College Quality, Educational Attainment, and Family Income

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Abstract

1 Introduction

Theoretical models of schooling indicate that disadvantaged youth will under-invest in their human capital if they cannot obtain adequate funding for higher education.[1] Inefficiency in the schooling market is a concern for policy makers since it can lead to lower individual productivity, reduce growth, and perpetuate economic inequality. From a policy prospective, understanding the empirical relevance of such inefficiency is a first order objective. As a result, many studies have provided estimates of the impact of credit constraints on educational outcomes.[2] Unfortunately, this literature has primarily focused on the affect credit constraints have on the likelihood of college attendance and graduation, neglecting the fact that students can also choose the type or quality of the college they attend.[3]

We address this shortcoming in the literature by examining how credit constraints impact the quality of the college a student graduates from. Our motivation is three-fold. First, to the extent that individuals are constrained in their schooling choices, ignoring the quality margin will likely understate the overall importance of liquidity constraints. School quality and tuition

[1] Becker (1975)

[2] See Kane (2006), Carneiro and Heckman (2002), and Belley and Lochner (2007) for examples.

[3] Exceptions include Fuller et al. (1982), Long (2004), Lovenheim (2010).

are positively correlated, putting financially constrained youth at a further disadvantage. Second, college tuition has increased dramatically over the past three decades, leading many to conclude that the impact of financial constraints have worsened for recent cohorts.[4] The overall increase in tuition has been particularly severe at the top of the college quality distribution, suggesting that constraints in the quality dimension have also worsened.[5] However, the amount of financial aid and grants offered by top institutions has also increased significantly.[6] Thus, it is unclear a priori how constraints in the quality dimension have changed over time. Finally, individuals who are constrained along the attendance margin may be quite different from those constrained along the quality dimension. Only high ability students are likely to be quality constrained since high quality schools will not be in the choice set for low ability students. As a result, policies aimed at alleviating the constraint along the attendance margin may be less effective at reducing constraints in the quality dimension.

To explore the above issues, we use the National Longitudinal Survey of Youth 1979 and 1997 cohorts (NLSY79, NLSY97) to estimate how family income affects the quality of the institution a student graduates from. In an effort to quantify the importance of the quality channel, we map the effects of college graduation and college quality into future wages. By comparing results across the two cohorts, we can also determine how the effect of family income on schooling choices, and ultimately wages, has changed over the last 20 years. It is important to note that a significant relationship between family income and schooling outcomes is a necessary, but not sufficient condition for the existence of credit constraints. Belley and Lochner (2007) present evidence, however, that the empirical relationships between family income, ability, and college attendance are more consistent with the existence of borrowing constraints as opposed to a theory of schooling as consumption.

[4] See Kane (2006) as an example.

[5] According to the college board (http://trends.collegeboard.org/), average tuition at public two-year colleges, public four year colleges, and private four-year colleges have increased from 1980 to 2010 by approximately $2,000, $6,000, and $23,000 respectively (inflation adjusted). A more detailed examination of the changing price-quality gradient is presented in Section 3.

[6] Although average published tuition and fees increased by about 15% in inflation-adjusted dollars at private not-for-profit four-year colleges and universities from 2004-05 to 2009-10, and by about 20% at public four-year institutions, the estimated average 2009-10 net price for full-time students, after considering grant aid and federal tax benefits, is about $1,100 lower (in 2009 dollars) in the private sector and about $400 lower in the public sector than it was five years ago. Information obtained from http://trends.collegeboard.org/

Family income and college quality are likely to positively correlated with schooling ability and labor market productivity, making it difficult to isolate the causal impact of these variables on schooling and wage outcomes. An attractive feature of both the NLSY79 and NLSY97 is that respondents participate in a battery of tests, known as the Armed Services Vocational Aptitude Battery (ASVAB). Using these tests, we construct pre-college measures of math and verbal ability for each survey respondent and then condition on these variables when examining both schooling and wage outcomes.

Consistent with previous research, we find significant effects of family income on college attendance in both the 1979 and 1997 cohorts of the NLSY.[7] In the earlier cohort, high ability individuals appear to be most affected, but by the new millennium family income has a greater impact on attendance for low ability individuals.[8] The primary contribution of this paper is to extend this analysis to include college quality. We find that family income strongly impacts the quality of the college attended in the 1979 cohort, particularly for high ability individuals. However, family income only marginally affects the quality of the attended college in the 1997 cohort. These result indicate that constraints along the attendance margin remained relatively stable, while constraints along the quality dimension seem to have loosened considerably.

To put these results in perspective, we combine the schooling attainment regression estimates with estimates of the returns to schooling to predict how a move from the 4th quartile of family income to the 1st quartile of family income affects future wages. In the 1979 cohort, moving from the 4th to the 1st quartile of family income increases future wages for the average high (low) ability individual by 10% (1%). The wage increase reflects both a higher probability of graduating college and of attending a higher quality school. If we ignore the impact of family income on college quality, we understate the wage effects of a move from the 4th to 1st quartile of family income for a high ability individual by 25%. Thus, the overall importance of family income is significantly underestimated if only the graduation margin is considered. For the 1997 cohort, the patterns are quite different. Moving from the 4th to 1st quartile of family income increase future wages for the average high (low) ability individual by 6% (2%). Ignoring the quality dimension of college has no meaningful impact on these results, which is consistent with the result that family income and quality are only weakly related in the 1997

[7] See Carneiro and Heckman (2002), Belley and Lochner (2007), and Lovenheim (2008).

[8] This result is consistent with the findings in both Belley and Lochner (2007) and Lovenheim (2008).

cohort.

Combining the results across the two cohorts yields an estimate of the overall trend in the impact of family income on future wages. For low ability individuals, the wage gap generated from heterogeneity in family income and its effect on schooling is small in both time periods and changes very little. However, for high ability individuals, family income and its impact on wages through schooling has become significantly less important. In particular, the predicted wage change moving from the 4th to the 1st quartile has decreased from 10% to 6%. Approximately 30% of this change is a result of the weakening of the family income-college quality relationship among recent cohorts of college students.

The outline for the remainder of the paper is as follows. Section 2 briefly discusses the related literature. Section 3 discusses the data and sample restrictions in detail. The results of the analysis are contained in Section 4 and Section 5 concludes

2 Literature Review

As a result of the significant wage returns to a college degree, most of the research on credit constraints is concerned with how liquidity affects college attendance and graduation.[9] In practice, information on the amount of credit available to any individual is not observable, and as a result, researchers have often relied on the reduced-form relationship between family income and schooling attainment to gauge the importance of credit constraints.[10] Using data from the High School and Beyond Survey and National Education Longitudinal Study of 1992, Ellwood and Kane (2000) find that 80% of the students from the top income quartile attended some type of post-secondary institution within 20 months of their high school graduation, as compared with 57% of those from the lowest income quartiles. This attendance gap is

[9]Other outcomes besides attendance and graduation have also been investigated. Stinebrickner and Stinebrickner (2008) focus on college dropout, Kane (1996) and Belley and Lochner (2007) examine college delay, while Keane and Wolpin (2001) and Johsnon (2010) allow students to respond to credit constraints by working more while in school.

[10]Important exceptions include Keane and Wolpin (2001), Johsnon (2010), and Cameron and Taber (2004). The first two papers structurally estimate schooling and work decisions, modeling parental transfers and financial aid explicitly. Cameron and Taber (2004) employ both an IV and structural model to estimate importance of credit constraints. None of these papers find strong evidence that borrowing constraints significantly alter schooling decisions.

cut almost in half if math test scores from high school are taken into account. Carneiro and Heckman (2002) find similar patterns using the NLSY79. Unconditionally, family income appears to play a large and significant role in a student's decision to attend college. However, the gaps in attendance across terciles of the family income distribution shrink considerably when controls for student ability are included.

While the empirical evidence based on data from the 1980's does not provide strong support for the existence or importance of short-term credit constraints, there is a growing concern that credit constraints have become increasingly important over the past few decades in response to significant tuition hikes. Adjusted for inflation, tuition at public and private four-year colleges has increased approximately three-fold from 1980 to 2010.[11] Recent empirical evidence suggests that the rise in tuition has strengthened the relationship between family income and college attendance. Using race as a proxy for income, Kane (2006) shows that the gap in college attendance between black and whites in the annual October Current Population Survey increased between 1973 and 2002, despite a shrinking of the gaps in high school graduation and test performance. Belley and Lochner (2007) shows that conditional on ability, the relationship between family income and college attendance has strengthened considerably in the NLSY97 relative to the NLSY79. In addition, in contrast to the NLSY79, family income has the greatest impact on college attendance among low ability individuals. Lovenheim (2008) provides additional evidence regarding the importance of credit-constraints for recent college-going cohorts using the Panel Study of Income Dynamics. Using variation in home equity in the four years before a child is of college going age, Lovenheim (2008) finds that between 2000 and 2005, upwards of 12 percent of households with children in college use housing wealth to relax potential short-run credit constraints in college enrollment. These findings suggest that the recent downturn in housing prices may significantly impact the higher education market.

The rapid rise in college tuition however, masks important heterogeneity in the net price paid by individual students. For example, in 2008, the average student from the lowest quartile of family income receives institutional, state, and federal grants totaling approximately $7,000 at private, not-for-profit four-year institutions costing less than $18,000. For similarly defined schools that cost above $31,000, the average student from the lowest quartile of family income receives over $21,000 in combined grants. The increased funding across the differently

[11] Data available at http://trends.collegeboard.org/

priced schools is driven primarily by a more than 500% increase in institutional need-based grants.[12] Assuming quality is positively correlated with price, this example suggests that the higher quality school may not be any more expensive than the low quality school for low income students. Hoxby (2009) provides additional evidence that quality has become relatively cheaper over the past 40 years since average tuition paid as a share of student-oriented resources has declined dramatically at the top of the college quality distribution. Thus, it appears a closer look at the relationship between family income and quality is needed.

Direct empirical evidence relating family income and college quality is rather sparse, though a number of studies have examined how sensitive students are to price when choosing between colleges. Fuller et al. (1982) find that students from high income families are less price sensitive, while Long (2004) finds that low-income students in 1992 are as negatively affected by price as students in 1972. The paper that most closely examines how important constraints are in the quality dimension is Lovenheim (2010). Using variation in housing wealth generated by the timing of the housing bubble, he finds that less financially constrained families tend to purchase higher quality schools. Our paper adds to this literature by comparing directly how family income and college quality are related, both in the early 80's and 2000's. In addition, we explicitly link family income to future wages through its impact in schooling choices.

This final step of our paper is critical since if the returns to a college degree did not vary by quality, there would be little interest in how the choice of quality is affected by family income. Research on heterogeneity in college returns strongly suggests that there are increasing returns to college quality. Brewer et al. (1999) find a large wage premium from attending an elite private institution relative to a bottom-rated public school when estimating a selection corrected wage regression. Using numerous measures of college quality and varying econometric specifications, Black and Smith (2004) and Black and Smith (2006) consistently find a strong relationship between college quality and wages. Exploiting a discontinuity in the probability of enrollment at one flagship state university, Hoekstra (2009) finds that attending the most selective state university causes earnings to be approximately 20% higher for white men. These findings suggest that constraints in the quality dimension of school choice can have significant impacts on future wages.

[12] Data available at http://trends.collegeboard.org/

3 Data

For our analysis, we turn to the NLSY79 and NLSY97. The NLSY79 is a nationally representative sample of 12,686 young men and women who were 14-22 years old when they were first surveyed in 1979. These individuals were interviewed annually through 1994 and are currently interviewed on a biennial basis. Similarly, the NLSY97 consists of a nationally representative sample of approximately 9,000 youths who were 12 to 16 years old as of December 31, 1996. Youths continue to be interviewed on an annual basis. Both the NLSY79 and NLSY97 contain detailed information about respondents' family background, schooling outcomes, labor market outcomes, and ability.

One variable that is not readily available is access to credit for higher education. As a result we rely on measures of family income at the time higher education decisions are being made to proxy for short-term credit constraints. Within each sample, respondents are asked about total household income in the previous year. Using this variable, we construct average household income for each respondent when they were 16 and 17 years of age.[13]

The simple unconditional correlation between family income and schooling attainment is not a useful measure of credit constraints since family income is correlated with other individual and family characteristics that are likely to affect schooling choices. For example, high ability individuals are both more likely to come from high income households and attend college. To isolate the role of family income in the short-term decision to attend college, we control directly for student ability and a host of other family background variables.[14] Rather than use a single ability measure, such as AFQT, we construct separate measures of math and verbal ability for each respondent. Math ability is measured by averaging the scores on the Arithmetic Reasoning and Mathematics Knowledge portions of the ASVAB. Verbal ability is measured by averaging the scores on the Word Knowledge and Paragraph Comprehension portions of the ASVAB.

Because family income and student ability are utilized in all dimensions of the subsequent

[13] If family income is missing for one of these years we simply use the available measure. If family income is not available at either 16 or 17 years of age, we sequentially look at family income from earlier ages to avoid dropping respondents. Respondents who report not living with their parents at these ages are excluded.

[14] In addition to ability we include controls for race, gender, education of the mother, age of the mother at birth, number of siblings, a rural indicator and an indicator for whether the family is intact.

analysis, our primary sample selection criteria is driven by these two variables. In the NLSY79, many respondents are more than 18 years of age at the time of the first survey. This creates two issues. First, contemporaneous family income may not reflect constraints at the time college decisions were initially made, and for individuals already living outside the home, no measure of parental income is available. Second, ASVAB test scores for students older than 18 are endogenous to schooling choices. This will tend to overstate the importance of ability in predicting college graduation and college quality. To avoid these problems, we exclude anyone who is 19 or older in the first survey year, leaving four cohorts of respondents between the ages of 15 and 18 in 1979. Eliminating cohorts in the NLSY79, however, has implications for comparisons with the NLSY97, since it has five cohorts of respondents. Any comparison of the restricted NLSY79 sample with the full NLSY97 sample will be contaminated by differences in the age distribution of respondents. As a result, we eliminate the youngest cohort from the NLSY97 sample. To summarize, only respondents born between 1961 and 1964 in the NLSY79 and respondents born between 1980 and 1983 in the NLSY97 remain in the sample. The over sample of minority groups is included in both the NLSY79 and NLSY97 cohorts. There are 5,161 respondents in the NLSY79 and 4,707 respondents in the NLSY97 that satisfy the above requirements and have both family income and ability available.[15]

Using family income and ability to predict higher education choices is useful for identifying whether there is any potential role for credit constraints. However, to assess the magnitude of these effects, it is useful to then map educational choices on to future wages. As a result, education acts as both an outcome and input in our analysis. Our construction of education related variables accounts for this duality. When analyzing education as an outcome, we select the highest degree received by 1989 for the NLSY79 cohort, and the high degree received for the NLSY97 cohort.[16] The restriction for the earlier cohort is to ensure that across the samples individuals have had the same amount of time for their schooling choices. When we utilize

[15]There are 5,945 respondents born between 1961 and 1964 in the 1979 cohort and 7,213 born between 1980 and 1983 in the 1997 cohort.

[16]We likely understate high school and college graduation rates due to attrition. If an individual exits the sample before obtaining a high school degree, he is classified as a high school drop-out. Similarly, if an individual exits the sample after graduating high school, but before completing college, they are classified as high school graduates. This is more of a concern in the NLSY97 because individuals start being interviewed one year younger. The attrition rate is about 16% in 1989 for the NLSY79 and in 2008 for the NLSY97.

education as an input into wages, we use the highest degree received by the year in which the wage was earned.

For both the NLSY79 and NLSY97 we rely primarily on the "highest degree received" variable to construct educational attainment. This variable only becomes available in the NLSY79 in 1988. At this time respondents are asked to report the year in which they received the highest degree. Because of attrition and missing variables we use additional information obtained between 1979 and 1987 about reported college degrees and enrollment status to pin down the degree year. In the NLSY97, degree assignment is based on changes in the highest degree received variable.

In addition to degree receipt, we need information about which school the respondent graduated from if we are going to analyze the impact of family income on college quality. Using the NLSY79 and NLSY97 geocode data we are able to identify the specific colleges students attend. School identifiers are available for all years in the NLSY97 and are available beginning in 1984 in the NLSY79. In 1984, respondents are asked to list the most recent colleges attended and we map these schools back to degree receipts prior to 1984. In general, we assign school identifiers across both sample in the following manner. If a student reports receiving a degree and is no longer enrolled, the school identifier of the most recent school is assumed to be the degree-granting school. If the the respondent receives a degree and remains in school, we use the school identifier of the second most recent school as the degree-granting institution.

The school identifiers available in the NLSY79 and NLSY97 can be linked to the Integrated Postsecondary Education Data System (IPEDS), which has a plethora of institutional information available, such as the type of school, location, faculty characteristics, and student characteristics. However, freshman SAT/ACT test score distributions and retention rates, two of the most widely-used measures of school quality, are not available until 2001. To provide a more accurate measure of school quality for the NLSY79, we collect data from the 1980 Barron's and Petersons's college guides. In 1980, typically the average freshman SAT/ACT scores are reported. IPEDS, however, reports the 25th and 75th percentiles of the freshman test score distributions in 2001 and beyond. To make these comparable we simply take the average of the 25th and 75th percentile scores when constructing college quality for the NLSY97 cohort.

Our primary measure of school quality is constructed using only SAT and ACT scores.[17] Many schools, particularly in 1980, required students to complete just the ACT exam. Because we want a single metric of quality, we construct a measure that utilizes both ACT and SAT information. We regress ACT onto SAT math and SAT verbal and predict the average ACT composite score for all colleges.[18] When SAT measures are missing but ACT are not, we use the reported ACT measures. All of our reported results use this measure of quality, however, we also constructed a measure of quality that combines SAT, freshman retention rates, and faculty salary information using factor analysis following Black and Smith (2004). All of our key findings are unchanged when we use this measure. Results are available upon request.

The final component of the data is labor market outcomes. We focus on hourly wages as the primary variable of interest. The NLSY79 and NLSY97 collect information on typical wages earned during the survey period for up to 5 and 8 jobs respectively. For those that are not paid by the hour, the NLSY scale it to hourly wages by using the usual amount of hours worked in the relevant unit of measure.[19] We consider wages and incomes only for those with positive hours. Wages are deflated in year 2000 dollars and we trim below $1 and above $1,000. For the NLSY79, when we restrict the sample to labor market outcomes prior to 1990, positive wages are available for 5,613 workers, with an average of 5.7 observations per individual. In the NLSY97, we observe positive wages for 6,937 workers, and an average of 11.4 observations per worker. The increased number of observations in the NLSY97 largely reflects greater labor market mobility in the most recent cohort.[20]

In all of the analysis to follow, the over samples of minority groups are included. As a result, in all education related regressions, each observation is weighted according to the sample weights provided by the NLSY. For labor market outcomes, we weight individual outcomes according to the sample weights provided by the NLSY and the number of hours worked in a

[17] We only construct quality measures for four-year institutions, and abstract from any quality differentials in two-year schools.

[18] Colleges that require neither ACT or SAT, or colleges that we cannot match in the IPEDS data are coded as missing. 16% and 14% of colleges are missing quality in the NLSY79 and NLSY97 respectively.

[19] Both surveys also collect information on total labor income during the previous year. Using information on total hours, we are able to construct an hourly measure. We have completed the full analysis using this alternative measure of wages and the results are largely unchanged. Results available upon request.

[20] Note that measuring a respondent's wage using total yearly income does not yield this disparity in individual labor market outcomes. As noted previously, this alternative wage measure yields almost identical results.

particular job.

While examining the relationships between family income, ability, college quality, and wages, it became apparent that accounting for non-linearities was quite important. As a result, in the regressions to follow we control for family income and ability quartiles rather than include simple linear terms. The ability quartiles are birth year specific. In addition, we assign colleges to quartiles of the quality distribution. The quartiles of college quality are generated with respect to the set of colleges included in each sample of the NLSY.

Basic summary statistics for both the NLSY79 and NLSY97 are shown in Table 1. In terms of family background variables, respondents are less likely to grow up in an intact family, have fewer siblings, and more educated mothers in the NLSY97 cohort relative to the NLSY79 cohort. In real terms, families are wealthier in 1997, though the dispersion in family income has increased significantly. Note that the increased dispersion in family income means that the average gap between the 1st and 4th quartiles of family income in the NLSY97 is larger than it was in the NLSY79. Thus, we likely understate the extent to which constraints have relaxed over time. Respondents in the NLSY97 cohort are more likely to graduate from college, and less likely to select every other category of schooling relative the the NLSY79 cohort. The patterns of wages across the two samples is similar to the pattern of family income, increases in both the levels and dispersion in 1997.

Information about college quality and tuition is illustrated in Table 2. Overall, average SAT math scores among incoming freshman have improved, and tuition, as previously noted, has increased dramatically both in level and variability. The correlation between average SAT Math score among incoming freshman and tuition is quite strong indicating that there is scope for constraints in the quality dimension. Finally, the last three rows of Table 2 provide more detailed evidence about the relationship between price and quality. In 1979, average tuition among the schools in the highest quartile of college quality was 70% higher than average tuition among schools in the lowest quartile of college quality. In 1979, this number increases to 82%. Interestingly, quality became relatively cheaper throughout the rest of the distribution in 1997 relative to 1979. Based on these simple comparisons, it is difficult to determine whether family income has become more or less important in predicting college quality. The next section addresses this directly.

4 Results

The analysis is split into three parts. First we show how family income impacts educational attainment and college quality. Second, we estimate the relationship between educational choices and wages. Wages provide a natural metric with which we can compare the impact of family income on educational attainment and educational quality since both dimensions of schooling impact productivity.[21] Finally, in the third part of the results section we combine the results from schooling and wage outcomes to provide a "monetized" measure of the impact of family income on future wages through both dimensions of schooling choices.

4.1 Schooling Attainment and College Quality

We begin our analysis of the relationship between schooling attainment and family income by examining how family income is related to college graduation, where college is defined as either a 2 or 4-year college. Much of the previous literature on the importance of credit-constraints uses a specification similar to this. As a first step in examining the impact of family income on college quality, we then explore how family income affects the probability of graduating from a four-year college conditional on graduating from college. Recall that when we examine schooling outcomes for the NLSY79 cohort, we only consider degree attainment by 1989, ensuring that the amount of time to obtain schooling is equivalent across the two samples.

Table 3 lists the marginal effects from a logit model where the outcome of interest is an indicator that the respondent graduated from a 2 or 4-year college.[22] Unconditionally, family income has a tremendous impact on college graduation. Moving from the first to fourth quartile of family income increases the probability of college graduation by approximately 33 percentage points in both the NLSY79 and NLSY97 samples. Conditioning on ability, other

[21] We realize that schooling affects other aspects of a student's life, such as labor market attachment, occupational choice, and direct utility derived from schooling. However we do not include this in the analysis.

[22] The reported marginal effects for categorical variables, such as quartiles of family income, refer to the change in probability associated with a move from the excluded group to the group for which the marginal effect is reported. All other covariates are evaluated at the sample averages. For example, the marginal effect of 0.09 associated with the second quartile of family income in 1979 indicates the change in predicted probability of college graduation when an individual moves from the first to the second quartile of family income. All marginal effects for categorical variables are constructed in this manner.

family background measures, and state specific variables related to the supply of colleges and labor market conditions, the effect of family income is reduced significantly. A move from the first to the fourth quartile of family income increases the probability of graduation by approximately 13 percentage points in both samples. These effects are highly statistically significant, but not statistically different across the NLSY79 and NLSY97 samples.[23] The ability coefficients are as expected. Higher ability students are significantly more likely to graduate from college, with particular weight given to math ability.

As a first pass on the role of family income in determining college quality, we estimate the likelihood of graduating from a four-year college conditional on graduating from college. The results in Table 4 indicate that conditional on ability, family background, and state characteristics, a move from the first to the fourth quartile of family income increases the probability of graduating from a 4-year college by approximately 6 percentage points in both samples. The coefficient is not statistically significant in either sample. Increased math and verbal ability make attendance at a 4-year college more likely, however, the impact of math ability has declined in the NLSY97 relative to the NLSY79.

The previous two models implicitly assume that students sequentially decide whether to graduate from college and then whether to graduate from a 2 or 4-year college. Approximating the decision process in this way, however, may mask important aspects of the choice among schooling levels. In particular, by making the choices sequential, family income necessarily affects graduating from a 2-year college since graduating from any college is affected by family income. To relax this assumption, we estimate a multinomial logit that allows respondents to simultaneously decide whether to be a high school graduate, 2-year college graduate, or 4-year

[23] Belley and Lochner (2007) find a statistically significant difference in the impact of family income on college attendance across the two samples. There are a handful of differences between our sample an theirs that can help explain this result. First, we include the over samples of blacks and hispanics in both 1979 and 1997. The over samples aid in identifying the effect of being from a low income family when the respondent is also of high ability. Second, rather than use AFQT, we control separately for math and verbal ability. Third, we use a logit model rather than a linear probability model. In regressions to follow we have more than two discrete outcomes, necessitating the use of a multinomial model. For consistency we then chose to do everything making the extreme value distribution assumption. Finally, our outcome is graduation, not attendance. However, if we eliminate the over samples and use AFQT as the proxy for ability, the estimated marginal effects from moving from the first quartile to the third or fourth quartile of family income are nearly identical to the results in Belley and Lochner (2007).

college graduate. The marginal effects are listed in Table 5.

When the two college choices are completely separated, it is clear that family income only impacts the probability of graduating from a 4-year college. For the 2-year college choice none of the family income coefficients are significantly different from zero across both samples. Family income has a large and statistically significant impact on the likelihood of graduating from a 4-year college. In the 1979 (1997) cohort, moving from the first to the fourth quartile of family income increases the probability of graduating from a 4-year college by 10.3 (11.1) percentage points. To put these effects in perspective, the probability of graduating from a 4-year college for the average individual in the 1979 and 1997 cohorts sample are only 0.13 and 0.24 respectively.

Table 5 also illustrates that the effect of ability on graduating from college seen in Table 3 is largely a result of the relationship between ability and graduating from a 4-year college. There is a small amount of sorting into 2-year colleges in the 1979 sample, but no significant sorting in the 1997 sample. Ability sorting into 4-year colleges is significant in both samples, though it appears to have become stronger for the more recent cohort. Again, math ability is the more important skill dimension.

Thus far we have seen that family income and ability play an important role in the likelihood of graduating from a 4-year college in both the 1979 and 1997 NLSY cohorts. In fact, the evidence suggests that for the average individual in each sample, the effect of family income has remained relatively stable. If graduation is the only channel through which family income impacts schooling, we would be tempted to conclude that financial constraints look very similar across the two samples. However, as previously discussed, it is quite likely that family income also impacts the quality of 4-year institution an individual graduates from.

To investigate the effect of family income on college quality, we restrict the sample to all 4-year college graduates, and estimate a multinomial logit relating college quality to family income.[24] Colleges fall into one of four college quality quartiles, where quality is determined

[24]In principle, we could allow for the quality decision to occur simultaneously with the attainment decision. There are two reasons we choose not to do this. First, as noted earlier, college quality is missing for a non-trivial portion of the data. If we combine the decisions, then we lose these respondents in the attainment outcome as well. Second, the multinomial logit specification assumes that the unobserved determinants of schooling are i.i.d. across the choices. If we split the 4-year college choice into quality quartiles, this assumption is likely to be violated. Rather than estimate a nested specification, we simply assume that attainment and quality are

according to average incoming freshman SAT/ACT scores.[25] Table 6 reports the marginal effects where the excluded category is the lowest quartile of college quality. Family income has essentially no effect on the probability of graduating from a second or third quartile quality school. However, family income has large and statistically significant effect on the probability of graduating from a high quality school in 1979. Moving from the first to fourth quartile of family income increases the likelihood of graduating from a college in the fourth quartile of the college quality distribution by 24 percentage points. This is essentially equivalent to the impact of moving from the first quartile of math ability to the fourth quartile of math ability. The effect of being in the fourth quartile of family income on the probability of graduating from a high quality school is almost cut in half for the NLSY97 sample, though it remains statistically significant. While the coefficients across the two samples are not quite statistically significant, the results certainly suggest that constraints along the quality dimension have relaxed for more recent college-goers. This is consistent with the recent trends in financial assistance discussed earlier.

The impact of ability on college quality is largely as expected. In the NLSY79, high math and verbal ability individuals are significantly more likely to graduate from a high quality college. A similar pattern exists in 1997, but because there are very few low math ability individuals attending high quality schools, the math ability coefficients are non-monotonic. However, the difference in the probability of graduating from a high quality college between the second quartile and fourth quartile of math ability is actually larger for the 1997 cohort relative to the 1979 cohort.

Tables 5 and 6 indicate that family income is a strong predictor of 4-year college graduation and the quality of the institution graduated from in both the NLSY79 and NLSY97. There are slight differences in the impact of family income on graduation over time, but large changes in how family income affects quality across the two samples. In order to understand how important constraints in the quality dimension are relative to the overall impact of credit constraints, and how credit constraints in general have changed over time, we next relate schooling choices to wage outcomes. This will allow us to describe monetarily the impact of

sequentially determined. If the choices are actually made simultaneously, we will tend to overstate the effect of family income on attainment and understate its effect on quality.

[25] Section 3 discusses in more detail how we construct college quality.

family income through schooling choices.

4.2 Labor Market Outcomes

In this section, we relate schooling outcomes to wages. Besides schooling, all regressions include controls for ability, potential experience, race, gender, and state-level unemployment rates. The controls for ability are necessary to minimize any bias in the returns to schooling as a result of ability sorting. We include state unemployment rate data to account for variation in the business cycle that could effect the returns to schooling across the NLSY79 and NLSY97.

We begin with a simple specification that measures the effect of graduating from a 2 or 4-year college relative to obtaining a high school degree. The results from this regression combined with the results in Table 5 allow us to calculate the effect of family income on future wages when considering only the extensive margin of higher education. Table 7 illustrates that there are significant wage returns to graduating from college. We first show the schooling returns using the full sample of wage observations from the NLSY79. Relative to high school graduates, 2 and 4-year college graduates earn 17% and 43% more on average. Recall that the NLSY97 cohort is observed for a shorter amount of time than the NLSY79, and thus we mimic this in the NLSY79 cohort by examining wages prior to 1989. When we limit the sample to young workers, the results are largely unchanged. 2 and 4-year college graduates earn 20% and 41% more than high school graduates in the NLSY79, and 24% and 40% more in the NLSY97. Over this twenty year period, the college premium for young workers appears to have been relatively stable. Math and verbal ability are positively related in wages for the 1979 cohort, but verbal ability is actually negatively related to wages in the 1997 cohort. We suspect that this is largely driven by differential selection into occupation by ability, whereby high verbal ability individuals in the 1997 cohort are more likely to choose occupations with lower wages but higher non-monetary amenities.

Table 8 illustrates the heterogeneity in 4-year wage returns according to the quartile of college quality. Again, we begin by showing results for the NLSY79 full sample to illustrate that the short-term impacts of quality and education more generally persist throughout the respondents life. For the full sample there exists a significant wage gradient across quartiles of college quality. Respondents who graduate from a college in the first quartile of quality earn 37% more than high school graduates, while graduating from a school in the fourth quartile

of quality generates a 53% increase in wages. These wage returns are highly statistically significant from zero and each other. The returns to quality are slightly smaller when workers are young in the NLSY79, and the gap in the returns between the first quartile of quality and the fourth quartile of quality is also smaller, though statistically different. The wage return associated with each quality quartile are slightly smaller in the NLSY97, however, the gap in returns between the first and fourth quartile of quality is actually larger. The impact of ability on wages is largely unchanged from Table 7.

The wage returns from obtaining a 4-year college degree are quite large, suggesting that the impact of family income on future wages through the extensive margin of higher education will likely be significant. However, it also appears that the returns to quality are significant. Given the large role family income played in determining college quality, particularly in the 1979 cohort, it seems likely that constraints in the quality dimension will have a significant impact on future earnings.

4.3 Estimating the Effect of Family Income on Wages through Schooling

Using the estimated models of schooling choice and wage returns, we can be much more precise about the importance of constraints along the extensive and intensive margin, as well as how these constraints have changed over time. Our approach is rather simple. Take an individual from the n^{th} quartile of family income. From the empirical models of the previous section, we can calculate the probability that this individual chooses degree level $j = \{HS, AA, BA\}$, where AA is an Associates degree from a 2-year college and BA is a bachelor's degree from a 4-year college. Denote the probability of choosing schooling level j, $P\left(j|n, X^E\right)$, where X^E are the schooling related covariates. If the individual decides to go to college, the quality of his/her eduction will be from from the q^{th} quartile with probability $P\left(q|n, X^E\right)$. Once in the labor market his/her wage will be on average $w\left(j, q, X^L\right)$, where X^L are the labor market related covariates. Assuming uncorrelatedness of the error terms across the different regressions and that there is no variation in the quality of associate degrees, expected wage

for an individual in the n^{th} quartile of family income is given by

$$\begin{aligned} w(n,X) &= P\left(HS|n,X^E\right)\times w\left(HS,\cdot,X^L\right)+P\left(AA|n,X^E\right)\times w\left(AA,\cdot,X^L\right)+ \\ &\quad +P\left(BA|n,X^E\right)\times\sum_{q=1}^{4}\left[P\left(q|n,X^E\right)\times w\left(BA,q,X^L\right)\right]. \end{aligned}$$

Although the assumption on the uncorrelatedness of the error terms is quite restrictive, it keeps the analysis of family income on wages straightforward. The alternative would be to jointly estimate schooling choices and labor market outcomes. This would naturally lead to a formulation of a dynamic structural model that would indeed be very useful, although we feel that it would be beyond the scope of this paper.

To identify the impact of family income on future wages for a given individual X we can simply calculate the following statistic,

$$w(4,X)-w(1,X)$$

which is the difference in predicted wages moving an individual from the 1st to the 4th quartile of family income. Given that different individuals respond to variation in family income in distinct ways we consider how changing family income from the 1st to 4th quartile affects four "types" of students.[26] First we consider how the predicted wages of the average individual in our data set is affected.[27] As you can see from Table 3, this individual is not very likely to obtain college education and therefore the impact of family income is likely to be small. Family income will likely have a much larger impact for an individual who is likely to attend college, so we also consider how wages for the average respondent that goes to college are affected. Because selection into college in terms of ability may vary significantly over time, we also calculate the impact of family income for high and low ability individuals. High (low) ability individuals are respondents whose math and verbal ability are both in the top (bottom) quartile. For high and low ability "types", all other covariates take their sample averages.

The results are presented in Table 9. The numbers in parenthesis are the standard errors which are obtained bootstrapping the sample 500 times. We report both the percent change

[26]Note that we do not include any interaction terms when estimating the impact of family income on educational choices. Heterogeneity is working through the non-linearity of the logit. We discuss this further below.

[27]Remember that this is still a selected sample because we only consider individuals with at least high school education.

in the wage for the case in which we include quality of college in our analysis and also for the more standard case in which the quality of education is ignored. The numbers in italics are the percent change in the impact of family income on future wages once we include college quality.

The impact of family income on wages through schooling varies significantly across respondent "types". Moving from the 1st to the 4th quartile of family income has essentially no effect on future wages for low ability individuals, a moderate 5% wage increase for the average sample respondent, and a significant 10% wage increase for high ability individuals in the 1979 cohort. Not surprisingly introducing college quality does not have any impact for low ability respondents or even the average sample respondent because these students are not likely to attend very good colleges. But when we look at the more able students, college goers or high ability respondents, we see that by including quality, we increase the impact of family income on future wages by as much as 25%. For the high ability type, the changes in the predicted wage gap associated with introducing quality are statistically significant in both the NLSY79 and NLSY97.

Comparing the predicted wage gaps across the NLSY79 and NLSY97 gives us a sense for how financial constraints have changed from the early 1980's to early 2000's. Table 10 shows the change in the predicted wage gap across the two samples for each respondent type, with and without controlling for quality. The results indicate that for the average individual in the sample and low ability types, the impact of family income has not changed over this time period. In contrast, for the average college goer and high ability types, financial constraints lessened over this time period. Allowing family income to affect college quality closes the predicted wage gap even further, consistent with the earlier results suggesting that family income is less predictive for college quality in the NLSY97. For the high ability type, 28% of the change in the wage gap is a result of relaxing constraints in the quality dimension. It is important to note that none of the results from Table 10 are statistically significant. However, when we complete the analysis using a measure of college quality that includes not just SAT/ACT information, but also freshman retention rates and faculty salary, the change in the predicted wage gap for the high ability type is larger in absolute value and statistically different from zero. We do not use this measure more generally since the number of colleges with missing quality increase significantly.

The results in Tables 9 and 10 make clear that heterogeneity plays a critical role in the importance of family income on future wages through both attainment and quality. As previously noted, the choice models we estimate do not interact family income with any other covariates. Thus the resulting heterogeneity may be highly influenced by the inherent nonlinearity of the logistic probabilities. To provide evidence that the results are not strictly driven by our functional form assumption, we re-estimate the multinomial logit schooling attainment model separately by ability type and investigate how the impact of family income on quality varies by ability in a simple linear framework.[28] Essentially this is equivalent to interacting ability with all the other covariates in the model. The results of these two exercises are displayed in Tables 11 and 12.

For both schooling attainment and school quality we find that family income is significantly more important for the high ability types. This is consistent with the results from our basic specification. In fact, if we complete the same monetary exercise for each ability type, the results are even starker. For high ability individuals, the wage gap between individuals from the 1st and 4th quartile of family income is 13% in the 1979 cohort, and the gap closes to 2% in the 1997 cohort. For low ability individuals, the wage gap between individuals from the 1st and 4th quartile of family income actually expands from 1% in the NLSY79 to 5% in the NLSY97. It should be noted that consistent with Belley and Lochner (2007), family income does not affect the attainment decisions of low ability individuals in the NLSY79, but does affect attainment in the NLSY97. Interestingly, family income appears to affect equally the likelihood of graduating from a 2 or 4-year college for low ability types. Because the returns to a 2-year college degree are significantly smaller than the returns to a 4-year college degree, the additional impact on the predicted wage gap as a result of constraints at 2-year colleges is minimal.

[28]Note that we do not repeat the multinomial logit model of college quality when we split the sample by ability, but rather estimate a simple linear specification. This is largely a result of the fact that there are so few low ability individuals attending high quality schools that we cannot accurately estimate all the coefficients of the multinomial model.

5 Conclusion

In this paper we examine how family income affects future wages through schooling attainment and schooling quality using the NLSY79 and NLSY97. We find that the effect of family income on college quality constitutes a significant portion of the link between family income and future wages for college goers in the early 1980's, but that constraints in the quality dimension lessened considerably for more recent cohorts. Overall, it appears that the impact of family income on future wages through schooling has diminished from the NLSY79 sample to the NLSY97 sample, though there exists considerable heterogeneity in this effect.

As noted in the introduction, a significant negative relationship between family income and schooling quality is a necessary but not sufficient condition for the existence of credit constraints. However, the trends we uncover in the relationship between college quality and family income are difficult to reconcile with a story of schooling as consumption. If the relationship between family income and quality in the NLSY79 simply reflected consumption, then the declining role of family income in predicting college quality in the NLSY97 could only result if the consumption value for high quality schools diminished significantly relative to all other schools. However, as pointed out by Hoxby (2009), spending on student-oriented resources among the most selective institutions has increased dramatically over the past 30 years, making it hard to believe that the consumption value at top institutions declined relative to other schools. Thus, we interpret the change in the effect of family income on schooling quality as evidence that credit constraints have weakened.

References

Becker, Gary, *Human Capital*, 2nd ed., New York, NY: Columbia University Press, 1975.

Belley, Philippe and Lance Lochner, "The Changing Role of Family Income and Ability in Determining Educational Achievement," *Journal of Human Capital*, 2007, *1* (1).

Black, Dan A. and Jeffrey A. Smith, "How robust is the evidence on the effects of college quality? Evidence from matching," *Journal of Econometrics*, 2004, *121*, 99–124.

_ **and** _ , "Estimating the Returns to College Quality with Multiple Proxies for Quality," *Journal of Labor Economics*, 2006, *24* (3), 701–728.

Brewer, Dominic J., Eric R. Eide, and Ronald G. Ehrenberg, "Does It Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings," *The Journal of Human Resources*, 1999, *34* (1), 104–123.

Cameron, Stephen V. and Christopher Taber, "Estimation of Educational Borrowing Constraints Using Returns to Schooling," *The Journal of Political Economy*, 2004, *112* (1).

Carneiro, Pedro and James J. Heckman, "The Evidence on Credit Constraints in Post-Secondary Schooling," *The Economic Journal*, 2002, *112* (482), 705–734.

Ellwood, David T. and Thomas J. Kane, "Who Is Getting a College Education? Family Background and the Growing Gaps in Enrollment," in Sheldon Danziger and Jane Waldfogel, eds., *Securing the Future: Investing in Children from Birth to College*, Russell Sage Foundation 2000.

Fuller, Winship C., Charles F. Manski, and David A. Wise, "New Evidence on the Economic Determinants of Postsecondary Schooling Choices," *The Journal of Human Resources*, 1982, *17* (4), 477–498.

Hoekstra, Mark, "The Effect of Attending the Flagship State University on Earnings: A Discontinuity-Based Approach," *The Review of Economics and Statistics*, 2009, *91* (4), 717–724.

Hoxby, Caroline M., "The Changing Selectivity of American Colleges," *Journal of Economic Perspectives*, 2009, *23.*

Johsnon, Matthew T., "Borrowing Constraints, College Enrollment, and Delayed Entry," 2010. Working Paper.

Kane, Thomas J., "College cost, borrowing constraints and the timing of college entry," *Eastern Economic Journal*, 1996, *22* (2), 181–194.

_ , "Public Intervention in Post-Secondary Education," in Eric A. Hanushek and Finis Welch, eds., *Handbook of Economics of Education*, Vol. 2 2006.

Keane, Michael P. and Kenneth I. Wolpin, "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment," *International Economic Review*, 2001, *42* (4), 1051–1103.

Long, Bridget Terry, "How have college decisions changed over time? An application of the conditional logistic choice model," *Journal of Econometrics*, 2004, *121*, 271–296.

Lovenheim, Michael F., "Housing Wealth, Liquidity Constraints and College Enrollment," 2008. Working Paper.

_ , "The Eect of Housing Wealth on College Choice: Evidence from the Housing Boom," 2010. Working Paper.

Stinebrickner, Ralph and Todd Stinebrickner, "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study," *American Economic Review*, 2008, *98* (5), 2163–2184.

Table 1: Summary Statistics

	1979	1997
Family Background		
Urban	0.769	0.799
Intact family	0.717	0.524
Siblings	3.244	2.308
Hispanic	0.066	0.130
Black	0.143	0.167
Female	0.490	0.488
Mother's age	25.674	26.459
Mother HS Dropout	0.327	0.169
Mother HS Graduate	0.466	0.365
Mother Some College	0.206	0.466
Family Income	48,359	63,327
Standard Deviation of Family Income	30,819	57,744
Attainment		
High School Drop-Out	0.145	0.125
GED	0.086	0.075
High School	0.500	0.489
Two Year College	0.067	0.060
Four Year College or More	0.203	0.250
LM Outcomes		
Wage	10.968	13.009
Standard Deviation of Wage	16.671	27.536
Log Wage	2.240	2.317
Standard Deviation of Log Wage	0.499	0.545

Samples are restricted to respondents born between 1961 and 1964 in the NLSY79 and respondents born between 1980 and 1983 in the NLSY97 who have valid income and ability measures. Observations are weighted using the sampling weights provided by the NLSY. Statistics for the 1979 cohort only use information through 1989, allowing for simple comparisons between the two samples.

Table 2: Relationship Between Quality and Tuition

	1979	1997
SAT Math, mean	488.24	523.63
SAT Math, standard deviation	72.57	70.35
Tuition, mean	4882.83	8617.78
Tuition, standard deviation	2574.85	5465.90
Correlation SAT Math and Tuition	0.52	0.47
Tuition, mean 2nd versus 1st quartile SAT	1.22	1.18
Tuition, mean 3rd versus 1st quartile SAT	1.42	1.33
Tuition, mean 4th versus 1st quartile SAT	1.70	1.82

The sample of colleges in each cohort reflects only those colleges that NLSY respondents ever attended rather than the universe of colleges. Similarly, quartiles of college quality are defined within the NLSY sample of colleges. College data for the 1979 cohort is obtained from IPEDS, and Barron's and Peterson's college guides. College data for the 1997 cohort is obtained entirely from IPEDS.

Table 3: Marginal Effect of Family Income on College Graduation

	1979	1979	1997	1997
INCOME: Quartile 2	0.092***	0.043*	0.088***	0.013
	(0.020)	(0.025)	(0.018)	(0.026)
INCOME: Quartile 3	0.154***	0.047*	0.205***	0.039
	(0.021)	(0.026)	(0.019)	(0.028)
INCOME: Quartile 4	0.329***	0.133***	0.348***	0.133***
	(0.023)	(0.030)	(0.020)	(0.030)
MATH: Quartile 2		0.037*		0.063**
		(0.021)		(0.025)
MATH: Quartile 3		0.110***		0.173***
		(0.025)		(0.028)
MATH: Quartile 4		0.383***		0.380***
		(0.035)		(0.032)
VERBAL: Quartile 2		0.062***		0.089***
		(0.024)		(0.029)
VERBAL: Quartile 3		0.177***		0.138***
		(0.030)		(0.032)
VERBAL: Quartile 4		0.209***		0.187***
		(0.034)		(0.035)
Family/Demographic Controls	N	Y	N	Y
State Controls	N	Y	N	Y
Probability(Average Respondent)	0.295	0.243	0.355	0.342
Observations	4332	4190	5034	4183

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients are marginal effects associated with a movement across income and ability quartiles. Dependent variable in all regressions is an indicator for whether the respondent graduated from either a 2- or 4-year college. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age and number of siblings. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.

Table 4: Marginal Effect of Family Income on 4-yr College Graduation

	1979	1979	1997	1997
INCOME: Quartile 2	0.072	0.016	0.055	-0.003
	(0.054)	(0.050)	(0.040)	(0.035)
INCOME: Quartile 3	0.092*	-0.034	0.091**	-0.017
	(0.052)	(0.053)	(0.037)	(0.037)
INCOME: Quartile 4	0.224***	0.071	0.174***	0.056*
	(0.046)	(0.050)	(0.034)	(0.034)
MATH: Quartile 2		0.121		-0.028
		(0.110)		(0.053)
MATH: Quartile 3		0.224**		0.085*
		(0.111)		(0.052)
MATH: Quartile 4		0.336***		0.166***
		(0.113)		(0.053)
VERBAL: Quartile 2		0.080		0.099*
		(0.111)		(0.054)
VERBAL: Quartile 3		0.101		0.124**
		(0.117)		(0.057)
VERBAL: Quartile 4		0.188		0.144**
		(0.119)		(0.059)
Family/Demographic Controls	N	Y	N	Y
State Controls	N	Y	N	Y
Probability(Average Respondent)	0.754	0.789	0.815	0.852
Observations	1083	1061	1662	1452

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients are marginal effects associated with a movement across income and ability quartiles. Dependent variable in all regressions is an indicator for whether the respondent graduated from a 4-year college. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age and number of siblings. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.

Table 5: Marginal Effect of Family Income on Schooling Attainment, Multinomial Logit

	1979		1997	
Excluded Category: HS	2-yr	4-yr	2-yr	4-yr
INCOME: Quartile 2	0.011	0.031*	0.011	0.002
	(0.014)	(0.018)	(0.014)	(0.024)
INCOME: Quartile 3	0.024	0.025	0.022	0.016
	(0.016)	(0.018)	(0.015)	(0.025)
INCOME: Quartile 4	0.015	0.104***	0.014	0.111***
	(0.016)	(0.023)	(0.015)	(0.029)
MATH: Quartile 2	0.003	0.034**	0.027*	0.034*
	(0.014)	(0.015)	(0.015)	(0.021)
MATH: Quartile 3	0.019	0.087***	0.024	0.146***
	(0.017)	(0.018)	(0.016)	(0.024)
MATH: Quartile 4	0.054**	0.311***	0.013	0.359***
	(0.023)	(0.031)	(0.018)	(0.031)
VERBAL: Quartile 2	0.015	0.050***	-0.004	0.100***
	(0.014)	(0.019)	(0.016)	(0.026)
VERBAL: Quartile 3	0.064***	0.113***	-0.002	0.150***
	(0.018)	(0.024)	(0.018)	(0.027)
VERBAL: Quartile 4	0.029	0.168***	0.000	0.192***
	(0.020)	(0.027)	(0.020)	(0.031)
Family/Demographic Controls	Y		Y	
State Controls	Y		Y	
Probability(Average Respondent)	0.088	0.132	0.082	0.239
Observations	4190		4183	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients are marginal effects associated with a movement across income and ability quartiles. Dependent variable indicates the chosen level of education: HS (excluded), 2-year, or 4-year college. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age and number of siblings. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.

Table 6: Marginal Effect of Family Income on College Quality, Multinomial Logit

	1979			1997		
Quartile of College Quality	2	3	4	2	3	4
INCOME: Quartile 2	0.031	-0.121	0.081*	0.010	-0.040	0.017
	(0.084)	(0.090)	(0.049)	(0.055)	(0.074)	(0.061)
INCOME: Quartile 3	0.084	-0.047	0.126***	0.011	-0.038	0.046
	(0.085)	(0.094)	(0.046)	(0.055)	(0.072)	(0.060)
INCOME: Quartile 4	-0.033	0.009	0.240***	-0.005	-0.068	0.125**
	(0.078)	(0.094)	(0.052)	(0.053)	(0.071)	(0.059)
MATH: Quartile 2	0.227*	-0.012	0.081	0.019	0.199***	-0.097
	(0.120)	(0.140)	(0.081)	(0.098)	(0.068)	(0.106)
MATH: Quartile 3	0.128	0.111	0.138*	-0.093	0.283***	-0.037
	(0.100)	(0.144)	(0.072)	(0.096)	(0.059)	(0.102)
MATH: Quartile 4	0.066	0.150	0.219***	-0.193**	0.256***	0.137
	(0.098)	(0.144)	(0.069)	(0.096)	(0.057)	(0.103)
VERBAL: Quartile 2	0.194	-0.386**	0.120	0.125	-0.295***	0.060
	(0.129)	(0.194)	(0.074)	(0.077)	(0.110)	(0.067)
VERBAL: Quartile 3	0.172	-0.398**	0.116*	0.072	-0.282***	0.174***
	(0.125)	(0.195)	(0.068)	(0.073)	(0.107)	(0.061)
VERBAL: Quartile 4	0.088	-0.436**	0.278***	0.008	-0.306***	0.277***
	(0.124)	(0.198)	(0.070)	(0.074)	(0.109)	(0.063)
Family/Demographic Controls		Y			Y	
State Controls		Y			Y	
Probability(Average Respondent)	0.268	0.322	0.234	0.213	0.364	0.303
Observations		638			992	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients are marginal effects associated with a movement across income and ability quartiles. Dependent variable indicates the quality of college the respondent graduated from measured in quartiles. The first quartile of college quality is the excluded category. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age and number of siblings. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.

Table 7: Wage Returns to Schooling

	1979 All	1979-1989	1997
2-yr College Degree	0.172***	0.198***	0.238***
	(0.00931)	(0.0147)	(0.0153)
4-yr College Degree	0.432***	0.410***	0.398***
	(0.00776)	(0.0120)	(0.00914)
MATH: Quartile 2	0.0874***	0.0780***	0.0760***
	(0.00735)	(0.0102)	(0.0103)
MATH: Quartile 3	0.145***	0.130***	0.0976***
	(0.00877)	(0.0117)	(0.0110)
MATH: Quartile 4	0.202***	0.139***	0.140***
	(0.0105)	(0.0141)	(0.0124)
VERBAL: Quartile 2	0.106***	0.0548***	-0.00312
	(0.00753)	(0.0106)	(0.0104)
VERBAL: Quartile 3	0.0809***	0.0337***	-0.00336
	(0.00940)	(0.0127)	(0.0109)
VERBAL: Quartile 4	0.109***	0.0503***	-0.0499***
	(0.0104)	(0.0142)	(0.0123)
Additional Controls	Y	Y	Y
Observations	88,100	39,912	54,996
R-squared	0.292	0.206	0.152

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dependent variable is the self-reported hourly wage for all jobs held in the previous year. Observations are weighted using a combination of the sampling weights provided by the NLSY and the number of hours reported at each job. Each regression includes as additional control variables gender, race, potential experience, potential experience squared, and the contemporaneous state unemployment rate.

Table 8: Wage Returns to Schooling Accounting for College Quality

	1979 All	1979-1989	1997
2-yr College Degree	0.173***	0.199***	0.238***
	(0.00932)	(0.0147)	(0.0153)
4-yr Degree: Quality Quartile 1	0.365***	0.349***	0.318***
	(0.0137)	(0.0234)	(0.0178)
4-yr Degree: Quality Quartile 2	0.417***	0.376***	0.375***
	(0.0123)	(0.0190)	(0.0194)
4-yr Degree: Quality Quartile 3	0.468***	0.444***	0.407***
	(0.0149)	(0.0244)	(0.0146)
4-yr Degree: Quality Quartile 4	0.531***	0.477***	0.453***
	(0.0144)	(0.0212)	(0.0168)
MATH: Quartile 2	0.0878***	0.0794***	0.0773***
	(0.00737)	(0.0102)	(0.0103)
MATH: Quartile 3	0.142***	0.130***	0.0984***
	(0.00879)	(0.0118)	(0.0110)
MATH: Quartile 4	0.193***	0.134***	0.137***
	(0.0106)	(0.0142)	(0.0125)
VERBAL: Quartile 2	0.107***	0.0560***	-0.000677
	(0.00756)	(0.0106)	(0.0105)
VERBAL: Quartile 3	0.0865***	0.0369***	-0.00145
	(0.00942)	(0.0127)	(0.0110)
VERBAL: Quartile 4	0.106***	0.0488***	-0.0489***
	(0.0105)	(0.0142)	(0.0123)
Additional Controls	Y	Y	Y
Observations	86,584	39,470	54,496
R-squared	0.292	0.207	0.153

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dependent variable is the self-reported hourly wage for all jobs held in the previous year. Observations are weighted using a combination of the sampling weights provided by the NLSY and the number of hours reported at each job. Each regression includes as additional control variables gender, race, potential experience, potential experience squared, and the contemporaneous state unemployment rate.

Table 9: Impact of Family Income on Wages through Schooling

$$(\hat{Wage}_{\text{Income Qrt. 4}} - \hat{Wage}_{\text{Income Qrt. 1}})$$

	1979		1997	
	No Quality	Quality	No Quality	Quality
Average Respondent	4.54***	4.82***	4.75***	4.90***
	(1.08)	(1.08)	(1.09)	(1.09)
		6.20%		*3.26%*
Average College Graduate	8.25***	9.68***	5.66***	6.26***
	(1.81)	(1.83)	(1.37)	(1.42)
		*17.33%***		*10.60%*
Low Ability	0.87***	0.90***	1.77***	1.74***
	(0.30)	(0.31)	(0.49)	(0.49)
		3.60%		*-1.56%*
High Ability	8.16***	10.16***	5.35***	6.29***
	(1.84)	(1.98)	(1.33)	(1.44)
		*24.61%***		*17.55%**

Standard errors obtained by bootstrap. *** p<0.01, ** p<0.05, * p<0.1.

Main table entries reflect the change in predicted wage moving from the 1st quartile of family income to the 4th. Wage changes reflect only how family income affects schooling choices. The percentages indicate the percent increase in the importance of family income when quality is accounted for. The rows indicate for which type of individual the income change was completed. The average respondent is evaluates that change at the average value of all the other observable characteristics besides family income. The high and low ability samples examine individuals in the highest or lowest quartiles of both math and verbal ability. All other covariates take the average values in the sample.

Table 10: Changing Impact of Family Income on Wages through Schooling

$$(\hat{Wage}^{97}_{\text{Income Qrt. 4}} - \hat{Wage}^{97}_{\text{Income Qrt. 1}}) - (\hat{Wage}^{79}_{\text{Income Qrt. 4}} - \hat{Wage}^{79}_{\text{Income Qrt. 1}})$$

	No Quality	Quality
Average Respondent	0.20	0.08
	(1.59)	(1.59)
Average College Graduate	-2.59	-3.41
	(2.33)	(2.37)
Low Ability	0.90	0.84
	(0.058)	(0.58)
High Ability	-2.81	-3.88
	(2.34)	(2.49)

Table entries reflect the change over time in the predicted wage gap from moving from the 1st quartile of family income to the 4th. Negative numbers indicate that the gap has gotten smaller between 1979 and 1997.

Table 11: Heterogeneity in Marginal Effect of Family Inc. on Attainment, Mult. Logit

	1979				1997			
Ability Type	Low		High		Low		High	
	2yr	4yr	2yr	4yr	2yr	4yr	2yr	4yr
INCOME: Quartile 2	-0.014	0.014	0.015	0.052	0.019	0.000	-0.021	0.028
	(0.010)	(0.010)	(0.031)	(0.055)	(0.014)	(0.014)	(0.026)	(0.051)
INCOME: Quartile 3	-0.005	-0.010	0.030	0.083	0.024*	0.000	-0.014	0.022
	(0.014)	(0.008)	(0.030)	(0.054)	(0.015)	(0.016)	(0.026)	(0.050)
INCOME: Quartile 4	0.012	0.016	-0.008	0.218***	0.070***	0.078***	-0.037	0.133***
	(0.020)	(0.014)	(0.027)	(0.055)	(0.024)	(0.028)	-(0.026)	(0.051)
Prob.(Avg. Respondent)	0.039	0.023	0.109	0.391	0.054	0.060	0.091	0.454
Fam/Demog Controls	Y		Y		Y		Y	
State Controls	Y		Y		Y		Y	
Observations	1,974		1,440		1,716		1,628	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients are marginal effects associated with a movement across income and ability quartiles. Dependent variable indicates the level of schooling attained, where HS is excluded category. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age, number of siblings, and math and verbal ability. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.

Table 12: Heterogeneity in Impact of Family Income on Quality: Linear Model

	1979		1997	
Ability Type	Low	High	Low	High
INCOME: Quartile 2	0.0808	-0.00236	0.0805	0.0367
	(0.162)	(0.257)	(0.136)	(0.154)
INCOME: Quartile 3	0.0239	0.317	0.138	0.0470
	(0.158)	(0.208)	(0.144)	(0.144)
INCOME: Quartile 4	0.204	0.599***	0.0333	0.305**
	(0.170)	(0.210)	(0.126)	(0.146)
Math Ability	0.762**	3.401***	0.530*	2.388***
	(0.307)	(0.995)	(0.270)	(0.663)
Verbal Ability	0.344	1.402	0.393	1.297**
	(0.400)	(0.886)	(0.257)	(0.543)
Family/Demographic Controls	N	Y	N	Y
State Controls	N	Y	N	Y
Observations	234	254	352	422
R-squared	0.216	0.217	0.122	0.171

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dependent variable indicates the quality of graduating school. Observations are weighted using the sampling weights provided by the NLSY. In order for the samples to be comparable, only schooling choices through 1989 are considered for the NLSY79 sample. Family background and demographic controls include indicator variables for urban, intact family, race, gender, mother is a HS graduate, mother has some college, and continuous controls for mother's age and number of siblings. State controls include the unemployment rate when exiting high school and the number of 2- and 4-year colleges in the state.