A New Test of Borrowing Constraints for Education

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Abstract

Models of investment and borrowing for education typically treat the family as a unitary decision-maker. Doing so may conceal the nature of borrowing constraints, since adults with college-age children are likely at a life-cycle stage where credit constraints are not important. We instead propose a simple model of altruistic parents and a child where both parties can make investments for education and for other purposes and parents can transfer cash to their child. The model implies that educational investment is inefficient for intergenerationally constrained parent-child pairs. The constraint arises because parents of constrained children rationally do not pay the share of college expenses that is assumed by federal financial aid formulas. The model highlights new empirical implications of borrowing constraints for education, which we examine making use of data from the Health and Retirement Study and the NLSY-97. The data are consistent with quantitatively important borrowing constraints for higher education.

There has been long-standing interest in whether U.S. students have access to educational borrowing for college sufficient to support efficient human capital investment (see, for example, Becker, 1967). Many papers document empirical relationships that authors interpret as being consistent with educational borrowing constraints (see, for example, Manski and Wise, 1983; Hauser, 1993; Kane, 1994; Card, 1999; Kane and Rouse, 1999; Ellwood and Kane, 2000; Rothstein and Rouse, 2007; and, at least in data from the National Longitudinal Survey of Youth, 1997 cohort, Belley and Lochner, 2007). In contrast, papers by Cameron and Heckman (1998, 2001), Shea (2000), Keane and Wolpin (2001), Carneiro and Heckman (2002), and Cameron and Taber (2004) argue that U.S. educational credit markets are nearly complete.[1] While many empirical and methodological contributions have been made the papers cited above, this is the first paper to model explicitly how the interactions between parents and children may rationally lead to credit constraints for college.

There are two actors in our model. Parents face complete credit markets and care about their own consumption and the well-being of their adult child. A child cares only about his or her well-being and cannot borrow against future earnings. Borrowing constraints for education may arise for at least two reasons. The parent may be poor relative to the child or care too little about the utility of their child to provide financial help for college, since parents cannot access the returns to education.[2] Alternatively parents and children may disagree over the optimal investment in education because of the possibility that the child will end up relying too heavily on the parent.

The potential for disagreement arises naturally in the context of U.S. college financial aid

[1] Carneiro and Heckman (2002) find that up to 8 percent of the relevant U.S. population may be short-run credit constrained.
[2] McGarry and Schoeni (1995) and McGarry (1998) document low rates of transfers from children to older parents, so we assume that parents cannot expect return transfers from children who make good on the education that parents finance.

policy: a student's federal assistance is determined based on their parents' presumed ability to pay, and standards for financial independence from parents are stringent. Parents are under no legal obligation to meet their expected contribution as specified in federal financial aid formulas.[3] If parents refuse to pay, children may face financial constraints in attending college.[4]

The equilibrium of the model has sharp implications for the types of families where we should and should not see evidence of borrowing constraints for higher education. First, when parents are relatively wealthy, or altruistic, or the child's ability is relatively modest, post-schooling cash transfers take place and financial aid will have no effect on the child's educational attainment. Second, when parents are relatively poor, or egoistic, or the child is relatively able, no post-schooling cash transfers occur and financial aid will affect the child's educational attainment in equilibrium. In practical terms, given a policy that conditions aid on expected family contributions that are neither legally guaranteed nor universally offered, we investigate whether federally determined aid matters more to the education of children with less generous parents.

We examine these implications using data from the Health and Retirement Study (HRS), with supplemental analysis based on the National Longitudinal Survey of Youth, 1997 Cohort (NLSY-97). We divide the sample into two groups based on whether or not post-schooling cash transfers are reported in the HRS. Though observing both children's actual college financial aid

[3] According to their parents, a third of all children in the Health and Retirement Study who got some post-secondary education did so without their parents' financial assistance. This distinction does not reflect only differences in need-based financial aid. A quarter of children whose parents held $200,000-$400,000 in net worth in 2000 attended college without parental support, as did 16 percent of those whose parents' net worth exceeded $400,000.
[4] Consider Diane, posting on 1/11/2005 to the Becker-Posner Blog, who writes, "Currently if you are under 25 and not in graduate school you are considered dependent on your parents' income and have to include their income on you FAFSA which will count against you when figuring your expected family contribution. For those of us who did not receive any financial support from parents other than cosigning loans this is a real kick in the ass. Not only is my family lower middle class and unable to contribute to my education, but the government will tell me that they expected them to contribute and will punish me by lowering my available loan total" (http://www.becker-posner-blog.com/archives/2005/01/governments_rol.html).

and post-schooling cash transfers for a period well after college is an unrealistic data requirement, we use a good proxy for financial aid. The parents' *total* "expected family contribution" (EFC) to the education of all of their children in a given year is based on income and assets. It is invariant to the number of children parents have in school that year. This means that the dollar amount of aid awarded to support the education of one child depends heavily on the overlap of that child's college years with those of his or her siblings. As a result, we rely on the birth spacing of siblings as a proxy for variation in students' federal aid.

As implied by our analytic model, we find a positive and statistically significant relationship between educational attainment and sibling overlap in college ages when no post-schooling cash transfers are reported, and no significant relationship when positive transfers are reported. Our empirical models include family-specific fixed and random effects specifications and the results are consistent across several HRS samples. The magnitude of the association implies a difference in educational attainment of nearly one semester between children with zero and four years of sibling overlap in college ages. We provide additional evidence from the NLSY-97 that, together with the HRS results, is consistent with borrowing constraints for higher education being important for some children in families where parents are relatively poor or egoistic, or children are relatively able, or a combination of these factors apply.

I. A model of transfers with exogenous financial aid

The specification of the underlying model of family behavior is fundamental when thinking about the importance of borrowing constraints for education. If parents and children act as a unitary decision-maker, it is not surprising that studies would find borrowing constraints to be an empirically negligible phenomenon. Parents of college age children are typically at a stage of the life-cycle where they have ample access to credit. There is considerable evidence, however, that key implications of the unitary model of intergenerational relationships are not supported in data (see, for example, Altonji, Hayashi, and Kotlikoff, 1992).[5]

The starting point for our model is the small theoretical literature on collective family schooling decisions. In order to generate an equilibrium that distinguishes between transfers for education and cash transfers and the timing of these, there must be scope for disagreement between parents and children over children's investments. We follow the intuition of Bruce and Waldman (1991),[6] who note that repeated transfer opportunities can generate a threat of strategic over-reliance of a child on an altruistic parent. In this case parents may prefer more education for the child due to the threat of over-reliance, but may also prefer less education for the child given that the parent has no access to the returns from the child's education.[7]

a. The Economic Environment

Consider a two period model where parents have altruistic concern for their children's utility. We assume that parents and children make independent, non-cooperative decisions. In particular, the parent moves first, choosing her consumption and physical capital investment, along with the dollar amounts of a cash transfer to the child and a tied transfer for college education. The child sees these choices and then decides how much to consume, invest in schooling, and save. In the second period, the parent again consumes and chooses a cash gift to the child; the child's only action is to consume the gift and the returns to his various investments.

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[5] When studies of borrowing constraints for education include analytic models, they almost always assume that families make unitary college decisions based on parents' resources and children's ability. Exceptions are Sauer (2003), who investigates the effects of parental transfers during law school reported in alumni surveys by University of Michigan law school graduates on borrowing and lifetime earnings, and Perozek (2005), who models and estimates the education decisions of a parent and multiple children using the HRS. Perozek's paper characterizes altruistic transfer rules in a dynamic setting and explores the effects of transfer policies on the investment behavior of children. She does not examine borrowing constraints.

[6] Pollak (1988) uses preferences for education to motivate parents' investments, and observes that distinctions among transfer forms must rely on a disagreement between parents and children and that effective tied transfers cannot function as collateral or be resold.

[7] Lindbeck and Weibull (1988) model repeated transfer opportunities between agents with linked preferences and generate a similar strategic concern to that in Bruce and Waldman.

While the parent has full access to credit, we assume that the child cannot borrow against his or her future income.[8]

Define *a* as the total parent and child investment in physical capital, and define *e* as their total investment in the child's postsecondary education. Assume that the rate of return on physical capital is constant at *R* and the return to total human capital investment *e* is *h(e)* such that $h'(\cdot) > 0,\ h''(\cdot) < 0$ and $h'(0) > R.$ The child can receive financial aid τ, which augments family human capital investments. Hence $e = e^p + e^k + \tau$.[9]

The parent, *p*, and child, *k*, have utilities of consumption in the two periods given by

$$U^k(c_1^k, c_2^k) = u(c_1^k) + \beta u(c_2^k) \text{ and}$$
$$U^p(c_1^p, c_2^p, c_1^k, c_2^k) = u(c_1^p) + \beta u(c_2^p) + \alpha\left(u(c_1^k) + \beta u(c_2^k)\right),$$

where c_t^j represents the period *t* consumption of agent *j*, α expresses the parent's degree of purely altruistic concern for the child's welfare, and β is the rate at which each agent discounts future utility. Single period utility of consumption for each agent, $u(\cdot)$, is such that $u'(\cdot) > 0,\ u''(\cdot) < 0$ and $u'(0) = +\infty.$

The parent acts as a Stackleberg leader, moving first in period 1, choosing c_1^p, a^p, e^p and first period transfer to the child g_1, subject to constraints $c_1^p + a^p + e^p + g_1 \le x^p$, $g_1 \ge 0$ and $e^p \ge 0.$[10] As a result of the one-sided altruism and non-cooperative interaction between the parent and the child, the parent is unable to draw resources from the child either through a

[8] As discussed in Brown *et al.* (2006), both assumptions – non-cooperative behavior and children have limited ability to borrow – are necessary to obtain empirical predictions on the timing and magnitude of transfers.
[9] It is important for our results that post-secondary education is not inefficiently high. Put differently, we assume that $h'(\tau) \ge R$.
[10] Our assumptions imply that $g_1 \ge 0$ does not bind at the parent's optimum: $u'(0) = +\infty$ and $\alpha > 0 \Rightarrow g_1 > 0;$ $e^p \ge 0,$ however, may bind. Key results in this paper hold even when the child has an endowment that can support first period consumption (Brown *et al*., 2006).

negative transfer or through negative investment in the child's education. The non-negativity of cash transfers in the second period will play a crucial role in determining equilibrium investments.

The child takes the parent's choices of c_1^p, a^p and e^p as given, choosing c_1^k, a^k and e^k subject to constraints $c_1^k + a^k + e^k \leq g_1$, $e^k \geq 0$ and $a^k \geq 0$. In the second period, the parent determines consumption c_2^p and the amount of the second period cash transfer to the child, g_2, subject to constraints $c_2^p + g_2 \leq Ra^p$ and $g_2 \geq 0$. The child consumes his total resources, so that $c_2^k = Ra^k + h(e^p + e^k + \tau) + g_2$.

b. Period 2

The parent's problem in the second period is

$$\max_{g_2 \geq 0} \left\{ u(Ra^p - g_2) + \alpha u(Ra^k + h(e^p + e^k + \tau) + g_2) \right\},$$

and the optimal transfer, given the second period resources of the parent and child, is

$$g_2(Ra^p, Ra^k + h(e^p + e^k + \tau)) = \begin{cases} g_2 \text{ such that } u'(Ra^p - g_2) = \alpha u'(Ra^k + h(e^p + e^k + \tau) + g_2) \\ \qquad \text{where } u'(Ra^p) < \alpha u'(Ra^k + h(e^p + e^k + \tau)), \\ 0 \quad \text{otherwise.} \end{cases} \tag{1}$$

When the transfer that equates second period marginal utilities across generations is positive, the parent achieves her preferred allocation of the family's total final-stage resources.[11] The parent's altruism toward the child implies that the final transfer decreases with the child's assets and earnings, no matter what choices preceded them, so second period transfers, when made, are compensatory.

[11] This surprisingly robust prediction is the focus of the theory and empirical analysis in Altonji, Hayashi and Kotlikoff (1997).

c. Period 1: Child

In the first period, the child determines his or her own consumption, saving, and educational investment given the $(g_1,\ a^p,\ e^p)$ chosen by the parent. The child's problem is

$$\max_{c_1^k, c_2^k, e^k \geq 0, a^k \geq 0} \left\{ u(c_1^k) + \beta u(c_2^k) \right\}$$
$$s.t.\ \ c_1^k + e^k + a^k \leq g_1,$$
$$c_2^k = Ra^k + h(e^p + e^k + \tau) + g_2(Ra^p, Ra^k + h(e^p + e^k + \tau)) \text{ and}$$
$$g_2(Ra^p, Ra^k + h(e^p + e^k + \tau)) \text{ as in (1).}$$

The function $g_2(Ra^p,\ Ra^k + h(e^p + e^k + \tau))$ is continuous but non-differentiable where $\alpha u'(Ra^k + h(e^p + e^k + \tau)) = u'(Ra^p)$. This non-differentiability creates two segments of the family's problem, representing the regions in which second period transfers do and do not take place.

The first order conditions to the child's problem make clear that whenever $g_2 > 0$, the child would like to over-consume in the first period in order to achieve consumption path $\{c_1^k, c_2^k\}$ such that

$$u'(c_1^k) = \beta \max\left\{R, h'(e^p + e^k + \tau)\right\}\left(1 + \frac{\partial g_2}{\partial(Ra^k + h(e^p + e^k + \tau))}\right)u'(c_2^k)\,. \qquad (2)[12]$$

This will be possible only if there exist an $e^k \geq 0$ and $a^k \geq 0$ that satisfy (2) given the parent's choices. As we show in the appendix, the parent can choose $g_1,\ e^p$ and a^p such that $e^k \geq 0$ and $a^k \geq 0$ bind.

[12] Recall the partial derivative $\frac{\partial g_2}{\partial(Ra^k + h(e^p + e^k + \tau))}$ is negative since second period transfers are compensatory.

d. Period 1: Parent

In period 1, parents choose c_1^p, g_1, e^p and a^p to maximize their utility, subject to $c_1^p + a^p + e^p + g_1 \le x^p$, $g_1 \ge 0$ and $e^p \ge 0$. We note three features of the model in proposition 1.[13]

Proposition 1*: (i)* There exist unique equilibrium consumption levels $\{c_1^p, c_2^p, c_1^k, c_2^k\}$. *(ii)* If $g_2 > 0$ in any equilibrium, then $h'(e^p + e^k + \tau) = R$ and the equilibrium transfers (e^p, g_1, g_2) are unique. *(iii)* If $g_2 \ge 0$ binds in any equilibrium, then $h'(e^p + e^k + \tau) > R$ – there is inefficient investment in education – and the equilibrium transfers need not be unique, since only the sum, $g_1 + e^p$, is determined.

The solution partitions the parameter space into two regions. In one region $g_2 > 0$ and $h'(e^p + e^k + \tau) = R$. The parents' c_1^p, g_1, e^p and a^p meet conditions

$$\begin{aligned}&u'(c_1^p) = \alpha u'(c_1^k),\ u'(c_1^p) = \beta R u'(c_2^p),\ h'(e^p + \tau) = R, \text{ and } u'(c_2^p) = \alpha u'(c_2^k),\\ &\text{where } c_1^p = x^p - g_1 - e^p - a^p,\ c_1^k = g_1,\ c_2^p = Ra^p - g_2, \text{ and } c_2^k = h(e^p + \tau) + g_2\end{aligned} \tag{3}$$

The solution will be in this region when parents are relatively wealthy or altruistic, or the child's return to human capital investment falls relatively quickly to the real interest rate, or some combination of these factors.

In the $g_2 > 0$ equilibrium strategic concerns arise so parents bear all responsibility for investing in the child's education. The child realizes that the parent will be in the interior of the transfer region in the second period. Hence, given the opportunity, the child over-consumes in the first period, as shown in equation (2). The parent takes this into account and makes a cash gift of only what she prefers for the child to consume in the first period. The parent ties all additional first period transfers to education, exhausting the region of educational investment that yields a return at or above the real interest rate. Overall, we find that families in the $g_2 > 0$

[13] Proofs of all propositions are given in the Appendix.

equilibrium face strategic concerns, and yet make efficient educational investments. Put differently, the parent relieves the child's educational borrowing constraint.

The other region of the parameter space occurs where conditions (3) can be met only with $g_2 < 0$. In this case, $g_2 = 0$ and $h'(e^p + e^k + \tau) > R$.[14] The equilibrium is described by

$$\begin{aligned}&u'(c_1^p) = \alpha u'(c_1^k),\ u'(c_1^p) = \beta R u'(c_2^p),\ \ h'(e^p + e^k + \tau) > R,\ u'(c_2^p) > \alpha u'(c_2^k),\\ &\text{and } u'(c_1^k) = \beta h'(e^p + e^k + \tau) u'(c_2^k), \text{where } c_1^p = x^p - g_1 - e^p - a^p,\\ &c_1^k = g_1,\ c_2^p = Ra^p, \text{ and } c_2^k = h(e^p + e^k + \tau).\end{aligned} \tag{4}$$

It occurs when parents are relatively poor, or egoistic, or a child's return to human capital investment falls relatively slowly with additional education, or some combination of these factors. The absence of a second period transfer means that the child has no incentive to behave strategically. As a result, the parent and child agree on the intertemporal condition to be met by the child's consumption: $u'(c_1^k) = \beta h'(e^p + e^k + \tau) u'(c_2^k)$.

While parents and children agree on the intertemporal condition, the $g_2 = 0$ equilibrium is inefficient. The post-schooling consumption that parents prefer to allocate to the child is less than the earnings produced by the efficient human capital investment. In other words, conditions (4) imply $c_2^k < h(e^*)$, where $e^* = h'^{-1}(R)$. Since parents cannot reclaim the return to e^p invested in the child's education, they invest in human capital to support the child's second period consumption but physical capital to support their own. This leads parents to tolerate the $h'(e^p + e^k + \tau) > R$ wedge in the investment returns, despite their unbounded access to credit. Families in the $g_2 = 0$ equilibrium face no strategic concerns, yet are led by an intergenerational borrowing constraint to invest inefficiently in their children's human capital.

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[14] We recognize that there may exist a knife's-edge case where $g_2 = 0$ and $h'(e^p + e^k + \tau) = R$, but $g_2 \geq 0$ does not bind. This case has no consequences for our empirical work.

Proposition 1 identifies two groups of families – one group faces an intergenerational borrowing constraint and invests inefficiently in their children's human capital, the other group does not. Given this equilibrium, we next discuss the role of financial aid in determining the child's equilibrium post-secondary education attainment.

Proposition 2: *(i)* In any equilibrium in which $g_2 > 0$, $\frac{\partial(e^p + e^k)}{\partial\tau} = -1$; financial aid does not influence total educational attainment. *(ii)* In any equilibrium in which $g_2 \geq 0$ binds, $\frac{\partial(e^p + e^k)}{\partial\tau} > -1$; financial aid does influence total educational attainment.

Propositions 1 and 2 suggest a new strategy for examining borrowing constraints for education. With data on parent-child pairs, g_2, and financial aid, we can examine the correlation between children's years of schooling and financial aid, conditioning on child characteristics, using two separate subsamples. The first is one in which the parent makes a post-schooling transfer ($g_2 > 0$), and the second is one in which she does not ($g_2 = 0$). Our model implies that financial aid will have no effect on the educational attainment of children in the first ($g_2 > 0$) sample, and a positive effect on the educational attainment of children in the other sample. We discuss our HRS-based work implementing this strategy below.

Federal and private financial aid is generally a decreasing function of parents' resources, with some lower resource bound at which aid reaches the full cost of attendance. Suppose that τ is $\tau(x^p)$. Proposition 3 describes the effects of parents' resources on children's educational attainment, incorporating the effects of financial aid.

Proposition 3: *(i)* Where $\tau'(x^p) < 0$, as long as x^p, α, τ and $h(\cdot)$ are such that $e^p + e^k = 0$ in equilibrium, $\frac{de}{dx^p} < 0$. *(ii)* Where $\tau'(x^p) = 0$, $\frac{de}{dx^p} \geq 0$.

Put differently, holding all else equal, educational attainment will vary *inversely* with parental resources for those intergenerationally constrained families where parents contribute nothing to their children's education. The explanation comes directly from financial aid rules. As parents' resources increase, the expected family contribution (EFC) increases. If children have parents who refuse to meet the EFC, the larger the unmet EFC, the lower the child's educational attainment. For low-income families who get full financial aid or high income families who are too wealthy to receive financial aid, educational attainment will be non-decreasing with parental resources.

This is the first paper to identify a subset of families where the effect of parents' resources on children's education may be negative.[15] Given the empirical literature on borrowing constraints for higher education, the proposition is noteworthy. Much of that literature presumes that a *positive* relationship between parental resources and a child's educational attainment is evidence of borrowing constraints. Carneiro and Heckman (2002), for example, argue that once ability is appropriately accounted for, this positive relationship is weak, and hence borrowing constraints are relatively unimportant. But the empirical relationship that has received the most attention in the literature is not meaningful in the context of our model. We would expect to get weak or insignificant income-attainment relationships if we mix constrained and unconstrained households in the estimation sample.

We turn to data from the HRS and NLSY-97 for our empirical work motivated by propositions 1 through 3.

II. The effects of financial aid on education in intergenerationally constrained and unconstrained families

There are two critical pieces of information needed to examine the implications of Propositions 1 and 2: post-college transfers and receipt of financial aid. The HRS has the

[15] The spirit of the strategic concern in Bruce and Waldman (1991) goes in this direction, but they demonstrate that in equilibrium parents correct children's incentive to under-invest via the tied transfer.

needed information. Proposition 3 requires information on family income while the child is in college, which the HRS does not have, so we use the NLSY-97 to examine it. The NLSY-97 does not have post-college financial transfers, so it is not useful for looking at Propositions 1 and 2.[16]

The HRS is a national panel study with an initial sample (in 1992) of 12,652 persons and 7,607 households. It oversamples blacks, Hispanics, and residents of Florida. The baseline 1992 study consisted of in-home, face-to-face interviews with the 1931-1941 birth cohort and their spouses, if married. Follow-up interviews were given by telephone in 1994, 1996, 1998, 2000, 2002 and 2004. Other cohorts, born before 1923 (Asset and Health Dynamics of the Oldest Old), between 1923 and 1930 (Children of the Depression), and between 1942 and 1947 (War Babies), were added to the main HRS cohort in 1998.[17] We use data from all these cohorts as long as needed information is available.

The NLSY-97 is a national panel survey of 8,984 youths who were born between 1980 and 1984. The first wave of the survey was conducted in 1997, at which time youths and one of their parents were interviewed in person. Youths have been interviewed annually since that time; 2004 is the last year for which data are currently available (making eight available waves). The sample reflects 6,748 cross-sectional respondents (designed to be representative of people living in the United States in 1997 and born in the years specified above), and 2,236 supplemental respondents resulting from an over-sampling of racial and ethnic minorities (blacks and

[16] In the NLSY-79 the latest measure of g_2 is elicited when the children are 21 to 28 years old. The ideal measure for identifying parents with active post-schooling financial linkages would use a long post-college period. Moreover, the age distribution of the sampling frame in the NLSY-79 is such that there are not enough siblings to estimate models with family fixed effects. The value of conditioning on time-invariant family-specific factors is discussed below.

[17] A 1948 to 1953 cohort (Early Baby Boomers) was added in 2004, but because we do not have information on this group in earlier waves, we do not include them in our study.

Hispanics).[18]

a. Measuring post-college cash transfers

In waves 3 through 7 of the HRS respondents are asked the following question about cash transfers exceeding $500 in the last 24 months.[19] The specific wording in 2000 (Wave 5) reads:

> "Including help with education but not shared housing or shared food (or any deed to a house), in the last 2 years did [the Respondent or Spouse] give financial help totaling $500 or more to any of their children or grandchildren?"

Those answering "yes" were then asked how much. We aggregate transfers reported by parents over the period 1998-2004 (Waves 4 through 7) for our first measure of post-college cash transfers, g_2.[20] There are three reasons for using this measure. First, starting in 1998 (wave 4) the HRS is a representative sample of all households born before 1948, so it is natural to start with this wave. Second, even if we were willing to ignore data from the new cohorts added to the HRS in 1998, it is not clear how to aggregate over the first three waves due to differences in the way the transfers question was worded in each wave. Third, problems with missing responses increase with the number of waves we use.

We would prefer, however, to use a measure of significant post-college transfers over a longer time period in the estimation. While no long-term retrospective question on major cash transfers to children is available in any of the HRS core surveys, Wave 2 of the HRS, fielded in 1994, does include a topical module on parent-child transfers. The Wave 2 survey (in Module 7) asked 827 HRS respondents:

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18 http://www.nlsinfo.org/nlsy97/docs/97HTML00/97guide/chap1.htm

19 Wave 1 asks about transfers exceeding $500 in the last 12 months and wave 2 asks about transfers exceeding $100 in the last 12 months.

20 Recall that the purpose of g_2 is to separate the sample into intergenerationally constrained and unconstrained parent-child pairs. The fact that the primary transfer question includes grandchildren is not ideal, given that the model we write down considers only two generations. But we think parents making cash gifts to grandchildren are likely to have relieved educational borrowing constraints for their children, so we do not view the inclusion of grandchildren in the transfers question to be an important limitation of the study.

> "Other than contributions toward education expenses, have you ever given substantial gifts to your grown children?"

Those who answer "yes" are asked the total amount of these gifts. This is arguably the exact question we require to distinguish families with relatively wealthy or altruistic parents who have active post-schooling financial linkages from those with relatively poor or egoistic parents who likely have no post-schooling financial linkages. The drawback to this question, clearly, is that it was asked only of a small subsample. Thus we report estimates using both the shorter window of cash transfers observed for the full HRS sample and this longer transfer window observed only for Wave 2, Module 7 respondents. Responses to this question are available for 334 of the 9471 families for whom we have complete demographic and education information on multiple siblings aged 24 and older. These families include 1,262 children.[21]

b. A proxy for financial aid

The median year in which children in our HRS sample reach the age of 18 is 1977, with a substantial number being college age in the 1970s, 80s, and early 90s. The U.S. Higher Education Act of 1965 authorized grants and subsidized loans for students pursuing post-secondary, graduate, and professional education. The Higher Education Act was reauthorized every 4 years between 1968 and 1980, and every 6 years thereafter. The 1992 reauthorization came with several major reforms. Before 1992, parents' EFC was calculated according to separate formulas for Pell Grants (the Pell Grant Index) and subsidized loans (the Congressional Methodology). After 1992 a common Federal Methodology was used.[22]

It would be difficult to trace and aggregate all of the historical details of U.S. financial aid policy over the relevant period for our sample children, and impossible to uncover parental asset

[21] Appendix Table 1 gives more detail on the construction of the full HRS sample and the module sample that we use for our analyses.

[22] Helpful discussions of federal financial aid policy can be found in NCES (2004), Kane (1998), Kim (1999), Monks (2004), and Wu (2006).

and income information relevant to financial aid formulas at the potential date of college entry for each sample child. One consistent feature of the aid formulas, however, allows us to infer a major component of within-family aid variation from family structure alone. Both before and after the 1992 reform, the EFC has been independent of the number of children a parent had in college in a given year. Once the family's "Adjusted Available Income" is determined based on income and assets, the EFC comes from dividing it by the number of children in college in the relevant academic year. This means there are large discontinuities in financial aid as a function of number of siblings in college.

Define *COA* as the cost of attending college for a given student, including tuition and fees, room and board, books and travel expenses. The objective of federal aid, in cooperation with most U.S. colleges, is to provide grants and loans that cover the cost of attendance after the individual student's expected family contribution is removed, *COA – (EFC/# children in college)*. This implies that for a lone student for whom *COA* > *EFC*, the amount of college costs not covered by aid is decreased by *EFC/2* dollars with another sibling attending college in the same year. Depending on the size of the expected family contribution, this formula may create large swings in individual siblings' costs of college as family members age through the education process, and may be responsible for large differences in the costs of educating siblings within the same family.

We use the variation in college financial aid due to children's birth spacing to proxy for unobserved aid levels.[23] It is handy that the landmark 1965 reforms in higher education finance occurred *after* the vast majority of children in our sample were born, so we are comfortable in assuming the spacing of births is exogenous to the way we model financial aid.

[23] Our use of child birth spacing is similar to the approaches taken by Kim (1999) and Monks (2004) to estimate the savings effects of the asset tax implicit in the federal financial aid formula.

Given that parental resources affect financial aid, families might want to declare their children's financial independence. The standards for independence, however, are strict. In order to declare independence a student must *(i)* reach age 24 by January of the academic year, or *(ii)* enroll in a graduate program, or *(iii)* be married, or *(iv)* have a dependent child or other dependents, or *(v)* be an orphan or ward of the court, or *(vi)* be a veteran of the U.S. Armed Forces (IFAP 2006). Thus a child under age 24 where parents decide not to make the expected family contribution has few options.[24]

c. The samples used for estimation

Our sample selection criteria include the requirement that we observe parents' household income and net worth and complete information on the education, date of birth, and relationship to the family of each child reported by the HRS respondent. We also require that children included in the estimation have at least one sibling. Finally, we include only children aged 24 or older at the 2000 survey in our estimation sample. The intention of this restriction is to allow the sample children time to complete their schooling, and to consider only cash transfers that take place following completion of the children's schooling.[25] As shown in Appendix Table 1, this leaves us with a sample of 34,593 children representing 9,471 HRS families.

Our empirical models include a series of child variables that allow us to condition on factors that may influence the schooling attained by a young adult student, particularly relative to his or her siblings. These include the child's age in 2000, the child's gender, indicators for whether the child is an oldest child or a youngest child, and the number of sibling-years of overlap for a

[24] The child could, of course, work during college. Work hours compete with study hours, and the schooling attainment and earnings costs of this competition are demonstrated in Keane and Wolpin (2001). Stinebrickner and Stinebrickner (2003) provide evidence of a significant academic performance cost of working while in college based on exogenous work-study assignments at Berea College.

[25] The qualitative results are similar, and the sample is still quite large, where we require sample children to be aged 30 or older in 2000.

college-age child. Specifically, the child's sibling-years of overlap is the sum of the number of siblings the child had between the ages of 18 and 21 while he or she was 18, plus the number of siblings aged 18-21 while he or she was 19, and so on, until the child is age 21.

Table 1 gives descriptive information for these variables for both the full HRS analysis sample and for the Wave 2, Module 7 respondents. Forty-nine percent of core sample children have parents who made positive cash transfers to them or to a sibling between 1998 and 2004, and 37 percent of the children of module respondents have parents who ever made substantial non-educational transfers to their adult children.[26] These variables allow us to split samples based on post-schooling transfers as suggested by the analytic model. Roughly half of each sample is female. The median child age in 2000 is 41 for both samples. Birth order indicators tell us that 29 (26) percent of core (module) sample children are oldest siblings, 26 (24) percent youngest, and 45 (50) percent are middle siblings. We do not include other information available on the sample children, such as marital status or earnings in 2000, as these variables are likely to have been determined after the completion of the child's schooling.

The dependent variable in our primary empirical specification is the child's education. Core sample children have attained a mean of 13.8 and a median of 13.0 years of schooling (it is 13.3 and 12.0 in the module sample). The large sample and broad range of ages give us a standard deviation of 6.88 years of schooling, despite the top-coding of schooling years to 17 for graduate and professional education.[27] The primary independent variable of interest is years of overlap with siblings. Its mean and median are 2.34 and 2.00 in the core sample and 2.63 and 2.00 in the

[26] Readers might expect that the fraction of the sample *ever* giving cash gifts would exceed the fraction of the sample giving cash gifts between 1998 and 2004. Three factors make the 49 and 37 percent responses not perfectly comparable. First, the Wave 2, Module 7 question refers to "substantial" gifts while the other question asks specifically about gifts exceeding $500. Second, the Wave 2, Module 7 question is asked of a much narrower cohort of households. Third, the core sample question includes gifts to grandchildren exceeding $500.

[27] The youngest children in the sample are 24. The oldest 1.8 percent of children have reached retirement age.

module sample. There is substantial variation in sibling-years of overlap in both samples, with a standard deviation for this variable of roughly 2.1 years in each.

III. HRS and NLSY-97 specifications and results

Recall that our model implies that financial aid will have a positive effect on the educational attainment of children whose parents make no subsequent gifts ($g_2 = 0$), but financial aid will not affect the educational attainment of children whose parents do make subsequent gifts to children ($g_2 > 0$).

Many factors likely influence the difference in schooling between two arbitrarily chosen, unrelated students. Among other issues, parents may differ in their attitudes toward education and their child investments. Heritable components of academic aptitude that the students received from their parents might differ. We would have a difficult time controlling adequately for these between-family differences using the HRS data. For these reasons we estimate the dependence of educational attainment on child characteristics accounting for unobserved family effects. A family fixed effect specification is appealing because it allows family effects to be arbitrarily correlated with other child characteristics used as regressors. It has a drawback, however, in that siblings in two-child families will have identical years of "overlap," so the central overlap coefficient is identified from families with three or more children. In sensitivity analysis, we also estimate random effect specifications. This alternative accepts the assumption that family effects are independent of the regressors in exchange for the ability to identify the overlap coefficient using families of all sizes.

Our empirical model is

$$e_{is} = \omega_i + X_{is}\beta + \gamma o_{is} + \varepsilon_{is}, \qquad (5)$$

where families are indexed by $i = 1,\ldots,N$ and siblings in family i by $s = 1,\ldots,S_i$.[28] In this expression e_{is} represents the education of sibling s in family i, X_{is} is a vector of exogenous characteristics of sibling s in family i, and o_{is} represents the number of years of overlap in college ages that sibling s in family i shares with his or her siblings. Family fixed effect ω_i represents the unobservable contribution to educational attainment shared by the children of family i. The measures of fit reported with our fixed effect estimates reflect the estimation of a separate intercept value for each sample family.

The coefficient of interest in the fixed effect specification is γ, the effect of the overlap variable (which proxies for financial aid) on children's total schooling. Table 2 reports estimates for the gift and no-gift subsamples using the full HRS sample and the special question asked of Wave 2, Module 7 respondents. We find a coefficient on overlap of 0.105 in the no-gift, full HRS sample, which is significantly different from zero at the one percent level. The corresponding coefficient in the gift, full HRS sample is 0.034. The estimate is not significantly different from zero at standard confidence levels. A similar pattern emerges in the results using the Wave 2, Module 7 sample. The coefficient on overlap in the no-gift sample is 0.094 and differs significantly from zero at the one percent level. The coefficient on overlap in the gift sample is -0.050 and is insignificant. Given the standard errors we can reject the null hypothesis that the overlap coefficient in the no-gift category is equal to the point estimate for the overlap coefficient in the gift category in both the full and module samples at standard confidence levels.

The magnitudes of the estimated overlap coefficients are similar in the two no-gift samples. The coefficient on overlap for the no gift group drawn from the Wave 2, Module 7 sample, for

[28] Note that sibling numbers vary by family, creating an unbalanced panel. The number of siblings within a family in the samples range from 2 to 11.

example, indicates that a college student with no siblings in college (during all four years) attains almost one semester less schooling than a student who has one sibling in college for each of the four years, all else equal. This implies there is a substantial effect of college financial aid on students' educational attainment in families of less generous parents. Our estimates indicate no effect of financial aid in the families of more generous parents. The estimated pattern of financial aid effects and parental generosity matches precisely the pattern suggested by the analytic model.

Other coefficients describe the effects of children's demographic characteristics at the time of schooling decisions on their attainments. Brothers get less schooling than their sisters on average, and this effect is significant at the five percent level in two of the samples. The implied difference in schooling between brothers and sisters on average is a third of a year or less. Controlling for birth order, older siblings get significantly less schooling than younger ones in both no-gift samples; one year more of age is associated with 5 hundredths of a year of school in the two samples. Oldest children receive more education than their middle-child siblings on average, though the estimated coefficient on the oldest child indicator is significantly different from zero for only one of the four samples. There is no clear pattern in the level of schooling of youngest children relative to those of middle children.

a. Estimation issues and sensitivity analyses with the HRS sample[29]

The central HRS results raise a number of considerations. We address many of these in the subsections below.

<u>1. The financial aid proxy</u>

A key question for our HRS analysis is whether our financial aid proxy is valid: is the sibling overlap variable used in the HRS specifications significantly, positively correlated with financial aid? We cannot answer this question with HRS data, since it does not include

[29] Any result not shown in the paper is available from the authors on request.

information on financial aid. But we can examine the relationship between sibling overlap and financial aid using the NLSY-97. To do this we regress the financial aid a student receives in his or her first term of college on a set of covariates, including parental income, parental income squared, net worth, net worth squared, AFQT, AFQT squared, a constant, and a measure of sibling overlap. We measure the sibling overlap variable as the number of siblings who are college age (ages 18 through 21) at the time financial aid is being measured for the child in question.[30] The sibling overlap variable does not require the sibling to be in college at the time, since this information is not available in the HRS. Despite this limitation, the coefficient of the overlap variable given in Appendix Table 2 is $358 and it is significant at the 5 percent level.[31] This result adds to our confidence that the financial aid proxy used in the HRS analyses does, in fact, capture financial aid differences within and across families.

2. Random effects

The random effect estimates from the full HRS sample are presented in Table 3. The results are consistent with the fixed effect results in Table 2. The overlap coefficient is 0.071 and significant in the "no gift" sample, and 0.034 and insignificant in the "gift" sample. Like others, we find that parental education is strongly correlated with educational achievement in both subsamples.[32]

3. Stepchildren

Behavior and outcomes within adult families have been found to vary greatly by whether a

[30] We used the household and non-household rosters to construct information on respondents' siblings (so that we could get siblings living both in and out of the respondent's home). Siblings are defined to be biological, half, step, adoptive, or foster siblings.

Our measure of financial aid includes the dollar amount of any grants, scholarships, loans, work study, or other kinds of government/institutional aid a respondent received during his/her first term of post-secondary schooling.

[31] The mean financial aid for all NLSY-97 college students is slightly under $3,000.

[32] Parental education is measured for the HRS family respondent. Most but not all family respondents are mothers. We chose to do this in order to retain families in which only the mother or only the father is represented in the HRS.

child is a stepchild of either parent.[33] We do not include any indication of children's biological, adopted or step child status in the estimation. The HRS does not distinguish between biological and adopted children. Wave 5 does identify step children of the family respondent in a couple, but this leaves unidentified any step children of the non-family respondent. We repeated the central estimation shown in Table 2 using only never married parents and parents who were still married to their first spouses in 2000 in an effort to drop step families. The results for the parameters of interest were qualitatively identical to those we report, except that the t-statistic for the coefficient on the overlap measure among intergenerationally constrained ($g_2 = 0$) families fell from 3.4 to 2.9.

4. The distribution of effects and financial aid policy

There are nonlinearities in the financial aid system that we do not account for in the central empirical specification given in Table 2. For example, the children of very wealthy parents can expect no federal financial aid whether or not they have siblings in college.[34] Similarly, federal aid formulas provide approximately full support to the children of very poor parents, and therefore educational achievement should be unrelated to sibling overlap. Thus, even in the no-gift subsample, we would expect years of schooling to be unresponsive to sibling "overlap" for children in low-income families, because they receive full financial aid, and for children in high wealth families, because their EFC exceeds any cost of schooling.

We do not know the parent's financial circumstance at the time their children were in school. So, to address the concern about non-linearities, we repeat the initial estimation dividing the full sample gift- and no-gift subgroups into terciles of parental net worth, with the idea that "overlap" should not matter for any tercile of the gift sample and it should be strongest for the

[33] See, for example, Light and McGarry (2004), Brown (2006), and Pezzin, Pollak, and Schone (2006).
[34] Monks (2004) emphasizes this point.

middle tercile of the no-gift sample.

Estimates are given in Table 4. Sample sizes for each subgroup exceed 5,000. As in the full gift sample, the estimated overlap coefficients are small and not significantly different from zero in each of the net worth terciles of the gift sample. In the no gift sample, we find positive but insignificant overlap coefficients for the poorest and wealthiest terciles. However, the point estimate of the coefficient on sibling overlap is 0.213 for the middle tercile. It differs significantly from zero at the one percent level.

Though we have no way of knowing whether the net worth tercile categorization appropriately reflects the parental income and wealth regions where financial aid is either complete or zero, regardless of sibling overlap, we nevertheless expect that the aid received by middle wealth children varied most in response to sibling years of overlap. The evidence that most of the effect of sibling overlap on educational attainment is observed in middle wealth families is encouraging, given the structure of financial aid policy.

5. Ability and birth spacing

We do not have an ability measure in the HRS. This is one of the reasons why a within-family (fixed effect) specification is useful with the HRS, since it accounts for time-invariant family-specific ability differences that might arise from the home environment. Nevertheless, there are obviously ability differences between children within a family. If closely spaced children have significantly different ability than children with greater birth spacing, our HRS-based estimates might be biased. For this bias to explain most or all of the results, it must be the case that the ability levels of closely spaced children exceed the ability levels of children spaced apart in families where there are no post-schooling transfers (constrained families, or families with $g_2 = 0$), and this ability differential with birth spacing does not occur in unconstrained

($g_2 > 0$) families. If families with closely spaced kids are resource-constrained over their life-cycle, either in the time or the money they are able to allocate to closely-spaced siblings, it seems unlikely the constrained subset have higher ability children relative to others, at least in an economically important magnitude.

Nevertheless, we can use the NLSY-97 to examine whether sibling overlap is correlated with AFQT. In Appendix Table 3 we show the result of regressing AFQT on sibling overlap (measured in the same way we measure it in the HRS) and covariates that we expect to be correlated with AFQT, including mother's education, parental income, parental income squared, indicator variables for the number of siblings, female, black, Hispanic, broken home, living in an urban area, and living in the South. Sibling overlap is significantly correlated with AFQT, but the relationship is negative, and the empirical magnitude is -0.51, while the standard deviation of AFQT is 29.2 in the sample. Hence, we find it implausible that unobserved ability accounts for the empirical patterns we document in the HRS data.

6. Borrowing constraints versus "price effects"

Our central results demonstrate that financial aid has a positive effect on educational attainment for children in families that are likely to be borrowing constrained. A skeptical view of our results might be that they simply are a result of "price effects," namely, that financial aid makes education less expensive, so more of it is purchased. This argument, however, does not withstand closer scrutiny. Recall that the marginal condition dictating the optimal choice of education is given by $h'(e)=R$. According to the price effect hypothesis, financial aid makes e cheaper and hence it must rise in equilibrium. If that is the case, e should rise for all families, not just the ones that are intergenerationally constrained (the $g_2 = 0$ subsample). Along with the other evidence presented in the paper, the fact that we see the effect of financial aid only in the potentially constrained (*h'(e)>R*) group but not in the unconstrained (*h'(e)=R*) group suggests that price effects, at least in its simplest version, is an implausible alternative explanation.

b. Examining Proposition 3

Our framework suggests two empirical implications we should observe in the NLSY-97 data. First, borrowing constraints will arise when families are intergenerationally constrained. These constraints arise when parents fail to meet their expected family contribution. This leads to a strong implication, demonstrated in Proposition 3: when parents make no contribution to college and their expected family contribution is positive, borrowing constraints imply the probability of completing college should *decline* with parental income. This expected empirical pattern is precisely the opposite of the positive college-income gradient that many previous studies interpret as being consistent with credit constraints.

We impose four sample restrictions to look at this hypothesis. First, parents make no contributions for college ($e^p = 0$);[35] second, parental income in 1996 exceeds $20,000 (in 2004/05 dollars); third, all children in the sample have enrolled in at least one semester of school beyond high school; and fourth, no covariates or variables to select the sample are missing. The first criterion is necessary to yield an unambiguous empirical hypothesis.[36] The second criterion is necessary because, below some threshold of income, the expected family contribution is zero. As long as institutions meet financial need through packages of grants and loans, parents with very low incomes would be expected to make no contribution to their children's higher education, yet their children would not be borrowing constrained. Twenty thousand dollars (in

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[35] Parental support for college (e^p) is positive for a given college term when the respondent indicates that one or both of her parents provided financial assistance during that particular term (through 2004). Respondents with college experience whose parents do not provide assistance during *any* of the terms they are in college compose our sample of $e^p = 0$ students.

[36] The expected relationship between income and educational attainment in the $e^p > 0$ subsample is ambiguous. Financial aid will decrease with income, but parental gifts presumably increase with income.

2004/05) is a conservative threshold below which the parent's expected family contribution is $0.[37] The third criterion arises because we select the sample on the condition $e^p = 0$. It is trivially true that parents provide no payments for higher education when their children never attend college. But these children may well not be intergenerationally constrained. To examine the sharp hypothesis of a *declining* relationship between income and college completion, we want to focus on families that are intergenerationally constrained. Descriptive statistics for the samples are given in Table 5.

As shown in the left-hand side of Table 6, which report the marginal effects from a Probit on college completion, parental income is indeed negatively related to college completion for incomes up to $112,000, which includes 97 percent of the sample. Evaluated at the means of continuous variables and modes of discrete variables, a $10,000 increase in income lowers the probability of college completion by 1.7 percentage points. This marginally significant result is consistent with the existence of borrowing constraints for higher education. The coefficients of other covariates have the expected signs, but only the coefficients of female (which is strongly, positively correlated with college completion), AFQT and student age are significant at usual levels of confidence.

The second unambiguous implication we can examine with NLSY-97 data is that income should not affect the educational attainment of families with expected financial contributions of $0, conditioning on ability and other factors thought to affect educational attainment. The intuition for this hypothesis is again straightforward. We assume educational institutions will provide grants (particularly Pell grants) and loans to students to meet the cost of attendance when federal formulas deem parents as being unable to contribute to college costs. To examine this we

[37] The guidelines state that the EFC should automatically be zero if gross income is under $15,000. With exclusions and other provisions, there is clearly a discrepancy between our NLSY-97 income measure and "gross income" as required in EFC calculations. We address this issue in greater detail below.

draw a sample where parental income is less than $20,000 (in 2004/05) – the threshold below which the expected family contribution is zero, assuming the family pays no state or federal income tax and has no work-related expenses for dual-earner couples. We again drop all observations with missing values. Details of the sample construction are giving in Appendix Table 4.

Probit estimates from this sample are shown in the right-hand columns of Table 6, where college completion is the measure of educational attainment. As hypothesized, the parental income terms are insignificant. College completion is positively correlated with AFQT and marginally correlated with being black or from a single-parent family.

Taken together, we view the evidence from the NLSY-97 as being broadly consistent with the evidence from the HRS documenting the presence of borrowing constraints for a portion of children in families that are intergenerationally constrained.

c. A direct examination of borrowing constraints for higher education

There is one further step that we can take with the NLSY-97 data. Our theory and empirical work emphasize the importance of identifying the potentially constrained population: those parent-child pairs where the parents do not invest efficiently by meeting their EFC. Up to this point we have followed the implications of the theory, distinguishing the constrained group by whether or not parents make post-schooling gifts. An alternative is to impute the EFC and then observe whether parents paid it based on reported contributions.

The EFC is a function of many factors including parents' income, assets, and family structure. We expect the child's years of education to decrease with $(EFC - e^p)$. A complication is that everything that goes into EFC is, in some way, a measure of the family's socio-economic status. And we expect the child's educational attainment to be positively correlated with socio-economic status. So unless we impute EFC perfectly and include exactly the right measure of the family's socioeconomic status in our empirical model, estimates of $(\widehat{EFC} - e^p)$ will be biased. Moreover, imputing EFC and comparing it with actual e^p requires us to look at individuals who have at least one term of college experience. The HRS-based analysis does not require this restriction, so the analysis can accommodate the fact that borrowing constraints may cause some children to never go to college in the first place. Hence, imputing EFC is not our preferred approach.

Nevertheless, we can use data from the NLSY-97 to construct an estimate of the parents' EFC. To do this, we incorporate the following assumptions. First, we use 2001-02 academic year financial aid rules. Over the relevant period covered in our data, there are few changes to the rules (beyond adjusting for inflation). Second, we use parental financial information from 1997 (in 2000 dollars), since these are the primary data collected by the NSLY-97 on parental resources. Third, we use the income of the custodial parent's household rather than the income of the biological parents, in cases where the child does not live with his or her biological parents. We do not have information on the non-custodial parent's resources, though the EFC calculations seek information on these. Fourth, we impute tax liabilities making use of the NBER's TAXSIM model (Feenberg and Coutts, 1993), which requires us to make assumptions about property taxes, mortgage interest, and state of residence, among other things.[38] Fifth, and perhaps most importantly, we assume the EFC calculation is based on the average cost of a child attending an in-state, four-year public university, while living at home. The choice of college is clearly endogenous to the parents' willingness to finance education. Consequently, we believe the costs of college are conservatively proxied by the average in-state tuition and fees for 4-year

[38] We assume property taxes are $9 for every $1,000 of home value, mortgage interest is 6 percent of the outstanding mortgage balance, and the household is living in an unspecified state in TAXSIM, which results in the household receiving roughly average state income tax liabilities.

public institutions. The figure (in 2006 dollars) in academic year 2001/02 was $4,326 (College Board, 2006).

The key covariate in our empirical model of the highest grade completed is $(\widehat{EFC} - e^p)$. As discussed above, the maximum EFC is capped at the in-state public college cost. The minimum value of $(\widehat{EFC} - e^p)$ is set to zero: parents who give larger gifts than our imputed EFC are simply considered to have met the full EFC, but not more. Other covariates in the empirical model include parent income and its square, net worth, AFQT, number of siblings, and indicator variables for the child's gender, race and ethnicity, child age, mother's education, and whether the child lives in a single-parent household, in an urban area, or in the South.

Results for a specification focusing on highest grade completed are given in Table 7.[39] The key coefficient estimate is for $(\widehat{EFC} - e^p)$: it is negative and significant at the one percent level. Its magnitude suggests that a child from a well-to-do family who is expected to meet the full cost of the in-state public university but who, for one reason or another, decides to give nothing, would get roughly 0.6 years less total schooling than an otherwise identical child whose family meets the full EFC. This result is again consistent with borrowing constraints for education being an economically important phenomenon for a non-trivial portion of parent-child pairs. Substantially fewer than half the families in the sample used in Table 7 meet their full EFC. More than forty percent of children in the sample have gaps exceeding $1,000 between estimated EFC and parents' actual contributions.

The other covariates in the empirical model conform to expectations. The highest grade completed is positively related to AFQT, being female, and being black, and negatively related

[39] Table 7 is not a good empirical specification for examining Proposition 3, because the sample include both families that do and do not make transfers for education. Proposition 3 applies only to families who make no transfers for higher education.

to the number of siblings, being from a single-parent home and being younger at the time of the initial NLSY-97 interview.

IV. Conclusions

This paper presents a theory of efficient human capital investment, focusing on the roles of parent and child decisions and financial aid. The theory implies that financial aid increases the educational attainment of intergenerationally constrained children who receive no post-schooling gifts from their parents, but financial aid does not matter to the attainment of intergenerationally unconstrained children. These effects each rely on an asymmetry in the access of parents and their college-aged children to credit.

Estimates using data from the HRS and NLSY-97 support each of the model's major predictions. Based on an idiosyncrasy in the dependence of U.S. financial aid on the number of children a parent has in college, we use years of overlap with siblings in college ages as a proxy for financial aid. We find that children whose parents are not observed to make post-schooling cash gifts respond to financial aid in their choice of schooling. Children of parents who do make gifts do not. These results suggest that parents can relieve educational borrowing constraints for their children, but that they do not always choose to do so. They further indicate that parents and children make distinct choices regarding children's schooling, and that these choices may well be consequential for financial aid policy.

Two additional sharp predictions that arise from the theory find support in the NLSY-97. First, when parents make no contribution to college and their expected family contribution is positive, borrowing constraints imply the probability of completing college should decline with parental income. Second, income should not affect the educational attainment of families with expected financial contributions of $0, conditioning on ability and other factors that likely affect educational attainment.

We interpret our results as providing strong evidence that the inability to borrow against future earnings affects the educational attainment of a set of children living in families where parents, for one reason or another, are unwilling or unable to meet their expected family contribution. Increases in financial aid for these children would increase educational attainment. At the same time, greater financial aid would likely reduced contributions made by families currently meeting (or exceeding) their expected family contribution. So policy-makers will need to grapple with this tradeoff – providing marginal subsidies for borrowing constrained students against infra-marginal subsidies to families willing to support their children's educational goals. Our evidence suggests that financial aid increases can increase educational attainment, though clearly at a cost that exceeds a perfectly targeted policy.

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Appendix: Proofs

Constraints $a^k \geq 0$ and $e^k \geq 0$ both bind for the child if the parent chooses e^p, a^p and g_1 such that

$$u'(g_1) \geq \beta \max\left\{R, h'(e^p+\tau)\right\}\left(1+\frac{\partial g_2}{\partial(h(e^p+\tau))}\right)u'(h(e^p+\tau)+g_2(Ra^p, h(e^p+\tau))). \qquad (6)$$

Lemma 1: If $g_2 > 0$ in equilibrium, then it must be the case that $a^k = 0$.

The intuition behind lemma 1 is that, since both the parent and the child earn return R on physical capital investment, the parent who anticipates a positive second period gift will always prefer to save for the child. A formal proof of lemma 1 is available from the authors.

Lemma 2: In the first period, the parent can do no better than to choose (g_1, a^p, e^p) to maximize $\left\{u(c_1^p)+\beta u(c_2^p)+\alpha\left(u(g_1)+\beta u(c_2^k)\right)\right\}$ subject to

$c_1^p + a^p + e^p + g_1 = x^p$, $c_2^p = Ra^p - g_2(Ra^p, h(e^p))$, $c_2^k = h(e^p) + g_2(Ra^p, h(e^p))$,

$g_2(Ra^p, h(e^p))$ as in (1), and $e^k \geq 0$ and $a^k \geq 0$ binding for the child.

Assume an equilibrium consisting of

$$(e^p, a^p, g_1, e^k, a^k, g_2(Ra^p, Ra^k + h(e^p+e^k+\tau)))$$

where $e^k + a^k > 0$, and associated consumption levels

$$\{c_1^p, c_2^p, c_1^k, c_2^k\} = \{x^p - g_1 - e^p - a^p, Ra^p - g_2(Ra^p, Ra^k + h(e^p+e^k+\tau)),$$
$$g_1 - e^k - a^k, Ra^k + h(e^p+e^k+\tau) + g_2(Ra^p, Ra^k + h(e^p+e^k+\tau))\}.$$

We find that the parent can replicate the consumption paths of any such equilibrium by deviating from the equilibrium in period 1 to choose first period transfer $\tilde{g}_1 = g_1 - a^k - e^k$, savings $\tilde{a}^p = a^p + a^k$ and human capital investment $\tilde{e}^p = e^p + e^k$. In the deviation constraints $e^k \geq 0$ and $a^k \geq 0$ bind for the child. This implies that the parent can replicate any feasible consumption path by choosing (g_1, a^p, e^p) in the first period such that $e^k \geq 0$ and $a^k \geq 0$ bind. Therefore the parent can do no better than to choose her most preferred period 1 (g_1, a^p, e^p) subject to $e^k \geq 0$ and $a^k \geq 0$ binding for the child. A formal proof of lemma 2 is available from the authors.

Proof of Proposition 1:

Proof Given Lemma 2, consider the parent's solution to

$$\max_{g_1, a^p, e^p} \left\{u(c_1^p)+\beta u(c_2^p)+\alpha\left(u(g_1)+\beta u(c_2^k)\right)\right\}$$

s.t. $c_1^p + a^p + e^p + g_1 = x^p$, $c_2^p = Ra^p - g_2(Ra^p, h(e^p+\tau))$, (7)

$c_2^k = h(e^p+\tau) + g_2(Ra^p, h(e^p+\tau))$, $g_2(Ra^p, h(e^p+\tau))$ as in (1),

and $e^k \geq 0$ and $a^k \geq 0$ binding for the child.

Recall that the requirement that condition (6) holds is equivalent to the requirement that $e^k \geq 0$ and $a^k \geq 0$ bind. Suppose that the parent is permitted to choose g_2 such that $u'(Ra^p - g_2) = \alpha u'(h(e^p + \tau) + g_2)$, even if this implies $g_2 < 0$. Without imposing (6), the parent's choice of (g_1, a^p, e^p) meets conditions

$$u'(c_1^p) = \alpha u'(g_1),\ u'(c_1^p) = \beta R u'(c_2^p),\ h'(e^p + \tau) = R,\ u'(c_2^p) = \alpha u'(c_2^k), \\ \text{where } c_1^p = x^p - g_1 - e^p - a^p,\ c_2^p = Ra^p - g_2,\ \text{and } c_2^k = h(e^p + \tau) + g_2. \tag{8}$$

Conditions (8) imply $u'(c_1^k) = \beta R u'(c_2^k)$. In transfer expression (1), $\frac{\partial g_2}{\partial (h(e^p + \tau))} \leq 0$. Given $h'(e^p + \tau) = R$ in (8), it must be the case that

$$u'(g_1) = \beta R u'(c_2^k)$$

$$\Rightarrow u'(g_1) \geq \beta \max\{h'(e^p + \tau), R\} \left(1 + \frac{\partial g_2}{\partial (h(e^p + \tau))}\right) u'(c_2^k)$$

and therefore (6) is satisfied at the parent's preferred feasible (g_1, a^p, e^p). Conditions (8) are met by a unique set of consumption levels $\{c_1^p, c_2^p, c_1^k = g_1, c_2^k\}$. If conditions (8) can be met with $g_2 \geq 0$, then these consumption levels result from the parent's optimal actions given her resource constraints and the choices available to the child.

However, it is possible that conditions (8) cannot be met with $g_2 \geq 0$. Where $g_2 \geq 0$ binds for the parent, the solution to (7) is such that

$$u'(c_1^p) = \alpha u'(g_1),\ u'(c_1^p) = \beta R u'(c_2^p),\ \ h'(e^p + \tau) > R,\ u'(c_2^p) > \alpha u'(c_2^k), \\ u'(g_1) = \beta h'(e^p + \tau) u'(c_2^k), \\ \text{where } c_1^p = x^p - g_1 - e^p - a^p,\ c_2^p = Ra^p,\ \&\ c_2^k = h(e^p + \tau). \tag{9}$$

Note that $h'(e^p + \tau) > R$, $u'(g_1) = \beta h'(e^p + \tau) u'(c_2^k)$, and $\frac{\partial g_2}{\partial (h(e^p + \tau))} \leq 0$ together imply

$$u'(g_1) = \beta h'(e^p + \tau) u'(c_2^k)$$

$$\geq \beta \max\{h'(e^p + \tau), R\} \left(1 + \frac{\partial g_2}{\partial (h(e^p + \tau))}\right) u'(c_2^k),$$

so that again (6) need not be imposed. Like conditions (8), conditions (9) are satisfied by a unique set of consumption levels $\{c_1^p, c_2^p, c_1^k = g_1, c_2^k\}$. In either case, Lemma 2 implies that the parent's lifetime welfare at this consumption vector, $u(c_1^p) + \beta u(c_2^p) + \alpha\left(u(c_1^k) + \beta u(c_2^k)\right)$, represents the maximum equilibrium welfare available to the parent given the resource constraints and the child's available choices. The uniqueness of the consumption levels that solve (7) implies that no other set of feasible consumption levels yields higher welfare for the parent, and therefore $\{c_1^p, c_2^p, c_1^k, c_2^k\}$ represents the family's unique equilibrium consumption, completing the proof of *(i)*.

We know, based on (8) and (9), that $\{c_1^p, c_2^p, c_1^k, c_2^k\}$ can be generated by only one set of parental choices $\{g_1, a^p, e^p, g_2\}$ at which $e^k \geq 0$ and $a^k \geq 0$ bind. It may still be the case, however, that this same consumption path can be supported by different transfers and investments where e^k and a^k take positive values. Define $\left\{c_1^p(0), c_2^p(0), c_1^k(0), c_2^k(0),\ g_1(0), a^p(0), e^p(0), g_2(0)\right\}$ as the values of $\left\{c_1^p, c_2^p, c_1^k, c_2^k, g_1, a^p, e^p, g_2\right\}$ in the only equilibrium in which $e^k + a^k = 0$. The parent transfers to the child through $g_1(0)$, $e^p(0)$, and $g_2(0)$. We seek to determine whether the same consumption is supported where the parent transfers some portion of $g_2(0)$ or $e^p(0)$ through g_1, expecting the child to save for herself or invest in her own education.

Where $g_2(0) > 0$, the answer is clear. The child's choices of e^k and a^k meet condition (2) where $e^k + a^k > 0$. Whenever $g_2(0) > 0$, (1), (2), and $h'(e^p) = R$ together imply $u'(c_1^k) < \beta R u'(c_2^k)$. However, among conditions (8) is the requirement that $u'(c_1^k) = \beta R u'(c_2^k)$. Thus whenever $g_2(0) > 0$, the parent and the child disagree on the child's optimal intertemporal consumption path. Allowing the child to save independently or invest in her own education will lead to consumption other than $\{c_1^p(0), c_2^p(0), c_1^k(0), c_2^k(0)\}$. Thus the $e^k + a^k = 0$ equilibrium is the only set of actions that supports the parent's preferred $\{c_1^p, c_2^p, c_1^k, c_2^k\}$. The parent chooses $\{g_1, a^p, e^p, g_2\} = \{g_1(0), a^p(0), e^p(0), g_2(0)\}$ as in (3) in this unique equilibrium, imposing $e^k + a^k = 0$ and $h'(e^p + \tau) = R$. This completes the proof of *(ii)*.

Where $g_2(0) = 0$, however, the parent may reallocate transfers and still achieve $\{c_1^p(0), c_2^p(0), c_1^k(0), c_2^k(0)\}$. Only the reallocation of e^p to g_1 must be considered. Define $\underline{e}$ such that $u'(Ra^p(0)) = \alpha u'(h(\underline{e} + \tau))$. Suppose that the parent increases g_1 to $g_1 = g_1(0) + \varepsilon$, where $\varepsilon \in \left(0, e^p(0) - \underline{e}\right]$, while maintaining $a^p = a^p(0)$ and $g_1 + e^p = g_1(0) + e^p(0)$. Since $e^p \geq \underline{e}$, the second period transfer is still zero. Further, the child's choice of $e^k = 0$ given $\left(g_1(0), a^p(0), e^p(0)\right)$ implies that she chooses an e^k at which $e^p + e^k \leq e^p(0)$ given $\left(g_1(0) + \varepsilon, a^p(0), e^p(0) - \varepsilon\right)$. Therefore, by conditions (9), $h'(e^p + e^k + \tau) > R$ and the child's condition (2) determining her choice of e^k reduces to

$$u'(c_1^k) = \beta h'(e^p + e^k + \tau) u'(c_2^k).$$

Since the above agrees with the intertemporal condition on the child's consumption in (9), we see that the parent's reallocation of $\varepsilon \in \left(0, e^p(0) - \underline{e}\right]$ from e^p to g_1 results in the same equilibrium $\{c_1^p(0), c_2^p(0), c_1^k(0), c_2^k(0)\}$. Finally, condition (2) and the definition of $\underline{e}$ together indicate that where p reallocates $\varepsilon \in \left(e^p(0) - \underline{e}, e^p(0)\right]$ from e^p to g_1 the child's educational investment may or may not be such that conditions (9) hold. Therefore where $g_2(0) = 0$ there does exist a continuum of

equilibria $\{g_1, a^p, e^p, a^k, e^k\} \in \left[\{g_1(0), a^p(0), e^p(0), 0, 0\}, \{g_1(0)+e^p(0)-\underline{e}, a^p(0), \underline{e}, 0, e^p(0)-\underline{e}\}\right]$ that support the unique equilibrium values of $\{c_1^p, c_2^p, c_1^k, c_2^k\}$, and there may exist further equilibria
$\{g_1, a^p, e^p, a^k, e^k\} \in \left[\{g_1(0)+e^p(0)-\underline{e}, a^p(0), \underline{e}, 0, e^p(0)-\underline{e}\}, \{g_1(0)+e^p(0), a^p(0), 0, 0, e^p(0)\}\right]$ that support the unique equilibrium values of $\{c_1^p, c_2^p, c_1^k, c_2^k\}$. Each possible equilibrium satisfies (9) and therefore implies $h'(e^p+e^k+\tau) > R$, completing the proof of *(iii)*.

Proof of Proposition 2*:* In the type I equilibrium,

$$h'(e^p+e^k+\tau) = R$$
$$\Rightarrow e^p+e^k = h'^{-1}(R)-\tau.$$

Since $h'^{-1}(R)$ is a fixed and exogenous level of investment, $\frac{\partial(e^p+e^k)}{\partial\tau} = -1$ and total educational investment is invariant to the child's financial aid, completing the proof of *(i)*.

The type II equilibrium requires only that $h'(e^p+e^k+\tau) > R$, and in it only $G_1 = g_1 + e^p$ is determined. Recall that $e = e^p+e^k+\tau$. Suppose $\frac{\partial(e^p+e^k)}{\partial\tau} \le -1$. Then $\frac{\partial e}{\partial\tau} \le 0$, $\frac{\partial c_2^k}{\partial\tau} = \frac{\partial h(e)}{\partial\tau} \le 0$ and $u'(c_1^k) = \beta h'(e)u'(h(e))$ from conditions (4) for the type II equilibrium implies $\frac{\partial c_1^k}{\partial\tau} \le 0$. With $u'(c_1^p) = \alpha u'(c_1^k)$ and $u'(c_1^p) = \beta R u'(c_2^p)$ from conditions (4), $\frac{\partial c_1^k}{\partial\tau} \le 0$ implies $\frac{\partial c_1^p}{\partial\tau} \le 0$ and $\frac{\partial c_2^p}{\partial\tau} \le 0$. Together these conditions imply $c_1^p + \frac{c_2^p}{R} + c_1^k + h^{-1}(c_2^k)$ is (weakly) decreasing in τ, contradicting the implication of $c_2^p = Ra^p$, $c_2^k = h(e)$ and the combined asset constraints of the problem that $c_1^p + \frac{c_2^p}{R} + c_1^k + h^{-1}(c_2^k) = x^p + \tau$. Therefore $\frac{\partial(e^p+e^k)}{\partial\tau} > -1$ in the type II equilibrium, completing the proof of *(ii)*.

Proof of Proposition 3*:* The $h'(\tau) > R$ assumption implies that wherever $e^p = 0$ in equilibrium, the family is in an equilibrium of type II. In the type II equilibrium,

$$\frac{de}{dx^p} = \frac{d(e^p+e^k)}{dx^p} + \frac{d\tau}{dx^p}. \qquad (10)$$

As long as x^p, α, τ and $h(\cdot)$ are such that $e^p + e^k = 0$ in equilibrium, $\frac{de}{dx^p} = \frac{d\tau}{dx^p} < 0$, completing the proof of *(i)*.

As before, in the type I equilibrium,

$$h'(e^p + e^k + \tau) = R$$

$$\Rightarrow e^p + e^k + \tau = e = h'^{-1}(R).$$

Since $e = h'^{-1}(R)$ is a fixed and exogenous level of investment, as long as x^p, α, τ and $h(\cdot)$ are such that the equilibrium is of type I and $\tau'(x^p) = 0$, $\frac{de}{dx^p} = 0$.

In the type II equilibrium, however, (10) applies. No exogenously set condition on the relative returns fixes educational investment. The ambiguity of the allocation of G_1 to e^p and g_1, and the resulting ambiguity in the levels of e^p and e^k, imply ambiguous signs for $\frac{de^p}{dx^p}$ and $\frac{de^k}{dx^p}$. However, conditions (4) do imply $\frac{d(e^p + e^k)}{dx^p} > 0$ as long as $x^p + \tau(x^p)$ increases with x^p. Where we assume $\tau'(x^p) = 0$, then, for x^p, α, τ and $h(\cdot)$ such that the equilibrium is of type II, $\frac{de}{dx^p} = \frac{d(e^p + e^k)}{dx^p} > 0$, completing the proof of *(ii)*.

Table 1: Child-Level Descriptive Statistics for the Health and Retirement Study Samples

Variable	Sample	Sample size	Mean	Median	Standard deviation
Parent made any gift to children, 1998-2004	1998-2004 Cores	34,593	0.4888	0.0000	0.50
Parent ever made major gift to child	1994 Module	1262	0.3700	0.0000	0.4988
Parent's 2000 household income	2000 Core	34,593	$42,155	$25,588	$64,439
	1994 Module	1262	$48,975	$35,000	$49,734
Parent's 2000 household net worth	2000 Core	34,593	$299,689	$111,000	$799,255
	1994 Module	1262	$309,531	$149,950	$571,914
Child years of education	2000 Core	34,593	13.80	13.00	6.875
	1994 Module	1262	13.30	12.00	2.194
Child gender (male = 1)	2000 Core	34,593	0.5004	1.0000	0.5000
	1994 Module	1262	0.4857	0.0000	0.5000
Child age in 2000	2000 Core	34,593	41.82	41.00	9.64
	1994 Module	1262	40.73	41.00	6.45
Oldest child indicator	2000 Core	34,593	0.2856	0.0000	0.4517
	1994 Module	1262	0.2647	0.0000	0.4413
Youngest child indicator	2000 Core	34,593	0.2617	0.0000	0.4395
	1994 Module	1262	0.2361	0.0000	0.4249
Years of overlap with siblings' college ages	2000 Core	34,593	2.337	2.000	2.130
	1994 Module	1262	2.631	2.000	2.141

Note: Sample children are aged 24 and older.

Table 2: Family Fixed Effect Estimates of Years of Schooling, HRS, Gift v. No Gift

	1998-2004 Gifts to Children		Transfer Module Gifts to Children	
	Gifts	No Gifts	Gifts	No Gifts
Independent variable	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**
Child gender, male=1	-0.242***	-0.086	-0.249	-0.314**
	(0.087)	(0.088)	(0.195)	(0.134)
Child age	-0.014	-0.048***	-0.008	-0.051***
	(0.013)	(0.012)	(0.029)	(0.018)
Oldest child indicator	0.147	0.296**	0.079	0.290
	(0.117)	(0.121)	(0.258)	(0.186)
Youngest child indicator	0.119	-0.089	0.187	-0.056
	(0.124)	(0.126)	(0.265)	(0.194)
Sibling-years of overlap	0.034	0.105***	-0.050	0.094**
in college ages	(0.031)	(0.030)	(0.064)	(0.046)
Number of Children	16,892	17,701	467	795
Number of Families	4890	4581	125	209
R-squared	0.5934	0.6521	0.5713	0.5941
Adjusted R-squared	0.4276	0.5304	0.4073	0.4454

* indicates significance at the 10 percent, ** at the 5 percent, and *** at the 1 percent level.

Table 3: Family Random Effect Estimates of Years of Schooling, HRS

1998-2004 Gifts to Children:	Gifts	No gifts
Independent variable	**Parameter (SE)**	**Parameter (SE)**
Sibling-years of overlap	0.07**	0.03
in college ages	(0.03)	(0.03)
Number of children	-0.26**	0.01
	(0.11)	(0.12)
Number of children squared	0.01	-0.01
	(0.01)	(0.01)
Child gender, male=1	-0.13	-0.25***
	(0.08)	(0.08)
Child age	-0.01	0.02***
	(0.01)	(0.01)
Oldest child indicator	0.12	0.12
	(0.11)	(0.10)
Youngest child indicator	0.06	0.13
	(0.12)	(0.11)
Parent's 2000 income in 100,000s	0.59	0.04
	(0.42)	(0.15)
Income squared in billions	-0.02	-0.00
	(0.01)	(0.00)
Parent's 2000 net worth in millions	0.39	0.37***
	(0.26)	(0.13)
Net worth squared in 100 billions	-0.98	-2.24**
	(0.76)	(0.92)
Black	0.63***	0.44**
	(0.23)	(0.20)
Hispanic	-0.94***	0.33
	(0.27)	(0.30)
Parent's education less than HS	-0.75***	-0.75***
	(0.20)	(0.18)
Parent some college	0.91***	0.70***
	(0.25)	(0.17)
Parent college graduate	0.98**	1.27***
	(0.39)	(0.22)
Parent post graduate education	1.79***	1.72***
	(0.44)	(0.23)
Mean family effect	14.74***	13.02***
	(0.50)	(0.43)
Total number of children	17327	16565
Number of families	4488	4820

* indicates significance at the 10 percent, ** at the 5 percent, and *** at the 1 percent level.

Table 4: Family Fixed Effect Estimates of Years of Schooling, HRS, Gift v. No Gift (1998-2004)

	Gifts			No Gifts		
Net Worth Tercile	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Independent variable	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**	**Parameter (Std error)**
Child gender, male=1	-0.564**	-0.016	-0.098	-0.162	-0.161	0.089
	(0.199)	(0.128)	(0.107)	(0.161)	(0.167)	(0.119)
Child age	0.032	0.005	0.018	-0.050**	-0.051**	-0.041**
	(0.027)	(0.019)	(0.018)	(0.020)	(0.021)	(0.019)
Oldest child indicator	-0.102	0.357**	0.177	0.157	0.565**	0.144
	(0.267)	(0.170)	(0.145)	(0.226)	(0.230)	(0.163)
Youngest child indicator	0.213	0.085	0.100	-0.180	0.067	-0.201
	(0.287)	(0.178)	(0.154)	(0.237)	(0.241)	(0.170)
Sibling-years of overlap	0.012	0.052	0.037	0.045	0.213***	0.021
in college ages	(0.064)	(0.047)	().042)	(0.053)	(0.056)	(0.045)
Number of Children	5557	5717	5618	5804	6019	5878
Number of Families	1488	1711	1729	1389	1508	1704
R-squared	0.56	0.69	0.55	0.64	0.57	0.77
Adjusted R-squared	0.40	0.55	0.34	0.52	0.43	0.67

* significant at 5%; ** significant at 1%

Table 5: Descriptive Statistics for the NLSY-97 Estimation Samples

	Respondents Whose Parent(s) Don't Pay for College, EFC>0 (501 observations)			Respondents Whose Families Face EFC=0 (725 observations)			Respondents Who Enroll in at Least One Term of College (1,338 observations)		
Variable Name	**Mean**	**Median**	**Std. Dev.**	**Mean**	**Median**	**Std. Dev.**	**Mean**	**Median**	**Std. Dev.**
Completed college	0.11	0.00	0.32	0.05	0.00	0.22	**	**	**
Highest grade completed	**	**	**	**	**	**	14.14	14.00	1.42
Parent's 1997 income, 1000s	48.21	42.00	31.12	8.13	8.26	5.49	60.95	52.10	47.45
Parent's 1997 net worth, 1000s	**	**	**	**	**	**	195.97	75.40	457.76
AFQT percentile	53.51	53.75	25.49	29.88	22.67	24.96	61.07	64.76	26.29
Mother's education <HS	0.15	0.00	0.36	0.44	0.00	0.50	0.10	0.00	0.31
Mother HS grad	0.38	0.00	0.49	0.34	0.00	0.48	0.33	0.00	0.47
Mother some college	0.47	0.00	0.50	0.21	0.00	0.41	0.57	1.00	0.50
Number of siblings	2.26	2.00	1.54	2.68	2.00	1.93	2.05	2.00	1.52
Female	0.52	1.00	0.50	0.56	1.00	0.50	0.56	1.00	0.50
Black	0.24	0.00	0.43	0.43	0.00	0.50	0.20	0.00	0.40
Hispanic	0.17	0.00	0.38	0.30	0.00	0.46	0.14	0.00	0.35
Broken home	0.47	0.00	0.50	0.82	1.00	0.39	0.40	0.00	0.49
Urban	0.72	1.00	0.45	0.78	1.00	0.41	0.73	1.00	0.44
South	0.33	0.00	0.47	0.47	0.00	0.50	0.34	0.00	0.47
12 years old in 1997 wave	0.20	0.00	0.40	0.23	0.00	0.42	0.21	0.00	0.41
13 years old in 1997 wave	0.20	0.00	0.40	0.22	0.00	0.41	0.25	0.00	0.43
14 years old in 1997 wave	0.21	0.00	0.41	0.22	0.00	0.42	0.21	0.00	0.41
15 years old in 1997 wave	0.21	0.00	0.41	0.18	0.00	0.39	0.17	0.00	0.38
16 years old in 1997 wave	0.17	0.00	0.38	0.15	0.00	0.35	0.16	0.00	0.37
Funding gap in first term of college, 100s	**	**	**	**	**	**	12.74	5.60	14.51

Table 6: Probit Estimates (Marginal Effects) of College Completion, NLSY-97

	Respondents Whose Parent(s) Don't Pay for College, EFC>0	Respondents Whose Families Face EFC=0
Independent variable	**Parameter (SE)**	**Parameter (SE)**
Parent's 1997 income, 1000s	-0.002*	-0.000
	(0.001)	(0.001)
Parent's 1997 income squared, 10000s	0.001**	-0.003
	(0.000)	(0.002)
AFQT percentile	0.002***	0.001***
	(0.000)	(0.000)
Mother's education <HS	0.023	-0.010
	(0.038)	(0.011)
Mother HS grad	-0.012	-0.012
	(0.023)	(0.011)
Number of siblings	-0.004	-0.005
	(0.007)	(0.003)
Female	0.069***	0.007
	(0.023)	(0.009)
Black	-0.011	0.026*
	(0.030)	(0.015)
Hispanic	0.034	0.013
	(0.037)	(0.014)
Broken home	-0.022	-0.048*
	(0.022)	(0.025)
Urban	-0.045	0.002
	(0.029)	(0.011)
South	-0.004	-0.000
	(0.024)	(0.010)
12 years old in 1997 wave	-0.117***	-0.044***
	(0.019)	(0.010)
13 years old in 1997 wave	-0.071***	-0.027***
	(0.022)	(0.010)
14 years old in 1997 wave	-0.032	-0.009
	(0.025)	(0.010)
15 years old in 1997 wave	-0.011	0.004
	(0.028)	(0.014)
Observations	501	725
Pseudo R-squared	0.172	0.193

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: OLS Estimates of Highest Grade Completed, NLSY-97

Independent variable	Parameter (Std error)
Parent's 1997 income, 1000s	0.012***
	(0.002)
Parent's 1997 income squared, 10000s	-0.004***
	(0.001)
Parent's 1997 net worth, 1000s	0.000*
	(0.000)
AFQT percentile	0.018***
	(0.001)
Mother's education <HS	-0.062
	(0.127)
Mother HS grad	-0.060
	(0.079)
Number of siblings	-0.045**
	(0.021)
Female	0.284***
	(0.066)
Black	0.422***
	(0.107)
Hispanic	0.124
	(0.107)
Broken home	-0.287***
	(0.077)
Urban	-0.047
	(0.075)
South	0.019
	(0.071)
12 years old in 1997 wave	-1.397***
	(0.121)
13 years old in 1997 wave	-0.992***
	(0.124)
14 years old in 1997 wave	-0.281**
	(0.129)
15 years old in 1997 wave	-0.078
	(0.143)
Funding gap in first term of college, 100s	-0.014***
	(0.003)
Constant	13.298***
	(0.205)
Observations	1338
R-squared	0.328

* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 1: HRS Sample Construction

Full HRS 2000 sample, with 1998-2004 gift data	
Initial number of households	13,091
Number of children of these households	40,667
Of these, children with complete age and education data	37,875
Of these, children aged 24 and over	36,353
Of these, children with complete gender and relationship data	36,351
Of these, children with at least 1 sibling	34,610
Of these, have 1998-2004 gift data	34,593
Number of families represented by remaining children	9,471
HRS Wave 2 Module 7 sample	
Initial number of module respondents	827
Number of families represented by the respondents	427
Number of children in the above families	1542
Of these, children with complete age data on all siblings	1536
Of these, children who are 24 and older	1458
Of these, children with gift data	1444
Of these, children with complete education, gender and relationshi	1362
Of these, children with at least 1 sibling	1262
Number of families represented by remaining children	334

Appendix Table 2: OLS Estimates of Financial Aid, NLSY-97

Independent variable	Parameter (Std error)
Sibling-years of overlap in first term of college	358.44**
	(179.52)
Parent's 1997 income, 1000s	-23.84***
	(6.38)
Parent's 1997 income squared, 10000s	7.14***
	(2.33)
Parent's 1997 net worth, 1000s	-2.19**
	(0.98)
Parent's 1997 net worth squared, 10000s	0.06*
	(0.03)
AFQT percentile	-28.97*
	(16.69)
AFQT percentile squared	0.63***
	(0.15)
Constant	3,152.17***
	(463.69)
Observations	2608
R-squared	0.06

* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 3: OLS Estimates of AFQT percentile, NLSY-97

Independent variable	**Parameter (Std error)**
Sibling-years of overlap in college ages	-0.51**
	(0.22)
Mother's education <HS	-18.13***
	(1.09)
Mother HS grad	-9.51***
	(0.86)
Parent's 1997 income, 1000s	0.24***
	(0.02)
Parent's 1997 income squared, 10000s	-0.07***
	(0.01)
Zero siblings	3.62**
	(1.49)
One sibling	1.88**
	(0.94)
Three siblings	-0.16
	(1.12)
Four siblings	-2.06
	(1.44)
Five or more siblings	-4.36***
	(1.46)
Female	2.81***
	(0.71)
Black	-19.43***
	(0.99)
Hispanic	-10.88***
	(1.09)
Broken home	-3.17***
	(0.83)
Urban	1.95**
	(0.86)
South	0.14
	(0.79)
Constant	50.66***
	(1.68)
Observations	4597
R-squared	0.32

* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 4: NLSY Sample Construction

Respondents Whose Parent(s) Don't Pay for College, EFC>0	
Initial number of respondents	8,984
Of these, respondents with non-missing college enrollment data in 2004	7,379
Of these, respondents with at least one term of college experience as of 2004	4,241
Of these, respondents with non-missing parental income data from 1997	3,159
Of these, respondents whose have families have EFC>0	2,709
Of these, respondents whose parents do not pay for college	661
Of these, respondents with non-missing AFQT score	574
Of these, respondents with non-missing mother's education data	547
Of these, respondents with non-missing number of siblings data	518
Of these, respondents with non-missing urban/rural residence data	501

Respondents Whose Families Face EFC=0	
Initial number of respondents	8,984
Of these, respondents with non-missing college enrollment data in 2004	7,379
Of these, respondents with non-missing parental income data from 1997	5,443
Of these, respondents whose have families have EFC=0	1,203
Of these, respondents with non-missing AFQT score	913
Of these, respondents with non-missing mother's education data	847
Of these, respondents with non-missing number of siblings data	771
Of these, respondents with non-missing urban/rural residence data	725

Respondents Who Enroll in at Least One Term of College	
Initial number of respondents	8,984
Of these, respondents with non-missing college enrollment data in 2004	7,396
Of these, respondents with at least one term of college experience as of 2004	4,263
Of these, respondents for whom EFC in first college term can be imputed	1,912
Of these, respondents with non-missing parental transfers data	1,721
Of these, respondents with non-missing parental net worth data from 1997	1,639
Of these, respondents with non-missing AFQT score	1,423
Of these, respondents with non-missing mother's education data	1,391
Of these, respondents with non-missing number of siblings data	1,389
Of these, respondents with non-missing urban/rural residence data	1,338