The Changing Roles of Family Income and Academic Ability for US College Attendance

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Abstract

We harmonize the results of a number of historical studies to document changes in the patterns of who attends college over the course of the 20th century. We find that family income or socioeconomic status were more important predictors of who attended college before World War II, whereas academic ability was afterward. We construct a model that explains this change through a decline in search costs, motivated by the movement to standardize college admissions and disseminate college information in the 1950s. Our model generates the reversal in sorting seen in the data as well as several other patterns documented in the literature using primarily this single driving force.

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1 Introduction

One of the central goals of U.S. higher education policy is to expand access to college. One interpretation of this goal is that students' abilities should be the sole determinants of who can attend college, and not factors such as their family's income, wealth, or location (Bowen et al., 2005). A large literature has studied whether federal loan programs effectively alleviate borrowing constraints and deliver access to college. The consensus in this literature seems to be that cohorts entering college around 1980 were not borrowing constrained, but that federal aid programs have failed to keep pace with rising college costs since. This failure has led to a decline in access to college (Belley and Lochner, 2007; Lochner and Monge-Naranjo, 2011).[1]

The existing literature has focus on the interplay between federal loan programs, borrowing constraints, and access to college for recent cohorts. Our goal is to add to the literature by providing a broader historical context. To do so, we make two contributions. First, we construct a database that documents changes in the composition of college attendees versus non-college attendees as far back as the high school graduating class of 1919. Our data show a pronounced increase in access over this time period, particularly in the 1940s and 1950s. Our specific metric will be the relative importance of academic ability (test scores, high school class rank) versus family background (socioeconomic status, income of parents). We find that the role of the former increases and of the latter decreases. Our second contribution is to provide a model to help understand these changes. We show that a simple model with falling costs of searching for colleges can explain our findings as well as several others in the literature. We link this falling search cost to the standardization of college admissions that took place in the U.S. shortly after World War II.

Our empirical contribution involves collecting, harmonizing, and analyzing the results from over forty datasets or studies that cover college attendance patterns. Our data cover two broad eras. For the graduating classes of 1960 onward, we have periodic access to microdata on nationally representative samples of high school students, including notably Project Tal-

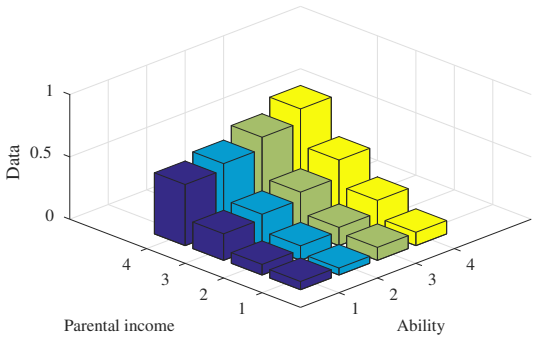
[1] Similarly, Galindo-Rueda and Vignoles (2005) documents that the importance of ability in determining educational attainment declined in the UK between 1958 and 1970. A number of papers documented that family income played little role in college attendance after controlling for individual characteristics such as ability in the NLSY79 (Cameron and Tracy, 1998; Cameron and Heckman, 1999; Carneiro and Heckman, 2002). Keane and Wolpin (2001) and Cameron and Taber (2004) also argue that borrowing constraints played little role in students' decisions. However, Belley and Lochner (2007) and Bailey and Dynarski (2011) document that access has subsequently declined by the metrics we use below. Finally, Ionescu (2009) models college and the current Federal Student Loan Program in great detail and finds that it plays little role in shaping college attendance decisions.

ent and NLSY79. These surveys include multiple measures of students' academic abilities, family characteristics, and college attendance decisions that allow us to construct directly college attendance patterns. We are unaware of extant microdata covering any earlier cohorts. Instead, we have collected the published reports from nearly three dozen studies that investigated college attendance patterns for these earlier cohorts. Our analysis for this earlier period rests on published tabulations from these studies.

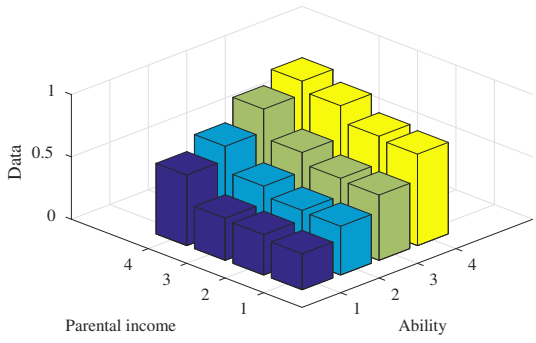
These early studies suggest dramatically different college attendance patterns than we see today. For example, Updegraff (1936) collected information on 15 percent of Pennsylvania's 1933 high school graduating class. In his report, he provides a table giving college attendance rates for students with different ranges of IQ test score and socioeconomic status (constructed using parental education and occupation). We reproduce his results on college attendance by test score and socioeconomic status "quartiles" in Figure 1a. Family background played the dominant role in determining who attended college; academic ability played a surprisingly small role. This finding is suggestive on its own. To provide context, we replicate the study as closely as possible in the NLSY79, mimicking how Updegraff measured family background, academic ability, and college attainment. The results, shown in Figure 1b, show a complete reversal: by the 1979 cohort academic ability is the dominant determinant of college attendance, with almost no role for family background, except at the very highest quartile

Figure 1: Changing Patterns of College Attendance: 1933 and 1979 Cohorts

(a) 1933 Cohort



(b) 1979 Cohort



We harmonize and replicate similar results from nearly three dozen other historical studies, then merge them with the results of the modern microdata to form a time series on college attendance patterns. We find large changes in sorting patterns over time. Updegraff's

findings are typical of studies from the 1920s and 1930s. There are few studies during or shortly after World War II; by the mid 1950s there is growing evidence of a complete reversal, with academic ability playing a strong role in college attendance and family background playing little role. We see little evidence of a systematic trend in these patterns since 1960.

We tie these trends to a number of other changes that affected higher education shortly after World War II and which can be jointly described as the national integration of the market for college (Hoxby, 2009). Most colleges streamlined and standardized their admissions process around this time. College guides disseminated information on colleges and their admission criteria. Students responded by widening their college search and applying to multiple colleges, which became increasingly important as more colleges practiced selective admissions. National integration produced other trends that have been studied elsewhere: stronger sorting of college students on ability; and stronger sorting of students of different abilities between college (Taubman and Wales, 1972; Hendricks and Schoellman, 2014; Hoxby, 2009).

Our second contribution is to provide a model of college search that rationalizes all of these observations. The model features students who are heterogeneous with respect to their academic ability, the family resources they can access if they attend college, and where they live. Each location has a local college with heterogeneous endowments (in the literal sense). Students can work straight out of high school or attend college, which augments their human capital and future earning power. If they choose to attend college, they can either apply to the local college at no cost, or pay a search cost to access and apply to the entire menu of colleges in the economy. Colleges set admissions policies to maximize an objective that includes both size and quality, where quality is in turn a function of their endowment and the mean ability of their students.

We feed into this model two exogenous driving forces. The first is a rising value of attending college, which captures for example the rising college wage premium. It allows our model to fit college attainment by cohort but is otherwise less essential for our results. The second is a falling cost of searching among non-local colleges, which captures the standardization of college admissions in the 1950s. This is the key driving force that allows our model to fit the patterns documented here and elsewhere in the literature.

We calibrate these two driving forces to fit college attainment and sorting patterns as well as possible. We show that using just these two parameters we can generate all of these patterns. The 1930s calibration features high costs to search. Most students attend their local college, which results in an equilibrium where all colleges are equally mediocre. As

search costs fall, high-ability students search nationally for high-quality colleges, since they have the most to gain due to a complementarity between ability and quality in the human capital production function. Low-ability students' college choices worsen because the best students are now segmented into selective, high-quality colleges that they cannot attend. Changes in the quality of colleges available to students of different abilities is critical to generating the changed sorting patterns as in Figure 1. The model also generates search behavior and sorting of students between colleges consistent with the evidence. We show that a model without time-varying search costs delivers none of these predictions.

In addition to the work listed above, our paper is related to two literatures. The first seeks to understand the rise of college attainment in the U.S. Restuccia and Vandenbroucke (2013) focus on the rise in the skill premium as a driving force. Several other papers agree, but add additional driving forces: Goldin and Katz (2008) explore a number of institutional changes that may have played a role; Donovan and Herrington (2017) argue that declining real college costs relative to income played a role until the 1968 cohort; and Castro and Coen-Pirani (2016) add that the decline in measured abilities across a wide variety of assessments may have helped explain the slowdown in attainment for post-1950 cohorts. Although our work is related to this literature, our focus is more on explaining the changing patterns of who attends college rather than how many do so. The second literature concerns the long-run trends in inequality. Probably the most related work by Chetty et al. (forthcoming) shows falling levels of income mobility, which diverges from the pattenrs we have documented here for access to college. Comerford et al. (2016) provide a unified theory that may help to rationalize these trends, by noting that a greater emphasis on human capital accumulation may actually lead to higher inequality once families' dynamic human capital investment responses are taken into account.

2 Historical Data

The central empirical claim of our paper is that the importance of family background in determining who attends college has declined throughout the twentieth century, while the importance of academic ability has risen. The evidence for this claim is derived from two very different types of sources. For the modern era (high school graduating classes of 1960 onward) we have access to large, nationally representative microdata surveys with multiple measures of family background and academic ability as well as students' post-graduation outcomes. These sources are largely familiar to economists and include most prominently

Project Talent and NLSY79. For students graduating before 1960, our evidence comes from the studies conducted by researchers in a variety of of fields, including psychology, economics, and education.

The original microdata from the pre-1960 studies no longer exist. Instead we rely on their published results, which we have collected from journal articles, dissertations, books, technical volumes, and government reports. The design, sample, and presentation of results are different for each study. Nonetheless, it may be helpful to consider a hypothetical typical study that utilizes the most common elements in order to understand our approach. Table D1 in the appendix gives references for the studies used and summarizes some of the most pertinent metadata for each.

In a typical study, a researcher worked with a State's Department of Education to administer a questionnaire and an aptitude or ability examination to a sample or possibly the universe of the state's high school seniors in the spring, shortly before graduation. A student's academic ability was measured by their performance on the examination or, in some cases, by their rank in their graduating class. The questionnaire inquired about the student's family background, with typical questions covering parental education and occupation or estimates of the family's income. This data was used to rank students based on family income or an index of socioeconomic status that would combine several different elements of the data. Finally, the researchers would inquire about the student's plans for college or, alternatively, follow up at a later date with the student, the student's parents, or school administrators to learn about the actual college attendance. Our main data source for this era is published tabulations of these results giving the fraction of students of different academic ability and/or family background that attended college.

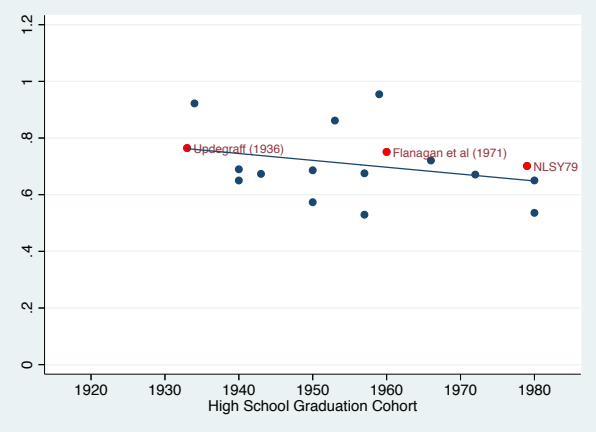
In order to summarize the results of these many studies, we convert family background and academic ability categories into percentile ranges. We then treat the reported tabulations as data on $C(a)$ and $C(p)$, where C is the percentage of students in a group who attend college and a and p are the midpoints of the percentile intervals of our proxies for ability and parents, respectively. We regress $C(a)$ on a and $C(p)$ on p and report the estimated coefficients β_a and β_p, which capture the importance of academic ability and family background for college attendance decisions in a way that is easily compared over time.

Figure 2 plots these coefficients against high school graduation cohort. For now we focus on tabulations of college-going as a function of family background or academic ability alone. There are three main facts to note. First, Figure 2a shows that the importance of family background (family income or socioeconomic status) has declined over time, although there

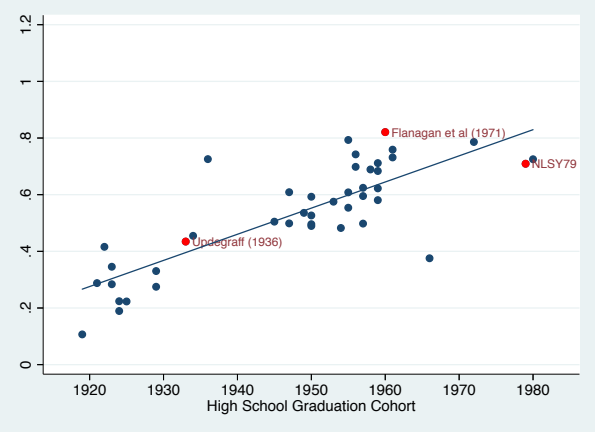
is substantial noise in the trend. Second, Figure 2b shows that the importance of academic ability (test scores or grades) has sharply risen over time, in line with the previous work of Taubman and Wales (1972) and Hendricks and Schoellman (2014). Studies conducted before World War II were especially likely to find academic ability to be unimportant in determining who attended college. Finally, comparing the two figures shows that family background was a much more important determinant of who attended college before World War II, whereas academic ability is a more important determinant afterwards. Finally, we note that while the pre-1960 studies are less ideal in that we do not have access to nationally representative microdata, the many tabulations we have collected from around the country agree on the broad trends we are interested in.

Figure 2: Changing Patterns of College Attendance: Univariate Studies

(a) Family Background



(b) Academic Ability

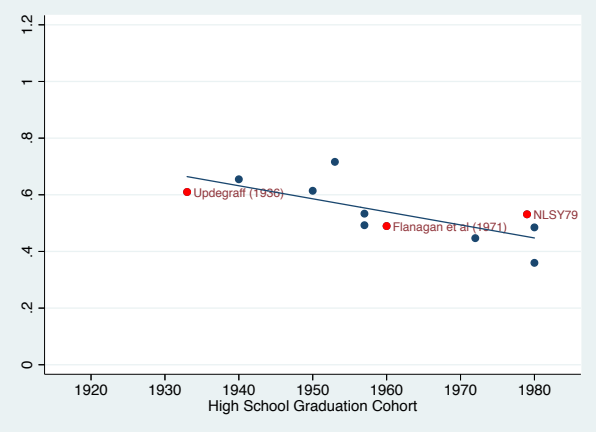


We highlight in red three studies of particular importance. Updegraff (1936) is the first study to cross-tabulate college attendance by family background and academic ability. It shows that family background was a more important determinant of who attended college than academic ability before World War II. Flanagan et al. (1971) is the first nationally representative study with existing microdata. Critically, it shows that sorting patterns had reversed already by 1959, which is important because this year predates most of the important changes in college financing that came during the 1960s. The NLSY79 captures the modern era, where academic ability is now the main determinant. The main difference between these modern cohorts is on the financing side; Flanagan et al. (1971) studies one of the last cohorts to graduate before the introduction of the federal loan programs, while the cohorts in NLSY79 have access to these programs.

For a subset of our studies we have a bivariate cross-tabulation of college-going as a function of both factors. This allows us to provide a crude measure of the importance of academic ability "controlling" for family background, and vice-versa. This control is important because family background and academic ability are positively correlated in every study for which we can cross-tabulate the two. To summarize the results of these cross-tabulations, we construct transform the reported tabulations into observations $C(a, p)$ similar to our $C(a)$ and $C(p)$ above. We then regress these observations on the a and p simultaneously and study the estimated coefficients β_a and β_p.

Figure 3: Changing Patterns of College Attendance: Bivariate Studies

(a) Family Background



(b) Academic Ability

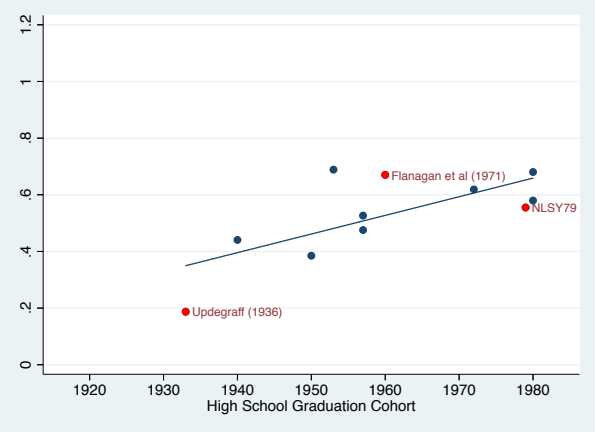


Figure 3 shows the results. There are fewer data points because we have cross-tabulations for only a subset of studies. However, the patterns are broadly similar to those shown in Figure 2. The main difference is that the decline in the importance of family background is more pronounced after controlling for academic ability. The reason for this is that college attendees are more strongly selected on academic ability over time and academic ability is positively correlated with family background; this confounding trend weakened the relationship depicted in Figure 2a. Again, we highlight the three studies of particular interest in red.

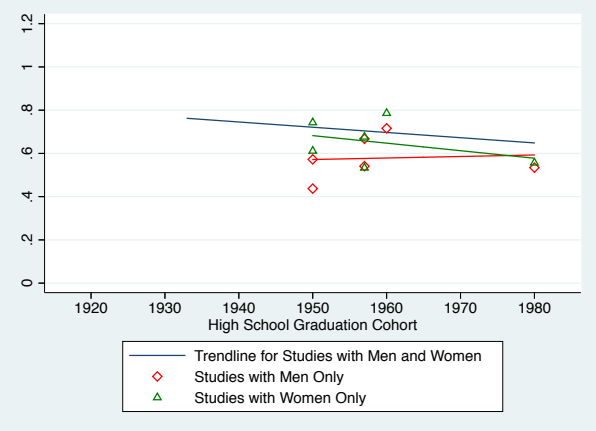
2.1 Patterns by Race and Gender

A natural question is whether our results apply to all groups, or whether they are explained by changing attendance patterns only for women or blacks. This hypothesis may

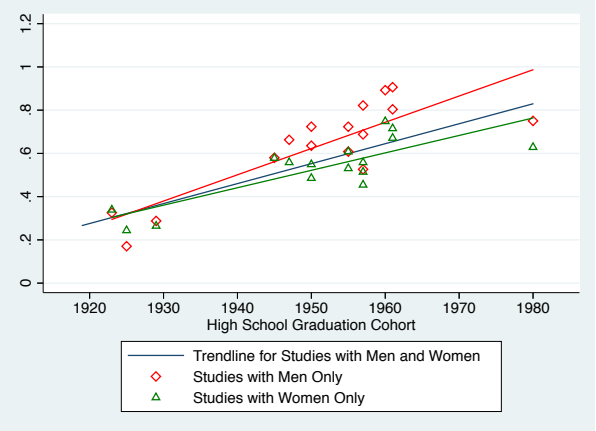
be natural given that the college and labor market opportunities available to women and blacks changed substantially over this period. To investigate the role of gender, we measure changes in college attendance patterns of men and women separately in the subset of studies that give tabulations by gender. We then compare these patterns to the overall trend for both genders, shown in Figure 4.

Figure 4: Changing Patterns of College Attendance by Gender

(a) Family Background



(b) Academic Ability



Relatively few studies separately tabulate results on family background by gender. The results of these few studies show no evidence of a bias from including women. However, the first such studies are available only in 1950; it is possible that there were differences earlier in the period. A larger number of studies separately tabulate results on academic ability by gender. College attendance of men seems to depend somewhat more on academic ability, as measured by the difference between the blue and red trend lines. On the other hand, both trend lines slope up, suggesting that increased sorting by academic ability is a common phenomenon that has affected both men and women.

Tabulations by race are almost non-existent in our historical sources. In large part this is because most of these studies were conducted in northern states where black students would have been much less common. For example, of the thirty-nine sources tabulated in Appendix D, only five draw on southern states. Hence, our early data sources and our overall trends should really be read as applying to white students. We have computed in the NLSY79 that black and hispanic students are relatively more sorted by academic ability and less sorted by family background than are white students. Given the absence of earlier race-specific data, we can only speculate about the long term trends implied by this fact.

2.2 Controlling for Variation in Historical Study Design

Our baseline results combine the findings of studies that differ in numerous ways, such as which proxies they use for family background or academic ability, when they measured college attendance, the size of the bins they used for tabulations, and so on. One possible concern is that these details may matter and may influence the trends in β_p and β_a that we are documenting. To help address this concern, we re-create the design of each original study as closely as possible using the microdata from the NLSY79. We focus on replicating four main components of study design. First, we match whether the study used test scores or class rank. The former is measured using AFQT score; the latter using class rank at high school graduation. Second, we match whether the study used parental income or socieconomic status. The former is measured using family income at the time of high school graduation; the latter is measured using principal componenent analysis to extract the common component from father's occupation, education of both parents, and family income. Third, we match how the study measured college attendance: either prospectively by asking their plans, or by following up at a later date to see whether they had yet attended college. We use the number of years of college high school seniors planned to attend for the former and the longitudinal aspect of the NLSY to track actual attendance for the latter. Finally, we form the data into bins whose marginal size is the same as the original study.

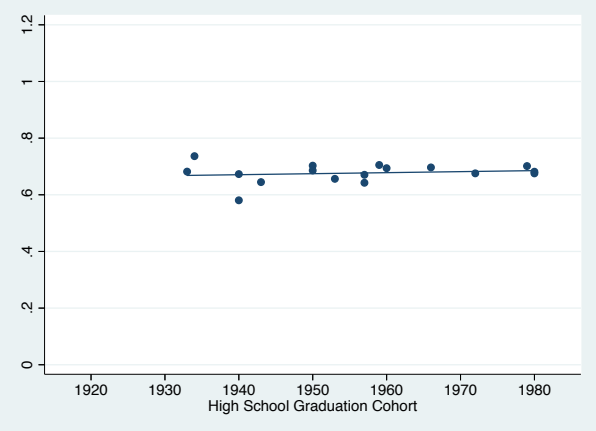
A simple example may help. Goetsch (1940) reports college-going as a function of family income for students who score on the top fifteen percent of a standardized test. She provides tabulations for eight family income categories, containing 24, 8, 16, 22, 20, 7, and 3 percent of the relevant population. Within the NLSY79, we restrict our attention to those who scored in the top fifteen percent on a standardized test, namely the AFQT. We then sort the remaining children on family income and form them into bins that contain the same 24, 8, 16, ... percent of the income distribution.

We then study the implied β_p and β_a that arise from applying these various study designs on the NLSY79. Since the underlying data is fixed throughout, this exercise helps isolate the extent to which various aspects of study design influence our measures of sorting. We find one aspect of study design that contributes importantly to our results. It is consistently true that socioeconomic status is a stronger predictor of college attendance than is family income. This holds when comparing different studies of similar cohorts and also when comparing within studies where both measures are available, of which we have three. The average gap from the within-study comparisons is 0.29. We adjust up all of the estimated β_p from family income studies by this amount to make them "SES-equivalent" studies.

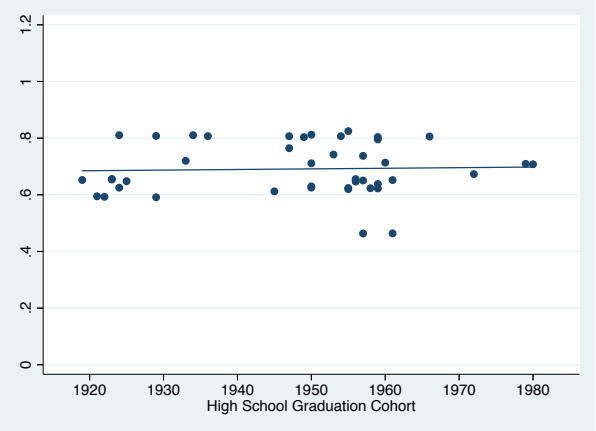
Conceptually, we can think of two reasons to prefer estimates based on SES and adjust those based on income. First, socioeconomic status may be a stronger predictor of lifetime income and hence the student's financial means. Second, socioeconomic status may be less prone to measurement error, particularly as compared to studies that ask students to report family income. Note that these adjustments do not affect our calibration below because each of our three main studies of interest (Updegraff, Project Talent, and NLSY79) uses socieconomic status as the measure of family background anyway.

Figure 5: Counterfactual Changes in Patterns of College Attendance: Univariate Studies

(a) Family Background



(b) Academic Ability



We find that the other aspects of study design have litlte impact on our results. This point an best be explained using figure 5, which shows the results of our simluated data using the historical study designs on the NLSY79. The x-axis shows the cohort of the original study whose design was copied and the y-axis shows the implied β_p and β_a from implementing that study design on the NLSY79. Thus, the data points at 1933 show what would have happened had we implemented the procedures of Updegraff (1936)'s study design on the NLSY79. In other words, it exactly replicates Figure 2, except that the underlying data are held fixed as the NLSY79 throughout.[2] There are two main takeaways from these figures. First, variation in study design induces noise in our estimates of β_p and β_a. Given the same NLSY79 data, we can find a range of possible results depending on what proxies we use and how we format the data. The second point is that there is no consistent bias in the time trend of how study design affects our estimates. This lends confidence to our conclusion

[2]Similar results apply for the bivariate studies; see Figure C1 in the Appendix.

that the trends depicted in Figures 2 and 3 reflect genuine changes in who attends college.[3]

3 Driving Forces

Our empirical results show that college attendance patterns changed sharply in the period between the 1930s and 1960. In the next section we provide a model that features declining search costs as the key force that generates these trends. Here, we define precisely what we mean by declining search costs and provide historical evidence.

A useful starting point is the work by Hoxby (2009), who documents many signs of national integration of education markets after World War II. She attributes this change to declining costs of transportation and communication that made it easier to learn about, travel to, and communicate from distant colleges. The prime consequence that she measures is a "fanning out" of colleges by quality: selective colleges have become more selective since 1962, while non-selective colleges have become less selective. She suggests that colleges may have been fanning out since the 1950s, although the available data on college quality (measured as mean admissions test score) becomes scarce before 1962.

Our data is a useful complement because we can describe trends in college-going behavior before World War II. Our data fit with her assessment that there was a trend towards national integration after World War II. Not only were students more sorted by ability *between* colleges, but our data show that they were more strongly sorted by ability *into* college during this period. We show in Section 5 that a simple model of college attendance with search costs naturally replicates both of these changes.

When we model a decline in search costs, we have in mind specifically the standardization of admissions that occurred in the 1950s. Prior to World War II, college admissions was idiosyncratic and highly fragmented. College admissions emphasized learned knowledge. When scrutinizing transcripts, they looked for students who had a minimum number of units (roughly, a course taken for a whole year) in total and also in various subjects. College entrance examinations were essentially lengthy subject examinations. However, the subjects preferred and examinations used varied by college. Additionally, the mechanics of admissions varied significantly by college: what forms were to be used; what information

[3] An alternative worry is that older tests may have been worse, which would explain our time trend in academic ability measures. In Hendricks and Schoellman (2014) we document that the predictive validity of tests seems reasonably stable over time. Further, a similar pattern emerges if one compares across cohorts taking the same test.

was required on them; when applications were due; and when applicants were to be notified all varied by school.[4] These detailed, idiosyncratic systems made it difficult to apply to a large number of colleges.

During and after World War II, three changes acted to replace this system with a more standardized, national one. First, results from a large-scale experiment in college admissions as well as the general experience with veterans attending college on the G.I. Bill suggested that detailed subject requirements offered little value as admissions tools (Aikin, 1942; Jencks and Riesman, 1968). Second, a shortage of labor during the war led the College Board to drop written subject exams in favor of the standardized SATs. The use of the SAT (and eventually the ACT) exploded throughout the 1950s and 1960s in part because of low cost and in part because the College Board began to require member colleges to use the SAT. Third, the College Board found a new mission in the 1950s: standardizing and communicating admissions policies. In 1951 it released the first edition of The College Handbook, which detailed college admissions policies for many colleges and soon became a standard reference for guidance. It also devoted a great deal of energy to simplifying the "mechanics of admission": "catalogs, application forms, requirements for admission, notifications, acceptances, deposit fees, and so forth."[5]

These changes had immediate impacts on students' application behavior. Prior to World War II, students faced a confusing admissions landscape; most applied to a single college with good working relationships with their high school. Since almost no colleges were selective, they would be assured of admissions except in unusual circumstances.[6] After World War II, the landscape changed rapidly. The most obvious sign of a decline in search costs is that students began to apply to multiple colleges. While multiple applications were rare before World War II, just under three-fourths of applicants applied to a single college in 1947; only one-half did so by 1959; and less than a third did so by 1979 (Roper, 1949; Flanagan et al., 1964; Pryor et al., 2007). This "plague" or "specter" of multiple

[4]See Kurani (1931) for a detailed examination of the admissions forms and requirements for several hundred colleges as of 1930. The first four chapters concern primarily the many different approaches to admissions and questions employed at the different colleges.

[5]Bowles (1967) covers this period of change in the College Board and its mission in great depth. Quotes are from p. 52.

[6]From Duffy and Goldberg (1998), p. 35: "...[S]tudents tended to apply only to their first-choice college, and they were usually accepted" and "Admissions officers visited selected high schools, interviewed candidates for admissions, and then usually offered admission to students on the spot." Less politely, this was the "warm body, good check" stage of admissions, p. 34. To some extent this reliance on relationships was a holdover of the older certificate system, whereby college officials would examine high schools and then certify the ones whose curriculums were up to their standards. The implication was that graduates of such high schools would be admitted to the college (Wechsler, 1977).

applications was a recurring topic of discussion among admissions officers in the 1950s.[7] It led admissions officers to adopt a new rule of thumb that they should admit their capacity plus one-third extra in each year, to account for students who were accepted but choose to attend elsewhere. The growth in college attendance and applications per student allowed admissions offices to switch from focusing on recruitment to selection of applicants and led to the "fanning out" of colleges documented in Hoxby (2009). Thus, we think that a decline in search costs is an important and plausible driving force to model, and we pursue this approach below.

The most plausible alternative driving force is changes in the financial environment. The reason we abstract from these in our analysis is that the changes in attendance patterns seem to have taken place already by 1960. On the other hand federal government intervention in college financing starts only in 1959 with the National Defense Education Act and ramps up throughout the 1960s and hence is too late to explain these trends.[8] To further document this point we draw on three surveys that collected information on how students financed college throughout the 1950s (Hollis, 1957; Iffert and Clarke, 1965; Lansing et al., 1960). These surveys all agree on the broad picture of how students financed college at the time. The main source of financing was students and their family, with the reported share ranging between 80 and 87 percent in the three studies. The next leading categories were scholarships (4.8–8.4 percent) and "other" (2.6–7.1 percent). Only 1.9–3.3 percent of students and 14 percent of families are borrowing from any source, with the total borrowed accounting for a tiny fraction of total expenditures.[9] To be clear, these figures were quiet different by 1969–1970; the share paid for by families had fallen below three-quarters, with loans taking up much of the shortfall (Haven and Horch, 1972).

4 Model

We develop a model of college choice with search frictions in the spirit of Lucas and Prescott (1974). The economy contains a discrete number of locations (islands) indexed by $i \leq I$.

[7] See Duffy and Goldberg (1998) pp. 37–39 and Bowles (1967) p. 117.

[8] An alternative story appeals to the GI Bill, but while the expenditures for the GI Bill were large they were also short-lived and confined to men, whereas the changes in sorting patterns were long-lived and affected both genders. We conclude that the effect of the GI Bill on sorting was not through its direct financial impact.

[9] We are aware of only one survey that covers the earlier era. Havemann and West (1952) surveyed college graduates of all ages in 1947 by mail survey. Perhaps tellingly, they included only two options for financing: by working or through their parents.

Each location is home to a single college and a measure 1 of new high school graduates per year. Locations are heterogeneous with respect to the quality of the local college.

There are two types of agents in the model, students and colleges. Students decide whether to attend college or work. If they choose to attend college, they also need to make a college choice. They can apply to the local college at no cost or they can pay a search cost to learn about and apply to colleges on other islands. Colleges set an admissions policy, which determines the students they accept and educate. We now describe the agents in further detail.

4.1 Colleges

Colleges are heterogeneous in terms of an initial endowment $\bar{q}_i$ drawn from a distribution G that affects quality. This endowment can be taken as the literal endowment: the land, buildings, and financial accounts that a college possesses. The college's actual quality q_{it} depends on both its endowment and the mean ability of its students $\bar{a}_{it}$, $q_{it} = \bar{q}_i + \bar{a}_{it}$.

The university sets an admission policy, which is an ability cutoff $\underline{a}_{it}$ such that any student who applies and has ability above this cutoff is accepted. The college chooses its admissions cutoff to maximize its objective:

$$P(q_{it}, e_{it}) = q_{it} e_{it} \tag{1}$$

subject to a capacity constraint $e_{it} \leq E$. Our objective is motivated by the work of Epple et al. (2006) and Epple et al. (forthcoming), who show that objectives of this type can rationalize much of the college admissions process. Including quality in particular is important for this. We also allow colleges to have direct preferences over the size of the student body, with two rationales in mind. First, college administrators may have direct preferences over running a larger (perhaps more important) college. Second, in a model with fixed costs of operating a college, a larger student body implies lower average costs or, alternatively, allows for higher expenditures per pupil, which may be an input to producing quality (Epple et al., 2006, forthcoming).

Note that both quality and enrollment depend implicitly on the cutoff $\underline{a}_{it}$. The tradeoff from a higher cutoff is clear: it weakly increases the mean ability of the college's students, but weakly reduces the number of enrollees. The multiplicative functional form gives the simplifying property that colleges maximize the total ability of the student body subject

to their capacity constraint. This implies that colleges accept all students until the capacity constraint binds; only then do they practice selective admissions, consistent with the evidence from the previous section. Since there is no uncertainty in the model we abstract from rejected applicants and assume that colleges will choose their cutoff $\underline{a}_{it}$ so that their capacity constraint is not violated.

4.2 Students

High school graduates have heterogeneous endowments (a, p, i). a is their endowed ability, which is a trait that allows them to learn more in college. p is the family (parental) resources that they can access in college, which combines transfers from their parents and any income they can earn through working. i is their location (island) and indexes the quality of the local college that they can attend without search costs. (a, p) are distributed according to a distribution $F(a, p)$ that is independent of location i. Given these endowments, high school graduates face a two-step decision problem. In the first step, they decide whether to work directly in the market as high school graduates; to apply to the local college; or to search among non-local colleges. Students who search among non-local colleges then realize taste shocks for each such college and choose the college that maximizes expected utility. We explain each choice in turn.

High school graduates who enter the labor force directly possess a single unit of human capital that they supply to the labor market inelastically. This labor supply determines their lifetime income. Given that all students who start work as high school graduates at date t earn the same income and have the same preferences, we can summarize the resulting value of working as a high school graduate as $V_{HS}(t)$, which is sufficient for our purposes.

Students can attend the local college as long as $a \geq \underline{a}_{it}$. If they do so, their consumption while in college is given by their family resources p. This assumption is equivalent to saying that students cannot borrow out of future income, which is consistent with the financial environment through at least the mid 1960s. College allows students to accumulate human capital $h(a, q_{it}) = a^{q_{it}}$. This functional form builds in that ability and college quality are complements in the production of human capital. After graduation students provide $h(a, q_{it})$ units of labor to the labor market inelastically in each period; they use this income to finance their post-college consumption. We make the simplifying assumption that the discount rate is equal to the inverse of the gross interest rate; this, plus the lack of uncertainty, implies that graduates consume an equal share of p each year in college and then consume exactly

their earnings for each post-graduate year. Then we can characterize the value function $V(a, p, i, t)$:

$$V(a, p, i, t) = \log(p) + \alpha \log\left[h(a, q_{it})\right] + V_c(t) = \log(p) + \alpha q_{it} \log(a) + V_c(t). \tag{2}$$

α here is a weight parameter that corrects for discounting and the duration of college versus work periods. $V_c(t)$ is a taste shifter that governs the attractiveness of college: it includes for example variation in the wage per unit of college labor and the tuition cost of college.

Finally, students can pay a search cost $\xi(t)$ to apply to non-local colleges. Doing so allows them to attend any college whose admissions requirements they meet. On the other hand, it reduces their consumption while in college to $p - \xi$. These tradeoffs are embedded in the value function for search:

$$W(a, p, i, t) = \mathbb{E}\left\{\max_{j:\underline{a}_{jt} \leq a} V(a, p - \xi(t), j, t) + \bar{\zeta}\zeta_j\right\} \tag{3}$$

ζ_j is an i.i.d. type-I extreme value taste shock for college j. It is revealed to students only after they choose to search. Its primary purpose is to make the model more tractable computationally. $\bar{\zeta}$ controls the mean of the shocks, which in turn controls the relative importance of taste versus human capital formation for college choices.

Students choose among these three options (work as high school graduate, attend local college, search among all colleges) to maximize lifetime utility:

$$\max\left\{V_{HS}(t) + \bar{\eta}\eta_{HS}, V(a, p, i, t) + \bar{\eta}\eta_V, W(a, p, i, t) + \bar{\eta}\eta_W\right\} \tag{4}$$

where the ηs are again i.i.d. type-I extreme value taste shocks scaled by $\bar{\eta}$ and introduced mainly for computational tractability. As is standard in these problems the level of utility is not identified, so without loss of generality we normalize $V_{HS}(t) \equiv 0$ for each date t. In this case $V_c(t)$ represents the relative attractiveness of college instead of high school. In what follows it will be useful to define the decision rule $d(a, p, i, t)$ that takes the value of 0 if students work as high school graduates and otherwise takes the value of i if the student attends the college i.

4.3 Equilibrium

An equilibrium in this model is an admissions policy $\underline{a}_{it}$ for each college and a decision rule for each student $d(a, p, i, t)$ such that:

1. $\underline{a}_{it}$ maximizes each university's objective in (1) subject to its capacity constraint $e_{it} \leq E$.

2. $d(a, p, i, t)$ maximizes the student's objective in (2)–(4) subject to the feasibility condition $a \geq \underline{a}_{d(a,p,i,t),t}$.

3. Enrollment at each college is consistent with student attendance decisions $e_{it} = \sum_i \int \mathbb{I}[d(a, p, i, t) = i] dF(a, p)$.

Generally we should not expect a unique equilibrium in this model. Since college quality depends in part on student abilities, there are strategic complementarities between the college attendance decisions of different students. If student abilities play a large role relative to endowments in determining college quality, multiple equilibria arise naturally. One simple and intuitive case arises when all colleges have the same endowment and taste shocks are removed from the model $\bar{\eta} = \bar{\zeta} = 0$. In this case the complementarities between quality and ability imply that the most able students will want to group together in a single college, but which college they choose is entirely indeterminate.

We restrict our attention to focus on the equilibrium with positive assortative matching between mean student ability and college endowment produced by a simple solution algorithm that results in an equilibrium where student ability is increasing in college endowment, which seems a natural restriction. Given parameters, we iterate on the following four steps:

1. Form a guess of the equilibrium mean ability of each college $\bar{a}_{it}(\bar{q}_i)$ that is increasing in endowment $\bar{q}_i$.

2. Order students' preferences over college and work.

3. Assign students to colleges. Working from the highest to lowest ability:

   (a) Assign each student to their most preferred remaining college or, if they prefer, to working as a high school graduate.

   (b) When a student is assigned to a college, reduce that college's capacity by one seat.

(c) When a college has no capacity remaining, remove it from the available set.

4. Compute actual college quality $\bar{a}_{it}$. If it is the same as $\bar{a}_{it}(\bar{q}_i)$, stop. If it is not, adjust $\bar{a}_{it}(\bar{q}_i)$ accordingly and return to step 1.

Although this algorithm iterates on mean ability by college, it does implicitly produce an admissions policy. For colleges that are capacity constrained, $\underline{a}_{it}$ is equal to the ability of the marginally accepted student. For colleges that are not capacity constrained (that have fewer applicants than spots), $\underline{a}_{it} = 0$. It turns out that it is easier to iterate on mean quality than cutoff rules. Likewise, the algorithm implicitly defines a student's equilibrium application process: the student either works as a high school graduate or applies only to the college he is assigned by this algorithm.

This algorithm, and in particular the assignment problem of step 3, produces an equilibrium (conditional on converging). To see recall that equation (1) is equivalent to assuming that colleges maximize the total ability of enrolled students. Given this, no college has an incentive to raise their cutoff, because doing so would result in a smaller class and less total ability. Capacity constrained colleges cannot lower their cutoff because doing so would violate their capacity constraint; colleges not at the constraint already set the minimum possible cutoff of zero. Student choices represent an equilibrium because each student is assigned to the best feasible college, if any. All colleges the student may prefer to the one they are assigned have higher admissions standards than the student can meet.

Now that we have described the model and the equilibrium of interest, we turn to our calibrated experiments and results.

5 Calibration and Results

In this section we calibrate the model and study its implications for the time series patterns of sorting. Our main goal is to show that the model can generate the changes in sorting patterns observed in Figures 1 and 3 as a result only of declining search costs. We show that the model also delivers other implications consistent with the time series evidence.

In order to do so, we need to calibrate three types of parameters. The first are the distributional parameters that govern the allocation of students and colleges of different endowments. We assume that $F(a, p)$ follows a Gaussian copula on the unit square $[a_0, a_0 + 1] \times [p_0, p_0 + 1]$.Using a Gaussian copula implies that the marginal distribution of

family income and ability are uniform over the respective ranges but allows us to flexibly choose the correlation in the bivariate distribution by choosing a correlation parameter ρ.[10] a_0 and p_0 are level scaling factors. a_0 controls the strength of complementarity between student ability and college quality; we impose $a_0 \geq 1$ to insure that complementarities are positive for all students. p_0 controls the mean family income; higher values of p_0 allow for more consumption in college and lower the utility cost of attending college. We impose $p_0 > 0$ so that any student can attend college, albeit perhaps with very low consumption. Finally, we assume that distribution of college endowments $G(\bar{q}_i)$ is uniform on the interval $[0, \delta]$.

The second set of parameters are the time-invariant preference and constraint parameters. We assume that the weight on work versus college consumption α, the preference scaling terms $\bar{\zeta}$ and $\bar{\eta}$, and the capacity of colleges E are all time-invariant.

Finally we have the time-varying parameters that drive the changes in sorting. We focus on just two such driving forces. First, we allow the relative value of college $V_c(t)$ to vary by year. This gives us flexibility to fit the mean college attendance by cohort exactly. Our focus is on whether we can generate the observed changes in sorting. Our only driving force to attempt to hit this is $\xi(t)$, a time-varying search cost.

Altogether, this gives us 12 parameters that we need to calibrate. We select these parameters to fit the college attendance by (a, p) quartile as closely as possible for both the 1933 and 1979 cohorts, as well as the fraction of college students who search outside of their local area. For data on this point we use the fraction of students who apply to more than one college, with the idea that students who apply to only one college are not searching. Our data for 1933 is 10 percent and for 1979 is two-thirds. The former figure is admittedly a bit rough; we strongly suspect it is low, certainly less than the one-fourth in 1947, but it is hard to be more precise. The latter figure comes from Pryor et al. (2007). Altogether, this gives us a total of 34 moments to pin down our 12 parameters.

5.1 Model Fit

Table 1 gives the calibrated parameters. The key parameters are the time-varying ones. We find that colleges becomes more attractive (relatively less unattractive) over this period. As we show below, this is key for fitting the time series of college attendance by cohort.

[10] ρ is actually the correlation of the standard normal variables used in the normal copula rather than the correlation of the resulting p and a. It acts to directly control the latter correlation but is not equal to it.

Table 1: Calibrated Parameters

	Description	Value
Endowments		
a_0	Ability scale factor	1.6
p_0	Transfer scale factor	1.43
ρ	Endowment correlation	0.464
δ	Dispersion of college endowments	0.0211
Colleges		
α	Weight on post college payoffs	2.42
E	College capacity	1.18
Preferences		
$V_c(t)$	Relative value of college	(-2.46, -1.61)
$\xi(t)$	Search cost	(1.91, 1.45)
$\bar{\zeta}$	Scale of taste shocks at college entry	0.673
$\bar{\eta}$	Scale of taste shocks when searching	0.37

We find that the cost of searching for a non-local college declines substantially. In 1933 it is approximately the same as the mean transfers from parents, implying that roughly half the population cannot afford to search for college. By 1979 it is much lower.

These parameters allow the model to generally fit the targets quite well. The most important for our purposes are the college attendance by (a, p) quartiles for 1933 and 1979 cohorts. The results are shown in Figure 6. The 1933 cohort is on top and the 1979 cohort on the bottom; the data is in the left column and the model in the right. The model is successful at generating the reversal in the patterns of sorting: family background is the dominant force in determining who attends college in 1933 but academic ability is the dominant force in 1979. More broadly, the model generally delivers a good fit to the college attendance patterns for both cohorts. The main difficulty the model faces is in fitting the high college attendance of students from the richest families in 1933. It also slightly overestimates the importance of income in 1979.

The model also does a good job of fitting overall college attendance by cohort. It fits attendance for Updegraff and NLSY79 quite closely by construction. To say more we measure the fraction of high school graduates that attend college by cohort using the U.S. Census.[11] We then simulate the model for cohorts between 1933 and 1979, assuming that $V_c(t)$ and $\xi(t)$ follow a simple linear trend between 1933 and 1979. We compare the two in

[11] We measure attendance for each cohort using the Census where people are 35–44 years old. For the 1940–1980 Censuses we know only years of schooling rather than degrees, so we infer this statistic as fraction with 13 or more years of schooling relative to those with 12 or more.

Figure 6: College Attendance Patterns

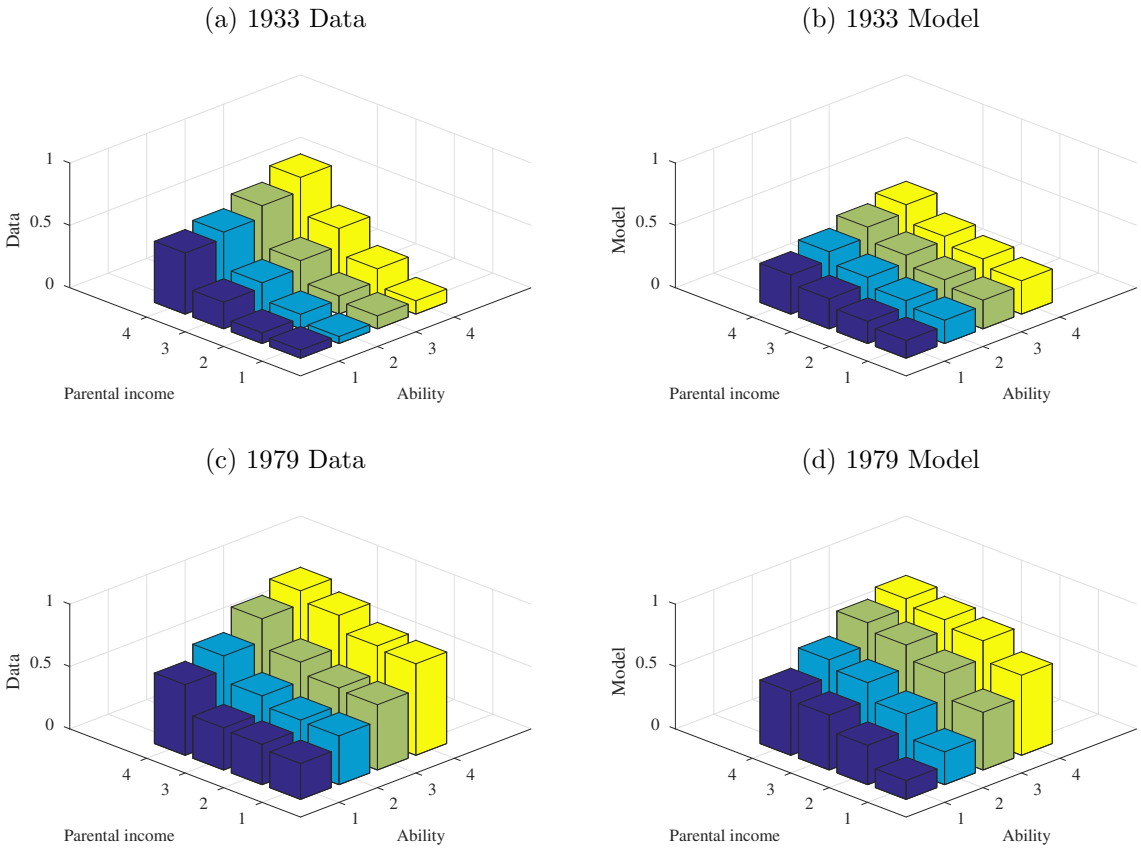


Figure 7. The Census data imply a higher level of college attendance than do the sources we use for the calibration. However, the model delivers a slow, steady rise in attendance, consistent with the data. $V_c(t)$ is the key driving force that delivers this fit.

Finally, the model does a good job of fitting the search behavior. In Figure 8 we compare the fraction of college attendees who search for college in the model and the data by cohort. We fit the start and end points closely by construction, but the model also delivers a reasonable fit in between the two points. The main deviation is that there was actually an acceleration in search behavior in the 1950s that the model does not capture. This acceleration is consistent with our view that the changes happened already in the 1950s and were driven by a decline in search costs. Now that we have shown that the model can fit the data, we explore the model's mechanics and its consistency with outside evidence in greater detail.

Figure 7: College Attendance by Cohort

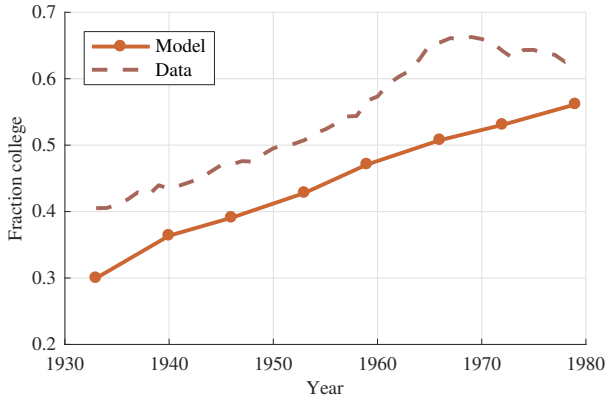
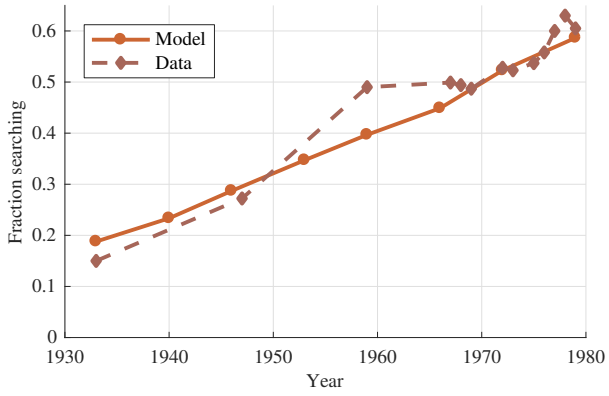


Figure 8: Fraction of Students Attending Local College



5.2 Model Mechanisms

The key mechanism of the model is the interplay between search behavior and the menu of college qualities. Our model is structured so that high-ability students always have the strongest incentive to search because they gain most from the complementarities between college quality and ability. However, the calibrated search costs in 1933 are large. This has a direct effect on search behavior, because many able students literally cannot afford to search, while others can afford search but find the resulting low consumption in college unattractive. Most students attend the local college. Given that $F(a, p)$ is independent of i, the student body of every college is roughly the same; quality heterogeneity is driven by heterogeneity in colleges' endowments. The fact that college quality is compressed in turn indirectly reduces the incentives to search.

As search costs fall, there are two effects. The first, direct effect is that more of the able students will find it optimal to search. The solution algorithm used ensures that the most able students congregate in the best colleges. The changing search behavior of high-ability students generates an indirect effect by changing the menu of college qualities available in the economy. Low-ability students near high-endowment colleges will eventually find that the college is oversubscribed and sets an admission standard that they cannot meet. They are then faced with the choice between foregoing college and working or paying to search for colleges elsewhere. Low-ability students near low-endowment colleges can still attend those colleges, but as high-ability students leave to attend college elsewhere the absolute quality of their college declines and hence they too find work more attractive. These two forces are summarized by Figure 9, which shows the resulting college quality by (a, p) quartile for the 1979 cohort. In 1933 there are essentially no differences in the quality of college attended for students with different (a, p). By 1979 it is clear that high-ability students have access to and attend better colleges than low-ability students.

These two forces together generate the reversal of sorting that is the main focus of this paper. In 1933 all students have access to roughly the same quality of college. In this state, the key determinant of college attendance is family income, which makes college less painful. In 1979 the quality of college one can attend depends on academic ability. High-ability students have access to better colleges at lower costs and are induced to attend college. Low-ability students have access to worse colleges and are less willing to attend.

Figure 10 shows how these forces play out as search costs fall. As before, we simulate the model for intervening periods, assuming that $V_c(t)$ and $\xi(t)$ follow a linear trend between their calibrated 1933 and 1979 values. Although crude, this interpolation is useful for

Figure 9: College Quality Patterns, 1979 Cohort

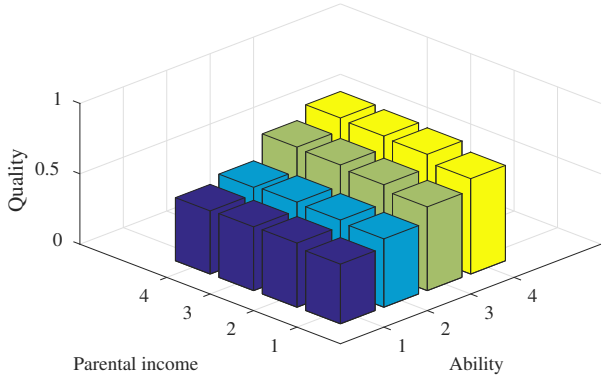
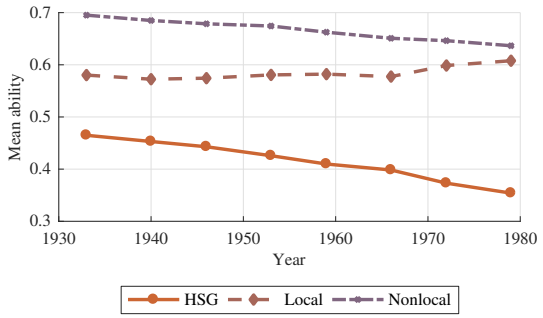
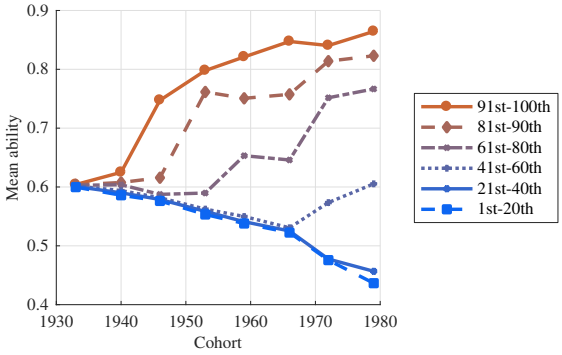


Figure 10: Additional Model Implications

(a) Ability Sorting



(b) College Segmentation



understanding how the model mechanisms play out. Figure 10a shows the mean ability of students who search for college, attend a local college, or work as high school graduates by cohort. As discussed above, more able students are more likely to attend college and are more likely to search for college in all cohorts. As search costs fall more students search, pushing the mean ability of students who search down. The declining search costs also provide incentives for most high-ability students to attend college, while lowering the incentives for the low-ability to attend college. This implies a large decline in the mean ability of students who work as high school graduates. It follows from this figure that the model generates a growing gap between the mean ability of students who attend college and those who do not, consistent with the previous empirical findings of Taubman and Wales (1972) and Hendricks and Schoellman (2014).

Figure 10b shows how college qualities evolve over time. To construct this figure we rank colleges by their endowment. We then plot the mean ability of students attending colleges in the top decile, the second decile, and so on. This figure is a close analogue to Figure 1 of Hoxby (2009). Our model predicts that all colleges had nearly the same mean ability in 1933. As search costs fall in the early 1940s, more and more high-ability students search. They concentrate in the highest endowment colleges, driving a growing wedge between the top decile and the remaining colleges, whose quality declines slightly. Starting from the mid-1940s the top decile of schools reach their capacity constraint. As search costs continue to fall above-average ability students start to search and congregate into the second decile of schools, opening up a wedge between that decile and the rest. This dynamic repeats until the 1979 cohort, which features large gaps between schools. This figure features the "fanning out" of colleges by mean student ability that is the focus of Hoxby (2009). Even the magnitudes of these shifts is line with the empirical evidence. Hoxby finds that the gap between the best and worst schools increased from about 40 to about 70 percentage points between 1962 and 2007, with some suggestive evidence that gaps were even smaller in the 1950s. Our model produces gaps that grow from nearly 0 to 40 percentage points by 1980.

5.3 Isolating the Role of Search Costs

At this point we have established that a model with just two time-varying parameters can fit not only our reversal of sorting but also changes in applications behavior, college admissions, and college selectivity consistent with the data. The goal of this section is to make it clear that the fall in search costs are the key driving force that delivers these features. To do so, we fix ξ to be the same for all cohorts, while allowing $V_c(t)$ to vary. We calibrate the now-11 parameters to fit the same moments as before.

[to be completed]

6 Conclusion

This paper documents large changes in the patterns of college attendance in the United States during the 20th century. We draw on and harmonize the results of a number of historical studies conducted before 1960 and add our own calculations using microdata from 1960 onward. Our main finding is that family income or socioeconomic status were more important predictors of who attended college before World War II, whereas academic

ability was afterward.

This trend fits into a broader picture of the national integration of the market for college degrees that took place shortly after World War II and has been previously documented in Hoxby (2009). The college application process was streamlined and standardized, and new publications gave students details on the colleges and universities nationwide. In response students applied more widely and to more colleges. Top colleges became more selective while many of the rest saw the quality of their student body decline.

We provide a simple model that generates each of these features as a result of a declining cost of college search. Falling search costs make it easier for the most talented students to search for and match with the best colleges. Less talented students find that their college options worsen over time. This driving force generates a fanning out of colleges by student ability; a growing ability gap between students who do and do not attend college; and a reversal of the patterns of who attends college consistent with our evidence.

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A Online Appendix: Robustness of Historical Trends

This appendix contains robustness checks and historical details relating to the time series patterns of college attendance.

A.1 Changes in College

One complication with studying changes in college attendance patterns is that the college itself has changed. This raises the potential concern that what it means to "attend college" or who is counted as "attending college" may have changed over time. Broadly, our principal is to construct the most consistent series possible that includes students who acquire a broad education in a wide range of subjects but excludes those who acquire shorter, narrower educations specific to a particular vocation or occupation. Here we explain how we apply this principle to construct measures of college attendance given three important changes in college over the 20th century.

First, American colleges used to be dedicated more narrowly to the liberal arts education. Students who wanted training for a specific profession often acquired that elsewhere, either through apprenticeships or at schools dedicated to the teaching of a single subject. For example, in 1900 there were specialized schools for students who wanted to teach or go into business. Over the course of the 20th century, these specialized schools were abolished and their teaching functions moved into colleges and universities. For engineering and agriculture, these changes predate our period of interest. The Morrill Act of 1862 established in each state a university (the land-grant university) that was required to teach agriculture and engineering; these programs were thus established inside the university fairly early (Grayson, 1977). For teachers, the process happened organically in our period of interest. Teacher's schools (also called normal schools) were commonly sponsored by states and offered a broad liberal arts education to help prepare teachers to teach a variety of subjects. These offerings were so similar to the traditional liberal arts curriculum that many normal schools slowly transitioned into regional state universities that offered a full range of degrees, including UCLA and Arizona State University (Labaree, 2008). Given that this education is broad and general, we include those who enroll in normal schools as attending college when they are separately enumerated. For business, there were actually two distinct types of institutions that went by the name "business school". The first was the business school attached to a university, as in the modern sense. While such schools were rare before 1910, they became increasingly common over the new few decades (Pierson, 1959). Since

students who attend these schools necessarily attend college, they are correctly included in our figures. The second was a stand-alone institute that specialized in teaching particular business skills, including secretarial, accounting, or trade courses. In some cases we have reports of the number of students intending to attend these institutes, but we exclude them from our college enrollment figures given the short duration and specialized, vocational nature of their training. Finally, the education of nurses changed during this period. Before 1964, most nurses were trained in three-year programs housed in hospitals that focused on "ward management, medical diagnosis and treatment, and sanitation" (Lynaugh, 2008). Reforms initiated in 1964 moved most nurse training to the university setting as a part of four-year programs. We chose to exclude the small numbers of students who report enrolling in nursing schools in the pre-reform period because the education provided, while lengthy, is narrowly focused on a particular vocation.

The second change in American colleges was specific to medical and legal training. In the 19th century, students of these two subjects acquired their training in apprenticeships or by enrolling in specialized schools, often directly from high school. Reform efforts in the early 20th century gradually pushed both subjects into universities as post-graduate subjects to be studied after exposure to or graduation from an undergraduate program. These changes generally happened before our period of interest. The great majority of medical schools required at least two years of prior college studies by 1920 (Hiatt and Stockton, 2003). The American Bar Association worked to enact similar standards in each state; by the 1930s they had succeeded in passing them in all states outside of the South (Harno, 1953; Shafroth, ed, 1939). Very few of our data points are from before 1920 or the South, so it is unlikely that changes in the location and requirements for medical or law school affect our trends.

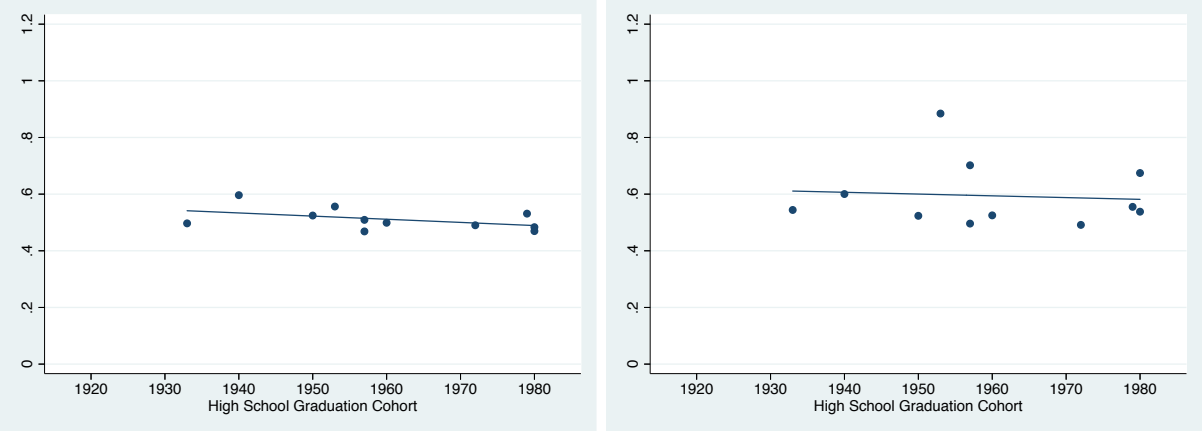
The third and final change in American colleges is the growth of junior colleges or community colleges, institutions that specialize in granting two-year degrees. Although institutions of this type first arose in the 19th century, their popularity greatly increased after World War II, particularly in the 1960s; today, roughly forty percent of college students are enrolled in junior or community colleges (Horn et al., 2006).[12] Community colleges are challenging to categorize because they combine two types of education. Some students at community colleges receive vocational training specific to a particular occupation, resulting in a certificate or a terminal associate's degree that qualifies them to practice a particular

[12]Currently, the term community college refers to public two-year institutions and junior college to the private equivalent, but this was not always the case. Nonetheless, the distinction is not important for our purposes so we lump the two together.

profession. On the other hand, other students who study at community colleges take a broad slate of courses with the goal of transferring to a four-year institution or graduating with a two-year associate's degree in some form of liberal arts studies. Ideally we would exclude the former group and include the latter to be consistent with our principal, but we cannot. We choose to include community college and junior colleges because the evidence suggests that the majority of students enroll there with the intention of pursuing a longer and broader degree. Horn et al. (2006) categorizes recent entrants based on whether they plan to transfer to a four-year institution; receive a general associate's degree; receive an applied associate's degree (defined as one specific to a chosen occupation); receive a certificate; or have no plans. Of those who have plans, 43 percent plan to transfer and 30 percent plan to receive a general associate's degree, as compared to just 18 and 9 percent who plan to receive an applied associate's degree or certificate. Since more than three-fourths of students view community college as a path to a broad education, we include community college in the broad grouping of college.

A.2 Other Robustness Checks

Figure C1 shows the counterfactual estimates of β_p and β_a if we replicate the design of our bivariate studies using the NLSY79. As with Figure 5, we find no evidence that changes in study design would tend to generate false patterns over time in patterns of who attends college.



(a) Family Background (b) Academic Ability

Figure C1: Counterfactual Changes in Patterns of College Attendance: Bivariate Studies

B Online Appendix: Historical Studies on College Attendance

The central empirical claim of our paper is that the importance of family background in determining who attends college has declined throughout the twentieth century, while the importance of academic ability has risen. The evidence for this claim is derived from studies performed throughout the 20th century, primarily from the Great Depression onward. For studies that predate the 1960s, the underlying raw data are no longer extant. Instead, the figures of this paper rely on the results of the original studies as they were reported in published journal articles, books, technical reports, and dissertations.

The original underlying studies were conducted by researchers in a variety of fields, including psychology, economics, and education. The typical study had a limited geographic scope and covered a single cohort or a narrow range of cohorts. The most common design was a study that collected information on high school seniors in a single state about their background and their college-going intentions. The goal of this appendix is threefold. First, it contains the basic details of the underlying studies, which we refer to as the metadata: the geographic scope, cohorts covered, how the data were collected, the underlying variables used, and so on. Second, it discusses how we used the NLSY data to help harmonize the results of these various studies. Third, it discusses the robustness of our results to various alternative assumptions. We describe the general pattern of results and how we replicate them before turning to a discussion of the details of the original studies.

B.1 College Attendance, Academic Ability, and Family Background

The main source of data is historical sources that cross-tabulated college attendance with measures of academic ability, family background, or both. In discussing these sources, it is useful to separate them into two broad time periods. For students who graduated high school before 1960, the record is much more fragmentary. Most of our studies describe selected samples of students in a particular city or state; the sample was sometimes but not always representative of the area. Hence, we have collected any such study that covers this early period, and rely on the preponderance of evidence from 34 such studies to substantiate our claim. For students who graduated high school during or after 1960, the record is much more complete. There exist numerous studies of large, nationally representative samples of

students. Further, the original microdata often exist for these such studies. Hence, for the post-1960 era we focus on large, representative samples, eschewing the task of collecting all such samples.

The underlying studies for the early samples differ along several key dimensions. First, they were conducted by different researchers in different geographic regions of the country, using different sample selection criteria, and so on. Second, the studies differed in how they collected information on each of the key variables. For academic ability studies used either class rank or test score on a standardized test, with varying tests over the years. For family background studies used family income or socioeconomic status, calculated different ways. Finally, to find college-going behavior studies either asked high school seniors about their plans to attend college (typically in the spring), or they followed up with students, their family, or their high schools in order to ascertain the actual behavior of students. In Table D1, we overview the most important metadata from each of these studies. For each line we describe the details of a single study: the citation; the location (city, state, or nationwide); the breadth (a selected sample, a large sample of most of the state, a citywide or statewide sample of all persons); the high school graduating cohort; the way college was measured (prospectively, before graduation, or follow-up); the measure of background and academic ability; and the number of bins used to describe the data.

The raw results reported in these studies are consistent with the claims made in the paper about the changing relative importance of academic ability and family background. However, it is natural to be concerned about the comparability of the results reported in different studies. The approach we adopt here is to utilize the NLSY to act as a "bridge" to improve the comparability of the studies. The idea is that the NLSY79 and the NLSY97 provide detailed microdata on family income, socioeconomic status, test score, high school performance, and college-going. Hence, it is possible to re-create the exact tabulations published in earlier papers using the NLSY data. Our reported results compare the importance of academic background and family income for explaining college attendance, *relative* to what the researcher would have found if he or she implemented the same design for the modern cohorts in the NLSY.

To conduct these replication we focus on two key dimensions.[13] First, we measure family background and academic ability as in the original studies. For family background, we differentiate between income reported by parents, income reported by studies, and socioe-

[13] Hendricks and Schoellman (2014) conducted robustness checks showing that several other dimensions were unimportant in replicating these results, including the identity of the state studied or the test used to measure academic ability, as well as how or when college attendance was measured.

conomic status (generated using a principal component analysis on father's occupation, parental education, and family income, similar to many of the original studies). For academic ability, we differentiate between test score and class rank. Second, we group the data in bins designed to deliver the same marginal distributions as in the original study, and then measure college attendance as a function of these bins. We compare the results from these replications to those from the original studies to help us understand whether the importance of academic ability and college attendance have changed over time.

An example may help. Goetsch (1940) reports college-going as a function of family income for students who score on the top fifteen percent of a standardized test. She provides tabulations for eight family income categories, containing 24, 8, 16, 22, 20, 7, and 3 percent of the relevant population. Within the NLSY, we restrict our attention who scored in the top fifteen percent on a standardized test, namely the AFQT. We then sort the remaining children on family income as reported by parents, then form them into bins that contain the same 24, 8, 16, ... percent of the income distribution.

The result is raw data $C(a, p)$ on college-going as a function of academic ability and family background and simulated functions of the same object from the NLSY79. We compare these two functions to understand the relative importance of family background p on college attendance C and how this has changed between 1937 and 1979. Below we give the details of all the studies in further detail.

B.2 Underlying Studies

This section gives further details on the sampling and variables of the studies used in the paper. The tables at the end summarize the basic details of the studies in a single location.

B.2.1 Book (1922)

Book (1922) arranged for more than 6,000 high school seniors throughout the state of Indiana to fill out a short questionnaire and complete an aptitude test, the Indiana University Intelligence Scale. The questionnaire asked about the student's family background (including their assessment of their family's income in five groups) as well as their plans for college. Unfortunately the reported findings do not contain a cross-tabulation of college-going by income and test score jointly.

B.2.2 OBrien (1928)

OBrien (1928) arranged for more than 4,000 high school juniors and seniors throughout the state of Kansas to complete an aptitude test, the Terman Group Test of Mental Ability. He used continued communication with school officials at most schools to track the progress of students as late as six years after graduation. He provides figures on college enrollment by test score for 3,780 of the students in the initial study (for the rest the school officials dropped out of the program). He also provides figures on college progress for all students who enrolled in Kansas colleges or universities, which includes more than half of those who enrolled in any college. Figures on college progress require some modest projection as to whether students still enrolled in college will graduate or not.

B.2.3 Mann (1924)

Book (1922) studied results from nearly 900 high school seniors throughout the state of North Carolina who filled out a short questionnaire and completed an aptitude test, the Mentimeter. The questionnaire asked about the student's college plans, including if available the specific college where the student planned to enroll.

B.2.4 Colvin and MacPhail (1924)

Colvin and MacPhail (1924) arranged for more than 3,000 students representing a random sample of high school seniors of Massachusetts to fill out a short questionnaire and complete an aptitude test, the Brown University psychological examination. The questionnaire asked about the student's family background (including their assessment of their family's income in five groups) as well as their plans for college. The presentation of the results are closely modeled after those of Book (1922) and like that study do not include a cross-tabulation of college-going by income and test score jointly.

B.2.5 Odell (1927)

Book (1922) arranged for more than 12,000 high school seniors representing more than half of the high schools of the state of Illinois to fill out a short questionnaire and complete an aptitude test, the Otis Test of Mental Ability. The questionnaire asked about the student's family background (including their father's occupation), the student's grades, and their plans for college. The author was also the first to subsequently follow up on students'

plans, by first asking students to list the colleges at which they would enroll and then following up at those colleges the next year. He also checked whether students remained enrolled at the end of that year, providing a measure of one-year attrition at college. Some colleges did not cooperate, leading to an undercount of those entering college. We use the number known to have enter college by test score grouping and by self-reported average grades; similar results obtain if we use instead the number planning to enter college.

B.2.6 Ames (1926)

Ames (1926) arranged for 1,400 Montana high school seniors (just less than half the state total) to fill out a questionnaire and complete an aptitude test, the Otis Test of Mental Ability. The questionnaire asked about the student's plans for college. The author collected a number of other potentially useful pieces of information (family income, class rank, and so on) but unfortunately did not produce usable tabulations from these data.

B.2.7 Benson (1942)

Benson (1942) followed up on an earlier study that administered an aptitude exam (the Haggerty Intelligence Examination) to sixth-grade students in Minneapolis. She followed their school records to determine whether they had dropped out or graduated high school and, for graduates, whether they had their credits transferred to a college. For those who did so, she followed up with the colleges to learn whether or not they had graduated. Her results give academic progress by original test score, which we use to compute probability of high school graduates attending college and probability of college entrants graduating as a function of test score.

B.2.8 Henmon and Holt (1931)

Henmon and Holt (1931) arranged for nearly 17,000 high school seniors representing 95 percent of the state of Wisconsin to fill out a short questionnaire and complete an aptitude test, the Ohio Psychological Test. The questionnaire asked about the student's plans for college. The authors also secured the assistance of high school and college officials to check which students actually enrolled the subsequent fall, which is the basis for the figures used here.

B.2.9 Updegraff (1936)

Updegraff (1936) conducted an intensive survey of roughly 12 percent of the students who were on the sixth grade class rosters in Pennsylvania in 1926. Using a number of college students and other employees organized under the guidance of faculty, they proceeded to locate and interview as many students as was possible in the fall of 1934, by which time students should have graduated high school if they were to do so. The interview covered family background and academic progress, including high school graduation and enrollment in college. For the students whose answers were sufficiently complete, Updegraff constructed a measure of socioeconomic status based on replies to questions about ownership of household durables, father's occupation, mother's and father's education, and language spoken at home. Test scores were taken from school records and to an intelligence test taken before the sixth grade. We aggregated categories for the college going by socioeconomic status and test score exercise to ensure sufficiently large cell sizes.

B.2.10 Barker (1937)

Scott (1935) administered a questionnaire to a subsample of more than 4,000 high school seniors throughout the state of Iowa who also took the Iowa Every-Pupil Exam. Barker (1937) conducted a follow-up with the school administrators of most of the schools to determine whether or not the students had enrolled in college within two years.

B.2.11 Gardner et al. (1942)

Gardner et al. (1942) collected data on the college attendance of Natchez, Mississippi as part of an intensive sociological study in the tradition of W. Lloyd Warner's Yankee City studies (e.g., (Warner and Lunt, 1941)).[14] The authors collected data on students' graduation from high school and college-going directly from the school principal. They organized the students' families into socioeconomic classes based on their own observations from two years of living in the city. We have aggregated together their "upper-upper" and "lower-upper" because the former is too small to be useful for analysis (3 persons).

[14] As was common for such studies, the city is given a pseudonym in the original manuscript. The names were never a particularly well-kept secret and are openly mentioned in recent versions and discussions of the research (Davis et al., 2009).

B.2.12 Livesay (1942)

Livesay (1942) arranged for more than 2,000 high school seniors in the state of Hawaii to fill out a short questionnaire and complete an aptitude test, the American Council Psychological Examination. The questionnaire asked about the student's plans for school. The author followed up the subsequent year to find out whether the student enrolled in college as planned.

B.2.13 Goetsch (1940)

Goetsch (1940) used data from Wisconsin's statewide testing program, which administered a short questionnaire and an aptitude test, the Henmon-Nelson Test of Mental Ability, to all of the state's seniors. Goetsch selected students from the city of Milwaukee who scored in the top 15 percent of the test score distribution. She used the information provided in the questionnaire to connect the student's family to their state tax records, which she used to measure family income. She also mailed a follow-up questionnaire to the students a year after graduation to find out whether or not they had enrolled in college.

B.2.14 Sibley (1948)

Sibley (1948) utilized administrative data from schools and tax records for a sample of 1940 high school graduates from the state of New York. The sampling framework was designed to represent ten percent of students throughout the state, although slightly different methodologies were employed in New York City versus the rest of the state. Principals were asked to furnish their students' graduating class rank, college enrollment status for the subsequent year, and parental names and address. Students whose college enrollment was unknown to the principal were excluded from the analysis. The names and addresses were used to link parents to New York state tax records and thereby to determine family income.[15]

[15] Sibley (1948) does not report directly the number of cases in each of the relevant bins. We use the 1944–45 edition of the U.S. Census Bureau (various years), which reports the distribution of family income for families of two or more persons in 1941, to approximate the distribution of families by income. We correct for the difference between 1943 New York average income and 1941 US average income using national and state per capita income figures from the same volume, which suggest roughly doubling income. The correspondence between adjusted bins in the Statistical Abstract and bins in Sibley are close but not exact.

B.2.15 Junker (1940)

Junker (1940) collected data on the college attendance plans of high school students of Dowagiac, Michigan as part of an intensive sociological study along the same lines as Gardner et al. (1942).[16] The author collected students' plans for attending college for all high school students. He organized the student's families into socioeconomic classes based on his own observations from two months of living in the city. We have disregarded data from the highest class, which has no students in high school anyway.

B.2.16 Lansing et al. (1960)

Lansing et al. (1960) conducted a survey of a nationally representative sample of families about family characteristics, including income as of the time of the survey, and the education of all children, including adult children. The reported results include college attendance for children 20–29 and 30–39 years old as of the time of the survey. We keep the data for these two groups separate and date them according to the midpoint of the age range, which makes them the 1943 and 1953 high school cohorts.

B.2.17 Keller et al. (1950)

Keller et al. (1950) arranged for a follow-up study of the 1945 class of Minnesota high school graduates. High school principals and superintendents were surveyed in the spring of 1946 were asked for basic information about the previous year's graduates, including demographic information, rank in class, and current activity. Responses for 83 percent of the state's graduates were received. Principals of urban schools were less likely to furnish all the necessary information, probably because they were less likely it know the current status of all their graduates.

The 1945 class graduated towards the end of World War II, so the majority of men had enlisted by the spring of 1946. The figures given are for women and for civilian men; the total figures refer to the unweighted sum of the two. Enlisted and civilian men showed little variation in class rank, which is the main variable of interest here.

[16]The original study was authored under a pseudonym and called the city "Hometown". The author's other writings of the time, under his real name, all concern Dowagiac and its school system.

B.2.18 Phearman (1948)

Phearman (1948) utilized test score data from Iowa high schools that administered the Iowa Tests of Educational Development to senior in the fall. He requested that the principals of high schools administering the exam furnish additional details about the seniors a year later, including whether they had graduated and enrolled in college, and their address. Roughly half of the principals participated. The researchers used the addresses to mail questionnaires to the students, which allowed them to collect information on family background such as father's occupation. More than half the students replied to the questionnaires.

B.2.19 Roper (1949)

Roper (1949) arranged for interviews of a nationally representative sample of 10,000 high school seniors. The interviewers collected data on class rank from the high school principal and asked students about their plans for college. The survey distinguished between those who had applied and been accepted and those who had been applied but not (yet) accepted. The interviewers followed up with the latter group to find out their enrollment status in the next fall. Interviewers also asked about other family characteristics, including father's occupation.

A second volume, Davis and Roper (1949), reports more findings from the same underlying study. We use any novel tabulations or those that include more detail.

B.2.20 Morehead (1950)

Morehead (1950) collected data from selected high school superintendents scattered throughout the state of Arkansas to report on the activities of 1.727 high school graduates from the class of 1949. Most of these schools had also participated administration of the American Psychological Examination, which furnished test scores for most of these seniors.

B.2.21 Berdie (1954)

Berdie (1954) arranged for 93 percent of high school seniors in the Minnesota class of 1950 to fill out a short questionnaire and complete an aptitude test, the American Council Examination. The questionnaire asked about the student's family background, including their assessment of family in broad groups ("frequently have difficulty making ends meet",

"sometimes have difficulty in getting the necessities", "have all necessities but not many luxuries", "comfortable but not well-to-do", "well-to-do", and "wealthy"), as well as their plans for college. A follow-up questionnaire was conducted by mail with a sample of students the next year to determine whether they had actually enrolled in college or not. Three-fourths of selected students responded to the follow-up questionnaire.

The authors report plans for attending college by class score and test rank, but report actual college attendance by family income from the follow-up. We use both sources of data.

B.2.22 White (1952)

White (1952) selected a sample of high schools in Northeast Ohio and then interviewed over 1,000 seniors at those high schools shortly before graduation. The researchers created an index of socioeconomic status based on replies about father's occupation, source of family income, and neighborhood of residence. Students were asked about their intention to go to college. The researchers recorded scores on an unspecified IQ test from the students' transcripts. The researchers also followed up with all transcript requests made to the high school to discern whether students had applied to and were enrolled in any colleges. Most of the necessary tabulations are provided using actual college attendance, but tabulations by gender are only given for intention to go to college.

B.2.23 Wiegman and Jacobsen (1955)

Wiegman and Jacobson (1955) arranged or a sample of more than 1,000 high school seniors in Oregon to fill out a short questionnaire that included information on their class rank and chances of attending college. A follow-up survey was mailed to the principals of their high schools the next year to determine who had actually enrolled in college.

B.2.24 State University of New York (1955)

State University of New York (1955) arranged for more than 20,000 high school seniors in three geographic subregions of the state of New York to fill out a short questionnaire. The questionnaire asked about the student's family background and plans for college. Students who were not sure as to their plans were re-surveyed in the fall to determine whether or not they had enrolled in college. The student's class rank and standardized test score (on

an unspecified IQ test) were collected from administrative records at the school. Finally, the researchers collected family income from the New York Department of Taxation and Finance for students above a minimum score cutoff on the standardized test.

The tabulations give two sets of results. First, they give college-going as a function of test score for all students. Second, they give college-going as a function of family income and test score, but only for students whose test scores put them in roughly the top thirty percent of the test score distribution. We repeat this procedure in the NLSY by first selecting only the top-scoring students on the AFQT, then classifying the remaining sample based on family income and studying college-going as in the original study.

B.2.25 Jones (1956)

Jones (1956) used data from Arkansas' statewide testing program, which administered the American Council Examination to more than 98 percent of the Arkansas high schools. The author questioned principals about whether the graduating seniors had enrolled in college the subsequent fall. Notably, this is the first study in a Southern state to present results separately for black and white students.

B.2.26 Daughtry (1956)

Daughtry (1956) collected data in the fall of 1955 on student class rank in terciles and college plans of the previous spring's graduates from high school principals covering 94 percent of Kansas' graduating class.

B.2.27 Educational Testing Service (1957)

Educational Testing Service (1957) describes the results from a study of more than 35,000 high school seniors at a sample of schools chosen to be nationally representative of public high schools. Students took a very brief (20 question) ability test, then filled out a questionnaire about their plans for college and family background. School principals provided details on students' grades. A follow-up with a sample of about one-fifth of schools the following fall was used to provide data on actual enrollment as well as plans for college. We use the results based on actual enrollment for the subsample of students in the follow up.

B.2.28 Cowen (1957)

Cowen (1957) arranged for a representative sample of more than 65,000 high school seniors in the state of New York to fill out a short questionnaire and complete an aptitude test, the New York State Scholastic Ability Test. The questionnaire asked about the student's plans for college and the certainty of those plans. The results are split into two because the sample includes roughly one-sixth of New York City school seniors but more than half of the upstate seniors, and the author cautions against combining results.

B.2.29 Little (1958)

Little (1958) arranged for 36,000 high school seniors representing almost 95 percent of the state of Wisconsin to fill out a short questionnaire and complete an aptitude test, the Henmon-Nelson Test of Mental Ability. The questionnaire asked about the student's family background (including self-assessed family income) and plans for college. The author also asked school officials to provide each student's class rank. Results of this study concern only a working subsample of approximately one-sixth of the total. A questionnaire was sent to the parents of this subsample the next fall to find out if students had followed up on their plans. About one-half of parents replied to this questionnaire. Reported tabulations use only plans for attending college. Sewell and Shah (1967) subsequently built on this study, see below.

In a separate phase of the study Little collected data on the 1953 Wisconsin high school graduates who enrolled in Wisconsin high schools and their subsequent progress as of 1957. Tabulations include students who had left the university, who were still enrolled, and who had graduated at the end of the fourth year, as a function of class rank and test score category.

B.2.30 Sewell and Shah (1967)

Sewell and Shah (1967) report results from a follow-up with one-third of the sample used in Little (1958); this subsample formed the basis for the ongoing Wisconsin Longitudinal Survey. The authors sent a follow-up questionnaire to the parents of the subsample seven years later using both mail and phone. 87.2 percent of parents of the subsample replied. The main new measure of interest is a complete record of graduation. Sewell and Shah (1967) also report findings by socioeconomic status of the family, which is constructed using

a weighted combination of father's occupation, parental education, estimates of funding available to pay for college, and approximate family wealth and income. College attendance and college graduation by gender were reported as a function of this socioeconomic status and scores on the Henmon-Nelson Test of Mental Ability (see above).

B.2.31 Stroup and Andrew (1959)

Stroup and Andrew (1959) administered a questionnaire to the 88 percent of high school seniors enrolled at schools that administered the American Council Examination in the state of Arkansas. The survey included questions about the student's family income in broad categories (such as "difficulty making ends meet" or "wealthy") and college plans, including specific institutions. The authors followed up with high school principals and colleges to verify the enrollment or non-enrollment of students at the colleges they had indicated they had planned to attend. Test scores were collected from administrative records for the testing program.

Basic statistics on college attendance rates are available separately for black and white students. These statistics indicate that a little more than 11,000 students in the sample were white versus 1,300 black, with 3,000 white students continuing to college versus 300 black. All other tabulations are for the two groups combined.

B.2.32 Montana (1960)

Montana State Department of Public Instruction (1960) reports results from data collected on the 1958 graduates of Montana high schools. Data were collected from high school guidance personnel on the number of graduates, their class rank, whether or not they had enrolled in college, and the location of the college, if any. Substantial effort was made to cross-check this information with the records of the relevant college admissions officers or registrars. College registrars were contacted again after a year to check on the re-enrollment of students at the start of the second year.

B.2.33 Nam and Cowhig (1962)

Nam and Cowhig (1962) administered a supplement to the Current Population Survey in October of 1959 that collected data on family background and college plans of high school seniors, in addition to the standard CPS questions on demographics, work, and income of

household members. The authors also administered a follow-up survey to principals of the students' high schools the following fall to collect data from school records and actual college attendance. The authors collected scores from a wide variety of tests and harmonized them using equivalence tables. They also collected class rank from principals. Family income was measured using parental responses to the usual CPS questions.

B.2.34 Medsker and Trent (1965)

Medsker and Trent (1965) arranged for an intensive study of more than 10,000 high school students from 16 selected communities in the Midwest and California. Students took a short aptitude test and responded to a questionnaire. Data on class rank and intelligence test score were collected, presumably from administrative records. The scores were from a number of different exams and were equated to a common scale, the School and College Ability Test. Students were mailed a questionnaire the October after their graduation to learn whether they had enrolled in college; more than ninety percent replied.

Preliminary results on one-year college persistence are available in the original study (Medsker and Trent, 1965). The authors also conducted a four-year follow up questionnaire in 1963. More than half of the original sample responded to this questionnaire, which was used to determine whether the college students had graduated, were still enrolled in (any) college, or had left college. Results of this study are given in Trent and Medsker (1968) by gender and for three academic ability groups.

B.2.35 Flanagan et al. (1971)

Flanagan et al. (1971) report the results from Project Talent, a nationally representative survey of 440,000 high school students in 5 percent of the nation's high schools. Students took an extensive battery of aptitude and ability tests. They also filled out lengthy surveys about their backgrounds, plans, interests, and activities. The Project Talent team created an index of socioeconomic status using value of home, family income, books in home, appliance and durable good ownership, whether the child had his or her own room, father's occupation, and parental education. The results here come from a five-year follow-up study that tracks actual college student enrollment. Project Talent generally had high response rates and used weights to help reduce any bias from nonresponse.

B.2.36 Berdie and Hood (1963)

Berdie and Hood (1963) arranged for a second study very similar in design and execution to Berdie's 1954 study (see above). The authors arranged for 97 percent of high school seniors in the Minnesota class of 1950 to fill out a short questionnaire that asked about the student's family background, including their assessment of family in broad groups ("frequently have difficulty making ends meet", "sometimes have difficulty in getting the necessities", "have all necessities but not many luxuries", "comfortable but not well-to-do", "well-to-do", and "wealthy"), as well as their plans for college. The students' test scores were taken from a junior year administration of the Minnesota Scholastic Aptitude Test, while class rank was taken from administrative records. Unlike the prior study, this one had no follow-up. Usable information on family income was not provided.

B.2.37 Tillery (1973)

Tillery (1973) reports the results from the SCOPE Project, which was a large survey of students in the ninth and twelfth grades of high school. 34,000 seniors from four states (California, Illinois, Massachusetts, and North Carolina) took an aptitude exam, the Academic Ability Test, and filled out a questionnaire about their family background and college intentions. The key background indicator is family income relative to the national average (which they were given) in five groupings. For college plans, they were also asked for details on where they were applying. This information was used in an intensive follow-up the next year to determine which students had actually enrolled in college.

B.2.38 Eckland and Henderson (1981)

Eckland and Henderson (1981) analyses the National Longitudinal Study of the High School Class of 1972 (NLS72), a nationally representative sample of about 21,000 high school seniors from the spring of 1972. Students were administered a battery of tests and then filled out a questionnaire that asked about a number of family background characteristics. The test score is a composite derived from vocabulary, reading, letter groups, and mathematics test scores. Socioeconomic status is an index derived from information on father's and mother's education, parental income, fathers occupation, and an index for ownership of various household items.

The NLS72 involves substantial efforts to follow up with students to measure their post-

graduation education and work. This study presents results from 4.5 years after graduation. We focus on results for those who have ever attended college as a function of socioeconomic status and family background. The authors break these results out by race at several points. We also use information on the college progress of those who entered in the fall of 1972; results are given for those who have graduated (in four years); those still and continuously enrolled (but have no degree yet); and those who dropped out at various points. The authors note that roughly one-third of students who drop out re-enroll at some point. Re-enrollment is positively correlated with academic aptitude.

B.2.39 Gardner (1987)

Gardner (1987) analyses the High School & Beyond Survey, a nationally representative sample of 28,000 high school seniors from the spring of 1980. Seniors were administered a battery of test, which was combined into a composite test score rating. They, or in a subsample of cases their parents, were asked to report family income. Students reported income in seven broad categories, while parents reported any dollar value. The dollar values of parents were recoded into the seven broad categories given to students. Students also reported the education and occupation of each parent; several variables on the learning environment in the home; and several variables on the household possession of consumer durables. These variables were combined with income to form a socioeconomic status variable. 11,500 seniors were randomly chosen for Follow-up two years later, at which time data on school enrollment was collected.

For most of our analysis we define college-going as someone who attended any school. The reported tabulations for college-going by family income and test score report only those who went to college at least six months instead of those who had ever attended college.

Table D1: Basic Sample Details

No.	Source	Location	Breadth	Cohort	Type
1	Book (1922)	Indiana	Large Sample	1919	Prospective
2	OBrien (1928)	Kansas	Large Sample	1921 & 1922	Follow-up (several yrs.)
3	Mann (1924)	North Carolina	Selected	1923	Prospective
4	Colvin and MacPhail (1924)	Massachusetts	Large Sample	1923	Prospective
5	Odell (1927)	Illinois	Large Sample	1924	Follow-up (1 year)
6	Ames (1926)	Montana	Large Sample	1925	Prospective
7	Benson (1942)	Minneapolis	Large Sample	1929	Follow-up (several yrs.)
8	Henmon and Holt (1931)	Wisconsin	Statewide	1929	Follow-up (1 year)
9	Updegraff (1936)	Pennsylvania	Large Sample	1933	Follow-up (1 year)
10	Barker (1937)	Iowa	Large Sample	1934	Follow-up (several yrs.)
11	Gardner et al. (1942)	Natchez, MS	Citywide	1934	Follow-up (multiple years)
12	Livesay (1942)	Hawaii	Statewide	1936	Follow-up (1 year)
13	Goetsch (1940)	Milwaukee	Citywide	1937	Follow-up (1 year)
14	Sibley (1948)	New York	Sample	1940	Follow-up (1 year)
15	Junker (1940)	Dowagiac, MI	Citywide	1940	Prospective
16	Lansing et al. (1960)	National	Sample	1943 & 1953	Follow-up (multiple years)
17	Keller et al (1950)	Minnesota	Large Sample	1945	Follow-up (1 year)
18	Phearman (1948)	Iowa	Large Sample	1947	Follow-up (1 year)
19	Roper (1949)	National	Sample	1947	Prospective
20	Morehead (1950)	Arkansas	Large Sample	1949	Follow-up (1 year)
21	Berdie (1954)	Minnesota	Statewide	1950	Prospective & Follow-up (1 year)
22	White (1952)	Northeast Ohio	Sample	1950	Prospective & Follow-up (1 year)
23	Wiegman and Jacobson (1955)	Oregon	Sample	1950	Follow-up (1 year)
24	State University of New York (1955)	New York	Sample	1953	Prospective & Follow-up (1 year)
25	Jones (1956)	Arkansas	Statewide	1954	Follow-up (1 year)
26	Daughtry (1956)	Kansas	Statewide	1955	Follow-up (1 year)
27	Educational Testing Service (1957)	National	Sample	1955	Prospective & Follow-up (1 year)
28	Cowen (1957)	New York	Sample	1956	Prospective
29	Little (1958)	Wisconsin	Statewide	1957	Follow-up (1 year)
30	Sewell and Shah (1967)	Wisconsin	Statewide	1957	Follow-up (multiple years)
31	Stroup and Andrew (1959)	Arkansas	Large Sample	1957	Follow-up (1 year)
32	Montana (1960)	Montana	Statewide	1958	Follow-up (1 year)
33	Nam and Cowhig (1962)	National	Sample	1959	Follow-up (1 year)
34	Medsker and Trent (1965)	Midwest/California	Sample	1959	Follow-up (1 year)
35	Flanagan et al. (1971)	National	Sample	1960	Follow-up (5 year)
36	Berdie and Hood (1963)	Minnesota	Statewide	1961	Follow-up (1 year)
37	Tillery (1973)	Four States	Large Sample	1966	Follow-up (1 year)
38	Eckland and Henderson (1981)	National	Sample	1972	Follow-up (4 years)
39	Gardner (1987)	National	Sample	1980	Follow-up (1 year)

Table D2: Basic Sample Details (cont'd)

No.	Background	Number	Ability	Number
1	Family Income (student)	5	Test Score (Indiana University Intelligence)	10
2			Test Score (Terman Group)	17
3			Test Score (Mentimeter)	20
4	Family Income (student)	5	Test Score (Brown University)	3
5			Test Score (Otis) & Class Rank (student)	15 & 15
6			Test Score (Otis)	13
7			Test Score (Haggerty Intelligence)	15
8			Test Score (Ohio Psychological)	32
9	Socioeconomic status (constructed)	10	Test Score (unknown)	16
10			Test Score (Iowa Every-Pupil)	8
11	Socioeconomic status (researcher)	5		
12			Test Score (American Council)	20
13	Family Income (tax records)	8	Test Score (Henmon-Nelson)	1
14	Family Income (tax records)	4	Class Rank (administrative)	3
15	Socioeconomic status (researcher)	5		
16	Family Income (parents)	5		
17			Class Rank (administrative)	3
18			Test Score (Iowa Test of Educational Development)	11
19			Class Rank (administrative)	5
20			Test Score (American Council)	4
21	Family Income (student)	6	Test Score (American Council) & Class Rank (administrative)	21 & 20
22	Socioeconomic status (researcher)	5	Test Score (unspecified IQ test)	3
23			Class Rank (uncertain)	4
24	Family Income (tax records)	3	Test Score (unspecified IQ test)	3–4
25			Test Score (American Council)	19
26			Class Rank (administrative)	3
27			Test Score (unnamed) & Class Rank (administrative)	4 & 10
28			Test Score (New York State Scholastic)	6
29			Test Score (Henmnon-Nelson) & Class Rank (administrative)	10 & 10
30	Socioeconomic status (researcher)	4	Test Score (Henmon-Nelson)	4
31	Family Income (student)	5	Test Score (American Council)	3
32			Class Rank (administrative)	5
33	Family Income (parents)	5	Test Score (various) & Class Rank (administrative)	4 & 4
34			Test Score (various) & Class Rank (administrative)	5 & 5
35	Socioeconomic status (researcher)	4	Test Score (unnamed)	4
36	Family Income (student)	6	Test Score (Minnesota Scholastic) & Class Rank (administrative)	10 & 10
37	Family Income (student)	5	Test Score (Academic Ability Test)	8
38	Socioeconomic Status (student)	3	Test Score (composite)	3
39	Socioeconomic Status (student)	4	Test Score (composite)	4