with increases in the demand for skilled workers in the labor force leading to increases in this parameter. Yet the fundamental concern (even in the cross section) is that because A is likely to be unobserved and omitted or poorly measured in this specification, estimates of the return to education are biased. This complicates the interpretation of the rise in the observed college–high school wage differential as an indicator of the expected return to college completion, as a clearly viable alternative hypothesis is that it is the return to ability (A) that has risen rather than the return to college completion (see, for example, Taber [2001] and Murnane, Willet, and Levy [1993]).

13. To illustrate, attending four years of college in the initial period is preferred to attending four years of college after a hiatus so long as

$$\sum_{t=5}^{T} \frac{Y_C}{(1+r)^t} - \sum_{t=1}^{4} \frac{F}{(1+r)^t} > \sum_{t=1}^{4} \frac{Y_H}{(1+r)^t} + \sum_{t=9}^{T} \frac{Y_C}{(1+r)^t} - \sum_{t=5}^{8} \frac{F}{(1+r)^t}.$$

It can be shown that this inequality holds so long as

$$\left(\frac{Y_C + F}{Y_H + F}\right)^{1/4} - 1 > r,$$

which must be the case because even with an infinite period over which to recoup returns.

rollment to a split of time between college attendance and employment at the noncollegiate wage.[14]

Evidence of extended time to degree and discontinuous spells of enrollment are in conflict with the predictions generated by this basic model. Important missing pieces from this analysis include the role of uncertainty in assessments of costs and benefits and the potential presence of credit constraints.

1.2.2 Violations of the Assumptions in the Basic Investment Analysis

This section briefly enumerates the potential violations of the assumptions in the basic investment analysis that would inhibit completion and extend time to degree. Note that to understand the empirical trends observed, it is necessary to explain why such explanations have taken greater significance over time.

Individual Constraints

The basic human capital model assumes that individuals are able to borrow at a market rate (r) in order to finance college. The violation of this assumption, owing to the reluctance of banks to make loans that they are unable to collateralize, will lead to an underinvestment in education at the collegiate level. Inability to borrow to finance education "up front" may explain why individuals may work before enrolling in college or pursue studies on a part-time basis. Moreover, even with some capital provided through government-sponsored student loan programs, students may exhaust borrowing capacity relatively quickly, forcing the termination or postponement of continued college study. Credit constraints are likely to be particularly significant for students from economically disadvantaged backgrounds. Providing clear identification of credit constraints in an empirical context is no easy task as economic disadvantage, including the inability of parents to contribute to the financing of college, is likely to be correlated with other factors determining collegiate outcomes, some of which may be difficult for researchers to observe.

Beyond the pecuniary costs of college and the capacity of individuals to

14. A simple demonstration is provided by the comparison of full-time attendance for four years to part-time attendance and employment for eight years:

$$\frac{1}{2}\sum_{t=1}^{8}\frac{Y_H}{(1+r)^t}+\sum_{t=9}^{T}\frac{Y_C}{(1+r)^t}-\frac{1}{2}\sum_{t=1}^{8}\frac{F}{(1+r)^t}.$$

It can be shown that full-time attendance is preferred so long as

$$\left(\frac{2Y_C+F}{Y_H+F}\right)^{1/4}-1>r,$$

which will again hold whenever any college has a positive net present value.

finance these investments, cognitive and noncognitive skills affect the costs and returns to collegiate investments.[15] Poor secondary performance plausibly explains some college attrition as students who have difficulty with subjects such as algebra or written expression may find that the costs associated with upper-level courses in which these skills are a prerequisite are prohibitive. Variations across local areas or over time in the effectiveness of elementary and secondary schooling could explain some of the observed changes in the level and timing of college completion. Moreover, people with General Education Development (GED) certificates rather than traditional high school diplomas may lack the task commitment and other noncognitive skills necessary to complete college. As such, changes in high school dropout rates and GED receipt may be a significant indicator of the potential for college completion. Because education is fundamentally iterative (unlike other investments, such as home ownership or owning a bond), costs at the collegiate level are related to outcomes in prior periods.

Supply-Side Constraints in Higher Education

Changes in tuition price and variations in the availability of collegiate options affect college completion and time to degree. Most colleges and universities (though not all) are either public institutions or private nonprofits, which receive substantial public subsidies. One implication of the mixed-market structure in higher education is that it is inappropriate to assume perfect elasticity of supply.

Increases in college price, particularly the difference between the tuition charged by two-year and four-year institutions, might have an adverse impact on attainment, though direct college charges are small, relative to opportunity costs. Ceteris paribus, increases in net college costs decrease attainment (weakening the link between enrollment and completion), while reduction in net cost increases attainment.[16]

Similarly, decreases in the quality of offerings or reductions in relative

15. In this chapter, individual cognitive and noncognitive skills are considered as part of the cost of collegiate attainment. Quite plainly, such characteristics affect both the costs and the returns to marginal investments in education. For a model illustrating individual heterogeneity in costs and returns, see Card (2001).

16. In considering the effects of public subsidies on collegiate participation and attainment, the characteristics of students at the margin will have a large effect on outcomes, particularly if the college preparedness of students receiving aid differs markedly from that of those likely to attend college without aid. Moreover, as the student at the enrollment margin changes in college preparedness, so too does the likelihood of college completion: that is, d BA/d Aid may well decrease as students further down the achievement distribution choose to enroll in college. It is particularly important to focus on "net price" rather than "sticker price" in evaluating how college costs affect enrollment and completion, as work by Hoxby (2000) and others demonstrates that changes in net price over the last two decades have been appreciably less than changes in the sticker price of college.

capacity at upper-level institutions would adversely affect persistence. It is well documented that institutional resources (some of which are very difficult to measure) affect both the economic benefits to college attainment as well as the likelihood of completion. Just as we would expect individuals with relatively strong elementary and secondary options to complete more years of education (Card and Krueger 1996), so too would we expect individuals with access to relatively high-quality collegiate options to complete more years of education. For this reason, policy makers at the state level may have significant impact on the supply-side of higher education through their role in setting tuition and determining the level and distribution of state appropriations to two-year and four-year institutions.

Uncertainty, Information, and College Persistence

It is typical to develop models of collegiate investment under the assumption that all of the parameters of the college investment problem are known to potential students at the time of college choice and that individuals do not make systematic mistakes in their assessment of the investment problem. Information available to potential college students and the ex ante uncertainty associated with different choices may have a substantial impact on the college investment problem and may explain behavior not well described in the traditional human capital investment formulation. Two types of information problems may contribute to the gap between enrollment and college completion: (1) individuals face considerable uncertainty about both the costs and the benefits of college investments; and (2) individuals make systematic mistakes by enrolling or persisting in college when it is perfectly predictable, given available information, that the costs of college completion will outweigh the benefits. Note that the first explanation is an economic argument involving uncertainty, while the second is inherently not an economic argument but a psychological argument.

Option Value

Collegiate attainment is really an investment under uncertainty.[17] As individuals consider college options they must form expectations about the true costs and returns, as well as assessing the likely variation in their forecasts of these variables. Variation in costs derives from uncertainty about one's own ability, the ability of classmates, and the characteristics of the college experience (the quality of faculty and so forth). Variation in the re-

17. Both Manski (1989) and Altonji (1993) present models where collegiate attainment is the product of sequential choice under uncertainty. While some individuals would not invest in college ex poste, the ex ante return is positive. In this regard, initial college attendance has an option value. Altonji (1993) provides a formal model of this decision process, with new information on individual ability and college characteristics affecting persistence from enrollment to college completion.

turns comes from uncertainty about future demand and supply conditions in the labor market. Taken together, these sources of variation imply that college is a risky investment, particularly since it cannot be bought and sold, and the risk cannot be separated from its owner through diversification.[18] An interesting question is whether one strategy individuals use to reduce the risk associated with collegiate investments is to combine school and work. Such a strategy would allow the accrual of both education and work experience, at the cost of somewhat longer time to completion in the collegiate program.

It is also likely that potential costs of college may vary systematically with individual characteristics, as potential students from the most advantaged backgrounds may have better information about different types of college options because they have more opportunities for campus visits and other types of information gathering. Research in progress by Avery and Kane (chap. 8 in this volume), studying the College Opportunity and Career Help program (COACH) intervention in financial aid guidance and college application at a number of schools in Boston, is likely to shed considerable light on the role of information available to high school students as they consider college options.[19]

Systematic Mistakes: Psychological Explanations

Youth predictions about success in college may be inconsistent with actual academic prospects and, as such, students may make mistakes in enrolling in college when it is predictable that the likelihood of a positive return is very low. Placed in the context of recent analysis at the intersection of economics and psychology, one might consider this to be "belief perseverance" or "overconfidence bias," capturing the reluctance of individuals to abandon college aspirations after receiving poor academic marks at the secondary level.

Much of the work exploring these psychological explanations for college attrition has fallen to sociologists, with one of the earliest assessments attributable to Burton Clark (1961), who hypothesized that open access institutions like community colleges may serve a "cooling out" function and thus have very high attrition rates. Rosenbaum (2001) suggests that one explanation for high college attrition is the mismatch between expectations formed in high schools which encourage a "college-for-all" norm and (un-

18. Levhari and Weiss (1974) present a model of the effect of risk on human capital investment. They make the further point that, under the circumstance where the variance in return increases with education, the average return (across individuals) will exceed the private marginal return, providing a rationale for a transfer of resources to human capital investment. In short, society is able to diversify the risk where individuals cannot.

19. In another example, Avery, Fairbanks, and Zeckhauser (2001) note that the early decision process may favor those from relatively affluent educational settings who are well informed about the "rules of the game," while others are effectively "informationally disadvantaged" in their college selection, which would ultimately affect college choice and persistence.

explained) realities related to the academic requirements for degree completion.[20]

1.3 Empirical Evidence on the Divergence

Understanding why college completion has not increased over time and why time to degree has increased depends on the determinants of college going, college choice, and college persistence. On one side of the market, changes in the characteristics of individuals—both financial and academic—affect collegiate attainment. On the other side of the higher education market, the structure of the production functions for colleges and universities and the level and form of state support for higher education affect the price, quality, and availability of undergraduate options and, in turn, affect the observed level of educational attainment.

The clear statistical identification of the impact of competing explanations is a difficult challenge that is largely unresolved in the empirical analysis that follows. Rather, the following section presents evidence that addresses the plausibility of competing explanations for the widening of the gap between participation and completion at young ages and the extension of time to degree. I begin with the assessment of underlying changes in demographics, family circumstances, and student achievement that may affect attainment at the collegiate level and BA attainment. Then I turn to the institutional and policy variables that are likely to affect college completion.

1.3.1 Demand Side: Individual Choices

Parental Financial Resources and Credit Constraints

The widely discussed changes in the structure of earnings have significant intergenerational effects, leading to increased inequality in parental income and, thus, the capacity to finance college. The top panel of figure 1.7 illustrates real family income in families with fifteen- to seventeen-year-olds by quartile and shows the widely known result that after 1980 there has been a substantial divergence between the top and bottom quartiles. What this implies is that in an environment of relatively constant or

20. The "college-for-all" norm is not just a coined phrase but an empirical observation—95 percent of high school seniors in the class of 1992 planned to attend college, despite the fact that nearly half of the twelfth-grade students' math and verbal skills were below the ninth-grade level. Rosenbaum's assessment of degree attainment a decade after high school for the 1982 cohort shows that aspirations are insufficient to guarantee degree attainment. Among those with BA aspirations, about 66 percent of those with As in high school had received a BA degree, while only 16.1 percent of those with Cs in high school had achieved the BA degree. At a more general level, Rosenbaum (2001) finds that those with low high school grades are the most likely to enter college and complete zero credit hours, with nearly 13 percent of C students with BA aspirations ending up with this outcome.

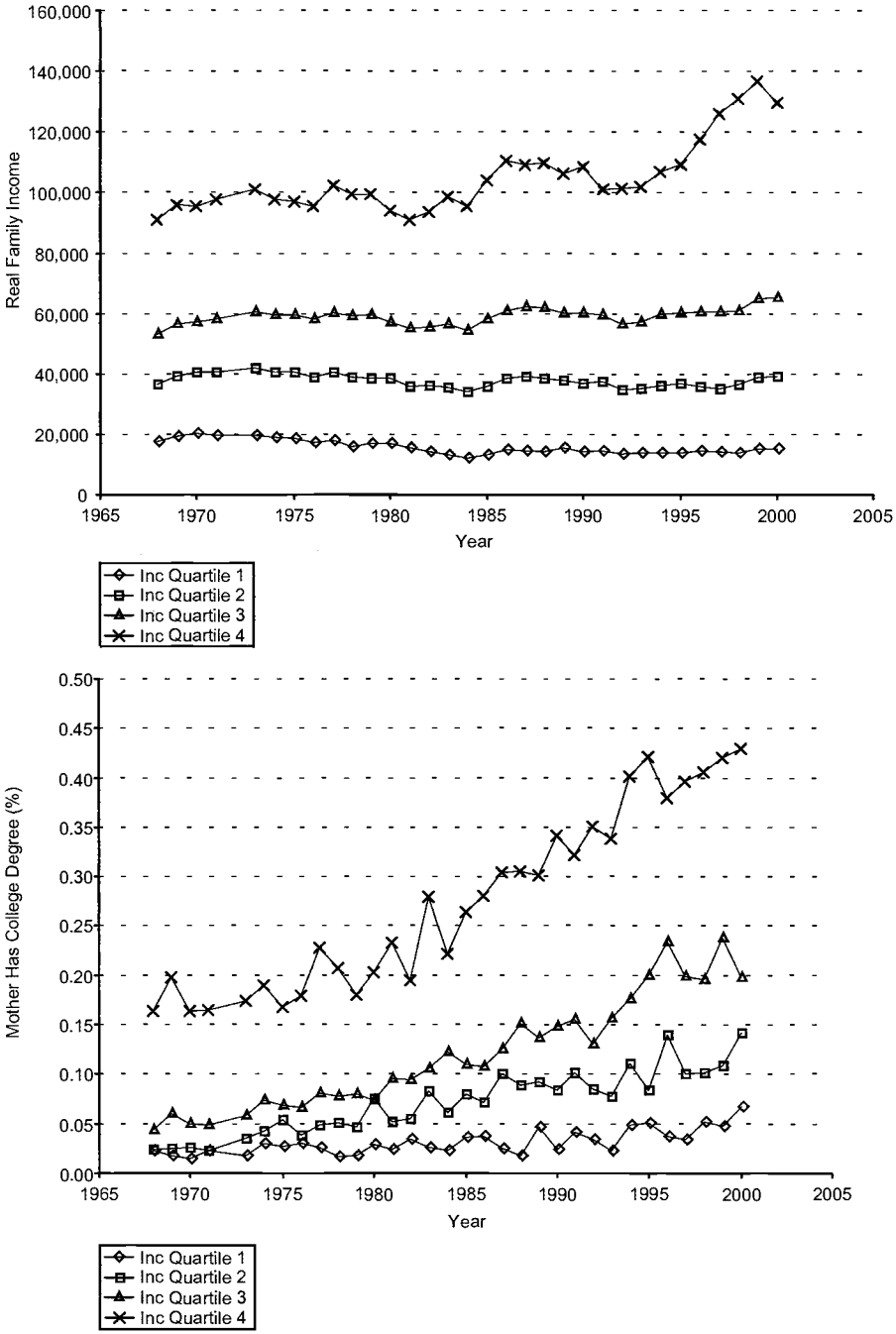


Fig. 1.7 Family background characteristics of potential college students
Source: Author's tabulations from the March CPS.

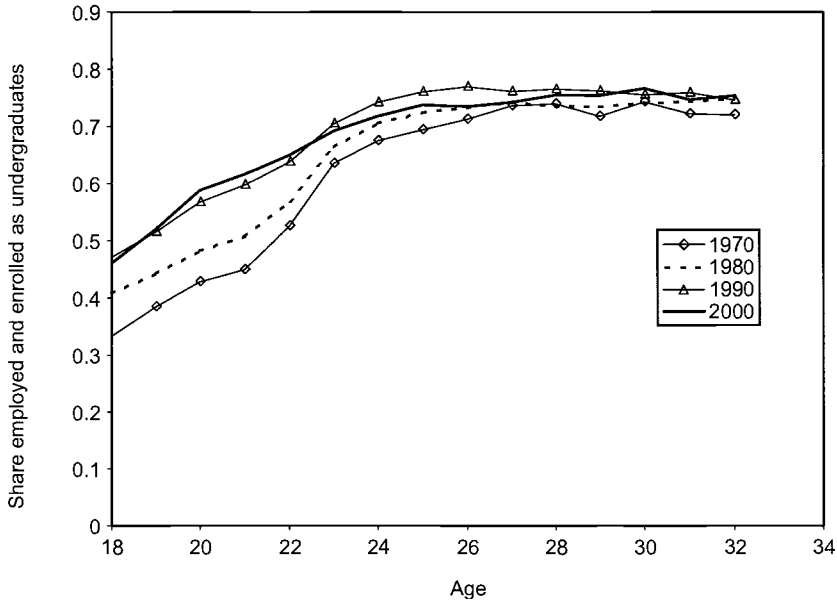


Fig. 1.8 Employment among undergraduate students by age, census years

Source: Author's calculations from 1970, 1980, 1990, and 2000 census microdata.

Notes: See appendix A for details. "Enrolled as undergraduates" includes those students enrolled with educational attainment greater than twelve and less than sixteen completed years before 1990 and attainment at least "Some College" and less than a BA degree in 1990 and 2000.

diminishing financial aid availability, those in the bottom quartiles of the income distribution are likely to face increasing difficulty paying for college in the absence of perfect credit markets or increased financial aid.

A second point, suggesting that recent high school graduates may find it increasingly difficult to finance full-time college study, is that the proportion of students working and enrolled in college has increased markedly over the last several decades (see figure 1.8). While employment rates have always been high among those students enrolled in their mid- to late twenties, a decided increase in employment among those in their late teens and early twenties took place between 1980 and 1990, persisting through 2000. This evidence of increased employment is consistent with the presence of credit constraints, though it does not prove that the young people who are dividing their time between school and work do so *because* they have exhausted credit markets.[21]

21. There is some research literature on the question of whether undergraduate employment reduces academic performance. Stinebrickner and Stinebrickner (2003) show that an additional hour of employment while in college substantially reduces academic performance.

Because it is inherently difficult to prove the existence and magnitude of credit constraints in higher education, this analysis goes no further than to assert their plausibility and to refer the reader to the related literature.[22] (See, for example, Heckman and Carneiro [2003] and Ellwood and Kane [2000].) What is imperative to the facts at hand is not just that credit constraints exist, but changes in economic circumstances and the pricing of higher education over the last two decades exacerbate the magnitude of these effects.

Demographics and Compositional Changes

Because the primary source of this divergence is the increased return to education, potential students in the top quartile of the income distribution are increasingly likely to come from a family with a college-educated parent. The bottom panel of figure 1.7 shows maternal educational attainment by income quartile over time. Among those teens in the top quartile of the income distribution in 1980, about one-fifth had a mother with a college degree. By the year 2000, this share had doubled to about 40 percent, while the change in the collegiate attainment of those in the bottom quartiles was much more modest. What is striking is the concentration in the rise in parental education in the top quartile of the income distribution. Thus, young people of college age in the top of the income distribution in the 1990s are better off than those in the same relative position in the income distribution in the 1970s for two reasons: their parents have more real financial resources and they are more likely to benefit from a college-educated parent. College participation and college completion are expected to rise with family income; at issue is the expected relative change in these outcomes.

What matters for this analysis is how changes in parental education and the level and distribution of parental income affect the link between college enrollment and college completion. One way to address this question is to estimate the change in college completion under the assumption of a known cross-sectional relationship between collegiate outcomes and

22. Two of the strongest pieces of evidence that potential college students would be better off with more access to credit markets are provided by examinations of federal loan programs. First, Kane (1999, figure 4.1) demonstrates a high degree of stacking in the distribution of student loans, with many students apparently constrained at the lower division limit of $2,625 and the upper division limit of $4,000. In addition, Dynarski (2002) finds significant changes in attendance behavior with the removal of home equity from the needs analysis formula in the early 1990s. Still, these observations do not demonstrate that increasing access to credit would increase collegiate attainment and completion. Using data from the NLSY, Cameron and Taber (2000) explore a number of different estimation strategies and fail to find evidence that borrowing constraints affect collegiate attainment. In a very different type of study, Stinebrickner and Stinebrickner (2001) examine the collegiate progression at Berea College, a school where all students receive full-tuition scholarships, and find that completion rates are persistently lower among the most economically disadvantaged, even when observable student characteristics such as test scores are held constant.

parental characteristics.[23] Taken as descriptive parameters, cross-sectional expressions show the very powerful relationship between maternal education and expected collegiate outcomes. The effects of parental income are also significant, but somewhat less robust, likely reflecting the presence of more measurement error in the reporting of income than education and the high correlation between parental education and income. Focusing on cross-sectional estimates from the NLSY, collegiate degree attainment by the respondent's mother corresponds with a 14 percentage point increase in the probability that the respondent will attain a BA and a 6 percentage point increase in the likelihood of college participation by age twenty-eight.[24] Thus, the dramatic increase in maternal education among potential college students, from 6.4 percent of mothers of those in their teens in 1970 to 21.2 percent of mothers of those in their teens in 2000, would have led to a *narrowing* in the difference between college participation and college completion for those entering college in the last three decades. Thus, changes in other factors—at the level of the individual college student or in the market for college education—must swamp the expected increase in college completion associated with the rise in maternal education.

Beyond parental economic circumstances, employment and family circumstances of students may have a significant effect on the level of collegiate attainment and time-to-degree attainment. With increased age comes a different set of responsibilities, including children and employment.[25] College enrollment among women with children has increased dramatically over the last two decades, and the presence of young children may limit attainment in several ways—reducing the time available to study and limiting course and institutional options, for example.[26] Tables 1.2 and 1.3 show the enrollment rate among women with and without children in cen-

23. This approach assumes constant parameters over time in the relationship between parental characteristics and collegiate outcomes, correct specification of the cross-sectional regression equation, and the absence of general equilibrium adjustments associated with changes in college-going.

24. All coefficients are statistically significant; other included covariates are dummy variables for maternal education at the some-college and high school degree levels, race, and sex. Estimates with the inclusion of respondent's Armed Forces Qualification Test (AFQT) score produce effects of maternal college education of 0.06 and 0.14 on college participation and college completion, respectively.

25. In discussing the relationship between nontraditional collegiate attributes and outcomes, the ambiguity of the causal arrows needs to be acknowledged. In particular, the changes in achievement and the demographic characteristics of potential college students may contribute to higher levels of participation among older, nontraditional students. At the same time, changes in federal and state policies may lead to institutional adjustments that favor the expansion of programs aimed at nontraditional students. To this end, an important further research agenda is the explanation of the rise of nontraditional student enrollment.

26. Causation seems nearly impossible to identify here. One hypothesis is that people who have children in their late teens or early twenties may lack some of the unobservable attributes contributing to college success, while another explanation is that children have a negative effect on educational attainment.

Table 1.2 **Undergraduate Enrollment Rate for Women With and Without Children, Decennial Census Data: Enrollment Rates**

	No Children			With Children		
Age	1970	1980	1990	1970	1980	1990
18	0.32	0.31	0.22	0.01	0.03	0.04
19	0.43	0.45	0.44	0.02	0.04	0.07
20	0.37	0.41	0.48	0.02	0.04	0.07
21	0.31	0.36	0.43	0.02	0.04	0.07
22	0.14	0.20	0.28	0.02	0.03	0.07
23	0.06	0.10	0.17	0.01	0.03	0.06
24	0.04	0.08	0.12	0.01	0.03	0.06
25	0.03	0.07	0.10	0.01	0.03	0.06

Notes: Author's tabulations using census microdata files for 1970 (2 percent), 1980 (5 percent), and 1990 (5 percent). Undergraduate enrollment rate is defined as the number of individuals enrolled in school with at least a high school degree divided by the total number of women in the age group.

Table 1.3 **Undergraduate Enrollment Rate for Women With and Without Children, Decennial Census Data: Grade Attending**

	No Children		With Children	
	1970	1980	1970	1980
1st	0.36	0.34	0.35	0.47
2nd	0.27	0.25	0.28	0.28
3rd	0.20	0.19	0.21	0.15
4th	0.16	0.22	0.16	0.11

Note: Author's tabulations using census microdata files for 1970 (2 percent) and 1980 (5 percent).

sus years. Women with children have always been appreciably less likely to enroll in college than those without children in their late teens and early twenties. Nevertheless, dramatic increases in college enrollment have occurred among women with children, and the share of young women with children enrolled in college has approximately doubled over each decennial census interval. Table 1.3 shows the year of college enrollment for these women. While about 1/3 of the women without children are in their first year of college, about one half of the women with children are in their first year of college. This relatively limited level of education suggests that women with children may be particularly likely to have interrupted spells of college participation and to end up with modest levels of college attainment and low levels of college completion.

More generally, recent policy reports highlight the rise in the number of

nontraditional students and raise questions about the collegiate trajectories of the increasing share of nontraditional students.[27] Empirically, there is no question that nontraditional students are less likely than traditional students to attain a degree within five years of initial enrollment. Yet it is far from clear that this gap is caused by the conditions of nontraditional enrollment (type of programs available, jobs, and family constraints) rather than individual characteristics that determine nontraditional status.

Student Achievement

While parental educational attainment has risen over the last two decades, student achievement has not followed suit. Judging by standardized test scores, there has been a modest decrease over time in the college preparedness of high school students. For example, average National Assessment of Educational Progress (NAEP) math scores for seventeen-year-olds have decreased by about ten points since 1970. With a 9 percentage point increase in the college participation rate, this change implies that the student at the margin of college enrollment has declined about a quarter of a standard deviation in test performance, as illustrated in figure 1.9.[28] Combined with increasing rates of college-going, the implication is that the marginal college student may be less prepared to complete the college curriculum than students attending college in prior decades. Yet the completion rates for these marginal students would need to be unrealistically low—on the order of about 2 percent—for changes in students achievement to explain the observed change in college enrollment among those in their early twenties.

What is more, there are other potential changes in college preparedness to consider, including the observation that more and more college students are entering with a GED rather than a traditional diploma. Although high school graduation is often thought of as an important part of the educational pipeline through which students advance, a regular high school degree need not be a prerequisite for college enrollment, particularly at community colleges or other open-access institutions. Many institutions accept the GED as a substitute for a high school diploma, and a number of institutions allow older students to enroll without an equivalency certificate. While there is a long literature debating the returns to a high school

27. A recent report released by the U.S. Department of Education (2002) notes that nearly 73 percent of undergraduates in 1999–2000 were in some respect nontraditional, defined in terms of characteristics like the presence of dependents, the absence of a high school diploma, no parental financial support, and full-time employment.

28. Plainly, these calculations are oversimplified as they assume that college-going is perfectly correlated with test scores. Nevertheless, the calculations are illustrative, providing an upper bound on the extent to which achievement changes affect college completion. We can back out the effect of achievement on college persistence necessary for changes in test scores to accord with observed levels of college completion.

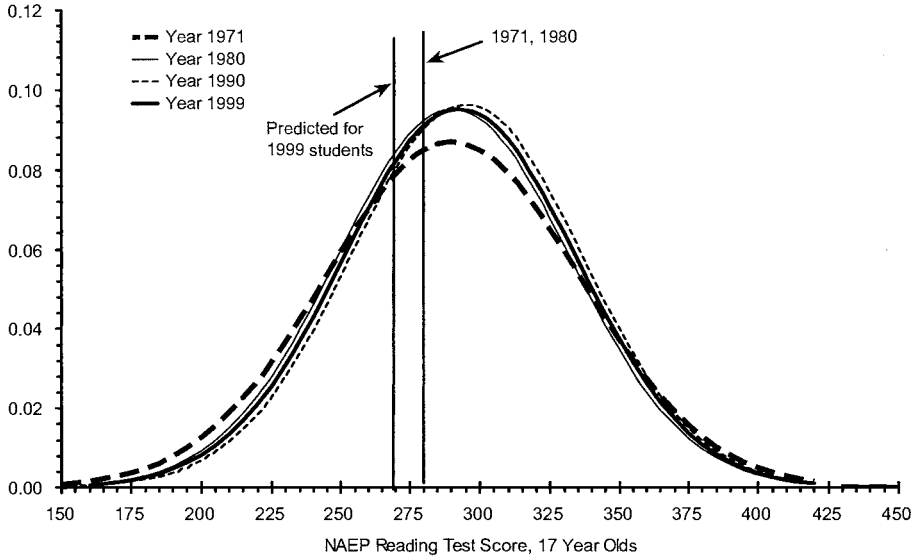


Fig. 1.9 Student achievement by cohort

Sources: Means and standard deviations of test performance in each year are from NCES tabulations. Computation of the normal distribution and predicted ability of marginal college students are author's calculations.

degree, it seems plausible that whatever characteristics of persistence are associated with high school completion may also affect college persistence—even if these "skills" are somewhat different than measured cognitive achievement. Recipients of the GED have increased dramatically as a fraction of the eighteen–twenty-four age group, rising from about 0.8 percent in 1989 to 1.3 percent of this age group in 2000 (U.S. Department of Education [2001] tables 15 and 106). Moreover, the rise in the share of test-takers who are nineteen years of age, from about 33 percent in 1975 to about 42 percent in the year 2000, suggests that an increasing number of young people may be substituting the GED for traditional high school completion. GED recipients are less likely to persist in the higher education pipeline than traditional high school graduates. On average, GED recipients complete fewer years of postsecondary education than high school graduates. An analysis by Garet, Jing, and Kutner (1996) shows that almost three-fourths of GED recipients enrolling in a higher education program completed one year or less of college, and the results shown in the tables presented in Cameron and Heckman (1997) are broadly similar. Thus, an increase in GED recipients in the collegiate pipeline implies an increase in the concentration of students who are least likely to persist in higher education, moving in the direction of explaining the gap between

college participation and college completion as well as the increased time to degree.

1.3.2 Supply Determinants and Public Policy

Market Structure: Changes in Institutional Shares

The stratification in the market for higher education has increased over time, with substantial differences among colleges in resources and course offerings. Considering changes in the distribution of enrollment and degrees across types of institutions provides an empirical starting point (see figure 1.10). In 1967, about 1/5 of all undergraduates were enrolled at community colleges, about 51 percent were at public four-year institutions, and the remainder were at private institutions, with selective private liberal arts colleges and research universities accounting for the relatively modest share of 7 percent. A major shift occurred between 1967 and 1977, with both an increase in the level of undergraduate enrollment and a shift in the distribution of enrollment away from four-year institutions toward com-

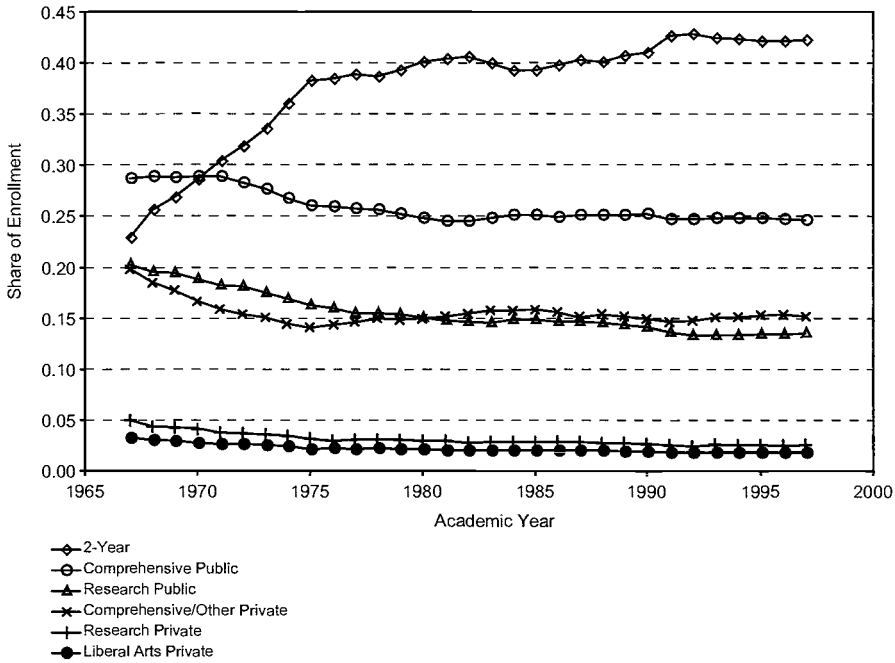


Fig. 1.10 Enrollment by type of institution

Source: Author's tabulations from HEGIS/IPEDS fall enrollment surveys.

Note: See appendix A for detail.

munity colleges—the two-year share rose from 21 percent to 34 percent. These results do not resolve the question of whether the change in the distribution of individuals across institutions reflects changes in the type of collegiate experiences demanded by students or shocks to the supply side of the market.

Not surprisingly, shifts in undergraduate enrollment across institutions are likely to affect BA output because persistence and the likelihood of degree completion differ across these institution types. Between 1967 and 1977, the ratio of full-time equivalent undergraduate enrollment to BA degrees increased from about 8 to 8.5. Enrollment growth at open-access institutions may not translate to growth in degree attainment if many of the courses of study are terminal certificate programs or if students find it difficult to get the courses they need in order to graduate. Many selective institutions, particularly in the private sector, are unlikely to respond to increases in enrollment demand with expansion in their residential undergraduate programs, as this would lead to dilution in per-student subsidies and reductions in quality.

Across states, there is considerable variation in the mix of different types of colleges and universities. A salient question is how these structural differences, as well as changes in the distribution of resources across institutions, affect degree completion within states. Over time, increased geographical integration in the marketplace has plainly led to a greater and greater concentration of the most able students at a relatively small number of institutions (Hoxby 1997). This stratification, in turn, raises quality at some institutions while reducing peer quality at other institutions. Institutional resources combined with peer quality are likely to have a real behavioral effect on college completion, and it is difficult to disentangle the effects of own ability, peer ability, and institutional resources in predicting completion. Yet, because more able students also attend the most selective schools, it is inherently difficult to disentangle the effects on outcomes of student characteristics versus institutional characteristics. To frame this point more concretely, consider the graduation rates from the National Collegiate Athletic Association (NCAA) Division I schools by Carnegie classification. Private research universities reported graduation rates of 84 percent, public research universities (which are generally somewhat larger) graduate about 60 percent of first-time students, while public institutions that do not award doctorates graduated only about 37 percent of entering students within six years. There are some distinctive examples at the bottom and top of the quality distribution. Among the institutions with six-year completion rates of less than 20 percent are Chicago State University, Texas Southern University, and McNeese State University (Louisiana). At the other extreme, institutions with completion rates over 90 percent include the University of Virginia, Georgetown University, and Northwestern University.

State Higher Education Policy

State-level politics may be a particularly important factor in the determination of the location, type, and number of institutions, as well as the relative support for research institutions, relative to comprehensive colleges or community colleges. To the extent that shifts in state support are driven by politics (e.g., the desire to reward the governor's alma matter or a move to reward a legislative leader with the opening of a community college in his home district) rather than student demand, shifts in state appropriations will operate like supply shocks. Shifts toward institutions with relatively low completion rates will likely lead to a reduction in the link between participation and completion.

One hypothesis to consider is that, in the last several decades, the political process has favored community colleges relative to four-year institutions, leading to a relative decrease in the supply of course offerings at upper-level institutions. Community colleges may advertise stronger direct links to local economic development than universities by providing job training for local employers. In addition, because community colleges are open to all local residents and are relatively widely dispersed across counties (while universities generally have much more limited locations), state legislators may receive much greater political rewards (in terms of reelection prospects) for increasing community college funding than increasing appropriations for the state flagship university, which may be hundreds of miles away and practically out of reach for many constituents. As an empirical matter, a regression of the share of state appropriations to higher education directed to four-year institutions on a time trend and state fixed effects for 1973 to 1996 shows a decidedly negative trend (–0.002 [0.0001], see table 1.4). For those states in which this trend is most pronounced, we would expect to see relative declines in the link between college enrollment and college completion, particularly among students in their early twenties. Our measures of state-specific completion rates are limited to crude indicators—either the ratio of BA degrees conferred to enrollment using the institutional data or the ratio of college completion to college participation for young people in the census.[29] Still, regression results that use variation across states in the change in the share of state appropriations as the key explanatory variable present a clear result (table 1.4). Increasing (decreasing) the share of state appropriations to four-year institutions has a strong positive (negative) effect on completion, with a 5 percentage point decrease in the share of appropriations directed to four-year institutions associated with a 1.7 percentage point decrease in college completion mea-

29. Note that these measures are fundamentally different. The institutional measure of degrees awarded relative to enrollment uses the ratio of two flows, while the census measure captures the age-specific stock of collegiate attainment.

Table 1.4 **Within-State Changes in the Share of State Higher Education Appropriations and College Completion**

Dependent Variable	Coefficient of Interest	Coefficient	Other
4-year share of state appropriation	Time trend	–0.002 (0.000)	State fixed effects
Ratio BA degrees conferred to undergraduate FTE enrollment	4-year share of state appropriation	0.049 (0.021)	State and year fixed effects
Decennial difference (90-80) in state completion rate (BA/any college)	Decennial difference (85-75) 4-year share of state appropriation	0.353 (0.125)	Age-specific dummy variables

Notes: Measures of the share of state appropriations to four-year institutions and two-year institutions are from the author's calculations using data from the HEGIS/IPEDS surveys of institutional financial characteristics. Data on degrees conferred and enrollments are also from the author's calculations using data from the HEGIS/IPEDS surveys. Census-based completion rates are calculated from the 1980 and 1990 census microdata. Share some college and share college completion is calculated at ages twenty-three–twenty-five and state reflects the place of residence five years prior in order to measure outcomes without the effects of migration. Calculations are based on forty-seven continental states, as South Dakota lacks a community college system. Standard errors in parentheses. FTE = full-time equivalent.

sured using outcomes from the census. Still, additional evidence on the exogeneity of state appropriations (demonstrating that shares are not adjusting to changes in local demand conditions) is necessary before claiming a causal relationship.

Tuition

It is well established that enrollment decisions are sensitive to tuition levels, yet there is very little evidence on how students at this enrollment margin progress in the collegiate pipeline (Kane 1995). Low-tuition strategies come at a substantial cost, as below-market tuition is essentially an across-the-board subsidy to all students, including those who would continue to enroll at higher tuition levels. Whether low-tuition policies have any affect on collegiate attainment is critical to determining whether public calls for continued reductions in tuition are sound policy recommendations.[30]

With the majority of undergraduate students attending public colleges

30. A significant trend in higher education finance in the last five years has been real declines in tuition costs in several major state systems (e.g., California, Michigan, New York). Governors and state legislators have found that low-tuition policies are particularly popular among their constituencies, and several governors instituted tuition rollbacks for in-state students. For example, in-state students in the 1998–1999 academic year at the University of Virginia paid $4,866 in tuition and required fees, followed by a rollback to $4,130 in the 1999–2000 academic year. California and Texas also reduced nominal tuition in the late 1990s. While reductions in state budgets have put upward pressure on tuition for the 2002–2003 academic year in many states, these increases come with reduced state appropriations and generally reduced resources per student. Efforts to freeze tuition at public colleges and universities are politically popular because they provide tangible near-term relief in an area of intense voter interest. Yet, without higher tuition, institutions of higher education may be forced to reduce quality or capacity.

Table 1.5 Effect of Tuition and Resources on Enrollment and Completion

	Coefficient on In-State University Tuition		
Dependent Variable (in logs)	(1)	(2)	(3)
FTE undergraduate enrollment	–0.21	–0.14	
	(0.06)	(0.04)	
BA degrees	–0.10	–0.02	0.05
	(0.02)	(0.04)	(0.04)
State effects	Y	Y	Y
Year effects	Y	Y	Y
Population 18–22	N	Y	Y
Undergraduate enrollment	N	N	Y

Notes: Author's tabulations from HEGIS/IPEDS "Degrees Conferred" and "Fall Enrollment" surveys. Tuition data are from Washington State Higher Education Control Board. Each set of estimates represents the effect of tuition (measured in lns) on full-time equivalent (FTE) enrollment or degrees as indicated (also measured in lns) using data from 1972–1996 at the state level with state and year fixed effects, with standard errors corrected for heteroskedasticity and clustering at the state level.

and universities in-state, direct tuition prices are often well below the cost of educational production. Indeed, about 43 percent of all students attend institutions with tuition prices less than $4,000 per year. Because tuition is only a fraction of total college costs, with foregone earnings of persistence in college likely to exceed direct college costs, it may be that changes in tuition levels do not have a significant effect on persistence decisions. At public colleges and universities, state policy makers have substantial influence in determining tuition levels and relative charges within state systems.[31] Ideally, the data would allow for the investigation of the extent to which the differentiated tuition policies within a state (e.g., the relative tuition at community colleges and flagship universities) affect attainment in addition to the effects of the levels on attainment. However, because there is only limited variation within states in relative tuition by institution type, it is very difficult to employ this source of variation, while variation across states may be related to other systematic differences between states.

Estimates in table 1.5 use within-state variation over time in regressions of enrollment and BA completion on tuition (producing coefficients in elasticity form). What is unambiguously clear from these specifications is that the behavioral effect is entirely concentrated at the enrollment margin as the BA degree elasticity is no larger than the enrollment elasticity. Inclusion of measures of cohort size (the population aged eighteen–twenty-

31. A survey of state higher education executive officers finds that in ten states legislatures explicitly set tuition in practice or in statute. In other states, tuition determination is generally the responsibility of governing boards or state higher education authorities, with these authorities often composed of political appointees (Kane, Orszag, and Gunter 2002).

two within the state) or undergraduate enrollment in regressions of BA degrees awarded on tuition produces effects that are consistently indistinguishable from zero. One explanation is that the demand for a BA may be quite inelastic among those students who are not at the enrollment margin.

Federal Policy

A final dimension to consider is the effect of federal policy on student enrollment and completion.[32] The primary instruments for federal policy designed to increase collegiate attainment over the last three decades have been the programs under Title IV of the Higher Education Act, notably Pell grants and Stafford student loans. More recently, beginning with the Tax Reform Act of 1997, tuition tax credits have provided another mechanism for the federal government to reduce the cost of college to students (the details of these programs are discussed elsewhere in this volume). A third type of aid funded at the federal level is the specially-directed aid aimed at specific populations to achieve objectives other than meeting financial need; these programs include G.I. benefits and the Social Security Student Benefit (SSSB) program.

Focusing first on Title IV, the primary programs are the Pell Grant program and the Stafford student loan program. Both programs are means tested, and eligibility is determined through the evaluation of a Free Application for Federal Student Aid (FAFSA) form that records student and parental assets and incomes. Applying a nonlinear benefit reduction formula yields an expected family contribution, and the difference between allowable college costs and expected family contribution is the aid eligibility.[33] Title IV financial aid is remarkable in the breadth of the programs covered and the range of potential students eligible to benefit. While early federal higher education programs such as the National Defense Education Act (NDEA) focused on selected degree programs, the only academic criteria for Title IV eligibility is "ability to benefit" from a postsecondary program, and the aid may be used at a range of postsecondary institutions, including nondegree granting institutions and proprietary institutions.[34]

32. For the most part, the federal role in financing higher education has historically been much more modest and considerably more targeted than the state role. Still, at particular times in history, federal support for institutions of higher education, including the Morrill legislation chartering many public institutions, has been decisive in determining the level and distribution of higher education services. Federal research funding no doubt has a significant effect on enrollment and completion in graduate programs, even though these resources are allocated largely at the institutional level (the Javitts and National Science Foundation [NSF] programs are exceptions).

33. In essence, a tax rate is applied to a measure of available resources, both income and assets, with fixed adjustments for family size and number of members of the family in college to determine the student's "ability to pay." If this amount is less than allowable college costs, the student is aid eligible.

34. The inaugural Higher Education Act passed in 1965 separated academic and vocational training in determining program eligibility. Most of the programs funded under the 1965

The Title IV financial aid programs are often described as the cornerstone of federal higher education policy; in academic year 2000–2001, Pell Grant aid totaled $7.9 billion in expenditures, while loan programs provided over $26 billion in capital, with about $12.6 billion of the amount provided through the subsidized Stafford loan program.

Despite the rhetoric (and almost sentimental attachment) surrounding the Title IV programs as the key dimensions of federal policy aimed at eliminating credit constraints, empirical evidence on the behavioral effects of these programs is mixed. Focusing first on the enrollment effects for traditional college-age students (defined as students who are recent high school graduates and still depend on their parents for financial support), evaluations consistently yield no evidence that the program changed enrollment (Hansen 1983; Kane 1994).[35] What is more, evidence presented by Manski (1992) indicates that low-income youth graduating from high school between 1972 and 1980 (after the introduction of the program) show no relative gain in college completion. One explanation for why the Pell Grant program has had such modest effects is that the complexity of the program and the difficulty in determining benefit eligibility may impose a high cost, inhibiting many potential students at the margin from applying. Another explanation is that factors beyond financial constraints, including academic achievement, are the factors limiting college enrollment and college attainment for the marginal low-income student.

While the Pell Grant program has not had a discernable effect on the collegiate attainment of traditional students, the effects on college participation for nontraditional students have been marked.[36] Despite restrictions

Higher Education Act were campus based (providing resources to institutions rather than portable aid to students). According to Gladieux (1995), Title IV of the Higher Education Act was the first explicit federal commitment to equalizing college opportunities for needy students, which was to be achieved through means-tested grant aid as well as student support programs (Upward Bound, Talent Search, and the programs now known as TRIO). The primary means-tested aid vehicle was the Student Educational Opportunity Grants (SEOG); award of aid under this program was administered by colleges and universities that were required to "make 'vigorous' efforts to identify and recruit students with 'exceptional financial need.'" (See Gladieux [1995] for additional history.) Under the 1972 reauthorization of the Higher Education Act, Congress substituted the term "postsecondary education" for "higher education," intending to broaden the range of options beyond traditional baccalaureate programs. In this regard, the Basic Educational Opportunity Grants (known now as the Pell Grant) included two- and four-year colleges and proprietary schools from the inception. Thus, in 1972, federal financial aid changed the choice set of students to include a wider range of short-term, nonbaccalaureate degree and vocational programs under Title IV.

35. In one of the initial assessments of the program using time series data, Lee Hansen examined the relative enrollment rates of more and less affluent students before and after the introduction of the Pell Grant program. Hansen's review of the evidence "suggests that expansion of federal financial aid programs and their targeting toward youth from lower-income and lower-status families did not alter to any appreciable degree the composition of postsecondary students or the college enrollment expectations of high school seniors over the 1970s" (Hansen 1984).

36. Under Title IV of the Higher Education Act, federal financial aid policy makes a statutory distinction between "dependent" and "independent" students in the determination of

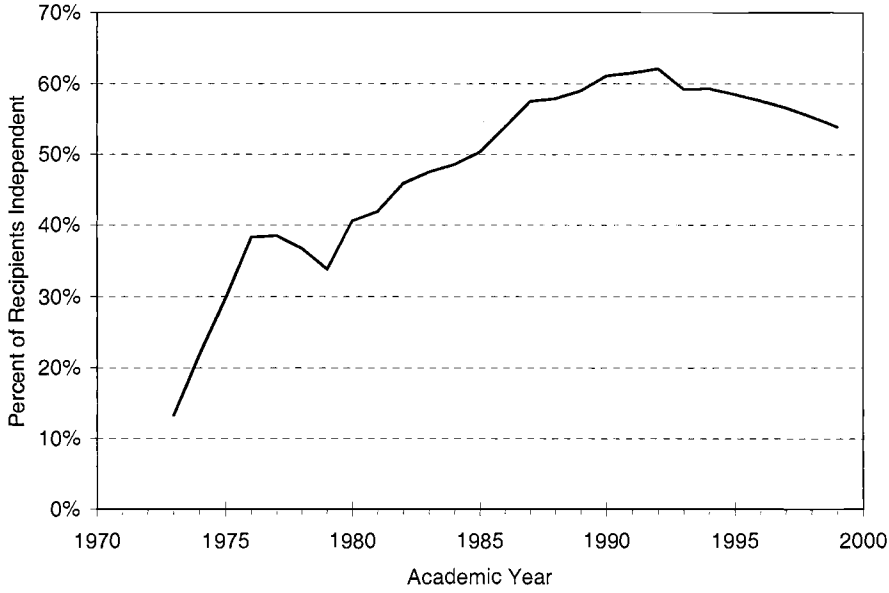


Fig. 1.11 Share of Pell Grants awarded to students classified as independent students
Source: College Board (2002), table 7.
Note: "Academic year" refers to the academic year beginning in the indicated year.

that potentially limit independent student eligibility, the share of Pell Grant recipients who are independent has risen steadily over the last three decades, from about 30 percent in 1975 to over 60 percent in the early 1990s (see figure 1.11). Research by Seftor and Turner (2002) finds that the introduction of the Pell Grant program, as well as changes in program eligibility, have a significant effect on the college enrollment decisions with college cost elasticities of about –0.26 for men and –0.67 for women. Overall, a review of changes in the determination of eligibility for Title IV aid, particularly the Pell Grant program, shows that many of the most significant changes in benefit determination have affected nontraditional students. To take but one example, Simmons and Turner (2003) examine the effects of the inclusion of child care expenses under allowable college costs

program eligibility. Eligibility for independent students rests only on the financial position of the applicant and his or her spouse, relative to direct college costs and other demands on resources including the number of children in the family. To be eligible for aid as an independent student, an individual must not be claimed as a dependent in the prior or current year for tax purposes and may only receive limited cash and in-kind contributions from parents. Eligibility for students claiming independent status has become more restrictive since the inception of the program. The 1986 amendments to the Higher Education Act required students to be at least twenty-four-years-old, married, or with children to qualify for aid as an independent student.

in aid determination and find that the addition of this benefit has a significant effect on enrollment for women with children. Expansion of the availability of federal financial aid for undergraduates to older students opens enrollment in higher education to many individuals who would not have been able to enroll in higher education in earlier decades. Yet such results raise three questions about the distribution of federal student aid. First, to what extent are older students able to convert enrollment to collegiate attainment and, in turn, earnings growth? Second, does the extended availability of federal financial aid through the life course encourage students to prolong or postpone studies? Finally, in the policy arena, does financial aid for nontraditional students come at the "expense" of higher levels of aid for younger postsecondary students?

Two programs targeting somewhat narrower groups of potential beneficiaries than Title IV aid are the SSSB program and the World War II G.I. Bill. Both initiatives had generally significant effects on both collegiate enrollment and completion (Dynarski 2003; Bound and Turner 2002).[37] The G.I. Bill and the SSSB program share several design features, including the transparency of eligibility determination, meaning that potential beneficiaries knew their eligibility and the level and duration of benefits without additional calculations or waiting for the results of a bureaucratic process, and the substantial size of the benefits, often covering the majority of college costs.

The evaluation of the effects of the SSSB program on enrollment and attainment yields results parallel in magnitude; Dynarski (2003) uses the death of a parent to estimate program eligibility and finds that college attendance dropped by about 4 percentage points per $1,000 of grant eligibility. A particularly striking feature of the SSSB program is that benefits expired at the end of the semester in which the recipient turned twenty-one, thereby creating a strong incentive to avoid extension of undergraduate degree programs beyond the four-year norm.

1.4 Implications for Future Research and Policy Tradeoffs

The economic consequences of the differences between college enrollment and college completion are near their historical maximum, as the

37. For veterans returning from World War II, Bound and Turner (2001) estimate that the effect of the G.I. Bill combined with the effect of World War II service on years of college completed was between 0.23 and 0.28 years of college (or 32 to 38 percent), and the effect on college completion rates was between 5 and 6 percentage points (or 39 to 46 percent). An exception to these results is the collegiate attainment of black men from the South eligible for the G.I. Bill who did not share the gains experienced by black men from non-Southern states or white men more generally (Turner and Bound 2003). Explanations for the divergence in these results include the limited supply of higher education opportunities for blacks in the segregated South as well as the potentially lower demand owing to the poor secondary school quality available to these men.

wage premium for a college degree, relative to a high school degree, remains near 60 percent (Murphy and Welch 1999). The divergence between college enrollment and college completion and the related extension in time to degree have a substantial impact on inequality as well as intergenerational opportunity. Hence, understanding the determinants of college completion and how public policies affect completion should be a fundamental concern for research at the intersection of economics and higher education.

An overriding conclusion from the data assembled for this analysis is that it is imperative to consider explanations (as well as policy interventions) beyond a myopic focus on "affordability" and student aid. Table 1.6 summarizes the empirical explanations discussed in the prior section, and what is clear is that there is no one factor that unambiguously explains the collegiate attainment behavior observed. Because many of the outcomes observed in higher education are affected by investments made in elementary and secondary education as well as family circumstances, it may be that students at the margin of college enrollment in recent years are less well prepared than those from prior decades. It is also possible that credit constraints, particularly for high-achieving students from poor families, may limit degree completion or extend the time it takes to complete a degree. On the other side of the market, colleges and universities—the institutions forming the supply side of the market—matter substantially in the process of transforming initial college participation to collegiate attainment and completion. Understanding how these institutions adjust to changes in demand and funding and how students are matched with institutions is critically important. Limited evidence points to soft supply constraints (Bound and Turner 2004) at four-year institutions as one factor limiting degree attainment.

However, what is known about the link between college enrollment and college completion is an insufficient basis for advocating direct policy interventions. Very broad-based programs such as tuition subsidies or across-the-board grants to low-income students are likely to have minimal effects on college completion while imposing large costs. A primary hurdle to the understanding of the enrollment–completion relationship is the absence of data for evaluation. One glaring failure is the absence of careful recording of collegiate experiences on the major surveys designed to measure economic well being, including the CPS and the census. "Some college" is the only measure of attainment available in the most recent census enumerations and the CPS in much of the decade of the 1990s for those who have not completed a degree. Unfortunately, this measure does not distinguish between the high school dropout attending college for less than a semester and a high school graduate completing three years of study. Distinguishing between these cases is critical for understanding the connection between enrollment and attainment. To this end, it is imperative to

Table 1.6 Summary of Evidence Potentially Explaining Reduction in Completion Rates and Extension of Time to Degree

	Evidence	Comment
	Individual Constraints	
Credit constraints	18-to-24-year-old students increasingly combine college enrollment and employment. For potential students with parents in the bottom quartile of the income distribution, capacity to pay for college has eroded in the last two decades.	Observation does not prove that credit markets are insufficient or that finances at the collegiate stage are the barriers to college enrollment.
Student characteristics		
Academic achievement	Combined with increases in college participation, the marginal student enrolling in college is likely to be less prepared academically than in prior decades.	Changes are unlikely to be sufficiently large to explain increased time to degree.
High school degree type	Increased GED attainment may indicate declines in affective skills of potential college students.	
Nontraditional status	There has been increased enrollment of women with children; increased employment of students, particularly in their early 20s; and increased college enrollment of older students.	These changes in enrollment may reflect other changes (in dimensions like achievement and capacity to pay for college) that have extended the time needed to complete the BA degree, rather than a direct effect of these characteristics on attainment.
Paternal education	Collegiate attainment of the mothers of students of college age has increased markedly over the last two decades. This variable is predicted to increase collegiate attainment.	Observed change goes in the "wrong direction" for explanation of overall trends in degrees conferred.
	Institutions and Policy	
Tuition policies	While increases in tuition prices at public institutions do have a significant negative effect on undergraduate enrollment, there is no additional effect on BA degree attainment.	
State appropriations	There has been a shift in the distribution of state support from four-year institutions to community colleges, potentially reducing the relative supply of upper-division courses and deterring college completion.	It is not clear if this shift is caused by relatively exogenous political forces or is simply a response to student demand.
Federal policy	Pell Grants and Title IV financial aid do not appear to have a substantial effect on enrollment or attainment of recent high school graduates. These programs do appear to have a substantial impact on the enrollment of older students. Programs like the Social Security Student Benefit Program (Dynarski 2003) have substantial effects on attainment. Such programs are generous, transparent, and relatively targeted.	

move beyond cumulative measures, recording only the last level of participation, and to add measures of the trajectory of educational experiences. For example, recording type (or presence) of high school credential and the duration and type of program for each spell of college participation would be particularly illuminating and not that costly.

Beyond traditional microdata, targeted policy experiments (such as the COACH program in Boston) provide one avenue for obtaining a sharper focus on how policy design affects behavior. From a different angle, the opening of detailed administrative data records (such as the institutional student records used by Bettinger and Long [2004] in Ohio), particularly when combined with employment and social service records, is likely to improve substantially the understanding of the economic, social, and institutional factors affecting college completion.

In addition to the need for additional empirical evidence, the observed growth in time to degree and the expansion of enrollment outside the late teens and early twenties suggest the need to revisit our traditional human capital investment theory with the objective of introducing a model that is more successful in capturing the observed pattern of collegiate attainment. The interpretation favored in this essay is that demand-side limitations in credit and information combined with supply-side constraints at four-year institutions contribute to the delay in degree completion. Alternatively, Taber (comment to this chapter) suggests a model in which individuals shift from investing in on-the-job training in the workplace to continuing education offered by postsecondary institutions, presumably resulting from either reductions in the relative cost of the former or increased complementarities between collegiate attainment and employment.

The primary contribution of this essay is in the clear documentation of the relationship between college participation and college completion. There are a number of developments, such as the rise in parental education and the growth in the return to college completion, that quite plainly go in the wrong direction to explain the relationship between college participation and college completion. It is more difficult to distinguish among other explanations—such as the relative importance of precollegiate achievement, limitations in the credit markets, and changes in the level and distribution of state and federal policy—in understanding the decline in the college completion rate among those in their early twenties and the stagnation in this rate for those at older ages.[38] These are not easy empirical questions

38. Starting with the unanswered questions in this paper, Bound and Turner (2003) take a closer look at the determinants of time to BA degree receipt. Employing data from multiple sources, including the annual October files of the CPS and the NLSY, this research will examine the extent to which BA degree recipients from more recent cohorts are less academically or financially prepared than those in prior decades. A competing explanation is that changes in the resources available to students at colleges and universities, particularly large public institutions, may limit the ability of students to complete their studies in a timely fashion.

to answer, but they are important to resolve if public investments in higher education are to contribute to economic productivity and to reduce intergenerational differences in opportunities.

Appendix A

The primary sources of data for this analysis are the CPS (March and October), institutional surveys of colleges and universities, and the decennial census files.

College Enrollment and BA Degree Outcomes

The nationally representative CPS is the primary source for information on collegiate enrollment and attainment by age (or birth cohort). As indicated, many tabulations in this analysis rely on the October questionnaire, which contains a module devoted to education. Additional tabulations use the March supplement, which focuses on income-related questions. The CPS records attainment in each year, but is not the ideal data set to the extent that information on prior educational experiences is somewhat limited. To this end, we do not observe individual time to degree directly, but must examine changes over time in the collegiate attainment of a birth cohort. In all tabulations, individual weights are employed, and observations are limited to those without allocated information.

The decennial census enumerations complement the CPS data by providing very large samples recording collegiate attainment to individuals by state of birth and age (or, implicitly, year of birth). All source data are from the Integrated Public Use Microdata Series (IPUMS; Ruggles and Sobek 2003) microdata, with a 3 percent (form 2) sample for 1970, 5 percent samples for 1980 and 1990, and the 1 percent sample available for 2000.

In using both the census and the CPS over an extended time horizon, changes in the structure of the education question leads to a relatively strong assumption about the correspondence between the degree-based enumeration (with direct indication of degree types) and the highest grade completed form of recording. When comparing across years where different questions were administered, it is assumed that sixteen years of completed education is equivalent to a BA degree. Jaeger (1997) provides an analysis of the empirical correspondence between these measures. For the CPS, surveys from 1992 to the present employ the degree-based question and early surveys use the attainment question. Census enumerations prior to 1990 used the years of completed education, while 1990 and 2000 have used the degree attainment question.

Beyond surveys of individuals, federal surveys of colleges and universities provide information on college enrollment and participation. The de-

gree data are based on the annual "Earned Degrees Conferred" survey conducted by the National Center for Education Statistics (NCES), which records degrees awarded in the twelve-month academic year from July to June. The enrollment data are from the "Fall Enrollment" surveys, which record the number of students enrolled in classes in the fall. Through 1986, these surveys were part of the larger NCES Higher Education General Information Survey (HEGIS), which was subsequently redesigned as the Integrated Postsecondary Education Data System (IPEDS) collection. Machine-readable data are employed after 1966 (1967 for enrollment), which allows for the distinction of institutions by control (public/private) and Carnegie classification. These institution-based surveys are important for recording the "products" of the higher education system; however, because they record neither student ages nor track prior collegiate experiences, these data provide only indirect evidence on time-to-degree and completion rates.

Higher Education Finance Variables

Each year as part of the institutional reporting to the federal government, colleges and universities complete a survey of institutional finances in which they report basic income and expense items, including the sources of revenues and expenses. In years prior to 1977, all state-level financial data are from published tabulations as we have found the machine readable data for early years (through Webcaspar) to be unreliable, presumably due to problems with imputations. One of the primary variables from this source used in the analysis is state appropriations. Data on tuition and fees, measured as a price, are available from 1970 to the current year from the "Institution Characteristics" part of the HEGIS/IPEDS surveys. In addition, the Washington Higher Education Coordinating Board conducts an annual survey of tuition and fees at public institutions, which includes data from 1972–1973 to the present.

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Comment

Christopher Taber

Sarah Turner has written a very nice paper on trends in college attendance and completion over the last thirty years. The most important point of the paper can be seen clearly in figure 1.2. College participation rates have increased considerably over time, but college completion has changed very little. Turner goes through a number of different explanations for this trend but finds no obvious explanation. We are left with a puzzle: w*hy has college completion changed very little while college enrollment has changed substantially?*

Turner documents another important, and in my view, even more puzzling trend. There has been a huge increase in the amount of time it takes students to complete their degrees. This can be seen clearly in the bottom panel of figure 1.5. The difference between completion rates at age twenty-three and completion rates at age thirty has increased substantially. Again, one can see no obvious explanation. We are left with a second puzzle: w*hy has the average amount of time that it takes students to complete their college degree increased?*

In this comment I will highlight and expand on a point that Turner made in her paper: economic theory can be a useful tool to understanding these puzzles. I will go through some schooling models that are useful in thinking about the two puzzles mentioned previously.

A Model of College Attendance and College Completion

The main point that I want to make in this section is that the difference in trends in college completion and in college attendance is not necessarily a puzzle with even a very simple schooling model. I develop a traditional Becker (1975) model whose solution is similar to Cameron and Heckman (1998) in that it resembles an ordered probit.

Assume that if individual i attended s years of school, he or she would receive log earnings of

$$\beta(s; \boldsymbol{\pi}) + \gamma(t - s) + \theta_i,$$

where $\beta(s; \boldsymbol{\pi})$ is the payoff to schooling level s and depends on parameter vector $\boldsymbol{\pi}$, t represents age so that $(t - s)$ is potential experience, and θ_i represents ability of the student. The student goes to school until age s and chooses schooling to maximize the present value of earnings

$$\int_f^T e^{\beta(s;\boldsymbol{\pi})+\gamma(t-s)+\theta_i} e^{-rt}\, dt = e^{\theta_i} \int_f^T e^{\beta(s;\boldsymbol{\pi})+\gamma(t-s)} e^{-rt} dt$$
$$\equiv e^{\theta_i} g(s; \boldsymbol{\pi}),$$

where r is the interest rate.

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Now suppose that students must incur some costs to attend school. To obtain commonly observed schooling patterns, assume that the cost of schooling differs for high school, college, and graduate school, so that the costs of schooling for individual i are

$$\begin{aligned} &\mu_{1i} \quad \text{if} \quad s \leq 12 \\ &\mu_{2i} \quad \text{if} \quad 12 < s \leq 16 \\ &\mu_{3i} \quad \text{if} \quad s > 16. \end{aligned}$$

Assume that g is increasing in s, differentiable, and concave and that $\mu_{1i} < \mu_{2i} < \mu_{3i}$. Solving the model leads to the following first-order conditions or inequalities:

$$\begin{aligned} e^{\theta_i}\frac{\partial g(s;\boldsymbol{\pi})}{\partial s} &= \mu_{1i} \quad s < 12 \\ \mu_{1i} \leq e^{\theta_i}\frac{\partial g(12;\boldsymbol{\pi})}{\partial s} &\leq \mu_{2i} \quad s = 12 \\ e^{\theta_i}\frac{\partial g(s;\boldsymbol{\pi})}{\partial s} &= \mu_{12} \quad 12 < s < 16 \\ \mu_{2i} \leq e^{\theta_i}\frac{\partial g(16;\boldsymbol{\pi})}{\partial s} &\leq \mu_{3i} \quad s = 16 \\ e^{\theta_i}\frac{\partial g(s;\boldsymbol{\pi})}{\partial s} &= \mu_{3i} \quad s > 16 \end{aligned}$$

Now consider college attendance and college completion in this model. A student attends college if $e^{\theta_i}(\partial g[12;\boldsymbol{\pi}])/\partial s > \mu_{12}$ and completes college if $e^{\theta_i}(\partial g[16;\boldsymbol{\pi}])/\partial s > \mu_{12}$. Let F and f be the cumulative and probability distribution functions of μ_1/e^{θ_i}, then

$$\Pr(S_i > 12) = F\left[\frac{\partial g(12;\boldsymbol{\pi})}{\partial s}\right]$$

$$\Pr(S_i \geq 16) = F\left[\frac{\partial g(16;\boldsymbol{\pi})}{\partial s}\right].$$

My goal is to predict the manner in which college completion and college attendance adjust to parameter changes. Notice that

$$\frac{\partial \Pr(S_i > 12)}{\partial \boldsymbol{\pi}} = f\left[\frac{\partial g(12;\boldsymbol{\pi})}{\partial s}\right]\frac{\partial^2 g(12;\boldsymbol{\pi})}{\partial s \partial \boldsymbol{\pi}}$$

$$\frac{\partial \Pr(S_i \geq 16)}{\partial \boldsymbol{\pi}} = f\left[\frac{\partial g(16;\boldsymbol{\pi})}{\partial s}\right]\frac{\partial^2 g(16;\boldsymbol{\pi})}{\partial s \partial \boldsymbol{\pi}}.$$

One can see that the response of schooling to demand shocks at different levels of schooling depends on two things, the payment structure itself (e.g., $[\partial^2 g\{12; \boldsymbol{\pi}\}]/\partial s \partial \boldsymbol{\pi}$) and the density of individuals who are on the margin of whether to complete the schooling transition (e.g., $f[\{\partial g(12; \boldsymbol{\pi})\}/\partial s]$). One explanation of the difference in patterns is that the density of individuals that are close to indifferent about attending college is much larger than the density of individuals that are close to indifferent about completing college. There are a number of testable implications of this model that make this explanation straightforward to investigate.

A Model of Delayed Schooling

One objection to the previous model may be that I have assumed that students stay in school until a certain point and then leave. Turner clearly finds evidence to the contrary as she documents a large increase in part-time schooling (or fluctuating back and forth from schooling to work), leading to increased time to completion. In this section, I modify the previous model to allow for part-time schooling. In particular, assume that $I(t)$ is the fraction of time that an individual spends in school at the point in time t. The individual spends the rest of his or her time working. Schooling at time t, $s(t)$, is defined as the cumulative time spent in school:

$$s(\tau) = \int_0^{\tau} I(t)dt$$

I also extend the model to allow for utility maximization rather than just maximization of the present value of earnings. Let $c(t)$ be consumption at time t, let $u(.)$ denote the instantaneous utility from that consumption, and δ the discount rate. The student's problem is to maximize

$$\int_0^T u[(c(t)]e^{-\delta t}dt$$

subject to

$$\int_0^T c(t)e^{-rt}dt \leq \int_0^T [1 - I(t)]e^{\beta[s(t);\pi]+\gamma[t-s(t)]+\theta_i}e^{-rt}dt - \int_0^T I(t)\mu_i[s(t)]e^{-rt}dt,$$

where $\mu_i(s[t])$ is just defined as the marginal cost of schooling level s in a similar manner as the previous section.

It is straightforward to show that this model collapses to one analogous to the previous section.[1] First, notice that schooling only shows up on the right-hand side of the budget constraint. Thus, students make schooling decisions to maximize the present value of earnings. The second point that

1. It is not exactly identical due to the discounting of the costs of college. In the previous model if the marginal cost of a year of college is constant across years, but in present value terms that would mean that the marginal cost of a year of college is falling with years of schooling.

students will not choose part-time schooling is somewhat less obvious. The marginal benefit of investment falls over time because the horizon to reap the benefits falls, while the marginal cost in terms of forgone earnings rises because earnings increase with schooling. Thus, this model does not predict that students would participate in part-time schooling.

As Turner points out, borrowing constraints represent a reason why schooling may be delayed. To see why, consider an extreme example in which a student is completely excluded from credit markets so that they can neither borrow nor save. In this case they must just consume their income in each period. Thus, the student makes schooling decisions to maximize

$$\int_0^T u\{[1 - I(t)]e^{\beta[s(t);\boldsymbol{\pi}]+\gamma[t-s(t)]+\theta_i} - \mu_i[s(t)]I(t)\}e^{-\delta t}dt.$$

As long as u has the property that $u(0) = -\infty$ and costs of schooling are nonnegative, it is clearly the case that students cannot be in school full-time, so $I(t)$ must be less than 1. In general, students will still invest in schooling so that at the beginning of their life $I(t) > 0$. Thus, borrowing constraints can explain why students participate less than full-time in school.

If it is indeed borrowing constraints that lead to partial schooling, there is potential for policymakers to act. The increase over time could be due either to worsening of the constraints or due to increases in the costs of schooling.

However, there is another standard human capital model that gives a quite different prediction. Consider the classic model of Ben Porath (1967). I keep the notation the same, but interpret $s(t)$ as human capital gained in school rather than years of schooling. Schooling now is produced according to the human capital production function

$$S(t) = A[S(t)I(t)]^{\beta} - \sigma S(t),$$

where A, β, and σ are parameters. People now choose time in school ($I[t]$) to maximize the present value of earnings. The solution to this problem is well known. Under many parameterizations, students first specialize in full-time schooling ($I[t] = 1$), and then investment gradually falls to zero.

In the classic Ben Porath (1967) model, the period with $I(t) = 1$ is interpreted as schooling. After the period of specialization, $I(t)$ is interpreted as in invested in training on the job. In this model, workers would be indifferent between investing in human capital on the job or in school. From that perspective, there is nothing puzzling about the increase in time to completion.

More generally, one might expect that colleges have a comparative advantage over firms in producing general human capital. If this is the case, it is puzzling why we don't observe more part-time schooling. The most obvious explanation is fixed costs of school attendance. It is straightforward

to include fixed costs of school attendance in the previous model that could eliminate part-time schooling.

This model gives a quite different perspective on the increase in time to completion; it may be due to a fall in fixed costs of schooling. If this were the case, the fall in time to completion is actually welfare improving, and one can see no obvious reason why policymakers may want to intervene.

Whether the increase in time to completion is due to credit constraints or decreases in the fixed costs of schooling is ultimately an empirical question.

Conclusion

Turner does a very good job in documenting two important changes in schooling patterns over time—a divergence between college completion and college attendance and an increase in time to completion. There is much work to be done using both theory and empirical work to uncover these puzzles.

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