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Three essays on child labor, schooling outcomes and health

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Abstract

This dissertation examines the interrelationships between child labor, schooling and health, using nationally representative data from the United States and from Brazil. In developing countries, child labor can begin at an early age. However, child labor can be found in developed countries as well, particularly in the teenage years. This dissertation examines (1) whether and how much current state child labor legislation affects the employment and schooling decisions of U.S. high school students; (2) whether there is a cumulative effect of teen work on schooling outcomes; and (3) whether adults who worked as children experience increased incidence of illness or physical disability in Brazil. Variation in state government restrictions on child labor, the availability and quality of local schools, and the opportunity cost of schooling are used as instruments to correct for the potential endogeneity of child labor or years of schooling. This dissertation shows that U.S. child labor laws are not effectively enforced in limiting teen labor supply or in improving schooling outcomes. Nevertheless, child labor does have adverse consequences on lifetime learning and health, even if the work is legal and not of the "worst forms" of child labor, although these consequences are often of modest magnitudes. These findings suggest that policies limiting child labor may be justified as a means of improving the child's welfare later in life, but weak enforcement means that such policies have been only modestly successful in the past.

Chapter 1. General Introduction

This dissertation is composed of three essays aimed at improving our understanding of the causes and consequences of child labor. The International Labor Organization (ILO) estimated that in 2000, there were 352 million children aged 5 to 17 who were economically active. This accounts for about one-fifth of all children in that age group. Of these, 171 million children were estimated to work in hazardous conditions either because the production process is considered hazardous or because the children work more than 43 hours per week.

In developing countries, child labor can begin at an early age. For example, about one-third of Brazilian adults first entered labor market before 12, the youngest legal working age. However, child labor can be found in developed countries as well, particularly in the teenage years. According to the National Longitudinal Survey of Youth (NLSY97), the proportion of U.S. high school students working during the school year ranges from 23% in the freshman year to 75% in the senior year.

Child labor has drawn considerable attention from policy makers over the last decade. The policy prescriptions are not necessarily consistent. While some policy makers advocated programs to combine school and work aiming at improving the transition to full-time employment, others have advocated restrictions on youth employment. The high proportion of high school children who hold jobs clearly suggests that many parents view working while in school positively, at least for some youth.

ILO Convention 182 passed in 1999 is aimed at eliminating the worst forms of child labor. The worst forms have been defined as work that by its nature harms the child's physical and emotional development such as bonded labor, prostitution, or drug trafficking. However, it is possible that less obviously damaging forms of child labor could have lifetime adverse consequences for lifetime well-being if working while young adversely affects lifetime educational attainment or health.

Because of the lack of consensus on the desirability of working while attending school or of entering the labor market at an early age, numerous recent studies have investigated the causes and consequences of child labor in both developed and developing countries. Human capital theory emphasizes the importance of forgone earnings as a cost of schooling, and so a common focus has been to investigate tradeoffs between current earnings and consumption against human capital accumulation and enhanced future earnings and consumption. Particular emphasis has been paid to identifying the magnitude of presumed lost human capital when children spend more time at market work. Less attention has been paid to other potential costs of early labor market entry on the physical and mental health of the child. Even less has been learned about potential permanent health consequences from working as a child.

This dissertation examines (1) whether and how much current state child labor legislation affects the employment and schooling decisions of U.S. high school students; (2) whether intensity of working during the school year affects the schooling outcomes of high school students in the U.S.; and (3) whether adults who worked as children experience increased incidence of illness or physical disability in Brazil.

There are two main themes that span the essays in this dissertation. One of them is to correct for the likely endogeneity of child labor or years of schooling. Unobserved individual abilities or health endowments may affect the amount of time a child spends in school or at work, and these unobserved endowments will also affect schooling and health outcomes. Ordinary Least Squares estimates that do not account for these unobserved attributes will yield biased estimates of the impact of child labor on schooling and health outcomes. To address the estimation problem, the instrumental variable strategy is used. Variation in state government restrictions on child labor, the availability and quality of local schools, and the opportunity cost of schooling are used as instruments for endogenous hours worked, age of labor market entry and years of schooling completed.

A second common theme considers the cumulative or long term effects of child labor. It is possible that child labor has permanent effects on success in school that are only apparent after many years. Similarly, the adverse health consequences of child labor may take time to manifest themselves. To account for this potential problem, I examine whether the cumulative work histories of U.S high school students affect schooling outcomes. I also examine whether working as a child results in the early onset of adverse health outcomes for samples of adults in Brazil.

The dissertation is organized as follows. In the second chapter of the dissertation, I examine how state child labor laws affect the time American high-school aged youth devote to school and work. In the United States, both federal and state governments have tried to establish and enforce child labor laws to protect youth from work that interferes with their schooling. While federal child labor law focuses on the work experience of minors, especially those aged 15 and below, state child labor laws often place further restrictions on the work activities of 16- and 17-year olds. The two most common state child labor restrictions are work permit requirements for teenagers and school dropout ages that are more stringent than federal requirements. If these laws are effectively targeted and enforced, children living in states legislating more stringent child labor laws should be less likely to work, should work fewer hours if they do work, and they should have better average schooling outcomes.

The third chapter examines the effect of school-year work on schooling outcomes using the U.S. National Longitudinal Survey of Youth. Working while in school and school performance are joint decisions, and so estimates of the impact of work on schooling outcomes must correct for the likely endogeneity of working while in school. Variation in individual date of birth and in state truancy laws along with the strength of local demand for low-skill labor are used as instruments for endogenous cumulative work hours during the high school career. Several measures of schooling outcomes are used: probability of dropout: high school grade point average: and the probability of attending college. Working may affect some but not all outcomes.

In chapter four, I investigate whether adults who entered the labor market early in life suffer higher rates of chronic diseases and functional limitations in adulthood. Estimating the causal effect of early entry into labor market on adult health is complicated by the selection process which sorts children into the labor market. Another confounding factor is that child labor may affect a child's years of schooling completed, and education has been shown to positively affect adult health. The effect of child labor on education in Brazil is uncertain, and in turn, a complete assessment of the effect of child labor on health must consider the indirect effect of child labor on schooling. The analysis corrects for the likely endogeneity of child labor and years of schooling using variation in number of schools per children, number of teachers per children and low skill wages at the time the adults were children.

Chapter 2. If Johnny Can't Work, Can Johnny Read Better?: Child Labor Laws, Labor Supply and Schooling Outcomes

Abstract

In the United States, both federal and state governments have tried to establish and enforce child labor laws to protect youth from work that interferes with their schooling. While federal child labor law focuses on the work experience of minors, especially those aged 15 and below; state child labor laws often restrict the work activities of 16- and 17-year olds. The two most common state child labor restrictions are work permit requirements for teenagers and school dropout ages that are more stringent than federal requirements. If these laws are effectively targeted and enforced, children living in states legislating more stringent child labor laws should be less likely to work, should work fewer hours if they do work, and they should have better average schooling outcomes. The results show that stricter state laws do not lower the likelihood that a child works or the likelihood a working child works in excess of federal guidelines, although they do lower how frequently a child engages in illegal work. State work permit requirements have a very small positive effect on the likelihood of college entry. Truancy laws do not affect the likelihood of going to college, but increase marginally high school academic performance.

2.1. Introduction

A surprisingly large proportion of American high school-aged youth works while in school. Nearly one-fifth of 14 year-olds, the youngest legal working age, works at least one week at any point during school in session. The likelihood of working rises steadily with age:

29% of 15-year-olds; 60% of 16-year-olds; 71% of 17-year-olds.[1] These high youth employment rates raise concerns about the desirability of working while attending high school.

Parents believe that child labor can foster self-reliance and money management skills, smooth the transition from school to work, and allow the child to save money for college. However, employment during high school could lead to less time being spent on academic or extracurricular activities that presumably improve learning while in school. Under current competing views, some policy makers advocated programs to improve school - work connections for youth[2] while others have advocated restriction on child labor.[3]

In the United States, both federal and state governments have tried to establish and enforce child labor laws to protect youth from work that may be dangerous and that may interfere with their schooling. Since 1938, the Fair Labor Standards Act (FLSA) has regulated child labor at the Federal level. It limits the number of hours and the type of work for 14- and 15-year olds. In addition, many state laws mandate standards that go beyond the Federal law. The most common of these set maximum hours and/or night work restrictions for 16- and 17-year olds or set more stringent restrictions on school-leaving age.

This study examines how state child labor legislation affects the employment and school decisions of youth aged 14 through 17. Our findings suggest that stricter state child labor laws do not lower the likelihood that a child works, they do not lower the likelihood of

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[1] Similar patterns are shown in Rothstein (2001) and in USDL 03-40, a news release from the U.S. Bureau of Labor Statistics (2003). There are two types of job related to early work experience. "Employee" jobs involve an ongoing relationship with a particular employer (for example, working in a grocery market). "Freelance" jobs have no specific boss (for example, babysitting). We only use information on employee jobs and those are the only jobs that can be effectively regulated by the government..

[2] For example, "1994 School-to-Work Opportunities Act" includes incentives for states to strengthen the linkage between school and work.

[3] For example, in 1998, National Research Council panel recommended that the number of hours of work for 16- and 17-years olds while in school be limited.

working in excess of federal hours limits, and they only modestly lower how frequently a child violates the federally proscribed hours maximum. Furthermore, children who work excessive hours relative to the legal limits do not suffer inferior schooling outcomes. Nevertheless, stricter state work permit requirements do have a small, positive effect on college entry but not high school performance. Higher state school truancy ages have a small positive effect on high school grade points but not on high school completion rates and college entry. Overall, results suggest that stricter laws regulating child labor and truancy age are only marginally successful in altering the schooling and labor choices of U.S. teens.

The next section summarizes the existing literature on the relationships among child labor laws, youth employment and their schooling outcomes. Section 2.3 describes existing federal and state child labor laws. Section 2.4 specifies an empirical strategy for measuring how state laws affect labor supply and schooling choices. Section 2.5 presents the data and section 2.6 reviews our results. In section 2.7, we discuss the implications of this study for policy and further research.

2.2. Literature Review

Lleras-Muney (2002) examined how state compulsory attendance and child labor laws contributed to the increase in educational attainment of U.S. residents in the first half of the twentieth century. Laws requiring children to attend 1 more year of school or increasing the minimum working age by one year increased average years of schooling by 5 percent from 1915 to 1939. These laws not only increased average education levels but also decreased education inequality.

Nevertheless, recent studies have argued that illegal child labor is common. Moskowitz (2000) argues that federal and state child labor laws do not adequately protect children against occupational hazards. Because laws that deal with child labor are only weakly enforced due to poor funding and weak incentives to inspect worksites, significant numbers of teens in the United States are employed illegally. Kruse and Mahony (2000) provide comprehensive estimates of the extent of illegal child labor in the United States using Current Population Survey (CPS) and other sources.[4] They estimate that 154,000 children under 18 or roughly 0.7% of the population of children were engaged in working in violation of state or federal child laws in an average week.[5] Because teenagers move in and out of the labor force frequently, the fraction of teens working illegally during a year is much larger.

The Moskowitz and Kruse and Mahoney studies leave unanswered whether there are adverse consequences for children engaged in illegal child labor. This study extends their work by examining how state child labor laws affect child work time allocation and school outcomes. Because states vary in the strictness of state labor and truancy regulations, we can determine if stricter laws are effective in limiting teen work and whether they improve schooling outcomes.

2.3. Child Labor Laws

States can have stricter child labor laws than the federal law, but the federal child labor laws hold in the absence of stricter state laws. Federal child labor provisions covered by the Fair Labor Standards Act (FLSA) are summarized in Appendix 1. In the United States, FLSA gives the Department of Labor authority to prohibit minors under age 18 from working in occupations deemed too hazardous. The FLSA also limits the number of hours and times

[4] They combined 33 monthly CPS surveys from January 1995 to September 1997 in order to estimate illegal employment of teens aged 15 and older. Their information on 14-years old and younger workers was taken from the NLSY79, the NLSY97 and the NLS-Adolescent Health data.

[5] They determined illegal working by matching occupation codes of youth into the federal or state restrictions on type of work. Also, hours restriction of FLSA is applied to estimate of illegal working of 14-and 15-year-olds.

of day that 14- and 15-year olds can work. At those ages, children are limited to work a maximum of three hours per day and eight hours per week during weeks that school is in session, and no more than forty hours per week during school vacations. Children under the age of 14 are prohibited from working except for agricultural employment, working for a family business, or performing “freelance work” such as babysitting or delivering newspapers. Child labor in agriculture is much less regulated. Regardless of age, children may be employed in any non-hazardous farm job without any restriction on number of hours during the school year. Children younger than age 14 may work only on their parents’ farm or on another farm with the written consent of their parents. Children who are 14 or older may work on farms without parental consent. By age 16, youths are no longer subject to protective restrictions on agricultural jobs which are regarded as hazardous.

While the FLSA concentrates on the labor of youth under 16 years of age, some states have extended restrictions to older youth. Sixteen states have child labor laws restricting the working hours of 16 and 17 year-old youth through a work permit requirement (See Appendix 2). An additional 22 states require work permits for 14 and 15 year olds that are more restrictive than the federal requirements. State compulsory school attendance laws limit work indirectly by requiring time in school. Twenty two states have truancy ages above 16, the federal truancy age (See Appendix 3).

The stated goal of the FLSA and state child labor law is to protect youth from long work hours or dangerous working conditions. Presumably, the hours restrictions are intended to guide youth on levels of work intensity that will not retard educational development but will allow work experience that may ease entry into the full-time labor market after leaving high school. If these laws are effective, they should have a positive impact on the probability of completing high school or attending college and should improve academic performance in high school. The next section proposes an empirical strategy for assessing whether those expectations are consistent with the data on child academic progress across states.

2.4. Model Specification

Parents decide (or at least approve) their child's intensity of employment. Let W_{ij} be an ordered response representing progressively higher values {0, 1, 2, 3} depending on hours of work for a child *i* in state *j*. To relate the observed data to our policy application, we set the thresholds relative to the legal federal limits on child working hours. For a child who does not work at all during school year, $W_{ij} = 0$. For a child who works within FLSA guidelines, $W_{ij} = 1$. $W_{ij} = 2$ indicates one to five weekly violations of FLSA hours limits during the year. $W_{ij} = 3$ is for children whose weekly work hours violated federal guidelines more than five weeks in the school year.

There are two issues that require comment regarding our use of these ordered work states. First, we use federal hours limits as the reference for W_{ij} despite the fact that we are evaluating state child labor laws. Had we used the state limits as the reference, states with more restrictive laws would have violations that would not be counted as violation in more lax states. The federal guidelines provide a common reference across all states. Second, we could have used child work hours directly rather than these four groupings. Our use of the groups helps to highlight the threshold nature of working within versus working outside the FLSA guidelines. In addition, the groupings may help to sidestep some measurement problems associated with recollections of working hours during the year. We expect that youth may be able to recall occasional from frequent weekly hours violations, but not necessarily the actual number of occurrences of those violations. Therefore the ordered groupings may be better measures of the incidence of illegal work.

We use an ordered probit specification to model teen labor supply. Letting W_{ij}^* be a latent variable indexing progressively greater work intensity, we assume

$$W_{ij}^* = Z_{ij}\beta^W + D_{ij}\gamma^W + \varepsilon_{ij}\ , \tag{1}$$

where D_{ij} is a dummy variable indicating whether the state has more restrictive child labor laws than the federal level; Z_{ij} is a vector of individual and household demographic and socioeconomic characteristics; and ε_{ij} is a random error for child *i* in state *j*. As W_{ij}^* increases, the probability a child is found in a particular work intensity state is given by

$$\begin{aligned} W_{ij} &= 0 \qquad \text{if } W_{ij}^* \le 0 \\ W_{ij} &= 1 \qquad \text{if } 0 < W_{ij}^* \le \mu_1 \\ W_{ij} &= 2 \qquad \text{if } \mu_1 < W_{ij}^* \le \mu_2 \\ W_{ij} &= 3 \qquad \text{if } \mu_2 < W_{ij}^* . \end{aligned} \tag{2}$$

If we assume the errors are distributed standard normal conditional on Z_{ij} and D_{ij}, the regression parameters β^W, γ^W and the two cut points can be estimated as an ordered probit specification using maximum likelihood.

In typical cases, if restrictive state child labor laws are effective in regulating work intensity, then $\gamma^W < 0$. In our ordered specification, it is possible that the laws may both shift children into legal work from illegal work, but also from not working to working, in which case the opposite sign might be obtained. To check for this possibility, we must also evaluate the probability of each outcome W_{ij} as the laws change.[6]

To examine the effect of child labor laws on schooling outcomes, we consider the regression

$$S_{ij} = \delta_0 + Z_{ij}\beta_D^E + D_{ij}\gamma_S^D + \nu_{ij}, \quad (3)$$

where S_{ij} is the schooling outcomes mentioned above; ν_{ij} is the error term; and the other variables are as defined above. If restrictions on child labor are useful, they should positively affect measurable academic outcomes so that $\gamma_S^D>0$.

If the restrictions on child labor are set appropriately, we should find stronger effects of illegal than legal labor and there should be no adverse impact of legal labor on school outcomes. To investigate these hypotheses, we can insert measures of hours worked within and beyond the federal guidelines as measures of the degree of violation of child labor limits. These hypotheses can be tested directly by replacing D_{ij} by W_{ij} in (3) so that

$$S_{ij} = \delta_0 + Z_{ij}\beta_W^E + W_{ij}\gamma_S^W + \upsilon_{ij}. \quad (4)$$

Youth working beyond federal guidelines should suffer adverse schooling outcomes so that $\gamma_S^W < 0$.

A. Are state child labor laws exogenous?

[6] Using the standard normal distribution for ε_{ij} and using $X\beta$ as shorthand notation for ($Z_{ij}\beta^W + D_{ij}\gamma^W$), Pr($W_{ij}=0$) = Pr($W_{ij}^* \le 0$) = ($X\beta+\varepsilon_{ij} \le 0$) = $\Phi(X\beta)$, Pr($W_{ij}=1$)= Pr(0< $W_{ij}^* \le \mu_1$) = (0< ($X\beta+\varepsilon_{ij}$) $\le \mu_1$) $=\Phi(\mu_1 - X\beta)$ - $\Phi(-X\beta)$,… ,and Pr($W_{ij}^* \ge \mu_2$) = ($X\beta+\varepsilon_{ij} \ge \mu_2$) = 1- $\Phi(\mu_2 - X\beta)$ where Φ is the standard normal cumulative distribution function. Each of these probabilities can be evaluated at D_{ij}=1 and D_{ij}=0, holding all other exogenous variables constant.

The specifications above presume that state child labor and truancy laws are exogenous. This would not be true if households move across state boundaries because of the child labor or truancy laws, or if those laws are altered in response to prevailing and pervasive tastes for child labor or schooling outcomes in the state. It seems unlikely that parents migrate across states because of state laws restricting child labor, but it is more plausible that child labor laws are set in response to preexisting attitudes toward child labor in the state. We explore the issue using a probit regression of a dichotomous variable indicating the existence of restrictive state child labor laws on state per capita income, state unionization rates and a dummy variable indicating whether the state has a higher minimum wage than the federal minimum wage rate. States are defined as having more stringent child labor laws if they require a work permit for 16- or 17-year olds or if they specified a legal dropout age above age 16. Note that this specification does not presume a causal relationship between the regressors and the dependent variable—it is merely a convenient mechanism to assess underlying correlations in the data. For example, a high correlation between minimum wage and child labor legislation would suggest a greater likelihood that an underlying taste for protective labor legislation exists in the state.

Results are reported in Table 1. The first column (work permit requirement) and the second column (compulsory schooling attendance) show that states with restrictive child labor legislation are not disproportionately wealthy, unionized, or prone to passing other protective legislation.[7] While this is not a definitive test, it does not appear that state child

[7] The results are similar when ordered measures reflecting increasing rigor of child labor laws are used in place of the dummy variables. For example, when ordered measures of the existence of a work permit requirement with higher values for requirements through ages 16, 17 and 18 are used in place of the dichotomous measure, we also find no significant predictors of the existence of restrictive child labor legislation.

labor laws are highly correlated with other state restrictive legislation or preexisting tastes that would bias our coefficient estimates.

2.5. Data

A. NLSY97

The National Longitudinal Survey of Youth 1997 (NLSY97) provides data on the transition from school to work for a representative sample of U.S. youths born in 1980 through 1984. The NLSY97 sample covers 43 states and provides a wealth of useful information on household factors that may be correlated with labor market behavior and educational experiences. It also tracks the working hours of youths on a weekly basis from age 14 onward. The tracking data also include information on whether and when respondents obtained a high school diploma, how well they performed in school, and whether they went to college.

By May 31, 2002, roughly two-thirds of the NLSY97 sample was old enough to have graduated from high school, and roughly 77% of those had actually graduated. We are interested in assessing how measures of child labor intensity and school performance are related to state child labor and truancy laws, holding constant Z_{ij} that should affect schooling and employment decisions.

The vector Z_{ij} includes measures of child ability, gender and race, and the socioeconomic and demographic attributes of the parents. Child ability is measured by 8th grade GPA. Poor academic preparation for high school may lower the returns to schooling and increase the likelihood of working at a young age. Previous studies have shown that a child's performance in school is strongly influenced by the child's parents. We control for the presence of two biological parents in the household and households with at least one missing parent. We also control for the education of the father and mother and for aggregate household income, all of which would be expected to raise household demand for schooling. The impact of these variables on child labor is less certain in the literature. Finally, we include a dummy variable for rural residence, as there may be more demand for child labor in rural areas, particularly with regard to agricultural work.

B. Descriptive analysis

B.1. Employment experience of high school-aged youth

Table 2 reports the school year employment rate and average working hours of eventual high school graduates. Samples are further broken down by demographic and community characteristics. American youths are more likely to work as they get older. Nineteen percent of children work in their 14th year at an average of 6.4 hours per week. Labor force participation dramatically increases to 61% by age 16, with average weekly hours worked rising to 11.6. There is a significant difference between boys' and girls' labor-force participation rates and cumulative working hours. At earlier age, boys are more likely to work, but the gap disappears by age 17. At all ages, however, boys work more hours. White children have higher labor force participation rates and work more hours than either Black or Hispanic youth. Those with the highest 8th grade GPAs are the most likely to work, but they work fewer hours per week.

Child labor force participation differs significantly by parental attributes. Children with two-biological parents in the household are more likely to work. Children worked least if their parents did not complete high school. They worked most if their parents had some college training. However, children with more educated parents tend to work more modest hours. Students in households with lower income might be expected to work more in order to pay for additional schooling or to finance current consumption. However, youth in the lowest income households are the least likely to work. Youth in wealthier households participate most in the labor market, but they work fewer hours than average. Rural youth are modestly more likely to work than their urban counterparts. The rural-urban gap in average cumulative hours shrinks with age.

B.2 Illegal youth employment

To assess the effectiveness of child labor regulations, we need to know how many youth are working illegally. We define a work week as illegal if a child worked an excessive number of hours using the FLSA standards as a gauge. The most common violation is working beyond the legal hours. By federal standards, 14-and 15-year-olds are regarded as working illegally if they worked over 40 hours per week during the summer or more than 18 hours per week when school is in session. Following the classification used in the model, Table 3 shows the distribution of employment states for youth aged 14 and 15 between 1994 and 1997. Work states $W_{ij} = 2,3$ indicate working in violation of FLSA maximum hours limits. For high school graduates, 3% of 14-year-olds worked illegally between 1 and 5 weeks during the school year or 17% of working 14-year olds. A similar proportion violated the law more than 5 weeks of the school year. By age 15, the proportion of regularly violating the hours' restrictions during the school year rises to 9% or nearly one-third of working 15-year-olds. Dropouts violated FLSA guidelines at the almost same rate. However, conditional on working, dropouts were more likely to work in violation of FLSA hours limits. Violations were less common in summer months than during the school year, reflecting the much higher hours limits during school vacations.[8]

Table 4 presents information on the incidence of illegal work for 14-15 year old children by whether they ultimately dropped out of or graduated from high school. The information is further broken down by demographic characteristics. Children who eventually dropped out of school were significantly less likely to work than those who eventually graduated from high school. However, graduates worked more commonly within federal hours guidelines. White and Hispanic dropouts are more likely to violate FLSA hours limits, but for the most part, the demographic distribution of illegal workers is similar between dropouts and graduates.

2.6. Empirical Results

A. Are state child labor laws effective in limiting child labor?

Taking the state child labor laws as exogenous, we examine whether variation in the rigor of the laws affects employment intensity or intensity of violations federal labor laws at age 14 and 15 shown in equation (1). Table 5 contains the estimates from the ordered probit equation for youth employment at ages 14 and 15 among high school graduates.

The first three columns of Table 5 show that the estimated coefficients on the dummy variables related to rigor of state child labor laws are insignificant for youth employment status at age 14. Neither work permit requirements nor truancy laws alter the intensity of work for 14-year-olds. The same conclusions hold for 15-year-olds. It does not appear that

[8] The percent of youth who violated FLSA standards in this study is greater than reported by Kruse and Mahony (2000) based on the Current Population Survey (CPS). This is to be expected because the NLSY97 reports employment over 52 weeks rather than only in the last week as in the CPS. Also, the CPS relies on a primary respondent other than the youth him or herself to collect data on youth employment. The NLSY97 survey is always answered by youths themselves. Parents may not always be aware of the children's working hours, especially if the employment is sporadic or occasionally involves excessive hours.

state child labor regulations affect whether a child works, how much a child works, or whether the child works in violation of federal guidelines. Of the other factors, youth are more likely to work in violation of federal guidelines if they are white, male, rural, and from wealthier households.

To obtain a clearer idea of the impact of state child labor laws on probability of each work intensity state, we evaluate the probabilities of each outcome at sample means.[9] We estimate the probabilities alternating D^W (or D^S) = 1 and D^W (or D^S) = 0, all other variables held at their averages.[10] When D^W =0, the predicted probabilities are Pr ($W_{ij} = 0$) = 0.82, Pr ($W_{ij} = 1$) = 0.12, Pr ($W_{ij} = 2$) = 0.03 and Pr ($W_{ij} = 3$) = 0.03. The comparable probabilities when D^W =1 are 0.82, 0.12, 0.03 and 0.03 with small change in third decimal place. On the basis of this procedure, Table 6 summarizes the marginal effect of placing more stringent state child labor laws on work intensity. More stringent work permit requirements reduce the incidence of legal and illegal work by less than one percentage point. The same lack of substantial change in labor supply choices can be seen contrasting the presence and the absence of stringent state compulsory attendance laws. Controlling for other demographic factors, the predicted probability of working in violation of the FLSA is decreased by less than 1% by imposing more stringent compulsory attendance laws.

It is possible that the combination of constraints on child labor may matter, even when no individual policy appears to affect choices (Moehling, 1999). We report the change in probability of each employment state when both policies are operative compared to neither policy being in effect. The combined policies lower the likelihood of working by only 2

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[9] Our derivations are based on Greene (1997).
[10] See Appendix 4 for detailed outcomes.

percentage points and decrease the likelihood of frequent federal hours violations by less than one percentage point. Nearly identical results are found for 15 year olds. On the whole, state work permit requirements and compulsory school attendance laws change child labor patterns only marginally. It is difficult to believe that these modest effects alter the time available for schooling by an economically important amount.

B. Are state child labor laws effective in raising schooling attainment?

Child labor laws aim to protect youth from work that hinders their education. Table 7 report estimates of equation (3). Our measures of schooling outcomes include high school grade point average and completion and the choice to attend college. Requiring a work permit under age 18 does not seem to affect the probability of completing high school, nor does it affect high school GPA. It does raise the probability of attending college by 3 percentage points at the 10% significant level. Compulsory attendance laws that require youth to stay in school through ages 17 or 18 have small positive effects on high school GPA. More stringent compulsory attendance laws raise high school GPA by 0.06 or 2%. State compulsory attendance laws have no discernable effect on the probability of attending college. The combined effect of those two state laws on schooling attainment is found only on high school GPA in a significant level.

The rest of the effects are sensible. Students are more likely to complete high school and attend college if they have a high 8^{th} grade GPA, high household income, well-educated parents, and with both parents present in the home.

C. Are federal hours guidelines effective in raising schooling attainment?

It appears that state laws are marginally effective in raising schooling outcomes even if they do not affect child labor supply decisions. This begs the question of whether hours guidelines are set effectively so as to ensure children's schooling does not suffer. To examine this question, we estimate equation (4). Dummy variables indicate three employment status measures, ($W_{ij} = 1, 2, 3$) with non-workers ($W_{ij} = 0$) as the reference group. The results are given in Table 8.

The reference state is not working ($W_{ij} = 0$). Compared to children not working, we find that children working within FLSA limits have a greater likelihood of completing high school. However, those frequently working in violation of FLSA are no less likely to complete high school than are children who do not work at all. There is no discernible effect of child labor patterns on high school GPA or the probability of going to college. Overall, there is no strong consistent evidence that children working hours in excess of the federal hours guidelines have inferior schooling outcomes relative to children who do not work at all. This suggests that the federal guidelines are not well targeted to limit types of child labor that hinder academic outcomes.

Several papers have used variation in child labor regulations across states to identify potentially endogenous hours of work in equations explaining schooling outcomes. The weak power of state labor regulations to explain variation in the probability of violating FLSA hours guidelines require that we interpret school outcome equations that use state labor laws as instruments with considerable caution. Nevertheless, we report the results in Table 9 which use the predicted probability that the child repeatedly violates FLSA hours guidelines, Pr($W_{ij} = 3$), as the measure of child work while in school. The measures of schooling outcomes are not significantly affected by higher predicted probability of FLSA hours violations, consistent with our findings from Table 8.

2.7. Conclusion

If restrictions on child labor are useful, they should be tied to measurable employment status or academic outcomes. Our study show that more stringent state child labor laws requiring work permit under age 18 and mandating that children stay in school through age 17 or 18 years have almost no impact on labor market entry decisions or the frequency of working hours in violation of federal labor law. In addition, youth whose work hours exceed federal guidelines do not have inferior schooling outcomes to teens who do not work at all. These findings suggest that state labor laws do not have strong effects on youth labor supply choices and that hours restrictions are not well supported by evidence on adverse impacts of work hours on schooling.

State truancy and work permit regulations do have small positive effects on high school academic performance, the likelihood of completing high school, and the likelihood of entering college. However, in all cases the effects are smaller than 3%. Past studies have shown that these laws have had more substantial effects on schooling decisions historically. Variations in state employment and truancy laws have played a prominent role in studies of returns to schooling. Historically, changes in federal and state labor laws have been found to have important effects on youth schooling and labor supply decisions. Consequently, these laws have proven useful as exogenous factors shifting years of schooling to correct for endogeneity in years of schooling completed. Our findings suggest that these laws are much weaker instruments for current educational and labor supply decisions than they may have been historically.

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Table 1. Effect of state characteristics on the rigor of state child labor laws using probit analysis (N=51)

State characteristics	State child labor laws: Work permit requirement under age 18 $(D^w = 1)$	State child labor laws: Compulsory schooling attendance above age 16 $(D^s = 1)$
Log of state per capita income	2.315	-2.229
	(1.726)	(1.572)
State union density	.029	.002
	(.037)	(.036)
State minimum wage above FLSA standard	-.108	.622
	(.535)	(.510)
Constant	-24.369	22.163
	(17.231)	(15.652)
Log-likelihood	-28.317	-33.105
Pseudo R2	.083	.042

Note. Standard errors are in parenthesis.

Table 2. Percent of high school graduates employed while ages 14 to 17 in 1994-2001 and average weekly hours worked of working participants during the school year by individual characteristics (N=3384)

Characteristics	Age14	Age15	Age16	Age17	Age14-17
Total	18.9	29.3	60.5	73.3	81.7
	(6.4)	(8.2)	(11.6)	(16.0)	(6.8)
Gender					
Female	14.3	26.3	59.3	73.5	80.6
	(5.7)	(7.4)	(11.3)	(15.8)	(5.9)
Male	24.1	32.6	61.8	73.0	82.9
	(7.0)	(8.9)	(11.9)	(16.3)	(7.2)
Race or Ethnicity					
Black	11.1	19.6	50.6	64.7	73.8
	(5.5)	(7.6)	(12.2)	(15.3)	(6.2)
Hispanic	14.7	20.2	48.7	64.8	73.1
	(5.0)	(7.3)	(11.2)	(15.4)	(6.0)
White	23.4	36.0	68.2	79.4	87.5
	(6.9)	(8.4)	(11.6)	(16.4)	(7.3)
8th Grade GPA					
Less than 2.50	18.3	27.8	59.5	72.3	81.4
	(5.9)	(7.6)	(11.8)	(16.1)	(6.7)
2.51 – 3.50	18.2	29.0	60.2	73.9	81.6
	(6.5)	(8.2)	(11.9)	(16.6)	(7.0)
3.51 – 4.00	20.9	31.4	62.2	73.3	82.1
	(6.9)	(8.7)	(10.7)	(15.0)	(6.7)
Family Structure					
Two-biological parents	21.5	30.9	61.7	73.7	82.5
	(6.3)	(8.2)	(11.3)	(15.6)	(6.8)
Not Two-biological parents	14.9	26.8	58.6	72.7	80.5
	(6.7)	(8.2)	(12.1)	(16.7)	(6.9)

Note. Average hours worked per week is computed by dividing cumulative hours of work during school year at the age into the number of weeks in the school term. Weekly hours worked is in parenthesis.

Table 2. (Continued)

Characteristics	Age14	Age15	Age16	Age17	Age14-17
Father's education					
HS dropout	16.5	22.0	52.5	69.5	75.8
	(5.7)	(8.3)	(13.3)	(16.2)	(6.9)
HS graduate	21.5	31.5	63.9	76.6	84.1
	(7.4)	(8.6)	(12.2)	(17.3)	(7.5)
Some College	22.1	34.0	67.3	78.3	86.8
	(6.9)	(8.8)	(11.9)	(16.9)	(7.4)
College and higher	20.8	32.0	63.0	73.5	82.9
	(5.5)	(7.0)	(9.7)	(13.9)	(5.9)
Mother's education					
HS dropout	13.1	20.4	48.3	63.0	71.7
	(6.8)	(8.6)	(12.0)	(16.0)	(6.5)
HS graduate	20.6	31.3	63.0	76.7	83.7
	(6.8)	(8.8)	(12.4)	(17.4)	(7.6)
Some College	18.9	32.0	64.5	79.7	86.2
	(5.9)	(8.4)	(11.5)	(15.7)	(6.9)
College and higher	20.8	29.5	60.7	70.7	81.5
	(5.8)	(6.8)	(10.1)	(13.8)	(5.9)
Household Income					
Less than $ 25,000	14.5	22.2	51.1	64.7	73.4
	(5.8)	(8.1)	(11.2)	(15.1)	(6.2)
$25,000 - $44,999	18.9	28.2	58.0	73.0	81.9
	(7.2)	(8.2)	(12.2)	(17.0)	(7.1)
$45,000 - $74,999	19.2	31.0	66.1	76.7	84.1
	(6.7)	(8.6)	(11.9)	(16.8)	(7.4)
$75,000 or more	22.5	34.7	65.2	77.2	86.0
	(6.0)	(7.8)	(11.1)	(15.1)	(6.7)
Residence Area					
Rural	22.4	31.4	61.1	73.8	81.9
	(7.6)	(9.2)	(12.2)	(16.3)	(7.3)
Urban	17.4	28.4	60.2	73.1	81.6
	(5.9)	(7.7)	(11.4)	(15.9)	(6.6)

Table 3. Distribution of 14- and 15-year-olds' employment status of eventual high school dropouts and high school graduates in 1994-1997 (N=3384)

	$W_{ij}=0$: Not Working		$W_{ij}=1$: Working within FLSA hours limits		$W_{ij}=2$: Occasionally violating FLSA hours limits		$W_{ij}=3$: Frequently violating FLSA hours limits	
(All children)	Dropouts	HS graduates	Dropouts	HS graduates	Dropouts	HS graduates	Dropouts	HS graduates
School months								
At age 14	85.3	81.1	7.6	12.5	4.1	3.3	3.3	3.2
At age 15	76.4	70.7	9.2	15.8	4.8	4.8	9.7	8.7
Summer months								
At age 14	84.1	80.4	14.3	18.6	1.0	0.4	0.7	0.6
At age 15	77.7	68.8	20.6	29.1	0.2	0.8	1.6.	1.4
(Working children)	Dropouts	HS graduates	Dropouts	HS graduates	Dropouts	HS graduates	Dropouts	HS graduates
School months								
At age 14	NA	NA	50.6	66.0	27.5	17.2	22.0	16.7
At age 15	NA	NA	38.9	54.0	20.1	16.4	41.0	29.6
Summer months								
At age 14	NA	NA	89.7	95.0	6.2	2.0	4.1	3.0
At age 15	NA	NA	91.9	93.1	0.7	2.6	7.4	4.4

Table 4. Distribution of school-year employment status of eventual high school dropouts and high school graduates while their age 14 and 15 in 1994-1999 (N_{drop}=608 and N_{hs}=3384)

	$W_{ij}=0$: Not working			$W_{ij}=1$: Working within FLSA hours limits			$W_{ij}=2$ or 3: Violating FLSA hours limits		
	Dropouts	HS Graduates	[c].	Dropouts	HS Graduates	[c].	Dropouts	HS Graduates	[c].
Total	71.6	66.6	*	11.3	17.7	**	17.1	15.7	
Gender									
Female	74.9	70.5	**	9.2	15.7	***	15.9	13.8	
Male	69.0	62.2		13.0	19.9	***	18.0	17.9	
Race or Ethnicity									
Black	80.7	76.2		9.9	9.7		9.4	14.2	*
Hispanic	78.8	74.5		6.4	12.8	***	14.8	12.8	***
White	60.9	59.6	**	15.8	22.9		23.3	17.4	**
8th Grade GPA									
Less than 2.50	74.8	68.0	***	11.4	17.3	***	13.8	14.7	
2.51 – 3.50	60.8	66.8	*	12.4	16.7		26.9	16.5	***
3.51 – 4.00	90.5	64.4	**	4.8	19.9	*	4.8	15.7	
Family Structure									
Two-biological parents	66.4	65.1		14.3	19.8	**	19.3	15.1	*
Not two-biological parents	74.3	69.1	**	9.8	14.4	***	15.9	16.6	
Father's Education									
HS dropout	72.7	72.8		11.5	12.3		15.8	15.0	
HS graduate	68.4	63.2		12.0	18.6	*	19.7	18.2	
Some College	57.9	61.3		15.8	22.4		26.3	16.4	*
College and higher	60.0	64.5		15.0	22.3		25.0	13.2	
Mother's Education									
HS dropout	76.6	76.4		6.3	10.2	*	17.1	13.5	
HS graduate	69.8	63.0	**	13.2	18.2	*	17.0	18.8	
Some College	67.0	64.5		19.4	20.4		13.6	15.1	
College and higher	61.1	65.7		16.7	20.3		22.2	14.1	

Note. [c] Test of difference in means between high school dropout and high school graduate samples.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 4. (continued)

	$W_{ij}=0$: Not working			$W_{ij}=1$: Working within FLSA hours limits			$W_{ij}=2 \text{ or } 3$: Violating FLSA hours limits		
	Dropouts	HS Graduates	[c].	Dropouts	HS Graduates	[c].	Dropouts	HS Graduates	[c].
Household Income									
Less than $ 25,000	77.7	74.0		9.5	12.6		12.7	13.4	
$25,000 - $44,999	63.6	67.6		11.4	14.8		25.0	17.5	**
$45,000 - $74,999	64.7	64.9		17.2	19.3		18.1	15.8	
$ 75,000 or more	61.4	60.6		13.6	23.7		25.0	15.9	
Residence Area									
Rural	71.3	63.7	*	13.5	17.7		15.2	18.6	
Urban	71.6	67.8	*	10.7	17.6	*	17.6	14.6	*

Table 5. Ordered probit estimation of employment status on the rigor of state child labor laws and control variables

Variable	Employment status at age 14			Employment status at age 15		
Work permit requirement	-.023		-.028	-.019		-.022
under age 18 $(D^W = 1)$	(.049)		(.049)	(.044)		(.044)
Compulsory schooling attendance		-.084	-.085		-.034	-.036
above age 16 $(D^S = 1)$		(.051)	(.051)		(.045)	(.045)
8th grade GPA	.012	.011	.010	.011	.010	.010
	(.037)	(.036)	(.037)	(.033)	(.033)	(.033)
Male	.333***	.334***	.333***	.167***	.167***	.167***
	(.050)	(.050)	(.050)	(.045)	(.045)	(.045)
Black	-.348***	-.344***	-.344***	-.410***	-.404***	-.405***
	(.070)	(.070)	(.070)	(.061)	(.061)	(.061)
Hispanic	-.245***	-.227***	-.225***	-.412***	-.406***	-.404***
	(.073)	(.074)	(.074)	(.067)	(.068)	(.068)
Urban	-.110**	-.109**	-.109**	-.021	-.021	-.021
	(.054)	(.054)	(-.054)	(.049)	(.049)	(.049)
Log household income(10,000$)	.003	.003	.003	.012**	.011**	.011**
	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)
Father education	-.002	-.002	-.002	-.001	-.001	-.001
	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)
Mother education	-.002	-.002	-.003	-.009	-.009	-.010
	(.007)	(.007)	(.007)	(.006)	(.006)	(.006)
Broken family	-.132	-.132	-.134	.064	.065	.063
	(.072)	(.071)	(.072)	(.063)	(.063)	(.063)
Constant	-.820	-.784	-.765	-.459	-.449	-.434
μ_1	.656***	.656***	.656***	.570***	.570***	.570**
	(.030)	(.030)	(.030)	(.023)	(.023)	(.023)
μ_2	.998***	.998***	.999***	.829***	.830***	.830**
	(.041)	(.041)	(.041)	(.028)	(.028)	(.028)
Log-Likelihood	-2143.2	-2472.7	-2141.8	-2969.5	-2969.3	-2969.2
Pseudo R2	.026	.026	.026	.018	.018	.018
N	3384	3384	3384	3384	3384	3384
Test of H_0: two state laws are not			Chi2 = 3.03			Chi2 = .81
jointly significant			p =.220			p =.666

Note. Standard errors are in parenthesis. *** Significant at 1% level, ** Significant at 5% level,* Significant at 10% level.

Table 6. Marginal effect of rigor of state child labor law on employment status

	$W_{ij}=0$: Not working	$W_{ij}=1$: Working within FLSA hours limits	$W_{ij}=2$: Occasionally violating FLSA hours limits	$W_{ij}=3$: Frequently violating FLSA hours limits
At age 14				
$(D^W=1)-(D^W=0)$	.006	-.004	-.001	-.002
$(D^S=1)-(D^S=0)$	.023	-.013	-.005	-.006
$(D^W=1$ & $D^S=1)-(D^W=0$ & $D^S=0)$	.031	-.017	-.006	-.007
At age 15				
$(D^W=1)-(D^W=0)$	.007	-.003	-.001	-.003
$(D^S=1)-(D^S=0)$	.013	-.005	-.002	-.006
$(D^W=1$ & $D^S=1)-(D^W=0$ & $D^S=0)$	.021	-.008	-.004	-.009

Note. D^W and D^S are dummy variables reflecting the rigor of state child labor laws in terms of work permit requirement and compulsory school attendance respectively.

Table 7. Estimates of state child labor laws on highs school completion, college entry and high school GPA

Variables	High school completion[1]	College entry[1]	High school GPA[2]
Work permit requirement under age 18 ($D^w = 1$)	.013	.030*	-.005
	(.009)	(.017)	(.019)
Compulsory schooling attendance above age 16 ($D^s = 1$)	.012	-.003	.062***
	(.009)	(.018)	(.019)
8th grade GPA	.107***	.262***	.611***
	(.007)	(.013)	(.013)
Male	-.015*	-.068***	-.115***
	(.009)	(.017)	(.019)
Black	.036***	.066***	-.116***
	(.009)	(.022)	(.025)
Hispanic	.020*	-.002	-.097***
	(.011)	(.025)	(.027)
Urban	-.017*	.054***	-.066***
	(.010)	(.020)	(.021)
Log household income ($10,000)	.014***	.028***	.011***
	(.002)	(.003)	(.002)
Father education	.002**	.003*	.006***
	(.001)	(.002)	(.002)
Mother education	.006***	.017***	.005**
	(.001)	(.002)	(.002)
Broken family	-.047***	-.077***	-.016
	(.013)	(.024)	(.027)
Constant			.962***
			(.058)
R^2			0.442
Pseudo R^2	0.235	0.211	
N	3992	3992	3992
Test of H_0: two state laws are not jointly significant	Chi2 = 4.06	Chi2 = 3.18	F = 5.36
	p =.132	p =.204	p =.005

Note. [1] Probit regression for marginal effect [2] OLS regression
Standard errors are in parenthesis. *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level..

Table 8. Estimates of employment status on high school completion, college entry and high school GPA

Variables	High school completion[1]	College entry[1]	High school GPA[2]
A. Employment status at age 14			
$W_{ij} = 1$: Working within FLSA hours limits	.037*** (.011)	.035 (.027)	.011 (.029)
$W_{ij} = 2$: Occasionally violating FLSA hours limits	-.058** (.031)	.005 (.047)	-.066 (.052)
$W_{ij} = 3$: Frequently violating FLSA hours limits	.007 (.023)	.003 (.048)	-.024 (.053)
B. Employment status at age 15			
$W_{ij} = 1$: Working within FLSA hours limits	.025** (.012)	.032 (.025)	.020 (.027)
$W_{ij} = 2$: Occasionally violating FLSA hours limits	-.002 (.020)	.074* (.039)	-.026 (.044)
$W_{ij} = 3$: Frequently violating FLSA hours limits	-.013 (.016)	-.039 (.031)	-.024 (.033)

Note. [1] Marginal effects are reported from a probit regression
[2] OLS regression.
Group of students who didn't work at all during the time is used as a reference.
All regressions included the other demographic variables used in Table 5.
Standard errors are in parenthesis. *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 9. Estimates of employment status on high school completion, college entry and high school GPA using index value

	High school completion[1]	College entry[1]	High school GPA
Predicted index value for working at age 14	.427	-.147	-.794***
	(.46)	(.08)	(.42)
R^2			.441
Pseudo R^2	.234	.210	
Predicted index value for working at age 15	-.065	.067	-1.327
	(.08)	(.04)	(.82)
R^2			.441
Pseudo R^2	.234	.210	

Note. [1] Marginal effects are reported from a probit regression

[2] OLS regression.

|Z| statistics are reported in parenthesis.

All regressions included the other control variables used in Table 5.

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 1. Child labor provisions in FLSA

Age	Permissible jobs	Hours of work	Times of day
13 or younger	Casual free-lance jobs such as babysitting and delivering newspapers	NA	NA
14 and 15	Non-manufacturing, non-mining, non-hazardous jobs[1]	Up to 3 hours on a school day and 18 hours in a school week; up to 8 hours on a non-school day and 40 hours in a non school week	Between 7am and 7pm except from June 1 through Labor Day, when evening hours are extended to 9 pm
16 and 17	Non-hazardous jobs	No restrictions	No restrictions

Age	Permissible jobs	Hours of work	Times of day
Under 12 years	Jobs on farms owned or operated by parent(s) or non-hazardous jobs on farms	Outside of school hours	With a parent's written consent or on the same farm as the parent(s)
12 and 13	Non-hazardous jobs	Outside of school hours	With a parent's written consent or on the same farm as the parent(s)
14 and 15	Non-hazardous jobs	Outside of school hours	
16 and older	Any jobs	Unlimited	

Note. [1] For example, occupations involving transportation, construction, warehousing, or communication, or occupations involving the use of power-driven machinery are regarded as hazardous jobs.

Appendix 2. Distribution of states across age of work permit requirement

Age required for work permit	States affected	Total number
No	Arizona, Florida, Idaho, Kentucky, Montana, Nevada[1], Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Wyoming	13
Under age 16	Arkansas, Colorado, Connecticut, Hawaii, Illinois, Iowa, Kansas, Maine, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Mexico, North Dakota, Ohio, Oklahoma, Rhode Island, Vermont, Virginia, West Virginia	22
Under age 18	Alabama, Alaska[2], California, Delaware, District of Columbia, Georgia, Indiana, Louisiana, Maryland, Michigan, New Jersey, New York, North Carolina, Pennsylvania, Washington, Wisconsin	16

Note. [1]. Working at under age 14 is required work permit. Since this study deals with working of age 14 and older, this state comes under no requirement.

[2] Under age 17 or under age 19 if employer licensed to sell alcohol. Under considering the weight of those two terms, this state is included in this category.

Appendix 3. Distribution of states across age of legal dropout

Age allowed to leave school	States affected	Total number
Age 16	Alabama, Alaska, Arizona, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Rhode Island, South Dakota, Vermont, West Virginia, Wyoming	29
Age 17	Arkansas, Maine, Mississippi, Nevada, Pennsylvania, South Carolina, Tennessee	7
Age 18	California, District of Columbia, Hawaii, Indiana, Louisiana, Nebraska, New Mexico, Ohio, Oklahoma, Oregon, Texas, Utah, Virginia, Washington, Wisconsin	15

Appendix 4. Marginal effect of rigor of state child labor law on employment status

	$W_{ij} = 0$: Not Working	$W_{ij} = 1$: Working within FLSA hours limits	$W_{ij} = 2$: Occasionally violating FLSA hours limits	$W_{ij} = 3$: Frequently violating FLSA hours limits
At age 14				
$D^W = 0$	.816	.124	.031	.029
$D^W = 1$	.823	.120	.030	.027
$D^S = 0$	.809	.128	.033	.031
$D^S = 1$	.832	.115	.028	.025
$D^W = 0$ & $D^S = 0$	.805	.130	.033	.032
$D^W = 1$ & $D^S = 0$	.813	.126	.032	.030
$D^W = 0$ & $D^S = 1$	.829	.117	.029	.026
$D^W = 1$ & $D^S = 1$	.836	.113	.027	.024
At age 15				
$D^W = 0$	.710	.159	.047	.084
$D^W = 1$	.717	.157	.046	.081
$D^S = 0$	.708	.160	.047	.085
$D^S = 1$	.720	.155	.045	.079
$D^W = 0$ & $D^S = 0$	.703	.162	.048	.087
$D^W = 1$ & $D^S = 0$	.711	.159	.047	.083
$D^W = 0$ & $D^S = 1$	.717	.157	.046	.081
$D^W = 1$ & $D^S = 1$	.724	.154	.045	.077

Note. D^W and D^S are dummy variables reflecting the rigor of state child labor laws in terms of work permit requirement and compulsory school attendance respectively.

Appendix 5. Definition of variables and summary statistics (N=3992)

Variables	Definition	Mean	Std.Dev.	Min	Max
Dependent					
HS complete	Dummy: one if having completed high school, zero if otherwise	84.7	.359	0	1
HS GPA	Overall marks they received from the 9th to the 12th grade. It ranged from 1(below D) to 8(Almost A) and translated into 4.0	2.86	.783	.5	4
College entry	Dummy: one if having attended college, zero if otherwise	.572	.495	0	1
Work status14	Employment intensity ordered response representing progressively higher values at age 14	.280	.678	0	3
Work status15	Employment intensity ordered response representing progressively higher values at age 15	.508	.935	0	3
Independent					
Work permit	Dummy: one if state required work permit under 18, zero if otherwise	.503	.500	0	1
School leave	Dummy: one if state required students to stay above 16, zero if otherwise	.463	.499	0	1
8th grades	Overall marks they received at 8th grade. It ranged from 1(below D) to 8(Almost A) and translated into 4.0 scale	3.04	.755	.5	4
Male	Dummy: one if male, zero if female	.481	.500	0	1
Black	Dummy: one if black, zero if otherwise	.246	.431	0	1
Hispanic	Dummy: one if Hispanic, zero if otherwise	.190	.392	0	1
Urban	Dummy: one living in urban areas, zero if living in rural areas	.715	.452	0	1
HH income	Average household income during the last 5 years (10,000dollars)	5.44	4.57	0	32.9
Father education	Biological father or residential father's highest education level It ranged from 1(1st grade) to 20(8th year college)	13.1	3.26	2	20
Mother education	Biological mother or residential mother's highest education level It ranged from 1(1st grade) to 20(8th year college)	12.8	2.95	1	20
Broken family	Dummy: if there is at least one missing biological parents, zero if students living with both biological parents.	.439	.496	0	1

Chapter 3. High School Employment, School Performance, and College Entry

Abstract

The proportion of U.S. high school students working during the school year ranges from 23% in the freshman year to 75% in the senior year. This study estimates the effects of working while in school on probability of dropout, high school grade point average, and the probability of attending college. Variation in individual date of birth and in state truancy laws along with the strength of local demand for low-skill labor are used as instruments for endogenous work hours during the high school career. Instrumental variable estimates indicate that working more hours in high school does not affect high school academic performance. However, increased high school work intensity raises the likelihood of completing high school but lowers the probability of going to college. These results are similar for boys and girls, and so working in school does not explain the gap in college entry between men and women.

3.1. Introduction

It is common for high school students in the United States to work during the school year.[11] Data from the National Longitudinal Survey of Youth 1997 (NLSY97) indicate that over the 1997-2003 period, the percentage of students who worked at least one week during the school year was 23% for freshmen; 45% for sophomores; 66% for juniors and 75% for

[11] Youth labor force attachment has been declining recently. The October labor force participation rate for 16- to 19-year-olds dropped over the 1994-2003 period from 50.4% to 42.2%. (Current Population Survey, Bureau of Labor Statistics)

seniors. This study examines whether working while in high school has any adverse consequences for school outcomes.

With such high percentages of working students, many must feel that combining school and work is innocuous or even beneficial to children, at least for older children. Nevertheless, governments appear to believe there are adverse consequences for working at younger ages. The federal government limits the number of hours that children under 16 can work, and state and local governments may place additional age and hours restrictions on working youth. However, other state governments have concluded that combining school and work enhances human capital development, and have implemented programs to encourage working while in school in the belief that such programs improve school-to-career transitions.

Academic studies have also yielded inconsistent evidence regarding the effect of high school work on academic performance. Some find no effect or even a positive effect of working on schooling outcomes while others find negative effects. One potential reason is that studies may have very noisy measures of work, basing the measure on only a representative week or else confusing work during the school year with work in the summer. Another problem is that working while in school and school performance are joint decisions, suggesting that estimates must correct for the likely endogeneity of working while in school. It is highly likely that if children are doing poorly in school, working hours will be cut or curtailed entirely.

Our study examines how cumulative work history while in high school affects schooling outcomes. We also use variation in state regulations regarding truancy ages and birth dates along with the strength of local demand for unskilled labor as plausible instruments to correct for endogenous work. We use several measures of schooling outcomes to examine whether conclusions regarding working while in school are sensitive to the outcome used in the analysis.

Our results indicate that more intensive employment experiences while attending high school have a small and insignificant effect on high school GPA. However, more intensive work has a small negative effect on probability of high school dropout and a large and statistically significant negative impact on the probability of attending college. A 10% increase in cumulative hours of work in high school leads to a 1.4% decreased likelihood of entering college. However, despite the fact that boys work more hours than girls in high school, girls' college entry is more adversely affected by work, and so working while in high school does not explain boys' lower likelihood of entering college.

The format of this paper is as follows. In the next section, we briefly review past research focusing on the relationship between employment experience during the school year and school performance. In section 3.3, we provide a model relating school performance and employment experience and validate instrumental variables. In Section 3.4, we describe the data and present descriptive statistics. In Section 3.5, we provide empirical results and sensitivity analysis. In Section 3.6, we summarize the results and discuss the policy implications as conclusions.

3.2. Past Research

Previous studies that ignore the potential endogeneity of working while in school have yielded mixed results about the effect on measures of school performance such as high school GPA, dropout, or continuing education after high school. Depending on the specification, Steinberg et al. (1982) found either no correlation or a positive correlation between working while in school and Grade Point Average. D'Amico (1984) concluded that school-year employment didn't affect high school rank. Warren et al. (2000) found that working during high school didn't affect curriculum choices or grades.

Modest working schedules do not appear to have serious consequences for academic achievement. Lillydahl (1990) reported that working up to 13.5 hours per week has a positive effect on GPA. Mortimer et al. (1996) found that high school seniors who worked less than 20 hours per week have higher grades compared to non-working students. D'Amico (1984) and Tienda and Ahituv (1996) reported that school work lowered the probability of dropping out.

Other studies found harmful effects of school-year work on high school academic performance, particularly with more intensive work schedules. Greenberg and Steinberg (1986) reported that working over 20 hours per week lowers high school GPA. Stern (1995) found that working more than 15 hours per week has a negative effect on grades, time spent on homework and the likelihood of completion high school. Eckstein and Wolpin (1998) found a small negative effect on academic performance of employment during high school. Some studies find racial or ethnic differences in the estimated effect of school-year work on academic achievements. Oettinger (1999) reported that working more than 20 hours per week lowers high school GPA of black and Hispanic youth but not of whites.

While hours of work can affect how well a student performs in school, school performance could also affect how many hours a student works.[12] Consequently, it is necessary to control for factors that affect the probability of working while in school in order

[12] Warren et al (1990) and Oettinger (1999) tested for but failed to find a reverse causal relationship in which academic performance influences on the employment during school. However, their tests of reverse causality will be biased if school attainment and work are jointly determined.

to determine how working affects school performance. Tyler (2003) examined the effect of working while in the last year of high school on twelfth-grade school test scores. When work is instrumented by variation in state child labor laws, he found a larger and significant decline in high school test scores relative to least squares estimates. Stinebrickner and Stinebrickner (2003) found similar effects on first-year college students. Random assignment of job types across students created exogenous variation in hours worked per week. They found that working three hours more per week cost about one-half of a grade point in first semester grades.

Neither of these papers examined whether there were cumulative effects of work while in school that might magnify or moderate the short-term relationship between work and achievement. In fact, most studies of high school work and academic performance used the number of hours worked per week over a short time period, typically in the week or month prior to the interview date. Of the exceptions, D'Amico (1984) generally found working regularly did not affect school performance regardless of work intensity. Ruhm (1997) found that working more intensively during high school increased earnings later in life. Both of these studies treat increased work intensity as exogenous, making it impossible to tell if their results might be due to unmeasured differences among students that cause some students to work more than others and that are also correlated with school performance or later earnings.

Recently, Rothstein (2007) found a small negative impact of current and past work while in school on high school GPA. Using a slightly different empirical strategy, our paper obtains results similar to Rothstein's findings on high school GPA. In addition, we find that working while in school has a small positive effect on the likelihood of completing high school but a larger negative effect on college entry. When evaluated at sample means, these findings are of similar magnitude for boys and girls.

3.3. Model

A. Theoretical background

A household is comprised of a parent and a teen-age child. The parent is assumed to make decisions so as to maximize household utility from consumption (C), and from the students' school performance (S). School performance is related to the child's capacity for future human capital investments and earnings, and so S could be viewed as an index of expected future child wealth. The parent selects child time allocation and current consumption so as to maximize utility $U=U(S, C)$. The child's time, normalized to unity, is divided between schooling (T_S) and child labor (T_W).[13] The child's school performance depends on the number of hours spent studying during high school and a vector of students' individual, household, and community characteristics (X). Numerous studies have shown that children with wealthier parents perform better in school. Child learning also depends on unobserved child's individual ability or motivation (μ_C) which may affect child time in school and work.

A high school student who works outside the household is assumed to earn an exogenous local market wage (W_C). The parent's labor supply is inelastic and yields an exogenous income (W_A). The earned household income $(W_A + W_C T_W)$ is used to purchase

[13] We are implicitly assuming that other uses of child time such as leisure consumption, household chores, or time spent on personal care (hygiene, sleeping, eating) are exogenous. Adding these activities into the model will not affect the reduced form solution to the optimization problem provided the opportunity cost of leisure or personal care time is the same as for schooling, and so we exclude these activities from the model for simplicity.

consumption goods at price normalized to unity and to purchase schooling that is priced at P_S.

The price of schooling is assumed to be altered by government policy on truancy age and age of school entry. For example, if state compulsory school attendance laws mandate that students living in the state must stay in school at an older age, the opportunity cost of schooling is lower because the option of working during school hours is removed. State policies on the minimum age at which children can enter school alter the average age and opportunity costs of schooling as well. Parents may be induced to send their children to private school to avoid age restrictions.

Incorporating these various elements, the parent's problem is to maximize

$$U = U(C, S) \tag{1}$$

subject to the household budget constraint

$$W_A + W_C T_W = C + P_S T_S \tag{2}$$

and the school performance production function

$$S = S(T_W, W_A, \mu_C, X). \tag{3}$$

Assuming interior solutions and considering child's time constraint, the tradeoff between household consumption and educational investments on child is described by[14]

$$W_C \frac{\partial U}{\partial C} = -\left(\frac{\partial U}{\partial S}\frac{\partial S}{\partial T_W} + \frac{\partial U}{\partial C} P_S\right). \tag{4}$$

The parent allocates child time to school so that the marginal utility from current consumption purchased by the last hour of child time spent working is equal to the marginal

[14] In addition, parents' concave utility function implies that educational production function has the usual properties: $s' > 0$ and $s'' < 0$ with respect to time spent on studying.

utility from the last hour of child time spent in school net of the lost utility from consumption. The solution of this problem yields a reduced form equation for child time spent in work:

$$T_W = T(W_A, W_C, P_S, X, \mu_C) . \tag{5}$$

B. Empirical strategy

Our empirical work focuses on the linear approximations to equations (3) and (5).

$$T_W = \alpha_0 + \alpha_A W_A + \alpha_C W_C + \alpha_P P_S + X^{'} \alpha_X + \varepsilon_T \tag{6}$$

$$S = \beta_0 + \beta_W T_W + \beta_A W_A + X^{'} \beta_X + \varepsilon_S \tag{7}$$

where the error terms will be of the form $\varepsilon_k = \gamma_k \mu_C + \xi_k ; k = T, S$. Errors will have a component related to unobserved abilities and a purely random component. Ordinary Least Squares (OLS) will only yield a consistent estimate of school-year work on school achievement, β_W in (7), if X and T_W and are uncorrelated with the error ε_S . But this will only happen if $\gamma_T = 0$ in (6), which is unlikely given that μ_C alters the optimal allocation of T_W in (5). For example, suppose that teens with better endowments of μ_C earn higher grade point averages. Suppose also that parents allocate child time to work activities only if they are doing well in school and so μ_C and T_W are positively correlated. Then the OLS estimate of the effect of work on high school GPA will be upward-biased. This could explain why some studies using OLS found no effect or even positive effects of school-year work on measured school achievement. Of course, the bias could go in the other direction if less able teens are more likely to work.

We use an instrumental variables strategy to address the estimation problem. The theory suggests that factors that shift the value of child time, W_C , or the price of child time in school, P_S, will be good candidates for factors that shift the likelihood a child works but that do not directly affect schooling performance.

C. Instrumental variables

The strength of the local market for low-skilled labor is measured by average county retail sector earnings, as reported by the Bureau of Economic Analysis, during the period when the student is in high school. Higher average retail earnings should induce more high school students to work part-time while in school. Cameron and Taber (2004), Black et al (2005) and Rothstein (2007) found that local low-skilled earnings can significantly affect years of schooling across areas and time periods. Compared to other industries, the retail industry has the advantage that earnings and employment are reported for almost every county and that it is a heavy user of youth employees.[15] As an example, eating and drinking establishments are the most common employers of high school aged youth (Rothstein, 2001).

We use variation in legal restrictions on child time across states to approximate variations in the cost of child time in school. Every state stipulates an age at which students can legally leave school. The longer a child is required to stay enrolled in school, the less time potentially available for work. Students in states with lower dropout ages might be expected to work more during high school, if only because a young truancy age makes it more difficult for authorities to assess whether a working child is legally out of school. Similarly, restrictions on the age at which children can work suggest that children who enter high school at a younger age are less likely to work while in school. The Fair Labor Standard

[15] A variety of industries were investigated for inclusion such as agriculture, wholesale trade, service and construction suggested by Cameron and Taber (2004).

Act (FLSA) restricts work opportunities for children under the age of 16.[16] Students who enter high school at older ages are not subject to the FLSA work limitations, although stricter state rules might still apply.

Similarly, the age at which a child enters high school may affect his decision to work. The expected age at grade 9 is computed based on the age entering 1st grade. In our sample, 68 % of students entered high school at age 14 and 25 % at age 15. All of these students can legally work while in high school and could drop out before completing high school, although when these laws take effect varies by age of the child and by the state in which the child resides. The legal drop out age by state is reported in Table 1 (National Center for School Engagement, 2003). Of the 43 states included in our sample, 26 states require students to remain in school until age 16; 5 states until age 17; and 12 states until age 18.

Because school and work entry decisions are related to a child's age, random variation in birth dates can affect the ages a child attends high school. If true, month of birth can affect the likelihood and intensity of working while in high school. Figure 1 shows the variation in the portion of students entering high school by ages 13 and 14, by birth month. Students born in the last quarter of the year are the most likely to enter high school by age 14 and many enter at age 13. Probability of early entry drops sharply for those born in the

[16] The Fair Labor Standard Act (FLSA) limits the number of hours and the type of work for 14- and 15- year olds. They may work outside school hours in various non-manufacturing, non-mining, non-hazardous jobs under the following conditions: no more than 3 hours on a school day, 18 hours in a school week, 8 hours on a non-school day, or 40 hours during a non-school week. Since age 14 is a typical starting age for high school, we can interpret the FLSA as allowing high school students to work with modest restrictions in terms of time and type of work.

months before the start of the school-year. Those born in September are 25 percent more likely to enter school before age 15 than are those born in August.[17]

3.4. Data

The main data source for this study is the 1997 National Longitudinal Survey of Youth (NLSY97) consisting of 8,984 individuals born between 1980 and 1984. We make use of data up to the 2002 survey, the last year for which data were available. To concentrate on students who could have completed high school, we restrict the sample to students who enrolled in grade 9 by 1998 and who were born before 1984. Observations with missing values in key variables of this study are also excluded. Our working sample includes 3380 youths who obtained a high school diploma and 607 high school dropouts.

The NLSY97 collects retrospective employment data from the interview date back to the preceding interview date. This data include the beginning and ending dates of all jobs, all gaps in work within the same job and usual hours spent at work on each job. Based on this information, we generated weekly hours of work for each student both during the school year and in the summer. For some of our analysis, we also used aggregated work hours over time.

The NLSY97 provides a wealth of useful information on household factors that may be correlated with labor market behavior and educational experiences. It includes gender, ethnicity, household income, family structure, parent's highest education level, school performance and county of residence. Our analysis utilizes the restricted-use geocoded edition of the NLSY97 to identify each student's county of residence. That allowed us to

[17] Angrist and Krueger (1991) and Rothstein (2007) also used timing of birth to help identify years of schooling and child labor, respectively.

merge in indicators of local county labor market conditions and state compulsory schooling attendance laws.

Table 2 reports weighted sample means of the variables used in the analysis, sorted by student status (high school dropouts; terminating high school graduates; and high school graduates who enter college). About 15% of the sample is high school dropouts; 28% ended schooling with the high school degree; and 56% entered college after completing high school. As one would expect, the high school graduate subset performs better in school. High school graduates had average GPAs of around 3.0, whereas dropouts had average GPAs of 2.1.[18] Employment intensity during the first two years of high school also differs between the two samples. On average, dropouts worked 180 hours more during the first two school years than did high school graduates who worked while in school. High school dropouts also worked around 85 hours more during the first summer of high school. Nevertheless, the summary data suggests other reasons why more intense work might be correlated with dropout. Dropouts come from poorer households than do high school graduates, and so the higher work hours of dropouts may reflect other observable or unobservable differences between the two samples.

3.5. Empirical Results

A. Labor supply while in high school

We are relying on our labor supply equation (6) to identify school-year working hours in our human capital production equation (7). We first demonstrate that our child labor supply shifters can significantly influence hours of work while in high school. Research has demonstrated

[18] The NLSY reports high school grades on a scale from 0 to 13. These scores correspond to approximate grades such as "mostly C" or "mixed A with B" and so on. These approximate grades were converted into a 4.0 scale. "Mostly C" is converted to 2.0 and "Mixed A with B" is converted to 3.5.

that instruments that are only weakly associated with the endogenous variables invalidate the estimation method (Bound et al. 1995). We regress cumulative hours of work during high school on the expected age at which students enter high school, the legal drop out age by compulsory schooling attendance laws in state, local average earnings per worker in retail industry during their high school year, month at which students were born, the square of the month, and a number of other control variables. For comparison purposes, the first column of Table 3 contains the regression incorporating only the vector of exogenous control variables.

The first and second rows in column 2 of Table 3 show month of birth has a quadratic relationship with hours of work during high school. Cumulative hours are decreasing in month of birth until June, but then increase for students born in the second half of the year. The difference apparently reflects differences across birth months in the probability of entering high school at ages where work is illegal. As shown in Figure 1, the probability if entering high school before age 15 rises from September through April and then falls thereafter. Entering high school at an older age has a dramatic effect on child labor supply: delaying age of entry by one year raises hours worked in high school by 50.7%. Black and Hispanic children are less likely to work than white children with similar home situations. However, poverty does influence child labor. Probability of working decreases as household income and parental education increase, while children from single-parent homes work more.

In the third column, legal dropout age is included. Individuals in states with truancy ages one year older work 12% fewer hours during high school. The fourth column shows that adding local earnings to the third column specification increases the model's explanatory power. Average county retail earnings of students' school year have a positive and significant effect on hours worked in high school. A 10% increase in average retail earnings increases cumulative hours of work while in school by 8% on average. The null hypothesis that the coefficients on the set of instruments used are jointly zero can easily be rejected with an *F*-statistic of 9.9, providing evidence that local labor market conditions and compulsory schooling attendance laws are related to the high school students' work.

It also appears that these instrumental variables are not directly correlated with school performance. Though it is not a definitive test, the fifth column of Table 3 provides the results when high school grade point average is regressed on individual characteristics and the instrumental variables used in this study. We failed to reject the null hypothesis that the instruments have no joint influence on grades at all levels of significance.

B. Impact of working while in school on school outcomes

Table 4 presents the OLS and IV estimates of β from equation (7). The estimated effect of employment on schooling outcomes is shown in the first row of each column. The OLS estimate of the direct academic performance effect of work during high school year is very small but statistically significant. It implies that a 10 % decrease in cumulative hours of work during high school would increase high school GPA by around 0.02.[19] As we mentioned earlier, OLS estimates would be biased from unobserved ability or measurement error of hours of work.

The IV estimates in the second column is obtained when labor supply during high school is instrumented with expected age entering high school, the month of birth, and the square of the month. It shows that the IV point estimate of having a part time job is about 100 percent larger than the OLS estimates in absolute value but is not significant. The literal

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[19] The calculation is based on Δ HS GPA $\cong$ $(\frac{\beta}{100})$ (%Δ Work hours).

interpretation is that a 10% in hours worked during high school lowers high school GPA by 0.039 points, although the estimate is not statistically significant. The same results are obtained when we use different sets of instruments.[20] Both OLS and IV estimates indicate that cumulative hours of work during high school do not greatly hamper high school academic performance.[21]

The results also show that, holding family background fixed, girls outperform boys by 0.25 points in high school GPA. Gaps of comparable magnitude are found between Whites and Blacks or Hispanics. Living with richer and better educated parents raises GPA substantially with an average 0.8 points difference between students with college educated parents compared to students with high school educated parents. To put the child labor effect in perspective, two years of parental education more than compensates for the lost GPA from working 10% longer hours in high school.

Since we have more instruments than endogenous variables, our model is over-identified. The test of over-identifying restrictions produces a χ^2 statistic of at most 3.81. Thus, we fail to reject the null hypothesis that the instruments are uncorrelated with the error term.

The same approach used above is applied to examine the effect of work during high school on the likelihood of attending college. Table 5 presents the probit estimates and two stage probit estimates. The marginal effects are reported as evaluated at the mean of each variable. The uncorrected estimate treating work hours as exogenous suggests that a ten

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[20] Various definitions of birth month were tried. For example, instead of numbering months starting in January, an alternative specification numbered the months starting in September to reflect the school year. Another alternative replaced the numbered months by a series of 11 birth month dummy variables. Results are invariant to the definition used. (See Appendix 1.a and 1.b for high school GPA and college entry respectively)

[21] We also found there is no different effect across male youth and female youth. (see Appendix 2)

percent increase in hours worked during high school decreases the probability of entering college by 0.2%, a statistically significant but numerically small effect.[22] The IV estimates obtained using a two stage probit correcting for the endogeneity of labor supply finds a more substantial effect. A 10 % increase in employment intensity during high school lowers the probability of college entry by about 1.4%.

Other things equal, women are 1.3 percent more likely to enter college than men. Blacks are 1.5% less likely to attend and Hispanics are 2.4% less likely to attend than comparable whites. College entry is more probable for urban residents, and for children in higher-income and more educated families.

C. The gender gap in schooling

Recently, boys have been less likely to continue on to college after their high school graduation than girls.[23] In our sample, 71% of female high school graduates entered college compared to 62% of their male counterparts.[24] In our sample, boys work more than girls while in high school. Can differential work histories explain some of the gender gap in college entry? To examine this question, we replicate our estimation procedure separately for boys and girls. The results are shown in Table 6.

Teenage work while in high school negatively affects college entry decisions for both boys and girls, but the effects are significantly different between the sexes. The marginal effect shows that a 10% increase in hours worked during high school lowers college entry by 1.7% for girls and by about 1.1% for boys. Consequently, the lower rate of college entry for boys is not caused by spending more time working.

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[22] The elasticity is computed by multiplying the marginal effect by a reciprocal of the average college entry probability which is 0.66.
[23] Women currently make up 57% of all college students.
[24] See Appendix 3 for summary statistics of high school graduates by gender.

D. Sensitivity analysis

A number of additional analyses were run to test the sensitivity of these results to the specification of the work intensity variables. In one set, we replaced cumulative hours of work during the school year with cumulative hours of work in the summer. Table 7 and Table 8 show the estimates of different sets of employment intensity measures on high school GPA and college entry respectively. For comparison purposes, we add the previous estimates obtained using cumulative hours worked during high school year. Results adding in work during the summer months did not alter conclusions, presumably because those who worked most in the school year also worked most in the summers.[25] Instrumented summer work hours had a negative but insignificant effect on GPA, and they reduced the probability of going to college by the same magnitude as when school year work hours were used.

We also used annual measures of school-year work rather than cumulative work hours across four years. In all cases, predicted work hours in the freshman, sophomore, junior and senior years failed to affect high school GPA. Annual school-year hours worked significantly lowers the probability of attending college in all four years with the largest negative effect from work hours during the freshman year. A 10% increase in employment intensity during 9th grade lower the probability of attending college by 2.6%. However, the coefficients in other years are only modestly smaller in magnitude.

Our college entry results were conditioned on having graduated from high school. There is a possibility that the possible selection problems due to dropouts are clouding our estimates of the impact of hours worked on college entry. To examine this, we estimated a

[25] Nearly 77% of freshmen who worked during the school year worked in the following summer. This percentage rises steadily with school- year grade: 80% of sophomores; 83% of juniors; 87% of seniors. (Source: Author's computations based on the sampled NLSY97)

multinomial logit model that measures the impact of school-year work during the first two years of high school on three choices, dropout, ending schooling after completing high school graduation, or entering college. In Table 9, we report the marginal effect of each independent variable on the probability of changing students' status relative to dropping out of school. Increasing instrumented cumulative hours of work in high school raises the likelihood of high school graduation but lowers the probability of attending college.[26] This seems to mimic the mixed message found in earlier studies regarding the impact of school-year work on academic performance. Child labor seems to be marginally good for high school graduation but marginally harmful for college entry.[27]

3.6. Conclusion

Although the teenage labor force participation rate has been declining in the United States, the majority of high school students work during the school year at some point in the four years of high school. Past studies have found mixed results regarding the impact of working in high school on academic outcomes. This study takes into account the endogeneity of the school-year labor supply decision and of the possibility of increasing damage from more intense work hours in assessing the impact on success in school. We show that the intensity of school-year work varies directly with the strength of the local retail sector and with the expected age at high school entry and inversely with the strength of state child labor and truancy regulations. We also found significant differences in work hours depending on the month of birth, presumably because the month of birth alters the probability of entering

[26] Similar results are obtained when we replicate this analysis separately by gender. (see Appendix 4)

[27] All the instruments pass standard overidentification tests. Probability of dropout is uncorrelated with all of the instruments except expected age of high school entry. Our results are the same whether we include or exclude expected age of high school entry.

high school at a younger age. Our results show that more intense work while in school does not affect high school academic performance and it actually has a small positive effect on the probability of completing high school. However, a ten percent increase in hours of work leading to a 1.4% reduction in the probability of attending college. Often working while in high school is defended as a means of earning money that could be used for further schooling, but on average, the income earned on school-year work might be destined for other purposes.

Several states have attempted to limit child labor beyond the federal limits. We found that those state restrictions do have a significant effect on the amount of time children in those states spend working during high school. As to the effectiveness of those laws in influencing human capital investments, it appears that they do raise the likelihood of going to college but they do not affect high school academic performance.

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Figure 1. Distribution of students who entered high school by age 14 and birth month

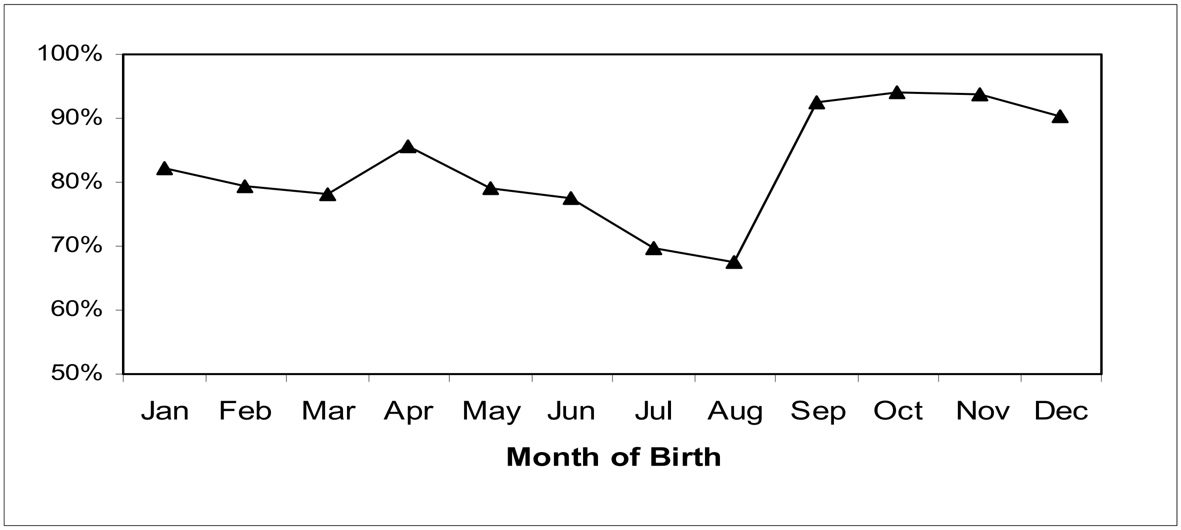

Table 1. Distribution of states and observations across legal dropout age

Age allowed to leave	Number of states affected	Stated affected	Number of observations affected
Age16	26	Alabama, Alaska, Arizona, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Jersey, New York, North Carolina, North Dakota, Rhode Island, South Dakota, Vermont, West Virginia	2037
Age17	5	Arkansas, Mississippi, Pennsylvania, South Carolina, Tennessee	423
Age18	12	California, District of Columbia, Indiana, Louisiana, New Mexico, Ohio, Oklahoma, Oregon, Texas, Virginia, Washington, Wisconsin	1537

Table 2. Summary statistics

	HS Dropouts (1)		Terminating HS graduates (2)		College attending (3)		Least HS graduate (2) + (3)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent								
HS GPA	2.12	0.80	2.70	0.67	3.13	0.66	2.99	0.70
College	NA	NA	NA	NA	1	0	0.66	0.47
Work HS	NA	NA	1429	1157	1172	947	1259	1029
Work Fr/Sop	657	707	554	608	442	544	480	569
Work Jun/Sen	NA	NA	1187	855	985	726	1053	778
Work Summer in Freshman	391	296	331	258	294	248	306	252
Independent								
Male	0.55	0.49	0.53	0.49	0.43	0.49	0.46	0.49
Black	0.29	0.45	0.26	0.44	0.22	0.41	0.23	0.42
Hispanic	0.23	0.42	0.22	0.41	0.15	0.36	0.18	0.38
Urban	0.76	0.42	0.67	0.46	0.71	0.44	0.70	0.45
HH income	30,307	26,279	43,464	30,374	66,356	51,837	58,717	47,056
Broken family	0.67	0.46	0.48	0.5	0.35	0.47	0.39	0.48
Father's education	11.2	2.9	12.0	3.0	13.9	3.1	13.3	3.2
Mother's education	11.3	2.8	11.9	2.7	13.4	2.8	13.0	2.9
Instrument								
Birth month	6.1	3.3	6.1	3.4	6.3	3.4	6.2	3.4
Expected age at grade 9	14.2	0.7	14.0	0.55	14.0	0.4	14.0	0.4
Legal dropout age	16.8	0.9	16.9	0.9	16.8	0.9	16.9	0.9
Local earnings	10,033	2,530	10,243	2,210	10,118	2,233	10,160	2,226
N	607		1128		2252		3380	
Weighted fraction	15.2%		28.2%		56.4%		84.6%	

Table 3. OLS regressions for hours of work during the school year and high school GPA including control variables and instruments

	Regression				
	ln (Cumulative hours of work)				HS GPA
Variable	(1)	(2)	(3)	(4)	(5)
Instrument					
Birth month		-.140**	-.134**	-.131**	.004
		(.056)	(.056)	(.056)	(.014)
Birth month square		.012***	.011***	.011***	-.001
		(.004)	(.004)	(.004)	(.001)
Expected age at grade 9		.507***	.508***	.490***	-.021
		(.097)	(.097)	(.097)	(.026)
Legal dropout age			-.117**	-.151***	.010
			(.050)	(.051)	(.013)
ln (local earnings /1,000)				.766***	.069
				(.205)	(.051)
Control					
Male	.092	.065	.068	.081	-.256***
	(.089)	(.089)	(.089)	(.089)	(.023)
Black	-.979***	-.941***	-.943***	-.913***	-.251***
	(.126)	(.119)	(.119)	(.125)	(.030)
Hispanic	-1.080***	-1.055***	-.993***	-.956***	-.182***
	(.139)	(.130)	(.133)	(.141)	(.035)
Live in urban area	.062	.083	.094	.150	-.026
	(.099)	(.101)	(.101)	(.101)	(.027)
ln (family income)	.180***	.189***	.191***	.187***	.026**
	(.051)	(.044)	(.043)	(.052)	(.011)
Father's education	-.004	-.003	-.004	-.005	.010***
	(.010)	(.010)	(.010)	(.010)	(.003)
Mother's education	-.027**	-.024**	-.027**	-.027**	.012***
	(.012)	(.012)	(.012)	(.012)	(.003)
Broken family	.305**	.306*	.303**	.290**	-.043
	(.123)	(.128)	(.128)	(.122)	(.034)
Intercept	4.324***	-2.662*	-.728	-1.685	2.687***
	(.549)	(1.460)	(1.678)	(1.744)	(.442)
R^2	.042	.050	.052	.056	.109
N	3380	3380	3380	3380	3380
Test of H_0	------	$F = 9.90$	$F = 8.79$	$F = 9.85$	$F = 0.81$
Instruments are jointly zero	------	P = .000	P = .000	P = .000	P = .541
Partial R^2	------	.0100	.0143	.0213	------

Note. Numbers in parentheses are robust standard errors.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 4. OLS and IV estimates of cumulative hours of work and other control variables on high school GPA

	Regression			
Variable	OLS (1)	IV1 (2)	IV2 (3)	IV3 (4)
ln (Hours of work)	.017**	-.039	-.050	-.010
	(.004)	(.047)	(.044)	(.037)
Male	-.255**	-.254***	-.253***	-.257***
	(.022)	(.023)	(.023)	(.023)
Black	-.269**	-.290***	-.302***	-.263***
	(.030)	(.056)	(.053)	(.047)
Hispanic	-.195**	-.219***	-.232***	-.189***
	(.033)	(.061)	(.058)	(.053)
Live in urban area	-.028	-.027	-.026	-.029
	(.025)	(.026)	(.026)	(.026)
ln (family income)	.029*	.033**	.036***	.028**
	(.011)	(.014)	(.014)	(.013)
Father's education	.009**	.010***	.010***	.010***
	(.002)	(.003)	(.003)	(.003)
Mother's education	.011**	.011***	.011**	.012***
	(.002)	(.003)	(.003)	(.003)
Broken family	-.036	-.030	-.027	-.039
	(.032)	(.036)	(.036)	(.036)
Intercept	2.788**	2.882**	2.931**	2.760**
	(.122)	(.238)	(.225)	(.198)
Instrument for birth month	NA	Yes	Yes	Yes
Instrument for birth month square	NA	Yes	Yes	Yes
Instrument for expected age at grade 9	NA	Yes	Yes	Yes
Instrument for legal dropout age	NA	No	Yes	Yes
Instrument for local earnings	NA	No	No	Yes
Overidentification test:				
Basmann test (Chi-sq)	------	.475	.839	3.806
P-value(Degrees of Freedom)	------	.789(2)	.840(3)	.433(4)
R^2	.111	.106	.097	.111
N	3380	3380	3380	3380

Note. Numbers in parentheses are robust standard errors.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 5. Probit and Two-stage probit estimates of cumulative hours of work and other control variables on college entry

	Regression			
	Probit	Two-Stage Probit		
Variable	(1)	(2)	(3)	(4)
ln (Hours of work)	-.011***	-.099***	-.088***	-.089***
	(.003)	(.021)	(.023)	(.019)
	[-.017]	[-.149]	[-.132]	[-.134]
Male	-.110***	-.082***	-.088***	-.088***
	(.017)	(.020)	(.020)	(.019)
Black	-.018	-.104***	-.094**	-.095***
	(.022)	(.029)	(.031)	(.029)
Hispanic	-.067***	-.155***	-.146***	-.147***
	(.025)	(.029)	(.032)	(.029)
Live in urban area	.073***	.065***	.068***	.068***
	(.019)	(.019)	(.019)	(.019)
ln (family income)	.032***	.042***	.042***	.042***
	(.009)	(.008)	(.007)	(.007)
Father's education	.006***	.005**	.005***	.005**
	(.002)	(.002)	(.002)	(.002)
Mother's education	.017***	.011***	.013***	.012***
	(.002)	(.003)	(.003)	(.003)
Broken family	-.057**	-.019	-.025	-.025
	(.024)	(.026)	(.026)	(.025)
Instrument for birth month	NA	Yes	Yes	Yes
Instrument for birth month square	NA	Yes	Yes	Yes
Instrument for expected age at grade 9	NA	Yes	Yes	Yes
Instrument for legal dropout age	NA	No	Yes	Yes
Instrument for local earnings	NA	No	No	Yes
Overidentification test:				
Amemiya-Lee-Newey minimum Chi-sq	------	1.667	5.779	5.734
P-value(Degrees of Freedom)	------	.435(2)	.123(3)	.220(4)
Pseudo R^2	.071	.071	.070	.071
N	3380	3380	3380	3380

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Standard errors from Maximum likelihood estimates (ivprobit in Stata 9) are reported in parentheses.
3. Numbers in brackets are the elasticity.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 6. Probit and Two-stage probit estimates of cumulative hours of work and other control variables on college entry by gender

	Regression			
	Probit	Two-Stage Probit		
	(1)	(2)	(3)	(4)
Girls				
ln (Hours of work)	-.009**	-.119***	-.107***	-.107***
	(.004)	(.022)	(.026)	(.023)
	[-.017]	[-.179]	[-.161]	[-.161]
Overidentification Test:				
Amemiya-Lee-Newey minimum Chi-sq	------	.900	4.662	4.586
P-value(Degrees of Freedom)	------	.638(2)	.198(3)	.333(4)
Pseudo R^2	.057	.060	.058	.059
N	1799	1799	1799	1799
Boys				
ln (Hours of work)	-.015***	-.074**	-.068*	-.068**
	(.005)	(.035)	(.036)	(.030)
	[.024]	[.111]	[.102]	[.102]
Overidentification test:				
Amemiya-Lee-Newey minimum Chi-sq	------	.393	1.228	1.222
P-value(Degrees of Freedom)	------	.822(2)	.746(3)	.874(4)
Pseudo R^2	.071	.073	.072	.073
N	1581	1581	1581	1581

Note. 1. Two stage probit estimates in column (2), (3) and (4) use different set of instruments following previous procedure.
2. Marginal probabilities are reported rather than probit coefficients.
Standard errors from Maximum likelihood estimates (ivprobit in Stata 9) are reported in parentheses.
3. Numbers in brackets are the elasticity.
4. All regressions included the other control variables used in Table 5.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 7. IV estimates of cumulative hours of work during summer or during each school-year grade on high school GPA

	Regression			
	OLS	IV1	IV2	IV3
ln (Hours of work)	(1)	(2)	(3)	(4)
A. during high school	.017**	-.039	-.050	-.010
	(.004)	(.047)	(.044)	(.037)
B. during summer	-.003	-.029	-.040	-.031
	(.005)	(.042)	(.038)	(.038)
C. during 9th grade	-.007	-.037	-.044	-.049
	(.006)	(.061)	(.061)	(.061)
D. during 10th grade	-.004	-.019	-.023	-.013
	(.004)	(.029)	(.028)	(.027)
E. during 11th grade	.009	-.030	-.043	-.012
	(.004)	(.047)	(.040)	(.035)
F. during 12th grade	-.016	-.056	-.067	-.016
	(.004)	(.062)	(.052)	(.042)
Instrument for birth month	NA	Yes	Yes	Yes
Instrument for birth month square	NA	Yes	Yes	Yes
Instrument for expected age at grade 9	NA	Yes	Yes	Yes
Instrument for legal dropout age	NA	No	Yes	Yes
Instrument for local earnings	NA	No	No	Yes
N	3380	3380	3380	3380

Note. 1. All regressions included the other control variables used in Table 4.
2. Numbers in parentheses are robust standard errors.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 8. Probit and Two-stage probit estimates of cumulative hours of work during summer or during each school-year grade on college entry

	Regression			
	Probit	Two-Stage Probit		
ln (Hours of work)	(1)	(2)	(3)	(4)
A. during high school	-.011***	-.099***	-.088***	-.089***
	(.003)	(.026)	(.031)	(.026)
B. during summer	-.002	-.112***	-.085***	-.095***
	(.003)	(.023)	(.029)	(.027)
C. during 9th grade	-.004	-.173***	-.172***	-.181***
	(.003)	(.028)	(.028)	(.026)
D. during 10th grade	-.007**	-.075***	-.073**	-.078***
	(.003)	(.020)	(.021)	(.019)
E. during 11th grade	-.003	-.111***	-.101***	-.101***
	(.003)	(.018)	(.023)	(.019)
F. during 12th grade	-.010***	-.124 ***	-.114 ***	-.108***
	(.003)	(.019)	(.026)	(.022)
Instrument for birth month	NA	Yes	Yes	Yes
Instrument for birth month square	NA	Yes	Yes	Yes
Instrument for expected age at grade 9	NA	Yes	Yes	Yes
Instrument for legal dropout age	NA	No	Yes	Yes
Instrument for local earnings	NA	No	No	Yes
N	3380	3380	3380	3380

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. All regressions included the other control variables used in Table 5.
3. Standard errors from Maximum likelihood estimates (ivprobit in Stata9) are reported in parentheses.
4. All regressions except regressions using summer hours worked pass overidentification test.
5. Numbers in brackets are the elasticity.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 9. Multinomial logit model of dropouts, high school graduation, and college attending

Variable	Coefficients	P-value	Marginal Effects	P-Value
		High school graduation		
Log predicted work hour	-.361	<.001	.032	.041
Male	.013	.910	.065	<.001
Black	-.021	.902	.047	.078
Hispanic	-.083	.637	.081	.005
Urban	-.419	.001	-.066	<.001
Log household income	.204	<.001	-.033	<.001
Father Education	.028	.014	-.004	.025
Mother Education	.030	.013	-.011	<.001
Broken Family	-.454	.003	.022	.307
Constant	-.473	.316		
		College attending		
Variable	Coefficients	P-value	Marginal Effects	P-Value
Log predicted work hour	-.624	<.001	-.090	<.001
Male	-.361	.002	-.090	<.001
Black	-.298	.071	-.070	.018
Hispanic	-.569	.001	-.126	<.001
Urban	-.132	.266	.042	.031
Log household income	.439	<.001	.072	<.001
Father’s education	.056	<.001	.009	<.001
Mother’s education	.103	<.001	.020	<.001
Broken family	-.685	<.001	-.090	<.001
Constant	-2.524	<.001		
Log Likelihood	-3486			
N	3987			
Pseudo R2	.095			

Note. Dropouts is used as a reference.

Appendix 1.a. IV estimates of cumulative hours of work on high school GPA by different definition of birth month

	Regression			
	OLS (1)	IV1 (2)	IV2 (3)	IV3 (4)
A. (1=January,…..,12=December)	.017**	-.039	-.050	-.010
	(.004)	(.047)	(.044)	(.037)
B. (1=September,……,12=August)	.017**	-.013	-.030	.004
	(.004)	(.048)	(.043)	(.036)
C. 11 birth month dummies	.017**	-.039	-.048	-.014
	(.004)	(.043)	(.039)	(.034)

Note. Numbers in parentheses are robust standard errors. Column (2), (3) and (4) use different set of instruments. *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 1.b. Probit and Two-stage probit estimates of cumulative hours of work and other control variables on college entry

	Regression			
	Probit	Two-Stage Probit		
	(1)	(2)	(3)	(4)
A. (1=January,…..,12=December)	-.011***	-.099***	-.088***	-.089***
	(.003)	(.021)	(.023)	(.019)
B. (1=September,……,12=August)	-.011***	-.099***	-.099***	-.089***
	(.003)	(.021)	(.022)	(.019)
C. 11 birth month dummies	-.011***	-.114***	-.107***	-.103***
	(.003)	(.016)	(.018)	(.016)

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Standard errors from Maximum likelihood estimates (ivprobit in Stata 9) are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 2. OLS and IV estimates of cumulative hours of work and other control variables on high school GPA by gender

	Regression			
	OLS (1)	IV1 (2)	IV2 (3)	IV3 (4)
Girls				
ln (Hours of work)	-.010*	-.068	-.069	-.025
	(.006)	(.075)	(.064)	(.055)
Overidentification Test				
Basmann Test (Chi-sq)	------	.128	.128	2.182
P-value(Degrees of Freedom)	------	.938(2)	.988(3)	.702(4)
R^2	.086	.039	.037	.083
N	1799	1799	1799	1799
Boys				
ln (Hours of work)	-.015***	-.015	-.024	.005
	(.005)	(.059)	(.057)	(.048)
Overidentification test	-------	.47	.79	.63
Basmann test (Chi-sq)	------	.445	.812	1.602
P-value(Degrees of Freedom)	------	.800(2)	.847(3)	.808(4)
R^2	.095	.093	.095	.082
N	1581	1581	1581	1581

Note. 1. IV estimates in column (2), (3) and (4) use different set of instruments following previous procedure.
2. All regressions included the other control variables used in Table 4.
3. Numbers in parentheses are robust standard errors.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 3. Summary statistics by gender

	Female high school graduates (n=1799)		Male high school graduates (n=1581)	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Dependent				
HS GPA	3.10	.69	2.87	.70
College	.71	.45	.62	.49
Work HS	1175	924	1354	1130
Work Fr/Sop	405	459	552	649
Work Jun/Sen	1020	731	1091	827
Work Summer in Freshman	277	219	336	279
Independent				
Black	.26	.44	.21	.41
Hispanic	.18	.38	.18	.39
Urban	.71	.45	.70	.46
HH income($)	56,906	47,198	60,777	46,825
Broken family	.42	.49	.37	.48
Father's education	13.3	3.2	13.4	3.2
Mother's education	13.0	3.0	13.0	2.8

Appendix 4. Multinomial logit model of dropouts, high school graduation, and college attending by gender

Girls				
		High school graduation		
Variable	Coefficients	P-value	Marginal Effects	P-Value
Log predicted work hour	-.200	.170	.055	.007
		College attending		
Variable	Coefficients	P-value	Marginal Effects	P-Value
Log predicted work hour	-.558	.140	-.095	<.001
Log Likelihood	-1710			
N	2967			
Pseudo R2	.090			
Boys				
		High school graduation		
Variable	Coefficients	P-value	Marginal Effects	P-Value
Log predicted work hour	-.507	<.001	.006	<.001
		College attending		
Variable	Coefficients	P-value	Marginal Effects	P-Value
Log predicted work hour	-.691	<.001	-.085	<.001
Log Likelihood	-1761			
N	1920			
Pseudo R2	.096			

Note. Dropouts is used as a reference.

Chapter 4. Lifetime Health Consequences of Child Labor in Brazil

Abstract

Health consequences of child labor may take time to manifest themselves. This study examines whether adults who worked as children experience increased incidence of illness or physical disability. The analysis corrects for the likely endogeneity of child labor and years of schooling using variation in number of schools per children, number of teachers per children and low skill wages at the time the adults were children. Results show that the effects of child labor on adult health are complex. When child labor and schooling are treated as exogenous variables, child labor appears to increase the likelihood of poor health outcomes in adulthood. However, when they are considered endogenous, child labor loses power to explain adverse adult health outcomes. The effect remains marginally significant for only a few adult health measures. This finding is consistent with other evidence that child laborers select lifetime occupations with higher incidences of ailments and physical disabilities.

4.1. Introduction

The International Labor Organization (ILO) Convention 182 calls for the prohibition and elimination of the worst forms of child labor. In addition to universally condemned occupations such as child slavery, prostitution, pornography and drug trafficking, the worst forms include work that is likely to jeopardize the health, safety or morals of young persons (ILO, 1999). The ILO estimates that there are 111 million children aged 5 to 14 involved in hazardous work.[28] This number is equivalent to 53% of working children and about 9% of all children in the world. Children engaged in such activities are presumed to face immediate health threats by the nature of the work. However, child labor could also have health consequences that only become manifest in adulthood. Such long-term health risks can develop from early exposure to dust; toxins; chemicals such as fertilizer and pesticides; inclement weather; heavy lifting; or the forced adoption of poor posture. Hazards may also threaten psychological health through exposure to abusive relationships with employers, supervisors or clients (ILO, 1998).

The linkage between working as a child and health status later as an adult has not been widely explored. This study aims to fill that knowledge gap by examining whether adults who entered the labor market early in life suffer higher rates of chronic diseases and functional limitations in adulthood. We address the question using the 1998 Pesquisa Nacional por Amostra de Domicilios (PNAD) which included a series of questions on health and disability status. It also included questions on whether current adults worked as children.

Estimating the causal effect of early entry into labor market on adult health is complicated by the selection process which sorts children into the labor market. On the one hand, we might expect that only reasonably healthy children would be sent to work at young ages as sickly children would not be capable of work. On the other hand, children from the poorest households are the most likely to work, and growing up in poverty may be correlated with adverse health outcomes.[29] Thus, the early incidence of child labor may be correlated

[28] All children aged 5-14 are considered by the ILO to be engaged in hazardous work if they are working in mining or construction or in occupations or processes considered hazardous by their nature or if they work more than 43 hours per week.

[29] Case et al. (2002) and, Currie and Stabile (2003) present evidence that children in poorer families have significantly worse health than children in richer families.

with unobservable positive or negative health endowments that could affect adult health in addition to any direct impact of child labor on health. These unobserved health endowments cloud the interpretation of simple correlations between child labor and adult health outcomes.

Another confounding factor is that child labor may affect a child's years of schooling completed, and education has been shown to positively affect adult health.[30] The effect of child labor on education in Brazil is uncertain. Because the average school day lasts only four hours, many children in Brazil both work and attend school. Child labor may help the household afford more years of schooling. On the other hand, child labor may retard child cognitive attainment per year of schooling, and it may also lead to earlier exit from school into full time work.[31] A complete assessment of the effect of child labor on health must consider the indirect effect of child labor on schooling.

In this study, adult health is measured by the incidence of chronic diseases and by functional limitations in performing activities. We estimate the relationship of these adult health outcomes to child labor first by assuming that age of labor market entry and years of schooling completed are exogenous. We then use variation in the supply and quality of local schools and low skill wages in the state the adult was born at the time the adult was a child as instruments for endogenous age of labor market entry and years of schooling completed. These variables affected the relative value and cost of child time in school versus work and of household ability to support child time in school and so they should have influenced labor

[30] Studies have consistently found a large positive correlation between education and health (Van Doorslaer (1987), Wagstaff (1993), Grossman, Michael and R. Kaestner (1997), Lleras-Muney (2005)).
[31] Evidence of the impact of child labor on schooling attainment is mixed with some studies finding negative effects (Psacharopoplous, 1997) while others (Patrinos and Psacharopoulos (1997), Ravallion and Wodon (2000)) finding that schooling and work are compatible. There is stronger evidence that child labor lowers test scores, presumably because it makes time in school less efficient (Post and Pong (2000), Heady (2003), Rosatti and Rossi (2003), Gunnarrson et al (2006)).

supply and schooling decisions during childhood. However, these factors should have no direct impact on the child's health a quarter century later in adulthood.

The results are complex. When treated as exogenous, child labor is positively correlated with a higher incidence of adult chronic diseases and functional limitations. However, when they are considered endogenous, child labor loses power to explain adverse adult health outcomes. The effect remains marginally significant for only a few adult health measures. We still find that there is a significant combined effect of child labor and schooling on the incidence of chronic health conditions later in life.

The next section summarizes the literature on child labor and long-term health. In section 4.3, we describe our model and estimation strategy. Section 4.4 provides data and descriptive statistics. In section 4.5, we present empirical results. In section 4.6, we summarize our findings and their implications for policy and further research.

4.2. Literature Review

Until recently, most studies linking child labor and health have focused on the health of currently working children. The comprehensive review by Graitcer and Lerer (1998) presented a mixed picture of international evidence regarding the impact of child labor on health, primarily because of data limitations. Data on the extent of child labor itself is subject to considerable error, but data on the incidence of child injuries on the job are even more problematic. Sources of information come from government surveillance, sometimes supplemented by data from worker's compensation or occupational health and safety incidence reports. These latter sources are less likely to be present in the informal labor markets in which child labor is most common, and government surveillance is often weak.

Nevertheless, reported injury rates are not small: of working children aged 10-14, 9% are estimated to suffer injuries annually, and 3.4% are estimated to suffer disabling injuries.

Information on longer term health consequences of child labor such as occupational diseases or repetitive motion injuries is even more limited and subject to errors. In a rare example of longitudinal data applied to the question, Satyanarayana et al (1986) examined anthropometric data on 410 children over a 17 year period in a rural area in India. They found that children who worked in agriculture, small-scale industry and services had worse growth in height and weight when followed through to adulthood than those who attended school. They did not consider the issue of nonrandom selection into work or industry.

Two larger-scale studies using different Brazilian data sets provide some evidence on the negative long term effect of child labor on adult health. Kassouf et al (2001) found that the probability of self-reported poor health increases as the age of labor market entry decreases. However, this result should be interpreted with caution in that child labor and schooling are treated as exogenous and no other control variables are used. Giuffrida et al (2005) found that starting to work under age 9 has a negative and significant effect on adult health. Their estimates control for age, race, education, wealth, housing conditions, and unemployment status. However, if child labor alters wealth, housing status or unemployment later in life, some of these controls are jointly determined with child labor and adult health, again raising concerns about endogenous child labor.

Rosati and Straub (2004) used a sample of Guatemalan siblings which controlled for unobservable household attributes in assessing the impact of child labor on adult health. However their strategy still treats child labor and possible resulting decisions regarding schooling and income as exogenous. In addition, their sample is restricted to adults who are still living with their parents, and so their sample is heavily weighted toward relatively young adults. Moreover, if the decision to live with parents is conditioned on health outcomes, as would be the case if healthy children are more likely to live on their own and children suffering illness or disability are more likely to remain with their parents, then their sample will be biased toward finding adults with health problems. Selection might explain why they find such large adverse health consequences: having worked as a child increased by 40% the probability of having health problems as an adult. Nevertheless, their finding of very large health consequences from child labor illustrates the importance of further examination of the link between child labor and adult health.

There does appear to be a *prima facie* case that starting to work early in life can lead to the early onset of physical disabilities and chronic illness in adulthood. Figure 1 shows the relationship between age of labor market entry and various health conditions for several birth cohorts in Brazil. Adults who started working earliest as children have a higher incidence of back problems and arthritis than do their contemporaries who entered the labor market at older ages. Older cohorts have a higher incidence of these problems than younger cohorts, but the downward pattern between health problems and age of labor market entry is found in all cohorts. Interestingly, there is no apparent pattern between the incidence of hypertension and age of labor market entry. Presumably, the incidence of hypertension would be tied more closely to heredity and life style and less to years of work.

The downward pattern between age of labor market entry and adult adverse health outcomes are found for self reported problems walking, bending, lifting, pushing, climbing stairs, and kidney disease (see Appendix 1). Other than the last measure, these health problems appear to be physical and potentially associated with repeated physical stress.

Patterns similar to the hypertension case are found for self-reported cancer, diabetes, asthma, heart disease, depression, tuberculosis, cirrhosis, and tendonitis. Other than the last indicator, these health conditions tend to reflect heredity and life style choices. The balance of the paper examines whether we can identify the nature of the link between child labor and adult health.

4.3. Model and Estimation Strategy

A. Conceptual model: A household model of child labor and schooling and adult health

Suppose that households have a single parent and a single child. The parent works full time, earning income *Y.* The child's time normalized to unity is divided between leisure (L^1); child labor (C^1); and schooling (S^1); so that $1 = L^1 + C^1 + S^1$. The superscript refers to the childhood period. If the child works, they are paid an exogenous wage, W^1. If they attend school, they access exogenous school inputs, Z^1.

The parent gets utility from the child's future wealth, ($U_{W^2} > 0$) where future wealth has the form $W^2 = W^2(C^1, S^1, Z^1, a, h, H^2)$. Wealth depends on the allocation of child time in the first period to school and to work; on the child's fixed endowments of ability (*a*) and health (*h*); and on the future health of the child, $H^2 = H^2(C^1, S^1, a, h)$. The child's future health also depends on how the child's time is allocated between school and work and on the ability and health endowments. Parents also derive utility from child leisure ($U_{L^1} > 0$) and from consumption of goods, X, so that $U_X > 0$.

The parents choose current consumption*,* child labor, and child time in school so as to maximize utility $U[X,(1-C^1-S^1),W^2(C^1,S^1,Z^1,a,h,H^2)]$ subject to the budget constraint $Y+W^1C^1=PX$ where *P* is the price of consumer goods purchased by the parent.

Assuming interior solutions, the first order conditions imply that

$$\frac{U_X}{P}W^1+U_{W^2}(\frac{\partial W^2}{\partial C^1}+\frac{\partial W^2}{\partial H^2}\frac{\partial H^2}{\partial C^1})=U_{W^2}(\frac{\partial W^2}{\partial S^1}+\frac{\partial W^2}{\partial H^2}\frac{\partial H^2}{\partial S^1}) \quad (1)$$

The left-hand-side of the equality is the marginal utility the parents derive from child labor. Child labor increases household income and so consumption rises, but child labor also affects the future wealth of the child through skill development ($\frac{\partial W^2}{\partial C^1}$) and through the child's lifetime health ($\frac{\partial H^2}{\partial C^1}$). Parents will discount the utility they get from consumption derived from child labor if at the same time they compromise the child's lifetime health (i.e. $\frac{\partial H^2}{\partial C^1}<0$) and health contributes to the child's future wealth.

The right-hand-side of the equality is the marginal utility from allocating child time to school. Schooling can affect child's future wealth through its impact on skill development and on lifetime health.

The reduced form equations for child time allocation to work and school will depend on all the exogenous variables W^1, Z^1, *a*, *h*, *Y*, and *P*. These reduced form equations will prove useful in identifying child labor and time in school as we explore there impacts on adult health outcomes implied by the health production equation $H^2=H^2(C^1,S^1,a,h)$.

B. Estimation strategy

We use our stylized household model to identify the variables entering the reduced form child labor and schooling equations. The linear approximations to these equations for child *i* born in state *j* as a member of age cohort *t* are of the form

$$C_{ijt}^{1} = \varphi_{Z}^{C} Z_{jt}^{1} + \varphi_{W}^{C} W_{jt}^{1} + \varphi_{Y}^{C} Y_{jt} + D_{ijt}^{'} \varphi_{D}^{C} + \delta_{j}^{C} + \delta_{t}^{C} + \varepsilon_{ijt}^{C} \quad (2)$$

$$S_{ijt}^{1} = \varphi_{Z}^{S} Z_{jt}^{1} + \varphi_{W}^{S} W_{jt}^{1} + \varphi_{Y}^{S} Y_{jt} + D_{ijt}^{'} \varphi_{D}^{S} + \delta_{j}^{S} + \delta_{t}^{S} + \varepsilon_{ijt}^{S} . \quad (3)$$

The vector D_{ijt} is composed of exogenous demographic attributes that only include time invariant race or gender or clearly exogenous age. We do not include occupation, employment status, marital status and the presence of children or other choices that would be conceivably correlated with health or ability endowments. To the extent that these variables are choices conditioned on schooling or child labor choices earlier in life, they would be endogenous to adult health outcomes and must therefore be excluded from the empirical model.

The dummy variables δ_{j}^{k} and δ_{t}^{k} control for differences in prices across cohorts and across birth states, but they will also help to control for differences in the mix of jobs children undertake across birth states and across time.

The error terms contains unobserved ability and health endowments which theory suggests ought to enter the reduced from equations, so that

$$\varepsilon_{ijt}^{k} = \alpha_{a}^{k} a_{ijt} + \alpha_{h}^{k} h_{ijt} + \xi_{ijt}^{k}; k = C, S. \quad (4)$$

The last term ξ_{ijt}^{k} is an iid random error. The reduced from equations (2) and (3) demonstrate that parental choices on age of labor market entry and child time in school will depend on parental observations of the child's endowments of ability and health. If, for example, the parameters in (4), α_{a}^{k} and α_{h}^{k} are positive, then children who are born with better health and ability will both work more and attend school more in period 1.

In period 2, these endowments of health and ability will carry over to observations of adult health. Let the equation explaining adult health be given by

$$H_{ijt}^{2} = D_{ijt}^{'} \beta_{D} + \beta_{C} C_{ijt}^{1} + \beta_{S} S_{ijt}^{1} + \delta_{j}^{H} + \delta_{t}^{H} + \varepsilon_{ijt}^{H} \quad (5)$$

where as before, the error term has the form $\varepsilon_{ijt}^{H} = \alpha_a^H a_{ijt} + \alpha_h^H h_{ijt} + \xi_{ijt}^{H}$. Because adult health is conditioned on unobserved health and ability endowments, $COV(\varepsilon_{ijt}^{H}, C_{ijt}^{1}) \neq 0$ and $COV(\varepsilon_{ijt}^{H}, S_{ijt}^{1}) \neq 0$. Ordinary least squares applied to equation (5) will yield biased estimates of β_C and β_S. To continue our hypothetical example, if the parameters α_a^H and α_h^H are also positive, β_C and β_S will overstate the impact of child labor and years of schooling on observed health. If the true value of β_C <0, then the coefficient on child labor will be biased against finding an adverse effect of child labor on adult health.

Our point is not to predict the direction of bias, but simply to indicate that unobserved health and ability endowments in childhood will carry over to cloud our interpretation of the consequences of decisions made in childhood on adult health. However, if our assumption that adult health is not directly influenced by the period 1 school attributes Z_{jt}^{1}, child wages W^1, or household incomes *Y,* then we have a battery of instruments with which to identify the true effect of child labor and years of schooling on adult health. Inserting the expected values of C_{ijt}^{1} and S_{ijt}^{1} into (5), we obtain

$$H_{ijt}^{2} = D_{ijt}^{'}\beta_D + \beta_C(\varphi_Z^C Z_{jt}^{1} + \varphi_W^C W_{jt}^{1} + \varphi_Y^C Y_{jt} + D_{ijt}^{'}\varphi_D^C + \delta_j^C + \delta_t^C) + \beta_S(\varphi_Z^S Z_{jt}^{1} + \varphi_W^S W_{jt}^{1} + \varphi_Y^S Y_{jt} + D_{ijt}^{'}\varphi_D^S + \delta_j^S + \delta_t^S) + \upsilon_{ijt}^{H} \quad (6)$$

The hypothesized exclusion restrictions generate variation in child labor and years of schooling that is uncorrelated with the unobserved ability and health endowments, and so we can derive unbiased estimates of β_C and β_S. Our strategy is to estimate equations (2), (3), and (6) jointly in order to derive efficient estimates of the coefficients of interest.[32] Because equations (2) and (3) have interest in and of themselves, insomuch as they show how the economic and school environment affects decisions on years of schooling and child labor, we also report those estimates as well. Finally, to provide a frame of reference for the estimates in (6), we estimate (5) directly to illustrate the nature of the biases.

[32] Emerson and Souza (2006) employed a similar approach to identify causal relationships between child labor and adult earnings.

C. Instruments

We observe health outcomes in period 2 when the individual is an adult, but decisions on child labor and schooling occur in period 1 when the individual is a child. Both child labor and years of schooling are period 1's household decisions that reflect unobservable characteristics of the individual's family. To properly control for the potential endogeneity of child work activity and years of education in the adult health production function, we need instruments that would affect age of entry into the labor market and years of schooling completed but would not directly affect health during adulthood. We do not have information on family background measures for adults during period 1 when they were children, and so we need to look to other sources of information for factors that should affect these schooling and labor market choices.

One set of variables that may satisfy the conditions reflect the availability and quality of schools in the area where the adult grew up.[33] The presence of more schools per child residing in the state lowers the average travel costs of attending schooling in the state. Similarly the number of teachers per child can be used as a proxy for school quality in the state. Since age 7 is the age of school entry in Brazil, we use the number of schools per child and the number of teachers per child at age 7 in the state in which the individual was born as our measures of period 1 school availability and school quality.

Other factors that have been commonly used to explain variation in schooling investments and child labor include household income and the opportunity cost of

[33] Bedi and Edwards (2002), Gertler and Glewwe (1990), Duflo (2001, 2004), Glick and Sahn (2006), and Alderman et al (2001) all found evidence that schooling decisions are influenced by distance and/or school quality.

schooling.[34] We measure the strength of labor demand by the relative wage for workers with four or fewer years of schooling as an indicator of the value of time for illiterate labor in period 1.[35] Because relatively few children work and those that do rarely work for wages, information on average pay for children is extremely limited and subject to selection problems. However, this will also be related more generally to shifting demand for adult labor in the state, as average years of schooling for parents at the start of the period would have been around four years. Rising low-skill wages will increase the income potential of the parents as well as the children. We date the measure at the time the adult was 12 years old in the state of birth, the youngest age at which a child could legally work in Brazil.

We do not have information on local prices, and so we include dummy variables for state of birth and age cohort to help control for price variation across states and across time. These dummy variables are not treated as instruments, and so we also include them in the second-stage health regressions.

As we will see, these instruments have strong predictive power for both the age of labor market entry and for years of schooling completed. In addition, they have signs that are consistent with the presumed roles of these variables in shaping the attractiveness of schools, and the opportunity cost of child time on the endogenous variables. However, they do not have direct predictive power for adult health, and so they meet the empirical criteria for valid instruments.

4.4. Data and Descriptive Analysis

A. Data

[34] Card (1995) and Cameron and Taber (2004) used local labor market conditions as opportunity cost of schooling. Rosenzweig (1980) used agricultural day wages in India.

[35] It is commonly presumed that on average, it takes about five years of schooling to attain permanent literacy.

The main source of data used for the analyses is 1998 Pesquisa Nacional Por Amostra de Domicilios (PNAD), the Brazilian equivalent of the Current Population Survey in the United States. The PNAD98 collected information from 112,434 households and 344,975 individuals and included information on labor force participation and earnings in conjunction with standard demographic characteristics such as age, gender, race, schooling, state of birth and state of residence. Periodically the PNAD survey contains extra questions on such topics as marriage, health, migration, nutrition and social mobility. The 1998 edition of the PNAD uniquely fits our needs. It included information on the age the respondent first entered the labor market. It also included a special health module which included questions eliciting the respondent's self reported health status. Questions related to twelve specifics chronic diseases or conditions (back problems, arthritis, cancer, diabetes, asthma, hypertension, heart disease, kidney disease, depression, tuberculosis, tendonitis, and cirrhosis) and to seven physical disabilities (difficulty feeding and bathing, raising objects, going upstairs, bending down, carrying and pushing, walking 1 kilometer, and walking 100 meters).

The remaining sources of data are related to construction of the instruments described in the previous section. Data on the number of primary schools, the number of teachers, and the population by state and year are taken from the IBGE Historical Series 2003.[36] Data on the average low skilled wage rate for each year and state were computed from data in the Integrated Public Use Microdata Series (IPUMS) International.[37] Average income measures

[36] We are grateful to Patrick Emerson and Andre Souza for providing us the historical data on schools and teachers by state.

[37] IPUMS International provides census data on wages every ten years. To interpolate state-specific average wage rates for low-skilled between census years, we use state-specific temporal variation in per capita income. We presume that there are larger changes in wages in years with larger annual increases in average income.

are computed from data from the IPEA historical series.[38] Their summary statistics are included in Table 1.

The sample was selected to include only household heads or their spouses aged 30-55. We exclude older people because we wish to concentrate on the early onset of health complications. As individuals age, all health complications become more common, and so the potential impact of early labor market entry becomes more difficult to isolate. Furthermore, required information on the wages for low-skilled workers was unavailable for the older birth cohorts. We exclude younger workers to concentrate only on those who have completed their potential years of schooling. Additionally, we restrict the sample to those who first entered the labor market at or before age 30. To allow for differential health outcomes by gender related to fertility and to possible occupational differences between men and women, we constructed two sub-samples: adult women aged 30-55, adult men aged 30-55. The total number of cases in the two sub-samples, after deletion of cases with missing data on the variables used, was 28,043 adult women and 39,884 adult men.

B. Descriptive analysis

Table 1 reports the summary statistics for the variables used in the study. Average age of labor market entry is 13.3 years. Male adults entered the labor market 1.4 year earlier. The average years of schooling is 6.8 years with women receiving 0.5 years more schooling than men. Men constitute around 60 percent of sample.[39] 54 percent of the sample is White, 39.2 percent Brown (or mixed), 6.1 percent Black.

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[38] IPEA is the research institute of the Ministry of Planning of the Brazilian Federal Government. These series can be obtained on line at http://www.ipeadata.gov/ipeaweb.dll/ipeadata?1026025750.

[39] In the initial sample, men and women are equally represented, but women were less likely to report age of labor market entry.

Self-reported adverse health status ranged from almost 30 percent for back problems to less than 1 percent for cancer, tuberculosis, cirrhosis and inability to walk 100 meters. Other than kidney disease, responses differed significantly between men and women. In most cases, women have higher rates of chronic ailments. There are also seven questions related to the individual's ability to accomplish tasks.[40] The highest incidence of physical limitation was the 9% reporting difficulty lifting heavy things. Women also report having more task-related disabilities.

In our sample, there are 25 states and 26 birth years from 1943 to 1968.[41] Thus, the maximum possible number of different values for each instrument is 650. To illustrate the range of values, we selected Piaui and Sao Paulo, the poorest and the richest states in Brazil. We also report statistics for Santa Catrina whose GDP per capita is the closest to the country average. Figures 2.a to 2.d show real income per adult, the number of schools per 1000 children, the number of teachers per 1000 children and the average wage rate of people with less than 5 years of schooling. In Figure 2.a, we can see the 'Brazilian economic miracle' years during the 1970s when GDP per capita almost doubled. The average number of schools per 1000 children increased from 4 to 6.5 for 25 years. While the number of schools per thousand children in Piaui increased by a factor of 4 from the 1950s to 1975, changes in other states were more modest. The ratio of teachers to students rose steadily in Brazilian states except in the early 1970s. Average wages of low-skilled people remained relatively stable

[40] For chronic conditions, responses were absence or presence of the condition. For disabilities, respondents evaluated their degree of disability as "unable to perform tasks"; "great difficulty performing tasks"; "little difficulty performing tasks"; or "no difficulty performing tasks". We treat the first two responses as indicating disability.

[41] Brazil has 27 states currently. Following the classification in Appendix E of Emerson and Souza (2006), we collapsed the states of Goias and Tocantines, and the states of Mato Grosso and Mato Grosso do Sul. Tocantins and Mato Grosso do Sul were created recently from a division of the old Goias and old Mato Grosso, respectively. Some territories were transformed into states and some states were merged along the 20th century. See Appendix E of Emerson and Souza (2006) for detail information.

from the mid 1950s to the late 1960s. As the economy boomed in 1970s, the gaps of low-skilled wage rates across states widened soaring in Sao Paulo and steadily rising in Piaui. The patterns show sizeable variations in the instruments across states at a point in time and across cohorts within states.

Figures 3 and 4 show the distributions of the age individuals first entered the labor market, and of their educational attainment. The most common age of labor market entry is 10, but there is substantial variation across individuals. About one-third of children enter the labor market before the legal working age. A larger percentage of boys than girls started working under age 15. The years of schooling attained are similarly broadly dispersed. Figure 5 shows that the birth cohort average age of labor market entry increased by only 1.7 years from 11.8 years for those born in 1943 to 13.5 years for those born in 1968. Over the same period, years of schooling increased 2.8 years from 4 years to 6.8 years.

Table 2 breaks the sample into age groups: 30-34, 35-39, 40-44, 45-49 and 50-55. This stratification allows us to explore the age-gradient of excess occurrences of chronic diseases by age of labor market entry. We concentrate on the three most common of the 12 diseases for which we have information, back problems, arthritis, and hypertension. Among women aged 30 to 34, approximately 36 percent of those starting work when under 10 had back pain. For those who began working after age 14, only 20% reported back problems. The incidence of back pain increases with cohort age. These patterns are similar for males, although fewer males report back problems even when age of labor market entry is held fixed.

Both males and females who started working before age 10 are significantly more likely to have arthritis. The same pattern is reported for early onset of the incidence of hypertension, although for men, differences in the incidence of hypertension by labor market entry disappear after age 45. The average incidence rates for the rest of diseases by age group are reported in Appendix 2. Overall, the descriptive analysis suggests that starting to work at an early age is correlated with earlier onset of some but not all adverse health problems in adulthood. Most common problems correlated with early labor market entry are physical ailments. In the next section, we examine if this pattern remains after controlling for other factors and for nonrandom sorting into school and work.

4.5. Empirical Results

A. Child labor and morbidity treating child labor and education as exogenous

We first examine the sets of health indicators that were considered chronic diseases or disabilities. We will repeat these exercises later using health indicators that measure physical disabilities.

Table 3 reports the marginal effects of a probit specification of equation (5), taking into account demographic factors such as age cohort, gender, race and state of birth. These specifications ignore the endogeneity problems. Early onset of child labor increases the probability of having spinal disorders. An adult who started to work one year earlier is 0.7% more likely to report back problems holding other factors fixed. The incidence of spinal disorders decreases by about 1% for each additional year of schooling, controlling for child labor. The other coefficients show that incidence of self-reported spinal disorders increase with age, are larger for women than men, and are larger for minority groups.

Similar results are obtained for the impact of child labor on adult incidence of arthritis and hypertension. Delaying labor market entry by one year lowers the probability of having arthritis by 0.4% and reduces hypertension by 0.2% after controlling for educational attainment. Larger positive effects on adult health are found from an additional year of schooling. Completing one more year of school lowers the incidence of arthritis by 0.7% and of hypertension by 0.3%.

Table 4 presents the related estimation for other chronic diseases. Even after controlling for educational attainment, child labor increases significantly the incidence of asthma, heart and kidney disease, depression and tendonitis.

Our results indicate that when child labor is treated as exogenous, child labor consistently is associated with adverse health consequences. Early entry into the labor market increases the probability of having more physical-related chronic diseases (i.e., back problems and arthritis), but they seem to be related to other health problems that would be less obviously tied to child labor. Of course, the correlation may be due to the unobserved ability and health endowments and not to a true causal relationship.

B. Child labor and morbidity considering child labor and education as endogenous

Our labor supply and schooling educations (2 and 3) are used to identify child labor and schooling in equation (6). We first demonstrate that our instruments can significantly explain variation in the age at which children first start working and the years of schooling completed. We regress age of labor market entry and years of schooling completed on state-level number of schools per thousand children, number of teachers per thousand children, and the wage for less-educated workers that prevailed at the time the adult was a child. The regression also includes time invariant demographic attributes and controls for cohort and state of birth.

Table 5 presents the first-stage regression results. Better access to schools delay labor market entry. Individuals born in states with more schools and more teachers per child enter the labor market at older ages. Stronger demand for low-skill labor, as indicated by higher wages for workers with less than five years of schooling, induces children to enter the labor market later in life. We do not have separate information on wages for children and adults, and so rising wages for low skilled labor may be increasing demand for labor generally. Rising labor demand can raise family income sufficiently that child labor is no longer needed, as was found by Edmonds and Pavcnik (2005b, 2006) in Vietnam.[42] The null hypothesis that the coefficients on these three variables are jointly equal to zero was easily rejected, as seen by the *F*- statistic reported at the bottom of the Table.[43]

The second column of Table 5 shows the first stage regression for years of schooling completed. Individuals born in states with easier access to grade schools and with more teachers per child in the population completed more years of schooling. Higher state average low skill wages were also associated with completing more years of schooling although it is not statistically significant. This may mean that older family members specializing in work earn sufficient amounts to help subsidize their siblings' schooling, or it may reflect the frequent practice of combining school and work for Brazilian children. The null hypothesis that the three coefficients are jointly equal to zero was again easily rejected.

Table 6 presents the results of estimating equation (6) jointly with equations (2) and (3). The estimated effects of early entry into labor force and years of schooling on the incidence of selected chronic disease are shown in the first two rows in each column.[44] The

[42] Emerson and Souza (2006) found that the number of schools per children and number of teachers per school is positively associated with age of labor market entry and that GDP per capita is negatively associated with age of labor market entry in Brazil. Cameron and Taber (2004) found individuals with a college in their county complete more year of schooling and local earnings at age 17 is not associated with schooling at significant level.

[43] Clustering by state of birth is applied. There is a possibility that individuals live in a state different from their birth state when instruments are applied; at their age 7 or 12. However, Fiess and Verner (2003) showed that less than 1% of Brazilian migrated to other states before their age about 10. Thus, using information of state of birth as instruments may not be a problematic.

[44] Related estimations for other diseases are reported in Appendix 3.

IV probit estimates of child labor effects on health are higher than the probit estimates in Table 3. Treating labor market entry as endogenous implies a one year delay decreases back problems by 23% and hypertension by 42%. There is also 11% increase in the incidence of arthritis with entering labor market by one year earlier but it is not statistically significant. However, the association between education and the incidence of these ailments are not maintained at significant level. The effect of schooling on adult health conditions becomes negligible when the endogeneity of child labor and education are considered. In fact, holding age of labor market entry constant, the coefficient on years of schooling turns positive but not significantly different from zero.

Nevertheless, there is a joint effect of child labor and schooling on adult back problems. Evaluated at sample means, entering the labor market one year earlier while reducing years of schooling by one year increases the incidence of back problems by 15%, other things constant. Similar joint effects are found for other chronic conditions reported in Table 6.

We conclude that the hypothesis that adverse health consequences follow directly from early entry into the labor market are partially supported by the data. In addition, we find evidence that there is a significant joint effect of child labor and schooling on the incidence of chronic health conditions later in life.

Women are more likely to suffer these ailments than men. Generally, minorities are less likely to report chronic diseases than are otherwise observationally equivalent Whites. There are no significant cohort effects on the incidence of disease or disability after correcting for the endogeneity of age of labor market entry and years of schooling.

C. Child labor and disability

We complete our analysis of the long-term impact of child labor on health by examining the connection between child labor and measures of physical limitations. The objective is to corroborate the morbidity evidence with results for other health indicators. As explained in section IV, the functional disability question provides important information on the long-term health of individuals. The same approach used for chronic diseases is applied to examine the effect of early entry into labor market on the probability of having functional limitations. We examine the effects of child labor and schooling on the probability of having health problems that impede an individual from performing activities such as raising objects, climbing stairs or walking 1 kilometer.[45] Treating child labor and schooling as exogenous, results in Table 7 show that delaying labor market entry by one year consistently lowers the probability of adverse health outcomes by small but statistically significant magnitudes after controlling for years of schooling. Compared to the results in Table 4, the implied adverse effects of child labor on health are larger for physical ailments than for chronic ailments with the exception of hypertension, kidney disease and depression for which impacts are of comparable size.

When child labor and schooling are treated as endogenous, as reported in Table 8, the harmful effects of early entry into the labor market and lower years of schooling on functional disability disappear.[46] The joint effect of child labor and schooling on adult health is found only in difficulty climbing stairs. In general, instrumented age of labor market entry and years of schooling have a little effect on the probability of having an onset of physical disability at a young age.

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[45] The remaining estimates of the other functional disabilities are reported in Appendix 4.a.
[46] Appendix 4.b includes the IV estimates for other functional limitations: pushing and carrying; bending down; walking 100m. They show a similar pattern like other work-limiting disabilities.

D. Child labor and adult health by occupation

It might be arguable that adverse adult health conditions come from occupational choice rather than age at start of work. People working in more physically demanding jobs would have more physical injuries by the nature of work. However, it is likely that child labor may reduce schooling, and in turn, limit occupational choice which does result in increased incidences of chronic condition in adulthood. Some of our results indicate that there is an adverse effect of child labor on adult health after controlling for education. To explore whether our results are sensitive to the current occupation individuals have, we divide our adult workers into age cohorts, and then within cohorts, we divide them into occupations. Then, we check for significant differences in adult health outcomes for members of the same cohort in the same occupation who differ only by age of labor market entry. We use a probit model to capture the average probability of an adverse health outcome for individuals who started to work before age 12 and those who started to work at ages 12 through 14, using those who entered the labor market after age 14 as the comparison group. Results are reported in Table 9.[47]

The reported marginal effects of early labor market entry for those in agriculture, manufacturing and service jobs control for age, gender, race and state of birth. All workers are between ages 37 to 43.[48] Entering the labor market earlier increases the incidence of back injury. Regardless of current occupation type, we find a higher incidence of spinal problems for people who started working before age 12, which is the youngest legal working

[47] We replicate this analysis for people with 4 through 7 years of schooling regardless of their current occupation type assuming that years of schooling is related to occupational choice. Similar results are reported in Appendix 5.a.

[48] We checked for different outcomes for other cohorts that might occur due to changes in the occupational distribution across age cohorts. Similar results are obtained.

age in Brazil, and the marginal effect is larger than for those who delayed work until ages 12-14. Similar results are obtained for the adverse effect of child labor on arthritis except that the estimates are not significant for agricultural occupations. There is no apparent significant pattern for hypertension. Same exercise is repeated for selected work-limitations as shown in Table 10.[49] The only difference is that starting work at age 12 through 14 does not increase the probability of having difficulty in selected functional limitations compared to starting work later.

Overall, the results indicate that early entry into labor market has adversely effect on adult health condition in marginal level beyond limitations on occupational choices to occupations with greater risk of physical disabilities through reduced schooling from child labor.

E. Child labor and adult health by gender

Another examination of the linkage between child labor and adult health is related to gender differences. Because girls and boys may perform different tasks, the effect of child labor on adult health might be different between males and females. As shown above, females have a higher incidence of adverse health outcomes than males. Replicating our estimation procedure separately for males and females, we test whether estimated coefficients of age of labor market entry and years of schooling differ across genders. There is no apparent differential effect of child labor on adult health between males and females except that for women, child labor is associated with greater problems lifting heavy objects, climbing stairs, and walking 100m. (See Appendix 6.a and 6.b)

[49] We replicate this analysis for people with 4 through 7 years of schooling regardless of their current occupation type assuming that years of schooling is related to occupational choice. Similar results are reported in Appendix 5.b.

4.6. Conclusion

This study examines the consequences of child labor on the individual's self-reported health as an adult. It utilizes a unique Brazilian labor market survey that incorporates both contemporaneous measures of health status with retrospective data on child labor. The health measures include both morbidity and work-limiting disabilities. This study takes into account the endogeneity of child labor and years of schooling completed using instrumental variables that measure the direct cost and opportunity cost of schooling and the ability to pay for schooling implicitly at the time the individual was a child and in the state in which the individual was born.

Without correcting for endogeneity, the results show that earlier labor market entrants suffer consistently from higher incidence of chronic diseases and disabilities after controlling for education. Controlling for endogeneity, we find that the adverse health consequences of child labor on adult health is marginally significant in several ailments including back problems and hypertension. Nevertheless, we still find evidence that there is a significant joint effect of child labor and schooling on the incidence of chronic health conditions later in life. This finding is consistent with other evidence that child laborers select lifetime occupations with higher incidences of ailments and physical disabilities.

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Figure 1. Age of labor market entry and self reported adult health conditions in Brazil by age cohort (Source: Authors' compilation based on data from the 1998 PNAD)

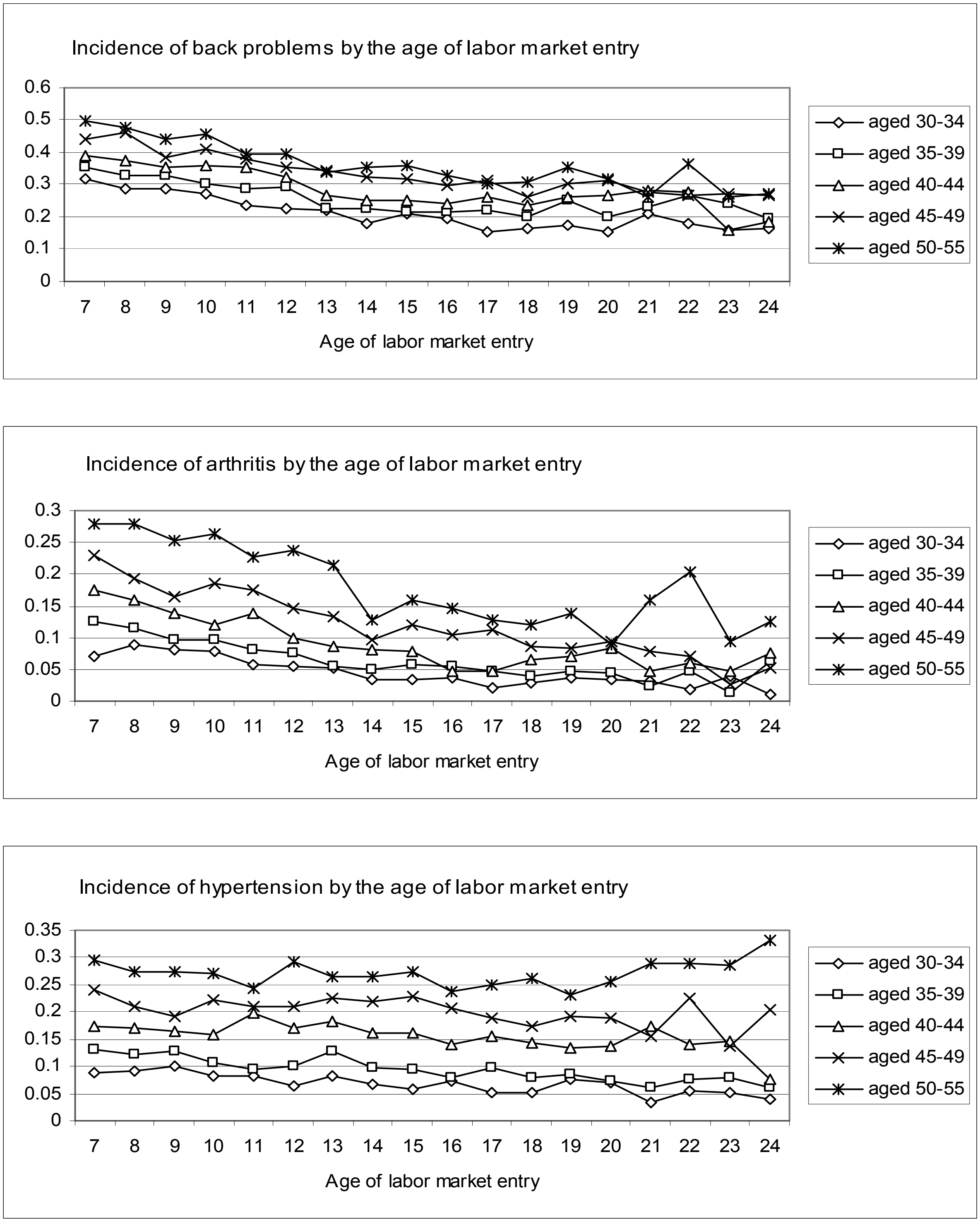


Figure 2.a. Real income (in thousands) per adult by year cohort was age 12:
Brazil and selected states (in 2000 Reals)

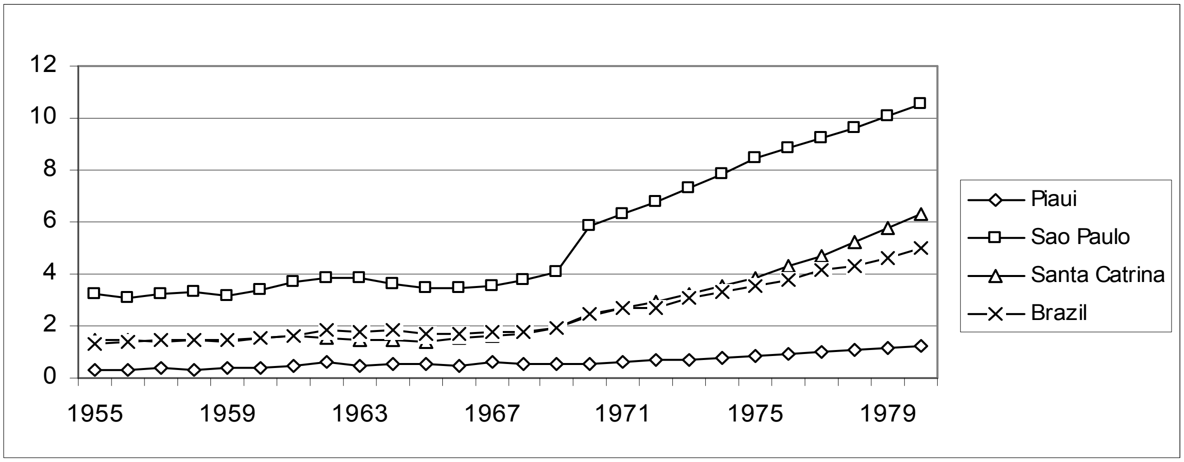


Figure 2.b. Number of schools per 1000 children by year cohort was age 7:
Brazil and selected states

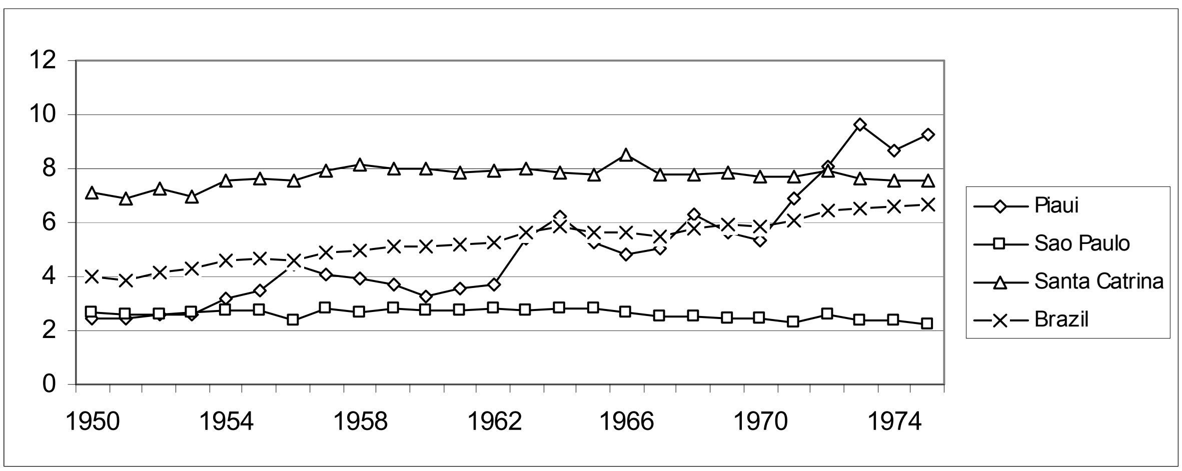


Figure 2.c. Number of teachers per 1000 children by year cohort was age 7:
Brazil and selected states

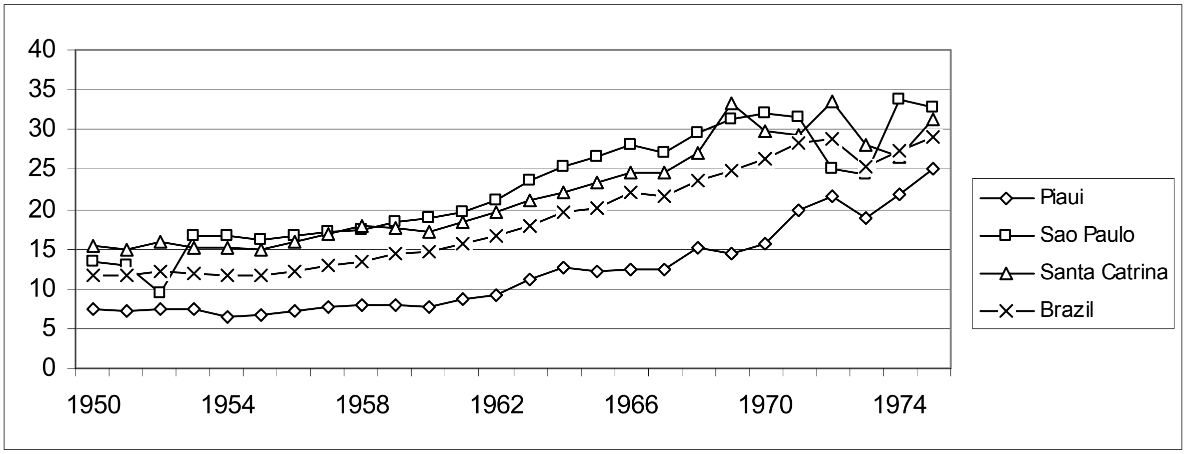


Figure 2.d. Average wage rate (in thousands) of workers with less than 5 years of schooling by year cohort was age 12:
Brazil and selected states (in 2000 Reals)

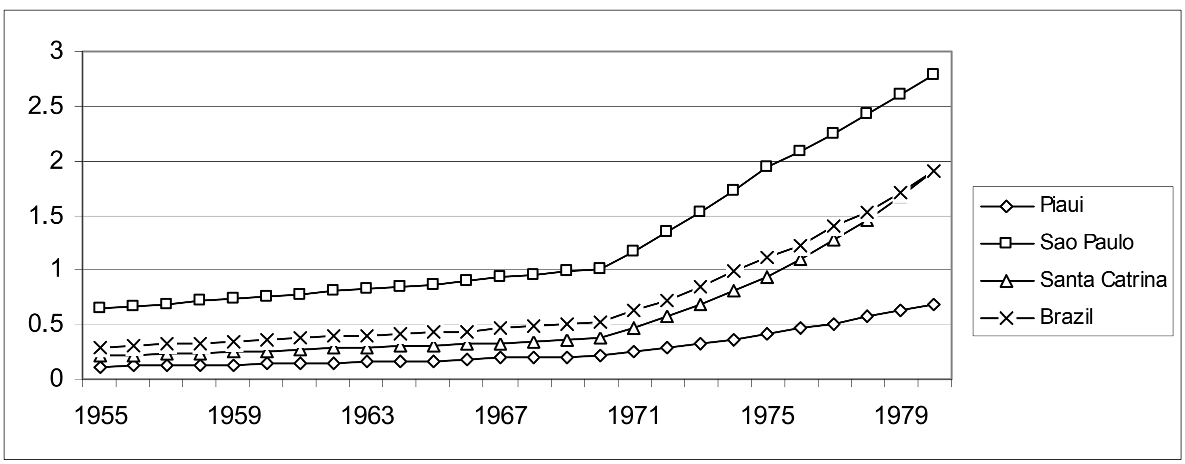


Figure 3. Distribution: Age of labor market entry (%)

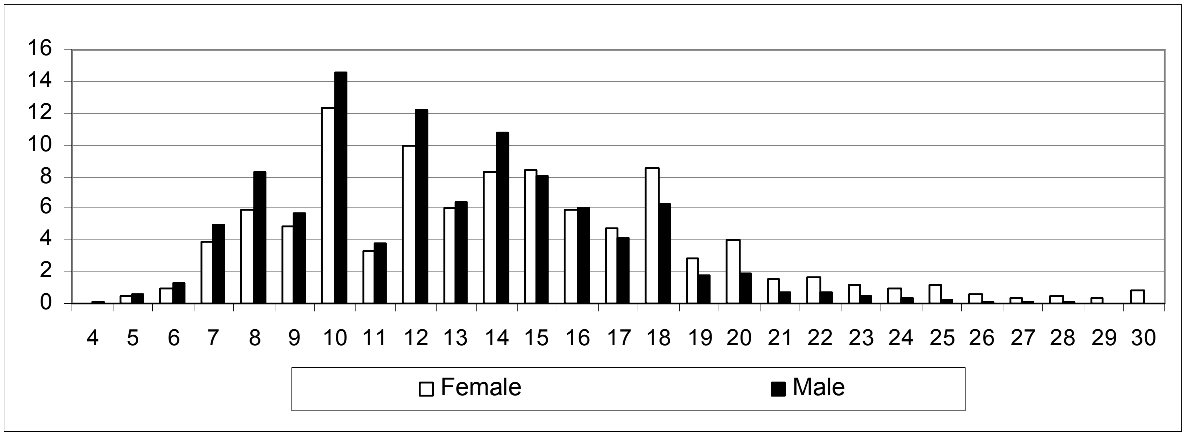


Figure 4. Distribution: Years of schooling completed (%)

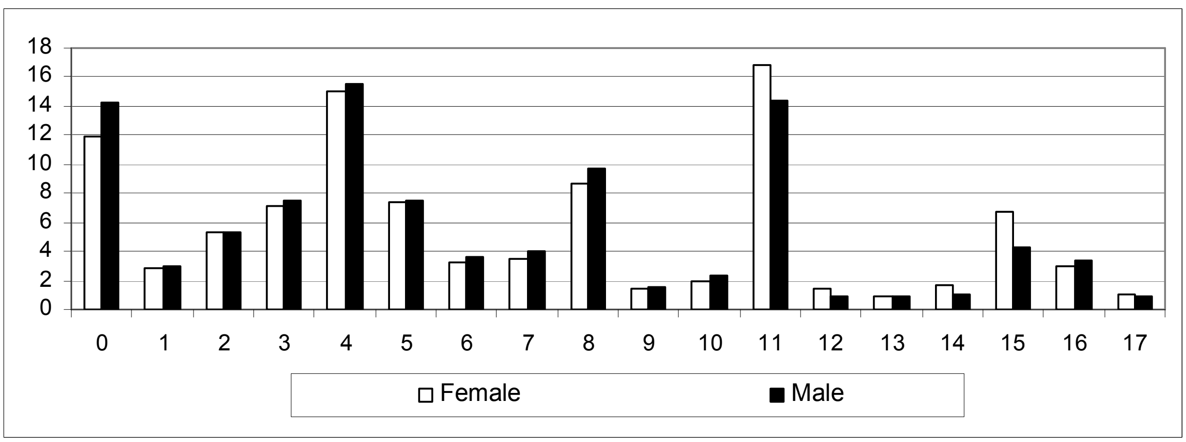


Figure 5. Average years of schooling completed and age of labor market entry by birth cohort

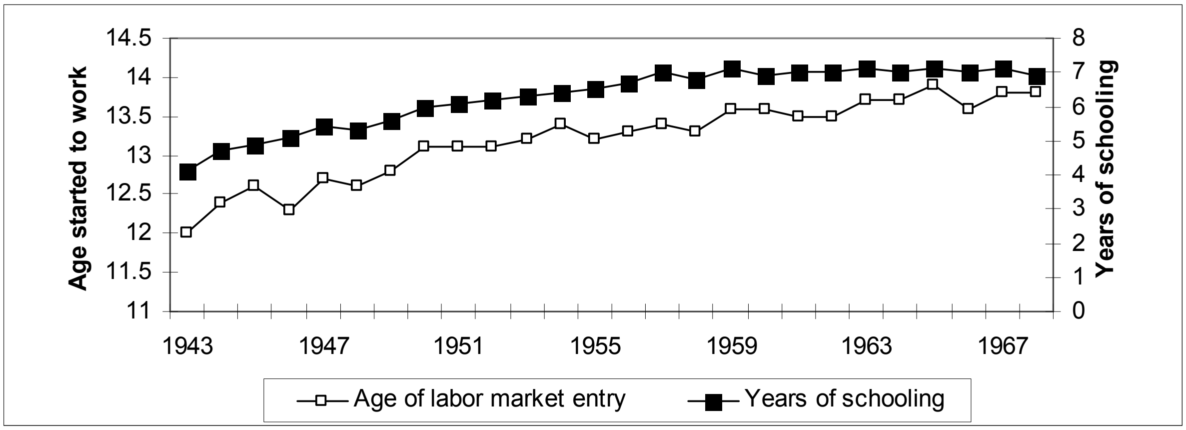


Table 1. Summary statistics

Variable	Pooled sample (n=66839)				Female (n=31133)		Male (39884)	
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Mean	Std. Dev.
Age started to work	13.3	4.4	4	30	14.1	4.9	12.7	3.9
Years of schooling	6.5	4.7	0	17	6.8	4.8	6.3	4.7
Male	.587	.492	0	1				
Age	40.7	7.0	30	55	40.4	6.9	40.9	7.0
Black	.061	.239	0	1	.060	.238	.061	.239
Brown	.392	.488	0	1	.388	.487	.394	.489
Other race	.006	.078	0	1	.006	.079	.006	.077
age3036	.334	.472	0	1	.344	.475	.328	.469
age3743	.318	.466	0	1	.326	.469	.312	.463
Chronic Disease								
Back problems	.296	.456	0	1	.326	.469	.274	.446
Arthritis	.104	.305	0	1	.137	.343	.080	.272
Cancer	.002	.044	0	1	.003	.052	.001	.037
Diabetes	.020	.139	0	1	.022	.147	.018	.133
Asthma	.030	.170	0	1	.037	.189	.024	.155
Hypertension	.150	.357	0	1	.183	.387	.126	.332
Heart disease	.040	.196	0	1	.050	.219	.032	.177
Kidney disease	.042	.200	0	1	.042	.200	.042	.200
Depression	.070	.254	0	1	.111	.314	.040	.197
Tuberculosis	.001	.034	0	1	.001	.029	.001	.037
Tendonitis	.031	.173	0	1	.046	.208	.021	.143
Cirrhosis	.002	.047	0	1	.001	.033	.003	.055
Functional Limitation								
Raising object	.086	.281	0	1	.114	.318	.067	.249
Pushing and carrying	.017	.130	0	1	.026	.160	.011	.104
Climbing stairs	.041	.198	0	1	.062	.241	.026	.158
Bending down	.039	.193	0	1	.053	.224	.029	.167
Walking 1km	.029	.167	0	1	.042	.200	.020	.139
Walking 100m	.004	.063	0	1	.005	.072	.003	.056
Instruments								
Number of school at age 7	5.5	1.8	1.4	11.9	5.6	1.8	5.5	1.8
Student -teacher ratio at age 7	20.1	8.5	5.1	51.6	20.3	8.6	20.0	8.5
Lower-skilled income at age 12	.79	.58	.11	3.18	.80	.58	.79	.58
GDP per capita at age 12	2.7	2.1	.3	11.8	2.7	2.1	2.7	2.1

Table 2. Average incidence rate of chronic diseases by people starting to work at different ages (%)

	Female				Male			
Age \ Age started to work	5-9	10-14	15+	Total	5-9	10-14	15+	Total
Back problems								
30-34	35.7	25.7	20.4	24.4	26.4	21.3	16.6	20.5
35-39	35.6	31.7	23.7	28.4	32.8	24.3	19.6	24.4
40-44	42.5	36.2	27.9	33.6	34.7	28.1	21.5	27.5
45-49	49.3	40.9	33.9	39.7	40.6	34.0	25.6	33.1
50-55	53.6	45.2	39.7	45.4	44.1	37.6	27.1	36.7
Total	43.1	34.7	26.8	32.6	35.7	28.0	21.1	27.4
Arthritis								
30-34	11.8	8.1	4.3	6.8	6.1	4.2	2.1	3.8
35-39	15.2	11.2	6.2	9.4	8.7	5.0	3.4	5.2
40-44	21.4	14.7	8.5	13.1	12.4	7.6	4.2	7.6
45-49	28.5	21.7	12.7	19.4	14.7	11.1	7.7	10.9
50-55	37.9	30.8	18.7	28.5	21.7	17.5	9.9	16.7
Total	22.7	15.7	8.4	13.7	12.7	8.2	4.7	8.0
Hypertension								
30-34	13.7	9.4	6.5	8.6	6.9	6.2	5.3	6.0
35-39	16.9	14.2	9.2	12.2	10.3	8.4	7.9	8.6
40-44	22.8	22.8	16.7	20.1	14.1	13.3	12.7	13.3
45-49	32.1	28.5	21.2	26.2	16.5	17.9	18.7	17.8
50-55	40.4	35.1	31.2	35.1	21.7	22.9	22.3	22.4
Total	24.9	20.2	14.1	18.3	13.9	12.6	11.8	12.6

Table 3. Probit estimates of age started to work, years of schooling and other control variables on the incidence of selected chronic diseases

Variables	Back Problems	Arthritis	Hypertension
Age started to work	-.0067***	-.0040***	-.0019***
	(.0005)	(.0003)	(.0004)
Years of schooling	-.0108***	-.0069***	-.0032***
	(.0004)	(.0003)	(.0003)
Age3036	-.1181***	-.0809***	-.1339***
	(.0040)	(.0020)	(.0026)
Age3743	-.0639***	-.0495***	-.0718***
	(.0041)	(.0020)	(.0027)
Male	-.0697***	-.0615***	-.0623***
	(.0036)	(.0023)	(.0028)
Black	-.0217***	-.0054	.0563***
	(.0075)	(.0024)	(.0066)
Brown	.0047	.0057**	.0163***
	(.0041)	(.0025)	(.0032)
Other race	-.0214	.0051	.0045***
	(.0231)	(.0153)	(.0178)
Pseudo R2	.0421	.1067	.0567
N	67927	67901	67927

Note.1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for state of birth.
3. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 4. Partial probit estimates of the health consequences of age started to work and years of schooling

Variables	Cancer	Diabetes	Asthma
Age started to work	<-.0001	-.0001	-.0003*
	(<.0001)	(.0001)	(.0002)
Years of schooling	<-.0001	<-.0001	-.0001
	(<.0001)	(.0001)	(.0002)
Pseudo R2	.0413	.0518	.0150
N	64853	67883	67901
	Heart disease	Kidney disease	Depression
Age started to work	-.0008***	-.0018***	-.0022***
	(.0002)	(.0002)	(.0002)
Years of schooling	-.0009***	-.0023***	-.0006***
	(.0002)	(.0002)	(.0002)
Pseudo R2	.0447	.0384	.0503
N	67857	67927	67867
	Tuberculosis	Tendonitis	Cirrhosis
Age started to work	<.0001	-.0003**	<.0001
	(<.0001)	(.0002)	(<.0001)
Years of schooling	<-.0001***	.0012***	-.0001***
	(<.0001)	(.0001)	(<.0001)
Pseudo R2	.0490	.0421	.0443
N	64421	67857	66459

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3.
3. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 5. IV Estimates-first stage regression

Variables	Age started to work	Years of schooling
Age3036	.098	.531***
	(.097)	(.139)
Age3743	.224***	.754***
	(.071)	(.114)
Male	-1.373***	-.502***
	(.059)	(.063)
Black	-1.013***	-2.637***
	(.195)	(.239)
Brown	-.0793***	-2.255***
	(.065)	(.085)
Other race	.287	1.295
	(.456)	(.815)
Number of school per 1,000 children by state	.103***	.153***
	(.020)	(.027)
Number of teacher per 1,000 children by state	.027***	.030**
	(.006)	(.012)
Average wage rate for low-skilled worker by state	.171**	.128
	(.067)	(.133)
Intercept	15.642***	7.885***
	(.114)	(.164)
Test of Excluded Instruments F(4,24)	31.8	19.2
R-Squared	.080	.134
N	67927	67927

Note. 1. Regression also includes dummy variables for state of birth.
2. Clustered robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 6. IV Estimates-second stage regression on incidence of selected chronic disease

Variables	Back Problems	Arthritis	Hypertension
Age started to work	-.2347*	-.1103	-.4242*
	(1.75)	(1.33)	(1.89)
Years of schooling	.0862	.0045	.2317
	(.78)	(.19)	(1.29)
Age3036	-.0648	-.0249	-.1101
	(1.50)	(1.14)	(1.63)
Age3743	-.0502	-.0114	-.1029
	(.94)	(.28)	(1.27)
Male	-.3378**	-.2415***	-.6050**
	(2.55)	(2.73)	(2.36)
Black	-.0016	-.0610	.3567
	(.02)	(1.32)	(.95)
Brown	-.0236	-.0787**	.0948
	(.25)	(1.79)	(.52)
Other race	-.0763	.0248	-.1095
	(.72)	(.62)	(.96)
Pseudo R2	.0270	.0783	.0561
N	67927	67901	67927
Test: Joint effects of child labor and schooling are zero	Chi2(1)=10.12	Chi2(1)=4.77	Chi2(1)=29.76
Overidentification test	Chi2(1)=3.06	Chi2(1)=.28	Chi2(1)=.21

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for state of birth.
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins'(2006) overid.ado program for Stata.9.
5. The overidentification test and joint test is distributed chi2(1) with a critical value of 3.84 at the .10 significance level.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 7. Probit estimates of age started to work and other control variables on the probability of having difficulty performing activity

Variables	Raising Object	Climbing stairs	Walking 1km
Age started to work	-.0030***	-.0014***	-.0011***
	(.0003)	(.0002)	(.0002)
Years of schooling	-.0043***	-.0021***	-.0015***
	(.0003)	(.0002)	(.0001)
Age3036	-.0660***	-.0321***	-.0209***
	(.0020)	(.0013)	(.0011)
Age3743	-.0400***	-.0183***	-.0125***
	(.0020)	(.0012)	(.0010)
Male	-.0523***	-.0361***	-.0222***
	(.0022)	(.0015)	(.0013)
Black	-.0085**	.0005	-.0017
	(.0041)	(.0028)	(.0022)
Brown	.0063***	.0044***	.0049***
	(.0024)	(.0015)	(.0013)
Other race	-.0178	-.0103	-.0154**
	(.0118)	(.0068)	(.0043)
Pseudo R2	.0707	.0857	.0654
N	67901	67901	67741

Note.1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for state of birth.
3. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 8. IV Estimates-second stage regression on the probability of having difficulty performing activity

Variables	Raising object	Climbing stairs	Walking 1km
Age started to work	-.0609	-.0750	-.0172
	(1.10)	(1.57)	(.62)
Years of schooling	-.0127	.0298	-.0079
	(.32)	(.78)	(.37)
Age3036	-.0177	-.0202	-.0034
	(1.15)	(1.56)	(.55)
Age3743	-.0035	-.0161	.0017
	(.20)	(.98)	(.09)
Male	-.1568**	-.1869***	-.0587*
	(2.52)	(2.57)	(1.73)
Black	-.0602	.0106	-.0208
	(1.49)	(.19)	(1.15)
Brown	-.0705*	-.0035	-.0250
	(1.81)	(.07)	(1.28)
Other race	.0089	-.0210	-.0091
	(.18)	(.83)	(.51)
Pseudo R2	.0553	.0705	.0521
N	67901	67901	67741
Test: Joint effects of child labor and schooling are zero	Chi2(1)=2.77	Chi2(1)=10.89	Chi2(1)=1.97
Overidentification test	Chi2(1)=.86	Chi2(1)=.05	Chi2(1)=.08

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for state of birth.
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins'(2006) overid.ado program for Stata.9.
5. The overidentification test and joint test is distributed chi2(1) with a critical value of 3.84 at the .10 significance level.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Table 9. Estimates of child labor effect on incidence of selected chronic disease by occupation

Occupation \ Diseases Age started to work	Spine	Arthritis	Hypertension
Agriculture			
Age started to work <12	.092***	.027	.029
	(.030)	(.022)	(.020)
Age started to work 12-14	.071**	-.021	.020
	(.035)	(.024)	(.024)
Pseudo R2	.015	.034	.042
N	3088	3078	3088
Manufacturing			
Age started to work <12	.089***	.044***	.012
	(.018)	(.011)	(.013)
Age started to work 12-14	.043**	.011	.004
	(.019)	(.011)	(.013)
Pseudo R2	.022	.066	.022
N	4242	4237	4212
Service			
Age started to work <12	.068***	.082***	.018
	(.024)	(.018)	(.020)
Age started to work 12-14	.044*	.054***	.035*
	(.025)	(.019)	(.021)
Pseudo R2	.018	.053	.031
N	2459	2453	2453

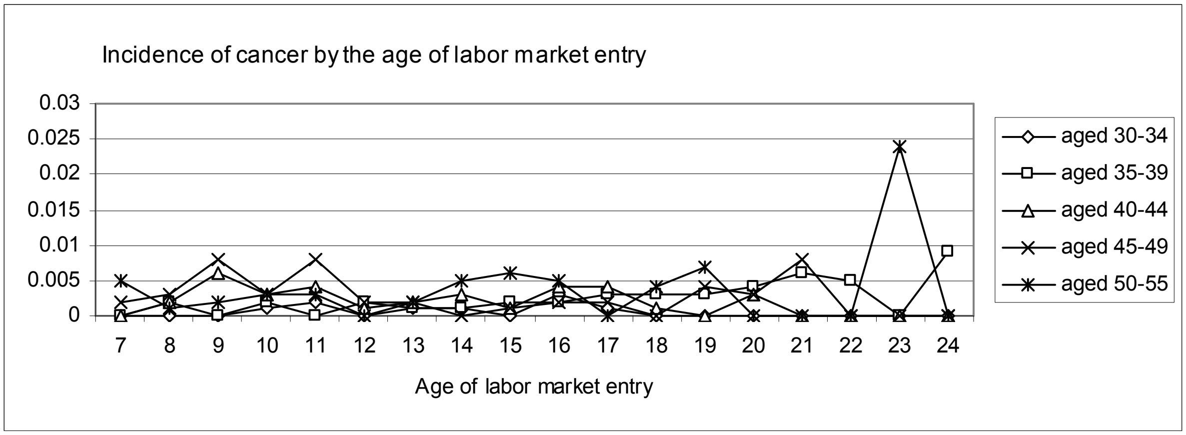
Note. 1. Regression also includes dummy variables for state of birth and demographic variables.
2. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

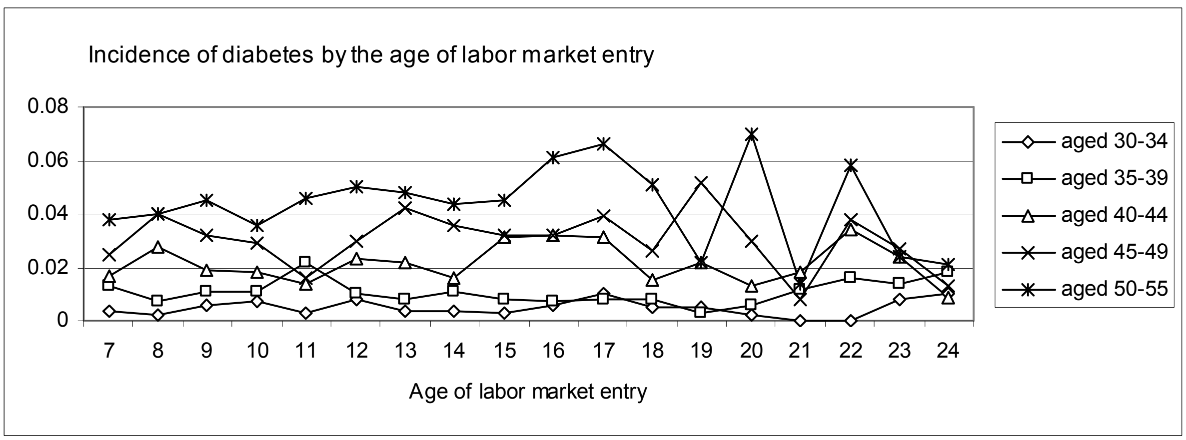
Table 10. Estimates of child labor effect on the probability of having difficulty performing activity by occupation

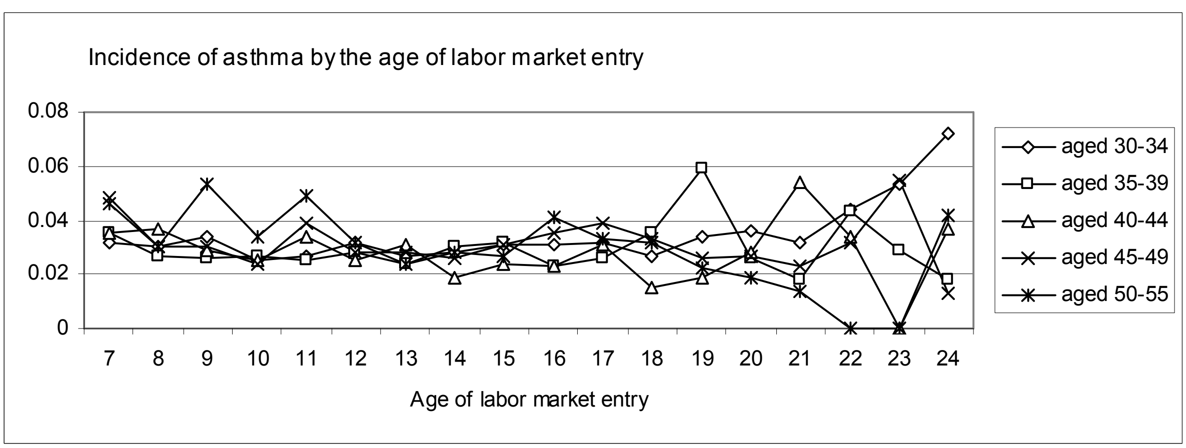
Occupation \ Limitation Age started to work	Raising object	Climbing stairs	Walking 1km
Agriculture			
Age started to work <12	.037**	.015	.018*
	(.018)	(.012)	(.009)
Age started to work 12-14	.012	.006	.011
	(.022)	(.015)	(.013)
Pseudo R2	.041	.061	.071
N	3088	3040	2926
Manufacturing			
Age started to work <12	.028***	.014***	.011**
	(.010)	(.006)	(.006)
Age started to work 12-14	.005	.004	.001
	(.010)	(.006)	(.005)
Pseudo R2	.058	.078	.094
N	4208	4182	4008
Service			
Age started to work <12	.024	.037***	.024**
	(.016)	(.013)	(.011)
Age started to work 12-14	.033**	.020	.011
	(.017)	(.014)	(.011)
Pseudo R2	.028	.034	.043
N	2433	2431	2328

Note. 1. Regression also includes dummy variables for state of birth and demographic variables.
2. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

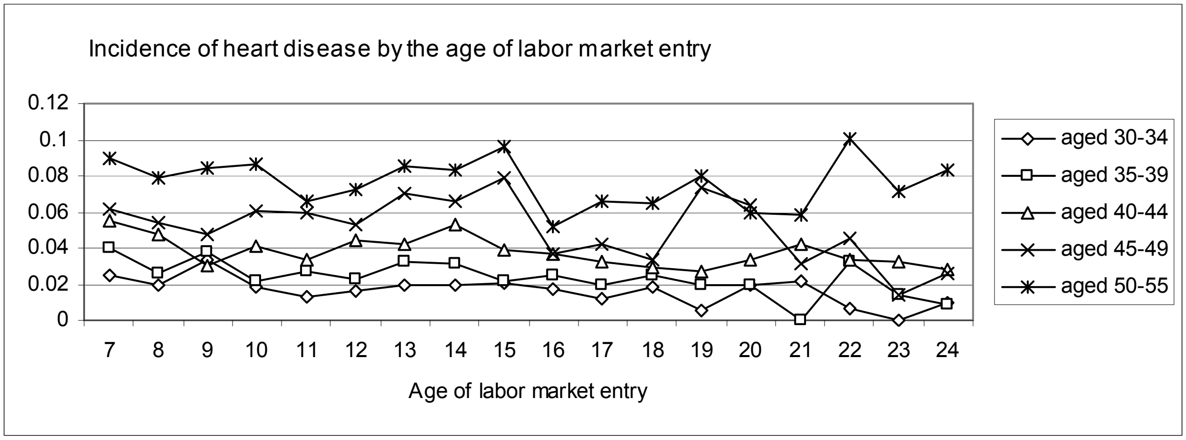
Appendix 1. Age of labor market entry and self reported adult health conditions in Brazil by age cohort (Source: Authors' compilation based on data from the 1998 PNAD)

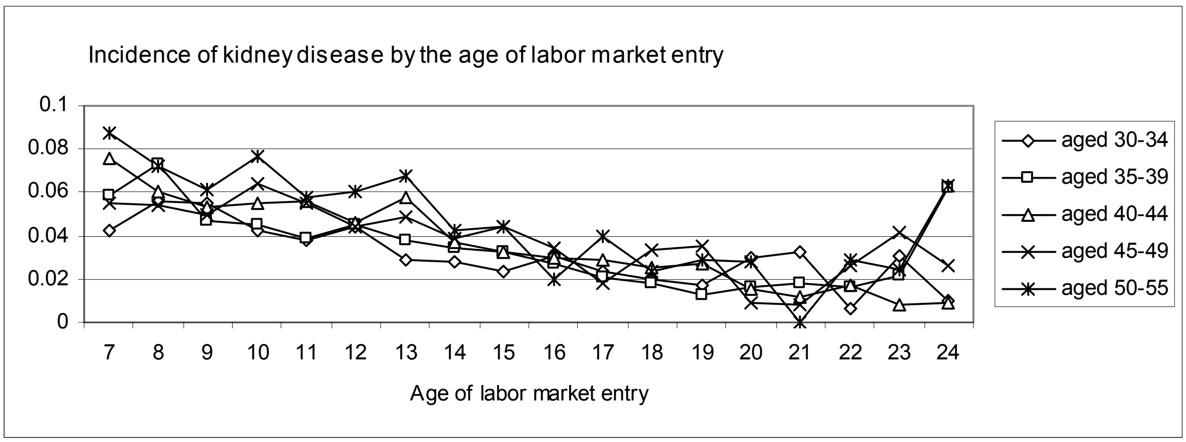


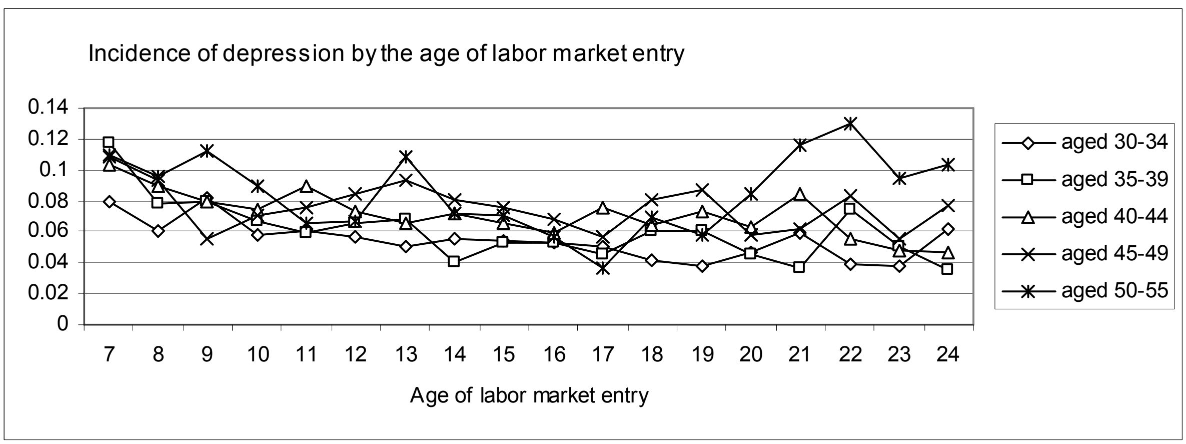




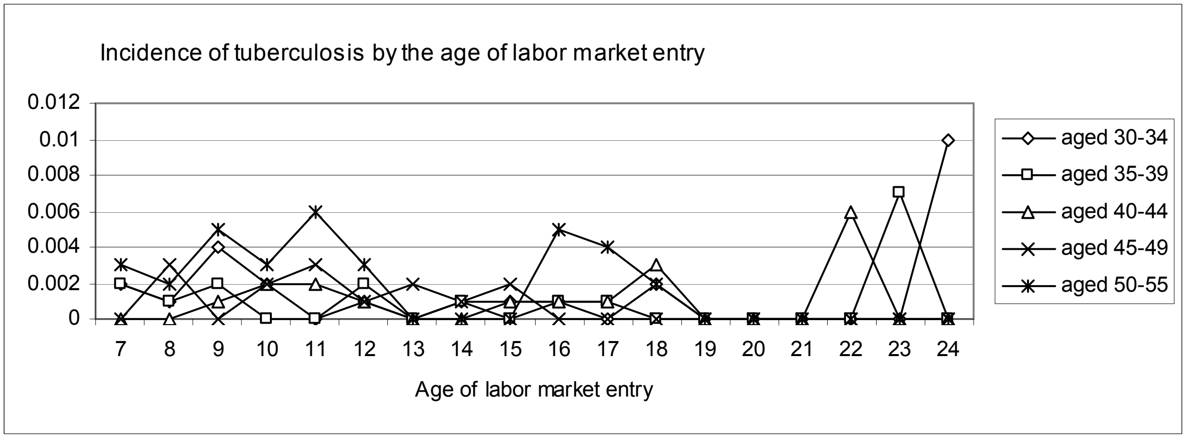
Appendix 1. (continued)

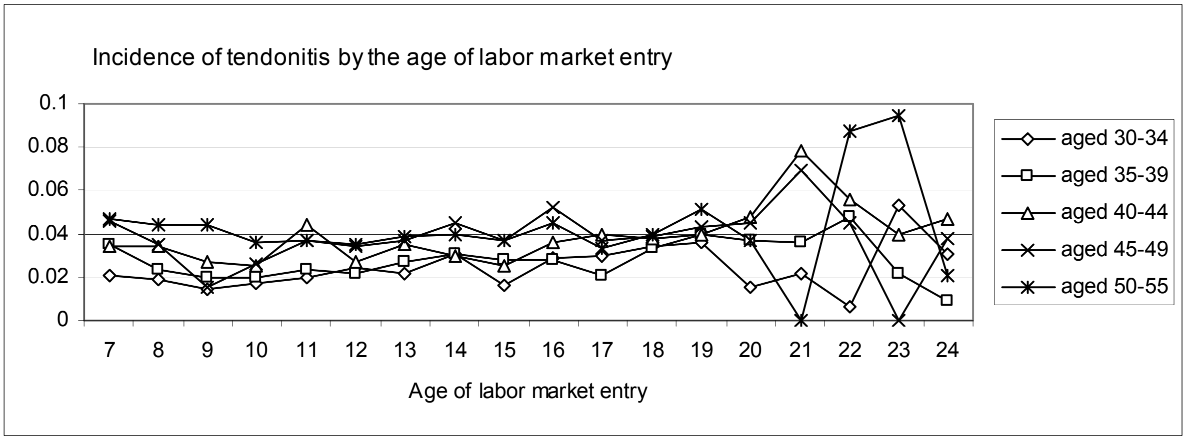


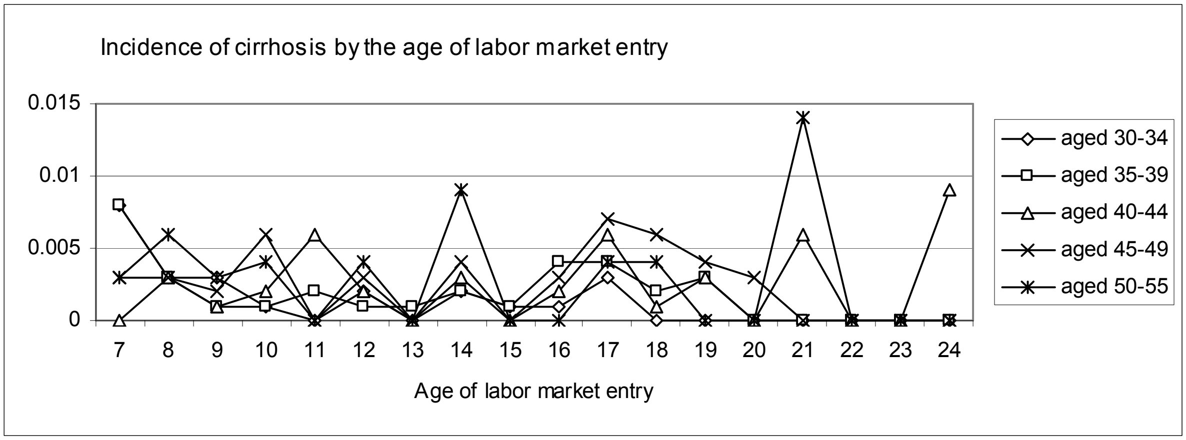




Appendix 1. (continued)







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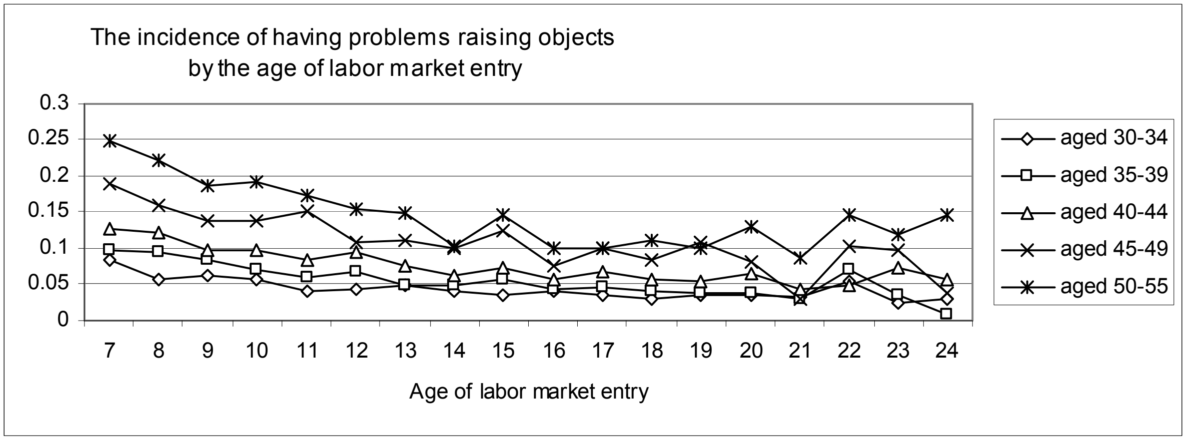
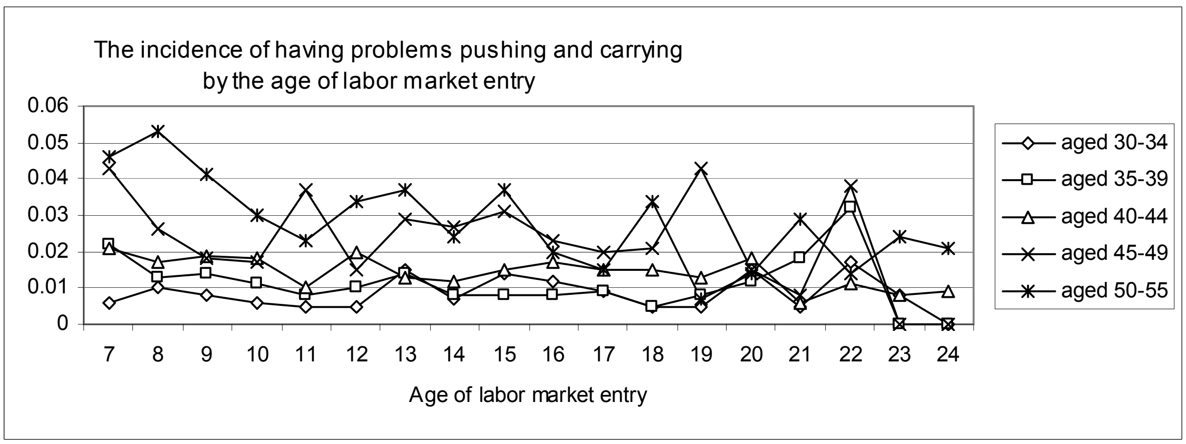
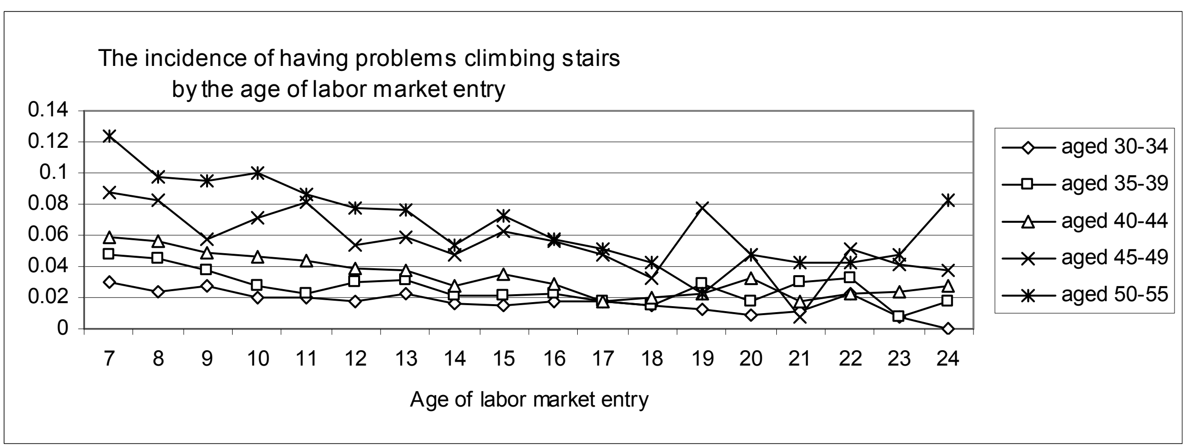
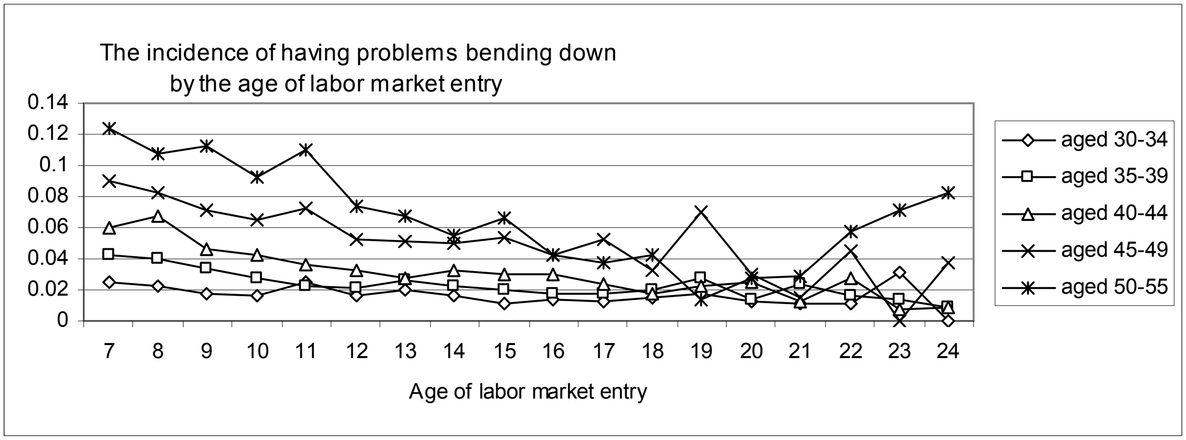
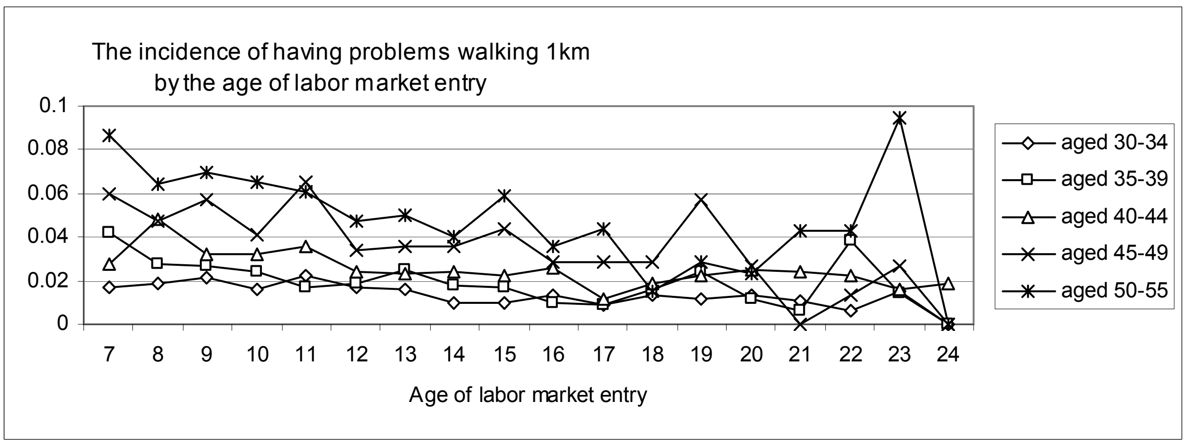


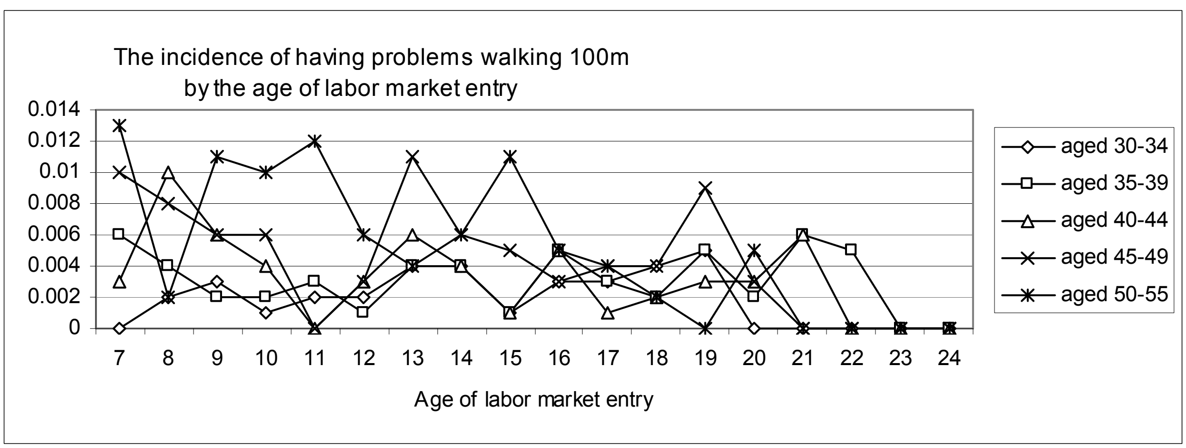




Appendix 1. (continued)







Appendix 2. Average incidence rate of chronic diseases by people starting to work at different age (%)

	Female				Male			
Age \ Age started to work	5-9	10-14	15+	Total	5-9	10-14	15+	Total
Cancer								
30-34	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1
35-39	0.2	0.2	0.4	0.3	0.0	0.1	0.2	0.1
40-44	0.4	0.2	0.2	0.3	0.3	0.3	0.1	0.2
45-49	0.7	0.5	0.3	0.4	0.2	0.1	0.0	0.1
50-55	0.2	0.3	0.6	0.4	0.2	0.2	0.3	0.2
Total	0.3	0.2	0.3	0.3	0.1	0.1	0.1	0.1
Diabetes								
30-34	0.5	0.6	0.4	0.5	0.4	0.6	0.5	0.5
35-39	1.3	1.4	1.0	1.2	0.7	0.9	0.6	0.8
40-44	3.4	2.0	2.4	2.4	1.8	1.8	2.5	2.0
45-49	4.0	4.4	2.8	3.7	3.1	2.4	3.4	2.9
50-55	4.8	5.7	5.4	5.4	3.5	3.6	4.6	3.8
Total	2.8	2.4	1.8	2.2	1.9	1.7	1.9	1.8
Asthma								
30-34	5.3	3.9	3.5	3.9	2.0	2.1	2.9	2.4
35-39	3.8	3.1	3.7	3.5	2.4	2.5	2.5	2.5
40-44	4.2	3.8	2.8	3.4	2.9	1.8	2.1	2.1
45-49	5.2	3.4	4.1	4.0	2.6	2.3	2.5	2.4
50-55	4.9	3.5	3.5	3.9	3.7	3.1	2.3	3.0
Total	4.6	3.6	3.5	3.7	2.7	2.3	2.5	2.4
Heart Disease								
30-34	3.8	2.4	1.8	2.3	1.9	1.4	1.4	1.5
35-39	5.0	3.5	2.8	3.3	2.6	1.6	2.2	2.1
40-44	6.7	6.0	3.9	5.2	3.2	2.9	3.4	2.1
45-49	7.6	8.0	6.4	7.3	4.5	4.0	5.0	4.6
50-55	13.8	10.4	8.4	10.5	6.2	6.2	6.8	6.5
Total	7.3	5.5	3.8	5.0	3.6	2.8	3.4	3.3

Appendix 2. (continued)

Age \ Age started to work	Female				Male			
	5-9	10-14	15+	Total	5-9	10-14	15+	Total
Kidney disease								
30-34	7.2	3.9	2.3	3.5	4.3	3.6	2.4	3.3
35-39	7.6	4.1	2.7	3.9	5.3	4.1	2.1	3.6
40-44	7.1	5.5	2.4	4.4	5.5	4.6	2.8	4.2
45-49	4.7	4.7	2.5	3.8	6.2	5.3	3.5	5.0
50-55	9.1	6.4	3.0	5.9	6.3	6.3	3.1	5.5
Total	7.2	4.8	2.5	4.2	5.5	4.6	2.7	4.2
Depression								
30-34	14.2	9.4	7.2	9.4	4.0	3.4	2.6	3.4
35-39	16.9	10.2	7.7	10.2	4.8	3.5	2.9	3.5
40-44	15.7	12.5	10.4	12.5	5.4	4.2	3.1	4.2
45-49	16.9	12.1	10.2	12.1	4.8	5.6	4.3	5.6
50-55	18.5	13.8	11.2	13.8	5.9	4.9	3.8	4.9
Total	16.4	11.3	8.9	11.3	5.0	4.2	3.2	4.2
Tuberculosis								
30-34	0.4	0.0	0.1	0.1	0.1	0.2	0.1	0.1
35-39	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.1
40-44	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
45-49	0.0	0.2	0.0	0.1	0.2	0.1	0.1	0.1
50-55	0.4	0.1	0.2	0.2	0.3	0.3	0.1	0.3
Total	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1
Tendonitis								
30-34	3.0	3.4	3.4	3.4	1.2	1.6	1.8	1.6
35-39	3.9	3.4	4.4	3.9	1.7	1.9	1.7	1.8
40-44	4.4	5.0	5.3	5.0	2.6	1.7	2.5	2.1
45-49	5.4	5.3	5.8	5.5	2.2	2.3	2.8	2.4
50-55	7.2	5.6	5.6	6.0	3.4	2.6	2.7	2.8
Total	4.7	4.4	4.6	4.6	2.2	1.9	2.2	2.1
Cirrhosis								
30-34	0.6	0.1	0.0	0.1	0.3	0.1	0.1	0.2
35-39	0.1	0.0	0.2	0.1	0.6	0.2	0.2	0.3
40-44	0.2	0.0	0.1	0.1	0.2	0.3	0.3	0.3
45-49	0.2	0.1	0.1	0.1	0.4	0.5	0.5	0.5
50-55	0.0	0.1	0.0	0.1	0.6	0.6	0.3	0.5

Appendix 3. IV Estimates-second stage regression on incidence of chronic disease

Variables	Cancer	Diabetes	Asthma
Age started to work	-.0148	-.1121*	.0435
	(1.15)	(1.76)	(.64)
Years of schooling	.0107	.0686	-.0363
	(1.02)	(1.34)	(.72)
Pseudo R2	.0455	.0569	.0149
N	64853	67883	67901
Test: Joint effects of child labor and schooling are zero	Chi2(1)=8.58	Chi2(1)=45.08	Chi2=16.40
Overidentification test	Chi2(1)=3.08	Chi2(1)=.03	Chi2(1)=.18
	Heart	Kidney	Depression
Age started to work	-.1016*	-.0215	-.1132
	(1.66)	(.58)	(.16)
Years of schooling	.0493	.0010	.0867
	(1.01)	(.10)	(.13)
Pseudo R2	.0437	.0213	.0465
N	67857	67927	67867
Test: Joint effects of child labor and schooling are zero	Chi2(1)=18.59	Chi2(1)=.81	Chi2(1)=23.80
Overidentification test	Chi2(1)=.25	Chi2(1)=.33	Chi2(1)=.04
	Tuberculosis	Tendonitis	Cirrhosis
Age started to work	.0067	.0272	-.0042
	(.85)	(.97)	(.89)
Years of schooling	-.0057	-.0265	.0033
	(.95)	(1.18)	(.889)
Pseudo R2	.0416	.0386	.0380
N	64421	67857	66459
Test: Joint effects of child labor and schooling are zero	Chi2(1)=1.45	Chi2(1)=.65	Chi2(1)=.93
Overidentification test	Chi2(1)=3.93	Chi2(1)=.44	Chi2(1)=.2.76

Note. 1 .Marginal probabilities are reported rather than probit coefficients.

2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3.
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins' (2006) overid.ado program for Stata.9.
5. The overidentification test and joint test is distributed chi2 (1) with a critical value of 3.84 at the .10 significance level.

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 4.a. Partial probit estimates of functional disability of age started to work and years of schooling completed

Variables	Pushing and carrying	Bending down	Walking 100m
Age started to work	-.0005***	-.0017***	-.0001***
	(.0001)	(.0002)	(.0001)
Years of schooling	-.0004***	-.0017***	-.0002***
	(.0001)	(.0002)	(.0001)
Pseudo R2	.0519	.0747	.0377
N	67901	67857	66574

Note. 1. Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3.
3. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 4.b. IV Estimates-second stage regression on the probability of having difficulty performing activity

Variables	Pushing and carrying	Bending down	Walking 100m
Age started to work	.0044	-.0552	-.0058
	(.24)	(1.34)	(.67)
Years of schooling	-.0218	.0070	-.0011
	(1.32)	(.18)	(.00)
Pseudo R2	.0501	.0616	.0347
N	67901	67857	66574
Joint effects of child labor and schooling are zero at sample mean	Chi2(1)=.22	Chi2(1)=10.06	Chi2(1)=1.04
Overidentification test	Chi2(1)=.14	Chi2(1)=2.08	Chi2(1)=.53

Note. 1 .Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3.
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins' (2006) overid.ado program for Stata.9.
5. The overidentification test and joint test is distributed chi2 (1) with a critical value of 3.84 at the .10 significance level.

Appendix 5.a. Estimates of child labor effect on incidence of selected chronic disease for people with lower primary (4-7 years of) schooling

Age started to work	Spine	Arthritis	Hypertension
Age started to work <12	.082***	.044***	.016
	(.015)	(.009)	(.011)
Age started to work 12-14	.013***	.016	.019
	(.016)	(.010)	(.012)
Pseudo R2	.016	.058	.031
N	6554	6548	6548

Note. 1. Regression also includes dummy variables for state of birth and demographic variables.
2. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 5.b. Estimates of child labor effect on the probability of having difficulty performing activity for people with lower primary (4-7 years of) schooling

Age started to work	Raising object	Climbing stairs	Walking 1km
Age started to work <12	.021***	.010*	.012***
	(.008)	(.005)	(.005)
Age started to work 12-14	.018**	.016***	.002
	(.009)	(.006)	(.005)
Pseudo R2	.043	.058	.063
N	6543	6543	6531

Note. 1. Regression also includes dummy variables for state of birth and demographic variables.
2. Robust standard errors are reported in parentheses.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Appendix 6.a. IV Estimates-second stage regression on incidence of chronic disease by gender

Variables	Back problems		Arthritis		Cancer	
	Female	Male	Female	Male	Female	Male
Age started to work	-.1382	-.2897	-.0535	-.1090	-.0262	-.0080
	(.94)	(1.39)	(.28)	(1.10)	(.49)	(.49)
Years of schooling	.0239	.1321	-.0555	.0222	.0195	.0050
	(.17)	(.78)	(.86)	(.09)	(.58)	(.13)
Pseudo R2	.0283	.0224	.0722	.0630	.0474	.0479
N	28043	39884	28033	39848	25513	33980
Joint effect test	4.54	15.97	2.84	6.75	8.20	1.29
Overidentification test	.003	5.06	2.09	4.13	5.58	4.28
	Diabetes		Asthma		Hypertension	
	Female	Male	Female	Male	Female	Male
Age started to work	-.1125	-.1061	.0724	.0217	-.3944	-.4192
	(1.04)	(1.37)	(.96)	(.64)	(1.11)	(1.44)
Years of schooling	.0663	.0658	-.0565	-.0196	.1942	.2442
	(.80)	(1.03)	(.94)	(.70)	(.73)	(1.03)
Pseudo R2	.0660	.0536	.0142	.0099	.0655	.0411
N	27851	39848	27988	39848	28009	39884
Joint effect test	14.86	15.41	4.33	.46	29.58	44.23
Overidentification test	.022	.010	.248	.019	.018	.330

Note. 1 .Marginal probabilities are reported rather than probit coefficients.

2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3..
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins' (2006) overid.ado program for Stata.9.
5. The overidentification test and joint test is distributed chi2 (1) with a critical value of 3.84 at the .10 significance level.

Appendix 6.a. (continued)

Variables	Heart disease		Kidney disease		Depression	
	Female	Male	Female	Male	Female	Male
Age started to work	-.0686	-.1264	.0116	-.0554	-.2038	-.0512
	(.87)	(1.32)	(.35)	(.98)	(1.09)	(.92)
Years of schooling	.0178	.0729	-.0224	.0265	.1481	.0420
	(.36)	(.93)	(.69)	(.56)	(1.00)	(.93)
Pseudo R2	.0456	.0338	.0203	.0258	.0134	.0095
N	27982	39848	28033	39831	28016	39831
Joint effect test	4.05	12.78	.9714	3.14	11.21	1.48
Overidentification test	.011	.306	.167	.017	.001	.543
	Tuberculosis†		Tendonitis		Cirrhosis	
	Female	Male	Female	Male	Female	Male
Age started to work	-.0046	.0142	.0199	.0296	-.0101	-.0016
	(.20)	(1.14)	(.48)	(.79)	(.58)	(.29)
Years of schooling	.0043	-.0128	-.0196	-.0294	.0085	.0008
	(.26)	(1.37)	(.57)	(.98)	(.58)	(.01)
Pseudo R2	.0447	.0390	.0265	.0189	.0105	.0369
N	17142	37838	28009	39815	22137	39000
Joint effect test	.45	3.47	.17	.81	2.21	.04
Overidentification test	1.285	2.497	.087	.317	.189	2.973

Appendix 6.b. IV Estimates-second stage regression on incidence of functional disability by Gender

Variables	Raising object†		Pushing & carrying		Climbing stairs†	
	Female	Male	Female	Male	Female	Male
Age started to work	.0161	-.1160	.0479	-.0215	-.0059	-.1233
	(.26)	(1.28)	(.78)	(.77)	(.01)	(1.34)
Years of schooling	-.0721	.0319	-.0613	.0032	-.0325	.0740
	(1.07)	(.42)	(1.20)	(.08)	(.75)	(.98)
Pseudo R2	.0468	.0430	.0365	.0298	.0569	.0396
N	28033	39868	28033	39793	28033	39793
Joint effect test	.18	8.73	.79	2.11	.44	17.42
Overidentification test	.083	1.065	.182	.026	.353	.001
	Bending down		Walking 1km		Walking 100m†	
	Female	Male	Female	Male	Female	Male
Age started to work	-.0562	-.0409	.0367	-.0452	.0185	-.0309
	(.74)	(.88)	(.60)	(1.08)	(.67)	(1.27)
Years of schooling	-.0063	.0069	-.0574	.0216	-.0199	.0196
	(.11)	(.13)	(1.08)	(.64)	(.91)	(.98)
Pseudo R2	.0566	.0459	.0426	.0345	.0429	.0302
N	28009	39815	27937	39780	27360	37854
Joint effect test	3.67	3.25	.11	4.03	1.34	8.70
Overidentification test	.412	1.846	.097	.462	.451	.070

Note. 1 .Marginal probabilities are reported rather than probit coefficients.

2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3.
3. |Z| statistics from the initial estimation using New's minimum chi square estimators are reported in parentheses.
4. † There are jointly differential effects of child labor and years of schooling completed on adult health between male and female sampled group.
5. The Amemiya-Lee-Newey test results for overidentification of instruments were generated using Baum, Schaffer, Stillman and Wiggins' (2006) overid.ado program for Stata.9.
6. The overidentification test and joint test is distributed chi2 (1) with a critical value of 3.84 at the .10 significance level.

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Chapter 5. General Conclusion

This dissertation examined the interrelationships between child labor, schooling and health, using nationally representative data from U.S. and from Brazil. The analyses assumed that parents allocate child time between work and school in the context of the family's utility optimization problem. Parents make these decisions taking into account information on the child's abilities and health endowments that are not observable to outside observers. These decisions also take into account presumed impacts of child labor on the child's lifetime human capital development and health.

In that context, the dissertation examined (1) whether state government legislation restricting youth employment actually change parental decisions on child time allocations to work or school, and whether the legislation affects academic achievements; (2) whether there is a cumulative effect of teen work on schooling outcomes; and (3) whether child labor affects future adult health.

In the second chapter, I examined how state child labor legislation affects the employment and school decisions of youth aged 14 through 17. If state restrictions on child labor are useful, they should be tied to measurable employment status or academic outcomes. I found that more stringent child labor laws requiring work permit under age 18 and mandating that children stay in school through age 17 or 18 years have almost no impact on teen labor supply decisions. The exception is a modestly lower frequency of work that violates federal hours guidelines in states with more stringent child labor laws. While state work permit requirements have a very small positive effect on the likelihood of college entry, truancy laws do not affect the likelihood of going to college, but increase marginally high school academic performance. These findings suggest that state labor laws do not have strong effects on youth labor supply choices and that hours restrictions are not well supported by evidence on adverse impacts of work hours on schooling.

In the third chapter, I examined the effects of working while in school on probability of dropout, high school grade point average, and the probability of attending college. Past studies have suggested that working while in high school does not affect high school GPA. My instrumental variable estimates indicated that more intensive employment experiences while attending high school have a small and insignificant effect on high school GPA. However, increased high school work intensity does alter the distribution of years of schooling completed: raising the likelihood of completing high school but lowering the probability of going to college. A 10% increase in cumulative hours of work in high school leads to a 1.4% decreased likelihood of entering college. These results are similar for boys and girls, and so working in school does not explain the gap in college entry between men and women.

In the fourth chapter, I examined the long term effect of child labor on health in Brazil. The results are complex. When child labor and schooling are treated as exogenous variables, child labor appears to increase the likelihood of poor health outcomes in adulthood across almost all health indicators. However, when work and school are considered endogenous, child labor loses power to explain most adverse adult health outcomes. Nevertheless, I still find evidence that there is a significant joint effect of child labor and schooling on the incidence of chronic health conditions later in life. This finding is consistent with other evidence that child laborers select lifetime occupations with higher incidences of ailments and physical disabilities.

On the whole, these chapters show that child labor can have adverse consequences for lifetime learning and health, even if the work is legal and not of the “worst forms” of child labor. In the U.S., the adverse effects of child labor on schooling are small but statistically significant. Child work is only weakly responsive to regulatory efforts, suggesting that child labor laws are not effectively enforced. In Brazil, child labor appears to contribute to the early onset of some physical disabilities, although the effects are typically modest in magnitude. These findings suggest that policies limiting child labor may be justified as a means of improving the child’s welfare later in life, but weak enforcement means that such policies have been only modestly successful in the past.

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