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

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Abstract

We harmonize the results of three dozen historical studies stretching back to the early 20th century to construct a time series of college attendance patterns. We find an important reversal around the time of World War II: before that, family characteristics such as income were the better predictor of college attendance; after, academic ability was the better predictor. We construct a model of college choice that can explain this reversal as a consequence of the post-War surge in the demand for college, explained by the rise in the college wage premium and declining real tuition. Although these factors affected college demand for all types of students equally, they set off a chain reaction in the model: colleges hit capacity constraints; colleges institute selective admissions; colleges become more dispersed in quality; and students apply to a broader set of colleges. High-ability students become more likely to attend college because their options become more attractive, but the opposite is true of high-income students. The driving forces and mechanisms are consistent with changes in higher education after the war, documented here and elsewhere.

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1 Introduction

A central goal of U.S. higher education policy is to make college accessible to students with the appropriate abilities, regardless of their family backgrounds (Bowen et al., 2005). A large literature has studied the corresponding empirical patterns of who attends college, with a strong focus on the role of federal aid programs in securing access. The consensus in that literature is that cohorts entering college around 1980 were not borrowing constrained and so enjoyed broad access to college. A subsequent decline in access suggests that federal aid programs have not kept pace with rising college costs (Belley and Lochner, 2007; Lochner and Monge-Naranjo, 2011).[1]

Little is known about access to college and college attendance patterns for earlier cohorts, particularly those when college attendance was less common.[2] This missing information is notable in light of the literature that documents long-term changes in access to jobs, income inequality, and income mobility, and which naturally raises the question of whether there was a corresponding change in access to education (Hsieh et al., 2016; Chetty et al., forthcoming).

We answer this question by collecting, harmonizing, and analyzing the results from over forty datasets or studies that cover college attendance patterns as far back as the high school graduating class of 1919. 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. These surveys include multiple measures of students' academic abilities, family characteristics, and college attendance decisions that allow us to construct 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.

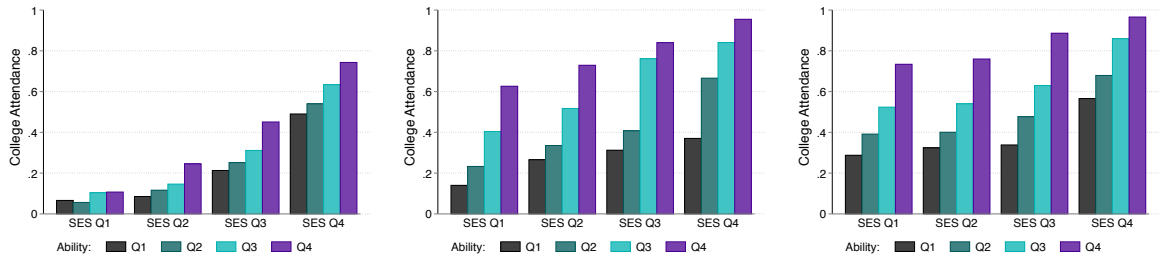
These early studies suggest dramatically different college attendance patterns than we see today. For example, Updegraff (1936) collected information on 15 percent of Pennsylvania's 1933 high school graduating class. In his report, he provides a table giving college attendance rates for students with different ranges of IQ test score and socioeconomic sta-

[1] The literature documenting that borrowing constraints had little role for college attendance for the 1980 cohort is substantial (Cameron and Tracy, 1998; Cameron and Heckman, 1999; Carneiro and Heckman, 2002; Keane and Wolpin, 2001; Cameron and Taber, 2004). See also Bailey and Dynarski (2011) for changes in access subsequently and Ionescu (2009) for a detailed analysis of the importance of the federal student loan program.

[2] Although there are several proposed theories of the overall rise in college attendance (Goldin and Katz, 2008; Restuccia and Vandenbroucke, 2013; Donovan and Herrington, 2017; Castro and Coen-Pirani, 2016).

Figure 1: Changing Patterns of College Attendance: Select Cohorts

(a) 1933 Cohort (b) 1960 Cohort (c) 1979 Cohort



tus (constructed using parental education and occupation). We reproduce his results on college attendance by test score and socioeconomic status quartiles in Figure 1a.[3] Family background played the dominant role in determining who attended college; academic ability played a surprisingly small role. For comparison, Figures 1b and 1c show the same figures constructed from Project Talent and the NLSY79, which are nationally representative surveys covering roughly the graduating high school classes of 1960 and 1979. The figures reveal a complete reversal: by the 1960 cohort academic ability drives college attendance, and this changed little between 1960 and 1979.

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.

Our second contribution is to provide a model that explains the change in college attendance patterns. The model draws on an existing literature on the changes in higher education at the time. It emphasizes two main changes¿ First, enrollment in college surged after the War, driven by a rising college wage premium; declining real college costs; and the lasting effects of the success of the G.I. Bill. Second, the market for higher education became nationally integrated, as documented by Hoxby (2009). Students applied more broadly and traveled further to attend college. Better colleges began to practice selective admissions, leading colleges to fan out by average incoming student test score.

[3]The published tabulations are not exactly quartiles, with 20–30 percent of the population per bin.

We construct a model of student's college choices and college admissions that captures this dynamics. Students are heterogeneous with respect to their academic ability, which governs how much they learn in college, and their family background, which governs the resources they can consume if they attend college. Students decide whether to work after high school, attend their local college, or attend a college outside their local area. College are heterogeneous with respect to their quality, which is determined by their endowment and the average quality of students they attract. Colleges accept students until they hit an enrollment cap; at that point, they adopt selective admissions and accept only the students with the highest expected ability. Neither students nor colleges know students' abilities; instead, they form expectations using available signals such as grades.

We feed into this model three exogenous driving forces. The quantitatively dominant force is a rising value of college, consistent with the rising college wage premium. The second is a change in the composition of students who graduate high school, motivated by the fact that high school graduation is itself a time-varying selection process. The third is improved information about students' abilities, motivated by the widespread adoption of standardized college admissions testing (from 6 percent of college freshmen in 1945 to 76 percent in 1960). We then calibrate the model to fit the large change in sorting patterns between 1933 and 1960 as shown in Figures 1a and 1b. We show that the model can do so using just these forces.

The intuition for the reversal in sorting is as follows. The 1930s equilibrium features low college attendance due to the low return college. Most students who attend college choose their local college, which implies that college quality varies little. The 1960 equilibrium features a higher return to college and higher college attendance. This surge of demand for a college degree sets off a chain reaction. The best colleges are oversubscribed and institute selective admissions, leading their quality to diverge from colleges that do not. This divergence in college quality induces talented students to apply to and attend colleges outside their local area, which further magnifies the divergence of college quality. High-ability students become more likely to attend college because their options become more attractive, but the opposite is true of high-income students. Crucially, the main model mechanisms (surging attendance, adoption of selective admissions, broader applications, and a divergence in college quality) are all supported by the existing literature.

If college quality and student ability are complementary, then our findings imply the allocation of students has become more efficient over time. This relates directly to what Cooper and Liu (2016) call mismatch of students and educational opportunities. It also ties into

the more efficient allocation of workers to jobs documented in Hsieh et al. (2016). Given the uncertainty about the magnitude of the complementarity, we do not quantify the size of the efficiency gains.

Our model generates changing college attendance patterns without implementing any traditional policies that would expand "access". High-ability but low-income high school graduates face low consumption in college if they choose to attend. The difference is that the higher college wage premium and wider range of college quality in 1960 induces them to attend college in spite of this low consumption. It is worth noting that this does not imply student loan programs would not have a role; students in both cohorts would find loans attractive if they were offered. As noted by Lochner and Monge-Naranjo (2011), the central question becomes whether student loan programs expand access faster than rising college tuition restricts it. This question is further complicated by recent research by Comerford et al. (2016) suggesting that a more efficient allocation of students to educational opportunities may increase income inequality and lower income mobility, as well as work by Cai and Heathcote (2018) suggesting that income inequality itself may drive the rise in college tuition.

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 levels that attended college.

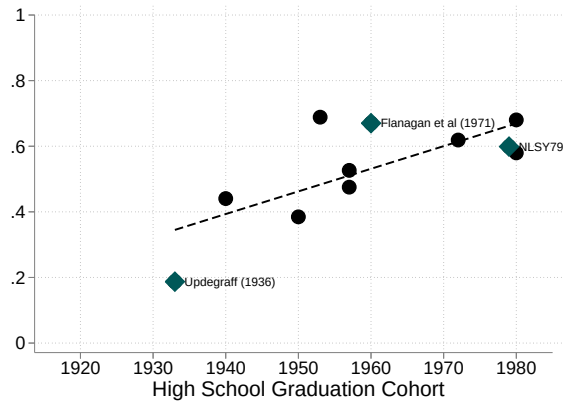
Our goal is to summarize the results of these studies in a simple way that is easy to compare over time. We start with the subset of studies for which we have the ideal information, which is the full bivariate cross-tabulation of college-going as a function of family background and academic ability. We convert family background and academic ability categories into percentile ranges. We then treat the reported tabulations as data on $C(s, p)$, 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 ability (score) and family background, respectively. We regress $C(s, p)$ on s and p and report the estimated coefficients β_s and β_p, which capture the importance of academic ability or family background for college while "controlling" for the other factor. This control is useful because family background and academic ability are positively correlated in every study for which we can cross-tabulate the two.

Figure 2 plots the estimated coefficients β_s and β_p against high school graduation cohort. The role 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). The role of family background (parental income or socioeconomic status) has fallen. Studies conducted before World War II tend to find that family background is more important than academic ability, while studies after World War II tend to find the opposite.

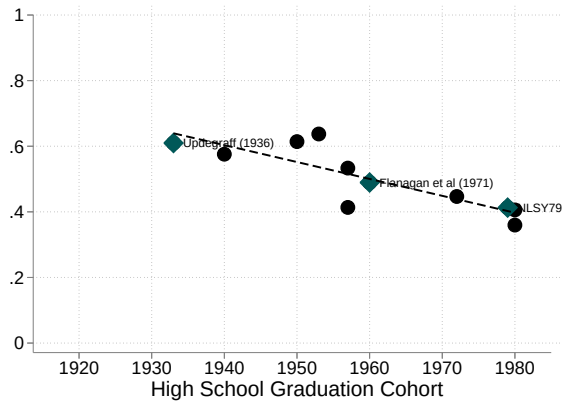
We have highlighted three data points of particular importance. Updegraff (1936) is the first study to cross-tabulate college attendance by family background and academic ability.

Figure 2: Changing Patterns of College Attendance: Bivariate Studies

(a) Academic Ability



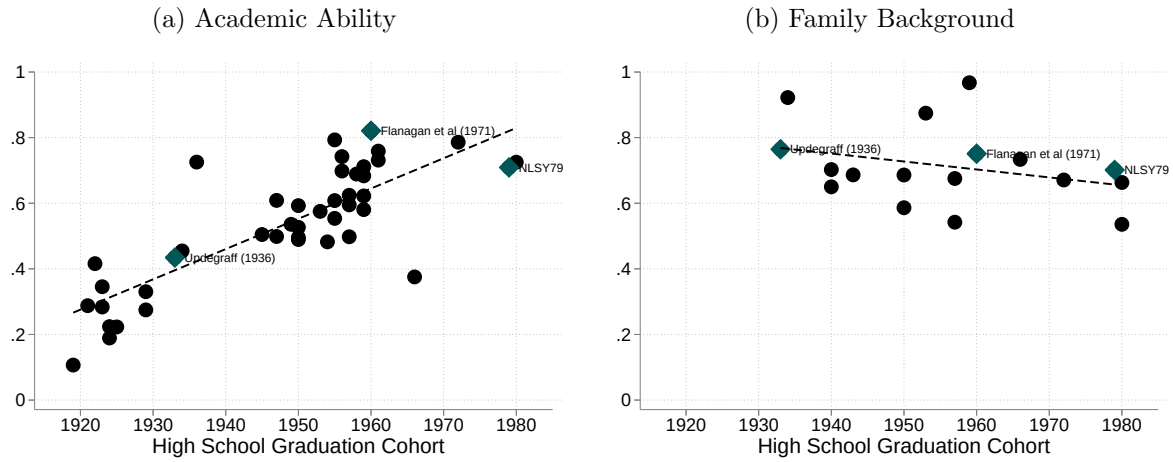
(b) Family Background



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. It shows that sorting patterns had reversed already by 1959. The NLSY79 is the starting point for most of the existing literature. Our data suggest that the level of sorting did not change appreciably between Project Talent and the NLSY79. Thus, in our quantitative exercises we attempt to explain what changed sorting between 1933 and 1959.

In addition to these studies with full bivariate tabulations, we have many more studies that tabulate college-going as a function of family background or academic ability alone. We construct a similar time series with these univariate tabulations, regressing now $C(p)$ on p or $C(s)$ on s individually. Figure 3 shows the results. Figure 3a shows that a large number of studies investigated the role of academic ability for college attendance before World War II and consistently found that it played little role. Figure 3b shows that we have fewer studies that investigate family background but that they support a declining role for family background. The trend is weak, but this is not surprising since we do not control here for academic ability. Academic ability and family background are positively correlated and selection on academic ability is increasing over time, which generally provides a bias in favor of finding an increased role for family background.

Figure 3: Changing Patterns of College Attendance: Univariate Studies



2.1 Patterns by Gender and Race

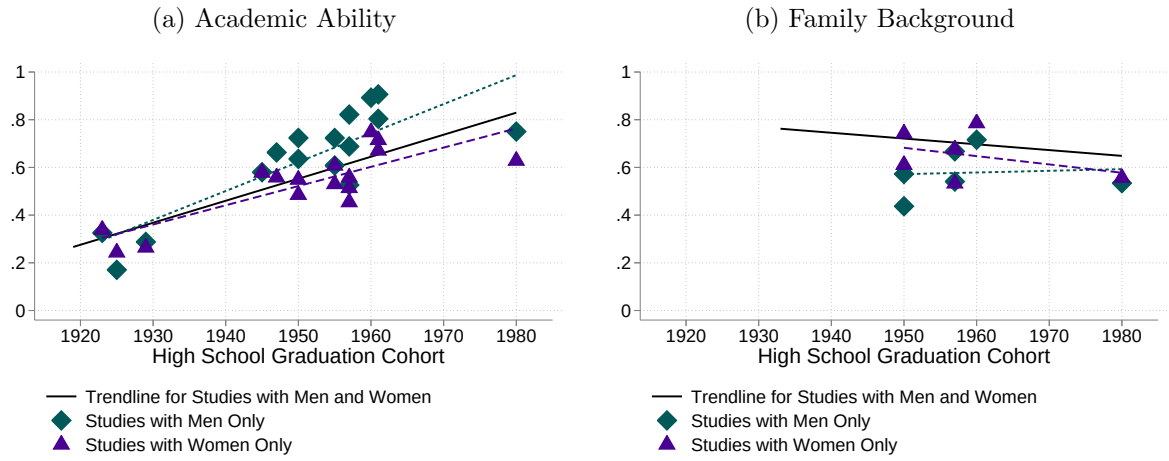
Our results so far have covered aggregate trends. A large literature has documented important changes in the access of women and minorities to educational and labor market opportunities over this time.[4] Hsieh et al. (2016) argues that these changes may have contributed to aggregate economic growth. Given these findings we want to explore whether the patterns apply equally or perhaps even more strongly for women and minorities.

We start with the role of gender. About one-third of our studies include separate tabulations of college-going for men and women; these are all tabulations of college-going as a function of academic ability or family background. We repeat our measurement exercises separately for each gender and then study the time series for men and women separately, with comparison to the trend for the two genders combined from the previous subsection.

The results are shown in Figure 4. We have a large number of studies investigating the role of academic ability by gender, including three studies from the 1920s. Those studies show that academic ability was equally unimportant for both genders in the 1920s and that it became more important for both in the 1940s and 1950s. Academic ability seems to have risen in importance more for men than for women, as indicated by the fact that the data points for men exceed those for women for almost all studies in the 1950s. We have fewer studies investigating the role of family background by gender, and the first such study dates

[4]See Altonji and Blank (1999) for an overview of labor market differences between men and women, including historical trends.

Figure 4: Changing Patterns of College Attendance by Gender



only to 1950. Family background is equally important for men and women in the NLSY79, and it appears from the few studies we have to have been more important for women than for men in the 1950s. This is consistent with the conventional wisdom that the college attendance choices of women were more sensitive to family income in the past because it was harder for them to work their way through college, both because they had fewer job opportunities and because they earned lower wages (Greenleaf, 1929; Hollis, 1957).

Unfortunately, we have little to say about the importance of race. None of our historical sources provide separate tabulations by race. 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. Of the few studies of southern states, several explicitly mention that they restrict attention to schools for white students, and we suspect the others may have done so implicitly. 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. In this section we explore whether variation in study design systematically affects the estimated trends in β_p and β_s that we are documenting.

Our approach is based on fixing a dataset for which we have the microdata – the NLSY79 – and exploring the implications of varying four dimensions of study design. First, studies vary in whether they measure academic ability using test scores or class rank. Within the NLSY we experiment with using AFQT test score or class rank at high school graduation. Second, studies vary in whether they measure family background using parental income or socioeconomic status. Within the NLSY we experiment with using family income at the time of the student's high school graduation or creating an index of socioeconomic status. Our index of socioeconomic status uses principal component analysis to extract the first principal component from Duncan occupational prestige score for the father's occupation, the mother's and father's years of schooling, and family income. Third, studies vary in whether they measure college attendance plans or actual college attendance. Within the NLSY we experiment with using whether high school seniors planned for 1 or more years of college (versus zero) and using the longitudinal aspect of the NLSY to track whether they actually attended college. Finally, historical studies grouped academic ability and family background into bins of various sizes. We do the same within the NLSY.

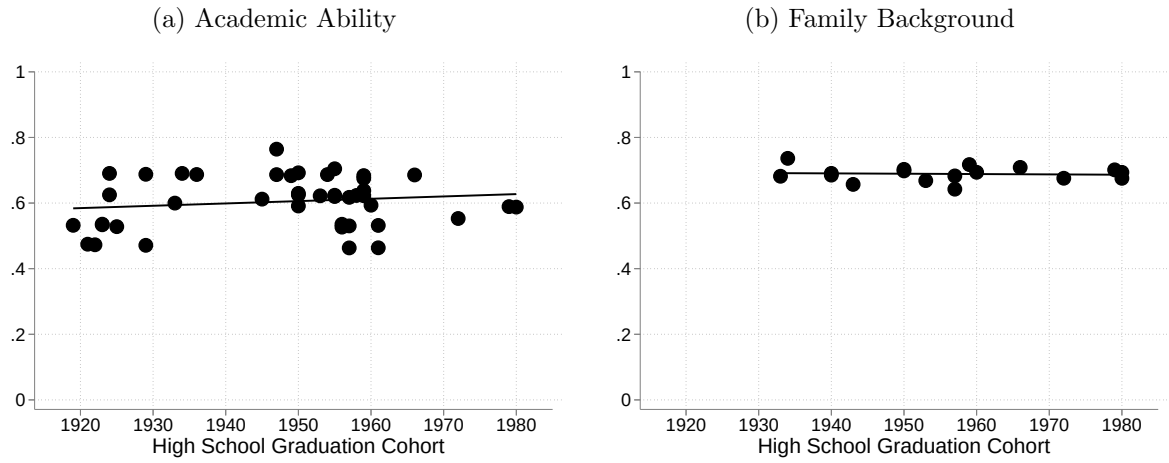
We vary these four dimensions systematically within the NLSY and study how the affect the resulting estimates β_p and β_s. By far the most important dimension is family background. Estimates of β_p are systematically larger when family background is measured as socioeconomic status than when it is measured as parental income.[5] We conjecture that this result may arise because socioeconomic status is a better measure of permanent income than is parental income in one year. Fortunately, our three main studies of interest (Updegraff, Project Talent, and NLSY79) all use socioeconomic status as the measure of family background. We find lesser roles for the other dimensions.

To formalize these findings we conduct a falsification test. We mimic each of our historical studies by taking the NLSY data and setting the four dimensions of interest to match those of the original study. For example, Goetsch (1940) reports college-going as a function of

[5]Estimates of β_p are roughly 0.3 higher when using socioeconomic status.

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. We take students who score in the top 15 percent of the AFQT in the NLSY and form them into eight family income categories, containing the same percent of the population. We then estimate the counterfactual β_p that Goetsch would have found if she had conducted her study on the NLSY sample.

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



We re-create Figure 3 with out counterfactual estimates of β_s and β_p plotted against high school graduation cohort (for the original study).[6] It is clear from this figure that variation in study design induces noise in our estimates of β_p and β_s. 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. However, the main message is that this variation seems to be uncorrelated with time and hence likely does not bias our estimates of the underlying trends.[7]

[6]Similar results apply for the bivariate studies; see Figure B1 in the Appendix.

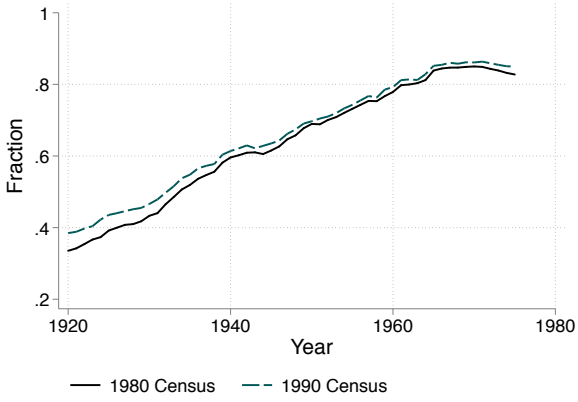
[7]An alternative worry is that older tests may have been worse, which would explain our time trend in academic ability measures. In Hendricks and Schoellman (2014) we document that the predictive validity of tests seems reasonably stable over time. Further, a similar pattern emerges if one compares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

3 The Growth and National Integration of College

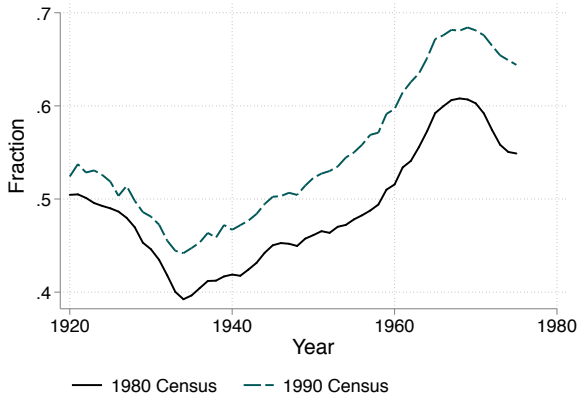
Our empirical results show that college attendance patterns changed sharply in the 1940s and 1950s. Our hypothesis is that these changes were driven by the surge in college attendance shortly after World War II. This surge of demand for a college degree lead the better colleges to institute selective admissions and the better students to apply to and attend colleges nationally rather than locally. High-ability students become more likely to attend college because their options become more attractive, but the opposite is true of high-income students. In this section we overview briefly the relevant history of college applications, attendance, and admissions.

Figure 6: Increase in Educational Attainment

(a) High School Graduation Rate



(b) Graduates who Attend College



We start with the surge in educational attainment around World War II. We use population census data from Ruggles et al. (2010). We focus on attainment by high school graduation cohort (year the person turned 18) in the 1980 and 1990 censuses. We choose these two censuses because they capture the main cohorts of interest band because they used two different questions about attainment: the 1980 census asked about years of schooling, while the 1990 census asked about attendance and attainment by level.[8]They reveal small level differences but tell the same basic story. Figure 6a shows that high school graduation rates rose almost uniformly from the 1920 to the 1970 cohorts, from 40 to 90 percent, where it leveled off. Figure 6b shows the fraction of high school graduates that attempted college,

[8]In 1980 a high school graduate is someone with twelve or more years of schooling, while attending college means 13 or more years. In 1990 a high school graduate reports a high school degree, GED, or higher degree, while attending college means reporting having attended college for at least a part of a year.

which is somewhat more nuanced. The fraction fell in the late 1920s and into the middle of the Great Depression. It then rose about twenty percentage points from its trough around 1925 to a peak around 1970.

Although we will take this surge of demand for education as an exogenous driving force in our model, there are at least three well-known culprits that help explain it. First is the rising college wage premium (Goldin and Katz, 2008). Second is declining real college costs for high school graduation cohorts between 1930 and 1960 (Donovan and Herrington, 2017). Third is the Servicemen's Readjustment Act of 1944, commonly known as the G.I. Bill, which greatly subsidized college attendance especially for veterans of World War II.[9]

A useful step in this expansion was a streamlining of the college admissions process. Prior to World War II, college admissions decisions were based on whether students had demonstrated mastery of certain knowledge. The subjects to be mastered; level of knowledge required; and mechanism for demonstrating mastery varied widely by college and year, with many colleges offering multiple paths to achieve admissions (Kurani, 1931). Given the idiosyncratic nature of college requirements and admissions processes, college guides from the 1930s recommended that students choose a college as early as possible and then work with its admissions departments to demonstrate compliance with the relevant standards (Halle, 1934).

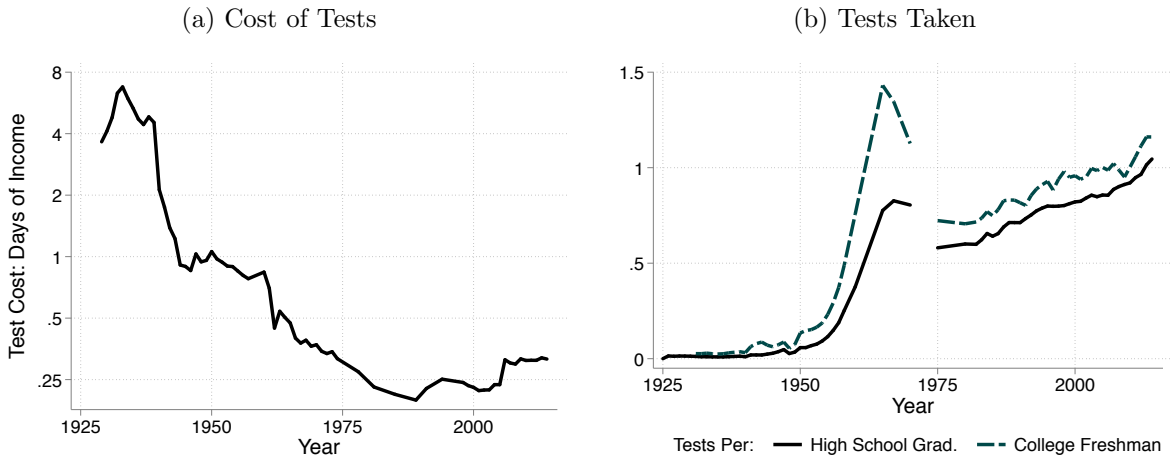
Three trends converged to replace this college admissions system with one based on standardized college admissions exams (the SAT and later the ACT) in the 1940s and 1950s.[10] First, results from a large-scale experiment in college admissions as well as the general experience with veterans attending college on the G.I. Bill suggested that detailed subject requirements offered little value as admissions tools (Aikin, 1942; Jencks and Riesman, 1968). Second, the relative price of scoring standardized tests fell with the introduction of automatic scoring machines in 1937. Meanwhile, labor shortages during the war made the labor-intensive grading of written exams even more costly. Finally, the College Board used its leverage as a provider of admissions services and distributor of an influential college guide to pressure schools to offer the SAT in the 1950s (Bowles, 1967). Although Midwestern colleges generally resisted, they mostly signed up for the ACT from 1959 onward.

Figure 7 shows two important time series for standardized admissions testing. Figure 7a

[9]Similar but less generous policies applied later to veterans of other wars, including the Korean War.

[10]The names of the college admissions exams and the entities responsible for them have changed numerous times over the years. We fix terminology for ease of exposition: the College Board refers to the entity responsible for the SAT test; its competitor is the ACT test.

Figure 7: College Entrance Examinations



shows the cost of the SAT normalized by average daily disposable income per capita.[11] Although the test cost more than a week's income in the early 1930s, machine scoring lowered the cost closer to a day's income by the 1940s, and it continued to decline thereafter. Figure 7b shows that this declining cost, along with the increased number of colleges asking for it, led to an explosion in test-taking from 1950–1965. At the peak, there were more tests taken that college freshmen and roughly three-quarters of high school seniors took a test.[12]

The standardization of admissions and the surge of demand for college had two important implications that will act as mechanisms for our model. First, it led to students to apply to more colleges over a larger geographic area. Hoxby (2009) documents some geographic facts and cites the fall in transportation and communication costs. Before the War, students applied to multiple colleges only rarely because of the difficulty of complying with multiple admissions requirements.[13] College guides from after the war already recommend applying to "three or four" colleges (Dunsmoor and Davis, 1951). Just under three-fourths

[11]The cost of the SAT is taken from various sources, including college guides for various colleges in early years and College Board records in later years. Disposable income is taken from the National Income and Product Accounts, adjusted to a daily level by assuming 5 working days per week and 50 working weeks per year.

[12]Figures include ACT test-taking from 1959 onward. The discontinuity reflects a break in how the SAT reports its tests taken information; up to 1971 it reports tests taken, while from 1972 it reports unique test-takers.

[13]Partridge (1925) provides figures from a large, urban high school with a large majority of students attending college, which was rare at the time. Even at this evidently advantaged high school only 11 percent of students applied to more than one college.

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 applications was a recurring topic of discussion among admissions officers in the 1950s.[14]

Second, the growth in applications allowed at least better colleges to switch from recruitment to selective admissions. Before the War, colleges typically accepted all applicants who met the posted requirements, except in unusual circumstances.[15] After the War, better colleges had more applicants than slots and could select students. College entrance exam scores emerged as a key metric for measuring college quality and hence of metric of how selective colleges were. The result was the "fanning out" of colleges documented in Hoxby (2009), with the gap in test scores between colleges growing over time from roughly the mid 1950s, with the trend particularly clear since 1962.

In the next section we formulate a model that takes the general increased demand for college and produces changes in sorting patterns consistent with the data. The main mechanism of the model is a change in application and admissions behavior consistent with the national integration of education. First, we briefly review key alternative hypotheses that we abstract from in our model.

3.1 Alternative Hypotheses

The most important alternative hypothesis is that these changes were driven by changes in the financial environment, particularly the development of federal government loan and aid programs. 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.[16] To further document this point we draw on three surveys that collected

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

[15] 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. Admission was certainly implied under the certificate system (Wechsler, 1977).

[16] 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.

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 college financing. 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.[17] To be clear, these figures were quite 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). Given that the goal of our quantitative exercise is to explain the switch in attendance patterns between 1933 and 1960, we focus on a model where students cannot borrow.

4 Model

We develop a model of college choice and admissions where both students and colleges are only imperfectly informed about students' abilities. The economy contains a discrete number of locations (islands) indexed by $i \leq I$. 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 but are otherwise identical. Each college sets an admissions policy that specifies the expected ability needed for admission. Students with heterogeneous family backgrounds and expected abilities decide whether to attend the local college, attend college elsewhere, or work straight out of high school.

The model is static: it covers the college attendance decisions of a single high school graduation cohort in isolation. Our goal in the next section is to show that the model can generate a quantitatively significant reversal of who attends college consistent with the data using only a few mechanisms. We use time t subscripts to highlight the forces that we will vary when we take the model back to earlier cohorts.

[17] 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.

4.1 Colleges

Colleges are endowed with heterogeneous initial endowment $\bar{q}_i$ spaced uniformly on the interval $[\underline{q}, \overline{q}]$. This endowment represents the literal endowment of the college: the land, buildings, and financial accounts that a college possesses. The college's quality q_i depends on both its endowment and the mean ability of its students $\bar{a}_i$, $q_i = \bar{q}_i + \bar{a}_i$.

Colleges set an admission criteria, which is specified as a minimum expected student ability for acceptance, $\underline{a}_i$. Their objective is lexicographic. Their first priority is to maximize enrollment e_i, until it hits capacity E. If they are at capacity, their goal is to maximize quality. We assume that if there are more applicants than spots, a random subset of applicants is accepted.

4.2 Students

High school graduates have heterogeneous endowments (a, p, g, s, l). a is their ability, which affects how much they learn in and benefit from college. p is their family (parental) background. Family background determines the resources students can access to finance consumption if they attend college; it can be thought of as including transfers from parents but also the income that students can earn while working. Children from richer families can access more funding and enjoy higher consumption while in college, making it more enjoyable. g is their grades while in high school. s is their score on a standardized test, such as the SAT. Finally, l is their endowed location, which determines the quality of their local college. Endowments are drawn from a distribution $F_t(a, p, g, s)$ which is constant across locations. We use the t subscript here to call attention to the fact that we vary the distribution of high school graduates over time, which allows us to capture the fact that the set of high school graduates itself changes over time as high school graduation becomes more common.

Graduates do not know their own ability when making their college choices. Instead, they form expectations about their own abilities based on the available pertinent information. The set of information available to them $\mathbb{I}_t$ is the key force that changes over time. We assume that pre-War cohorts had information sets $\mathbb{I}_t = (p, g)$. Given that family background and proxies for student ability are consistently positively correlated, it is a useful signal to students of their own ability, as are their grades while in high school. Post-War cohorts also took standardized college admission exams and so had $\mathbb{I}_t = (p, g, s)$. Students form expectations about their ability given their information set, $\mathbb{E}(a \mid \mathbb{I}_t)$.

Given this time-varying information set, graduates make an irrevocable decision whether to work as a high school graduate or attend college. High school graduates who enter the labor force directly possess a single unit of human capital that they supply to the labor market inelastically at the prevailing wage for high school graduates when they are of age $h \in \{0, 1, ..H\}$, w_h^{HS}. They solve a simple life-cycle consumption problem:

$$\max_{c_h} \sum_{h=0}^{H} \beta^h \log(c_h)$$
$$s.t. \sum_{h=0}^{H} c_h R^{-h} = \sum_{h=0}^{H} w_h R^{-h}$$

where β is the discount rate and R is the gross interest rate. We assume $\beta R \equiv 1$, which gives that consumption is constant over the life cycle and allows us to solve for the flow value of being a high school graduate V_t^{HS}.[18] This value can vary over time to capture growing wages or (indirectly) changes in the non-pecuniary aspects of working as a high school graduate.

Alternatively, graduates can choose to attend a college. The structure of the model is easiest to explain if we start with the local college, which they can attend as long as their expected ability given their application is high enough, $\mathbb{E}(a \mid \mathbb{I}_t) \geq \underline{a}_l$. While in college they finance their consumption using their family resources p, which gives them flow utility $\log(p)$. Students are restricted from borrowing against their future income although they would wish to do so, consistent with the financial environment through the mid 1960s. Upon graduation they acquire human capital given by a CES production function that mixes their own ability and the quality of the college they attend, $h(a, q_i) = [\phi q^\gamma + (1-\phi)a^\gamma]^{\alpha/\gamma}$. The virtue of a CES production function is that it allows flexibility in γ, which governs how substitutable college quality is for student ability. α is a parameter that governs the overall curvature of human capital formation.

College graduates enter the labor market and supply one unit of labor inelastically each year at the prevailing wage for college graduates when they are of age h, w_h^C. They solve a similar life-cycle consumption problem as high school graduates. Extending the logic above, the expected post-graduation utility of working as a college graduate taken before ability is known can be represented as $\mathbb{E}_a[\log(h(a, q_i)) \mid \mathbb{I}_t] \sum_{h=1}^{H} \beta^h + V_t^C$.[19] The total value of

[18] $V^{HS} \equiv \log\left(\frac{\sum_{h=0}^{H} w_h^{HS}\beta^h}{\sum_{h=0}^{H}\beta^h}\right)\sum_{h=0}^{H}\beta^h$.

[19] If we assume that college takes one period, then $V^C \equiv \log\left(\frac{\sum_{h=1}^{H} w_h^C R^{-h}}{\sum_{h=1}^{H} R^{-h}}\right)\sum_{h=1}^{H}\beta^h$.

attending the local college is then given by:

$$V(p, \mathbb{I}_t, l) = \log(p) + \hat{\alpha}\mathbb{E}_a \left[\log \left([\phi q^\gamma + (1-\phi)a^\gamma]^{1/\gamma} \right) \mid \mathbb{I}_t \right] + V_t^C \tag{1}$$

where $\hat{\alpha} \equiv \alpha \sum_{h=1}^{H} \beta^h$.

Finally, students can pay cost κ to apply to and attend non-local colleges. This cost represents transportation costs, search frictions, out-of-state tuition fees, and so on. Once paid, they can attend any college where their expected ability meets the admissions criteria. On the other hand, it reduces their consumption while in college to $p - \kappa$. These tradeoffs are embedded in the value function for search:

$$W(p, \mathbb{I}_t) = \mathbb{E} \left\{ \max_{j:\mathbb{E}(a|\mathbb{I}_t) \geq \underline{a}_j} V(p - \kappa, \mathbb{I}_t, j) + \bar{\zeta}\zeta_j \right\} \tag{2}$$

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 by smoothing students' application behavior across the parameter space. $\bar{\zeta}$ controls the dispersion 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:

$$\max \left\{ V_t^{HS} + \bar{\eta}\eta_{HS}, V(p, \mathbb{I}_t, l) + \bar{\eta}\eta_V, W(p, \mathbb{I}_t) + \bar{\eta}\eta_W \right\} \tag{3}$$

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 $V_t^{HS} \equiv 0$ for each cohort and interpret V_t^C as the relative attractiveness of college as compared to high school, which depends in part on the college wage premium but also the non-pecuniary benefits of the available jobs and so on.

We then have three forces which we will vary as we simulate the choices of different cohorts: $F_t(a, p, g, s)$, which we read in from the data to fit the changing distribution of students who graduate high school by cohort; V_t^C, which we use to fit the fraction of each cohort that attends college; and $\mathbb{I}_t$, which captures the improved signals of students' abilities after the introduction of standardized testing. This last force will be the key for delivering the reversal in college attendance patterns.

4.3 College Admissions Algorithm

If we allow for arbitrary application and admissions behavior by students and colleges, this model will tend to have multiple equilibria because of the peer effects. For example, if we take an equilibrium where colleges are ranked from highest to lowest quality, it may be the case that we can switch the student bodies of the best and worst colleges and obtain a new equilibrium. The extent of multiplicity depends on the relative importance of peer effects as compared to differences in college endowments in the overall production of college quality. We sidestep this issue by focusing on the equilibrium produced by a college admissions algorithm that we find intuitively appealing.

The algorithm works as follows. We start by forming a guess of the quality of each college q_i, which is restricted to be weakly increasing in college endowment $\bar{q}_i$. We rank students by expected ability, $\mathbb{E}(a \mid \mathbb{I}_t)$. We assign each student in turn to their most preferred available outcome: working as a high school graduate; attending the local college; attending their most preferred college nationwide. When a student chooses college i we augment enrollment in that college e_i by one student.

At some point, when allocating student with signal $\widehat{\mathbb{E}(a \mid \mathbb{I}_t)}$, we will hit the enrollment limit at college i, $e_i = E$. We use this point to define college i's admissions cutoff: $\underline{a}_i \equiv \widehat{\mathbb{E}(a \mid \mathbb{I}_t)}$. Note that this step automatically satisfies the college's objective. They would not want to set cutoffs any higher, because then they would not be at capacity; they would not want to set it lower, because doing so would lower their expected ability and quality. Students with lower signals then view this admissions cutoff as a binding constraint that prevents them from attending college i.

We continue this procedure until all students are allocated. We then compute expected quality of all colleges and compare it to our initial guess. We iterate until these two objects agree.

This algorithm has three desirable features. First, it produces an equilibrium where student ability and college endowment are positively related, discarding any possible equilibria where high ability students coordinate on attending the low-endowment college to benefit from peer effects. Second, it is tractable and converges rapidly. Third, the algorithm appears to produce an unique equilibrium, based on experimentation from a wide range of possible starting guesses for college quality q_i.

5 Quantitative Assessment

In this section we calibrate the model and study its implications for the time series patterns of sorting. We calibrate the model to fit the fraction of students of different types who attend college in the 1933 (Updegraff) and 1960 (Project Talent) cohorts, as well as the application behavior of students by cohort. As emphasized in the last section, most of our parameters are time-invariant. Thus, our calibration strategy can also be understood as testing whether we can generate an increase in students attending non-local colleges and a reversal in who attends college with our three key driving forces: a change in the composition of high school graduates; a change in the overall relative value of college; and an increase in information about students' abilities. We show that the model is capable of doing so, and that the increase in information is the central driving force that generates this reversal. In addition, the model delivers other, untargeted moments, including the growing dispersion of colleges by quality emphasized in Hoxby (2009).

5.1 Calibration

The model has a number of parameters that need to be calibrated for a quantitative assessment. We start with the parameters relevant to colleges. We assume that colleges have quality spaced uniformly on the interval $[\underline{q}, \bar{q}]$. We also need to choose the capacity of each college, E.

The second set of parameters govern students' endowments. We construct the distribution $F_t(a, p, g, s)$ in three steps. First, we assume that $(a, \log(p))$ are drawn from a time-invariant binormal distribution with mean (μ_a, μ_p), standard deviations $(1, \sigma_p)$, and correlation ρ.[20] Second, we designate a subset of this distribution to be high school graduates. Here we take the sorting patterns from the data in the form of graduation rates from the population by (a, p) quartile. This data is provided for the 1933 cohort in the original Updegraff (1936) study, but is not provided for the 1960 cohort. Instead we substitute the high school graduation patterns from the 1979 cohort. Given that high school graduation increased yet further between 1960 and 1979, this overstates somewhat the magnitude of the shift in the composition of high school graduates. We show below that even this overstated shift plays a minor role for our results. Third, we assume that grades and test scores are both noisy, independent signals of ability, drawn from normal distributions with mean a

[20] Our human capital production function requires a to be positive. We truncate the distribution and replace all non-positive values with a small positive value.

and standard deviations σ_g and σ_s that control their information content. Recall that one important difference between 1933 and 1960 cohorts is that students in the 1933 cohort do not observe a test score, s. Since all variables are jointly normal, we can solve for analytically for $\mathbb{E}(a \mid \mathbb{I}_t)$.

The third set of parameters govern the human capital formation and its labor market returns. The human capital production function has three parameters, ϕ, γ, and α, which govern the relative weight on quality versus ability in the production of human capital; the elasticity of substitution between the two; and the overall curvature of human capital production. κ is the cost to apply to non-local colleges (the local college is always free, if the student meets the admissions requirement); and V_t^C is the relative value of college (as compared to high school) for cohort t, which captures differences in wages, among other factors.

Finally, we have two preference parameters, $\bar{\zeta}$ and $\bar{\eta}$, which provide a scale to the type-I i.i.d. extreme value shocks for the three broad career choices (work as a high school graduate, attend local college, attend national college) and for specific colleges, respectively. All told, this gives us seventeen parameters, which are summarized in Table 1.

We choose these parameters to fit 34 moments. Our main moments are the college attendance by (a, p) quartile for the 1933 and 1960 cohorts, before and after the sorting change occurred. We also fit the fraction of students who apply to non-local colleges, which in the data we take to be the fraction of students who apply to multiple colleges. Our target for 1933 is 15 percent and for 1960 is one-half. The former figure is a midpoint between the estimate of 11 percent from the 1920s and 25 percent from 1947 (see Section 3 for sources). The latter is the application behavior of the Project Talent students (Flanagan et al., 1964).

5.2 Model Fit

Table 1 gives the calibrated parameters. We note three features of these parameters. First, college quality plays an important role in the production of human capital, as revealed by its high share in the production function. Second, $\gamma < 1$ indicates that college quality and student ability are complements. This parameter is important in understanding sorting patterns of students by ability. Third, we are particularly interested in the changes in the driving forces over time. We find that the value of college rises over time, consistent with the rise in the college wage premium. This force helps explain why the level of college attendance rises. Recall that students in our 1960 cohort have access to their test score.

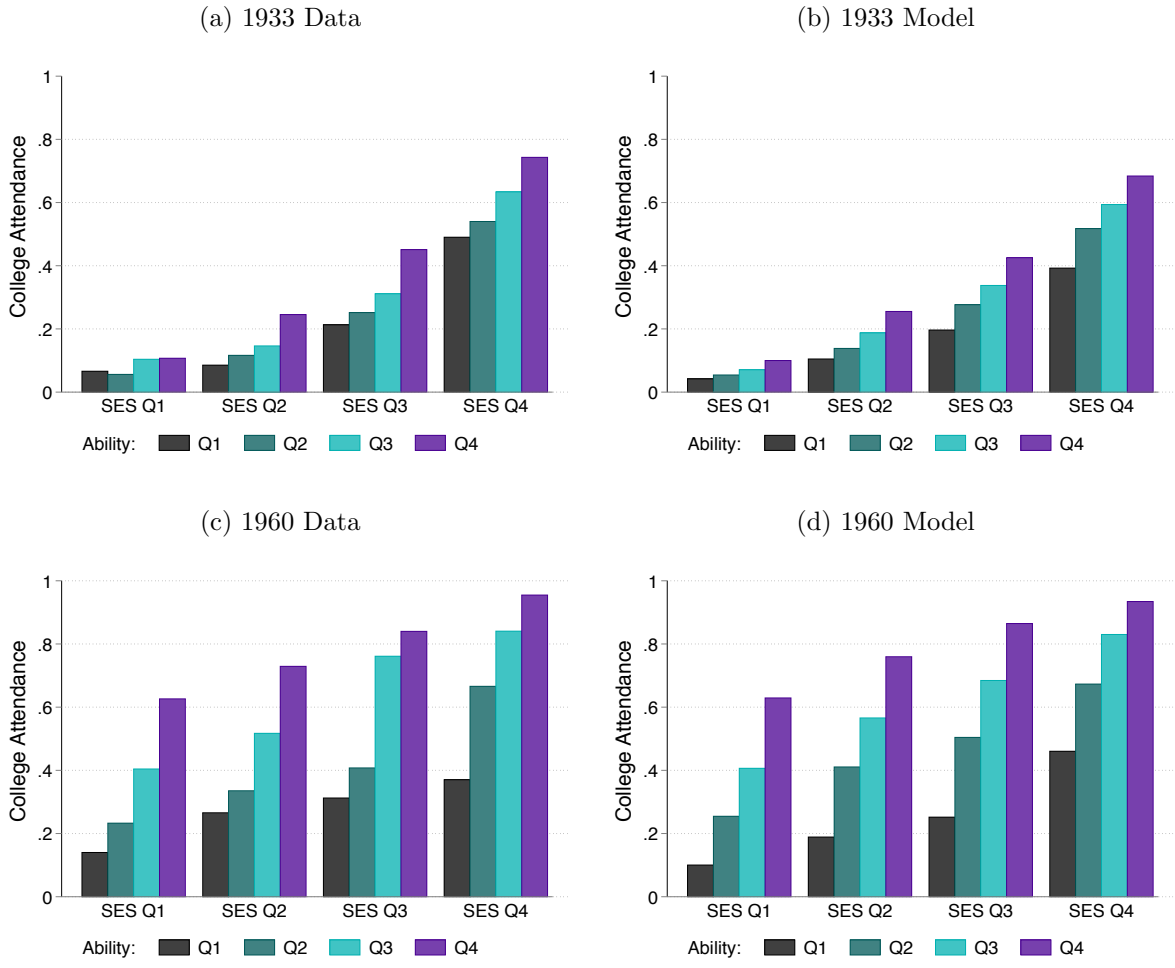
Table 1: Calibrated Parameters

Parameter	Description	Value
Colleges		
$\underline{q}$	Lower bound on college quality	0.64
$\overline{q}$	Upper bound on college quality	2.18
E	College capacity	1.45
Endowments		
μ_p	Mean parental transfer	-0.23
μ_a	Mean ability	0.95
σ_p	Standard deviation of transfer	0.15
ρ	Correlation of parental transfers and ability	0.20
σ_g	Noise in grades	0.72
σ_s	Noise in test scores	2.29
Human capital production		
γ	Substitution between ability and quality	-0.49
ϕ	Weight on quality	0.87
α	Curvature of human capital production	0.82
κ	Application cost	0.39
V_t^C	Relative value of college	$(-0.31, 1.21)$
Preferences		
$\bar{\zeta}$	Scale of taste shocks at college entry	0.11
$\bar{\eta}$	Scale of taste shocks when searching	0.07

Our calibration implies that test scores are noisy relative to the existing signals from grades and other factors.

The model delivers a good fit to the data. First, and most importantly, the model delivers the change in sorting into college attendance. Figure 8 shows the entry patterns by (a, p) quartile from the data and the model for the 1933 and 1960 cohorts. Family background dominates attendance patterns for the 1933 cohort but academic ability does for the 1960 cohort, consistent with the data. The main area where the model struggles is that it slightly underemphasizes the role of family background in 1933.

Figure 8: College Attendance Patterns



The model also fits several other time series moments well, shown in Table 2. Since we target college entry by quartile, it is natural that we also fit well overall college entry, which roughly doubled. We targeted a large increase in multiple application and attending

Table 2: Model Predictions: 1933 and 1960

Moment	1933 Cohort	1960 Cohort
Fraction attending college	0.33	0.56
Fraction attending local college	0.84	0.53
Mean test score percentile, entrants	0.60	0.64
Mean test score percentile, non-entrants	0.44	0.31

non-local colleges, which the model fits as well. Finally, the changes in sorting patterns are consistent with the finding elsewhere that there was a growing gap in the test scores of students who did and did not attend college (Taubman and Wales, 1972; Hendricks and Schoellman, 2014). Given that the model is consistent with the data, we now turn to understanding the model's main mechanisms and its additional predictions.

5.3 Model Mechanisms

The model generates the reversal through two mechanisms. The first is the direct effect of improved information. College in this model is a risky endeavor: students endure a period of low consumption financed through p and then receive a payoff which depends on their ability, which is uncertain. High school graduates with higher family income are more willing to take this risk. Allowing students to see their test score adds to their information and reduces the risk of college attendance. However, as we emphasized in the previous section, this direct effect is small, because test scores do not contain much additional information.

The main mechanism that generates the reversal is an indirect effect through the menu of available colleges and their quality. In the calibrated 1933 version of the model, few students attend college, and few colleges are at their capacity constraint. Given low enrollment, the model settles at an equilibrium where most college students remain at the local college; few colleges practice selective admissions; and the quality gaps between colleges, which are driven mostly by endowments, are small. These three pieces reinforce each other.

The rising value of college (for all students) and the better information provided by standardized tests raise the value of college, which eventually leads to a doubling of enrollment. Expanded enrollment disrupts the 1933 equilibrium. As more students attend college and general and more students apply outside their local college, some colleges hit their capacity constraint and respond by instituting selective admissions. Selective admissions helps gen-

erate the reversal in two ways. First, selective admissions means that the quality of colleges begins to diverge, as colleges with better endowments also begin to attract notably better students. These excellent colleges are particularly attractive to intelligent but poorer students, who were less likely to attend their mediocre college in the 1933 equilibrium. Second, selective admissions means that the college options of low-ability, high-income graduates worsen. Before, many would have access to an excellent local college, while the rest could have applied nationally to a college with an excellent endowment. Now, both types find that these excellent colleges will not accept them.

Figure 9: Impact of Selective Admissions

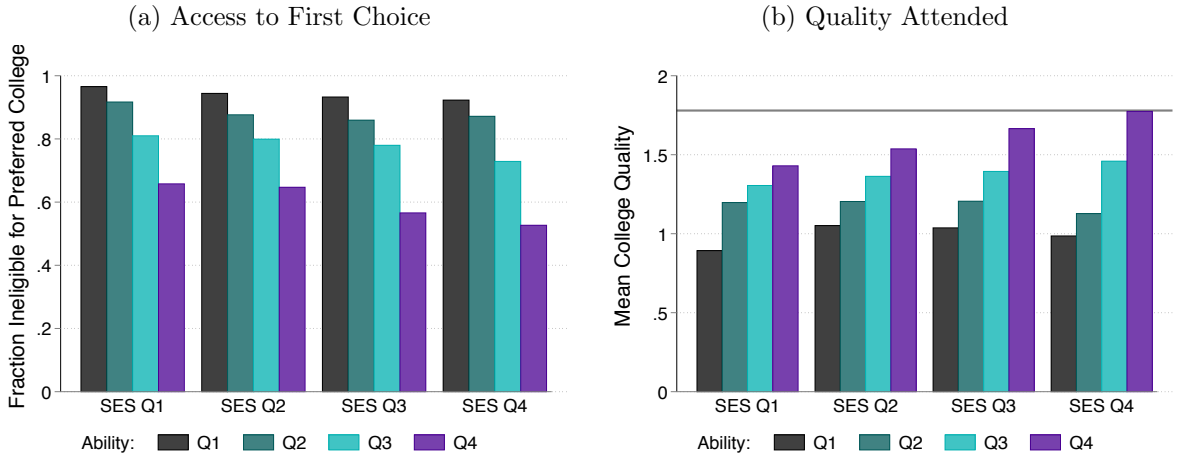


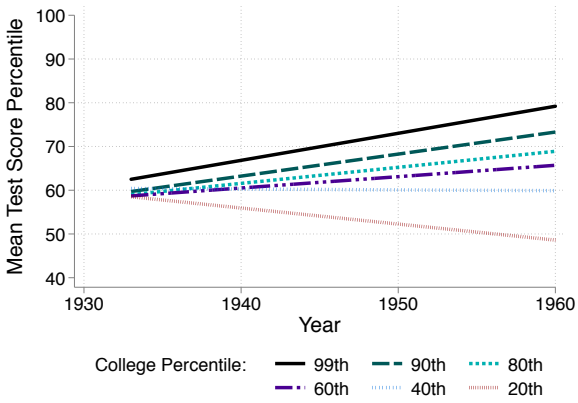
Figure 9 shows how these forces play out in the model. Figure 9a shows the fraction of students in each test score and family background quartile in the 1960 cohort that does not meet the admissions criteria for their most preferred school. For the 1933 cohort these figures are less than 1 percent for each group, because most students prefer to attend their local college and find that they can. However, around half of all students face a binding constraint in the 1960 equilibrium. High ability students are less likely to be face constraints simply because they are more likely to meet the admissions criteria. High-income students are more willing to apply nationally but then also more likely to find that they cannot attend their preferred national college.

Figure 9b shows the implications of selective admissions for the quality of colleges students actually attend. We use the solid gray line to denote the figure for the 1933 cohort, which is essentially constant across groups. By the 1960 cohort students fanned out a great deal. In particular, more able students had much more attractive college options available to them,

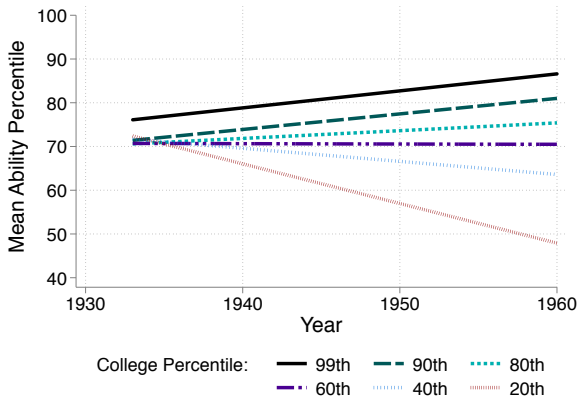
while less able students had much less attractive college options. This is the key indirect force that generates the reversal in sorting.

Figure 10: Fanning out of Colleges

(a) Standardized Test



(b) Ability



These key forces are consistent with the changes happening in higher education at the time. We already provided evidence on the rise of wider application and selective admissions in Section 3. More broadly, they are consistent with the nationalization of the college market starting at around the same time documented by Hoxby (2009). She gives numerous signs, including for example students traveling further to college or going out of state to college. One piece of evidence that is particularly relevant is that colleges have "fanned out" by quality. In particular, Hoxby (2009) constructs a figure that ranks colleges by mean student student test score and shows that mean test scores at top schools have risen while mean test scores for the median and bottom schools have fallen. Our model generates patterns consistent with this as an essential part of the mechanism. To highlight this, we construct the equivalent of Hoxby's graphs by plotting mean test score by college against high school graduation cohort, although of course there are only two cohorts.

Figure 10 shows the results. Figure 10a is constructed using mean test score, just as she does. Whereas all colleges are roughly the same in 1933, by the 1960 cohort we have large dispersion in test scores. It is hard to line the timing up because Hoxby's graphs start in 1962, with some suggestive evidence starting from 1955, but our graphs fit with the general idea colleges have become more dispersed in terms of their student quality in the post-War era. In Figure 10b we plot the same figure, ranking colleges by mean ability of the students. Because colleges accept students on the basis of expected ability, and because test scores

are a fairly small and noisy part of the overall signal, the fanning out by student ability is actually even larger for the 1960 cohort.

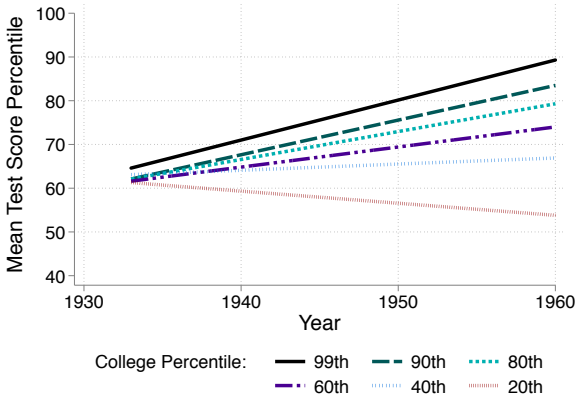
6 Extension: Sorting on Test Scores

One potential concern with our findings as well as those of Hoxby (2009) is that they may in part reflect a growing propensity for colleges to admit students based on test scores since colleges were ranked on average SAT score of their incoming class in college guides from the 1950s. In this section we consider the implications of implementing this admissions algorithm. We use the same algorithm for both the 1930s and 1960 equilibrium, although there is so little sorting in the 1930s equilibrium that it matters little.

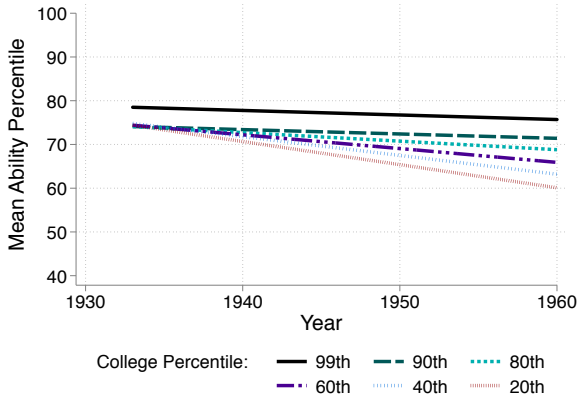
We find that this change has little effect on most of our results.

Figure 11: Fanning out of Colleges: Test Score Sorting

(a) Standardized Test



(b) Ability



7 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 surge in demand for college attainment and the national integration of the market for college degrees that took place shortly after World War II and has been previously documented elsewhere. We provide a simple model that takes the surge in attainment as its main driving force and produces the change in sorting patterns as a result of the endogenously explained nationalization of the market for higher education. The key intuition is that although these factors affected college demand for all types of students equally, they set off a chain reaction in the model: colleges hit capacity constraints; colleges institute selective admissions; colleges become more dispersed in quality; and students apply to a broader set of colleges. High-ability students become more likely to attend college because their options become more attractive, but the opposite is true of high-income students.

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Online Appendices: Not for Publication

A NLSY Details

This appendix describes the 1979 National Longitudinal Survey of Youth (NLSY79) data used to replicate the historical studies. Our sample of NLSY79 respondents is obtained by taking the universe of respondents (including the supplementary oversamples) and first dropping individuals with missing data on birth year, Armed Forces Qualifying Test (AFQT) score, or those who have not completed high school by May 1 of the year following their 19th birthday.

We measure family background using either income or socioeconomic status (SES). In the case of income, we use total net family income in past calendar year. The question asks for income during the previous calendar year, so we take observations during the survey year after the individual turns 18 in order to capture income during the year the individual turned 18. If individuals are missing the income variable for this year, but at least two other observations of the same variable are available, then we impute family income by regressing total net family income on the child's age and interpolating or extrapolating to age 18. If income data is missing and can not be imputed, then we drop those individuals. All income variables are inflation adjusted to 1978, which was the first year of reported income when the survey was initiated in 1979.

We measure socioeconomic status by creating an index from parental income, mother's and father's years of education, and father's occupation. Our index follows the procedure of Herrnstein and Murray (1994), Appendix 2 closely. Parental income is total net family income in 1978 or an average of 1978 and 1979 if both are available. If neither are available but the data exist for at least two other years, then we impute income in 1978 as described above. Each parent's income is measured as the highest grade completed. For father's occupation we take Duncan's socioeconomic index score associated with the 3-digit occupation code as shown in the NLSY79 codebook supplement. For each of these variables we calculate a z-score, and construct an SES index as an equally weighted average of all non-missing z-scores. We prefer this approach over principal component analysis because it allows us to include more students who are otherwise dropped because they miss some components of the index. Nonetheless we have verified that we obtain similar results if we measure socioeconomic status as the first principal component extracted from the same four variables.

We measure student ability be either standardized test score or class rank. In the former case, we take the respondent's percentile score on the AFQT. In the latter case we compute the class rank percentile from the respondent's rank in class and the class size, both of which come from the NLSY transcript survey.

We measure college attendance as either prospective or actual attendance. For prospective attendance, we utilize responses to the survey question that reads: "As things now stand, what is the highest grade or year you think you will actually complete?" This question was asked in 1979, 1981, and 1982. We check responses up to age 20 and count individuals as planning to attend college if they answer more than 13 years (i.e., completing at least one year of college). For actual attendance we utilize the longitudinal aspect and check each respondent's highest grade completed for the requisite number of years following their 19th birthday. Individuals are counted as attending if they complete at least 13 years of education.

Finally, when calculating the college attendance rates we weight the individual observations. In each case, we obtain custom weights corresponding to the survey years that we use for that particular replication. For example, replicating an historical study with a seven-year follow up to check college attendance would require six years additional data compared to a replication that used a one-year follow up. Custom weights are obtained from the NLSY79 at https://www.nlsinfo.org/weights/nlsy79.

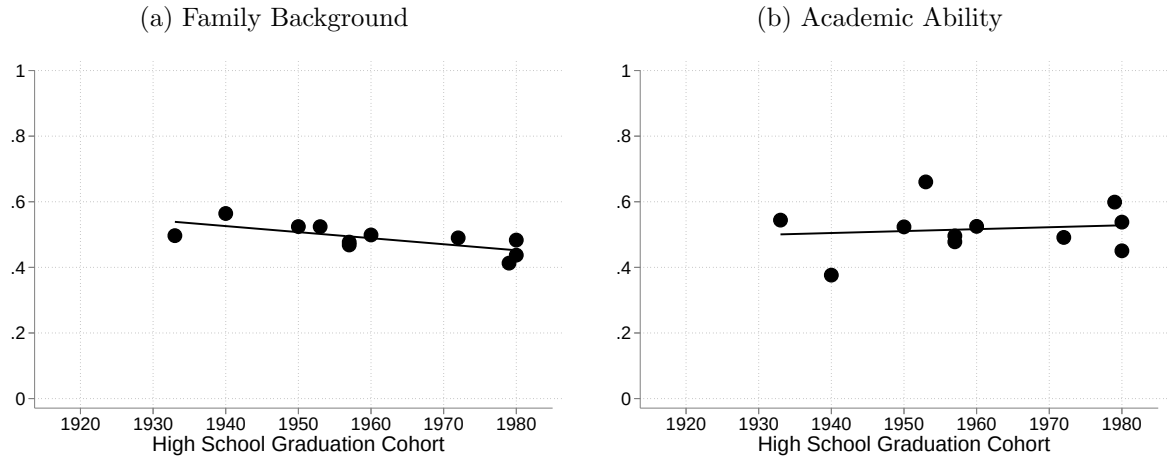
B Additional Results

Figure B1 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.

C Changes in College and College Financing

This appendix summarizes some of the relevant history of college financing and changes in the nature of college.

Figure B1: Counterfactual Changes in Patterns of College Attendance: Bivariate Studies



C.1 College Financing

In order to feed these trends into our model we need to account for inflation and growth in incomes. To do so, we detrend all figures by nominal GDP per worker from NIPA.[21] Table C1 summarizes the main information for the three cohorts of interest. The main point we want to make with this table is that there is a mismatch in timing between when the college attendance and sorting patterns changed versus when college financial conditions changed. The attendance and sorting changes were largely complete by 1960, if not a few years earlier; the rise in the college earnings premium, the rise in college tuition, and the introduction of federal loan programs were all between 1960 and 1979.

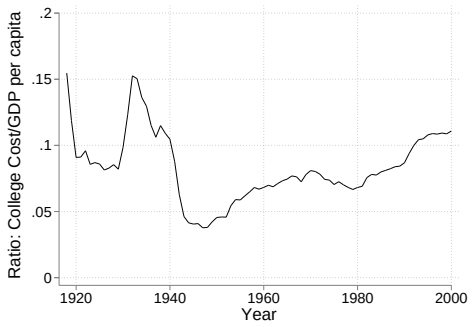
We start with the changes in the direct cost of college, which we measure as the total tuition and fees collected by public universities divided by the number of students who attend public universities. Our approach is similar to Donovan and Herrington (2017), which contains data sources and details. This series has two desirable properties. First, tuition receipts is an improvement on reported tuition because it accounts for any grants or other financial aid provided by the university. Second, we focus on public universities because our paper is about access to college. We have little to say about the separate question of why some students choose to pay a higher price in order to attend private colleges. Our series can be constructed in a comparable way for all the cohorts of interest, and is shown in Figure

[21] We would prefer to measure directly family income or annual wage income, but are not aware of any annual series for these figures.

Table C1: Summary: Sorting and Financial Conditions for Select Studies

Study	Updegraff (1936)	Flanagan et al. (1971)	NLSY79
Cohort	1933	1960	1979
Panel A: Attendance and Sorting			
College entry rate	0.39	0.53	0.58
β_{IQ}	0.22	0.70	0.58
β_F	0.68	0.48	0.42
Panel B: Financial Conditions			
College premium	0.36	0.35	0.56
Borrowing limit	0	0	22,596
College cost	2,154	2,038	2,731

Figure C1: Real College Cost by Cohort



C1 with our four main cohorts of interest marked. Real college costs have risen sharply, particularly between 1945 and 1965 and again between 1975 and 1990.

We now turn to the changing role of the federal government in college financing. We focus on the federal government because most state and local government support for colleges takes the form of direct budget support. This form of support affects the tuition that (especially public) universities charge students, but we have already accounted for this in our cost of college series above. Most federal government support for colleges worked similarly before 1958. That is, most federal government support was directed towards specific non-instructional activities, such as support for agricultural research (Conlan, 1981). There are two exceptions. First, the government helped subsidize work-study programs as part of the National Youth Administration that ran between 1935 and 1939. This program started two years after the 1933 cohort graduated high school and so had little effect on our cohorts of interest. Second, the government provided direct funding for veterans to increase their

education through the GI Bills. The largest and most generous payments were made to World War II veterans shortly after the end of the War; GI bill payments played little role by the 1960 high school cohort of interest.[22]

The first explicit, generally available aid for college was introduced in 1958 through the National Defense Education Act. This act brought about the first federally sponsored student loans (Perkins loans), which were initially directed towards students who would study subjects of national interest, which included particularly science, math, and engineering (Conlan, 1981). Federal support expanded dramatically with the Higher Education Act of 1965 and the 1972 Higher Education Amendments. These pieces of legislation expanded the National Defense Education Act; introduced subsidizes loans for college students; transferred control of work-study programs to the Department of Education; and introduced programs to provide financial assistance to students with limited financial means, including particularly Pell Grants.

In Table C2 we summarize how these changes affected direct federal support for students between 1960 and 2000. We highlight three main changes. First, there has been a tremendous growth in real federal spending per pupil. While the figure was just 700 dollars per pupil in 1960, it more than tripled by 1970, largely as a result of the new legislation passed in 1965. The figure continued to grow modestly and was nearly 2,700 dollars per pupil by 1979 (roughly when the NLSY79 cohort graduated high school) and continued to grow until it stood at over 4,500 dollars per pupil. Underlying this aggregate figure were two important changes in the composition of aid. First, nearly three-quarters of aid in 1960 was targeted to specific subgroups, largely veterans, continuing a trend since World War II and the GI Bill. However, aid became increasingly general throughout this period; two-thirds of aid was generally available in 1980 and essentially all aid was by 2000. Second, loans became increasingly important. While loans were only 15 percent of total aid in 1960, they rose to more than two-thirds by 2000.

[22] An alternative hypothesis is that the GI Bill induces a broad social change by demonstrating that a new type of non-traditional student was capable of attending and succeeding in college. The available evidence does suggest that the maximal effects of the GI Bill were large for men; both Stanley (2003) and Bound and Turner (2002) estimate that veterans in peak cohorts increased attendance by roughly 20–50 percent. However, this effect was confined to male veterans of a narrow range of cohorts, roughly those born 1923–1928. Those born earlier were too old to have been affected; those born later were more strongly influenced by the Korean War. The Korean War policies changed incentives by allowing drafted men to defer service to attend college, making college a substitute for rather than a complement to serviced in the armed forces for many young men. Further, Stanley (2003) finds no evidence that men from lower socioeconomic status backgrounds increased their postsecondary education in response to the G.I. Bill; the increase in attendance was almost entirely concentrated among students from above-median SES backgrounds. This evidence suggests that it is unlikely that the G.I. Bill brought about a long-lasting social change.

Table C2: Changing Federal Role in College Financing

	Year			
	1959–1960	1969–1970	1979–1980	1999–2000
Real Spending per Pupil (2010 $)	703	2,361	2,672	4,545
Fraction General Aid	0.28	0.48	0.68	0.95
Fraction Loans	0.15	0.39	0.40	0.70

Note: Spending figure for 1960 from the 1965 edition of the U.S. Census Bureau (various years); for remaining years, they are from *Trends in Student Aid* (various years). Each source breaks spending down into categories that makes it possible to decompose general versus specific aid, where specific is targeted to student subpopulations such as veterans. Likewise, each source breaks aid down into loans (Perkins, Stafford, and so on) versus other (grants, veterans' payments, work-study, and tax benefits). Dollar figures are deflated by CPI, while enrollment is taken from Snyder and Dillow (2012), Table 196.

C.2 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. Over the course of the 20th century, these specialized schools were abolished and their teaching functions moved into colleges and universities. These changes generally predate our period of interest for engineering and agriculture (Grayson, 1977). Teacher's colleges (also called normal schools) were 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).[23] Community colleges are challenging to categorize because they enroll two types of students: those who are engaging in terminal vocational training, and those pursuing a broader college degree . We include community college and junior college students in our figures because the majority of students who enroll

[23]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.

there intend to transfer at a four-year institution (43 percent with definite plans) or receive a general associate's degree (30 percent) rather than receive an applied associate's degree or certificate (27 percent) (Horn et al., 2006).

D 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. This appendix gives a brief description of the studies. Table D1 summarizes the basic details of the underlying studies, which we refer to as the metadata:t he 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.[24]

D.1 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.

[24] 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.

D.1.1 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.

D.1.2 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.

D.1.3 Mann (1924)

Mann (1924) 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.

D.1.4 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.

D.1.5 Odell (1927)

Odell (1927) 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.

D.1.6 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.

D.1.7 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.

D.1.8 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.

D.1.9 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.

D.1.10 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.

D.1.11 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)).[25] 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).

D.1.12 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.

D.1.13 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.

D.1.14 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

[25] 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).

were used to link parents to New York state tax records and thereby to determine family income.[26]

D.1.15 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).[27] 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.

D.1.16 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.

D.1.17 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.

[26] 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.

[27] 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.

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.

D.1.18 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.

D.1.19 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.

D.1.20 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.

D.1.21 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.

D.1.22 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.

D.1.23 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.

D.1.24 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.

D.1.25 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.

D.1.26 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.

D.1.27 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.

D.1.28 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.

D.1.29 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.

D.1.30 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).

D.1.31 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.

D.1.32 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.

D.1.33 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.

D.1.34 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.

D.1.35 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.

D.1.36 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.

D.1.37 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.

D.1.38 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.

D.1.39 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