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ABSTRACT

Recent cohorts of college enrollees are more likely to work, and work substantially more, than those of the past. October CPS data reveal that average labor supply among 18 to 22-year-old full-time undergraduates nearly doubled between 1970 and 2000, rising from 6 hours to 11 hours per week. In 2000 over half of these "traditional" college students were working for pay in the reference week, and the average working student worked 22 hours per week. After 2000, labor supply leveled off and then fell abruptly in the wake of the Great Recession to an average of 8 hours per week in 2009. This paper considers several explanations for the long-term trend of rising employment—including compositional change and rising tuition costs—and considers whether the upward trend is likely to resume when economic conditions improve.

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I. INTRODUCTION

Today's college enrollees are more likely to work, and work more, than their counterparts in the past. The trend is most pronounced among "traditional" undergraduates: 18 to 22 year olds enrolled full-time at either two-year or four-year colleges. Overall labor supply among these students rose steadily between 1970 and 2000, nearly doubling from 6 hours to 11 hours per week. In 2000, more than half were working for pay during the October Current Population Survey (CPS) reference week, and the average working student worked about 22 hours per week—significantly more time than the typical student spends on schoolwork outside of class.[2] After 2000, labor supply leveled off and then fell sharply in 2009 to 8 hours per week—giving up nearly half of the long-term increase in a single year. The same pattern is repeated across age, race, gender, family income, and institutional subgroups.

Given the unrelenting rise in tuition prices over the past 40 years, an immediate concern is that the increase in student employment may reflect a market failure rather than an economically efficient time allocation decision. Unless student employment has other benefits, students would be better off borrowing money to finance rising costs, so that they could finish college faster or with higher levels of achievement. But credit-constrained students may have little choice but to work. This in turn may delay or diminish their acquisition of human capital, thus decreasing the return on their educational investment.

This concern is reinforced by empirical evidence that student employment interferes with academics. First, rising levels of term-time employment roughly correspond with an increase in the time students take to complete their degrees (Bound, Lovenheim, and Turner, 2010). In 2003,

[2] The National Survey of Student Engagement (2004) reports an average of 14 hours per week studying for full-time seniors in college, and an average of 13 hours per week studying full-time first-year undergraduates (the same survey reports average weekly work hours of 14 and 8 for seniors and first-years, respectively). Stinebrickner and Stinebrickner (2003) also report an average of 2 hours per day of studying.

less than 40 percent of college graduates age 30 and younger had earned their degree by age 22, compared to about 60 percent in the 1970s and 1980s (Turner, 2005). Moreover, several studies using plausibly exogenous variation to estimate the consequences of student employment have found significant negative effects on academic performance. Tyler (2003) uses cross-state variation in the stringency of child labor laws to instrument for hours worked by twelfth graders, and concludes that working an additional 10 hours per week is associated with a 0.20 standard deviation decrease in math test scores. Similar effects may apply to college student employment. Stinebrickner and Stinebrickner (2003) examine students at Berea College, all of whom are required to work at least 10 hours per week, and who are randomly assigned to an on-campus job. Because some jobs allow students to work more than 10 hours per week, while others do not, the authors use initial job assignments to instrument for hours worked. They find that an additional hour worked per week decreases the first semester grade point average by 0.162 points out of a four-point scale. Finally, Scott-Clayton (2011) uses institutional variation in access to Federal Work-Study (FWS) funds to instrument for FWS participation, and finds that program participation is associated with significant declines in GPA and graduation rates for women, though it may have some positive effects for men.[3]

Credit constraints are not the only possible explanation for rising student employment, however. Student work is hardly a new phenomenon: even in 1970 over a third of young, full-time students were working, including more than one in five students at four-year institutions from the top quartile of family income.[4] Unless all of these students were credit constrained, many students apparently believe there are benefits to working that outweigh any potential harm

[3] DeSimone (2008) and Kalenkoski and Pabilonia (2010) instrument for student employment (using parental schooling and religion, and parental transfers and net schooling costs, respectively) and find negative effects on students' grades, but substantially smaller in magnitude (reductions of 0.011 to 0.017 in GPA per hour of work) than those found by Stinebrickner and Stinebrickner (2003).
[4] Author's calculations using October CPS data on 18 to 22 year olds.

to their studies. For example, two particularly careful non-experimental analyses by Ruhm (1997) and Light (1999) conclude that high school employment improves future labor market outcomes in the decade after high school graduation, despite possibly negative effects on academic achievement. Moreover, the relevance of credit constraints remains a matter of debate among economists, with several studies arguing that such constraints are nonexistent or quantitatively unimportant (see, e.g., Cameron and Taber, 2004, and Carneiro and Heckman, 2002, respectively), while other work has found evidence of tightening constraints in recent years (Belley and Lochner, 2007).

Indeed, even in the absence of borrowing constraints, students may rationally combine school and work if the additional hours spent studying within a given time period produce diminishing marginal amounts of human capital (Ben-Porath, 1967). Students will then balance the benefits of working against the costs to their academic performance and progress, and thus many factors other than credit constraints may help explain the changes over time, including changes in demographic composition, wages, or returns to work experience. These and other alternative explanations must be considered; the rise in student employment cannot be taken as prima facie evidence of tightening credit constraints.

In Section II, I outline the trends in student employment using data from the October Current Population Survey (CPS). I show the increase over time cannot be explained away by any simple shifts in student demographics. In Section III, I describe a stylized model of human capital investment and analyze its key predictions regarding student employment. In Section IV, I draw upon a broad array of empirical evidence to weigh the relative importance of alternative explanations for the changes over time.

I find that no single factor can explain the overall trend, and different factors appear to dominate in different time periods. For example, approximately one-quarter of the increase between 1970 and 2000 occurred before 1982, a time when neither compositional changes, economic fluctuations, nor tuition increases appear to be plausible contributing factors. Instead, this early increase may be explained by the significant expansion of the Federal Work-Study program, as well as declining returns to college during that decade. Compositional changes and economic improvements can explain most of the increase between 1982 and 1994, and the recent recession can explain most (but not all) of the decline in student employment since 2005. Tightening credit constraints, however, are plausibly the driving explanation for higher-than-predicted levels of student employment between 1994 and 2005, and the subsequent relaxation of these constraints appears to have contributed to the faster-than-predicted decline in recent years.

II. TRENDS IN UNDERGRADUATE LABOR SUPPLY, 1970-2009

It is well-established that college enrollment has risen dramatically over the past several decades: the percentage of 18- to 22-year-old high school graduates who are enrolled in either a two-year or four-year college rose from around 38 percent in the early 1970s, to an all-time high of 58 percent in 2009. Enrollment has risen in both two-year and four-year institutions, and both part-time and full-time enrollments are increasing. Contrary to popular impression, two-year students have comprised a fairly stable share of these young college enrollees over the past 40 years (30 percent), as have part-time students (10 percent).

Over the same time period (until 2009), October employment for these young high school graduates remained surprisingly stable at about 63 percent.[5] Average weekly hours of work (including zeros for those not working) hovered around 19-20 hours per week, with a barely

[5] Unless otherwise noted, the "employment rate" here refers to the employment-to-population ratio. Labor force status is not a particularly useful concept for college students, since those enrolled in school will generally be in the labor force if they work and not in the labor force if they do not work.

perceptible decline over time. (In 2009, employment rates fell to 51 percent and average hours fell to 14 hours per week.)

Since employment has remained stable while college enrollment has increased, it follows that more young people today are combining school and work. Figure 1 illustrates this trend by categorizing individuals by their activities: college only, college and work, work only, or neither. The expanding or contracting band widths over time show the shifts in distribution across categories. The figure shows that the fraction of 18 to 22 year old high school graduates combining school and work nearly doubled, rising from 15 percent in 1970 to a peak of 29 percent in 2005, before falling to 25 percent in 2009.

Turner (2005) has shown that college students are taking longer to finish their degrees; however, it is not the case that 18- to 22-year-olds are working more but 23- to 27–year-olds are working less. I demonstrate this by comparing three simulated cohorts: high school graduates who were aged 18 in 1970-1974, 1980-1984 or 1995-1999. Using repeated cross-sectional data from the CPS, I link the data from those who were 18 in 1970 with data from those who were 19 in 1971, 20 in 1972, and so on. The results (available on request) indicate that while those in the recent cohorts are more likely to be enrolled in school at every age, at no age has labor force participation notably decreased. Although the phenomenon is most pronounced for 18- to 22-year-olds, young high school graduates are combining work and school in substantial numbers throughout early adulthood.

When the sample is limited to 18- to 22-year-old college students enrolled full-time, the trend emerges clearly.[6] The top panel of Figure 2 shows employment rates, while the bottom panel shows average weekly hours. Employment rates during the survey week rose steadily from

[6] For the remainder of the paper, all references to "college students" will refer to 18- to 22-year-old full-time college enrollees at either two-year or four-year institutions, unless otherwise noted.

33 percent in 1970 to 52 percent in 2000.[7] The trend reverses after 2005, with employment falling from 48 to 40 percent in just five years. Similarly, average hours rose steadily from 6 hours per week in 1970 to a peak of 11 hours per week in 2000, before leveling off to about 10 hours per week for the past decade and then dropping to 8 hours per week in the last year of the series.

Not only are more students working, but employed students work more hours than in the past. Average hours among workers increased from about 18 to 22 hours per week between 1970 and 2008 before dipping to 21 weekly hours in 2009. The percentage of students working more than 20 hours per week nearly doubled from 10 percent to 19 percent over this same time period before falling to 13 percent in 2009. Finally, the percentage of students working full time rose from 4 percent in 1970 to 7 percent in 2008, before falling back to 4.5 percent in 2009.

Interestingly, the long-term trend among college enrollees does not mirror that of high school students. From 1970 to 2000, October employment rates among 16- to 18-year-old high school students averaged 34 percent (and total labor supply averaged about 5 hours per week, including zeros), with no clear upward or downward trend. After 2000 labor supply fell sharply to a low of 16 percent employed and an average of just over 2 hours per week (including zeros) in 2009.

How much of the trend in students' labor supply can be explained by purely compositional changes (that is, changes in who attends college)? How much is explained by economic conditions? And how much can be attributed to rising tuition costs in combination with credit constraints? The following section presents a simple theoretical model to help frame the empirical evidence.

[7] Employment and hours data are taken from the October CPS question, "How many hours did you work last week?" Surveys that ask more generally about typical weekly hours or jobs held "during the school year" tend to elicit substantially higher estimates.

III. STUDENT EMPLOYMENT IN HUMAN CAPITAL INVESTMENT THEORY

Under the simplest model of human capital investment, versions of which were formulated by Becker (1962) and Rosen (1976) and later utilized and adapted by many authors, it is not optimal to interlace periods of schooling with periods of work. Doing so necessarily postpones the moment at which the individual will complete her education, and thus reduces the number of years she can spend in the labor force reaping the returns on her investment. Only in the presence of credit constraints may it be optimal to combine work and school.

I will return to the topic of credit constraints. However, a minor modification of the standard model can justify a life-cycle phase combining school and work even in the absence of credit constraints. While the simplest model assumes that human capital can be obtained at constant marginal cost, the time students devote to schoolwork likely produces diminishing marginal amounts of human capital within any given period. As Yoram Ben-Porath (1967) writes in introducing his model of human capital investment,

> It is hard to think of forms of human capital that the individual can acquire as final goods—he has to participate in the creation of his human capital. His own abilities, innate or acquired, the quality of co-operating inputs, the constraints and opportunities offered by the institutional setup—all determine the "technology" or the production function (p. 352).

As long as the human capital production function is concave, students will balance the marginal benefits of working against the marginal costs to their academic performance and progress. Focusing on school alone thus will not be optimal for all students in all situations.

The basic intuition underlying the concavity of human capital production is that students' time becomes less productive as more and more of it is devoted to schoolwork. This seems a plausible assumption. This concavity could be interpreted as an additional dimension of student ability, including mental focus and stamina, developmental maturity, organizational ability, or

study skills. It need not be fixed by nature, though; it also may result from institutional factors regarding course offerings and logistics. For example, as students add more courses they may find they are more restricted in their choices of instructors and course times. At some point, course availability may be restricted such that marginal costs effectively become infinite—the student may not be able to enroll in any additional courses that would count towards the degree.

In equilibrium, the marginal benefits the student gains from an additional hour of working while in school should just equal the marginal costs, in terms of foregone (or delayed) human capital. If working students take longer to graduate, or graduate with fewer credits or lower grades, this does not necessarily indicate a market failure or irrationality on the part of working students. But the higher the estimated marginal costs, the higher the marginal benefits ought to be.

A simple time allocation model captures the essence of this tradeoff. Consider a two-period model in which individuals divide non-leisure time T between schooling (s) and work (h) in the first period. Everyone works full-time in the second period. Individuals can freely borrow, so the goal is to choose s and h in the first period to maximize lifetime income. Base wages w vary by individual ability, a. In the first period, wages are simply $h(w(a)+\varepsilon_1)$ where ε_1 captures periodic random variation in economic conditions. In the second period, wages are $w(a)+r^s f(s(h);q^s,a)+r^h g(h;q^h,a)+\varepsilon_2$ where r^s and r^h are the per-unit wage gains from observable school-based and work-based human capital, respectively, and ε_2 again captures temporary economic fluctuations (with expectation zero). I assume that both $f(\,)$ and $g(\,)$ are increasing and concave in s or h, respectively, and both functions also depend on the quality of human capital obtained, q^s and q^h (with low quality units requiring less time to produce) and

individual ability *a* (with low ability students requiring more time to produce the same number of units). The objective function is thus:

$$(1) \qquad \underset{h}{Max}\ Y = h(w(a)+\varepsilon_1) + \beta E[w(a) + r^h g(h;q^h,a) + r^s f(s(h);q^s,a) + \varepsilon_2]$$

where $s(h)=T-h$ and β is a measure of total hours worked in the second period (it could also be interpreted as accounting for discount rates). The first-order condition for this problem is:

$$(2) \qquad w(a) + \varepsilon_1 + \beta r^h \frac{\partial g(h;q^h,a)}{\partial h} = \beta r^s \frac{\partial f(s(h);q^s,a)}{\partial s}$$

Intuitively, the left side of this equation represents the lifetime earnings benefit to an additional hour of work in the first period, while the right side represents the lifetime earnings benefit to an additional hour of schooling. Both school and work generate human capital that can be converted to additional earnings in the second period, while work also provides wages in the first period. At the margin, the lifetime earnings benefit of an additional hour of school or work should be equal. Note, if neither $g(\,)$ nor $f(\,)$ were concave, the result would be a corner solution in which individuals would devote all of their non-leisure time to either school or work.

For simplicity, I assume that leisure time is fixed and that the individual is only making tradeoffs between school and work. If leisure were incorporated, individuals would ensure that an additional hour of school or work "purchases" the same amount of utility as an additional hour of leisure. Key predictions are summarized below; details are provided in Appendix A.

A. Student wages

As in any model of labor supply, wages matter. When base wages rise or there is a positive economic shock, students will shift towards working more. In either case, the shift is smaller when β is large and/or when returns to human capital are high (in other words, when first-period wages are a relatively small piece of lifetime earnings).

B. Returns to work experience

In addition to wages (or in some cases, in place of wages), students may acquire valuable work experience through student employment. Even in relatively low-skilled jobs, students may develop soft skills, build career networks, secure references, and/or acquire information that enables better job matches later in life. Students shift towards work in the first period when returns to work experience rise, all else equal.

The value of work experience may vary by subject. For example, those majoring in business may get more out of student employment than those majoring in English, particularly given the types of jobs available to young, part-time workers. Sales experience in a retail outlet may be directly relevant to a future businesswoman, but only marginally relevant to a future English teacher. Though not formally incorporated into the above model, work experience could be particularly valuable in the context of uncertainty about individual returns: acquiring some amount both of formal and informal human capital may be a form of "portfolio diversification" that increases lifetime utility by decreasing risk even if it does not increase expected lifetime earnings.

C. Returns to schooling

On the other side of the equation, students have less incentive to work when the returns to schooling are high. The time spent working must come from somewhere, and a student who either takes a bit longer to finish her degree or graduates with a lower-quality education will pay a higher price in terms of future earnings when the returns to schooling are high.

D. Student ability

Intuitively, the relationship between ability and student work decisions is ambiguous. High ability students may have a comparative advantage in producing school-based human

capital, and thus they have more to lose by increasing work hours at the cost of valuable school-time. On the other hand, if high-ability students also command higher wages, this will increase their incentives to work.

E. Credit constraints

The factors above will influence student employment decisions even in the absence of credit constraints, as long as the educational production function is concave. But incorporating these other factors does not negate the potential for credit constraints (see Belley and Lochner [2011a] for a detailed treatment of human capital investment under borrowing constraints). An individual is credit constrained if she is unable to finance the full costs of attendance, including both direct costs and opportunity costs (foregone earnings), as well as any additional spending that may result from a desire to smooth consumption over the lifetime. While extremely constrained individuals may ultimately opt out of schooling, an alternative response for moderately constrained students is to work while enrolled, using current earnings to pay for both direct costs and current consumption (indeed, simulations by Keane and Wolpin [2001] suggest that student employment is the primary margin of response to borrowing constraints).

While credit constraints may be most consequential for students from low-income or low-wealth families, it is important to recognize that credit constraints may be an issue for middle-class or even wealthier students as well. As Lochner and Monge-Naranjo (2011a) note, a student who can borrow enough to pay for tuition and fees is not necessarily unconstrained. If students cannot borrow enough to optimally smooth their consumption, this represents a credit constraint that may affect behavior, even if students can borrow enough to finance tuition and whatever

their parents or society might consider to be the other nondiscretionary costs of attendance.[8] Further, even if students had unlimited access to credit, they may choose to limit their own borrowing because of either risk aversion (if there is uncertainty around future economic outcomes) and/or debt aversion (if students incur negative psychic costs to holding debt). These internal borrowing constraints may similarly affect behavior but may be less correlated with family income/wealth than external constraints.

To clarify the types of credit constraints that may affect student employment, it is useful to categorize them along two dimensions: whether such constraints are "strict" (preventing students from financing direct costs and nondiscretionary living expenses) or "fuzzy" (preventing students from financing additional consumption), and whether they are internally or externally imposed. The resulting possible types of constraints are summarized in Table 1.[9]

Students facing strict constraints have two options: work more, or forego schooling altogether. Individuals who face fuzzy constraints have the additional option of reducing in-school consumption—it is not necessary either to work more or to forego schooling. Both types of constraints are real: both will distort behavior. Either may cause students to work more and spend less time on schoolwork, thus delaying or diluting their educational progress; either may cause some to skip college altogether. But in the case of fuzzy constraints, students have more than one means of adjustment: they could decrease their discretionary consumption rather than (or at least in addition to) reallocating some of their school-time to paid employment (this is consistent with the standard implication that when individuals face constraints, educational

[8] Assuming that the educational investment is a good one, lifetime income will be higher if an individual chooses to enroll. Thus, in the absence of credit constraints there is no reason for an individual to choose a lower level of consumption as a student than as a non-student.

[9] Of course, these are not the only dimensions along which constraints can vary. Lochner and Monge-Naranjo (2011b) focus on exogenous constraints versus endogenous constraints, where access to credit is tied to the direct costs of educational investment.

investments will be more sensitive to changes in direct costs than opportunity costs; see Lochner and Monge-Naranjo [2011a]). The economically optimal solution will depend on each student's intertemporal consumption preferences, i.e. the extent to which the student is willing to trade consumption now for consumption later.

Internally-imposed constraints, whether a result of risk aversion or pure debt aversion, can have similar consequences. Even when students are able to borrow to finance their educational investment, they may not want to. Even if trading school for work is expected to be a good investment on average, it may not pay off for everyone, at least within the time frame of loan repayment requirements. Alternatively, internal constraints may result from a purely psychological disutility associated with being in debt or from a semi-rational rule-of-thumb that leads students to avoid financial transactions they don't fully understand. In comparison with externally imposed constraints, internal constraints may be less correlated with family income/wealth, and may have very different policy implications.

F. Other possible explanations

To the extent a college degree is purely a signal and true effort/quality are difficult for employers to observe, students may have incentives to "free-ride" off the hard work of their predecessors, completing their degrees with the least effort required (see, e.g. Babcock and Marks 2011). One might hypothesize that when school quality is low (in this framework, meaning that coursework is not very demanding) students will have more time to spend working. But the opposite conclusion is relatively easy to reach: when q^s is low, the time-cost of obtaining human capital is low, so there is an incentive to purchase more human capital. Rather than freeing up more time for work, low-quality schooling may create incentives for students to pursue higher grades, "stock up" on additional courses or degrees (for example, adding double or

even triple-majors), or simply to finish degrees faster, if their school allows. The effect of school quality or course difficulty on student employment is thus ambiguous, and will depend both on students' ability to adjust their course loads as well as on employers' ability to observe school quality.

Institutional context may affect student employment via at least two pathways. First, the educational production function is not necessarily fixed by nature, but may vary depending on institutional context. Institutional crowding may cause the production function to become flat after a point, if students are not able to get into all of the courses they want in a given term. Second, the structure of tuition and fee charges may affect student employment. The model above assumes that tuition is fixed (per term), so that it does not affect the marginal tradeoff between school and work. But if tuition is charged per-course, this will strengthen the incentives to work even in the absence of credit constraints. In the case of per-term charges, when tuition rises students may have an incentive to work less, if doing so makes it possible to complete schooling in fewer terms.

IV. EMPIRICAL EVIDENCE

Credit constraints, in combination with rising real tuition costs, provide one popular hypothesis for the change over time. But with so many students working, and with so many factors potentially affecting students' employment decisions, it is important to consider the role of alternative explanations for the trend. In this section I evaluate the evidence for these alternative explanations, based on the factors described above in Section III.

A. Compositional changes

Many of the factors listed in Section III will vary depending on the individual. As college enrollments have expanded, it is possible that the composition of the student population has

shifted. Perhaps some individuals who in a previous era would have only worked, either because of low returns to schooling, high returns to work experience, or socioeconomic barriers to access, are now shifting into college. These marginal individuals may retain their higher propensity to work even as they enroll in school, and thus compositional change may drive an increase in student employment even without any deeper structural changes.

If this were the case, controlling for the changing composition of the college student population would eliminate the apparent increase over time. Relevant covariates are limited in the CPS, but one can examine subgroups defined by race, gender, age, dependency status, parental income quartile, parental education, and attendance at public versus private institutions.[10, 11] As indicated in the panels of Figure 3, while the trend is slightly stronger for some groups (such as students at public institutions, and 19 to 21 year olds) and slightly weaker for others (such as those in the top income quartile), the basic pattern is replicated for every subgroup I examine. It is thus clear that basic compositional changes are not going to explain away the trend.

Nonetheless, there are important differences in levels of work along some dimensions that are shifting, most notably age and dependency status, which may explain some of the change over time. For example, older, independent students are more likely to work and make up an increasing fraction even of this "traditional" college population. In 1970, 21 and 22 year olds made up only 11 percent of this group, but comprised 31 percent of the sample when average hours peaked in 2000. Also, the percentage of the sample defined as independent increased from

[10] I have classified anyone who is not a household head or spouse as dependent to ensure a consistent definition over time. This will include some individuals living with roommates rather than parents; however, the coding of the CPS's "household relationship" variable changed in 1989, 1994, and 1995, making it impossible to more specifically identify dependent children in a consistent way over time.

[11] Parental income and education are available only for students who are still dependent on their parents (dependent students, even if living away at college, are to be surveyed as part of their parents' household).

about 8 percent to 14 percent over this time period. To summarize the role of compositional change, I regress hours worked on age and dependency status, as well as gender, race/ethnicity, marital status, region, parental income quartile, parental education dummies, and public/private enrollment status (regression results are provided in Appendix B).[12] Using the parameter estimates from this regression I predict hours worked in each year; the predicted trend indicates how much we would have expected labor supply to change as a result of compositional changes alone.[13]

The predicted and actual values are plotted in Figure 4. This shows that compositional changes (primarily by age and dependency status) alone would have predicted an increase of about 1.3 hours between 1970 and 2009, or about 65 percent of the actual increase. Looking at the full 1970-2009 trend is misleading, however, because it combines severe under-predictions of both the 1970-2000 increase as well as the subsequent decrease in hours. When I separate these two time periods, I find that predicted hours can explain only about 20 percent of the 1970-2000 increase, and actually predict a slight increase between 2000 and 2009 when hours fell substantially. I conclude that while compositional changes can explain a fraction of the increase up through 2000, they are not the driving factor during that period nor do they explain any of the reversal in trend since then.

Of course, there is still room for substantial compositional shifts even within these broad demographic groups. Even among white, male, middle-income nineteen year olds attending private universities, the marginal student may have a higher propensity to work. But the evidence

[12] Parental income and education dummies are set to zero for independent students, and the dependency dummy serves as the missing data indicator in these regressions. Income quartile cutoffs are established using families including at least one member between age 16 and 30, regardless of college enrollment status.
[13] I utilize ordinary least squares (OLS) regression; however, a Tobit specification to account for the left-censoring of hours at zero returns virtually identical results.

above suggests that the trends in student labor supply are remarkably broad-based and thus cannot be explained away by any simple shifts in student demographics.

B. Economic conditions

The recent recession makes obvious the need to incorporate economic conditions into any model of trends in students' labor supply. As the wages students can command rise and fall, this will change the tradeoff between time spent on schoolwork versus paid employment. Although the October CPS does collect wage data, they do so only for a relatively small subsample and only since 1981. For these reasons I choose instead to use unemployment rates (by state and year) as a proxy for broader economic conditions. Unemployment rates follow a similar (inverse) pattern as wages, are less noisy and enable me to utilize the entire 40-year data series.

Economic conditions clearly will do little to explain the increases in both employment and hours between 1970 and 1982, a period of generally rising unemployment. But the long-term decline in unemployment rates between 1982 and 2000, and the subsequent fluctuations, are broadly consistent with trends in student labor supply. To quantify the role of economic conditions, I add state-year unemployment rates to the model above that predicts average weekly hours as a function of demographic characteristics, and generate a new series of predicted hours. The resulting predictions are plotted in Figure 5, with actual hours plotted for comparison.

With two periods of notable exception, the predicted hours now generally track actual hours. Overall, this model—including both demographic characteristics and economic conditions—can explain about 29 percent of the increase in hours between 1970 and 2000, and 70 percent of the decrease since then. But between 1970 and 1982, labor supply rose by 1.1 hours per week although a decline of 1.4 hours was predicted; between 1993 and 2005, actual

labor supply rose faster and then remained persistently about three-quarters of an hour higher than predicted.

C. Rising real tuition costs in combination with credit constraints

College costs have risen dramatically over the past 40 years, even after accounting for inflation. As shown in Figure 6, average published tuition and fee charges have risen substantially at all institution types since 1980. At public four-year institutions, which enroll the majority of 18- to 22-year-old students, inflation-adjusted costs more than tripled, from $2,097 in 1980 to $7,396 in 2009 (measured in constant 2011 dollars). Tuition and fees have also more than doubled at both two-year and private four-year institutions.

Rising tuition costs, however, do not appear to be a good explanation for the rapid increase in student employment between 1970 and 1982, because tuition prices were stable in real terms during that time. Moreover, both Pell Grants and federal Stafford Loan limits were at historical highs relative to tuition prices during that period (see Figure 7). For example, in 1977-78 the average Pell Grant (among recipients, in 1977 dollars) was $748, which would more than cover the average tuition of $655 at a public four-year institution; the Stafford Loan limit for a first-year student was $2,500, which would nearly cover the $2,700 tuition and fees at a private four-year institution (College Board, 2011b).[14]

Credit constraints are a much more plausible explanation for the faster-than-predicted increase and then persistently higher-than-predicted average hours of work during the 1993-2005 period. While prices continued to rise, sources of financial aid failed to keep up. As shown in Figure 6, 1994 was the first year in which the Stafford Loan limit (then $2,625) would fail to

[14] For historical information on Pell Grant average awards, see "FinAid: FinAid for Educators and FAAs: Pell Grant Historical Figures." FinAid: The Smart Student Guide to Financial Aid, http://www.finaid.org/educators/pellgrant.phtml. For historical information on Stafford Loan Limits, see "FinAid: Loans: Historical Loan Limits." FinAid: The Smart Student Guide to Financial Aid, http://www.finaid.org/loans/historicallimits.phtml.

cover average tuition and fees at a public four-year institution (then $2,705); the loan-limit-to-tuition ratio continued to fall steadily through 2005. Similarly, the average Pell Grant had fallen to cover just 56 percent of the average public four-year tuition by 1994, and fell even further to cover just 45 percent by 2005.

A relaxation of credit constraints can also potentially explain why labor supply has fallen faster than predicted since 2005 (recall that economic fluctuations only explained about 70 percent of the decline since 2000—most of which took place since 2005). While published prices have continued their steady upward climb, Figure 6 shows that net prices in all sectors were actually lower in 2009-10 than they were in 2005-06. These net prices are calculated by subtracting out estimated grant aid (from all sources) and the estimated value of education-related income tax credits and deductions, by sector (College Board, 2011a). The net price of a private four-year in 2009 was 2 percent lower than the net price in 2005, and the net price for a public four-year was 13 percent lower. The net price of a public two-year institution went from negative $60 to negative $810 over this time period, meaning the average student received more in grant aid than he or she was charged in tuition and fees.

Evidence of tightening constraints between the late 1970s and the late 1990s comes from other sources as well. Using data from the NLSY-79, Carneiro and Heckman (2002) compare college enrollment and completion across income groups, controlling for ability and demographic characteristics. Under the assumption that families in the top quartile are unconstrained, they calculate that the adjusted differences in outcomes by income imply that no more than 8 percent of the U.S. population was credit constrained in the late 1970s and early 1980s. Belley and Lochner (2007) update and extend this analysis using data from the NLSY-97. While they do not provide a specific estimated percentage constrained, they find that college

attendance gaps by income (controlling for ability) increased substantially for the NLSY-97 cohorts. They conclude that this pattern cannot be explained except by credit constraints. Belley and Lochner also examine patterns of student employment, and find that while hours worked were unrelated to family income in the NLSY-79 cohorts, they were strongly related in the NLSY-97 cohorts for high-ability students: among the top quartile of ability, low-income students worked about twice as much as high-income students.

One remaining puzzle for the borrowing constraints explanation, however, is that while trends in average hours are slightly less pronounced for the top quartile of family income, they have followed similar patterns for all income groups (see panel D of Figure 3). For example, among students in the top quartile of family income labor supply as measured in the CPS still rose by more than 80 percent between 1970 and 2000, from 5 to over 9 hours per week, before falling to 6.6 hours in 2009. Belley and Lochner (2007) also concede that they find large income effects on college enrollment even for the top half of the income distribution, evidence which they find "difficult to reconcile" with borrowing constraints (p. 80).

One way to measure credit constraints directly is simply to ask students, "Could you afford college without working?" A student who responds "No" to this question is almost by definition credit constrained. In this case perception equals reality: it matters little for behavior (though immensely for policy) whether the student actually has no access to credit, or simply perceives she does not. Table 2 presents employment statistics, along with responses to this question for 18 to 22-year-old full-time four-year working students in the 2003-04 NPSAS. The statistics are broken out by income quartiles, where quartiles are defined over this sample of dependent, full-time four-year enrollees.

The pattern of responses raises several points. First, about half of working students say they could not afford school without working. This suggests that credit constraints are a significant factor in students' employment choices, even if they are not the only factor. Second, responses clearly correlate with family income, but the biggest gap on this "affordability" question is between the top two income quartiles: working students in the upper-middle quartile are 16 percentage points more likely to say they could not afford school without working than those in the top quartile. (Unfortunately, the "affordability" question was not asked in early iterations of the NPSAS.) The difference between the middle two quartiles is 9 percentage points, and between the bottom two quartiles, less than 3 percentage points. Third, even among working students in the top quartile (with a median family income of $143,000), nearly one in three responded that college would be unaffordable without a job.

This suggests that credit constraints may be a significant factor in student employment decisions even among the relatively well-off—a possibility that is rarely discussed, but becomes plausible when one considers a broad definition of credit constraints as described in Section III, rather than focusing purely on strict, externally-imposed constraints. Wealthy students, for example, tend to attend significantly pricier schools (College Board, 2006) and are more likely to have siblings enrolled at the same time (author's calculations using NPSAS:04). Moreover, they may have a greater desire to consumption-smooth if they have a greater expectation of high earnings after graduation.

Table 2 sheds light on the types of constraints facing different families. Working students from the bottom quartile are almost twice as likely as those in the top quartile to say that their primary reason for working is to pay tuition and fees (62 percent versus 35 percent), and half as likely to say they work primarily to pay "living expenses" (27 percent versus 50 percent). This

supports the hypothesis that low-income families are more likely to face strict constraints while the rich are more likely to face fuzzy constraints. Finally, the third panel of Table 2 indicates that both external and internal constraints may be important for those who report they couldn't afford school without working. About half of these students took out the maximum student loan, an indicator that they may face binding external credit constraints. On the other hand, half did not, suggesting an internally-imposed constraint. Interestingly, among those eligible for a subsidized student loan, poor students were slightly *more* likely than eligible rich students to decline these loans.

D. Other possible explanations

1. The Federal Work-Study Program

About one-quarter of the increase in hours between 1970 and 2000 occurred in the 1970s, when neither compositional changes, economic conditions, nor borrowing constraints appear to play much role. One possible explanation for the increase in this early period is the expansion of the Federal Work-Study (FWS) program. The program was inaugurated in 1964, and the number of students receiving assistance from it rose from 425,000 in 1970 to over 900,000 in 1979 before falling and then leveling off around 700,000. The ratio of FWS recipients to the 18- to 22-year-old full-time enrolled student population rose from 12 percent in 1970 to 18 percent in 1979, and has fallen steadily since to less than 9 percent in 2007.[15] At the prevailing average of 18 hours of work per week among workers during this period, this would account for up to a 1.1 hour increase in overall labor supply (18*0.06=1.1).

Referring back to Figure 2, note that the student employment rate rose from 34 to 38 percentage points during the 1970s and average hours rose by 1.1. Thus, the expansion in FWS

[15] Students over age 22 are also eligible for FWS assistance; accounting for changes in the age distribution of college enrollees would only accentuate the pattern here (i.e. including older students in the denominator would lower the ratio disproportionately in more recent years).

participation is large enough to account for all of the actual increase in employment.[16] Moreover, while employment was increasing during this period, hours among those who worked remained steady and there was no increase in the proportion of students working more than 20 hours per week. This is also consistent with the FWS explanation, since students in the program are generally limited to 10 to 15 hours of work per week.

2. Returns to work experience

Previous literature (Ruhm 1997, Light 1998) suggests that students' in-school work experience may have labor market payoffs after graduation. Is it possible that increases in the return to work experience can explain the particularly rapid growth in student employment during either the 1970s or the period from 1994-2005?

At least in recent years, work experience does not appear to be a primary motivation for student employment: only 8 percent of working students surveyed in the 2003-2004 NPSAS reported work experience as their "main reason" for working. That it plays such a small role in a recent cross section makes it a less plausible candidate for the large increases over time. Unfortunately, similar survey data are unavailable for the 1970s. But if work experience were an increasingly important factor, we might expect to see students shifting towards higher-skilled jobs. Figure 8 thus presents trends in broad occupational categories among working students in the CPS. Though data are available for the entire series, major revisions to the occupational classification scheme occurred in 1983 and 2003, so the large shifts in those years likely result from definitional rather than real changes.

The patterns revealed in Figure 8 confirm that changes in the returns to working are an unlikely explanation for the increase in student employment between 1982 and 2000; however, it

[16] Recall, however, that because the 1970s were also a period of rising unemployment, we might actually have expected a decline in hours during this time.

may have played some role both in the increase during the 1970s and the decline post-2003. For example, during the 1970s there was a significant shift among working students away from labor/farm occupations towards service positions. Interestingly, these occupational shifts diverged from the trends among non-enrolled young workers at the time, for whom the likelihood of working in labor/farm occupations continued to increase through 1978. This occupational shift would, however, be consistent with the expansion of Federal Work-Study. Since 2003, student employment has shifted towards lower-skill jobs: working students are increasingly in service occupations rather than professional, technical, managerial, or clerical positions. The decreased availability of high-return jobs may help explain the decline in hours in recent years (which has been more rapid than simply the broad unemployment rate would predict).

3. Returns to schooling and the possibility of declining educational quality

The lower the labor market returns to schooling, the higher the incentive to work while enrolled. This provides an additional possible explanation for the increase in labor supply during the 1970s, since the college wage premium was declining during this decade. It is clearly not a good candidate explanation for more recent trends, since the college wage premium has risen steadily and substantially since 1980 (see Goldin and Katz, 2008).

There is less evidence about trends in educational quality, mainly because educational quality is so difficult to measure. And as described in Section III, it is not theoretically clear that declining educational quality should lead students to shift time from school to work, but it is certainly possible (particularly if students are approaching a flat part of the educational production function). Recent research by Babcock and Marks (2011) does provide suggestive evidence that the "time-cost" of college is falling: using multiple sources of survey data, the

authors find that full-time college attendance required 40 per week in 1961 but only 23 to 26 hours per week in 2004. Babcock and Marks have only fairly granular measures of student labor supply. They find that the decline in study time corresponds with an increase in work, but also that study time has decreased even among non-workers. One explanation they offer for the decline in study time is that today's students may be "free-riding" off of the hard work of previous generations of students who established the high returns to a college degree.

There are two problems with this as an explanation for the trend in student employment. First, relying only on time use data leaves the direction of causality unclear. Students might work more because they are spending less time on school, or they might be working more for some other reason, and spending less time on school as a consequence. Second, if a college degree requires less effort than in the past, this does not square with the trend that students are taking longer to finish their degrees (Turner, 2005).

4. Institutional crowding

If institutional capacity has not kept up with rising enrollments, students may not be able to take all of the courses they need in a given semester, and this would increase the incentive to work. Bound and Turner (2006), comparing outcomes between birth cohorts of varying sizes, find suggestive evidence that those in large birth cohorts within states take longer to finish their degrees, which they hypothesize may be due to institutional crowding. It follows that students whose degree progression is slowed would have more time to work while in school. Bound, Lovenheim, and Turner (2010) also find that while resources per student have increased for private and the most selective public institutions, they have stagnated or declined over time for the remaining institutions.

The increase in labor supply is certainly stronger for students at public four year institutions. Between 1970 and 2005, labor supply rose from 5.1 to 10.1 hours per week among full-time students at four-year public institutions, a 98 percent increase. It rose from 3.6 to 8.1 hours per week for equivalent private-college enrollees, an 80 percent increase. If institutional crowding plays no role at these private institutions, but explains all of the difference in labor supply trends between public and private enrollees, then institutional crowding could explain up to 25 percent of the overall increase in labor supply during this time.[17] This is a generous upper bound; the true effect will be smaller if other factors such as credit constraints also apply disproportionately to public enrollees (recall that prices have risen fastest in percentage terms at public four-year schools).

V. DISCUSSION

This paper has documented and attempted to explain the large increase in student employment between 1970 and 2000, followed by a stagnation through 2005 and recent sharp decline. My analysis suggests that no single factor is responsible for the observed pattern, and the importance of different factors itself has shifted over time.

Table 3 summarizes the plausibility of alternative explanations during different time periods. Between 1970 and 1982, compositional change plays a modest role – explaining about half of the observed increase (or about 20 percent of the "residual" increase after accounting for economic conditions).[18] Neither economic conditions nor trends in college costs can explain any of the increase during this early period. Instead, the expansion of the Federal Work-Study program appears to be a significant factor. Increases in the return to work experience, declines in

[17] This calculation assumes that institutional crowding explains the full difference-in-difference of hours worked between public and private enrollees (1.4 hours), weights this by the fraction of enrollees that are at public institutions in 2005 (78 percent) and divides by the total increase of 4.4 hours (1.4*0.78/4.4=25 percent).
[18] The "residual increase" is larger than the observed increase because economic conditions suggest that hours should have been declining during this period, all else equal.

the return to schooling, and institutional crowding may also have contributed to the increase over the 1970s.

Between 1982 and 1993, compositional change and economic fluctuations can more than explain the observed increase (explaining 19 percent and 94 percent, respectively). Rising tuition and potential institutional crowding are also consistent with, but not necessary to explain the trend during this period.

Since 1993, however, credit constraints appear to play more of a role. Compositional change and economic fluctuations (primarily the latter) together can explain only about 40 percent of the increase between 1993 and 2005, and only about 60 percent of the decline since 2005. Between 1993 and 2005 tuition continued to rise sharply in real terms while the value of student aid declined. Since 2005, however, net tuition has actually fallen in real terms after accounting for significant increases in student aid.

In 2009, for the first time ever, 18 to 22 year old high school graduates were more likely to be going to college and not working than they were to be working and not going to college. Employment rates and hours of work among college students in 2009 were near a 30-year low.. Clearly, broader economic conditions are the predominant explanation for the recent reversal in student employment trends, and students are likely to return to work again in larger numbers when unemployment rates decline. However, this analysis suggests that borrowing constraints (whether strict or fuzzy, internally-imposed or externally-imposed) are also a significant factor for explaining recent trends. Thus, what happens to student employment in coming years will also depend on whether recent increases in student aid can continue to outpace increases in published prices.

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Table 1
Types of Credit Constraints

	Source of constraint	
Margin of constraint	External	Internal
Strict	Student cannot borrow the minimum required to pay tuition and nondiscretionary living expenses. Likely to apply mainly to students from low-income families (or those estranged from their parents)	Students can borrow the minimum required to pay tuition and basic living expenses, but choose not to because of either risk aversion or disutility of debt. May apply to anyone, but mainly becomes an issue for low-income students (or those estranged from their parents)
Fuzzy	Students can borrow the minimum required to pay tuition and nondiscretionary living expenses, but cannot borrow enough to optimally smooth consumption. Worse for lower-income students, but may apply across the income scale (particularly if parents' generosity is bounded).	Students can borrow enough to fully finance schooling and smooth consumption, but choose not to because of either risk aversion or disutility of debt. May apply to students at any point in the income distribution.

Table 2

Employment and Reasons for Work, By Family Income

Variable	All	Bottom Quartile	Q2	Q3	Top Quartile
Average weekly hours of work	14.0	15.2	15.1	13.9	11.8
Employed during school year (%)	70.0	71.7	74.0	71.2	63.3
Conditional weekly hours of work	20.0	21.2	20.5	19.5	18.7
Received any federal work-study aid (%)	18.8	26.5	22.3	16.4	9.9
Median income ($)	74,530	21,200	51,669	81,119	144,168
Sample size (rounded to nearest 10)	17,050	4,430	4,210	4,120	4,290
Among working students					
Main reason for employment					
Pay tuition and fees (%)	49.8	61.5	55.6	47.3	34.8
Pay living expenses (%)	37.9	27.1	33.8	40.4	50.0
Work experience (%)	8.4	7.0	6.7	8.3	11.6
Cannot afford school without working (%)	47.3	58.3	54.5	45.6	30.1
Median income ($)	74,003	21,634	51,703	80,982	142,631
Sample size (rounded to nearest 10)	9,170	2,310	2,380	2,340	2,140
Among students who "cannot afford school without working"					
Took out maximum federal student loan	49.6	44.2	52.5	52.4	49.4
Took out loan, but less than maximum	10.4	14.3	10.0	9.3	5.5
Took out no loan	39.9	41.3	37.4	38.2	44.9
Eligible for any subsidized loan	77.0	98.2	93.7	61.8	27.3
Of these, took out less than maximum	55.0	56.6	55.1	52.3	54.4
Of these, fully declined the loan	39.4	41.4	39.7	36.4	34.3
Sample size (rounded to nearest 10)	4,210	1,310	1,260	1,030	610

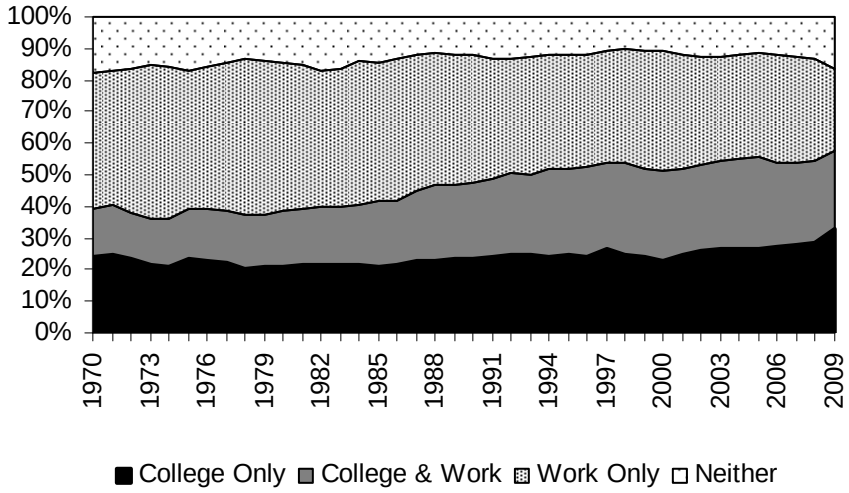
Source: Author's calculations using NPSAS:2003-04 data.

Notes: Income quartiles are defined over this sample of full-time dependent four-year enrollees. Students who exclusively worked at a work-study job were not asked the questions about the main reason for working or whether school could be afforded without working. Thus these students are excluded in the bottom two panels of the table. Students are eligible for federally-guaranteed loans regardless of need. Subsized loans are based on need, a combination of financial status and cost of attendance.

Table 3
Explanations for Student Employment Trends, 1970-2009

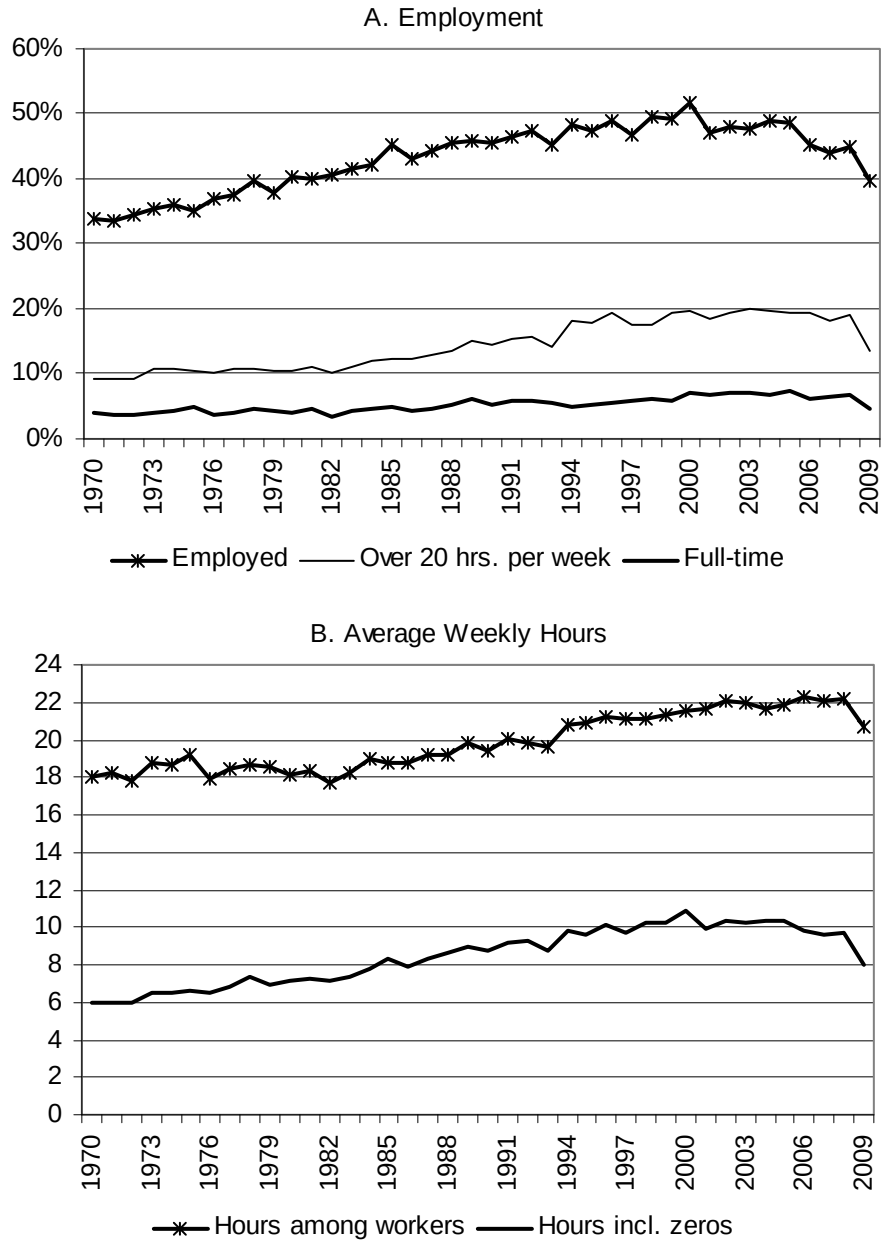
Explanation	Time Period 1970-1982	1982-1993	1993-2005	2005-2009
Actual change in hours	1.1	1.6	1.7	-2.4
Expected change due to compositional change	0.6	0.3	0.2	0.2
Expected change due to economic fluctuations	-2.0	1.5	0.5	-1.7
Residual unexplained trend	2.5	-0.2	1.0	-0.9
Explanations consistent with residual trend?				
Tuition/fees net of aid	no (stable)	yes (increasing)	yes (increasing)	yes (declining)
Federal Work Study	yes (increasing)	no (declining)	no (stable)	no (stable)
Returns to work exp.	yes (decline in labor/farm occupations)	no (stable)	no (stable)	yes (decline in prof/mgr occupations)
Returns to schooling	yes (declining)	no (increasing)	no (increasing)	no (increasing)
Institutional crowding	yes (increasing)	yes (increasing)	yes (increasing)	no (increasing)

Figure 1
Enrollment and Employment Combinations
Of 18- to 22-Year-Old High School Graduates



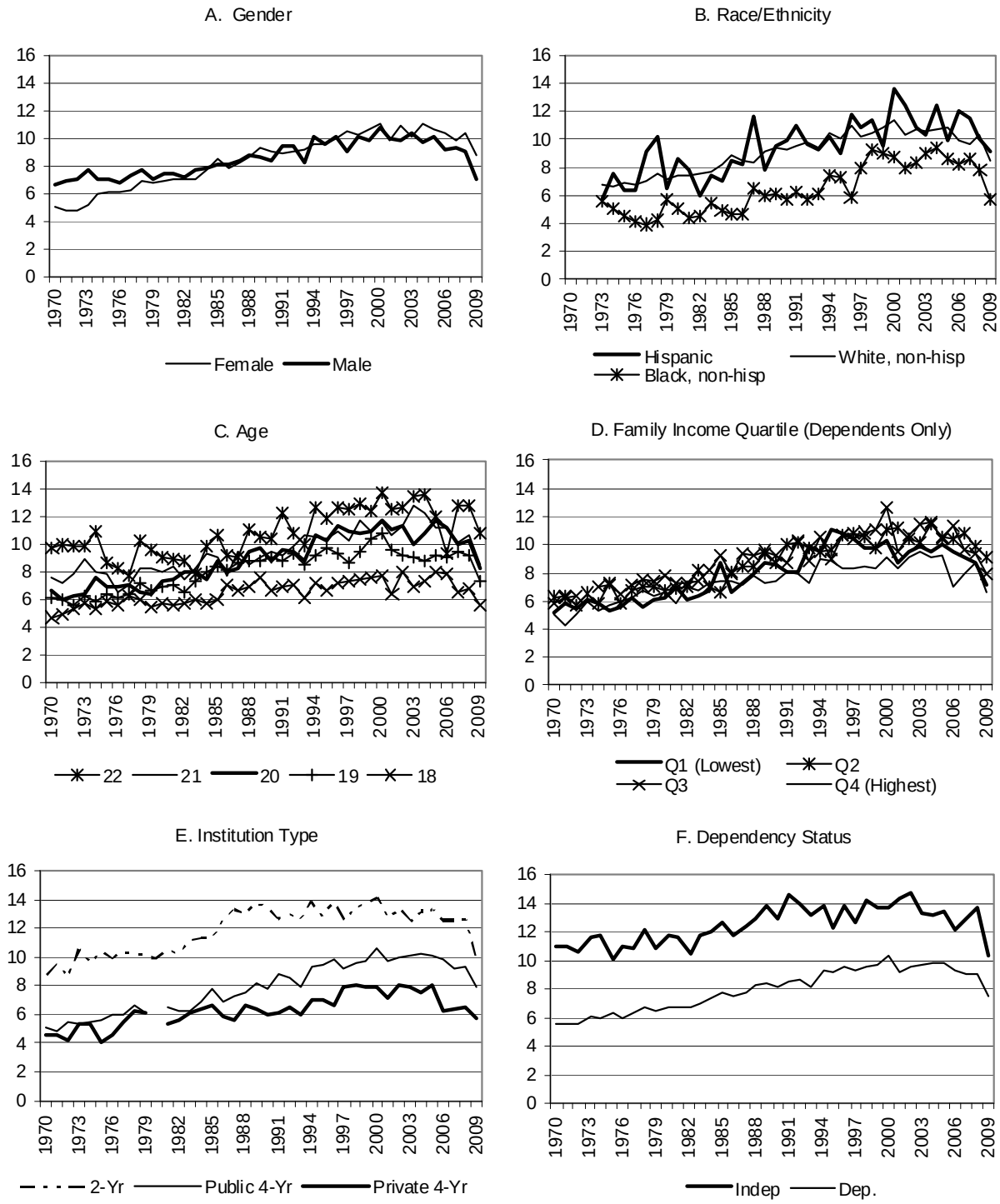
Source: Author's calculations using October Current Population Survey, 1970-2009, compiled by Unicon Corp.
Notes: College refers to part- or full-time enrollment in a two- or four-year institution.
Employment refers to part- or full-time paid employment in the past week.

Figure 2



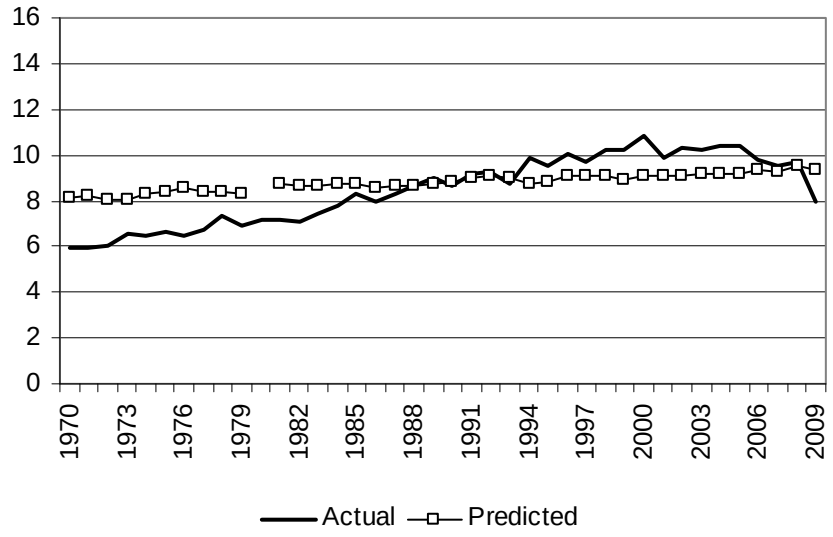
Source: Author's calculations using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on 18- to 22-year-old full-time college enrollees.

Figure 3
Average Weekly Hours By Selected Characteristics



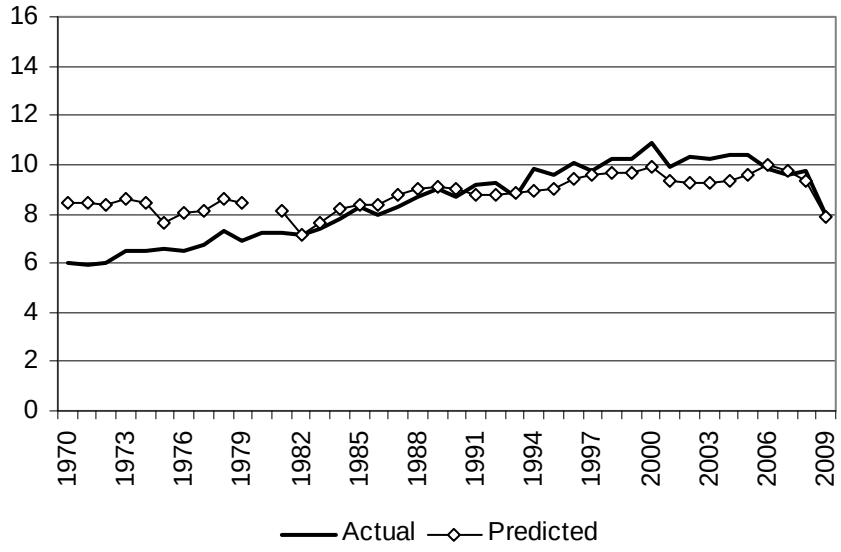
Source: Author's calculations using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on 18- to 22-year-old full-time college enrollees.

Figure 4
Actual and Predicted Average Weekly Hours
(Using Demographic Characteristics Only)



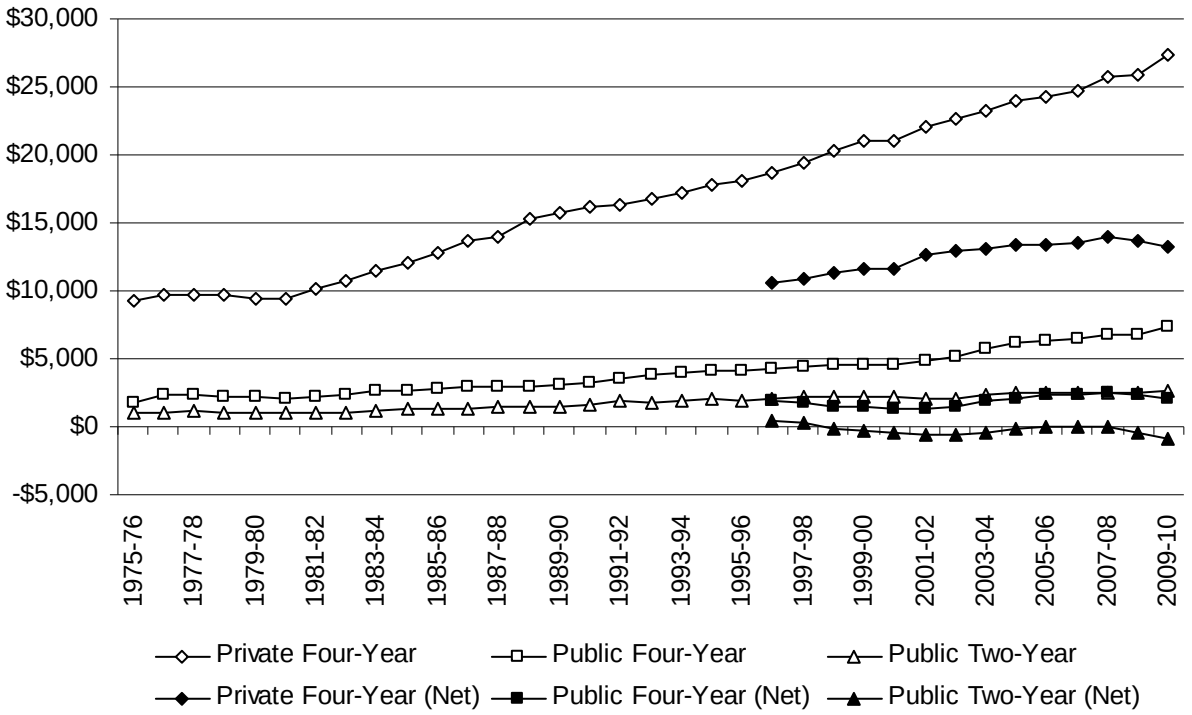
Source: Author's estimates using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on 18- to 22-year-old full-time undergraduates.
Notes: Average hours include zeroes for non-workers. See text for details.

Figure 5
Actual and Predicted Average Weekly Hours
(Using Demographics and Economic Conditions)



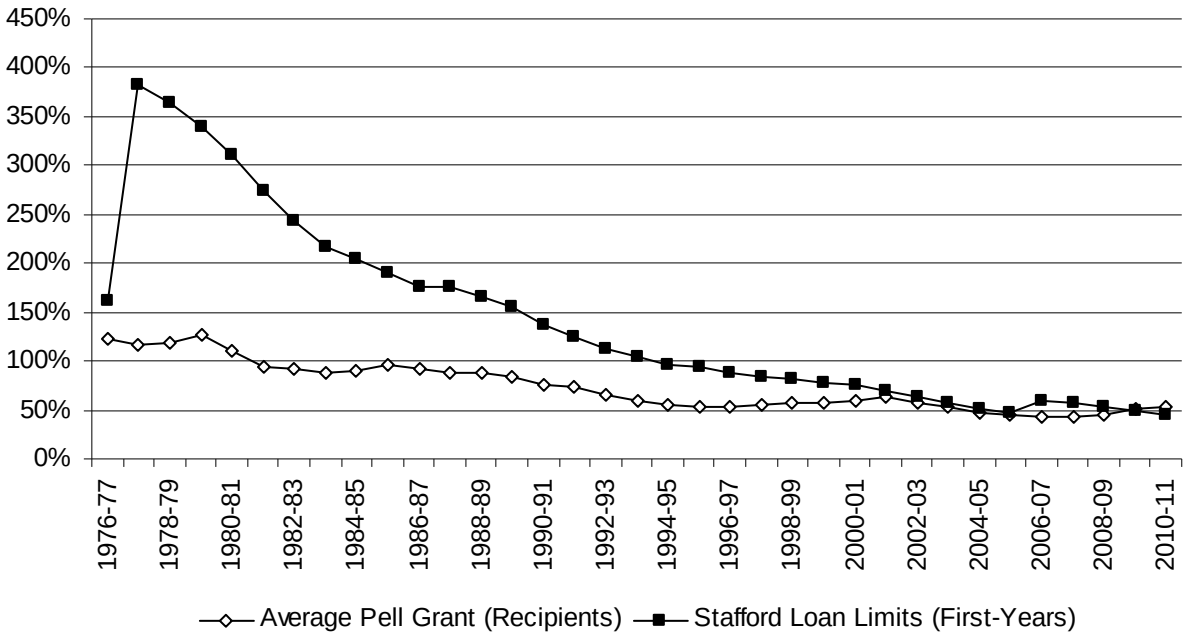
Source: Author's estimates using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on 18- to 22-year-old full-time undergraduates.
Notes: Average hours include zeroes for non-workers. See text for details.

Figure 6
Published and Net Tuition and Fees
(Constant 2011 Dollars)



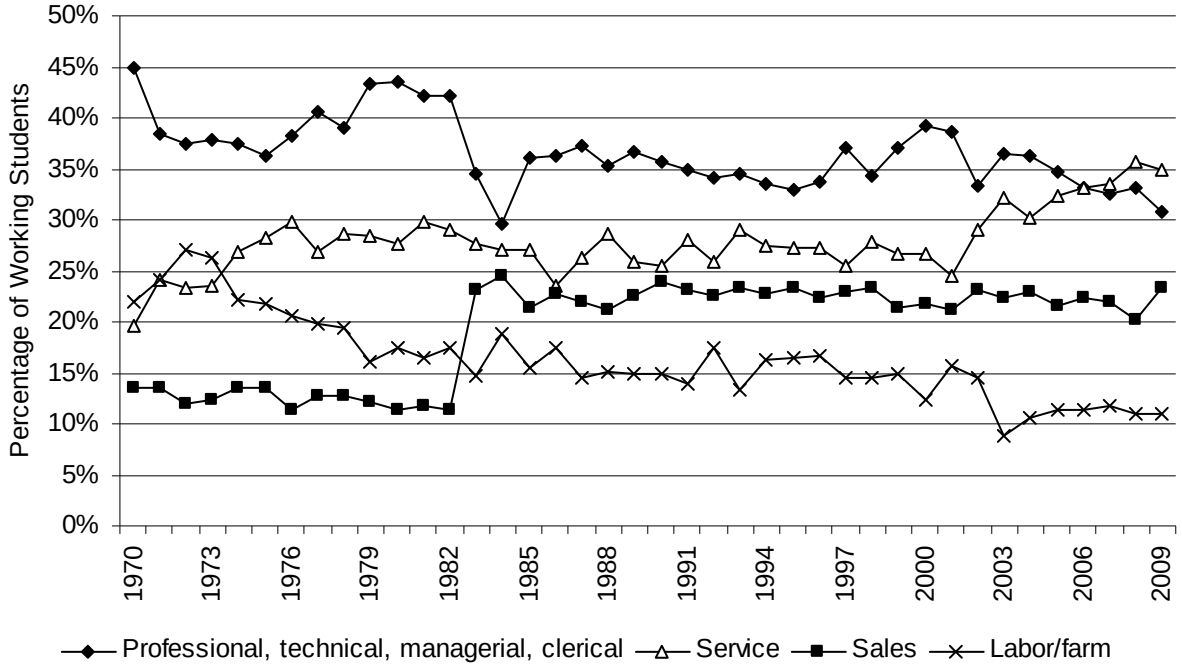
Source: College Board (2004, 2005, 2011b). Net tuition and fees are calculated by subtracting estimated average grant aid plus tax benefits per full-time student in the sector from the published price. Original source for data 1987-88 through 2010-11: Annual Survey of Colleges, The College Board. Original source for earlier data: Integrated Postsecondary Education Data System (IPEDS), U.S. Department of Education.

Figure 7
Average Pell Grants and Stafford Loan Limits
as a Proportion of Average Public Four-Year Tuition



Source: Author's calculations based on tuition and fee data from the College Board (2004, 2005, 2011b). For historical information on average Pell Grant awards and Stafford Loan maxima, see "FinAid: The Smart Student Guide to Financial Aid," www.finaid.org.

Figure 8
Occupational Groupings Among Employed Students Over Time



Source: Author's estimates using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on employed 18- to 22-year-old full-time undergraduates.
Notes: Occupational classifications underwent major changes in 1983 and 2003; thus, changes in the observed occupational distribution during those periods is likely due to definitional rather than real changes.

APPENDIX A

Noting the dependence of h^* on the exogenous parameters, the first-order condition can be rewritten as an identity:

$$w(a) + \beta r^h \frac{\partial g(h(w(a), \beta, r^h, r^s, q^h, q^s, a); q^h, a)}{\partial h} \equiv \beta r^s \frac{\partial f(s(h(w(a), \beta, r^h, r^s, q^h, q^s, a)); q^s, a)}{\partial s}$$

Analyzing this equation will formalize largely intuitive implications regarding how h^* depends on wages, returns to school and work, ability, school quality, and other factors—even in the absence of credit constraints.

Student wages. As in any model of labor supply, wages matter. Higher base wages will increase the value of work relative to schooling:

$$\frac{\partial h^*}{\partial w} = \frac{-1}{\left(\beta r^h \frac{\partial^2 g(h(); q^h, a)}{\partial h^2} + \beta r^s \frac{\partial^2 f(s(); s^h, a)}{\partial s^2} \right)}$$

Since both $g(\,)$ and $f(\,)$ are concave, $\frac{\partial h^*}{dw} > 0$. Students shift time from school to work in the first period when wages rise, all else equal. The shift is smaller when β is large and/or when returns to human capital are high (in other words, when base wages are a relatively small piece of lifetime earnings).

Returns to work experience. Formally:

$$\frac{\partial h^*}{\partial r^h} = \frac{-\frac{\partial g(h(); q^h, a)}{\partial h}}{\left(r^h \frac{\partial^2 g(h(); q^h, a)}{\partial h^2} + r^s \frac{\partial^2 f(s(); s^h, a)}{\partial s^2} \right)}$$

Again due to the concavity of $g(\,)$ and $f(\,)$, $\frac{\partial h^*}{\partial r^h} > 0$. Students shift towards work in the first period when returns to work experience rise, all else equal.

Returns to schooling. Formally:

$$\frac{\partial h^*}{\partial r^s} = \frac{\dfrac{\partial f(s();q^h,a)}{\partial s}}{\left(r^h \dfrac{\partial^2 g(h();q^h,a)}{\partial h^2} + r^s \dfrac{\partial^2 f(s();s^h,a)}{\partial s^2} \right)}$$

Again due to the concavity of $g(\,)$ and $f(\,)$, $\frac{\partial h^*}{\partial r^s} < 0$. Students work less in the first period if returns to schooling increase.

Student ability. Intuitively, the relationship between ability and student work decisions is ambiguous. This ambiguity is reflected in the formal analysis:

$$\frac{\partial h^*}{\partial a} = \frac{\left(\beta r^s \dfrac{\partial^2 f(s();q^s,a)}{\partial s \partial a} - \beta r^h \dfrac{\partial^2 g(h();q^h,a)}{\partial h \partial a} - \dfrac{dw}{da} \right)}{\left(\beta r^h \dfrac{\partial^2 g(h();q^h,a)}{\partial h^2} + \beta r^s \dfrac{\partial^2 f(s();s^h,a)}{\partial s^2} \right)}$$

The denominator is negative, but the sign of the numerator is ambiguous. To the extent that ability affects the marginal productivity of school-based human capital more than it affects the marginal productivity of work-based human capital (and to the extent that returns to schooling are higher than returns to work experience), this will push higher-ability students to work less. If high-ability students also command significantly higher base wages, however, this creates an incentive to work more.

School quality. Intuitively, one might guess that when school quality is low students will have more time to spend working. However, this conclusion does not clearly follow from the formal analysis:

$$\frac{\partial h^*}{\partial q^s} = \frac{r^s \frac{\partial^2 f(s();q^s,a)}{\partial s \partial q^s}}{\left(r^h \frac{\partial^2 g(h();q^h,a)}{\partial h^2} + r^s \frac{\partial^2 f(s();s^h,a)}{\partial s^2} \right)}$$

I assume that $\frac{\partial^2 f(s();q^s,a)}{\partial s \partial q^s} < 0$, in other words, that marginal productivity of observable school-based human capital is higher when school quality is lower. Intuitively, students need less time to produce the same number of courses completed when coursework is less demanding. This would imply that $\frac{\partial h^*}{\partial q^s} > 0$ and that students work *less* when coursework is less demanding.

This result, however, relies crucially on the assumption that school quality affects only the cost of educational investment, not the returns on that investment. In reality, returns may be an increasing function of school quality—employers may not be completely blind. If this is the case, we would have:

$$\frac{\partial h^*}{\partial q^s} = \frac{\left(r^s(q^s) \frac{\partial^2 f(s();q^s,a)}{\partial s \partial q^s} + \frac{dr^s}{dq^s} \frac{\partial f(s();q^s,a)}{\partial s} \right)}{\left(r^h \frac{\partial^2 g(h();q^h,a)}{\partial h^2} + r^s \frac{\partial^2 f(s();s^h,a)}{\partial s^2} \right)}$$

The denominator remains negative but the numerator is now ambiguous. The first term in the numerator remains negative, but the second term is positive. The less that returns depend on school quality and the higher the levels of returns overall, the more likely that $\frac{\partial h^*}{\partial q^s}$ will be positive; that is, the more likely that low-quality schooling will induce students to work *less* rather than more.

APPENDIX B

Table B1
Predictors of Average Weekly Hours

Independent variable	Model 1 Coeff.	Model 1 (Std. Err)	Model 2 Coeff.	Model 2 (Std. Err)
Female	0.39	(0.07)	0.36	(0.07)
Black, non-hispanic	-2.84	(0.12)	-2.77	(0.12)
Hispanic	0.22	(0.15)	0.23	(0.15)
Missing race/ethnicity	-0.44	(0.40)	-0.35	(0.40)
Midwest region	2.10	(0.10)	2.05	(0.10)
South region	1.78	(0.10)	1.82	(0.10)
West region	1.81	(0.11)	2.07	(0.11)
Ever married	0.04	(0.21)	0.09	(0.21)
Not household head or spouse	-5.73	(0.14)	-5.67	(0.14)
Age 19	1.85	(0.10)	1.83	(0.10)
Age 20	3.06	(0.11)	3.04	(0.11)
Age 21	3.56	(0.11)	3.57	(0.11)
Age 22	4.54	(0.13)	4.55	(0.13)
Public four-year institution	-4.24	(0.09)	-4.30	(0.09)
Private four-year institution	-5.32	(0.11)	-5.38	(0.11)
Lowest family income quartile	-1.33	(0.14)	-1.33	(0.14)
Lower middle family income quartile	0.09	(0.12)	0.08	(0.12)
Upper middle family income quartile	0.69	(0.10)	0.72	(0.10)
Mother: Less than HS education	0.41	(0.18)	0.57	(0.18)
Mother: HS diploma only	1.12	(0.11)	1.24	(0.11)
Mother: Some college, no degree	1.58	(0.11)	1.58	(0.11)
Mother: Missing education	2.95	(0.17)	2.95	(0.16)
Father: Less than HS education	0.99	(0.18)	1.04	(0.18)
Father: HS diploma only	1.96	(0.12)	1.95	(0.12)
Father: Some college, no degree	2.09	(0.11)	2.04	(0.11)
Father: Missing education	2.36	(0.13)	2.35	(0.13)
State-year level unemployment rate			-39.26	(1.74)
Constant	11.57	(0.18)	13.76	(0.20)
R-squared		0.074		0.078
Sample size		113,899		113,899

Source: Author's estimates using October Current Population Survey data, 1970-2009 (compiled by Unicon Corp.) on 18- to 22-year-old full-time undergraduates.
Notes: Average hours include zeroes for non-workers. All coefficients are from ordinary least squares regression. Using a Tobit specification produces virtuallly identical predictions of annual average hours.