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Self-financing, Parental Transfer, and College Education

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Abstract

We show that financial constraints can affect the human capital accumulation of college students by influencing students' labor supply. We document that many college students work a substantial number of hours at low-skill jobs, and students who have fewer financial resources (in particular, parental transfer) tend to work more. We develop a model that incorporates college students' labor supply and its interaction with parental transfer in the presence of financial constraints. By estimating the model, we quantify the trade-off between self-financing and human capital accumulation and discuss the implications of a wage subsidy policy.

Keywords: College Education, Parental Transfer, Labor Supply, Intergenerational Mobility, Financial Constraints

JEL classification number: I22, I23, I24

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1 Introduction

College education in the economics literature is often considered a lumpy investment. Decisions made during the college period, which could generate different trajectories of post-college labor outcomes, are abstracted in many economics models. One such decision is college students' labor supply. Besides financial resources, going to college requires time. This time can be used for studying or for working to finance educational investment or consumption. Table 1 illustrates a possible trade-off of working during college. Students who work more hours are less likely to earn more credits or a higher GPA, less likely to meet with their academic advisor or participate in a school club, and more likely to withdraw from enrollment in college for a period of time.[1]

In this paper, we show that financial constraints can impact human capital accumulation among college students by influencing their labor supply decisions. We also highlight the significant role played by endogenous parental transfer in determining the extent to which financial constraints affect human capital accumulation through self-financing. Using the National Longitudinal Survey of Youth 1997 (NLSY97) and the Survey of Income and Program Participation (SIPP), we first document facts that suggest financial necessity, rather than career development, is an important motive for college students' labor supply. First, a large number of college students work a substantial number of hours at low-skill jobs. In our data, college students work 1,775 hours, on average, for the first two years after college enrollment. The most common job is cashier, followed by retail salesperson, waiter or waitress, and nanny. Second, students who have fewer financial resources during college tend to work more. In particular, students from low-income families tend to work longer hours. Using a father's job-loss shock as an instrumental variable (IV), we show lower parental income leads to more working

[1] College students' working hours have increased substantially over the past 50 years. The proportion of full-time students at four-year colleges who work more than 20 hours per week was 5% in 1961, 17% in 2003, and 30% in 2012. Over the same time period, the average number of hours that full-time students at four-year colleges spent in class and studying decreased: 40 per week in 1961, 27 per week in 2003, and 15 per week in 2012. (Sources: Babcock and Marks [2011], the National Postsecondary Student Aid Study (NPSAS) 2012, and the American Time Use Survey (ATUS) 2012).

hours by students.

To quantify how easily a constrained student can substitute the lack of parental support with working while in college, we develop a theory that specifies the trade-off involved in students' decision to work, while accounting for the endogenous response of parental transfer. In the model, altruistic parents first make a monetary transfer to the child, who then decides whether to complete college or drop out and how much to work to finance her consumption/educational cost. We extend the Ben-Porath model to the college-financing problem, assuming human capital accumulation during college depends on time investment. We also assume that students may face constraints that limit consumption smoothing between college and the working period, based on recent evidence of financial constraints among college students.[2]

College students choose their working hours so that the marginal benefit (associated with additional consumption) is equal to the marginal cost (associated with loss of human capital due to reduced study time). If a student does not have enough support from her parents, she is more likely to be constrained to finance the tuition and consumption during college. Working in low-skill jobs can alleviate such a constraint, which increases constrained students' incentive to work. However, as the time devoted to working increases, the time for studying decreases, and future human capital will be compromised. If the value of graduating becomes lower than the value of dropping out, students decide to drop out of college.

Altruistic parents choose to transfer resources in order to equalize the marginal return from extra resources across generations. When the child can achieve the optimal level of college education and consumption, the parental transfer is driven by a compensating motive that equalizes the marginal return from extra consumption between the child and the parents. However, parental transfer can have a greater marginal impact on the child's utility when the child is constrained, because it can also

[2]Using Texas administrative data, Black et al. [2020] show that nearly half of dependent undergraduates hit the annual borrowing limits of federal loans (Stafford loan), leading to the conclusion that millions of U.S. undergraduates encounter credit constraints.

enhance the child's human capital by reducing the child's self-financing burden.

To quantitatively evaluate the trade-off between self-financing and human capital accumulation while accounting for the endogenous response of parents, we estimate the model based on the method of simulated moments. Using the estimated model, we conduct counterfactual experiments on a wage subsidy policy. The federal work-study program in the US provides part-time jobs for students with financial needs, allowing them to earn money to help pay their education expenses. Government subsidy is essential for the work-study program because the federal government finances a large fraction of wages. To prevent students from overworking, the federal work-study program typically sets limits on the number of working hours. In line with these features, in our counterfactual wage subsidy policy, students can opt in to receive a 25% higher wage as a subsidy, which amounts to 2 USD for every working hour during college, while adhering to a working hour restriction to ensure they do not exceed 1,000 hours of work per year during their college years. The wage subsidy policy is applied throughout the college years and financed by a budget-neutral, one-time income tax on parents.

We find that the above wage subsidy policy increases the aggregate college completion rate by 5.69 percentage points. Focusing on students who complete college in both baseline and counterfactual simulation, the wage subsidy policy decreases the working hours by 125 during the college years. Consequently, the average human capital of college students (including both dropouts and graduates), as measured by annual earnings after college, increases by 245 USD. The parental transfer decreases by 3,515 USD because the child can earn a higher wage from working. The average welfare gain of the wage subsidy policy is 0.14% increases in the lifetime consumption for the child. Despite positive welfare effects for children and reduced parental transfers, the welfare effect for parents is near zero due to the income tax.

We also find substantial heterogeneity in the effects of the wage subsidy policy on students' human capital based on their family income. Specifically, we observe that the positive impact of the wage subsidy policy on students' human capital is more pronounced among low-income students. The higher earnings per unit of working hours, resulting from the wage subsidy, allow financially constrained low-income students to allocate more hours towards developing their human capital rather than using them for self-financing purposes.

To emphasize the significance of the interaction between parental transfer and the child's choices, we conduct a counterfactual analysis where we eliminate the endogenous response by parents to the wage subsidy policy. Abstracting from the endogenous responses by parents would slightly *understate* the positive impact of the wage subsidy policy on the college completion rate. This is because when endogenous responses by parents are allowed, certain parents, particularly those with children who are at risk of dropping out of college, may choose to increase their financial support to prevent their child from working excessive hours while in college.

On the other hand, without accounting for changes in parental transfer, we would *overstate* the impact of the wage subsidy policy on the average human capital of the students. This is because the majority of parents, especially those with children who complete college, would crowd out their transfer when their child can earn higher wages during college. Accordingly, the model without endogenous parental response would overstate the increase in the average human capital and the welfare effect of the wage subsidy policy for the child.

This paper relates to the literature on human capital accumulation during college. Our contribution is twofold. First, we document the prevalence of college students working in low-skill jobs and show that parental income is a significant determinant students' working hours during college. Second, we develop a model that demonstrates how the option for self-financing, in the presence of financial frictions, shapes the incentives of both parents and children. The model provides a novel mechanism that explains heterogeneity in human capital accumulation during college.[3]

[3] Since Becker and Tomes [1979, 1986], the question of whether and how credit constraints affect human capital investment and intergenerational mobility has been central in the literature. Earlier findings indicate credit constraints are not major determinants of college attendance (e.g., Cameron and Heckman [1998]; Keane and Wolpin [2001]; Cameron and Taber [2004]; Ionescu [2009]), whereas studies using recent data suggest credit constraints play an important role in college enrollment (e.g., Belley and Lochner [2007]; Lochner and Monge-Naranjo [2011, 2012, 2016]; Hai and Heckman [2017]; Black et al. [2020]).

While previous studies incorporate the option to work while enrolled in a college (e.g., Keane and Wolpin [2001], Johnson [2013], Hai and Heckman [2017], Abbott et al. [2019], Joensen and Mattana [2021], Long [2020]), we extend the existing literature in the following ways. First, by leveraging the Ben-Porath model, we explicitly model the time allocation problem for students between working and studying, considering time investment as an essential input for human capital accumulation. This differs from Keane and Wolpin [2001], Johnson [2013], and Joensen and Mattana [2021], in which students have the option to work while enrolled, but human capital accumulation during college is determined solely by enrollment status. Thus, in their frameworks, students' labor supply increases financial resources without crowding out time investment in human capital. In contrast, our paper highlights that the trade-off between self-financing and time investment in human capital can explain considerable variations in college outcomes.

We also extend previous studies by incorporating the interaction between endogenous parental transfers and students' working hours. Garriga and Keightley [2007] and Long [2020] develop models in which students choose labor supply, study time, and college completion. Relatedly, Fu et al. [2019] examines the interaction between college loans and post-college human capital accumulation. Our model complements this literature by endogenizing parental transfers and embedding the Ben-Porath framework into the college financing problem. As emphasized by Abbott et al. [2019], accurately assessing the crowd-out effects of parental transfers in response to policy is crucial for welfare analysis.

Closely related, Brown et al. [2011] and Abbott et al. [2019] discuss how the interaction of incentives between parents and the child affects college-enrollment decisions. Our paper extends upon their analysis by incorporating time investment, which varies substantially among students who have enrolled in college.[4]

The paper proceeds as follows. Section 2 discusses data and motivating facts. Section 3 describes

[4]Our framework of endogenous parental transfers is also consistent with the literature on incomplete risk-sharing within families. For example, Altonji et al. [1997] show that inter vivos transfers respond only weakly to income shocks—a puzzle under full altruism. In our model, parents adjust transfers in response to student work and borrowing, but only partially, consistent with this evidence.

the model. Section 4 discusses estimation results, and section 5 concludes.

2 Facts about Labor Supply by College Students

We use two main datasets for this study. First, we use the NLSY97 to document facts about students' labor supply during college. We also use it for the estimation of our structural model. Second, we use the SIPP to show the relationship between parental income and students' working hours. We now explain these two datasets in more detail.

2.1 National Longitudinal Survey of Youth 1997 (NLSY97)

The NLSY97 is a panel dataset from a nationally representative sample of youths, 12 to 17 years old, living in the United States as of December 31, 1996. The data include detailed information on how students finance the cost of postsecondary education since 1997. First, we observe the total amount of loans taken out by students.[5] Second, we observe the amount of transfer from parents to children (which children are not supposed to repay). We also observe lending from parents for college education separately from parental transfer. Although the amount of lending by parents is negligible, we include that lending when constructing the variable for parental transfers so as not to understate the resources allocated by parents. Given that NLSY does not provide separate data on transfers from parents and from other family members, we use the total transfer from all family members as the parental transfer. Third, the NLSY97 provides the amount of grants from either government or college.[6]

In addition to financing information, the NLSY97 reports working hours and types of jobs while enrolled in college and labor income during and after college. The data also include students' de-

[5] Loan data from the NLSY97 represent the answer to the following question: "Other than assistance you received from relatives and friends, how much did you borrow in government subsidized loans or other types of loans while you attended this school/institution?" As the question clearly indicates, students are asked to report all student loans, including private loans obtained to attend the school. We use the total amount of loans students take out for college education (up to three institutions at one time) in our analysis.

[6] The survey collected how students finance college education for each term, year, and college. Because financing information for other than the first term has too many missing observations, we impute annual data for educational financing by multiplying the financing variable for the first term by the number of terms for each academic year. For example, if the college has a trimester system, we multiply the term-one financing variables by 3 to construct the annual data.

mographic characteristics, cognitive test score (the Armed Forces Qualification Test (AFQT) score), parents' income, and students' enrollment history and the highest grade completed.

We use observations for those who ever attended a four-year college.[7] The cost of attendance, financial aid policy, types of jobs available during study, and returns to investment are substantially different between undergraduate and graduate programs (Belasco et al. [2014]; Altonji and Zhong [2021]). To focus on the dropout and the college-graduation decision, we drop those who attended a post-college program. The resulting sample consists of 1,164 individuals. All monetary amounts are denominated in 1997 USD using the Consumer Price Index (CPI).

Survey of Income and Program Participation (SIPP)

To supplement the NLSY97, we use the Survey of Income and Program Participation (SIPP), which is a nationally representative household-based survey of the US population. Each SIPP panel follows a large number of respondents, ranging from approximately 14,000 to 36,000, for three or four years. We use the 1996, 2001, 2004, and 2008 panels. In the SIPP, eligible household members were interviewed every four months, using questions about, for example, college-enrollment status, weekly working hours, monthly income, and demographic characteristics such as race and sex. Because the SIPP is a household-based survey, we can merge students' information with their parents' information. The SIPP also asks the main reason surveyed individuals stopped working, which we used to construct a parental-income shock we explain later. We keep observations for individuals aged 16-30 who were enrolled in their first, second, third, and fourth year of an undergraduate program at the time of the interview. All monetary amounts are denominated in 1997 USD using the CPI.

[7] In the previous version of our paper, we included two-year college students in our analysis and confirmed that our main findings remain robust.

2.2 Working While in College

In Table 2, we first document the summary statistics for students' working hours after college enrollment based on the NLSY97. Four-year college students, on average, work 819 hours for the first year, 1,775 hours for the first 2 years, and 4,111 hours for the first 4 years after they start their college education. If we instead look at the median, students work 676 hours for the first year, 1,535 hours for the first 2 years, and 3,823 for the first 4 years. This finding implies more than half of the students work more than 13 hours ($\frac{676}{52}$) per week over the first year after college enrollment, and the working hours are not concentrated within a particular year after college enrollment.[8]

To illustrate how college students' labor is distributed throughout the year, we report working hours during the summer periods (June to August) within the first two years after enrollment. Students tend to work more during these months, yet approximately two-thirds of working hours occur during non-summer periods.

Next, we document the type of jobs a typical student works. Figure 1 shows the occupation composition of all jobs reported by college students ages 18-22 when they were enrolled in a four-year undergraduate program. Based on the 3-digit code of the 2000 Standard Occupation Classification, we calculate the share of jobs in each occupation. We exclude internships from this analysis, which account for 1.3% of jobs for college students. Across 509 occupations, 10 occupations account for 38% of jobs held by college students. The most frequently observed job is cashier, followed by retail salesperson, waiter or waitress, and nanny.

To understand the source of heterogeneity in students' working hours, we conduct a linear regression for students' working hours with respect to students' ability (the AFQT score), parental income, student loans, and the amount of grants students receive. The first column of Table 3 shows the

[8] A similar pattern is found in other datasets as well. By using the October Supplement of the Current Population Survey (CPS), Planty et al. [2007] find that about half of full-time students and 85% of part-time college students ages 16–24 were employed in 2005. In their analysis, full-time college students are defined as students who enroll in two- or four-year colleges and take at least 12 hours of classes per week. They also find that about 21% of full-time students work 20–34 hours per week, 9% of full-time students work 35 or more hours per week, and 47% of part-time students work more than 35 hours per week.

results. A student with higher ability, more grants, or from a high-income family tends to work less. In contrast, students who take out student loans are more likely to work longer hours. In the second column of Table 3, we additionally control for parental transfers. First, the magnitude of the coefficient for parental transfer is as high as the coefficient for grants. Second, as long as we control for parental transfers, no significant association exists between parental income and students' working hours. This finding implies the negative relationship between parental income and working hours in the first column of Table 3 is mainly due to wealthy parents providing more transfers.

The relationship between parental transfer and working hours in Table 3 may be due to factors that simultaneously affect both parental transfer and students' working hours. To check whether a lack of parental transfer is indeed a reason for students' working, we use the SIPP. Every four months, the SIPP asks the main reason any surveyed individual stopped working. Possible answers include the following: (1) employer bankrupt, (2) employer sold business, and (3) slack work or business conditions.[9] We first construct a dummy variable (i.e., job-loss shock) that takes a value of 1 if the reason the individual stopped working is one of the three choices. Given that the SIPP does not provide parental-transfer information, we focus on the relationship between parental income and working hours. To handle the endogeneity issue, we use the father's job-loss shock (or mother's job-loss shock in the case of single-mother households) in the previous four months as an IV for parents' monthly income.[10] In the SIPP, a job loss in the current period is defined if a respondent had a job at the beginning of the reference period (4 months) and the respondent stopped working during the reference period. Therefore, the current-period income might capture monthly income before the job loss that happens later in the same reference period. For this reason, we use the job-loss shock in the

[9]Other answers include discharged/fired, retirement or old age, childcare problems, other family/personal obligations, own illness, own injury, school/training, job was temporary and ended, quit to take another job, unsatisfactory work arrangement, and quit for some other reason.

[10]We use the father's job-loss shock for two-parent households given that paternal income is a major source of parental income in our dataset. For example, the average paternal income is almost as twice the average maternal income in the SIPP.

previous period as an IV for parental income in the current period.[11]

Table 4 shows summary statistics for students whose parents experienced a job-loss shock, and students whose parents do not experience a job-loss shock. The average parental income before a job-loss shock is slightly lower for those whose parents experience a job-loss shock. For example, in the initial survey period, the average monthly income for parents who will experience a job-loss shock is 3,630 USD, whereas average monthly income for parents who will not experience a job-loss shock is 4,038 USD. The proportion of household heads who attended some college or above is 0.69 for both groups. Other demographic characteristics such as gender and race are also similar across the two groups.

Column (1) of Table 5 shows the results from the first-stage regression. The parental job-loss shock in the previous period leads to a 1,450 USD decrease in monthly parental income in the current period. Note the mean and median monthly parental income during the entire survey periods are 4,432 USD and 3,348 USD, respectively. Therefore, the magnitude of the parental job-loss shock is about 33% ($\frac{1{,}450}{4{,}432} \times 100$) of the mean monthly parental income and 43% ($\frac{1{,}450}{3{,}348} \times 100$) of the median monthly parental income.

Columns (2) and (3) of Table 5 report OLS and IV regression estimates, respectively. The magnitude of IV estimate is larger than OLS estimate, suggesting students from different income background may have a different taste for working. The coefficient for parental income from IV regression is estimated at -2.425 and statistically significant, suggesting a 1,000 USD higher parental income leads to about 2.5 fewer weekly working hours.

Note that we assume that the main channel through which the parental job-loss shock affects college students' working hours is via reduced parental income. To further confirm that a father's job loss is associated with reduced financial resources for the child, we check whether the child took out a

[11] Given that the measure for parental income during which the job loss shock incurs can be noisy, we remove the observations for the periods with the job-loss shock when we conduct the IV regression. A similar IV is used in Stevens and Schaller [2011] and Boar [2021].

new loan right after their father's job loss. The result is shown in column (4) of Table 5. Controlling for an individual fixed effect, we find that students whose father experienced a job loss in the previous 4 months increased the probability of taking out a new loan by 5 percentage points. This result suggests that a father's job loss is indeed associated with a reduction in financial resources that compelled students to take up a new loan and work more.

Overall, we conclude that parental income is an important determinant for students' working decisions during college. Combining this result with the findings in Table 3, we believe parental transfer is the key mechanism behind this result; children whose fathers hit a job-loss shock will receive less transfer from their parents and will need to work more.

2.3 Discussion

We have shown that a large number of college students work a substantial number of hours in low-skill jobs, and students who have fewer resources (especially parental transfers) work more. When students have to work a substantial number of hours, the time for studying can be limited and the academic outcome can be negatively affected as described in Table 1.

We find that the data patterns are consistent with this prediction. In the first column of Table 6, we estimate a linear probability model for college graduation based on observable variables, including working hours in the first two years after enrollment. A student is defined as a college dropout if she ever enrolled in a four-year college, and the highest grade completed as of age 30 is less than or equal to 14.[12]

Working an additional 1,000 hours during the first two years after enrollment reduces the graduation probability by about 5%. In the second column of Table 6, we include controls for working hours during the summer (June to August) within the first two years after enrollment. The lack of

[12] We choose this particular margin to define a dropout because the labor income after college presents a discrete jump when the highest grade completed changes from 14 to 15 in our sample. A similar definition of a dropout is used in the literature (e.g., Stinebrickner and Stinebrickner [2008a]).

a negative association between summer working hours and graduation probability suggests that the strong negative relationship is generated by working hours during non-summer periods.[13]

3 Quantitative Framework

In this section, we provide a quantitative framework that can rationalize the observed pattern of students' working hours during college and its implication on college investment. The model builds on the work by Lochner and Monge-Naranjo [2011]. Because parental transfer is important in determining students' working hours, we explicitly model the interaction between college students' labor supply, investment, and their parents' endogenous decision to transfer in the presence of financial constraints.[14]

3.1 Environment

A family consists of parents and a child. Time is continuous. The child lives for $t \in [0, T_k]$, where $t \in [0, P_J)$ is the college period, $t \in [P_J, R_k)$ is the working period, and $t \in [R_k, T_k]$ is the retirement period. The timing when the college period ends (P_J) depends on whether the child drops out ($J = 0$) or completes college ($J = 1$). The parents live for $t \in [0, T_p]$ periods, where $t \in [0, R_p)$ is parents' working period and $t \in [R_p, T_p]$ is parents' retirement period.

The parents are altruistic and hence receive utility from their child's utility, but the child cares only about herself. The parents first make a transfer (m_p) to the child before the college period starts, and then the child decides whether to complete college or drop out, how many student loans to take out, and how many hours to work during college. We abstract from the post-schooling transfer from the parents to the child. The per-period utility from consumption (c) of the parents and the child is given by $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. A child is characterized by her ability $A \in \mathbb{R}_+$, unobserved characteristics $\epsilon \in \mathbb{R}_+$ that captures the individual's intrinsic motivation. Parents are characterized by their lifetime

[13]The finding in Table 6 is in line with previous studies on the relationship between labor supply during college and students' outcomes (Ehrenberg and Sherman [1987]; Light [2001]; Hotz et al. [2002]; Stinebrickner and Stinebrickner [2003, 2008b]; Wenz and Yu [2010]; Darolia [2014]; Triventi [2014]; Joensen and Mattana [2022]).

[14]In Appendix A, we present a two-period version of our quantitative model and provide a more detailed characterization.

income $x_p \in \mathbb{R}_+$ and an altruistic preference $\alpha \in \mathbb{R}_+$.

The human capital production function that determines labor income at the end of the college period ($t = P_J$) is defined as:

$$h = \overline{h} + \pi A(T - \epsilon n_k)^{\gamma}.$$

Here, $\overline{h}$ is the initial human capital stock before the college education. $T = J \cdot T_1 + (1-J) \cdot T_0$ represents the time endowment for education. Working hours during college, n_k, are defined as $J \cdot n_{k1} + (1-J) \cdot n_{k0}$, where $n_{k1} = \{ \int_0^{P_1} e^{-rt} n_{kt} dt \}$ and $n_{k0} = \{ \int_0^{P_0} e^{-rt} n_{kt} dt \}$.[15] $\pi = J + (1-J) \cdot \pi_0$ captures the extent to which the human capital of a college dropout is discounted in the labor market.

The extent to which working hours affect human capital accumulation depends on ϵ, the unobservable characteristic of the child. We allow such unobserved heterogeneity in the form of ϵ, which can be interpreted as an individual's intrinsic "motivation": highly motivated students (students with a low ϵ) learn better than students who are not motivated (students with a high ϵ), given the same number of working hours. Therefore, the marginal cost of working is smaller for highly motivated students than for less motivated students, and highly motivated students tend to work more than less motivated students.

Let m_k be the monetary cost for college education, given by $m_k = J \cdot m_{k1} + (1-J) \cdot m_{k0}$, where m_{k1} is the monetary cost for college graduates, and m_{k0} is the monetary cost for college dropouts. To finance the college cost, the child can take out student loans, subject to a financial constraint. We assume the present value of the total student loan borrowing, denoted as $d_k = \{ \int_0^{P_J} e^{-rt} d_{kt} dt \}$ cannot exceed the present value of monetary cost net of grant ($d_k \leq (1-s) m_k$), where s is the share of monetary cost supported by grants. This is known as the tied-to-investment constraint. With this specification, the child can borrow or save within the college period as long as the total borrowing during the college

[15] With this specification, the model is characterized up to n_k, whereas $\{n_{kt}\}$ for $t \in [0, P_J)$ is indeterminate given $n_k = \{ \int_0^{P_J} e^{-rt} n_{kt} dt \}$.

period does not exceed the borrowing limit $(1-s)m_k$. The tied-to-investment constraint is typically less stringent than the fixed borrowing constraints associated with federal Stafford loans.[16] However, if we allow students to borrow from private loans, the tied-to-investment constraint becomes a more relevant borrowing limit because private loans usually cover expenses up to the cost of attendance net of grants.[17]

The hourly wage during the college period is fixed at w. Then, the present value of labor income during college at $t = 0$ can be written as wn_k. The labor income increase at a constant rate g over the working period $t \in [P_J, R_k)$. Let Φ_J denote the present value of one dollar growing at a constant rate g from the end of the college period P_J: $\int_{P_J}^{R_k} e^{(g-r)(t-P_J)}dt = \frac{1}{g-r}\left[e^{(g-r)(R_k-P_J)} - 1\right]$. Then, the present value of lifetime labor income at the end of the college period is $\Phi_J h$.

The child's problem can be defined as follows:

$$\max_{\{C_{kt}, n_k, d_k, J\}} \int_0^{T_k} e^{-\delta t} u(C_{kt})dt \quad \text{subject to}$$

$$(1-s)m_k + \int_0^{P_J} e^{-rt} C_{kt}dt \leq wn_k + d_k + m_p, \tag{1}$$

$$\int_{P_J}^{T_k} e^{-r(t-P_J)} C_{kt}dt \leq \Phi_J h - e^{rP_J} d_k, \tag{2}$$

$$d_k \leq (1-s)m_k, \tag{3}$$

$$h = \overline{h} + \pi A(T - \epsilon n_k)^{\gamma}, \tag{4}$$

$$T - \epsilon n_k > 0, \tag{5}$$

where δ is the subjective discount rate. Equations (1) and (2) are the budget constraint during and

[16] Specifically, the unsubsidized Stafford loan has annual limits of 2,625, 3,500, and 5,500 USD for the first, second, and third year and beyond of college, respectively, before 2007. Considering the average annual cost of attendance for four-year colleges, approximately \$13,096, the fixed annual borrowing limit would be stricter than the tied-to-investment constraint for most students, given that the share of the cost of attendance covered by grants is typically below 0.5 (Table 7).

[17] We also abstract the financial friction parents may face. In our model, although parents can borrow at the risk-free interest rate, they may not completely relax the financial constraint their child faces, because their child will never pay them back. Parental transfers in our model are driven by an altruistic motive. For low-income parents, the marginal cost of the transfer, which is the forgone marginal utility of consumption, is high; therefore, the transfer of low-income parents is, on average, smaller than that of high-income parents, even without financial constraints for parents. Therefore, incorporating a financial constraint for parents would not change our results significantly.

after college, respectively. Equations (3) and (4) represent the financial constraint and the human capital production function, respectively.

The child smooths her consumption within each sub-period $t \in [0, P_J)$ and $t \in [P_J, T_k]$. Therefore, consumption grows at the constant rate $(r - \delta)/\sigma$ during and after college. If the financial constraint is binding, consumption will exhibit a discrete jump at $t = P_J$. Denote $\hat{C}_{k1} = \int_0^{P_J} e^{-rt} C_{kt} dt$, and $\hat{C}_{k2} = \int_{P_J}^{T_k} e^{-r(t-P_J)} C_{kt} dt$. Rearranging the child's problem leads to

$$\max_{\{\hat{C}_{k1}, \hat{C}_{k2}, n_k, d_k, J\}} \frac{\left(\hat{C}_{k1}\right)^{1-\sigma}}{1-\sigma} + \hat{\beta} \frac{\left(\hat{C}_{k2}\right)^{1-\sigma}}{1-\sigma} \quad \text{subject to}$$

$$\hat{C}_{k1} = w n_k + d_k + m_p - (1-s) m_k, \tag{6}$$

$$\hat{C}_{k2} = \Phi_J h - e^{r P_J} d_k, \tag{7}$$

$$\text{equations (3), (4), and (5),}$$

where $\hat{\beta} = e^{-\delta P_J} \left(\frac{\Theta_{[P_J, T_k]}}{\Theta_{[0, P_J]}} \right)^{\sigma}$ and $\Theta[t_0, t_1] = \int_{t_0}^{t_1} e^{[((r-\delta)/\sigma) - r](t - t_0)} dt$. Here, $\hat{\beta}$ reflects the combined effect of time discounting and the relative lengths of the schooling and post-schooling periods.

Given that parents have access to the complete credit market, the parents' problem becomes equivalent to solve the following problem:

$$\max_{m_p} \frac{(\Theta_{[0,T_p]})^{\sigma} (x_p - m_p)^{1-\sigma}}{1-\sigma} + \alpha V_k(A, \epsilon, m_p) \quad \text{subject to} \quad m_p \geq 0,$$

where $V_k(A, \epsilon, m_p)$ is the value from the child's problem. Intuitively, $\left(\Theta_{[0,T_p]}\right)^{\sigma}$ measures the combined effect of discounting and the way in which parents distribute their lifetime resources $(x_p - m_p)$ over time.

3.2 Discussion

We impose a few assumptions to make our model tractable and parsimonious. Before characterizing the model, we discuss the limitations and justifications for such assumptions.

First, we assume parents are altruistic, but we abstract from other motives such as the exchange motive (Light and McGarry [2004]). Because most papers on inter vivos transfers mainly rely on altruism (e.g., Becker and Tomes [1986]; Restuccia and Urrutia [2004]; Brown et al. [2011]), we follow previous studies to emphasize our novel mechanism regarding self-financing and parental transfer. In addition, from the Health and Retirement Study (HRS), we find the upstream transfer made by the child is small; the median amount of transfer from the child is about 1,000 USD over two years.[18] Also, the child with a higher labor income is less likely to provide informal care for elderly parents (McGarry [1998]) due to their high opportunity cost. Thus, the exchange motive might not play a quantitatively important role in explaining parental transfer for the child's college education.[19]

Second, to endogenize parental transfers in a simpler way, we abstract from repetitive interactions between parental transfers and student actions. In the data, parental transfers are primarily concentrated in the first two years of enrollment periods. Therefore, we assume that parents first decide on the amount of transfers, and students choose their actions given parental transfers.[20]

Finally, to better illustrate our mechanism, we abstract from leisure in our model. A key concern may be that students could reduce their leisure time instead of sacrificing their study time while working for financing. However, our empirical analysis suggests otherwise. Using the ATUS 2004 data, we found that a student's study time significantly decreases with working hours (Appendix B).[21]

[18]The distribution of monetary transfer from the adult child to parents is largely skewed to the right. Although the mean is 2,555 USD, due to less than 1% of children making a transfer of more than 25,000 USD to the parents, about 27% of children give less than 500 USD to parents over two years.

[19]Brown et al. [2011] consider parental transfers both during and after schooling periods. We abstract from parents' post-schooling transfer, given that information on parents' post-schooling transfer is not available in the NLSY97. Empirically, Haider and McGarry [2012] show parental transfer made after the child's schooling period is not correlated with the transfer made during the schooling period.

[20]We also abstracts from general-equilibrium effects, treating the returns to study and work as fixed. While large-scale policies could in principle shift wages and enrollment patterns, the wage subsidy we study is modest in size and unlikely to affect aggregate prices. This partial-equilibrium analysis allows us to clearly isolate student time allocation and parental transfer responses, which are the core mechanisms of interest.

[21]In the previous version of our paper, we incorporated leisure into our quantitative model and showed that our findings are robust.

3.3 Equilibrium under Optimal Investment

We first analyze a situation in which the financial constraint is not binding. In this case, the child can optimally invest and smooth consumption. Assuming an interior solution, the child chooses n_k so that the marginal cost of self-financing that reduces human capital is equalized to the marginal benefit of self-financing that increases income ($-\frac{\partial \hat{h}}{\partial n_k} = wR$), where $\hat{h} = \Phi_J h$ and $R = e^{rP_J}$. The optimal time investment for an interior solution satisfies

$$(T - \epsilon n_k) = \big(\frac{\pi\gamma\hat{A}\epsilon}{wR}\big)^{\frac{1}{1-\gamma}}, \tag{8}$$

where $\hat{A} = \Phi_J A$. When students can optimally invest and smooth consumption, the college-completion decision is characterized by the lifetime income. The child chooses to complete college if the lifetime income from completing college is greater than that from dropping out.

Now consider the parents' problem. Without the binding constraint, the child can always optimally borrow to finance education and consumption and maximizes the lifetime income taking parental transfer as given. Therefore, the parental transfer does not affect the child's human capital.

3.4 Equilibrium under Suboptimal Investment

We now analyze a situation in which the financial constraint binds. If $d_k = (1 - s)m_k$, the first-order condition with respect to interior solutions for n_k for those who do not drop out is

$$wu'(wn_k + m_p) = \hat{\beta}\big(-\frac{\partial \hat{h}}{\partial n_k}\big)u'(\hat{h} - R\hat{m}_k), \tag{9}$$

where $\hat{m}_k = (1-s)m_k$. The marginal return from self-financing increases ($-\frac{\partial \hat{h}}{\partial n_k} > wR$), and the child works more than the optimal level. Extra working hours directly reduce the time investment and, thus, reduce human capital. Some students who could have graduated in the absence of the constraint may decide to drop out if the value from graduation becomes lower than the value from dropout.

The binding constraint also affects parental transfer. The marginal impact of the parental transfer on the child's value V_k can be represented as

$$\frac{dV_k}{dm_p} = \underbrace{\frac{\partial V_k}{\partial m_p}}_{\text{(I)}} + \underbrace{\frac{\partial V_k}{\partial \hat{h}}\frac{\partial \hat{h}}{\partial m_p}}_{\text{(II)}\geq 0 \text{ if } d_k = \hat{m}_k}. \tag{10}$$

In contrast to the case without binding constraint, the second term is added. Parental transfer can increase child utility by increasing child initial endowment, and hence consumption, as described in part (I) of equation (10). When the constraint binds, the parental transfer can further increase child utility by increasing child investment and human capital, as described in part (II) of equation (10). By relaxing the constraint for the child's consumption, additional parental transfer reduces self-financing, which in turn increases time investment in human capital.

3.5 Predetermined Parameters, Specification, and Variable Construction

To estimate the model, we first specify the predetermined parameters, which are summarized in Table 7. We normalize time so that one period represents four calendar years. On average, college dropouts have 1.4 years of college experience, while graduates typically spend 4.2 years in their education. Accordingly, in our life-cycle model, the child attends a college for $t = [0, P_J)$, where $P_0 = 1/3$ and $P_1 = 1$. The child works for $t = [P_J, R_k)$, where $R_k = 10$ and lives until $T_k = 15$. The parents retire at $R_p = 5$ and live until $T_p = 10$. We choose $\sigma = 2$, which belongs to the empirically supported range for the intertemporal elasticity of substitution (IES) (Browning et al. [1999]).[22] We set 0.07 for the growth rate of income over four years (g).[23]

The annual sticker price for attending a four-year college is set at 13,096 USD from NPSAS 2004. The monetary cost for college dropouts is calculated as $m_{k0} = 13,096 \times 1.4$, and for graduates, it is

[22] A greater value of IES ($\frac{1}{\sigma}$) implies a weaker preference for intertemporal consumption smoothing. To examine the robustness of the findings when we assume a weaker preference for intertermporal consumption smoothing, we estimated the model with a higher value of IES ($\sigma = 1.5$) in the previous version of our paper. The main findings remain robust.

[23] According to the experience-wage profile in Lagakos et al. [2018], the average wage for workers with 35-39 years of potential experience is 88% higher than for workers with 0-4 years of potential experience in the US, which translates into an annual growth rate of 1.7%.

$m_{k1} = 13,096 \times 4.2$, based on the respective years of college experience for dropouts and graduates. Similarly, the time endowment for college graduates (T_1) is 10,000, while for college dropouts (T_0), it is $10,000/3$.[24]

Grant is calculated for each family income quartile based on the NPSAS 2004. The share of sticker price covered by grant (s) is 0.47, 0.21, 0.14, and 0.10 for the first, second, third, and fourth quartile, respectively, of the family income distribution. Accordingly, the borrowing limit is set at $(1-s)m_{k0}$ for college dropouts and $(1-s)m_{k1}$ for college graduates, where s varies across family income quartiles.

For the lower bound of the initial stock of human capital, $\overline{h}$, we multiply the average annual income of high school graduates, which is $16,000$ USD, by four.[25] For the wage rate of college students, w, we use the average hourly wage of college students ages 18 - 21 (8 USD), focusing on income during the first two years of the college-enrollment period. We use the same value of w for all students, because we find no systematic variation in w during the college period by students' AFQT score or parental income. We set the annual interest rate as 0.05 based on the 10-Year Treasury Bill between 1998 and 2006.

The altruistic preference is different across different income quartiles: $\alpha = (\alpha_{q1}, \alpha_{q2}, \alpha_{q3}, \alpha_{q4})$, where $\alpha_{qj} = exp(\hat{\alpha}_{qj})$ for $j \in \{1,2,3,4\}$. Finally, we impose the log-normal assumption on ϵ and A: $\log \epsilon \sim N(\epsilon_0, \sigma_\epsilon)$ and $\log A \sim N(\zeta, \sigma_\zeta)$. To account for a potential correlation between a child's ability and family income, we assume that $\zeta = \zeta_0 + \zeta_1 \log(\tilde{x}_p)$, where $\tilde{x}_p$ represents the average family income when the child is between 16 and 17 years old.

The variables used for estimation are summarized in Table 8. For parents' lifetime income x_p, we calculate parents' income over 20 years by multiplying the average family income when the child is between 16 and 17 by $4\Phi_p$, where $\Phi_p = \int_0^{R_p} e^{(g-r)t} dt = \frac{1}{g-r}\left[e^{(g-r)R_p} - 1\right]$. In the data, late-college

[24]The figure 10,000 represents the 99th percentile of the observed distribution of total working hours over the college period in our sample.

[25]We calculate the average annual income of high school graduates between ages 22 and 27. Note that $16,000$ USD represents the minimum annual income that our model can generate. To align our model with the data, we replace any average annual income for a student below $16,000$ USD in the data with $16,000$ USD.

work hours often consist of internships or other career-related jobs that enhance human capital rather than diminish it. Because our focus is on student work that crowds out study time, we use early-college work hours (years 1–2) as the empirical counterpart to model labor supply. For graduates, we double early-college hours to approximate their total work effort during college. For the initial human capital after college, we multiply the average annual income for a student when she is between 26 and 30 by four.

3.6 Identification

The structural components $\{F(\epsilon), F(A), \pi_0, \gamma, \alpha\}$ are to be identified from the data. Note that ϵ influences the marginal cost of working during college, thereby affecting individuals' working hours. Therefore, under the log-normal assumption, the distribution of ϵ can be recovered from the mean and variance of log working hours during college periods. Similarly, A impacts labor income after college and can thus be identified by the mean and variance of log income following the college period, given the log-normal assumption. Note that ζ_1, which captures the association between A and family income, affects both working hours and labor income conditional on family income. Therefore, mean working hours or mean labor income, conditional on each family income quartile, can be used to recover ζ_1. The value from dropping out is directly influenced by π_0, and therefore, the proportion of dropouts can be used to determine the value of π_0. Holding working hours and A constant, post-college labor income is determined by γ. Therefore, γ can be identified by using labor income conditional on working hours. Finally, α directly affects the parental transfers, and hence can be identified by the average parental transfer by family income quartiles.

3.7 Estimation

We estimate the structural parameters using the method of simulated moments. To estimate 11 structural parameters, we target 23 moment conditions. The choice of moment conditions is based on the identification argument. Figure 2 displays how the model fits data on college completion rates, parental transfers, working hours, and annual labor income after college for each parental income quartile. The model fit is reasonable.[26]

We do not directly target college completion rates based on annual working hours during college. For an out-of-sample fit test, we compare the simulated college completion rates relative to annual working hours with the actual college completion rate relative to annual working hours from the data. The results, presented in Figure 3, demonstrate a good fit between the model and the data.

4 Results

In this section, we present our results from the model estimation.

4.1 Estimates

Table 9 shows the estimates for model parameters. First, parents' altruistic preferences show substantial heterogeneity. For instance, although the amount of parental transfer increases by family income, the altruistic preference measured by α decreases by family income. Poor parents are estimated to be relatively more altruistic than rich parents, because they also contribute to financing their child's education, although the utility cost of doing so is much higher than for rich parents. Second, students' unobservable characteristic ϵ also shows substantial heterogeneity, which suggests accounting for unobserved heterogeneity is important in understanding the impact of students' working hours on the labor market outcome. Third, ζ_1 is estimated as positive, suggesting that students' ability and family income are positively associated. Finally, π_0 is estimated at 0.231, indicating that the labor market penalties on dropouts are substantial.

[26] Table C1 in the Appendix displays all the data and simulated moments used for estimation.

4.2 Policy Experiments

In this section, we conduct counterfactual policy analyses to evaluate a wage subsidy policy. We examine the effects of such a policy while accounting for the endogenous response of parents. Subsequently, we explore how these effects are altered when assuming that parents do not adjust their transfers accordingly, in order to quantify the importance of the interaction between parental transfers and the child's self-financing when evaluating the policy implications.

4.2.1 Wage Subsidy

We are considering the following wage subsidy policy: students receive a 25% of the baseline wage rate of 8 USD, which is 2 USD, as a subsidy for every working hour during college.[27] However, there is a working hour restriction in place to ensure that students cannot exceed 1,000 hours of work per year during their college years. Students have the option to participate in the wage subsidy policy, and those who choose not to participate can still work at the baseline wage rate without any restrictions on their working hours. A wage subsidy is closely related to the federal work-study program. The federal work-study program in the US provides part-time jobs for undergraduate students with financial needs that allow them to earn money to help pay education expenses. Although the program has been implemented as a "self-help" component of financial aid, government subsidies play a vital role in the program. Although the share varies by institution, a maximum of 75% of the salary the student receives can be financed by the government.[28] As a result, government spending on the work-study program is sizable: 0.96 billion USD in 2018.[29] On the other hand, the federal work-study program generally imposes a working hour restriction to prevent students from overworking. The specific details of this restriction may vary depending on the institution and program guidelines, but a typical restriction is

[27] Two dollars is roughly the difference between the maximum (9.32 in Washington) and the minimum (7.25 in Alabama) level of the minimum wage across states in the US in 2014.

[28] Source: fsapartners.ed.gov/knowledge-center/fsa-handbook/2020-2021/vol6/ch2-federal-work-study-program.

[29] In the 2017-2018 academic year, the total amount of federal grants (loans) awarded to students was 41.7 billion (93.9 billion) USD, the total amount of education tax benefits amounted to 17.0 billion USD, and the total amount for the federal work-study program was 0.96 billion USD. Source: Trends in Student Aid 2018.

that students cannot work more than 20 hours per week during the academic year. We choose to use a limit of 1,000 hours per year to partially reflect this feature. Therefore, our framework can be useful for understanding the impact of the work-study program in the form of a wage subsidy.

The wage subsidy policy is funded by a one-time income tax on parents. We adjust the tax rate, which is proportional to parents' annual income, to balance the total amount of subsidies provided by the program with the revenue generated from the one-time income tax. The tax rate that satisfies the aforementioned condition in our counterfactual simulation is 8.95%.

Column (1) of Table 10 summarizes the aggregate impacts of the wage subsidy policy. The wage subsidy policy increases the aggregate college completion rate by 5.69 percentage points. The working hours over the college period of students who complete college decrease by 125. However, due to the increased total working hours among students who transition from dropping out to college completion with the wage subsidy, the working hours during the college period for all students remain largely unchanged. The average human capital of all students, as measured by annual earnings after college, increases by 245 USD. This overall improvement is due to increased study time for intramarginal students (those who either consistently complete or drop out in both scenarios) and increased college completion for marginal students (those who would have dropped out without the wage subsidy). The average parental transfer decreases by 3,515 USD.

Despite the decrease in parental transfer, the increased earnings from the higher wage and improved human capital result in a positive welfare gain for the child. The welfare effect of the wage subsidy policy for the child is a 0.14% increase in lifetime consumption. The welfare effect for parents is close to zero, with a 0.002% decrease in lifetime consumption. While reduced parental transfers and improved child utility have a positive welfare effect for parents, the income tax used to finance the wage subsidy policy directly impacts parents' consumption negatively. These opposing forces cancel each other out, resulting in a near-zero overall effect.

To investigate the distributional impact on students' outcome and welfare, in Table 11, we report changes in the college-completion rate (Panel A1), average human capital (Panel B1), average parental transfer (Panel C1), average students' welfare (Panel D1), and average parents' welfare (Panel E1) by family income quartile.

The college completion rates increase for all groups, but the impacts are greater for low-income students (A1 of Table 11). The impacts on human capital are positive for low-income students, but negative for high-income students. Equation (9) can be helpful for understanding the different responses of working hours across different parental income levels. When the constraint binds, the impact of a wage increase on human capital is ambiguous. First, a higher wage during the college period increases the opportunity cost of studying in terms of foregone earnings. The binding constraint further amplifies the opportunity cost of studying compared to the case without a financial constraint. This is because the consumption level of students during college is lower than the optimal level. Self-financing through wage earnings (wn_k) becomes an important means to increase consumption during the college period. As a result, a higher wage can lead to a reduction in study time and, consequently, a decrease in human capital accumulation (substitution effect).

On the other hand, a higher wage can increase students' earnings and consumption during college for each unit of working hours. As a result, this increase in consumption reduces the marginal utility of additional consumption, denoted as $u'(wn_k + m_p)$. By reducing the marginal return from extra consumption during college, a higher wage can reduce self-financing and increase human capital (income effect).

Note that the second mechanism is stronger for students with lower parental transfers m_p during the college period. For students who have limited financial support from their parents, a higher wage during college can help them maintain a reasonable consumption level without having to work extensive hours. This, in turn, can have positive effects on their college graduation and human capital. On the other hand, for students who receive substantial financial support from their parents, an increase in wages during college may have adverse effects on the accumulation of human capital. This is because the substitution effect could outweigh the income effect. Therefore, the impact of wage increases on the intensive margin of human capital would vary among students.

Conditional on a student's ability, the mechanism mentioned above implies that the income effect would be stronger for low-income students with less parental support, leading to a greater reduction in working hours and an increase in human capital. However, students' ability is estimated to be positively correlated with their parents' income. This counteracts the aforementioned mechanism, as high-ability students face a higher opportunity cost of working on their human capital. Consequently, the policy impacts on working hours and human capital do not change monotonically by family income, and the negative effect on human capital is greatest for the second-highest quartile group.[30]

The parental transfer decreases for all groups, with a smaller extent of decrease observed among low-income students. Although the compensation motive of altruistic parents decreases as the child can earn higher wages, parents still need to take into account the fact that if they reduce financial support for the child, the child may end up working excessive hours following the wage increase, which could have adverse effects on their human capital. Because the marginal effects of the parental transfer on a child's labor supply and human capital are generally greater for low-income students, all other factors being equal, the crowd-out effect of parental transfer would be smaller for low-income families.[31]

The welfare effect for the child is greater for low-income students because both the intensive and extensive margins of human capital increase relatively more compared to high-income students, while the decrease in the parental transfer is smaller for low-income students. The welfare effect on parents is also greater for low-income students because the child's welfare increases relatively more, and low-income parents experience a higher utility gain from reduced parental transfers. Note that the welfare

[30] Our mechanism mirrors the substitution–wealth-effect tradeoff in Lochner and Monge-Naranjo [2011], but it works through endogenous student labor supply (self-financing) rather than borrowing constraints alone.

[31] Note that, consistent with the findings on working hours and human capital, the reduction in parental transfers is most pronounced among students from the second-highest income quartile group. Parents from the highest-income quartile group could not decrease transfers as much as those from the second-highest income quartile because their children face a higher opportunity cost of working due to higher ability level.

effect for high-income parents is negative, not only because the child's welfare gain is smaller, but also because proportional income tax has a larger negative impact on the consumption of high-income parents.

4.2.2 Wage Subsidy without Endogenous Response by Parents

To quantify the significance of the interaction between parental transfer and the child's choices when assessing the impact of the wage subsidy policy, we conduct a counterfactual analysis where we eliminate the endogenous response by parents to the wage subsidy policy. In particular, when introducing the same wage subsidy policy as in the previous section, we keep the parental transfer fixed at the level obtained from the baseline simulation and only allow the child to make changes to their choices. We adjust the tax rate accordingly so that the total spending for the wage subsidy policy can be financed by the one-time proportional income tax on parents. The budget neutral tax rate in this simulation is 6.50%.

Column (2) of Table 10 summarizes the aggregate impacts. First, the wage subsidy policy without endogenous parental response would result in a 5.43 percentage point increase in the college completion rate, which is slightly smaller than the impact observed when we account for changes in parental transfers.

To understand why we have a smaller positive impact on the college completion rate, even though the average parental transfer is greater without endogenous response by parents, it is worth noting substantial heterogeneity in the impact of the policy. While many parents would decrease transfers when the wage increases for the child, certain parents, particularly those with children who are at risk of dropping out of college, may choose to increase their financial support to prevent their child from working excessive hours while in college.

We find that the share of parents who increase transfers under the wage subsidy policy comprises 5.71% of the entire sample. Table 12 further decomposes this share by family income and students' ability. High-income parents, or those with relatively low-ability children, tend to increase their transfers more than other groups in response to the wage subsidy. For those marginal students, the endogenous response by parents, which involves increasing transfers in response to the wage increase, is important to help them to complete college. Therefore, abstracting from parents' endogenous responses could *understate* the impact of wage subsidy policy on the college completion rate.

The wage subsidy policy would have greater positive impacts on time investment in college education if parents do not adjust their transfers. Focusing on students who complete college in both the baseline and policy simulations, the working hours decrease by 326 without considering endogenous parental responses, whereas it decreases by 125 once parental responses are incorporated. Similarly, the working hours decrease for the entire sample by 156 assuming fixed parental transfer, whereas they increase by 4 with endogenous parental transfer. Because most parents reduce transfers when the child can earn higher wages during college, abstracting such a crowd-out effect on parental transfers would overstate the impact of the wage subsidy policy on human capital, which is an increase of 1,267 USD. Consequently, the increase in human capital is overestimated, by approximately 1,000 USD.

Abstracting the endogenous parental response to the wage subsidy policy would overstate the welfare effect of the policy for children. Instead of a 0.14% increase in lifetime consumption with the endogenous parental response, it would be overestimated as a 0.50% increase. This overestimation occurs because not only does it overstate the average parental transfer when introducing the wage subsidy policy, but it also overstates the child's human capital. On the other hand, if we disregard parents' responses, the welfare effect of the wage subsidy policy for parents indicates a 0.03% increase in consumption. When parental transfers remain fixed at the baseline simulation level, the increase in student working hours due to the wage subsidy policy diminishes. Consequently, the income tax rate needed to finance the wage subsidy drops from 8.95% to 6.50%. Overall, despite the greater parental transfer, due to the lower income tax, parental welfare improves compared to a scenario with endogenous responses from parents.

5 Conclusion

We document that a large number of college students work a substantial number of hours in low-skill jobs and that students who have fewer resources (especially parental transfers) tend to work more. To quantify the trade-off that working during college entails, we develop a theory that shows how—in the presence of financial constraints—the interaction between college students' labor supply for self-financing and their parents' endogenous transfer decision leads to heterogeneous human capital accumulation during college. We find that a wage subsidy policy can positively affect college completion rates and enhance the welfare of students, particularly those from low-income families. Furthermore, our results emphasize the importance of considering the endogenous response of parents to accurately evaluate the impact of the wage subsidy policy.

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Tables and Figures

Table 1: Working Hours during College and Student Outcomes

	Working hours per week			
Variables	0-15	16-30	31-45	46-70
Total credit earned	109.6	93.9	80.9	60.0
	(1.0)	(1.9)	(3.5)	(8.7)
GPA first-year	3.0	2.7	2.7	2.4
	(0.02)	(0.04)	(0.06)	(0.26)
Never meet academic advisor	0.14	0.19	0.25	0.31
	(0.01)	(0.02)	(0.04)	(0.08)
Never participate in a school club	0.47	0.62	0.75	0.78
	(0.01)	(0.02)	(0.03)	(0.06)
Stopouts	0.24	0.35	0.36	0.39
	(0.01)	(0.02)	(0.03)	(0.07)
Percentage distribution	66.9	21.3	9.8	2.0

NOTE: The table shows the academic outcomes of students who were in their first year of a four-year college for the 2003-2004 academic year by their working hours per week during the first year of the college. "Total credit earned" is the total number of normalized postsecondary credits earned within six years. "GPA first-year" is the cumulative grade point average for the 2003-2004 academic year. The maximum GPA is 4. School activity variables (meeting academic advisor and participating in a school club) collect information on how frequently the student engaged in the activity for the first academic year, with three categories: 0:never, 1: sometimes, 2: often. "Never meet academic advisor" is the share of students who never met their academic advisor. "Never participate in a school club" is the share of students who never participated in a school club. Stopouts is the share of students who withdraw from college temporarily (longer than 4 months) during the 2003-2004 academic year. Standard deviations are in parentheses. Source: Beginning Postsecondary Students 2004 and 2009.

Table 2: Working Hours during College

	Working hours during			
	First year	First 2 years	First 4 years	First 2 summers
Mean	819	1,775	4,111	634
Std.	695	1,268	2,561	409
10th percentile	0	315	1,168	40
50th percentile	676	1,535	3,823	621
90th percentile	1,825	3,540	7,380	1,148
Number of observations	1,164	1,164	1,164	1,164

NOTE: This table shows the summary statistics for individuals' working hours after college enrollment. The term "First 2 summers" refers to June-August within the initial 24 months of a four-year college education. Source: NLSY97.

Table 3: Regression Estimates for Working Hours

Outcome	Working hours	
	(1)	(2)
AFQT	-2.539*	-1.572
	(1.494)	(1.501)
Grants/1000	-5.851***	-5.520***
	(1.446)	(1.438)
Student Loan/1000	6.603***	7.061***
	(2.128)	(2.115)
Annual parental income/1000	-1.586**	-0.817
	(0.693)	(0.711)
Parental Transfer/1000		-6.211***
		(1.469)
Constant	2,062***	2,020***
	(108.0)	(107.7)
Observations	1,164	1,164
R-squared	0.026	0.041

NOTE: This table shows the regression estimates for working hours for the first 2 years after enrollment with respect to observable variables. The amounts of grants, student loans, and parental transfers are aggregated over the enrollment period. Annual parental income refers to the average family income when a student's age is between 16 and 17. Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: NLSY97.

Table 4: Summary Statistics (SIPP)

	(1) Head never displaced	(2) Head displaced after 1st survey period
Monthly parental income in 1st survey period		
Mean	4,130	3,753
Std.	(4,568)	(4,045)
25th percentile	1,250	1,198
50th percentile	3,087	2,900
75th percentile	5,709	5,108
Head education (some college or above)	0.65	0.64
	(0.47)	(0.48)
Head age	49	49
	(7)	(6)
Grants	0.32	0.37
	(0.47)	(0.48)
Male	0.48	0.47
	(0.49)	(0.50)
White	0.77	0.75
	(0.42)	(0.44)
Black	0.14	0.16
	(0.35)	(0.37)
Number of students	23,947	228

NOTE: This table shows the summary statistics for students whose parents do not experience a job-loss shock (column (1)) and for students whose parents experienced a job-loss shock after the first survey period (column (2)). The parental job-loss shock is a dummy variable taking a value of 1 if a student's father (or mother in the case of single-mother households) lost his/her job in the previous 4 months due to (1) employer bankrupt, (2) employer sold business, or (3) slack work or business conditions. The observation is at each student level. We report the information in the first survey period. The average and standard deviation (in parentheses) of each variable are reported, otherwise indicated. The head of a household is defined as the male in two-parent households and the female in single-mother households. Head education is a dummy variable taking the value of 1 if the household head has attended some college or above institutions. Grants is a dummy variable for students who received a grant during the survey period (4 months). Source: SIPP.

Table 5: Regression Estimates for Working Hours (SIPP)

Outcome	Parental Income (Monthly) First Stage (1)	Working Hours (Weekly) OLS (2)	Working Hours (Weekly) 2SLS (3)	New Loan (4)
Previous job-loss shock	-1.450***			0.0450**
	(0.208)			(0.0195)
Parental Income/1000		-0.0299*	-2.425***	
(Monthly)		(0.0165)	(0.826)	
Year FE	Y	Y	Y	Y
Race/Sex/Grant Dummies	Y	Y	Y	Y
IV for Parental Income			Y	
Individual FE				Y
Observations	77,025	77,025	77,025	71,428

NOTE: This table shows regression estimates for the weekly working hours with respect to observable variables from the SIPP. The observation is at each student-period (4 months) level. We use the parental job-loss shock, a dummy variable taking a value of 1 if a student's father (or mother in the case of single-mother households) lost his/her job in the previous 4 months due to (1) employer bankrupt, (2) employer sold business, or (3) slack work or business conditions as an instrumental variable for monthly parental income. Grants is a dummy variable indicating whether the student received a grant during the period, while New Loan is a dummy variable for students who took a new loan during the period. Standard errors, clustered at the student level, are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: SIPP.

Table 6: Regression Estimates for College Completion

Outcome	College Completion	
	(1)	(2)
Working hours/1000	-0.0484***	-0.0569***
	(0.00930)	(0.0115)
Summer working hours/1000		0.0445
		(0.0354)
AFQT	0.0029***	0.0028***
	(0.0005)	(0.0005)
Grants/1000	0.0016*	0.0016*
	(0.0009)	(0.0009)
Student Loan/1000	-0.0024	-0.0023
	(0.0016)	(0.0016)
Annual parental income/1000	0.0008***	0.0008***
	(0.0002)	(0.0002)
Parental Transfer/1000	0.0014	0.0013
	(0.0009)	(0.0009)
Constant	0.622***	0.613***
	(0.0381)	(0.0387)
Observations	1,164	1,164
R-squared	0.091	0.092

NOTE: This table shows the linear regression estimates for graduation probability with respect to observable variables. "College Completion" is a dummy variable for graduation. "Working hours" refers to working hours for the first 2 years after enrollment. "Summer working hours" refers to working hours from June to August within the first 2 years after enrollment. The amounts of grants, student loans, and parental transfers are aggregated for the first 2 years after enrollment. Annual parental income refers to the average family income when a student's age is between 16 and 17. Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: NLSY97.

Table 7: Predetermined Parameters

Parameter	Value	Description	Data source
P_1	1	Start of working period for graduates	NLSY97
P_0	1/3	Start of working period for dropouts	NLSY97
R_k	10	Start of retirement period for the child	
T_k	15	End of lifetime for the child	
R_p	5	Start of retirement period for parents	
T_p	10	End of lifetime for parents	
σ	2	IES=0.5	Browning et al. [1999]
g	0.07	Growth rate of earnings over 4 years	Lagakos et al. [2018]
m_{k1}	$13,096 \times 4.2$	Mean sticker price for graduates	NPSAS 2004
m_{k0}	$13,096 \times 1.4$	Mean sticker price for dropouts	NPSAS 2004
s	0.47	Share of grant, first income quartile	NPSAS 2004
	0.21	Share of grant, second income quartile	NPSAS 2004
	0.14	Share of grant, third income quartile	NPSAS 2004
	0.10	Share of grant, fourth income quartile	NPSAS 2004
$\bar{h}$	16,000×4	Mean annual earnings for high school graduates×4	NLSY97
w	8	Mean hourly wage of college students	NLSY97
T_1	10,000	Time endowment for graduates	NLSY97
T_0	10,000/3	Time endowment for dropouts	NLSY97
$r = \delta$	$(1.05)^4 - 1$	5% is the annual interest rate	US 10 Year T-Bill 1998-2006

NOTE: This table summarizes the predetermined parameters for estimation. One unit of period is normalized as 4 years.

Table 8: Variable Construction for Estimation

Variable	Data
x_p	Family income over 20 years imputed by mean annual family income between ages 16 and 17
m_p	Total parental transfers over college period
n_k	Working hours up to the first two years for dropouts, $2 \times$ First 2-year working hours for graduates
h	$4 \times$ Mean annual earnings after college between ages 26 and 30

NOTE: This table summarizes how the variables are constructed for estimation. Source: NLSY97.

Table 9: Parameter Estimates

Variable	Estimate	Standard Error
γ	0.732	0.028
ϵ_0	0.585	0.024
σ_ϵ	0.404	0.017
$\hat{\alpha}_{q1}$	-0.770	0.039
$\hat{\alpha}_{q2}$	-2.230	0.030
$\hat{\alpha}_{q3}$	-3.254	0.026
$\hat{\alpha}_{q4}$	-4.345	0.040
ζ_0	2.030	0.159
ζ_1	0.252	0.029
σ_ζ	0.733	0.081
π_0	0.231	0.021

NOTE: This table shows parameter estimates for the quantitative model.

Table 10: Policy Simulation

	(1) Wage subsidy	(2) Wage subsidy, fixed parental transfer	(3) Baseline
College completion rate (percentage point)	5.69	5.43	75.96
Total Working hours (graduates)	-125	-326	3,344
Total Working hours (all)	4	-156	2,892
Human capital (annual earnings)	245	1,267	33,208
Parental transfer	-3,515	0	14,970
Welfare of students (%, lifetime consumption)	0.14	0.50	NA
Welfare of parents (%, lifetime consumption)	-0.002	0.03	NA

NOTE: This table presents the results from simulations of the wage subsidy policy (columns (1)-(2)) alongside the baseline model simulation (column (3)). Under the wage subsidy policy, hourly wages are increased by 25%, or 2 USD, compared to the current wage of 8 USD for students who work during college. Additionally, a working hour restriction is implemented to ensure that students who complete college do not exceed 1,000 hours of work per year during college. The policy is financed by budget-neutral, one-time income tax on parents. Column (1) represents the results when accounting for the endogenous response by parents to the policy change. Column (2) represents the results under the assumption that parents do not respond to the policy change and maintain the same transfer as in the baseline simulation. We report changes from the baseline (estimated) economy regarding (1) the college-completion rate (i.e., college-graduation rate in the simulated economy − college-graduation rate in the baseline economy), (2) average working hours over the college period for those who complete college both in the baseline economy and in the policy simulation, (3) average working hours over the college period for all students, (4) average human capital measured by annual earnings after college, (5) average parental transfer during the college period, and average welfare of students (6) and parents (7) measured by consumption changes relative to the lifetime consumption in the baseline economy.

Table 11: Heterogeneous Impacts of Policy Simulation

	Parental income			
	FQ1	FQ2	FQ3	FQ4
	Panel A. College-completion rate			
A1. Wage subsidy	9.14	6.05	4.06	3.51
A2. Wage subsidy, fixed parental transfer	8.80	5.70	3.92	3.30
	Panel B. Human capital			
B1. Wage subsidy	1,047	307	-243	-129
B2. Wage subsidy, fixed parental transfer	1,438	1,274	1,120	1,238
	Panel C. Parental transfer			
C1. Wage subsidy	-1,654	-3,571	-4,642	-4,196
C2. Wage subsidy, fixed parental transfer	0	0	0	0
	Panel D. Students' welfare			
D1. Wage subsidy	0.36	0.15	0.02	0.04
D2. Wage subsidy, fixed parental transfer	0.53	0.54	0.49	0.43
	Panel E. Parents' welfare			
E1. Wage subsidy	0.18	0.02	-0.06	-0.12
E2. Wage subsidy, fixed parental transfer	0.19	0.05	-0.02	-0.07

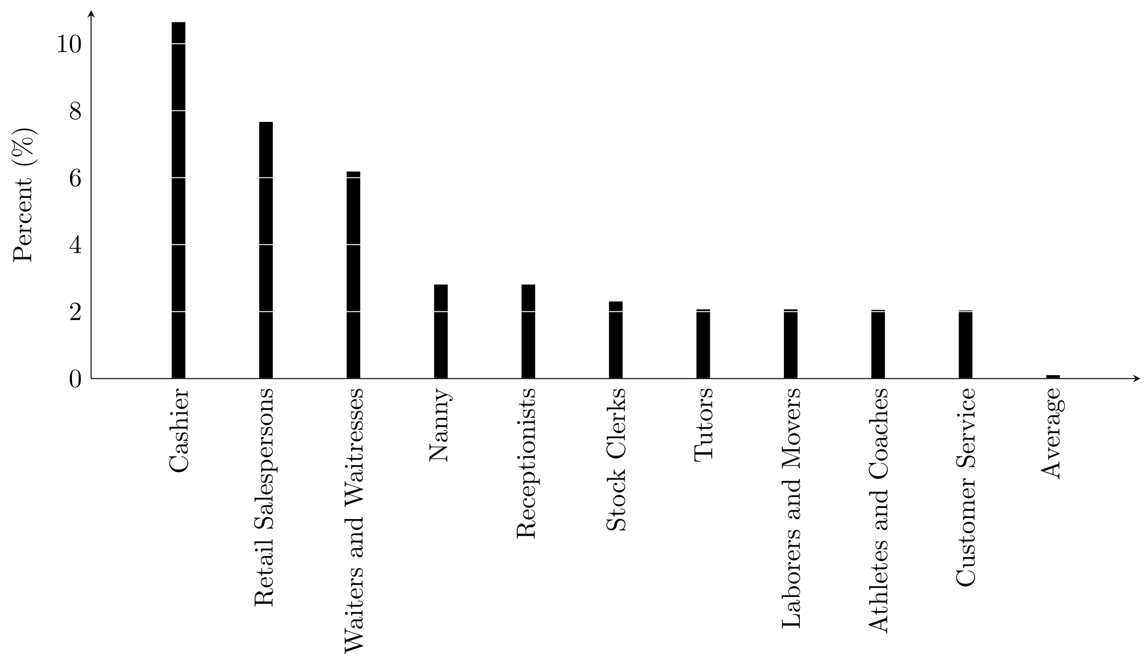
NOTE: This table shows the changes in the college-completion rate (Panel A), average human capital (Panel B), average parental transfer (Panel C), average students' welfare (Panel D), and average parents' welfare (Panel E) for each income group after each policy. FQ# refers to the #th quartile of the parental income distribution.

Table 12: Proportion of Parents Increasing Parental Transfers

	Parental Income	
	Below Median	Above Median
Ability (A)		
Below Median	2.16%	2.42%
Above Median	0.48%	0.65%

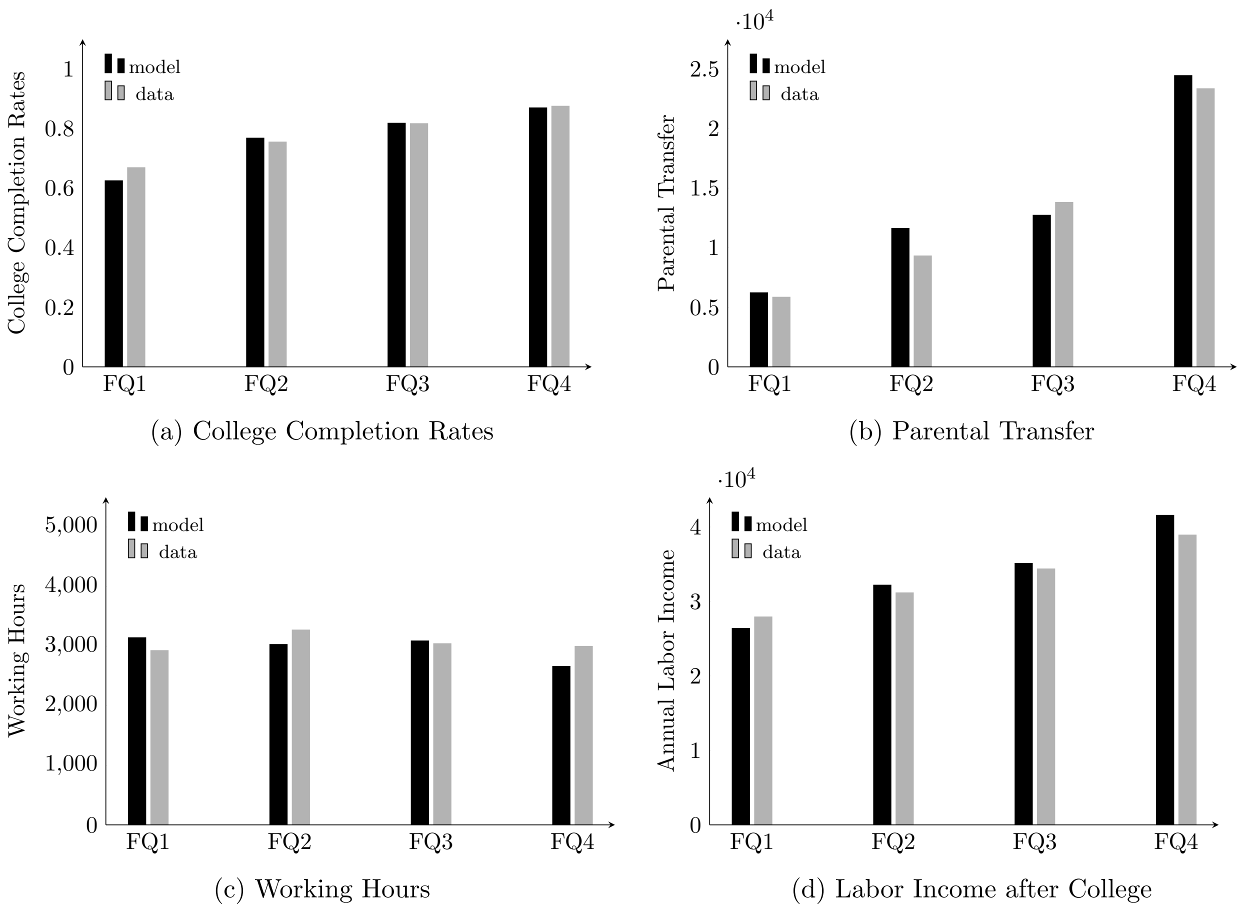
NOTE: This table shows the decomposition of parents who increase transfers when the wage subsidy policy is introduced, categorized by family income and the child's ability. The total share of parents with increased transfer with the wage subsidy policy is 5.71%.

Figure 1: Jobs Held by College Students



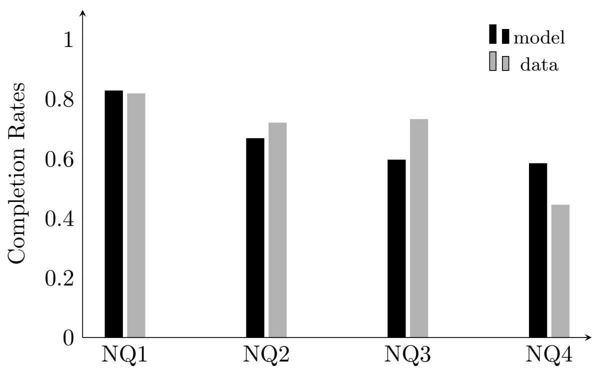
NOTE: The figure shows the most frequently chosen occupations by four-year college students during ages 18-22. Source: NLSY97.

Figure 2: Model Fit

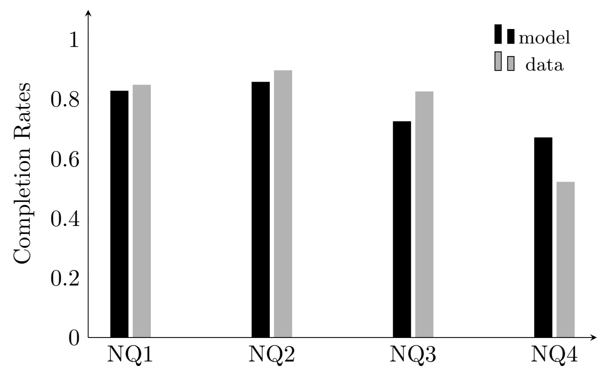


NOTE: The figure depicts the model fit for (a) college completion rates, (b) parental transfers, (c) working hours, and (d) annual labor income after college, organized by family income quartiles. FQ# refers to the #th quartile of the parental income distribution.

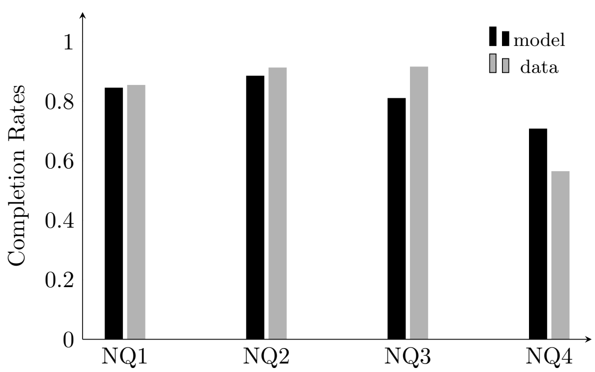
Figure 3: Out of Sample Prediction: Working Hours and College Completion Rates



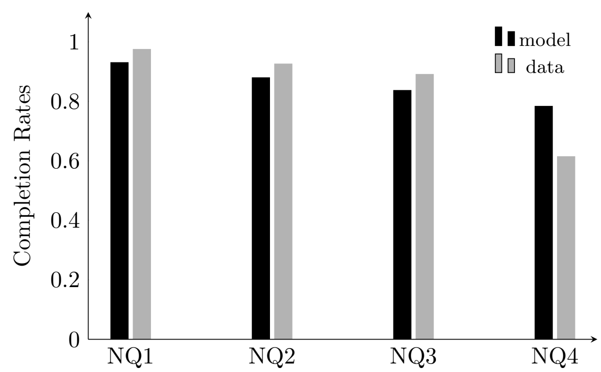
(a) First Income Quartile



(b) Second Income Quartile



(c) Third Income Quartile



(d) Fourth Income Quartile

NOTE: The figure displays the out-of-sample fit of the model. We compare model's predictions with actual data regarding the correlation between annual working hours during college and college completion rates. These moments are not targeted in the estimation. Each panel demonstrates how college completion rates change across quartiles of annual working hours, conditional on family income quartiles. NQ# refers to the #th quartile of the annual working hours during college. The annual working hours during college are calculated by dividing the total working hours during college by the number of years of college education.

Appendix

A Characterization of the Two-Period Model

In this section, we characterize a simplified version of our quantitative model. For clarity, we present a two-period model with a given value for the dropout option.

A family consists of parents and a child. They live two periods: the child's college period and the child's working period. The parents are altruistic and hence receive utility from their child's utility, but the child cares only about herself. The parents first make a transfer (m_p) to the child before college begins, and then the child decides how much money to invest in education, how many student loans to take, how many hours to work during college, and whether to drop out. The per-period utility from consumption (c) of the parents and the child is given by $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. A child is characterized by her ability $A \in \mathbb{R}_+$ and other unobserved characteristic $\epsilon \in \mathbb{R}_+$, and parents are characterized by their income $x_p \in \mathbb{R}_+$ and an altruistic preference $\alpha \in \mathbb{R}_+$.

Human capital accumulation from a college education (h) is is given by:

$$h = \overline{h} + A\big\{m_k^\gamma + (T - \epsilon n_k)^\gamma\big\}^{\frac{\rho}{\gamma}}, \qquad \rho < 1. \tag{11}$$

T represents the time endowment for college education, which is the same for all individuals. n_k is the working hours during the college period. The child's time investment decreases as she works more toward self-financing. The extent to which working hours affect human capital accumulation depends on ϵ, the unobservable characteristic of the child. We assume $\rho < 1$ to guarantee that the optimal level of human capital is finite. We also assume that $\gamma < 0$ so that the time and monetary investment is complement in the production function. $\overline{h}$ is the initial human capital stock before the college education. If the child decides to drop out, human capital is given by $h = \overline{h} + \phi_0 + \phi_1 A$.

A minimum monetary investment (m_d) is required to enroll in a college such that $m_k \geq m_d$. To finance the college cost, the child can take out student loans (d_k), but there exists a financial constraint such that $d_k \leq m_k$.

Given the parents' transfer (m_p), the child maximizes lifetime utility by choosing the first- and second-period consumption $\{C_{k1}, C_{k2}\}$ and $\{n_k, m_k, d_k, J\}$:

$$\max_{\{C_{k1}, C_{k2}, n_k, m_k, d_k, J\}} u(C_{k1}) + \beta u(C_{k2}) \quad \text{subject to} \tag{12}$$

$$C_{k1} + m_k \leq w n_k + d_k + m_p,$$

$$C_{k2} + R d_k \leq h,$$

$$d_k \leq m_k,$$

$$h = J \cdot \Big[\overline{h} + A\big\{m_k^{\gamma} + (T - \epsilon n_k)^{\gamma}\big\}^{\frac{\rho}{\gamma}}\Big] + (1 - J) \cdot \Big[\overline{h} + \phi_0 + \phi_1 A\Big],$$

$$m_k \geq m_d, \quad n_k \geq 0, \quad T - \epsilon n_k > 0, \quad \text{if } J = 1,$$

$$m_k = m_d, \quad n_k = n_d, \quad \text{if } J = 0,$$

where R and w are the risk-free gross interest rate and wage, respectively.

Knowing how the child behaves given parental transfer, the parents maximize their lifetime utility and their child's value by choosing the first- and second-period consumption $\{C_{p1}, C_{p2}\}$, transfer (m_p), and amount of savings (a_p):

$$\max_{\{C_{p1}, C_{p2}, m_p, a_p\}} u(C_{p1}) + \beta u(C_{p2}) + \alpha V_k(A, \epsilon, m_p) \quad \text{subject to}$$

$$C_{p1} + m_p + a_p \leq x_p,$$

$$C_{p2} \leq R a_p, \quad m_p \geq 0,$$

where $V_k(A, \epsilon, m_p)$ is the value function of the child, and α captures the extent of the parents' altruistic preference.

A.1 Equilibrium under Optimal Investment

We first analyze the case in which the child can optimally invest and smooth consumption. We solve the child's problem for a given parental transfer m_p, and then solve for m_p to fully characterize the model. For $J = 1$, we characterize the solution when $T - \epsilon n_k > 0$ and $m_k > m_d$ hold. Note that the human capital production function for $J = 1$ is $h_1 = \overline{h} + A\{m_k^\gamma + (T - \epsilon n_k)^\gamma\}^{\frac{\rho}{\gamma}}$.

For an interior solution ($m_k > m_d$, $n_k > 0$), the optimality conditions imply

$$
\begin{aligned}
\frac{\partial h}{\partial m_k} &= \rho A\big\{m_k^\gamma + (T - \epsilon n_k)^\gamma\big\}^{\frac{\rho}{\gamma}-1} m_k^{\gamma-1} = R \\
-\frac{\partial h}{\partial n_k} &= \epsilon\rho A\big\{m_k^\gamma + (T - \epsilon n_k)^\gamma\big\}^{\frac{\rho}{\gamma}-1} (T - \epsilon n_k)^{\gamma-1} = Rw.
\end{aligned}
$$

Without the constraint, the child chooses m_k that equalizes the marginal gain in human capital to the interest rate. Similarly, the child chooses n_k so that the marginal cost of self-financing that reduces human capital is equalized to the marginal benefit of self-financing that increases income by Rw. Denote $\{m_k^*, n_k^*\}$ to be the interior solution without the constraints. Combining the above two equations, we get $T - \epsilon n_k^* = \big(\frac{\epsilon}{w}\big)^{\frac{1}{1-\gamma}} m_k^*$. Therefore, the child's monetary investment decreases as the labor supply during college increases.

The optimal monetary and time investments for an interior solution are

$$
\begin{aligned}
m_k^* &= K_1 A^{\frac{1}{1-\rho}}, \\
T - \epsilon n_k^* &= \big(\frac{\epsilon}{w}\big)^{\frac{1}{1-\gamma}} K_1 A^{\frac{1}{1-\rho}},
\end{aligned}
$$

where $K_1 = \Big[\frac{\rho}{R}\Big\{1 + \big(\frac{\epsilon}{w}\big)^{\frac{\gamma}{1-\gamma}}\Big\}^{\frac{\rho}{\gamma}-1}\Big]^{\frac{1}{1-\rho}}$. Note that the optimal monetary and time investments increase as ability increases.

Denote $\{\hat{m}_k, \hat{n}_k\}$ to be the corner solutions without the constraints ($\hat{n}_k = 0$). The child chooses the corner solutions if the following condition holds:

$$\rho A\big\{\hat{m}_k^{\gamma} + T^{\gamma}\big\}^{\frac{\rho}{\gamma}-1}\hat{m}_k^{\gamma-1} = R, \tag{13}$$

$$\epsilon\rho A\big\{\hat{m}_k^{\gamma} + T^{\gamma}\big\}^{\frac{\rho}{\gamma}-1}T^{\gamma-1} > Rw. \tag{14}$$

For a given A, let $\hat{m}_k(A)$ be the unique solution that satisfies equation (13), and let $\hat{\epsilon}(A)$ be the solution for the following equation:

$$\hat{\epsilon}(A) \equiv \frac{Rw}{\rho A}\big\{\hat{m}_k(A)^{\gamma} + T^{\gamma}\big\}^{1-\frac{\rho}{\gamma}}T^{1-\gamma}.$$

Then, from equation (14), $n_k = 0$ if and only if $\epsilon > \hat{\epsilon}(A)$.

If the child chooses to drop out of a college ($J = 0$), human capital is determined as $h_0 = \overline{h} + \phi_0 + \phi_1 A$, and the child's m_k and n_k are m_d and n_d, respectively.

The lifetime income of the child W_J ($J \in \{0,1\}$) can be written as

$$W_J = \begin{cases} \overline{h}/R + G\cdot A^{\frac{1}{1-\rho}} + \frac{wT}{\epsilon} + m_p, & \text{if } J = 1 \text{ and } \epsilon \le \hat{\epsilon}(A), \\ \overline{h}/R + A(\hat{m}_k^{\gamma} + T^{\gamma})^{\frac{\rho}{\gamma}}/R - \hat{m}_k + m_p, & \text{if } J = 1 \text{ and } \epsilon > \hat{\epsilon}(A), \\ \overline{h}/R + (\phi_0 + \phi_1 A)/R - m_d + wn_d + m_p, & \text{if } J = 0, \end{cases}$$

where $G = \big(\frac{\rho}{R}\big)^{\frac{1}{1-\rho}}\big(\frac{1}{\rho} - 1\big)\Big[1 + \big(\frac{\epsilon}{w}\big)^{\frac{\gamma}{1-\gamma}}\Big]^{\frac{\rho(1-\gamma)}{\gamma(1-\rho)}} > 0$. Let J^* be the college-completion decision without the constraint. Without the borrowing constraint, the optimal college-completion decision (J^*) is characterized by the lifetime income such that $J^* = 1$ if and only if $W_1 \ge W_0$. Let $A^*(\epsilon)$ be the solution for $G\cdot A^{\frac{1}{1-\rho}} + \frac{wT}{\epsilon} = (\phi_0 + \phi_1 A)/R - m_d + wn_d$, and let $\hat{A}(\epsilon)$ be the solution for $A(\hat{m}_k^{\gamma} + T^{\gamma})^{\frac{\rho}{\gamma}}/R - \hat{m}_k = (\phi_0 + \phi_1 A)/R - m_d + wn_d$. Then, the optimal choice for J^* can be characterized such that $J^* = 1$ if and only if $A \ge A^*(\epsilon)$ for $\epsilon < \hat{\epsilon}(A)$, and $J^* = 1$ if and only if $A \ge \hat{A}(\epsilon)$ for $\epsilon \ge \hat{\epsilon}(A)$.[32]

[32]To simplify the characterization with $n_k = 0$, we assume that $\phi_1 < T^{\rho}$. Under this condition, which is the case in our baseline simulation, the college-completion rate among those who do not work ($n_k = 0$) increases by A.

The child's choice without the constraint, (M_k^*, N_k^*), can be summarized as

$$M_k^* = \begin{cases} m_k^* = K_1 A^{\frac{1}{1-\rho}}, & \text{if } \epsilon < \hat{\epsilon}(A) \text{ and } A \geq A^*(\epsilon), \\ \hat{m}_k, & \text{if } \epsilon \geq \hat{\epsilon}(A) \text{ and } A \geq \hat{A}(\epsilon), \\ m_d, & \text{otherwise.} \end{cases} \tag{15}$$

$$N_k^* = \begin{cases} n_k^* = T/\epsilon - \epsilon^{\frac{\gamma}{1-\gamma}} w^{\frac{-1}{1-\gamma}} K_1 A^{\frac{1}{1-\rho}}, & \text{if } \epsilon < \hat{\epsilon}(A) \text{ and } A \geq A^*(\epsilon), \\ \hat{n}_k = 0, & \text{if } \epsilon \geq \hat{\epsilon}(A) \text{ and } A \geq \hat{A}(\epsilon), \\ n_d, & \text{otherwise.} \end{cases} \tag{16}$$

Note the college-completion decision and the time and monetary investment do not depend on parental transfer m_p. Let H^* be the optimal human capital. Then,

$$H^* = \begin{cases} h_1^* = \overline{h} + K_2 A^{\frac{1}{1-\rho}}, & \text{if } \epsilon < \hat{\epsilon}(A) \text{ and } A \geq A^*(\epsilon), \\ \hat{h}_1^* = \overline{h} + A(\hat{m}_k^\gamma + T^\gamma)^{\frac{\rho}{\gamma}}, & \text{if } \epsilon \geq \hat{\epsilon}(A) \text{ and } A \geq \hat{A}(\epsilon), \\ h_0^* = \overline{h} + \phi_0 + \phi_1 A, & \text{otherwise,} \end{cases} \tag{17}$$

where $K_2 = K_1^\rho \{1 + (\frac{\epsilon}{w})^{\frac{\gamma}{1-\gamma}}\}^{\frac{\rho}{\gamma}}$. Let $W^* = W_1 J^* + W_0(1 - J^*)$ be the child's lifetime income without credit constraint. The child's lifetime income increases by A.[33] Denote $\overline{W}^* = W^* - m_p$ to be the child's lifetime income net of parental transfer.

Now consider the parents' problem. Note that without borrowing constraints, the child can always optimally borrow to finance education and consumption. Therefore, without borrowing constraints, parental transfer does not affect the child's human capital and is driven by the compensating motive.

[33] Consider two individuals, A and B, who are identical except for their ability. Suppose B's ability is higher than A's. Denote $\{m_k^A, n_k^A\}$ to be the optimal choices of individual A, at which A is maximizing her lifetime utility. Note that without borrowing constraints, maximizing lifetime utility implies maximizing lifetime income. Suppose B's choice is the same as $\{m_k^A, n_k^A\}$, which is feasible for B without borrowing constraints. Even in this case, the lifetime income for B is greater than A because w is homogeneous and B's human capital is greater than A's with identical inputs. Because (m_k^B, n_k^B) maximizes B's lifetime income, whereas (m_k^A, n_k^A) is in the feasible set for B, (m_k^B, n_k^B) is weakly better than (m_k^A, n_k^A). Therefore, B's lifetime income is greater than A's lifetime income without borrowing constraints.

Altruistic parents make a transfer to equalize the marginal utility from consumption across generations:

$$u'\Big(\frac{x_p - m_p}{1+\beta^{\frac{1}{\sigma}}R^{\frac{1-\sigma}{\sigma}}}\Big) = \alpha u'\Big(\frac{\overline{W}^* + m_p}{1+\beta^{\frac{1}{\sigma}}R^{\frac{1-\sigma}{\sigma}}}\Big).$$

Note that $m_p \leq 0$ holds. If parental income x_p is low enough or parents' altruism α is small enough, parents choose $m_p = 0$ because

$$u'\Big(\frac{x_p}{1+\beta^{\frac{1}{\sigma}}R^{\frac{1-\sigma}{\sigma}}}\Big) > \alpha u'\Big(\frac{\overline{W}^*}{1+\beta^{\frac{1}{\sigma}}R^{\frac{1-\sigma}{\sigma}}}\Big).$$

To sum, the optimal parental transfer (m_p^*) without constraints can be characterized as follows:

$$m_p^* = \begin{cases} \frac{x_p}{1+\alpha^{-\frac{1}{\sigma}}} - \frac{\alpha^{-\frac{1}{\sigma}}\overline{W}^*}{1+\alpha^{-\frac{1}{\sigma}}}, & \text{if } x_p > \alpha^{-\frac{1}{\sigma}}\overline{W}^*, \\ 0, & \text{otherwise.} \end{cases} \tag{18}$$

Because the child's income increases by A, the marginal utility from the parental transfer, and, hence m_p, decreases by A without borrowing constraints.

A.2 Equilibrium under Suboptimal Investment

In this section, we characterize the solution when the financial constraint in the form of $d \leq m_k$ exists. First, when parental transfers are lower than a certain threshold (which depends on children's characteristics A and ϵ), children's time and monetary investment are constrained by the constraint. To show this point, we first specify the optimal borrowing:

$$D_k^* = \frac{(\beta R)^{-\frac{1}{\sigma}}H^* + (M_k^* - wN_k^* - m_p)}{1+(\beta R)^{-\frac{1}{\sigma}}R}.$$

The constraint is binding when $D_k^* > M_k^*$. Rearranging $D_k^* > M_k^*$ implies the constraint is binding when parental transfer (m_p) is smaller than a threshold $\overline{m}_p = (\beta R)^{-\frac{1}{\sigma}}(H^* - RM_k^*) - wN_k^*$:

$$\overline{m}_p = \begin{cases} (\beta R)^{-\frac{1}{\sigma}}(h_1^* - Rm_k^*) - wn_k^*, & \text{if } \epsilon < \hat{\epsilon}(A) \text{ and } A \geq A^*(\epsilon), \\ (\beta R)^{-\frac{1}{\sigma}}(\hat{h}_1^* - R\hat{m}_k), & \text{if } \epsilon \geq \hat{\epsilon}(A) \text{ and } A \geq \hat{A}(\epsilon), \\ (\beta R)^{-\frac{1}{\sigma}}(h_0^* - Rm_d) - wn_d, & \text{otherwise,} \end{cases} \tag{19}$$

where h_1^*, $\hat{h}_1^*$, and h_0^* are defined in equation (17).

The Child's Problem

Suppose $m_p \leq \overline{m}_p$. Then, the constraint binds and the child's problem becomes

$$\begin{aligned} &\max_{\{n_k, m_k\}} u(wn_k + m_p) + \beta u(h - Rm_k) \quad \text{subject to} \\ &\qquad h = J \cdot \Big[\overline{h} + A\big\{m_k^\gamma + (T - \epsilon n_k)^\gamma\big\}^{\frac{\rho}{\gamma}}\Big] + (1 - J) \cdot \Big[\overline{h} + \phi_0 + \phi_1 A\Big], \\ &\qquad m_k \geq m_d, \quad n_k \geq 0, \quad T - \epsilon n_k > 0, \quad \text{if } J = 1, \\ &\qquad m_k = m_d, \quad n_k = n_d, \quad \text{if } J = 0. \end{aligned}$$

The first-order conditions with respect to m_k and n_k for students who complete college are

$$\frac{\partial h}{\partial m_k} = R \tag{20}$$

$$wu'(wn_k + m_p) \geq \beta\big(-\frac{\partial h}{\partial n_k}\big)u'(h - Rm_k). \tag{21}$$

The child always invests in education until the marginal return is equal to the interest rate (equation (20)). However, if the child cannot finance consumption from borrowing, the marginal return from self-financing increases ($-\frac{\partial h}{\partial n_k} > wR$), and the child would work more than the optimal level to finance consumption. Note that if $\gamma < \rho$, the marginal gain in human capital with respect to m_k decreases as working hours increase.[34] Therefore, the extra working hours can further reduce human capital due to the reduction in monetary investment when $\gamma < \rho$. As a result, the level of human capital decreases.

When the constraint $d \leq m_k$ is introduced, parental transfer (m_p) affects the child's investment decision in addition to the child's characteristics (A, ϵ). To demonstrate how the constraint changes the child's investment decision, in what follows, we present a graphical characterization of the choices of the child who would decide to complete college without the constraint. In doing so, we focus on characterizing the changes in the choice variables with respect to (ϵ, m_p) given A, which will be useful when we discuss the identification of ϵ and α.

Figure A1 describes how the constraint affects child's labor supply. The horizontal dashed line represents $\epsilon = \hat{\epsilon}(A)$. The solid line ($\overline{0abc}$) represents $\max\{0, \overline{m}_p\}$. The vertical line $\overline{bc}$ represents $\overline{m}_p = (\beta R)^{-\frac{1}{\sigma}}(\hat{h}_1^* - R\hat{m}_k)$ when $n_k = \hat{n}_k = 0$, and the line $\overline{ab}$ represents $\overline{m}_p = (\beta R)^{-\frac{1}{\sigma}}(h_1^* - Rm_k^*) - wn_k^*$ when $n_k = n_k^* > 0$.

If the constraint does not bind, child's labor supply depends only on ϵ. In particular, $n_k = \hat{n}_k = 0$ if $\epsilon > \hat{\epsilon}(A)$ (above the horizontal dashed line), and $n_k = n_k^* > 0$, otherwise (below the horizontal dashed line). When the constraint is introduced, the child's labor supply depends not only on ϵ but also on m_p. Students with $m_p > \max\{0, \overline{m}_p\}$ are not constrained (in regions (IV) and (V)), and, therefore, they will not change their decisions. The constraint affects the choices of students who are in regions (I), (II), and (III).

First, for students in region (I) who work positive hours even without the constraint, the constraint increases their labor supply because the marginal utility of labor increases due to the value from consumption smoothing. Second, consider students in regions (II) and (III). Those students would not work without the constraint ($n_k = \hat{n}_k = 0$) because of the high opportunity cost of working on human capital. Whether the constraint increases their working hours depends on the parental transfer because

[34] For the interior solution ($m_k > m_d$), $\frac{\partial h_1}{\partial m_k} = \rho A\{1 + (\frac{T - \epsilon n_k}{m_k})^\gamma\}^{\frac{\rho}{\gamma}-1} m_k^{\rho-1} = R$ always hold regardless of whether the constraint binds. If $\gamma < \rho$, increasing working hours reduces the marginal return to monetary investment because $\frac{\partial^2 h_1}{\partial m_k \partial n_k} < 0$.

the marginal benefit of self-financing decreases by parental transfer with the binding constraint. The dotted line $\overline{bd}$ represents the solution ($\hat{m}_p$) in the following equation:

$$\beta\epsilon\rho A\{\hat{m}_k^{\gamma}+T^{\gamma}\}^{\frac{\rho}{\gamma}-1}T^{\gamma-1}(\hat{h}-R\hat{m}_k)^{-\sigma}=w(\hat{m}_p)^{-\sigma}. \tag{22}$$

If $m_p \geq \hat{m}_p$ (region (III)), the child does not work, although the borrowing constraint binds, because the marginal cost of working at $n_k = 0$ is still higher than the marginal benefit of self-financing. If $m_p < \hat{m}_p$ (region (II)), equation (21) should hold with equality with the binding constraint, and, hence, the child who would have chosen zero-working hours without the constraint chooses to work positive hours with the binding constraint.[35]

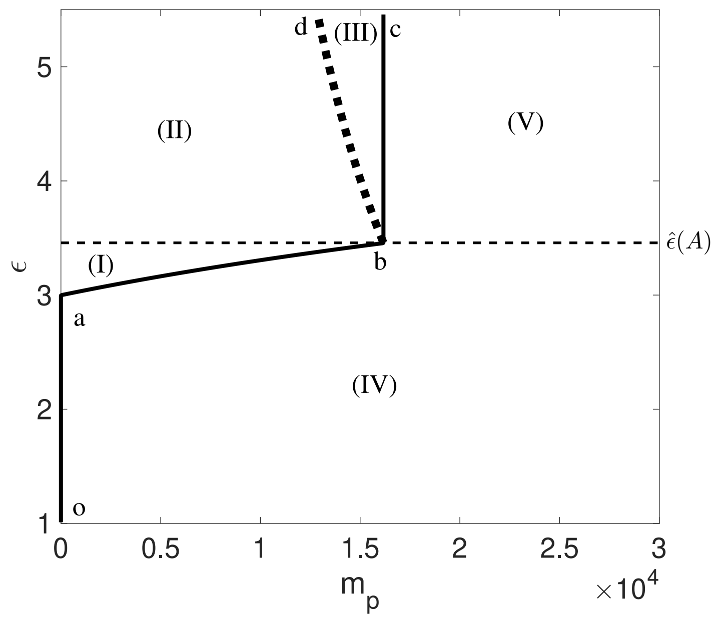
On the other hand, the value from dropping out, V_0, can be represented as follows:

$$\begin{cases} \dfrac{(wn_d+m_p)^{1-\sigma}}{1-\sigma}+\beta\dfrac{(h_0-Rm_d)^{1-\sigma}}{1-\sigma}, & \text{if } m_p<\overline{m}_p,\\ \dfrac{\left(1+\beta^{\frac{1}{\sigma}}R^{\frac{1-\sigma}{\sigma}}\right)^{\sigma}}{1-\sigma}\Big(h_0/R-m_d+wn_d+m_p\Big)^{1-\sigma}, & \text{otherwise.}\end{cases}$$

The value from dropping out is determined by (A, m_p). Thus, in the space of (m_p, ϵ) in Figure A1, for each m_p, there exists a unique value for dropping out that does not vary by ϵ. If the value from completing college decreases substantially due to the constraint, some students will change their extensive margin decision from completion to dropping out when the constraint is introduced.

[35]Note that $\hat{m}_p$ is decreasing in ϵ and $\overline{m}_p$ is increasing in ϵ up to $\epsilon = \hat{\epsilon}(A)$. Moreover, $\overline{m}_p = \hat{m}_p$ when $\epsilon = \hat{\epsilon}(A)$.

Figure A1: Policy Function of the Child



NOTE: This figure shows the policy function of the child over (ϵ, m_p). The dashed line represents $\hat{\epsilon}(A)$. The solid line $(\overline{oabc})$ represents $\overline{m}_p$. The dotted line $(\overline{bd})$ refers to $\hat{m}_p$. Children in regions (I), (II), and (III) are constrained when the constraint is introduced. Children in regions (IV) and (V) are not constrained, even in the presence of the constraint.

Parents' Problem

With the children's value function in hand, we now discuss the parents' problem:

$$\max_{m_p} \frac{\left(1+\beta^{\frac{1}{\sigma}} R^{\frac{1-\sigma}{\sigma}}\right)^{\sigma} \left(x_p - m_p\right)^{1-\sigma}}{1-\sigma} + \alpha V_k(A, \epsilon, m_p) \quad \text{subject to} \quad m_p \geq 0.$$

The first-order condition implies that

$$u'\left(\frac{x_p - m_p}{1+\beta^{\frac{1}{\sigma}} R^{\frac{1-\sigma}{\sigma}}}\right) \geq \alpha \frac{\partial V_k}{\partial m_p}. \tag{23}$$

From the children's problem (12), parental transfers expand children's budget set (regardless of whether or not the child constrained), and, therefore, V_k is an increasing function of m_p. If $u'\left(\frac{x_p}{1+\beta^{\frac{1}{\sigma}} R^{\frac{1-\sigma}{\sigma}}}\right) > \alpha \frac{\partial V_k}{\partial m_p}\Big|_{m_p=0}$, parents do not provide any transfer. Otherwise, parents choose m_p to make equation (23) hold as equality. Such a solution exists given that $\frac{\partial V_k}{\partial m_p}$ converges to zero as m_p goes to infinity.[36] Given that the marginal cost of transfer (the left-hand side of equation (23)) does not change by α, whereas the marginal benefit of transfer (the right-hand side of equation (23)) increases by α, parental transfers (m_p) are an increasing function of α given (ϵ, A, x_p).[37]

In what follows, we focus on characterizing m_p with respect to unobservable characteristics of the child and parents (α, ϵ), given the observable characteristics (A, x_p). This characterization will be useful when we discuss the identification of α. To provide a clear exposition, we focus on students who graduate college both with and without the constraint.

To illustrate how parents' policy function changes depending on the child's unobservable characteristic ϵ, we discuss the characterization of m_p for a given (A, x_p) for two cases. First, if ϵ is smaller than a threshold, the child can always choose the optimal investment even without a parental transfer. In this case, m_p can be characterized by equation (18). Second, if ϵ is greater than the threshold, the constraint may or may not bind, depending on α.

Consider the first case. Although the constraint exists, when the child's cost of working (ϵ) is small, she can achieve the optimal level of human capital even without parental transfers. In this case, the parental transfer is driven solely by compensating motives. To be more specific, from equation (19), we define $\Omega = (\beta R)^{-\frac{1}{\sigma}}(h_1^* - Rm_k^*) - wn_k^*$. For a given A, (1) Ω is an increasing function of ϵ when $\gamma < \rho$, (2) $\lim_{\epsilon \to 0} \Omega = -\infty$, and (3) $\Omega > 0$ at $\epsilon = \hat{\epsilon}(A)$. Therefore, for a given A, a unique $\epsilon_0(A) < \hat{\epsilon}(A)$ exists so that $\Omega = 0$ at $e = \epsilon_0(A)$ (point **a** in Figure A1). If $\epsilon < \epsilon_0(A)$, the constraint is not binding for all $m_p \geq 0$ (because $\overline{m}_p$ is negative if $\epsilon < \epsilon_0(A)$). Therefore, m_p is characterized by equation (18), which is illustrated in the left panel of Figure A2.

Next, consider the second case. If $\epsilon > \epsilon_0(A)$, the constraint binds if $m_p < \overline{m}_p$, where $\overline{m}_p$ is defined in equation (19). Given that m_p is an increasing function of α for any (A, x_p, ϵ), define $\overline{\alpha}(A, x_p, \epsilon)$ to

[36] This is because $\frac{\partial V_k}{\partial m_p} = \tilde{c}(H^*/R + wN_k^* - M_k^* + m_p)^{-\sigma}$ when $m_p \geq \overline{m}_p$, where $\tilde{c}$ is a constant.

[37] $\frac{\partial m_p}{\partial \alpha}$ is bounded above because the marginal increase in m_p is smaller than x_p in equilibrium.

be the α at which $m_p^*(A, x_p, \alpha, \epsilon) = \overline{m}_p$. Let $\tilde{m}_p(A, x_p, \alpha, \epsilon)$ be the parental transfer satisfying equation (23) as equality when the child is constrained. Then, for a given $(A, x_p, \alpha, \epsilon)$, parental transfers by those who have a child with $\epsilon > \epsilon_0(A)$ can be represented by equation (24).

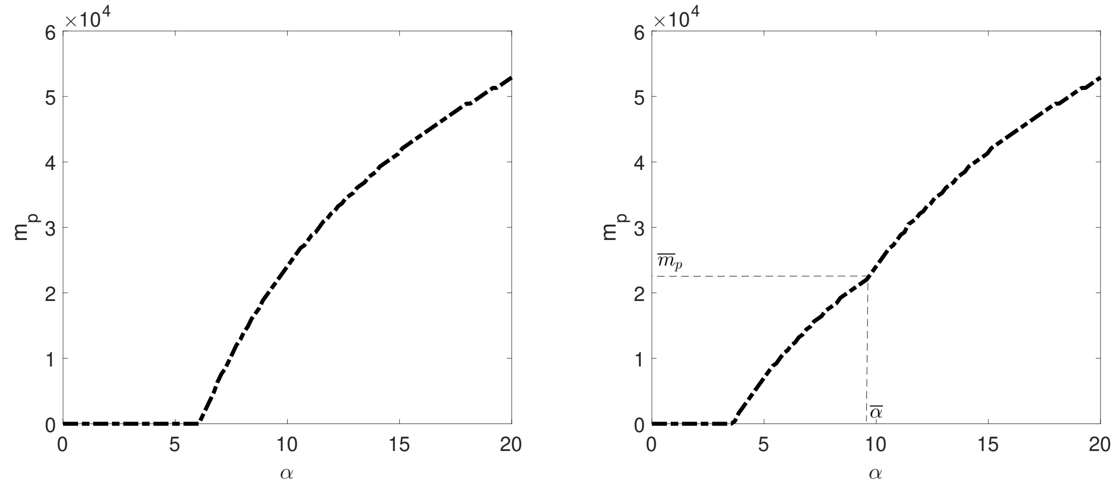
$$m_p = \begin{cases} \max\{0, \tilde{m}_p(A, x_p, \alpha, \epsilon)\}, & \text{if } \alpha < \overline{\alpha}(A, x_p, \epsilon), \\ m_p^*(A, x_p, \alpha, \epsilon), & \text{if } \alpha \geq \overline{\alpha}(A, x_p, \epsilon). \end{cases} \tag{24}$$

For a $\alpha < \overline{\alpha}(A, x_p, \epsilon)$ so that the child is constrained, $\tilde{m}_p(A, x_p, \alpha, \epsilon)$ is greater than or equal to $m_p^*(A, x_p, \alpha, \epsilon)$. To show this point, consider the derivative of value function for college graduates with respect to m_p:

$$\frac{dV_k}{dm_p} = \underbrace{\frac{\partial V_k}{\partial m_p}}_{\text{(I)}} + \underbrace{\frac{\partial V_k}{\partial h}\frac{\partial h}{\partial m_p}}_{\text{(II)} \geq 0 \text{ if } d_k = m_k} .$$

First of all, when the constraint is binding, parental transfers can increase the child's human capital by reducing n_k and increasing m_k (Part II). Moreover, parental transfers can reduce the utility cost associated with the limited intertemporal consumption smoothing by providing liquidity during college (Part I). As a consequence, the marginal impact of a parental transfer on the child's value function is higher when the is binding. Overall, the marginal value of a parental transfer increases given $(A, x_p, \alpha, \epsilon)$ when the constraint is binding. The graphical representation is shown in the right panel of Figure A2.

Figure A2: Parental Transfers



NOTE: The figure illustrates the policy function of the parent with respect to α for a given (A,x_p, ϵ). The left panel plots the parental transfer for the child with a small enough ϵ ($\epsilon < \epsilon_0(A)$) who can always choose the optimal level of investment even without a parental transfer. The right panel plots the parental transfer for the child who may face a binding constraint depending on m_p ($\epsilon > \epsilon_0(A)$). $\overline{\alpha}$ in the right panel is a cutoff value of α, below which the child faces the binding borrowing constraint.

B Additional Data

B.1 American Time Use Survey

To explore the relationship between labor supply and leisure, we utilize the ATUS 2004 dataset. The ATUS 2004 is a nationally representative survey comprising 13,971 individuals, documenting the amount of time individuals spend on various activities along with demographic characteristics. To calculate the daily time spent on classes and studying, we sum the time allocated to activities associated with class taking, research, and homework. Leisure time is calculated by summing the time spent on socializing, relaxing, and engaging in leisure activities. The sample for the analysis below consists of individuals who are enrolled in a college program.

The correlation between time spent on education and working is -0.35 without controlling for any other components. In Table B1, we run linear regressions for study time on working and leisure hours. If increased working hours perfectly substitute for leisure hours and do not affect study time, working hours would not be correlated with study time. We find that the coefficients of working hours are significantly negative in columns (1) and (2). Therefore, the data support the idea of a trade-off between study time and working hours.

Table B1: Regression Estimates for Study Time

VARIABLES	(1) Study time	(2) Study time
Working hours	-0.0798***	-0.136***
	(0.0134)	(0.0132)
Leisure hours		-0.418***
		(0.0335)
Age	0.295	-0.858
	(0.689)	(0.642)
Female	-21.94*	-37.68***
	(12.57)	(11.64)
Constant	154.3***	329.6***
	(28.20)	(29.54)
Observations	871	871
R-squared	0.042	0.188

NOTE: This table shows the estimates for linear regressions for study time on working and leisure hours. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

B.2 National Postsecondary Student Aid Study

The 2003-2004 National Postsecondary Student Aid Study (NPSAS 2004) is a nationally representative cross-sectional study of undergraduate and graduate students enrolled in postsecondary education in the US. We use the sample of undergraduate students, consisting of about 80,000 students who were enrolled at any time between July 1, 2003 and June 30, 2004 in about 1,400 postsecondary institutions. The sample collects data on the enrollment status, the cost of higher education, types of financial aid and the amount received, and demographic characteristics. We use the NPSAS 2004 for the annual sticker price and grant shares by family income quartiles for colleges.

B.3 Beginning Postsecondary Students

The Beginning Postsecondary Students Longitudinal Study (BPS) is a representative sample of US college students, consisting of students who are enrolled in their first year of postsecondary education. The sample consists of around 16,700 students who were first-time, beginning students in 2003-2004 academic year. The respondents were interviewed in their first, third, and sixth year since entering college. The survey collects data on college enrollment, completion, employment, financial aid, and demographic characteristics. We use the BPS 2004 cohort to document the trade-off between working while in college and students' outcomes in Table 1 in the paper.

C Additional Tables

Table C1: Moment Conditions and Model Fit

#	Moments	Data	Simulation
M1	$\frac{1}{n}\sum_{i=1}^{n} h_i$	1.6930	1.6571
M2	$\frac{1}{n}\sum_{i=1}^{n} BA_i$	1.8622	1.8833
M3	$\frac{1}{n}\sum_{i=1}^{n} h_i^2$	0.6317	0.6563
M4	$\frac{1}{n}\sum_{i=1}^{n} BA_i \cdot I_{F1i}$	0.4191	0.4486
M5	$\frac{1}{n}\sum_{i=1}^{n} BA_i \cdot I_{F2i}$	0.4911	0.4828
M6	$\frac{1}{n}\sum_{i=1}^{n} BA_i \cdot I_{F3i}$	0.5078	0.5070
M7	$\frac{1}{n}\sum_{i=1}^{n} BA_i \cdot I_{F4i}$	0.5263	0.5296
M8	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot I_{F1i}$	0.4569	0.4256
M9	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot I_{F2i}$	0.4146	0.4478
M10	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot I_{F3i}$	0.4641	0.4572
M11	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot I_{F4i}$	0.3953	0.4453
M12	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot BA_i$	1.0827	1.0492
M13	$\frac{1}{n}\sum_{i=1}^{n} n_{ki} \cdot (1 - BA_i)$	0.2782	0.4179
M14	$\frac{1}{n}\sum_{i=1}^{n} n_{ki}^2$	0.6678	0.7367
M15	$\frac{1}{n}\sum_{i=1}^{n} m_{pi} \cdot I_{F1i}$	0.1943	0.1827
M16	$\frac{1}{n}\sum_{i=1}^{n} m_{pi} \cdot I_{F2i}$	0.2290	0.1836
M17	$\frac{1}{n}\sum_{i=1}^{n} m_{pi} \cdot I_{F3i}$	0.2408	0.2612
M18	$\frac{1}{n}\sum_{i=1}^{n} m_{pi} \cdot I_{F4i}$	0.3037	0.2901
M19	$\frac{1}{n}\sum_{i=1}^{n} I(m_{pi} > 0)$	1.3399	1.5282
M20	$\frac{1}{n}\sum_{i=1}^{n} h_i \cdot I_{N1i} \cdot BA_i$	0.4097	0.3831
M21	$\frac{1}{n}\sum_{i=1}^{n} h_i \cdot I_{N2i} \cdot BA_i$	0.3300	0.4060
M22	$\frac{1}{n}\sum_{i=1}^{n} h_i \cdot I_{N3i} \cdot BA_i$	0.5034	0.4029
M23	$\frac{1}{n}\sum_{i=1}^{n} h_i \cdot I_{N4i} \cdot BA_i$	0.5504	0.4511

NOTE: This table compares actual and simulated moments. We report the weighted fit based on the inverse of the standard deviation of the targeted moments, assigning lower weights to moments with higher standard deviations. The variable definition for $\{h, n_k, m_p\}$ is shown in Table 8. BA is a dummy variable representing college completion. $I_{F\#}$ refers to a dummy variable for #th family income (x_p) quartile. $I_{N\#}$ refers to a dummy variable for #th working hours (n_k) quartile. The i refers to each observation, while n represents the total number of observations.