

# Constraints in the Demand for Education: What Can we Learn from Subjective Assessments?\*

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## Abstract

While the large disparities in educational attainment by socioeconomic status in the United States point towards the potential importance of credit constraints, there is no consensus in the economic literature regarding their pervasiveness. To evaluate how subjective information can enhance our understanding of the role of credit constraints in education, I focus on respondents' assessments of financial obstacles to schooling available in the NLSY79. About 12 percent of young adults in the data expect to underinvest in education because of financial difficulties or the need to work. Using this information in a regression model of educational attainment shows that it provides valuable behavioral insights, above and beyond standard measures of family background and income.

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# 1 Introduction

What can subjective reports of financial difficulties add to our understanding of the role of credit constraints in shaping the demand for college education? Substantial disparities in educational attainment by family socioeconomic status in combination with potentially imperfect capital markets for college investments point towards the possible importance of credit constraints.<sup>1</sup> However, our understanding of credit constraints in education remains limited, due in part to shortcomings of the data and differences in empirical methodologies.

While a wide number of studies have addressed the issue, researchers have had to rely on theoretical insights and information on educational outcomes to infer constraints in the absence of direct measures.<sup>2</sup> Some studies, for example, Manski (1992) and Ellwood and Kane (2000), interpret disparities in educational attainment by family income as evidence of credit constraints. Others (e.g., Kane, 1994) infer credit constraints from the greater sensitivity of low-income students to tuition costs. Still others appeal to an observation that marginal rates of return to education appear higher than average rates (see Card, 2001). By contrast, Carneiro and Heckman (2002) argue that it is "long-run" family and environmental influences rather than "short-term" liquidity constraints that largely determine educational outcomes.<sup>3</sup> A recent study by Stinebrickner and Stinebrickner (2008) made the first attempt to use subjective assessments to evaluate the impact of liquidity constraints on educational attainment. Using unique new data from a small private college with subsidized tuition, Stinebrickner and Stinebrickner show that most of college attrition is unrelated to self-reported borrowing constraints.

This paper contributes to the literature that evaluates the usefulness of subjective information in studying economic behavior. Relying on a widely used, nationally representative data set, the National Longitudinal Survey of Youth 1979 (NLSY79), I examine how individual assessments of financial difficulties may enhance more traditional methods of evaluating the role of credit constraints in education. I denote as constrained those respondents who report that they expect to receive less education than desired for financial reasons or the need to work. About 12 percent of young adults in the sample are constrained according to this definition. Although this classification is very general and not a precise definition of credit constraints, it helps identify individuals whose educational choices are potentially distorted by financial difficulties. With these considerations

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<sup>1</sup>A wide number of studies have documented disparities in educational attainment by socioeconomic status. See, for example, Manski (1992), Ellwood and Kane (2000), Cameron and Heckman (1998), and Carneiro and Heckman (2002). For a detailed discussion of why capital markets for human capital investment are likely to be imperfect see Becker (1993).

<sup>2</sup>Most prominent studies include Manski (1992), Ellwood and Kane (2000), Card (2001), Carneiro and Heckman (2002), Cameron and Taber (2004), Stinebrickner and Stinebrickner (2008), and Cao (2008).

<sup>3</sup>By conditioning the family background, Belley and Lochner (2007) have found a dramatic increase in the effect of family income on college attendance between the early 1980s and the early 2000s, consistent with the growing importance of credit constraints.

in mind, I use regression analysis to determine whether the probabilities of reporting constraints vary in a predictable and systematic way with individual characteristics, family resources, and educational costs. The results are mixed, but indicate that self-reported constraints covary appropriately with family income and college proximity.

To determine what it may add to our understanding of educational choices, I introduce the constraints indicator into a standard reduced-form model of educational attainment. I find that, conditional on standard controls for ability and socioeconomic background, for men, subjective financial constraints are strongly correlated with college enrollment and with a number of other dimensions of education. More specifically, subjective constraints are associated with a lower probability of graduating with a four-year degree, and higher probabilities of delaying college enrollment and attending a lower quality school. For women, there appears to be no significant relationship between education and subjective constraints. The improvement in model fit resulting from the inclusion of my measure indicates that it may be a useful addition to objective data in studying educational choices.

## **2 Operational Definitions and Data**

In this section I present an operational definition of constraints and discuss its drawbacks. The definition combines subjective assessment of financial difficulties with information on educational aspirations and expectations, and is not a precise indicator of credit constraints. At the same time, as many as 12 percent of NLSY79 respondents can be classified as constrained according to my definition. Constrained youths are more likely to come from lower socioeconomic backgrounds and have lower test scores than unconstrained youths. The results in this section indicate that, despite the potential problems, my measure of constraints captures important aspects of individual heterogeneity and warrants further analysis.

To examine subjective assessment of financial constraints in education I rely on a well-studied nationally representative data set, the NLSY79. Because of its detailed content, the NLSY79 has been extensively used by economists to evaluate the role of credit constraints in education (see, e.g., Keane and Wolpin, 2001; Carneiro and Heckman, 2002; Cameron and Taber, 2004; Belley and Lochner, 2007). It is a rich longitudinal data set that contains family background information and scholastic aptitude measures that are essential for the analysis of educational attainment. The NLSY79 has followed the respondents for over twenty-five years and collected detailed educational history, making it possible to analyze educational choices at a number of different margins, such as, for example, delays in enrollment, time to a degree, and school quality. Most importantly for this study, the NLSY79 contains information on the educational aspirations and expectations of respondents. Using this information, I derive a new, potentially more direct measure of financial constraints in education.

I create an indicator of constraints using answers respondents provide to three questions, asked during the 1982 wave of the survey. The questions elicit desired and expected education levels, and the reasons for any discrepancies between the two. Desired education is elicited by asking: *"What is the highest grade or year of regular school that you would like to complete?"* Expected education comes from answers to the question: *"As things now stand, what is the highest grade or year [of schooling] you think you will actually complete?"* Those who expect to complete fewer years of schooling than desired are asked: *"What is the main reason that you expect to complete less regular schooling than you would like to complete?"* The format of the questions is multiple choice with a wide set of options, including family responsibilities, academic abilities, and financial reasons. As an operational definition, I broadly denote as constrained those respondents who expect to receive less education than desired for financial reasons or need to work.

The focus of this study is young adults around the time they make post-secondary schooling decisions. The group of interest is the youngest respondents in the NLSY79: those who were between ages of 14 and 18, inclusively in January 1979. In 1982, when educational aspirations and expectations were recorded, they were 17 to 21 years old. The NLSY79 is a nationally representative data set that oversamples Black, Hispanic, and economically disadvantaged white youths.<sup>4</sup> In contrast to the earlier studies (e.g., Carneiro and Heckman, 2002; Belley and Lochner, 2007), I keep the economically disadvantaged and minority oversample, because these groups are of particular interest to policymakers. From my analysis sample I exclude respondents who were not living with their parents at age 16 or 17, and those with missing parental income or other background or personal data. The final sample size is 5,164 individuals.<sup>5</sup>

Table 1 presents the distribution of answers to the question about reasons for expecting less education than desired. In the sample 1,175 respondents (23 percent) report that their expected education is less than desired. Of these, 668 respondents, or about 13 percent, report financial difficulties (486 respondents, or 9 percent) or the need to work (182 respondents or 4 percent) as a reason, and, hence, are classified as constrained according to the definition above. To evaluate the proportion of constrained youths nationwide, it is necessary to correct for oversampling using sampling weights. When reweighted to be nationally representative, the proportion of constrained respondents in the sample is only slightly smaller, about 12 percent.

Because men and women usually differ in their educational and employment histories, due to childbirth and family care responsibilities, I also examine the reasons separately by gender. The second and third columns of Table 1 show that men are more likely

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<sup>4</sup>The survey also includes 1,280 individuals who served in the military in 1978. This subsample is excluded from the study because of the age restriction I impose.

<sup>5</sup>A total of 7,044 respondents ages 17 to 21 were interviewed in 1982. From the analysis sample I exclude 1,582 respondents (22 percent) who did not reside with their parents at age 16 or 17 and/or have missing parental income. In addition, I exclude 298 respondents (4 percent) with missing AFQT scores, region of residence, or other family background information.

Table 1: Distribution of Reasons by Gender.

Answer	All (I)		Men (II)		Women (III)		Difference (IV)
	N	Percent	N	Percent	N	Percent	T-stats.
Financial reasons	486	0.414	227	0.394	259	0.432	1.333
Have to work	182	0.155	116	0.201	66	0.110	4.350***
Family responsibilities	145	0.123	25	0.043	120	0.200	8.412***
School too difficult	53	0.045	37	0.064	16	0.027	3.108***
Health problems	1	0.001	1	0.002	0	0.000	1.019
Not necessary for job	46	0.039	27	0.047	19	0.032	1.338
Don't like school	68	0.058	37	0.064	31	0.052	0.915
Other	194	0.165	106	0.184	88	0.147	2.096**
Total	1175	1.000	576	1.000	599	1.000	

Notes: Testing the hypothesis of equality of means between men and women: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$ .

than women to report a need to work or that school is too difficult, while women are more likely to report family responsibilities.

In the absence of more accurate data on constraints facing the NLSY79 sample, I use the definition above definition as a proxy. Unfortunately, the NSLY79 data were not collected with an explicit purpose of identifying constrained respondents. As a result, the questions are not precisely formulated and the survey omits some important information. Below I explain most important problems with my operational definition and provide an assessment of the implications for my study.

In the standard human capital accumulation framework, individuals choose a schooling level that maximizes their expected lifetime utility subject to a budget constraint. When capital markets are imperfect, individuals may be faced with an additional constraint on borrowing. The strictest form of this constraint is an inability to borrow against future earnings. When credit constraints are binding, constrained individuals may forgo college education, even though the net benefits are positive and they would enroll if they could borrow intertemporally.

One of the problems with my indicator is that it does not necessarily identify the respondents with positive benefits to education – those would enroll in college if borrowing was permitted. At the same time, some individuals may want to continue being educated indefinitely (e.g. if schooling is a source of non-pecuniary benefits), so that a gap between aspirations and expectations would simply reflect the impact of a budget constraint and not a restriction on borrowing. Moreover, the answers "financial difficulties" and "have to work" may have a lot of different interpretations, and do not necessarily imply borrowing constraints.

Table 2: Summary Statistics of the Primary Variables

Variables	All (I)		Constrained (II)		Unconstrained (III)		T-stats <sup>b</sup> (IV)
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Individual Characteristics							
Female	0.497		0.487		0.499		0.606
Black	0.262		0.246		0.264		1.027
Hispanic	0.168		0.204		0.162		2.678***
Age	19.037	1.368	19.257	1.298	19.004	1.375	4.477***
AFQT percentile	37.381	27.674	34.653	26.194	37.787	27.867	2.733***
Family Background Characteristics							
Parental income	1,909	1,534	1,657	1,348	1,947	1,556	4.569***
Mother's education	11.981	1.873	11.783	1.782	12.001	1.884	2.499***
Father's education	12.574	2.415	12.347	2.160	12.606	2.447	2.071**
Number of siblings	3.780	2.593	4.010	2.700	3.746	2.575	2.463**
Local Characteristics							
Avg. public tuition	1,092	377	1,063	366	1,097	378	2.161**
Local college	0.851		0.868		0.848		1.350
Urban residence	0.758		0.737		0.761		0.083
N	5,164		668		4,496		
Proportion	100		12.9		87.1		

Notes: a) Expressed in 1979 dollars. b) Testing the hypothesis of equality of means across constrained and unconstrained respondents: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$ .

More importantly, only those respondents who state that their educational aspirations exceed expectations are asked to report a reason. If credit constraints reduce both aspirations and expectations of some respondents, my measure will underestimate the true proportion affected.

One other potential problem is that some respondents may report facing financial difficulties in an attempt to justify low educational expectations that are due to other factors, for example, a low expected returns to education or lack of scholastic aptitude. This phenomenon is commonly referred to as *justification bias*. It usually arises than some incentives make respondents more likely to report a specific condition (e.g., high self-reported disability rates among early retirees).<sup>6</sup>

The considerations above imply that my measure of financial difficulties in education does not necessarily identify credit-constrained individuals, i.e. those who would choose higher levels of schooling if an opportunity to borrow presented itself. It may, however, provide important information pertinent to educational choices. Some knowl-

<sup>6</sup>However, given a wide range of socially-acceptable answers to the reasons question, it is not clear why respondents trying to justify their low educational expectations would choose financial difficulties or a need to work over other possible answers.

edge about the information content of my measure can be gained from comparing the characteristics of constrained and unconstrained respondents. More specifically, I focus on individual, local, and family background characteristics that earlier studies have deemed to be important predictors of educational attainment (see, e.g. Carneiro and Heckman, 2002; Cameron and Taber, 2004).<sup>7</sup> Averages of these characteristics for constrained and unconstrained subsamples are presented in Columns (II) and (III) of Table 2, with t-statistics for the differences reported in Column (IV).

Overall, constrained youths are more likely to be financially disadvantaged than the unconstrained, which is consistent with the presence of financial difficulties. More specifically, constrained youths come from larger families and have lower parental income. Parental income of constrained youths is \$16,600 a year versus \$19,500 a year for unconstrained youths (in 1979 dollars). Constrained youths are also more likely to be of Hispanic ethnicity. At the same time, parental education and average AFQT ability test scores are lower among constrained. This implies lower college readiness and potentially lower demand for education among constrained youths.

Because ability and financial resources are the two most important determinants of educational attainment, it is instructive to examine their interactions with my indicator of financial difficulties. One would expect that "smart poor" youths are more likely to report financial difficulties in education than "dumb rich" youths. To see if this pattern exists, Figure 1 presents the proportion of constrained youths by parental income and tercile on the AFQT test. It indicates that 17 percent of high-ability youths from the lowest income tercile report financial difficulties versus only 12 percent of low-ability youths from the highest income tercile.<sup>8</sup> Moreover, there is a strict ordering by parental income among the youths in the top AFQT tercile: high-income youths are significantly less likely to report constraints than low-income youths.

### 3 Probability of Reporting Constraints

What distinguishes individuals who report facing financial difficulties in education from those who do not? A major factor may be parental resources. Individuals from lower-income families with more siblings would be more likely to perceive themselves as constrained. Because an opportunity to live at home substantially reduces schooling costs (see, e.g., Cameron and Taber, 2004), those living in a vicinity of a public two- or four-year college would be less likely to report constraints. Family background might matter as well, as it shapes preferences for education. This section presents descriptive regression estimates of the probability of reporting constraints, conditional on individual, local,

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<sup>7</sup>A detailed description of these characteristics is presented in the Appendix.

<sup>8</sup>This difference is statistically significant at the 10 percent level ( $t = 1.733$ ). Data and standard errors are presented in Table A-1 in the Appendix A-2. The Appendix also presents some additional evidence that self-reported constraints co-vary in the expected way with AFQT scores and parental income.

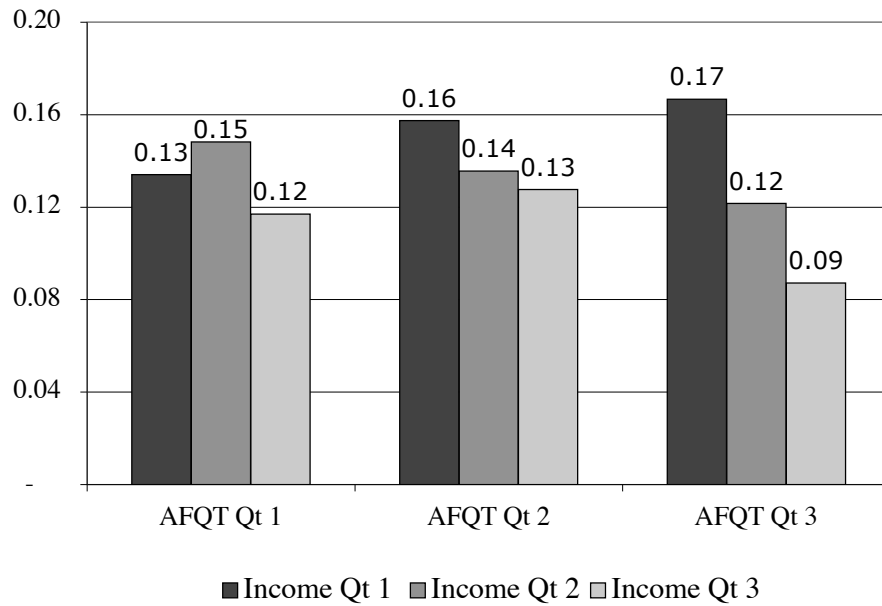


Figure 1: Distribution of Credit Constraints over Parental Income and AFQT Quartile, NLSY79

and family background characteristics. The results indicate that all the factors above are important, although to a different extent for men and women. Men and women appear to perceive financial constraints differently. The estimates can be interpreted as partial correlations and do not bear causal interpretations.

Coefficients and marginal effects from logistic regressions of the probability of reporting financial difficulties in education are presented in Table 3. The results show that parental income has a negative correlation with this probability. Men and women in the top quartile of parental income distribution have a 4 percentage-points (30 percent) higher probability of reporting constraints than men and women at the bottom of the income distribution. Similarly, living in a county with a two- or four-year public college or university is associated with a lower probability of reporting constraints. A nearby public college is associated with a 3 percentage-point (or a 25 percent) lower probability for men and a 5 percentage-point (or a 36 percent) lower probability for women.

The regressions are estimated separately for men and women because men are significantly more likely than women to report the need to work as an obstacle in expecting to achieve desired education (see Table 1). The results in Table 3 indicate that there are indeed some important gender differences in perceptions of financial constraints in education. Conditional on family income and other individual and local characteristics,

Table 3: Estimated Probability of Reporting Credit Constraints

	Men (I)		Women (II)	
	Coeff.	Marg. Effect	Coeff.	Marg. Effect
Black	-0.316* (0.174)	-0.033* (0.017)	-0.101 (0.178)	-0.010 (0.018)
Hispanic	-0.317 (0.203)	-0.032* (0.019)	0.432** (0.182)	0.051** (0.024)
Number of siblings	0.045** (0.023)	0.005** (0.003)	-0.015 (0.026)	-0.002 (0.003)
Mother's education	-0.001 (0.026)	-0.000 (0.003)	-0.048 (0.031)	-0.005 (0.003)
Father's education	-0.024 (0.020)	-0.003 (0.002)	0.015 (0.021)	0.002 (0.002)
Both parents	-0.075 (0.152)	-0.008 (0.017)	0.120 (0.143)	0.012 (0.014)
Urban residence	0.037 (0.203)	0.004 (0.022)	-0.563*** (0.162)	-0.066*** (0.021)
Local college	-0.329 (0.205)	-0.033* (0.019)	-0.508*** (0.193)	-0.047*** (0.016)
Avg. tuition/1,000	-0.177 (0.211)	-0.019 (0.023)	-0.112 (0.230)	-0.012 (0.024)
AFQT Q2	0.045 (0.145)	0.005 (0.016)	0.356** (0.181)	0.040* (0.022)
AFQT Q3	-0.076 (0.178)	-0.008 (0.019)	0.165 (0.204)	0.018 (0.023)
AFQT Q4	-0.384* (0.199)	-0.039** (0.019)	0.388* (0.223)	0.044* (0.027)
Income Q2	-0.205 (0.159)	-0.022 (0.016)	0.049 (0.171)	0.005 (0.018)
Income Q3	-0.078 (0.197)	-0.008 (0.021)	-0.341* (0.189)	-0.034* (0.018)
Income Q4	-0.382* (0.206)	-0.039** (0.020)	-0.384** (0.189)	-0.037** (0.017)
Constant	-1.122*** (0.432)		-1.486*** (0.403)	
Log likelihood	-988		-952	
Pseudo $R^2$	0.025		0.024	
N	2,595		2,569	

NOTES: a) For binary variables marginal effects are estimated for changes from zero to one. b) Standard errors (in parentheses) are robust to arbitrary correlation across persons who live in the same county. c) Additional controls include cohort indicators and indicators for residence in the four standard census regions. d) Wald test  $\chi^2 = 38.62***$

ability test scores have opposite sign correlations with the probability of reporting constraints for men and women. Relative to the lowest quartile of the ability distribution, the highest quartile is associated with a 4 percentage-point lower probability of reporting constraints for men. For women, by contrast, the highest quartile of ability distribution is associated with a 4 percentage-point higher probability of reporting constraints. This result is potentially consistent with the idea that women put more emphasis on the non-pecuniary benefits of schooling (see, e.g., Reisburg, 2000). Smarter women may have higher demand for education, and hence be more likely than their less "bright" counterparts to face binding financial constraints.

Moreover, there are other important gender differences. For example, minority status (Black or Hispanic) is associated with a 3 percentage-point lower probability of reporting constraints for men, while for women Hispanic ethnicity is associated with a 5 percentage-point higher probability of reporting constraints. Living in an urban area is associated with a 7 percentage-point lower probability for women, but not for men. A Wald test indicates that the coefficients are jointly different across the two equations.

## 4 Financial Constraints and Educational Outcomes

Does my measure provide any additional information about individual schooling choices, beyond that captured by the standard controls? Conditional on scholastic ability, parental income, and family background characteristics, is there a significant negative relationship between my subjective measure of credit constraints and educational outcomes? To answer these questions, I examine a number of dimensions of college education in a standard regression framework. I augment regression specifications similar to those used by Carneiro and Heckman (2002) with my credit constraints indicator. While this exercise is purely descriptive, it provides some insights about the information content and internal consistency of my measure.<sup>9</sup>

Table 4 reports marginal effects from a logistic regression of the probability of being enrolled in a college at age 21. Column I presents the baseline specification with controls for parental income, ability test scores, family background, and demographic characteristics similar to Carneiro and Heckman (2002). In Columns II and III the baseline specification is augmented with my subjective measure of financial difficulties (Column II) and its interaction with the gender binary (Column III).

The indicator of financial constraints appears an important correlate of college enrollment. Self-reported financial difficulties are associated with a 4 percentage-point lower probability of being enrolled in college at age 21. Although the interaction term

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<sup>9</sup>It is important to note that my measure of financial difficulties incorporates expectations of future educational attainment, which depends on current and future choices. This implies that in a regression model of educational outcomes my measure is potentially endogenous. This is why it is necessary to emphasize that the results below do not bear a causal interpretation.

Table 4: Estimated Probability of College Enrollment at Age 20

	(I)	(II)	(III)
Female	0.067*** (0.014)	0.067*** (0.014)	0.061*** (0.015)
Black	0.313*** (0.026)	0.312*** (0.026)	0.312*** (0.026)
Hispanic	0.228*** (0.038)	0.230*** (0.038)	0.229*** (0.038)
Both parents	0.028 (0.018)	0.027 (0.018)	0.027 (0.018)
Mother's education	0.018*** (0.004)	0.018*** (0.004)	0.018*** (0.004)
Father's education	0.013*** (0.003)	0.013*** (0.003)	0.013*** (0.003)
Number of siblings	-0.015*** (0.003)	-0.015*** (0.003)	-0.014*** (0.003)
South	0.053** (0.021)	0.053** (0.021)	0.053** (0.021)
Urban residence	0.019 (0.020)	0.019 (0.020)	0.019 (0.020)
AFQT Q2	0.278*** (0.027)	0.280*** (0.027)	0.280*** (0.027)
AFQT Q3	0.441*** (0.027)	0.442*** (0.027)	0.441*** (0.027)
AFQT Q4	0.702*** (0.019)	0.702*** (0.019)	0.701*** (0.019)
Income Q2	0.103*** (0.025)	0.103*** (0.025)	0.103*** (0.025)
Income Q3	0.097*** (0.024)	0.096*** (0.024)	0.096*** (0.024)
Income Q4	0.171*** (0.028)	0.170*** (0.028)	0.170*** (0.028)
Constrained		-0.039* (0.020)	-0.066** (0.026)
Female*Constrained			0.059 (0.046)
Pseudo $R^2$	0.274	0.274	0.274
Log likelihood	-2,374	-2,372	-2,371
LR test		$\chi^2(1)=3.62^*$	$\chi^2(2)=5.34^*$

NOTES: a) Robust standard errors in parenthesis. b) Additional controls include cohort indicators. c) Number of observations N=5,164.

between gender and financial constraints is not statistically significant at conventional levels, it indicates that self-reported financial difficulties have a positive correlation with college enrollment for women. For men, financial difficulties are associated with a 7 percentage-point lower probability of college enrollment.

Other controls have the signs and magnitudes consistent with earlier studies (e.g. Belley and Lochner, 2007). The probability of being enrolled in college is increasing with ability, parental income, and parental education. It is decreasing with family size. Conditional on ability, parental income, and family background characteristics, Blacks and Hispanics have a higher probability of college enrollment than whites. Introducing the financial difficulties indicator in Column II does not change the sizes and magnitudes of these coefficients, which indicates robustness of the model. At the same time, a Likelihood Ratio (LR) test shows that the model fit is significantly improved by introducing the indicator and its interactions with the gender variable.

From Table 4 it appears that the indicator of financial constraints that I develop captures some important information about college enrollment. What about other dimensions of education? Carneiro and Heckman, for example, have argued that credit constraints can affect individual schooling decisions at a number of margins, such as quality of the university or timing of enrollment. For this study, it is especially important to examine an array of schooling dimensions to evaluate internal consistency of the measure. If the measure is internally consistent, we can expect to see systematic and persistent differences between constrained and unconstrained youths along more than one dimension of schooling. Conditioning on family income, family background, and ability test scores allows me to isolate the unique information contribution of my measure.

Tables 5 and 6 present gaps in educational outcomes by financial constraints and partial correlations between the probabilities of these outcomes and the indicator of constraints, separately for men and women. Partial correlations are marginal effects from logistic regressions of outcomes on the same variables as in Table 4 above.<sup>10</sup> In addition to college enrollment, I use five other dimensions of education, expressed as binary outcomes. Information about the outcomes comes from the 1990 wave of the survey, conducted when respondents were between the ages of 35 and 39 and had completed the bulk of their schooling. Two binary variables capture educational attainment: an indicator for completing a four-year degree and an indicator for completing a two-year degree (for those who do not complete a four-year degree). For those with at least a two-year degree, another binary indicates whether the degree was received without a delay, i.e. the respondent had completed at least one year of college education by the age 21. Quality of education is captured by two indicators: enrollment in a four-year versus a two-year college, and enrollment in a college with competitive admissions standards. While the other measures have been previously examined by Carneiro and Heckman, the indicator

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<sup>10</sup>The first column ("Total") excludes the AFTQ test scores. The full regression results are available from the author upon request.

Table 5: Gaps in Educational Outcomes of Constrained Men

Total (I)		Bottom AFQT (II)		Middle AFQT (III)		Top AFQT (IV)	
Raw	Beta	Raw	Beta	Raw	Beta	Raw	Beta
Panel A - Enrollment in College at Age 21							
-0.112*** (0.026)	-0.076*** (0.025)	-0.026 (0.022)	-0.019 (0.016)	-0.035 (0.041)	-0.009 (0.042)	-0.180*** (0.056)	-0.173*** (0.063)
Panel B - Complete 4-Year College							
-0.097*** (0.022)	-0.054*** (0.015)	-0.010 (0.009)	-0.019 (0.006)	-0.070** * (0.028)	-0.047*** (0.019)	-0.121** (0.057)	-0.100* (0.058)
Panel C - Complete 2-Year College							
-0.047** (0.021)	-0.032* (0.018)	-0.018 (0.018)	-0.013 (0.010)	-0.028 (0.033)	-0.024 (0.027)	-0.069 (0.050)	-0.051 (0.049)
Panel D - Proportion of People not Delaying College							
-0.110*** (0.042)	-0.085* (0.048)	-0.139* (0.083)	-0.089 (0.089)	-0.063 (0.070)	-0.074 (0.079)	-0.093* (0.055)	-0.045 (0.068)
Panel E - Enrollment in a 4-Year versus 2-Year College							
-0.065 (0.046)	-0.056 (0.048)	0.021 (0.071)	0.009 (0.074)	-0.046 (0.082)	-0.023 (0.088)	-0.086 (0.081)	-0.084 (0.090)
Panel F - Enrollment in a Competitive College							
-0.062 (0.043)	-0.038 (0.043)	0.077 (0.059)	0.062 (0.059)	-0.082 (0.074)	-0.034 (0.074)	-0.162* (0.094)	-0.160* (0.095)

NOTES: Standard errors in parenthesis. All results are presented relative to the unconstrained men. Beta, or adjusted gaps, are marginal effects from logit regressions.

for competitive admissions standards is unique to this study. I define a college or university as competitive if it collects and reports average SAT or ACT scores of incoming freshmen.

Table 5 show substantial differences between constrained and unconstrained men along most of the dimensions of schooling. The first two columns of the table present the gaps estimated for all men ("Total"). All the raw gaps, except for the gaps in school quality, appear substantial and statistically significant, varying between 5 and 11 percentage-points. Men who report credit constraints have lower unconditional probabilities of receiving a two-year or a four-year degree and a higher unconditional probability of delaying enrollment. Conditional gaps (denoted as "Beta" in the table) are somewhat smaller in magnitude, but remain statistically significant. Self-reported financial difficulties account for a 5 percentage-point gap in the four-year and a 3 percentage-point gap in the two-year college completion rate. Financial difficulties are also associated with a 9 percentage-point higher probability of delaying college enrollment, for those with at least a two-year degree.

The rest of Table 5 presents the gaps estimated by the AFQT terciles. Depending on the location in the AFQT distribution, individuals vary in college readiness and

Table 6: Gaps in Educational Outcomes of Constrained Women

Total (I)		Bottom AFQT (II)		Middle AFQT (III)		Top AFQT (IV)	
Raw	Beta	Raw	Beta	Raw	Beta	Raw	Beta
Panel A - Enrollment in College at Age 21							
-0.018 (0.028)	0.011 (0.030)	0.027 (0.035)	0.047 (0.034)	-0.041 (0.047)	-0.048 (0.047)	-0.037 (0.050)	0.033 (0.053)
Panel B - Complete 4-Year College							
-0.037 (0.023)	0.012 (0.018)	0.033 (0.019)	0.015 (0.012)	-0.013 (0.033)	-0.004 (0.028)	-0.129*** (0.051)	-0.085 (0.054)
Panel C - Complete 2-Year College							
0.005 (0.025)	0.013 (0.024)	0.012 (0.030)	0.035 (0.029)	-0.013 (0.042)	-0.007 (0.038)	-0.017 (0.049)	-0.012 (0.051)
Panel D - Proportion of People not Delaying College							
-0.061* (0.034)	-0.026 (0.031)	-0.044 (0.067)	-0.015 (0.064)	-0.105** (0.054)	-0.079 (0.058)	-0.013 (0.047)	0.018 (0.028)
Panel E - Enrollment in a 4-Year versus 2-Year College							
-0.103*** (0.039)	-0.088** (0.042)	-0.066 (0.066)	-0.066 (0.065)	-0.159** (0.072)	-0.165** (0.072)	-0.099* (0.060)	-0.057 (0.065)
Panel F - Enrollment in a Competitive College							
0.042 (0.036)	0.074 (0.040)	0.043 (0.052)	0.055 (0.055)	0.083 (0.064)	0.096 (0.072)	0.003 (0.067)	0.055 (0.076)

NOTES: Standard errors in parenthesis. All results are presented relative to the unconstrained women. Beta, or adjusted gaps, are marginal effects from logit regressions.

expected benefits to education, and, hence, their demand for schooling. Low-ability individuals have a low demand for college education and hence are less likely to be sensitive to financial constraints. Hence, the absence of any significant gaps by constraints in schooling outcomes for men at the bottom of the AFQT distribution is not surprising. At the same time, there are large and significant gaps in college enrollment, completion, and quality for high-ability men. Constrained men at the top of the AFQT distribution are 18 percentage-points less likely to be enrolled in college at age 21, and 9 percentage-points more likely to delay if they do enroll. They are also 12 percentage-points less likely to complete a four-year degree and 16 percentage-points less likely to enroll in a competitive university. Controlling for parental income, individual, and family background characteristics does not eliminate the gaps in college enrollment and quality (but does eliminate the gap in the delay probability). The persistence of these gaps indicates that my financial difficulties indicator reveals important information about the college choices of men, beyond that captured by parental income and ability measures.

For women the picture is very different. The first column of Table 6 shows that, conditional on parental income and family background characteristics, constrained and unconstrained women differ only in the probability of enrollment in a four-year col-

lege vs. a two-year college. Self-reported financial difficulties are associated with a 9 percentage-point lower conditional probability of attending a four-year college. Conditional on ability, constrained women in the middle of the AFQT distribution are 17 percentage-points less likely to attend a four-year than a two-year college. Overall the results indicate that self-reported credit constraints are not a strong correlate of educational outcomes for women, when controls for parental income, ability, and family background are introduced.

## 5 Conclusions

This study investigates the use of subjective information about financial difficulties in education as a potentially more direct way of identifying credit-constrained students in the widely used NLSY79 data set. Using the information on educational expectations and aspirations, I develop an indicator of constraints and test its internal consistency and information content. Because of the synthetic nature of the indicator and specific features of the survey design, it is not likely to provide a reliable estimate of the fraction of credit-constrained students in the United States. However, it reveals some important aspects of heterogeneity in the demand for education, not captured by the standard socioeconomic variables. A comparison of educational outcomes across a wide number of dimensions shows substantial differences between men by self-reported constraints. Men who report constraints are less likely to enroll in college, more likely to delay enrollment, and less likely to graduate with a four-year degree than unconstrained men. These correlations are larger for the men at the top of ability distribution and persist when controls for parental income and family background are introduced.

On a broader scale the results in this paper suggest that although self-reported constraints need to be treated with caution, they can serve as a valuable source of information regarding individual decision-making. Subjective measures allow researchers to observe additional aspects of population heterogeneity that facilitate econometric analysis and reduce the need for economic assumptions.

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## Appendices

### A.1 Data

The NLSY79 is a longitudinal, nationally representative data set that oversamples Hispanics, Blacks, and white low-income individuals. The demographic characteristics in my study are race/ethnicity, age, and gender. Because the analysis sample included the minority oversample, 26 percent of respondents are Black, and 17 percent are Hispanic (see Table 2 in the text). Family background characteristics are parental income, parental education, and number of siblings. Parental income is measured when the respondents were age 17 (or age 16 if not available at age 17). Mean parental income in the sample is \$19,900 in 1979 dollars, which is equivalent to \$56,800 in 2007 dollars. Parental education is measured in years of schooling completed by the respondents' mother and father. The average level of parental education in the sample is high school.

Scholastic ability is captured by the Armed Forces Qualification Test (AFQT) scores. The AFQT scores have been widely used by social scientists as a measure of cognitive ability and scholastic aptitude (see, e.g., Cawley et al., 2000; Carneiro and Heckman, 2002). The score is a weighted average of the Armed Services Vocational Aptitude Battery (ASVAB) test results that measures knowledge and skill in ten different academic and vocational areas. Students in the sample took the test in the summer of 1980, when they were between 15 and 18 years old.

Local characteristics include state public tuition costs, presence of a two- or a four-year public college or university in the county of residence, binary variables for Census geographic regions, and a binary variable for residence in a metropolitan statistical area. Variables for state public tuition costs and presence of a college in the vicinity are created using the data from the Department of Education's Higher Education General Information Survey (HEGIS). The HEGIS data was merged to the NLSY79 using the Geocodes restricted-access state and county identifiers. Geocodes data contain sensitive information that makes it possible to identify individual respondents. To ensure confidentiality, the Bureau of Labor Statistics (BLS) only grants access to Geocodes data to researchers in the United States who agree to adhere to the BLS confidentiality policy.

To gain access to the data, an application must be submitted to the BLS describing the project's goals, methodology, and security policies to protect the data.

The Higher Education General Information Survey (HEGIS) was designed to provide comprehensive information on various aspects of post-secondary education in the United States. The study domain includes all post-secondary institutions operating in the United States and its territories. The data used in this paper come from the Institutional Characteristics module. The module contains annual data on type of institution, tuition, location, and other characteristics of colleges and universities in the United States. The study excluded federal institutions and colleges with enrollment of fewer than 100 students. The data are available from University of Michigan data repository, and can be accessed at <http://www.icpsr.umich.edu/cocoon/IAED-SERIES/00030.xml?token=6>.

Table 2 in the text shows that about 87 percent of individuals live in a county with a two- or a four-year accredited college nearby. Average public university tuition varies substantially across the states: from \$365 per-year in Washington, D.C., to above \$2,000 in Vermont, with a sample mean of about \$1,100, in 1979 dollars.

## A.2 Robustness of Operational Definition

Tables A-2 and A-3 present the distribution of financial difficulties by income and ability terciles by educational aspirations groups. Similar to Figure 1 in the text, high-ability youths from the lowers income tercile are significantly more likely to report financial difficulties than low-ability youths from the highest income tercile. Among youths who aspire to receive some college education this difference is 14 percentage-points (significant at ten-percent level,  $t = 1.743$ ), and among youths who aspire to receive a college degree or more education this difference is 8 percentage-points (significant at ten-percent level,  $t = 1.739$ ). Moreover among the high-ability youths, those from low-income families are more likely to report credit constraints than those from high-income families. At the same time, there are no significant patterns across the ability distribution, conditional on income.

To provide some further evidence about the internal consistency of my measure, I examine educational attainment of respondents twelve years after they reported educational expectations. If youths from lower socioeconomic backgrounds who have lower test scores are more likely to have inflated educational expectations, this would provide some evidence in favor of the justification bias hypothesis. Table A-4 in presents the fraction of individuals who report lower levels of education in 1994 relative to what they expected in 1982, classified by family income and ability terciles. Consistent with evidence in the earlier literature, (e.g. Reynolds and Pemberton, 2001; Rouse, 2004), sample respondents are overly optimistic in their educational expectations. About 40 percent of youths in my sample do not achieve their expected levels of schooling. The results show that 41 percent of high-ability youths in the lowest income tercile do not achieve their expected education compared with 45 percent of low-ability youths in the highest

income tercile. This difference, however, is not statistically significant ( $t = 0.914$ ). The table also shows that among medium- and high-income youths those with lower ability test scores are more likely not to achieve their expected education levels. It provides no evidence, however, that youths from lower socioeconomic background are more likely to have inflated expectations.

Table A-1: Proportion Constrained by Parental Income and AFQT Quartiles

AFQT	Parental Income			Diff. Q1-Q3	T-stats.
	Q1	Q2	Q3		
Q1	0.134	0.148	0.117	0.017	0.737
Q2	0.158	0.136	0.128	0.030	1.405
Q3	0.167	0.122	0.087	0.079	3.953***
Diff. Q3-Q1	0.033	-0.027	-0.030		
T-stats.	1.421	1.262	1.497		

Notes: a) Testing the hypothesis of equality of means between the constrained and the unconstrained: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$

Table A-2: Proportion Constrained by Parental Income and AFQT Terciles. Expected Education: Some College

AFQT	Parental Income			Diff. Q1-Q3	T-stats.
	Q1	Q2	Q3		
Q1	0.259	0.224	0.193	0.066	0.950
Q2	0.267	0.239	0.220	0.047	0.881
Q3	0.333	0.213	0.220	0.113	1.739*
Diff. Q3-Q1	0.074	-0.011	0.027		
T-stats.	1.031	0.181	0.423		

Notes: a) Testing the hypothesis of equality of means between the constrained and the unconstrained: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$

Table A-3: Proportion Constrained by Parental Income and AFQT Terciles. Expected Education: College or More

AFQT	Parental Income			Diff. Q1-Q3	T-stats.
	Q1	Q2	Q3		
Q1	0.057	0.047	0.035	0.022	0.603
Q1	0.056	0.056	0.045	0.010	0.408
Q1	0.113	0.085	0.049	0.064	2.980***
Diff. Q3-Q1	0.056	0.039	0.014		
T-stats.	1.559	1.179	0.468		

Notes: a) Testing the hypothesis of equality of means between the constrained and the unconstrained: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$

Table A-4: Probability that Educational Attainment Falls Fort of Expectations, by Parental Income and AFQT Terciles

AFQT	Parental Income			Diff. Q1-Q3	T-stats.
	Q1	Q2	Q3		
Q1	0.414	0.432	0.452	-0.038	1.113
Q2	0.407	0.408	0.377	0.030	1.004
Q3	0.413	0.382	0.368	0.046	1.443
Diff. Q3-Q1	-0.001	-0.050	-0.084		
T-stats.	0.027	1.640*	2.542***		

Notes: a) Testing the hypothesis of equality of means between the constrained and the unconstrained: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$