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The Distributional Effects of Direct College Costs

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THE DISTRIBUTIONAL EFFECTS OF DIRECT COLLEGE COSTS

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Abstract

This paper examines the distributional impacts of direct college costs – that is, whether the response of educational decisions to college costs varies by student characteristics. The primary obstacle in estimating these effects is the endogeneity of schooling costs. To overcome this issue, I use two measures of direct costs that are plausibly exogenous: living within commuting distance to a university and the elimination of the Social Security Student Benefit Program in the United States. Both sources of variation indicate that lower ability students are the most responsive to changes in college costs. In contrast, I find that the effect of both cost measures on college attendance and graduation does not substantially vary by family income, parent education, race or gender.

Keywords: Schooling Costs, Educational Attainment, Financial Aid Policy

JEL Codes: I20, I28, J24

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1 Introduction

One of the most enduring relationships in labor economics is the link between years of education and earnings. Earning a college degree in particular is widely viewed to be an important step in the path to establishing a successful career and a high standard of living. Students, however, vary in their willingness to pay for and in the ease with which they can finance a college education. Policy makers and economists have therefore been concerned that, regardless of family background, all qualified and interested students be able to go to college. This concern has led to government aid in the form of grants and loans. Additionally, colleges have considerable leeway in setting the amount of tuition paid by students, and in practice universities have used this ability to set prices to attempt to mitigate the financial burden of college, particularly for lower SES students.

The importance of financial aid and tuition policies has given rise to a literature in economics that studies the impact of financial aid (and college costs more generally) on college attainment and a related literature studying the distributional effects of these costs – that is, whether the response of schooling decisions to college costs varies by student characteristics.[1] This paper makes two contributions to this literature. First, while earlier research has studied only the distributional impacts of schooling costs on college enrollment, I focus both on enrollment and on college graduation. Second, though other papers have studied the distributional impacts of aid with respect to family background characteristics, this paper is (to the best of my knowledge) one of the first to provide evidence with respect to cognitive ability.[2]

This latter extension is relevant for at least two reasons. First, to the extent that the return to college is driven by the ability distribution of college students (e.g. in signaling models or if peer effects are important), changes in the cost of college could potentially alter the returns to schooling

[1]See, for example, Kane (1994), Dynarski (2000), (2002), and (2003), Bound and Turner (2002), Turner and Bound (2003), Stanley (2003), and Linsenmeier et al. (2006).

[2]Ehrenberg and Sherman (1984) allow the effect of schooling costs to vary by SAT scores. They find that both high and low SAT students responded most strongly to schooling costs (compared to students scoring in the middle), but their results were limited to one elite university. To the extent that the effect of schooling costs at one college on attending that college is conceptually different from the effect of schooling costs on attending college more generally, this paper and the paper by Ehrenberg and Sherman estimate distinct parameters. In particular, in Ehrenberg and Sherman (1984) the marginal students are deciding between attending different colleges, whereas the marginal students in this study will be deciding whether to increase their educational attainment.

if schooling costs also alter the ability distribution of college graduates. Second, ability sorting into different levels of schooling has been one of the primary concerns for economists attempting to estimate the causal effect of education on earnings. This paper provides evidence on the extent to which direct schooling costs drive sorting into college based on cognitive ability.

The primary obstacle in estimating the distributional effect of direct schooling costs is that students ultimately have considerable leeway over how much they spend on their education. For example, a student can attend a public university in their home state and pay a relatively low tuition level or attend an out-of-state public university or a private university. These decisions will likely depend on expected returns to education, tastes for education, unobservable costs (both monetary and non-monetary), and so on. Thus it is generally not possible to assign a causal interpretation to the joint relationship between college attainment, direct schooling costs, and student characteristics.

To overcome this issue, I consider two measures of direct college costs that are plausibly exogenous. First, using the High School & Beyond Sophomore cohort, I proxy direct college costs using distance to nearest four-year university. Versions of this measure of college costs have been widely used.[3] The idea of this measure of direct costs is that it is cheaper to live at home than in a separate residence from one's parents; thus students whose parents live within driving distance of a university have access to cheaper education than students living out of driving range because they have the opportunity to reduce their housing costs. I divide students into two categories: within driving distance and not within driving distance of a university.[4] Regardless of how "within driving distance" is defined, respondents who live within commuting distance of a university appear to be quite similar to those who live outside of driving range.[5] However, I find that living within driving distance of a university disproportionately increases the college graduation rate of lower ability college graduates, though this difference is concentrated among men. Along other dimensions such

[3]See, for example, Card (1993), Bedard (2001), and Cameron and Taber (2004).

[4]Typically, authors have defined "living near a college" as having a college in the same county as which the respondent resides. High School & Beyond does not contain this measure, but it does provide a variable indicating the distance from the respondent's high school to the nearest 2-year and nearest 4-year college.

[5]Clearly "driving distance" is a subjective notion. I consider several different cutoffs: 40, 50, 60, and 70 miles from a 4-year university. All measures present generally similar results (see Appendix Table A1), and the main results use the 50 mile cutoff.

as family income, parent education, race, and gender, there is little heterogeneity in the effect of living within commuting distance of a four-year college.

The second measure of direct college costs exploits the elimination of the Social Security Student Benefit Program (SSSBP), a large financial aid program that provided a sizable college grant for children of Social Security eligible parents who were retired, disabled, or deceased. This policy change was first used in Dynarski (2003) to estimate the effect of aid on college attendance. From 1965 through 1981, the Social Security Administration provided a very generous tuition subsidy to 18-22 year old children of deceased, disabled, or retired Social Security eligible parents. This program was so generous that the average subsidy more than covered average public school tuition and fees, and it almost completely covered average private school tuition. Furthermore, the amount of the benefit was not tied to realized schooling costs but to parents' Social Security benefit levels. After the elimination of this program, there was a drastic drop in tuition aid for individuals who were formerly eligible for this program (Dynarski (2003)). I find once again that aid eligibility disproportionately increases the college graduation rate of lower ability students. In contrast to the results using the presence of a local college as a cost measure, I find that aid eligibility disproportionately increases the college graduation rate of students from higher-income families as well. I find little heterogeneity in the effect of aid eligibility with respect to characteristics such as race, gender, and parental education. Finally, I find little evidence in favor of heterogeneous effects of schooling costs on college *enrollment*, though there is some evidence that higher income students increased their enrollments the most in response to SSSBP eligibility.

This evidence adds to a growing literature on the effects of financial aid (and college costs more generally). One strand of this literature has studied the impact of direct schooling costs on college attendance. In attempting to explain trends in college attendance among African-Americans, Kane (1994) finds that a $1,000 decrease in tuition increases college enrollment by approximately 4%. Dynarski (2003) finds results that are remarkably similar using the elimination of the Social Security Student Benefit Program: She finds that a $1,000 decrease in schooling costs increases enrollment by approximately 4% as well. Using eligibility for G.I. Bills, Bound and Turner (2002) and Stanley (2003) also find that reducing the cost of schooling increases college attendance.

A smaller group of studies has examined the distributional impacts of direct schooling costs. Kane (1994) finds that blacks respond to changes in public tuition more than higher income whites but similarly to low-income whites. Turner and Bound (2003) find that, because of segregated colleges, blacks in the South increased college attendance less than whites in response to the GI Bill, though blacks in the North responded similarly to whites. Dynarski (2000) finds that the HOPE scholarship in Georgia had the largest impact on college enrollment for middle-class whites, and Stanley (2003) finds that veterans from more-educated families responded the most to the Korean War GI BIll. Finally, Cameron and Taber (2004) find little evidence that enrollment rates respond to the presence of a local college differently by family income, minority status, or parent education.

Most recently, Oppedisano (2008) uses the introduction of new colleges and expansions of existing universities in the 1990s in Italy to examine, among other things, whether this educational expansion increased the share of students with lower high school grades in college. She finds that the introduction of local colleges increased the share of students with middle-range grades attending university. I believe that the present study offers a contribution that is distinct from Oppedisano (2008) for at least three reasons. Most importantly, a large expansion in higher education that introduces new colleges not only reduces the costs of schooling for students living near one of these colleges but also changes the types of schools available to students. It is not clear whether these schools draw different types of students because they differ from existing schools or because they reduce the costs of schooling for students living within commuting distance. It is therefore difficult to interpret the results in Oppedisano (2008) as being solely driven by direct schooling costs.[6] Second, the Italian university system is different from the American university system, and it is therefore relevant to produce evidence from both of these countries. Finally, I focus on cognitive test scores that are comparable across students in different schools rather than high school grades.

[6]While this paper also uses the presence of a local college as a measure of costs, these colleges were generally well-established and not systematically part of a concerted effort to expand education in the U.S.. While there is some possibility that "local colleges" are very different from schools that people generally do not live near, this seems unlikely both because a majority of students live within commuting distance of a 4-year college and because casual observation suggests that nearly all population centers in the US have major 4-year colleges.

The paper proceeds as follows: Section 2 describes the empirical strategy, Section 3 describes the data, Section 4 presents results, Section 5 concludes.

2 Empirical Strategy

The main specification I estimate is the probit regression

$$Pr(s = 1|X, c) = Pr(X'\alpha_1 + \alpha_2 c + c \times X'\alpha_3 > \epsilon|X, c), \tag{1}$$

where s is college attainment (college graduation or attendance depending on the specification), X is a vector of observable characteristics, and c is a measure of direct schooling costs. The primary coefficient of interest is α_3. Estimates of α_3 will reflect both the composition of students on the margin of choosing $s = 1$ as well as heterogeneity in price sensitivities: A change in c will change the college going behavior only for marginal students, and if the composition of marginal college students differs from non-marginal college students that will lead to a non-zero interaction between c and X. Additionally, marginal students with certain X characteristics may be more price sensitive than students with different X characteristics, and this will similarly lead to a non-zero interaction between X and c.[7]

The main challenge in estimating Equation 1 is finding a plausibly exogenous source of variation in college costs. I make use of two sources that yield very similar results: First, I use the presence of a 4-year college within commuting distance of a respondent's high school. Beginning with Card (1993), similar variables have frequently been used as a measure of direct college costs. The motivation for its use stems from the reduction in living expenses that students enjoy if they are able to commute to college while living with their parents.[8]

Second, I exploit the elimination of the Social Security Student Benefit Program (SSSBP).

[7]For example, higher family income students may be more likely to receive transfers from their parents to pay for college so that they pay less of a marginal increase in schooling costs (on average). Thus they might appear less responsive to a dollar change in schooling costs.

[8]Earlier papers using presence of a local college have often used presence of a college in a respondent's county of residence (e.g. Card (1993), Bedard (2001), and Cameron and Taber (2004)). The variable used in this paper is therefore not identical to these earlier papers, though it is similar in spirit.

This policy change was previously used to study the effect of college aid on college attendance and completion in Dynarski (2003). Between 1965 and 1981, 18 to 22 year old children of disabled, deceased, or retired Social Security beneficiaries were eligible to receive monthly payments while enrolled full time in college. In 1981, Congress voted to end this program. The policy change only affected children of disabled, retired, or deceased Social Security eligible parents , so I compare the difference in college attainment of the affected group of college graduates before and after the policy change to the difference in college attainment of the unaffected group of college graduates before and after the policy change, and this effect is allowed to vary by observable student characteristics.

The SSSBP was a very generous aid program. The average annual payment for students with a deceased parent was $6,700, which was quite substantial at the time: it was more than enough to cover public school expenses, where average tuition and fees were about $1,900, and it was nearly enough to cover private school tuition and fees which on average were about $7,100. At the peak of this program, nearly 12% of college students were receiving benefits from the SSSBP. In 1981, Congress voted to end this policy for all students graduating high school in the spring of 1982 and later. As was documented in Dynarski (2003), the decline in the number of students who were funded by the SSSBP was quite rapid. By the 1984-85 school year, spending on the program had dropped by $3 billion. This policy thus consituted one of the most rapid and drastic changes in funding for higher education since the GI Bill after World War II. (The figures in this paragraph were taken from Dynarski (2003), pages 280-281.)

3 Data

In this paper I make use of two data sets: The sophomore cohort of High School & Beyond (HSB) and the National Longitudinal Survey of Youth 1979 (NLSY). Collected by the U.S. Department of Education, HSB first surveyed two cohorts of students who were sophomores and seniors in high school in 1980. I focus on the Sophomore Cohort, which is surveyed again in 1982, 1984, 1986, and 1992. Sampling is conducted by first selecting schools and then sampling students within schools. HSB collected extremely detailed information on students' background and high school and college experiences. It is thus well suited to study the college decision problem. The key variable is distance from the respondent's high school to the nearest 4-year college.[9] Additionally, HSB contains a rich set of background data: family income, parental education, race, gender, number of siblings, and a cognitive test score at age 16.

I use HSB to estimate heterogeneity in the effect of schooling costs on college attainment where schooling costs are proxied by whether the respondent lives within 50 miles of a four year college. In appendix Table A1 I test the sensitivity of the results to this specification, and in general the results for cutoffs at 40, 60, and 70 miles are consistent with the results for 50 miles. In order to further corroborate this evidence using an additional measure of direct college costs, I turn to the NLSY and use the elimination of the SSSBP as the additional cost measure. The NLSY is in a number of ways well suited to studying the effects of this policy change. There are five cohorts of respondents who could have been seniors in high school while the survey was being conducted (between 1979 and 1983). Three of these cohorts would have been seniors in high school before the policy change (1979 - 1981) while two would have been seniors in high school after the policy change (1982 and 1983). It is possible to observe the year in which students attended high school as seniors and their educational attainment by age 24. Additionally, NLSY includes a rich set of background characteristics similar to HSB: family income, parental education, race, gender, number of siblings, and a cognitive test score. The cognitive test score is the Armed Forces Qualification Test (AFQT), which consists of the Arithmetic Reasoning, Mathematics Knowledge, Paragraph Comprehension, and Word Knowledge portions of the Armed Services Vocational Aptitude Battery (ASVAB).[10]

Unfortunately, the NLSY does not indicate whether college students received aid from the SSSBP. Instead, I follow Dynarski (2003) and proxy aid eligibility by an interaction between being a senior in high school before the policy change and having a deceased father. This approach is taken for three reasons. First, at this point in time there were relatively few women who were eligible for Social Security benefits, so having a deceased, retired, or disabled mother is less likely

[9]The assumption here is that most students live close enough to the high schools they graduated from that distance from a college to one's high school is a good approximation of distance from one's home to a college.

[10]This test is used by the U.S. Military to determine whether military applicants are qualified to enlist. Since the NLSY is a nationally representative sample, the military used the respondents to the NLSY to normalize the test to a scale of 0 to 100.

to leave a student eligible for this aid program (Dynarski (2003)). Second, while the aid policy may affect a parent's decision to retire or file for disability, it is probably less likely to affect a parent's "decision" to die. Third, from a practical standpoint, it is not easy to identify retired or disabled parents in the NLSY.[11] If anything, to the extent that respondents who are aid eligible are classified as aid ineligible, this should bias estimates of the effect of direct schooling cost towards zero.

Table 1 displays sample statistics for HSB (Column 1) and NLSY (Column 2). In general, the respondents from the two data sets appear to be similar along most observable dimensions. In HSB, average family income is $28,743 while it is $28,737 in NLSY,[12] slightly under half the sample of HSB is male and slight over half is male in NLSY, about 34% of both the NLSY and HSB samples had fathers who had at least attended some college,[13] while 27% of HSB mothers and 23.4% of NLSY mothers attended college. Respondents from both samples came from sibships that had on average about three children (including the respondent). The one fairly large difference between the samples is that about 23% of the NLSY earned a bachelor's degree by age 24 while only 15% earned a bachelor's by the same age from HSB. 88.9% of HSB respondents attended a high school that was within 50 miles of a 4-year college, while only 2.7% of respondents from NLSY are considered to be eligible for aid (as proxied by the $Before \times Deceased\ Father$ interaction).[14] Although neither source of cost variation has similar numbers of students facing expensive and less-expensive schooling, one attractive feature of the combination of these two cost measures is that one source has a large fraction of students who can access relatively cheap schooling (being within commuting distance of a 4-year college) while the other source has a small minority that

[11]It is possible to roughly proxy having a retired father by fathers who are over 65 and not working. When this group is added to the "aid eligible" group, the results do not substantially change.

[12]In HSB, the family income variable is categorical rather than the actual amount of income. I take the midpoint of each income category as the income level. NLSY provides the actual family income. Family income is in 1982 dollars in both the NLSY and HSB and is measured in the senior year of high school for all respondents.

[13]Parental education in HSB is measured as a categorical variable, while in the NLSY it is measured as years of schooling. Any father or mother who at least attended "less than two years of college" in HSB is considered to have at least attended some college. In the NLSY, any parent listed as having 13 years or more of education is considered to have attended some college.

[14]More students were in reality eligible for aid since I categorize those who had retired or disabled fathers and social security eligible retired, disabled, or deceased mothers as aid ineligible. At the peak of the SSSBP, about 12% of college enrollees were receiving aid under this program. See Dynarski (2003) for details.

is eligible for cheaper schooling (the SSSBP). It is therefore reassuring that the local college and SSSBP results are generally consistent with each other. The final two rows of Table 1 show that about 70% of the NLSY sample were seniors before the elimination of the SSSBP, and about 4% had deceased fathers. Details about the construction of the data are contained in the Data Appendix.

4 Results

4.1 Local Colleges

As discussed above, the main difficulty in estimating the distributional effects of college costs is that students can decide how much they would like to pay for college. The first measure of college costs overcomes this issue by using geographical variation in college locations: People whose parents live closer to universities have the option of living at home and commuting to school, thus reducing the amount spent on housing costs, whereas those whose parents do not live near a 4-year college do not have this option. In High School & Beyond, the measure of "local college" takes the form of distance from the respondents high school to the nearest four-year college.[15]

In order to capture the idea that someone who can commute to school has access to a cheaper college education, I create a dummy variable called *Local College* that is equal to 1 if a respondent lives within commuting distance of a 4-year university. For the main analysis, I consider anyone living within 50 miles ($\approx$ 80 kilometers) of a university to live within commuting distance. Since this is somewhat arbitrary, and in all likelihood the definition of a commutable distance varies by person, I consider cutoffs at 40, 60, and 70 miles in the Appendix Table A1. The results do not substantially change with these different definitions.

Table 2 presents evidence on the correlation between having access to a local college and a number of background characteristics for students in the HSB sample. Results are from a linear

[15]Unfortunately, in High School & Beyond one cannot distinguish between distance from 4-year private and 4-year public universities. To the extent that living near a private but not a public university does not provide access to cheaper schooling, some people classified as living near a 4-year university will in fact face more expensive schooling. This should bias estimates towards zero, so any effect that is statistically different from zero should be viewed as a lower bound (in absolute value).

probability regression of graduating from a high school within 50 miles of a 4-year college on background characteristics. In the first seven columns, local college is regressed on each regressor individually. Generally speaking, the relationship between *Local College* and the background characteristics is quite small. In Column 1, a $10,000 increase in family income is associated with a 1.3% higher likelihood of living within 50 miles of a 4-year college. While statistically significant from zero at the 1% level, this number is fairly small. Similarly, a standard deviation increase in cognitive test scores is associated with a 1.2% higher likelihood of having access to a local college, and this estimate is statistically significant at the 10% level but again quite small. Those with a father and a mother who attended college are 3.9 and 3.1% more likely to have graduated from a high school within 50 miles of a 4-year college (both are significant at the 1% level). Race and gender appear to be unrelated to local college, and the relationship between number of siblings and local college is significantly different from zero but once again very small. In the final column, local college is regressed on all variables, and once again all of the estimated coefficients are very small. Only the family income, father attended college dummy, and number of siblings coefficients are significantly different from zero at standard levels. If anything, these results indicate that children from a more advantaged background are slightly more likely to live close to a 4-year college.

Table 2 shows that a number of key observable characteristics are not strongly correlated with the local college variable in the whole sample. The question now arises whether some students' educational choices are affected more than others by changes in schooling costs. Table 3 presents results from estimating Equation 1, where c is proxied by a dummy for local college, X is several different observable characteristics (family income, non-white, number of siblings, having college educated parents, and a cognitive test score), and $s = 1$ if the respondent earned a bachelor's degree by age 24 and zero otherwise. The coefficient of interest is the interaction between local college and the background characteristics. There is little variation in the effect of *Local College* on the probability of college graduation rate: it does not appear to vary substantially by family income, parents' education, race, or gender. But there are two characteristics along which the effects of college costs appear to vary: In Columns (2) and (8), the results suggest that access to a local college increases college graduation more for lower ability students, and these differences are significant at the 10% level. Since these are probit coefficients on interacted variables, Figure 1 displays the relationship between predicted graduation probabilities and the cognitive test score by presence of a local college variable to more easily interpret the results. At lower test scores, access to a local college raises graduation rates. However, the slope of the bachelor's degree-cognitive test score gradient is steeper for students who cannot commute to school – one-and-a-half standard deviations above the test score mean, the predicted probability of graduating college is the same for students with and without access to a local college.

Additionally, there is some evidence that having more siblings increases the effect of *Local College* as well: In Column (7) having an additional sibling increases the effect of *Local College* on the probit index by 0.051 points. This coefficient becomes much smaller and statistically no different from zero when all background characteristics are interacted with *Local College* in Column (8), however.

If we take the *Local College* variable to be a reasonable proxy for college costs, these results suggest that lower ability students are most responsive to changes in schooling costs. Thus reducing the cost of higher education will serve to increase graduation rates, and this increase will be concentrated among lower ability students.

The results in Table 3 do not vary substantially by gender except along one important dimension: cognitive test scores. Tables 4 and 5 show that, along nearly all observable characteristics, heterogeneity in the effect of *Local College* is very similar along observable dimensions for both men and women. The one notable exception is for cognitive test scores. The finding that lower college costs disproportionately increase the graduation rates of lower ability students appears to be concentrated on men. Table 4 displays evidence that the effect of *Local College* on college graduation increases substantially as male cognitive ability decreases (both of these estimates are twice the size of the corresponding estimates in Table 3 and are significant at the 1% level). In contrast, there is little heterogeneity by cognitive test scores for women in Table 5.

Taken as a whole, the evidence suggests the following: having access to a local college is not strongly correlated a set of key observable characteristics. If we take this as a measure of direct schooling costs, the evidence also suggests that along many dimensions such as parent education, race, gender, and number of siblings, the effect of reducing college costs does not substantially vary along some very important observable dimensions. The effect of reducing college costs on college graduation does appear to vary by cognitive ability, however: reducing direct schooling costs disproportionately increases the graduation rates of lower ability students.

There is one caveat to this conclusion: Classification error in the *Local College* variable may bias results towards zero. To the extent that (a) a student may graduate from a high school far from his home and (b) that different students consider different distances to be commutable, some students may be classified as having access to a local college when in fact they don't and vice versa. While this both of these points could potentially be problems, to the extent that most students attend public high schools the first point is probably not a huge issue in practice under the assumption that students attend public high schools in their hometowns (85% of students in HSB attended a public school, 10% attended a religious school, and the rest attended another type of private school or had missing high school information). To address the second point, in Table A1 I present evidence that the results from this section are robust to defining *Local College* as graduating from a high school within 40, 60, and 70 miles from a 4-year college. The results are largely unchanged from Tables 3, 4, and 5: Male students with lower test scores increase their college graduation rates the most in response to a reduction in schooling costs.

4.2 Elimination of the Social Security Student Benefit Program

The results using *Local College* as a college cost measure indicate that lower ability men are particularly sensitive to changes in direct schooling costs. Although *Local College* is only weakly correlated with observable characteristics, there is still the possibility that it is correlated with unobservable variables. This could lead to inconsistent estimates of heterogeneous price effect. To test the robustness of the results in the previous section using a different source of variation in college costs, I present evidence from the elimination of the Social Security Student Benefit Program. As with the last section, I begin by presenting evidence that this measure of college costs is plausibly exogenous by estimating a linear probability model of aid eligibility on background characteristics:

$$Before_i \times Deceased\ Father_i = X'\alpha_1 + \alpha_2 Before_i + \alpha_3 Deceased\ Father_i + \mu_i, \quad (2)$$

where X is once again some pre-college characteristic or vector of characteristics, $Before$ is an indicator variable equal to 1 if the respondent was a senior in high school before the policy change and zero otherwise, $Deceased\ Father$ is an indicator variable equal to 1 if the respondent was no older than 18 when his father died, μ is an error term, and aid eligibility is proxied by $Before_i \times Deceased\ Father_i$. In practice, X is AFQT score, family income, number of siblings, and dummy variables for non-white, male, and having a father/mother who attended college. If aid eligibility is exogenous conditional on $Before$ and $Deceased\ Father$ dummy variables, we would expect α_1 to be close to zero.

Table 6 presents results. In all cases, the relationship between aid eligibility and each variable is small and insignificant. When each variable is used on its own as a regressor, the coefficients are all close to and statistically no different from zero; when $Before_i \times Deceased\ Father_i$ is regressed on all background variables, once again none are significantly different from zero. The evidence is therefore consistent with the hypothesis that aid eligibility is exogenous conditional on $Before$ and $Deceased\ Father$ effects.

I now restimate Equation 1 using eligibility for the SSSBP as a proxy for college costs, and Table 7 presents results. As was the case with the *Local College* variable, the first eight columns indicate that the main dimension along which the effect of college costs varies is along cognitive test scores. Students with higher family incomes, mothers who attended college, and men tended to be more price sensitive while students with fathers who attended college, more siblings, and white students were on average less price sensitive. However, none of these estimates are significantly different from zero at conventional levels. On the other hand, in Columns (2) and (3), aid eligibility increased the graduation rate of lower ability students more than higher ability students, and these estimates are statistically different from zero at the 10% and 5% levels, respectively. Columns (9) and (10) interact all background characteristics with the aid eligibility proxy. The main qualitative difference relative to the first eight columns is that there is substantial variation in the effect of aid eligibility by family income: in both Columns (9) and (10) students from higher income families are *more* price sensitive than students from lower income families. The variation in the effect of aid eligibility with respect to AFQT score is no longer significantly different from zero at conventional levels (Column (9)) though the coefficient is larger.[16] The variation with respect to having an AFQT score less than the median is still significantly different from zero at the 5% level and the coefficient is larger than in Column (3). To aid interpretation, Figure 2 displays the graduation probability - AFQT score relationship by aid eligibility status for students with deceased fathers. At low AFQT scores, the gap between predicted graduation for aid eligible and ineligible students is fairly large. However, at AFQT scores approximately one standard deviation above the mean aid eligible students are no more likely than aid ineligible students to graduate from college.[17]

How much does the effect of aid vary by AFQT score? The gap between the probability of graduating college for aid eligible and ineligible respondents (with a deceased father) is about 8 percentage points around the average AFQT score, and the average amount of aid received under the SSSBP is about $6,700.[18] This suggests that for respondents with average AFQT scores a $1,000 increase in aid increases the probability of college graduation by about 1.19%. Since about 12.6% of respondents with AFQT around the average graduated college by age 24, this represents an increase in the graduation rate of about 9.5%. The effect of aid eligibility on graduation by age 24 for respondents with AFQT scores one standard deviation above the mean is quite different: From Figure 2 we can see that there is almost no effect of aid eligibility on graduation rates.

The main caveat to the SSSBP results is that there are few respondents who have a bachelor's degree and a deceased father – only 27 respondents fit this description. While this cell size is small, a closer look at the distribution of AFQT scores of respondents with deceased fathers indicates that

[16]These results use imputed values of AFQT scores for the respondents missing this data (see the Data Apendix for details). When respondents who are missing AFQT scores are dropped, the results are quantitatively similar but more precisely estimated so that they are significant at conventional levels.

[17]It is striking that aid *ineligible* students with AFQT scores over one-and-a-half standard deviations above the mean are substantially more likely to graduate from college compared to aid *eligible* students. However, there are fairly few respondents with deceased fathers and AFQT scores one-and-a-half to two standard deviations above the mean, so it is not clear how much one can draw from results in this ability range.

[18]To increase the number of observations, I average over the predicted bachelor degree probability using people who are with 0.1 standard deviations of the average AFQT scores.

the aid eligible students are drawn from a large portion of the test score distribution: anywhere from the 12th percentile to the 99th percentile. This stands in stark contrast to the aid ineligible respondents, who come anywhere from about the 29th percentile to the 99th percentile. Thus it appears that this effect is at least partially driven by a truncated AFQT distribution for aid ineligible college graduates.

4.3 College Enrollees

Thus far I have only considered the effect of schooling costs on college graduation. In this subsection, I extend the analysis to heterogeneous effects of college costs on college enrollment. The approach taken is identical to the approaches taken in Sections 4.1 and 4.2 except that the dependent variable is enrollment in college by age 22 in the case of the local college analysis and by 23 in the case of the SSSBP analysis. Table 8 presents results when local college is the measure of schooling costs and Table 9 presents results when aid eligibility is the measure of schooling costs. Once again, results for the two cost measures are consistent with each other. However, results for college *enrollees* differ somewhat from the results for college graduation. In contrast to the college graduation results, I find no heterogeneous effects of aid eligibility with respect to cognitive test scores. Thus, while lower scoring students' graduation decision responded more to changes in schooling costs compared to higher scoring students, the effect of schooling costs on college enrollment does not vary substantially by ability. In Table 8, I find no evidence that the effect of local college on enrollment varies by any of the background variables. In Table 9 on the other hand, I find some evidence that higher income students are more likely to enroll in college when they are aid eligible compared with lower family income students. This heterogeneity with respect to family income is quite similar to the findings in Section 4.2.

Overall, the results suggest that lower ability students are very sensitive to changes in schooling costs for the decision to *graduate* college, but they are no more or less sensitive to price compared to higher ability students for the decision to *enroll* in college. One explanation for this result could be that there is a considerable amount of uncertainty regarding ability and the likelihood of success as a college student before going to college. However, once in college students learn about their ability to succeed in higher education. If this uncertainty is large enough, then there should be considerably less heterogeneity by test scores in the effect of schooling costs on enrollment compared to graduation. Consistent with this explanation is the finding that higher income families are more sensitive to SSSBP eligibility for both enrollment and for graduation: family income in one's senior year of high school is completely certain at the time of high school graduation, the enrollment decision, and the graduation decision.

5 Conclusion

In this paper I have presented evidence that direct college costs play a role in determining non-random selection into college. To generate plausibly exogenous variation in college costs, I use presence of a nearby 4-year college and the elimination of the Social Security Student Benefit Program. The results from both sources of variation are very consistent with each other. Both suggest that students differing in parent education, race, gender, and number of siblings respond similarly to changes in schooling costs. However, the results indicate that students with lower cognitive test scores are more responsive to price changes than students with higher cognitive scores. Evidence from the elimination of the Social Security Student Benefit Program further suggest that high family income students responded more strongly to the aid program than their lower family income peers.

Data Appendix

E.1 National Longitudinal Survey of Youth 1979

E.1.1 Variables

- Parent education: *R0007900* (Father's education), *R0006500* (Mother's Education)
- Family Income: *R0217900* (1979), *R0406010* (1980), *R0618410* (1981), *R0898600* (1982), *R1144500* (1983)

- Number of Siblings: *R0009100*
- Highest Grade Attended: *R0017200* (1979), *R0229100* (1980), *R0417300* (1981), *R0664400* (1982), *R0905800* (1983)
- Highest Grade Completed: *R0017300* (1979), *R0229200* (1980), *R0417400* (1981), *R0664500* (1982), *R0905900* (1983), *R1205800* (1984), *R1605100* (1985), *R1905600* (1986), *R2306500* (1987), *R2509000* (1988)
- Cognitive test: *R0618200*
- Sex: *R0214800*
- Race: *R0214700*
- Age: *R2871300*
- Deceased Father by age 18: *R2738300*, *R2738400,...*, *R2740000*

E.1.2 Creation of the Data Set

Missing Data

In most cases, missing values for explanatory variables were imputed. For continuous variables, this involved replacing the missing value with the average of the variable for non-missing cases. This included the measure of family income as well as number of siblings. A dummy indicating whether the case was missing this variable was created and included in regressions. For dummy variables such as whether the respondent's mother and father attended college, an additional category was created for the missing variable, and in the regressions the omitted variable in this set of dummies was the "education observed, did not attend college" category. Observations missing race, sex, the cognitive test score, or educational attainment data were dropped.

Creation of key variables

- Deceased father: A series of questions are asked about the times respondents were not living with their parents before age 18. These include the age, parent, and reason for which the respondent was not living with the parent. Anyone who stopped living with his/her father before age 18 because of the father's death was coded as having a deceased father.

- Cognitive test score: Are adjusted for age by regressing AFQT on age dummies taking the residual as the AFQT score. This is then converted to standard deviations.
- Aid eligibility: Equals one if respondent graduated high school in 1979-1981 and had a deceased father before he/she was a senior
- Bachelor's degree by age 24: If the respondent was 24 or younger at the time of degree receipt, this variable takes on the value 1 and 0 otherwise.

E.2 High School & Beyond

E.2.1 Variables

- Parent education: *fy55* (Father's education), *fy56* (Mother's Education)
- Family Income: *fy111*. Income variable gives 8 ranges of income; the midpoint of each is taken as the value. The last category is any income level greater than $50,000; I take 75,000 as the value for individuals in that category.
- Number of Siblings: *fy106*
- Cognitive test: *bytest*
- Sex: *sex*
- White: *race*
- Birth Date: *birthyr*, *birthmo*
- Higher education degree: *tdeg1...7*
- Year earned degree: *tdyear1...7*
- Bachelor Degree by age 24: *tdyear1...7*, *birthyr*, *tdeg1...7*
- School ID: *schid* or *schoolid*
- ID For parent file: *sparid*

- ID: *id*
- Distance to nearest 4-year college: *colldist*

E.2.2 Creation of the Data Set

Missing Data

In most cases, missing values for explanatory variables were imputed. For continuous variables, this involved replacing the missing value with the average of the variable for non-missing cases. This included the measure of family income as well as number of siblings. A dummy indicating whether the case was missing this variable was created and included in regressions. For dummy variables such as whether the respondent's mother and father attended college, an additional category was created for the missing variable, and in the regressions the omitted variable in this set of dummies was the "education observed, did not attend college" category. Observations missing race, sex, the cognitive test score, individual/school IDs, educational attainment data, or a FICE code were dropped. Observations missing individual and school IDs are also dropped.

Creation of key variables

- Cognitive test score: after dropping anyone with a missing id or school id, the cognitive test score is converted to a mean 0 standard deviation 1 variable (for non-missing cases).
- Local College: equals 1 if respondent's high school was within 50 miles of a 4-year college
- Bachelor's degree by age 24: Age at bachelor's degree receipt is calculated by age at degree receipt minus birth year for individuals who earned a bachelor's degree. If the respondent was 24 or younger, this variable takes on the value 1 and 0 otherwise.

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Table 1: Sample Statistics

	HS&B (1)	NLSY (2)
Family Income	$28,743	$28,737
Male	0.498	0.517
White	0.726	0.803
Father Attended College	0.337	0.337
Mother Attended College	0.270	0.234
Siblings	2.924	3.086
Bachelor's Degree by Age 24	0.143	0.228
Local College	0.889	
Before x Deceased Father		0.027
Before		0.695
Deceased Father		0.041

Notes: Family Income (in 1982 dollars) is the respondent's family income in her senior year of high school. Local college is a dummy variable equal to 1 if the respondent attended high school within 50 miles of a 4-year college. Eligibility for the Social Security Student Benefit Program is proxied by the interaction between Before and Deceased Father. Before equals 1 if the respondent was a senior in high school before the policy change, and Deceased Father equals 1 if the respondent was 18 or younger at the time of the father's death.

Table 2: Relationship Between Local College and Background Characteristics

	N = 13,336							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Family Income	0.013							0.010
	[0.003]**							[0.002]**
Cognitive Test Score		0.012						0.007
		[0.006]+						[0.006]
Dad Attended College			0.039					0.020
			[0.010]**					[0.009]*
Mom Attended College				0.031				0.006
				[0.010]**				[0.010]
White					-0.005			-0.018
					[0.012]			[0.012]
Male						-0.003		-0.008
						[0.005]		[0.005]+
Number of Siblings							-0.008	-0.006
							[0.003]**	[0.002]**
R-squared	0	0	0	0	0	0	0	0.01

Notes: ** Significant at 1% level, * significant at 5% level, + significant at 10% level. Standard errors are clustered by high school. Local college is defined as having a 4-year college within 50 miles of the respondent's high school. Family income is in 1982 dollars. Missing data is replaced with the average for non-missing observations, and a dummy indicating whether the observation is missing is included in the regression. Results are weighted by base year weights.

Table 3: Heterogeneous Effect of Local College on College Graduation

	N = 13,632							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Local College x Family Income	0.035							0.058
	[0.035]							[0.039]
Local College x Test Score		-0.165						-0.183
		[0.088]+						[0.096]+
Local College x Father Attended College			0.004					0.098
			[0.128]					[0.152]
Local College x Mother Attended College				-0.042				-0.185
				[0.144]				[0.170]
Local College x White					-0.114			-0.057
					[0.135]			[0.154]
Local College x Male						-0.161		-0.018
						[0.109]		[0.138]
Local College x Siblings							0.051	-0.002
							[0.029]+	[0.041]

Notes: + significant at 10% level, * significant at 5% level, ** significant at 1% level. Standard errors are clustered by high school. Dependent variable is whether the respondent received a bachelor's degree by age 24. Results are displayed from probit regressions of bachelor's degree on local college, an interaction between local college and background charcteristic(s), and the level effects of the background characteristic(s). Missing observations are replaced with the mean of non-missing observations, and missing variable dummies are included in regressions. Sample is limited to respondents with non-missing bachelor's degree and college information. Results are weighted by base year weights.

Table 4: Heterogeneous Effect of Local College on College Graduation - Men

	N = 6,699						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Local College x Family Income	0.040						0.065
	[0.045]						[0.050]
Local College x Test Score		-0.369					-0.492
		[0.154]*					[0.156]**
Local College x Father Attended College			0.246				0.490
			[0.178]				[0.217]*
Local College x Mother Attended College				0.016			-0.107
				[0.192]			[0.236]
Local College x White					-0.146		0.166
					[0.205]		[0.228]
Local College x Siblings						0.029	-0.048
						[0.042]	[0.055]

Notes: + significant at 10% level, * significant at 5% level, ** significant at 1% level. Standard errors are clustered by high school. Dependent variable is whether the respondent received a bachelor's degree by age 24. Results are displayed from probit regressions of bachelor's degree on local college, an interaction between local college and background charcteristic(s), and the level effects of background characteristic(s). Missing observations are replaced with the mean of non-missing observations, and missing variable dummies are included in regressions. Sample is limited to respondents with non-missing bachelor's degree and college information. Results are weighted by base year weights.

Table 5: Heterogeneous Effects of College Costs - Women

	N = 6,933						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Local College x Family Income	0.033						0.033
	[0.051]						[0.060]
Local College x Test Score		-0.015					0.035
		[0.108]					[0.127]
Local College x Father Attended College			-0.246				-0.221
			[0.186]				[0.228]
Local College x Mother Attended College				-0.112			-0.197
				[0.195]			[0.240]
Local College x White					-0.087		-0.171
					[0.173]		[0.204]
Local College x Siblings						0.078	0.037
						[0.040]+	[0.056]

Notes: + significant at 10% level, * significant at 5% level, ** significant at 1% level. Standard errors are clustered by high school. Dependent variable is whether the respondent received a bachelor's degree by age 24. Results are displayed from probit regressions of bachelor's degree on local college, an interaction between local college and background charcteristic(s), and the level effects of background characteristic(s). Missing observations are replaced with the mean of non-missing observations, and missing variable dummies are included in regressions. Sample is limited to respondents with non-missing bachelor's degree and college information. Results are weighted by base year weights.

Table 6: Relationship between Aid Eligibility and Background Characteristics

			N = 4,184				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Family Income	-0.0003						-0.0005
	[0.0008]						[0.0008]
AFQT		0.0011					0.0012
		[0.0018]					[0.0020]
Dad Attended College			-0.0003				0.0001
			[0.0036]				[0.0036]
Mom Attended College			-0.0026				-0.0030
			[0.0043]				[0.0042]
White				-0.0011			-0.0066
				[0.0039]			[0.0046]
Male					0.0003		0.0002
					[0.0033]		[0.0033]
Number of Siblings						-0.0016	-0.0016
						[0.0010]	[0.0011]
R-squared	0.69	0.69	0.69	0.69	0.69	0.69	0.69

Notes: ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level. Robust standard errors in parentheses. Dependent variable is the interaction between the Deceased Father and Before dummies. AFQT is converted to a mean zero standard deviation one variable. Family income is from the respondent's senior year in high school and is divided by $10,000. Missing data is replaced with the average for non-missing observations in each Before x Deceased father cell, and a dummy indicating whether the observation is missing is included in the regression. Results are weighted by base year weights.

Table 7: Heterogeneous Effects of Social Security Student Benefit Program - College Graduates

	N = 4,105									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Aid Eligible x Family Income	0.183								0.352	0.357
	[0.119]								[0.154]*	[0.150]*
Aid Eligible x AFQT		-0.407							-0.490	
		[0.245]+							[0.322]	
Aid Eligible x AFQT < Median			0.870							1.084
			[0.367]*							[0.496]*
Aid Eligible x Dad Attended College				-0.333					-0.752	-0.676
				[0.407]					[0.515]	[0.490]
Aid Eligible x Mom Attended College					0.213				-0.213	-0.101
					[0.468]				[0.608]	[0.580]
Aid Eligible x White						-0.173			-0.129	-0.056
						[0.288]			[0.427]	[0.386]
Aid Eligible x Male							0.397		0.225	0.201
							[0.341]		[0.342]	[0.341]
Aid Eligible x Siblings								-0.024	-0.110	-0.093
								[0.058]	[0.072]	[0.070]

Notes: ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level. Results are from probit regressions of a dummy variable equal to 1 if the respondent earned a bachelor's degree by age 24 on aid eligibility, background characteristics, and the interaction between eligibility and background characteristics. AFQT is converted to a mean zero standard deviation one variable. Family income is from the respondent's senior year in high school and is divided by $10,000. Missing data is replaced with the average for non-missing observations in each Before x Deceased father cell, and a dummy indicating whether the observation is missing is included in the regression. Results are weighted by base year weights.

Table 8: Heterogeneous Effect of Local College on College Enrollment

	N = 13,650							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Local College x Family Income	0.024							0.015
	[0.038]							[0.034]
Local College x Test Score		-0.024						-0.056
		[0.056]						[0.063]
Local College x Father Attended College			0.008					0.070
			[0.112]					[0.136]
Local College x Mother Attended College				0.030				-0.026
				[0.150]				[0.158]
Local College x White					0.061			0.043
					[0.101]			[0.140]
Local College x Male						-0.053		-0.003
						[0.089]		[0.095]
Local College x Siblings							-0.013	-0.039
							[0.030]	[0.030]

Notes: + significant at 10% level, * significant at 5% level, ** significant at 1% level. Standard errors are clustered by high school. Dependent variable is whether the respondent received a bachelor's degree by age 24. Results are displayed from probit regressions of bachelor's degree on local college, an interaction between local college and background charcteristic(s), and the level effects of the background characteristic(s). Missing observations are replaced with the mean of non-missing observations, and missing variable dummies are included in regressions. Sample is limited to respondents with non-missing bachelor's degree and college information. Results are weighted by base year weights.

Table 9: Heterogeneous Effects of Social Security Student Benefit Program - College Enrollees

	N = 4,184									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Aid Eligible x Family Income	0.287								0.228	0.257
	[0.172]+								[0.205]	[0.205]
Aid Eligible x AFQT		0.040							0.066	
		[0.150]							[0.208]	
Aid Eligible x AFQT < Median			-0.004							-0.016
			[0.273]							[0.360]
Aid Eligible x Dad Attended College				0.881					0.820	0.765
				[0.457]+					[0.516]	[0.513]
Aid Eligible x Mom Attended College					-0.154				-0.675	-0.445
					[0.489]				[0.640]	[0.616]
Aid Eligible x White						0.127			-0.008	-0.016
						[0.238]			[0.346]	[0.320]
Aid Eligible x Male							-0.205		-0.283	-0.333
							[0.262]		[0.281]	[0.283]
Aid Eligible x Siblings								0.033	-0.012	0.000
								[0.049]	[0.055]	[0.053]

Notes: ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level. Results are from probit regressions of a dummy variable equal to 1 if the respondent enrolled in college by age 23 on aid eligibility, background characteristics, and the interaction between eligibility and background characteristics. AFQT is converted to a mean zero standard deviation one variable. Family income is from the respondent's senior year in high school and is divided by $10,000. Missing data is replaced with the average for non-missing observations in each Before x Deceased father cell, and a dummy indicating whether the observation is missing is included in the regression. Results are weighted by base year weights.

Table A1: Distributional Effects of College Costs: Different Measures of Local College Variable

	N = 13,632			N = 6,699			N = 6,933		
	All Respondents			Males			Females		
	Dist < 70	Dist < 60	Dist < 40	Dist < 70	Dist < 60	Dist < 40	Dist < 70	Dist < 60	Dist < 40
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Local College x Family Income	0.120	0.090	0.008	0.108	0.085	0.024	0.134	0.105	-0.008
	[0.052]*	[0.046]+	[0.035]	[0.059]+	[0.055]	[0.046]	[0.075]+	[0.071]	[0.045]
Local College x Test Score	-0.255	-0.258	-0.087	-0.603	-0.585	-0.238	0.041	-0.040	0.013
	[0.145]+	[0.123]*	[0.085]	[0.239]*	[0.199]**	[0.122]+	[0.200]	[0.159]	[0.112]
Local College x Father Attended College	0.040	0.062	-0.055	0.706	0.475	0.019	-0.433	-0.207	-0.092
	[0.209]	[0.175]	[0.128]	[0.310]*	[0.258]+	[0.190]	[0.287]	[0.254]	[0.177]
Local College x Mother Attended College	-0.079	-0.080	-0.076	-0.498	-0.303	0.132	0.313	0.101	-0.236
	[0.214]	[0.197]	[0.145]	[0.286]+	[0.273]	[0.207]	[0.291]	[0.276]	[0.198]
Local College x White	-0.258	-0.175	0.180	-0.068	0.085	0.494	-0.457	-0.310	-0.067
	[0.186]	[0.176]	[0.164]	[0.288]	[0.282]	[0.202]*	[0.256]+	[0.246]	[0.183]
Local College x Siblings	-0.009	0.020	-0.041	-0.029	0.006	0.000	0.045	0.040	-0.086
	[0.060]	[0.056]	[0.036]	[0.080]	[0.077]	[0.046]	[0.075]	[0.069]	[0.052]
Local College x Male	-0.043	0.143	-0.105						
	[0.181]	[0.155]	[0.116]						

Notes: + significant at 10% level, * significant at 5% level, ** significant at 1% level. Standard errors are clustered by high school. Dependent variable is whether the respondent received a bachelor's degree by age 24. Results are displayed from probit regressions of bachelor's degree on local college, an interaction between local college and background charcteristic(s), and the level effects of the background characteristic(s). Missing observations are replaced with the mean of non-missing observations, and missing variable dummies are included in regressions. Sample is limited to respondents with non-missing bachelor's degree and college information. Results are weighted by base year weights.

Figure 1: Probability of Bachelor's Degree Receipt as a function of Cognitive Ability, by Presence of Local College. Results show the average predicted probability of graduating college by age 24 as a function of pre-college cognitive test scores. Average probabilities are predicted using the results in column (8), Table 3. Cognitive test score is converted to a mean zero, standard deviation one variable.

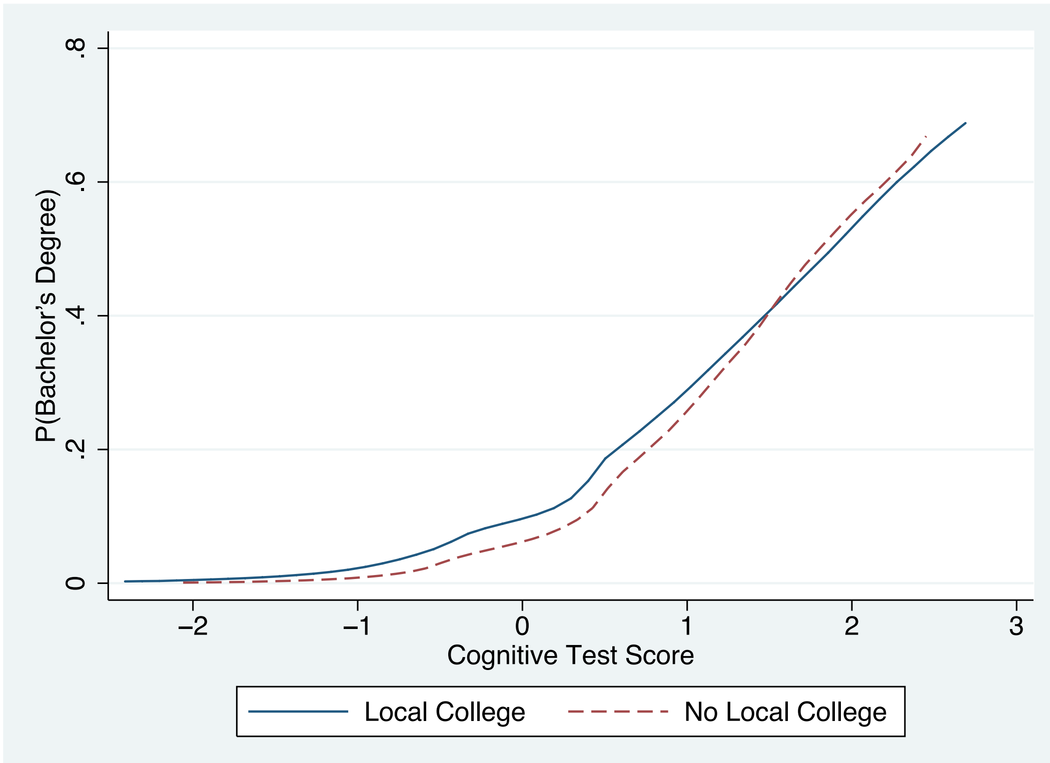
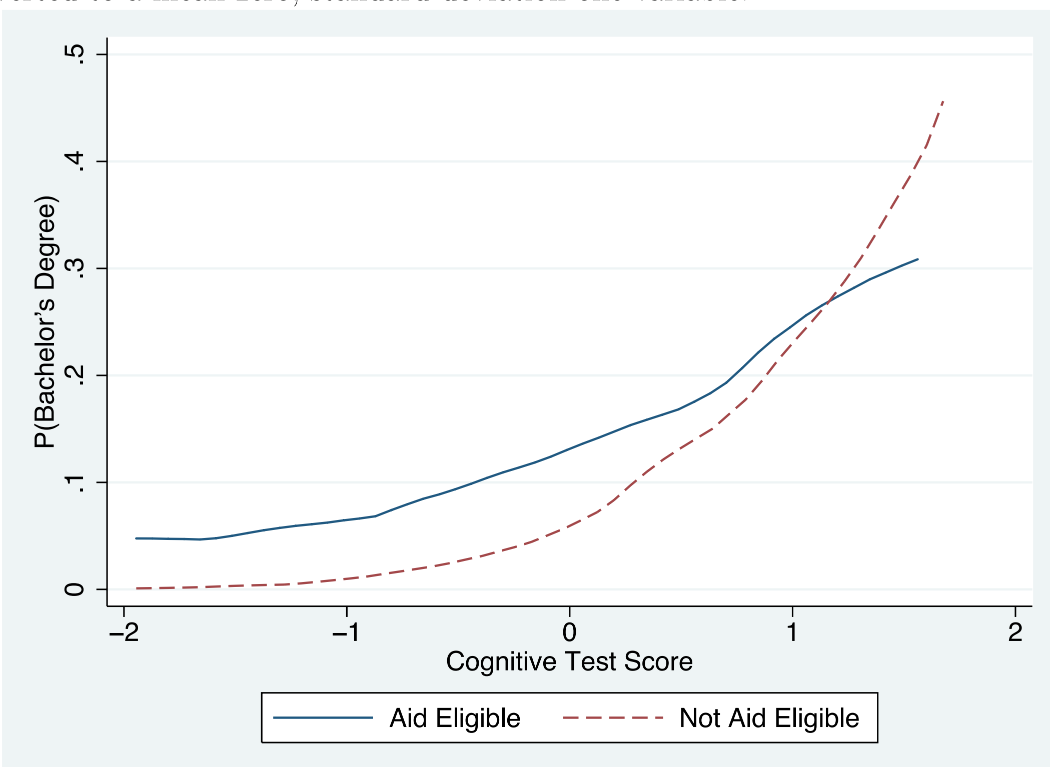


Figure 2: Probability of Bachelor's Degree Receipt as a function of AFQT score, by Aid Eligibility. Results show the average predicted probability of graduating college by age 24 as a function of AFQT scores. Average probabilities are predicted using the results in column (9), Table 7. Cognitive test score is converted to a mean zero, standard deviation one variable.



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