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The 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 across localities in the number of schools and teachers per child, and in low skill wages dated back to the time when 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 across a wide variety of health measures. However, when child labor and schooling are considered endogenous, they lose power to explain adverse adult health outcomes in almost all cases. When analyzed separately for subsamples of males and females, the explanatory power of schooling and child labor completely disappears. Failing to find a causal link between child labor and adverse adult health outcomes, we conclude that the correlation between the two is related to unobservable health and ability endowments that jointly affect child labor supply, schooling, and adult health.

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I. 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.[1] 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

[1] 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.

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 the 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. 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.[2] Thus, the early incidence of child labor may be correlated 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.[3] 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.[4] A complete assessment of the effect of child labor on health must consider the indirect effect of child labor on schooling.

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[2] 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.

[3] Studies have consistently found a large positive correlation between education and health. For examples, see Van Doorslaer (1987), Wagstaff (1993), Grossman, Michael and Kaestner (1997), and Lleras-Muney (2005).

[4] 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 and Ravallion and Wodon, 2000) finding that schooling and work are compatible. There is stronger evidence that child labor lowers test

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 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 child labor is treated as endogenous, it loses power to explain adverse adult health outcomes.

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

II. 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)

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scores, presumably because it makes time in school less efficient (Post and Pong (2000), Heady (2003), Rosatti and Rossi (2003), Gunnarrson et al (2006)).

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 gained less 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 that 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 examining 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 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 early labor market entry.

The downward pattern between age of labor market entry and adult adverse health outcomes are found for many self reported problems including 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. In contrast, no apparent correlation between child labor and adult health exists for self-reported asthma, diabetes, cancer, tuberculosis, cirrhosis, depression, heart disease, and tendonitis. Other than the last indicator, these health conditions tend to reflect heredity and life style choices rather than physical ailments. These correlations suggest that there may indeed be a relationship between starting to work at a young age and poor lifetime health. The balance of the paper examines whether we can identify a causal link between child labor and adult health that is consistent with the correlational patterns.

III. 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*, ($U_X > 0$).

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

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

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. Parents will discount the utility they get from consumption derived from child labor if at the same time they compromise the child's lifetime wealth, either because child labor directly reduces future earning as an adult ($\frac{\partial W^2}{\partial C^1}$ <0); or because child labor reduces earnings through an adverse impact on lifetime health ($\frac{\partial H^2}{\partial C^1} < 0$). The right-hand-side of the equality is the marginal utility from allocating child time to school. Schooling can affect the child's future wealth directly through its impact on skill development or indirectly through its impact 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 their 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 a child *i* born in state *j* as a member of age cohort *t* are of the form

$$C^1_{ijt} = \varphi^C_Z Z^1_{jt} + \varphi^C_W W^1_{jt} + \varphi^C_Y Y_{jt} + D'_{ijt}\varphi^C_D + \delta^C_j + \delta^C_t + \varepsilon^C_{ijt} \quad (2)$$

$$S^1_{ijt} = \varphi^S_Z Z^1_{jt} + \varphi^S_W W^1_{jt} + \varphi^S_Y Y_{jt} + D'_{ijt}\varphi^S_D + \delta^S_j + \delta^S_t + \varepsilon^S_{ijt} \quad (3)$$

The variables Z^1, W^1, and *Y* are included as required by the reduced form. 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 other adult outcomes such as occupation, employment status, marital status, 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^k_j and δ^k_t 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

$$\varepsilon^k_{ijt} = \alpha^k_a a_{ijt} + \alpha^k_h h_{ijt} + \xi^k_{ijt}; k = C, S. \quad (4)$$

The last term ξ_{ijt}^{k} is an iid random error. The reduced form 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

$$H_{ijt}^{2} = D_{ijt}^{'}\beta_D + \beta_C C_{ijt}^{1} + \beta_S S_{ijt}^{1} + \delta_j^{H} + \delta_t^{H} + \varepsilon_{ijt}^{H} \qquad (5)$$

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 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

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

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.[5] 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 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.

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.

The vector Z^1 would include the availability and quality of schools in the area where the adult grew up.[6] 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

[5] Emerson and Souza (2007) employ a similar approach to identify causal relationships between child labor and adult earnings.

[6] 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.

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.

We do not have household information on $W^1 \; Y$ but we do observe local unskilled wages that should be correlated with the opportunity cost of schooling. Because relatively few children work for wages, information on average pay for children is extremely limited and subject to selection problems.[7] Instead, we use the relative wage for workers in the state with four or fewer years of schooling as an indicator of the value of time for illiterate labor in period 1.[8] Because average schooling levels for parents at the time would have been around four years, rising low-skill wages will increase the income potential of the parents as well as the children. Therefore, we use this measure as a general indication of the relative strength of labor demand in the state and do not try to differentiate between child and parent wage levels. We date our low skill wage to 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, but our dummy variables for state of birth and age cohort will 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 demonstrate below, 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

[7] 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.
[8] It is commonly presumed that on average, it takes about five years of schooling to attain permanent literacy.

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.

IV. Data and Descriptive Analysis

A. Data

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.[9] 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.[10] Average income measures are computed from data from the IPEA historical series.[11] 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. In addition, 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.

We further restrict the sample to those who first entered the labor market at or before age 30. This does not greatly affect the sample of males but it does exclude women who never worked and/or were more likely not to respond to the question regarding age of labor market entry. As a result, our sample after deletion of cases with missing data on the variables used includes fewer women (28,043) than men (39,884). For this reason, we estimate the model separately over the subsamples of men and women to accommodate differences in labor market attachment. This also allows for differential health outcomes

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[9] We are grateful to Patrick Emerson and Andre Souza for providing us the historical data on schools and teachers by state.
[10] 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.
[11] 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.

across genders that may be related to fertility or to possible occupational differences between men and women.

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. The working sample is 60 percent male, 54 percent White, 39 percent Mixed race, and 6 percent Black.

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.[12] 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.[13] 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

[12] 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.

[13] 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.

average. Figures 2a to 2c show the time paths of the number of schools per 1000 children, the number of teachers per 1000 children and the average wage rate for those with less than 5 years of schooling. The average number of schools per 1000 children increased from 4 to 6.5 over 25 years. The availability of schools per child rose the most in the poorest states such as Piaui. Gains in the wealthier states negligible. More general improvement in quality is apparent in the time paths of teachers per student. Wealthier states had more teachers per student. Average wages of low-skilled people remained relatively stable from the mid 1950s to the late 1960s. Figure 2c shows the impact of the 'Brazilian economic miracle' years on wages for low-skilled workers. During the 1970s when real GDP per capita almost doubled, the wages for the least skilled rose everywhere. However, the gains were greatest in the richest states such as Sao Paulo and more modest in the poorest such as Piaui. Overall, these charts demonstrate sizeable variation in school availability and quality and in the price of labor 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.

We saw in Figure 1 that physical ailments occurred with greater frequency for those who began working earlier in life. As shown in Table 1, the incidence of health problems appears greater for women than men. The correlation with child labor holds up even when we examine the data separately by gender. For example, of 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. The pattern is similar for males, except that a smaller fraction of males report back problems at every age of labor market entry.

Overall, the descriptive analysis suggests that for both men and women, starting to work at an early age is correlated with earlier onset of some but not all adverse health problems in adulthood. The health problems most 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.

V. Empirical Results

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

Table 2 reports the marginal effects of a probit specification of equation (5) for a subset of the more commonly observed adverse health outcomes, holding fixed demographic factors such as age cohort, gender, race, and state of birth. These specifications assume that child labor and years of schooling are exogenous. The results are very consistent regardless of health outcome. Early onset of child labor increases the probability of reporting every adverse health outcome. Increasing years of schooling moderates these effects. For example, 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 the other health outcomes. Delaying labor market entry by one year lowers the probability of having arthritis by 0.4%; reduces hypertension by 0.2%; reduces difficulty in raising objects by 0.3%; and lowers difficulty in climbing stairs or walking by 0.1%. Larger positive effects on adult health are found from completing an additional year of schooling, ranging from reduced adverse effects as large as 0.7% for arthritis to 0.2% for difficulty walking or climbing stairs.

Table 3 presents the related estimation for other chronic diseases and physical disabilities. In all cases, child labor is associated with increased probability of adverse health outcomes at a relatively early age in adulthood, although the effects are small and are significant in only 8 of 12 cases. Increasing years of schooling lowers the likelihood of adverse health outcomes for all cases, although again the estimated effects are small and only 9 of 12 are statistically significant.

Our results indicate that when child labor is treated as exogenous, child labor consistently is associated with adverse health consequences. The largest adverse impacts are found for physical ailments such as back problems, arthritis, or difficulty raising objects. However, child labor also appears to be related to increased incidence of other health problems that would be less obviously tied to child labor such as hypertension or kidney disease. Increasing years of schooling reverses these effects. Of course, these correlations may be due to unobserved ability or 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 the individual's time invariant demographic attributes. The inclusion of dummy variable controls for seven-year birth cohort and for state of birth mean that our identification depends on differential growth rates of wages and school attributes across states and also on variation in these variables over a seven year time interval within states.

Table 4 presents the first-stage regression results. Compared to older cohorts, more recent birth groups have started working later and have spent more time in school. Males start working 1.4 years earlier and receive one-half year less schooling than women. The black and mixed race minorities also start working at earlier ages and receive less schooling.

Better access to schools and better school quality delay labor market entry. Individuals born in states at a time when there are more schools and more teachers per child enter the labor market at older ages. They also spend more time in school, with the marginal effects on time in school and age of labor market entry being nearly identical. Children born in states at a time when there are high wages for workers with less than five years of schooling enter the labor market later in life.

The impact of higher low-skill wages on years of schooling is also positive but not statistically significant. We do not have separate information on wages for children and adults, and so we can presume that rising low-skill wages increase labor market earnings for both parents and children. In other settings, general increases in labor demand have been shown to raise family income sufficiently that child labor is no longer needed, as was found by Edmonds and Pavcnik (2005b, 2006) in Vietnam.

The null hypothesis that the coefficients on these three variables are jointly equal to zero was easily rejected for both dependent variables. We correct our statistical tests for clustering by state of birth. 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 age 10. Thus, using information from the state of birth as our measures of the relevant wages and school attributes should not create too many errors.

Table 5 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. Compared to Table 2, the IV probit estimates of the impacts of child labor and schooling on adult health lose significance. In only two cases are the child labor effects even marginally significant. Years of schooling no longer has a significant impact in any of the six cases. The only consistent and persistent source of adverse health outcomes is related to gender: women report greater incidence of all adverse health outcomes. Continuing the tests in table 6, we find only two cases where child labor retains marginal significance and none where years of schooling retains a significant effect.

The other change from tables 2-3 is that the estimated effects of schooling no longer counteract the child labor effects. In only 3 of 17 cases do delaying work and increasing schooling reinforce each other. Therefore, even the weak child labor effects are counteracted by weak opposing effects of increased schooling.

Finally, the cases where we find the strongest remaining effects are no longer those involving physical ailments. Diabetes, heart disease and hypertension have no easily perceived link with early entry into the labor market. The sole remaining case where our *prima facie* evidence of a link between child labor and adverse health remains even marginally strong is that of early onset of back problems. We conclude that the hypothesis that adverse health consequences follow directly from early entry into the labor market are no longer supported by the data once the likely role of endogenous child labor and schooling are taken into account.

C. Differences across women and men

As we saw in Table 1, women are more likely to suffer these ailments than men. When we correct for endogeneity, the marginal effect of gender becomes quite large. Consequently, it is useful to separate the estimated effects by gender. It is possible that the large differences between men and women reflect differences in labor supply and occupational choices between the sexes, but may also reflect differences in exposure to health problems at an early age. In table 7, we report the IV probit estimates separately for men and women for the ailments most plausibly linked to child labor. We no longer find any evidence of a lifetime impact of child labor or schooling on adult physical disabilities. The same pattern of results holds for the other ailments as well. It appears that the correlation between child labor and health cannot be tied to a causal link. Furthermore, our results fail to demonstrate a causal link between schooling and health.

D. Child labor and adult health by occupation

It might be arguable that adverse adult health conditions come from occupational choice rather than the age at which an individual starts to 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 the range of occupational choices an individual can make. This may result in increased early incidence of physical ailments in adulthood.

To explore the role of observed occupational status on adult health, we examine the subset of individuals within an occupation and then examine whether there remains a link between child labor and health. We limit the age range to a single group aged 37-43 to reduce the likelihood that results are driven by factors that change over time and that are correlated with child labor. If the source of the correlation between child labor and adult health is observed occupational choices, then the link between child labor and health should disappear within occupations. Similarly, if child labor lowers years of schooling which in turn leads to adverse health outcomes, we should find no link between child labor and health holding schooling fixed.

Focusing on a single occupation or a narrow educational group, 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 8.

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. Across all sectors, entering the labor market earlier is correlated with increased incidence of back injury and difficulty raising objects and walking. In manufacturing and services, we also find raised incidence of arthritis and difficulty climbing stairs. The weakest relationship between early labor market entry and health is in the case of hypertension. Had occupational choice been the source of the correlation between child labor and adult health, we should have seen reduced evidence of a linkage between child labor and health, but that is not the case.

At the bottom of the table, we repeat the exercise for a sample that holds schooling and age fixed. Again we find a strong relationship between child labor and adult health for every health measure except hypertension. Apparently the correlation between child labor and adult health is not due to an underlying correlation between child labor and years of schooling either.

It is still possible that the correlation between child labor and adult health is related to another observable choice that is correlated with both. However, our findings that correcting for endogeneity removes the evidence of a link between child labor and health suggest that health and/or ability endowments are the likely source of the observed correlation.

VI. 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. The source of the underlying correlation between child labor and health appears to be related to unobserved differences in health and ability endowments. Controlling for endogeneity, we find that the adverse health consequences of child labor on adult health largely disappear.

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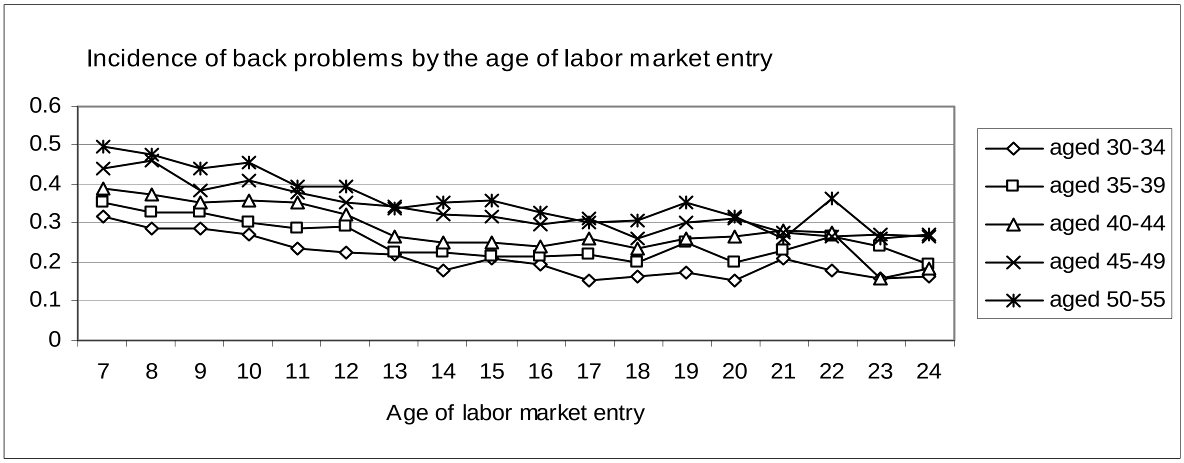
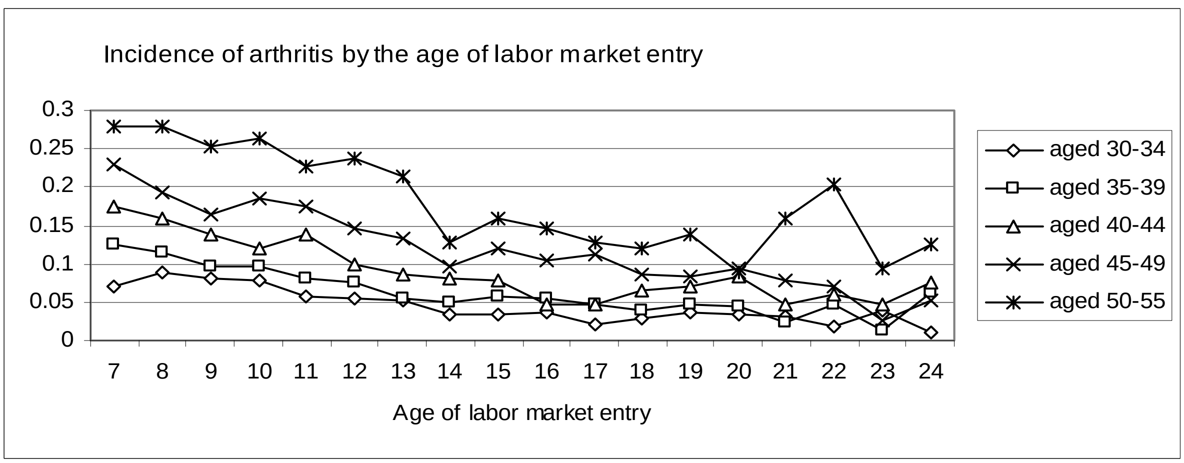
Figure 1. Age of labor market entry and self reported adult health conditions in Brazil by age cohort (Source: Authors' compilation based on data from the 1998 PNAD)





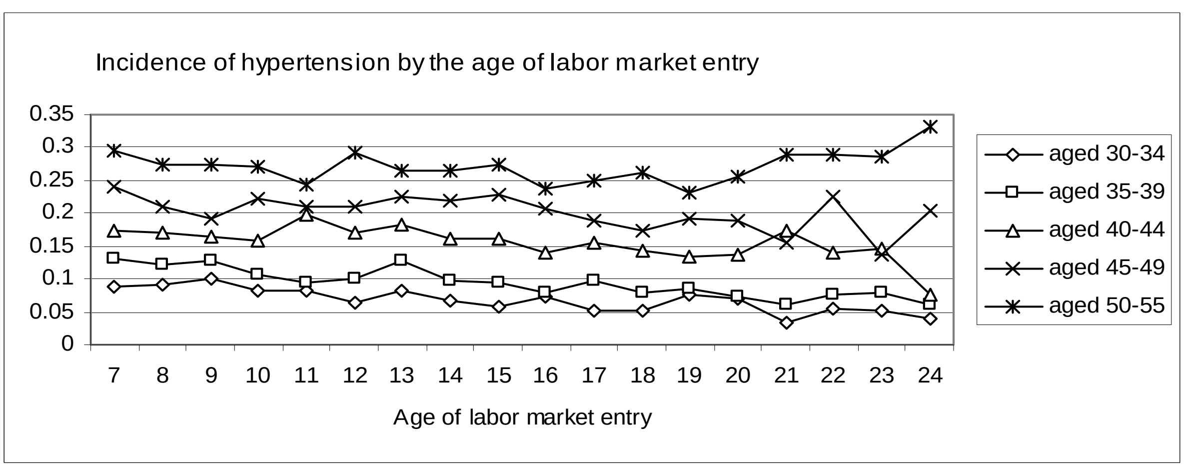


Figure 2a Schools per 1000 children by year cohort was age 7: Brazil and selected states

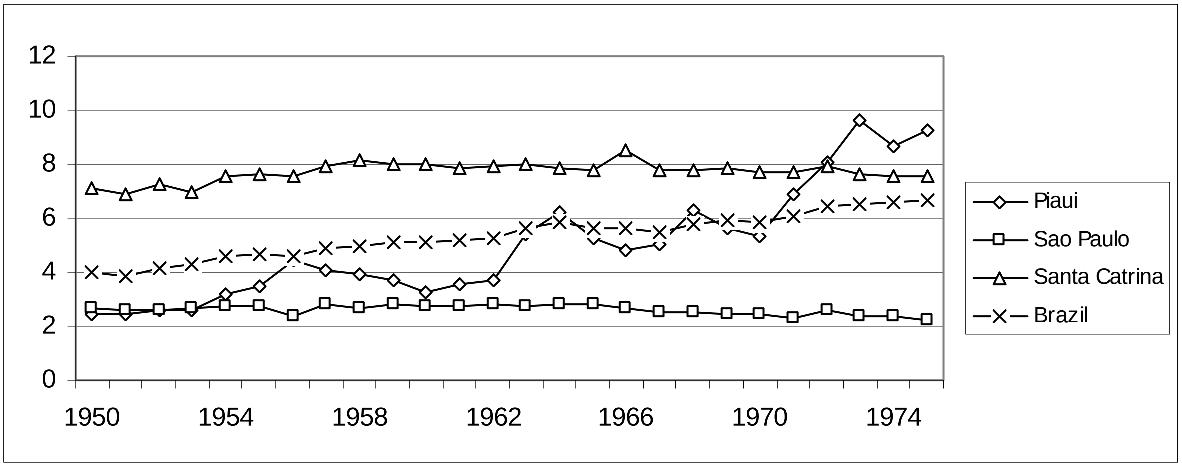


Figure 2b Teachers per 1000 children by year cohort was age 7: Brazil and selected states

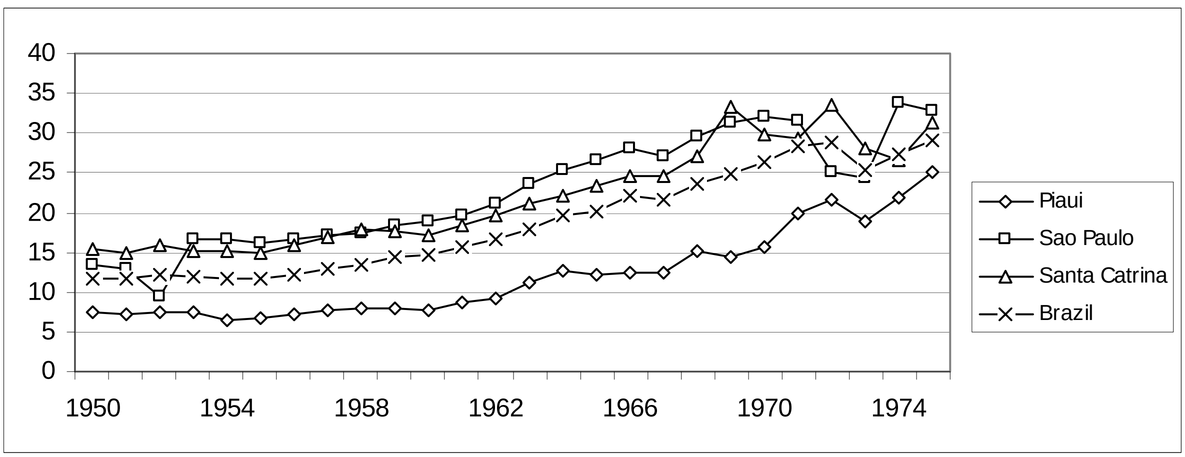


Figure 2c. Average wage rate (in thousands of 200 Reals) for workers with less than 5 years of schooling by year cohort was age 12: Brazil and selected states

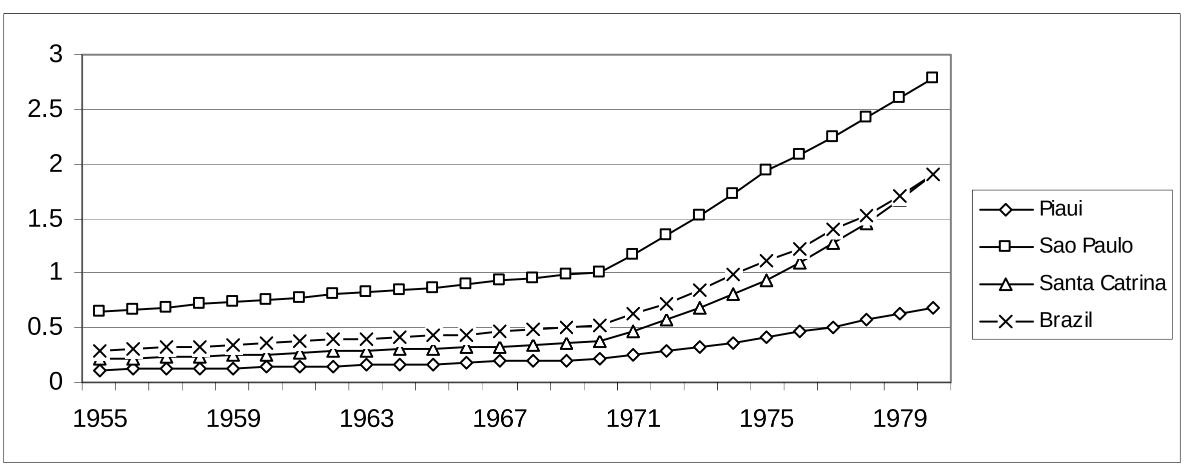


Figure 3. Distribution: Age of labor market entry (%)

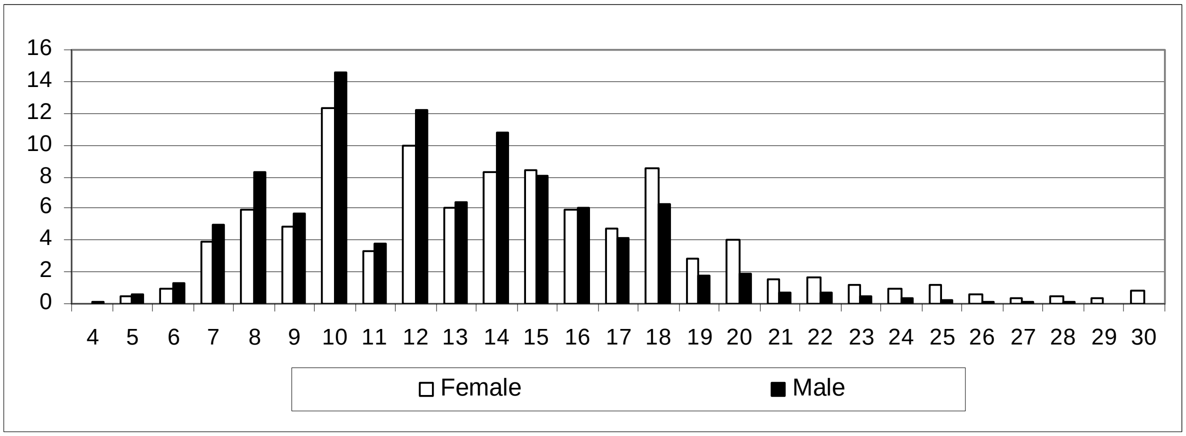


Figure 4. Distribution: Years of schooling completed (%)

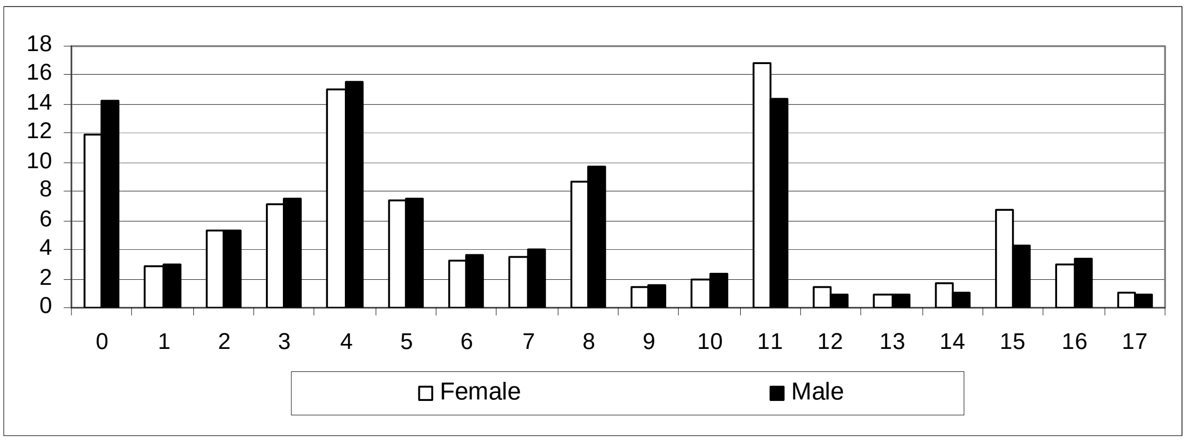


Figure 5. Average years of schooling completed and age of labor market entry by birth cohort

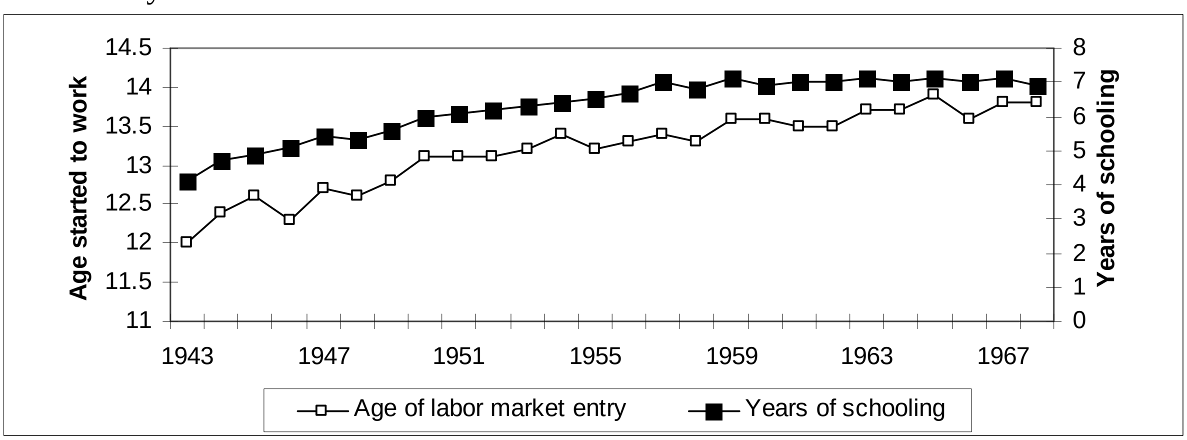


Table 1. Summary statistics

Variable	Pooled sample (n=66839) Mean	Std. Dev.	Min	Max	Female (n=31133) Mean	Std. Dev.	Male (39884) 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
Mixed	.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 schools 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 wage at age 12	.79	.58	.11	3.18	.80	.58	.79	.58

Table 2. 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	Raising Object	Climbing stairs	Walking 1km
Age started to work	-.0067***	-.0040***	-.0019***	-.0030***	-.0014***	-.0011***
	(.0005)	(.0003)	(.0004)	(.0003)	(.0002)	(.0002)
Years of schooling	-.0108***	-.0069***	-.0032***	-.0043***	-.0021***	-.0015***
	(.0004)	(.0003)	(.0003)	(.0003)	(.0002)	(.0001)
Age3036	-.1181***	-.0809***	-.1339***	-.0660***	-.0321***	-.0209***
	(.0040)	(.0020)	(.0026)	(.0020)	(.0013)	(.0011)
Age3743	-.0639***	-.0495***	-.0718***	-.0400***	-.0183***	-.0125***
	(.0041)	(.0020)	(.0027)	(.0020)	(.0012)	(.0010)
Male	-.0697***	-.0615***	-.0623***	-.0523***	-.0361***	-.0222***
	(.0036)	(.0023)	(.0028)	(.0022)	(.0015)	(.0013)
Black	-.0217***	-.0054	.0563***	-.0085**	.0005	-.0017
	(.0075)	(.0024)	(.0066)	(.0041)	(.0028)	(.0022)
Mixed	.0047	.0057**	.0163***	.0063***	.0044***	.0049***
	(.0041)	(.0025)	(.0032)	(.0024)	(.0015)	(.0013)
Other race	-.0214	.0051	.0045***	-.0178	-.0103	-.0154**
	(.0231)	(.0153)	(.0178)	(.0118)	(.0068)	(.0043)
Pseudo R2	.0421	.1067	.0567	.0707	.0857	.0654
N	67927	67901	67927	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 3. Partial probit estimates of the health consequences of age started to work and years of schooling

Variables	Cancer	Diabetes	Asthma	Pushing and carrying
Age started to work	<-.0001	-.0001	-.0003*	-.0005***
	(<.0001)	(.0001)	(.0002)	(.0001)
Years of schooling	<-.0001	<-.0001	-.0001	-.0004***
	(<.0001)	(.0001)	(.0002)	(.0001)
Pseudo R2	.0413	.0518	.0150	.0519
N	64853	67883	67901	67901
	Heart disease	Kidney disease	Depression	Bending down
Age started to work	-.0008***	-.0018***	-.0022***	-.0017***
	(.0002)	(.0002)	(.0002)	(.0002)
Years of schooling	-.0009***	-.0023***	-.0006***	-.0017***
	(.0002)	(.0002)	(.0002)	(.0002)
Pseudo R2	.0447	.0384	.0503	.0747
N	67857	67927	67867	67857
	Tuberculosis	Tendonitis	Cirrhosis	Walking 100m
Age started to work	<.0001	-.0003**	<.0001	-.0001***
	(<.0001)	(.0002)	(<.0001)	(.0001)
Years of schooling	<-.0001***	.0012***	-.0001***	-.0002***
	(<.0001)	(.0001)	(<.0001)	(.0001)
Pseudo R2	.0490	.0421	.0443	.0377
N	64421	67857	66459	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.

Table 4. 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)
Mixed	-.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 5. IV Estimates-second stage regression on incidence of selected chronic disease

Variables	Back Problems	Arthritis	Hypertension	Raising object	Climbing stairs	Walking 1km
Age started to work	-.2347*	-.1103	-.4242*	-.0609	-.0750	-.0172
	(1.75)	(1.33)	(1.89)	(1.10)	(1.57)	(.62)
Years of schooling	.0862	.0045	.2317	-.0127	.0298	-.0079
	(.78)	(.19)	(1.29)	(.32)	(.78)	(.37)
Age3036	-.0648	-.0249	-.1101	-.0177	-.0202	-.0034
	(1.50)	(1.14)	(1.63)	(1.15)	(1.56)	(.55)
Age3743	-.0502	-.0114	-.1029	-.0035	-.0161	.0017
	(.94)	(.28)	(1.27)	(.20)	(.98)	(.09)
Male	-.3378**	-.2415***	-.6050**	-.1568**	-.1869***	-.0587*
	(2.55)	(2.73)	(2.36)	(2.52)	(2.57)	(1.73)
Black	-.0016	-.0610	.3567	-.0602	.0106	-.0208
	(.02)	(1.32)	(.95)	(1.49)	(.19)	(1.15)
Mixed	-.0236	-.0787**	.0948	-.0705*	-.0035	-.0250
	(.25)	(1.79)	(.52)	(1.81)	(.07)	(1.28)
Other race	-.0763	.0248	-.1095	.0089	-.0210	-.0091
	(.72)	(.62)	(.96)	(.18)	(.83)	(.51)
Pseudo R2	.0270	.0783	.0561	.0553	.0705	.0521
N	67927	67901	67927	67901	67901	67741
Test: Joint effects of child labor and schooling are zero	Chi2(1)=10.12	Chi2(1)=4.77	Chi2(1)=29.76	Chi2(1)=2.77	Chi2(1)=10.89	Chi2(1)=1.97
Overidentification test	Chi2(1)=3.06	Chi2(1)=.28	Chi2(1)=.21	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 Newey'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 6 IV Estimates-second stage regression on incidence of chronic disease

Variables	Cancer	Diabetes	Asthma	Tuberculosis	Pushing and carrying	Bending down
Age started to work	-.0148	-.1121*	.0435	.0067	.0044	-.0552
	(1.15)	(1.76)	(.64)	(.85)	(.24)	(1.34)
Years of schooling	.0107	.0686	-.0363	-.0057	-.0218	.0070
	(1.02)	(1.34)	(.72)	(.95)	(1.32)	(.18)
Pseudo R2	.0455	.0569	.0149	.0416	.0501	.0616
N	64853	67883	67901	64421	67901	67857
Test: Joint effects of child labor and schooling are zero	Chi2(1)=8.58	Chi2(1)=45.08	Chi2=16.40	Chi2(1)=1.45	Chi2(1)=.22	Chi2(1)=10.06
Overidentification test	Chi2(1)=3.08	Chi2(1)=.03	Chi2(1)=.18	Chi2(1)=3.93	Chi2(1)=.14	Chi2(1)=2.08
	Heart	Kidney	Depression	Tendonitis	Walking 100m	
Age started to work	-.1016*	-.0215	-.1132	.0272	-.0058	
	(1.66)	(.58)	(.16)	(.97)	(.67)	
Years of schooling	.0493	.0010	.0867	-.0265	-.0011	
	(1.01)	(.10)	(.13)	(1.18)	(.00)	
Pseudo R2	.0437	.0213	.0465	.0386	.0347	
N	67857	67927	67867	67857	66574	
Test: Joint effects of child labor and schooling are zero	Chi2(1)=18.59	Chi2(1)=.81	Chi2(1)=23.80	Chi2(1)=.65	Chi2(1)=1.04	
Overidentification test	Chi2(1)=.25	Chi2(1)=.33	Chi2(1)=.04	Chi2(1)=.44	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 Newey'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: IV Estimates-second stage regression on incidence of chronic disease by gender

Variables	Back problems		Arthritis		Hypertension		Tendonitis	
	Female	Male	Male	Male	Male	Female	Male	Female
Age started to work	-.1382	-.2897	.0142	-.0016	.0217	.0116	-.0554	-.2038
	(.94)	(1.39)	(1.14)	(.29)	(.64)	(.35)	(.98)	(1.09)
Years of schooling	.0239	.1321	-.0128	.0008	-.0196	-.0224	.0265	.1481
	(.17)	(.78)	(1.37)	(.01)	(.70)	(.69)	(.56)	(1.00)
Pseudo R2	.0283	.0224	.0390	.0369	.0099	.0203	.0258	.0134
N	28043	39884	37838	39000	39848	28033	39831	28016
Joint effect test	4.54	15.97	3.47	.04	.46	.97	3.14	11.21
Overidentification test	.003	5.06	2.497	2.973	.019	.167	.017	.001

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

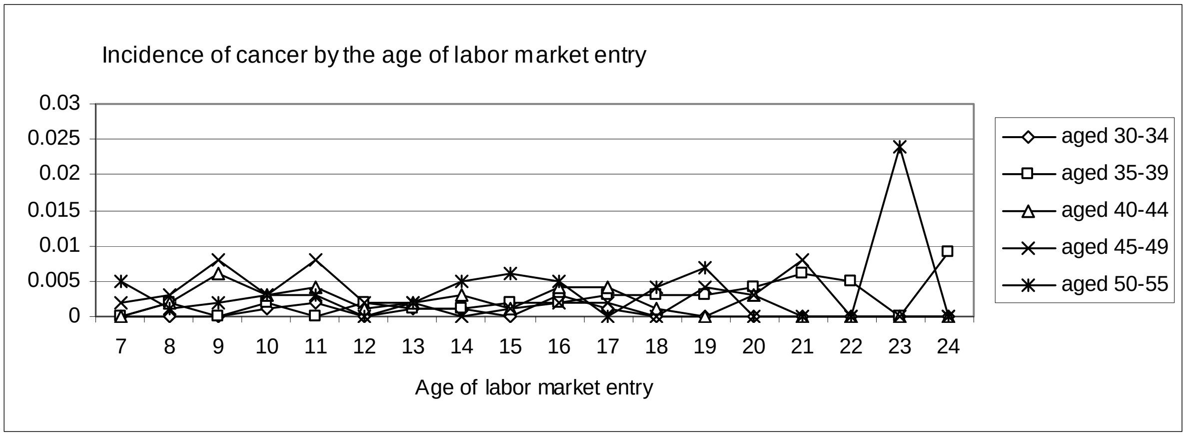
Note. 1 .Marginal probabilities are reported rather than probit coefficients.
2. Regression also includes dummy variables for cohort and state of birth and demographic variables in Table 3..
3. |Z| statistics from the initial estimation using Newey's minimum chi square estimators are reported in parentheses.
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.
6. † There are jointly differential effects of child labor and years of schooling completed on adult health between male and female sampled group.
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

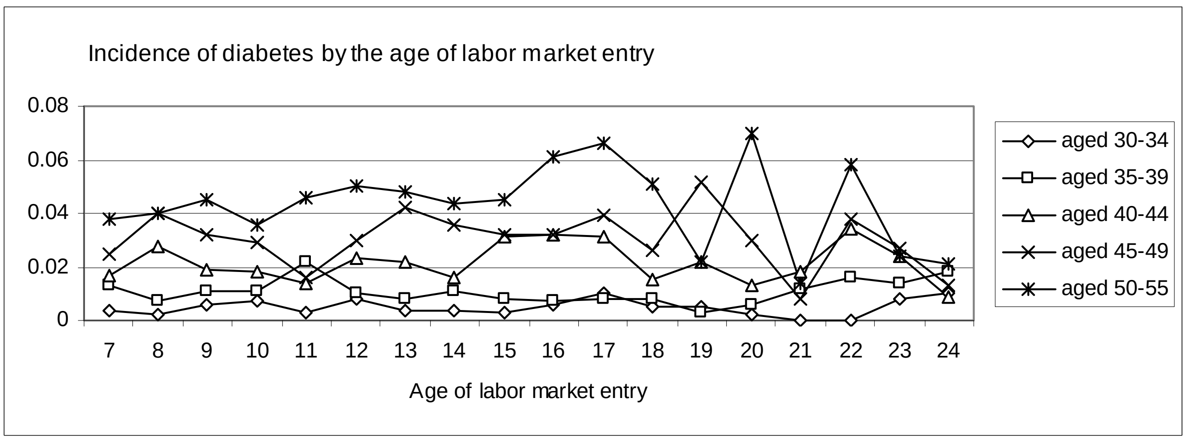
Table 8. Estimates of child labor effect on incidence of selected chronic disease by occupation or schooling level

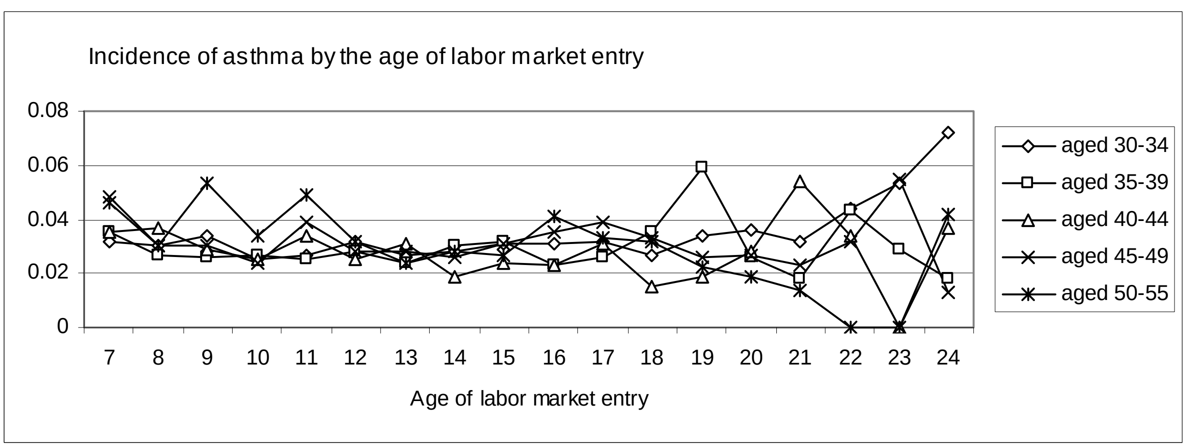
Occupation \ Diseases Age started to work	Back Problems	Arthritis	Hypertension	Raising object	Climbing stairs	Walking 1km
Agriculture						
Age started to work <12	.092***	.027	.029	.037**	.015	.018*
	(.030)	(.022)	(.020)	(.018)	(.012)	(.009)
Age started to work 12-14	.071**	-.021	.020	.012	.006	.011
	(.035)	(.024)	(.024)	(.022)	(.015)	(.013)
Pseudo R2	.015	.034	.042	.041	.061	.071
N	3088	3078	3088	3088	3040	2926
Manufacturing						
Age started to work <12	.089***	.044***	.012	.028***	.014***	.011**
	(.018)	(.011)	(.013)	(.010)	(.006)	(.006)
Age started to work 12-14	.043**	.011	.004	.005	.004	.001
	(.019)	(.011)	(.013)	(.010)	(.006)	(.005)
Pseudo R2	.022	.066	.022	.058	.078	.094
N	4242	4237	4212	4208	4182	4008
Service						
Age started to work <12	.068***	.082***	.018	.024	.037***	.024**
	(.024)	(.018)	(.020)	(.016)	(.013)	(.011)
Age started to work 12-14	.044*	.054***	.035*	.033**	.020	.011
	(.025)	(.019)	(.021)	(.017)	(.014)	(.011)
Pseudo R2	.018	.053	.031	.028	.034	.043
N	2459	2453	2453	2433	2431	2328
4-7 years of Schooling						
Age started to work <12	.082***	.044***	.016	.021***	.010*	.012***
	(.015)	(.009)	(.011)	(.008)	(.005)	(.005)
Age started to work 12-14	.013***	.016	.019	.018**	.016***	.002
	(.016)	(.010)	(.012)	(.009)	(.006)	(.005)
Pseudo R2	.016	.058	.031	.043	.058	.063
N	6554	6548	6548	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.

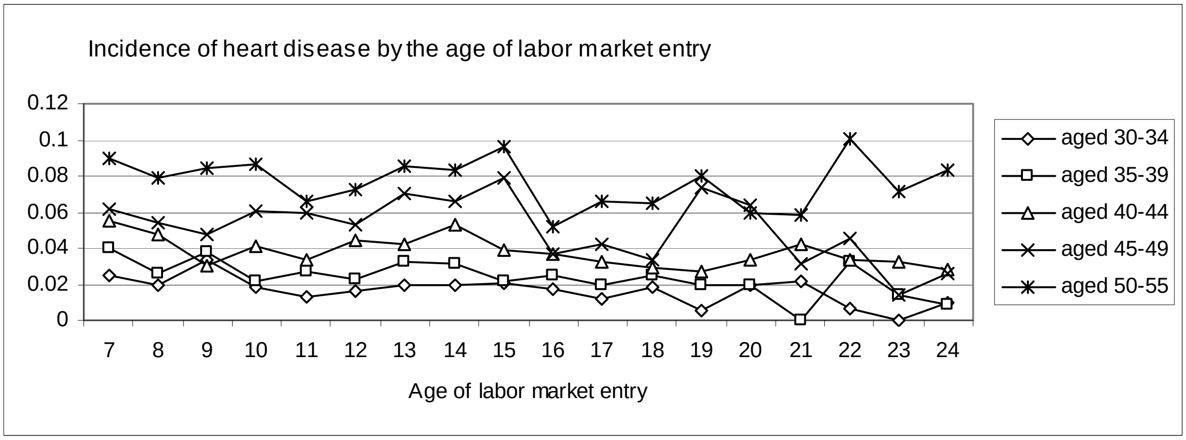
Appendix 1. Age of labor market entry and self reported adult health conditions in Brazil by age cohort (Source: Authors' compilation based on data from the 1998 PNAD)

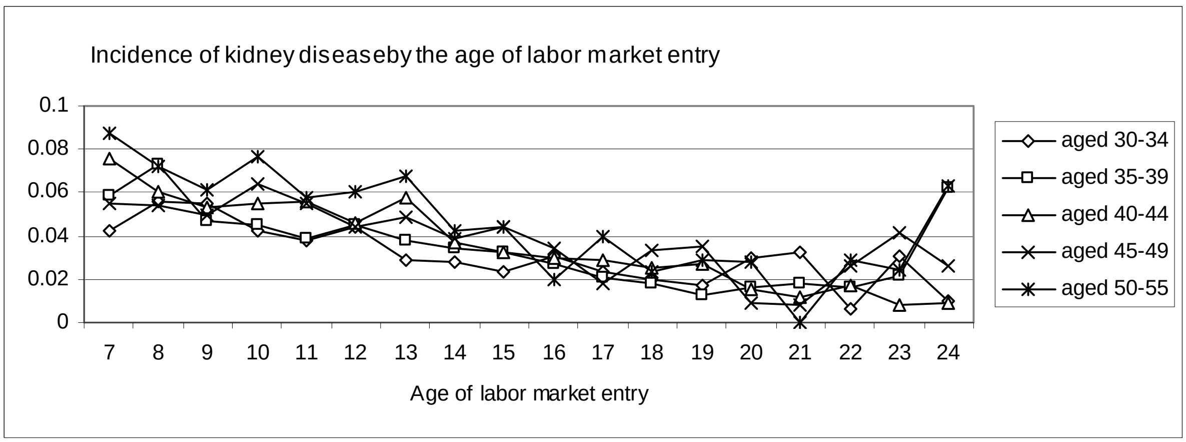


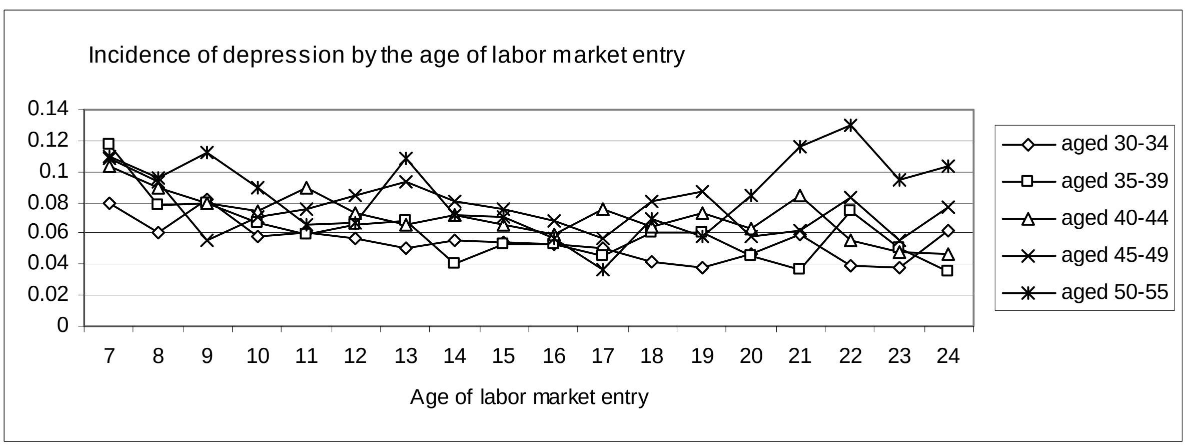




Appendix 1. (continued)







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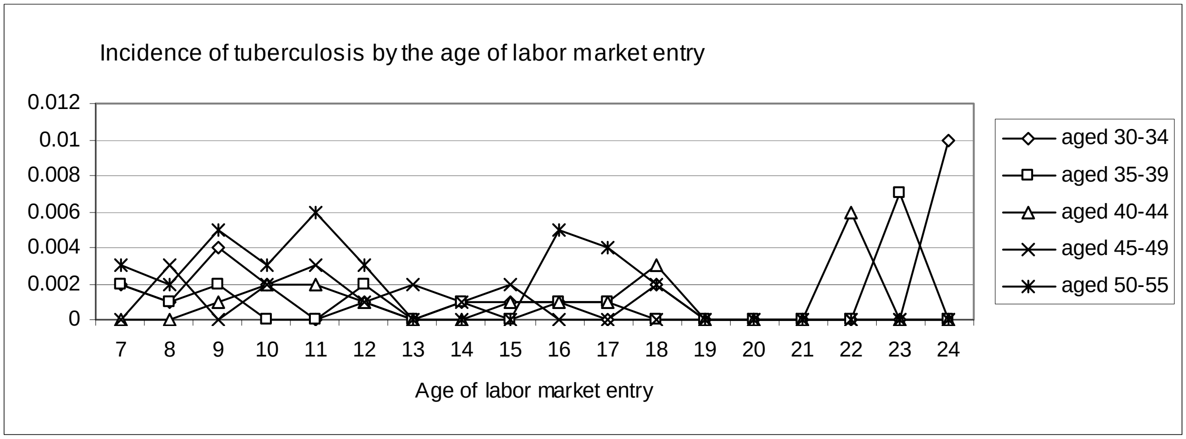

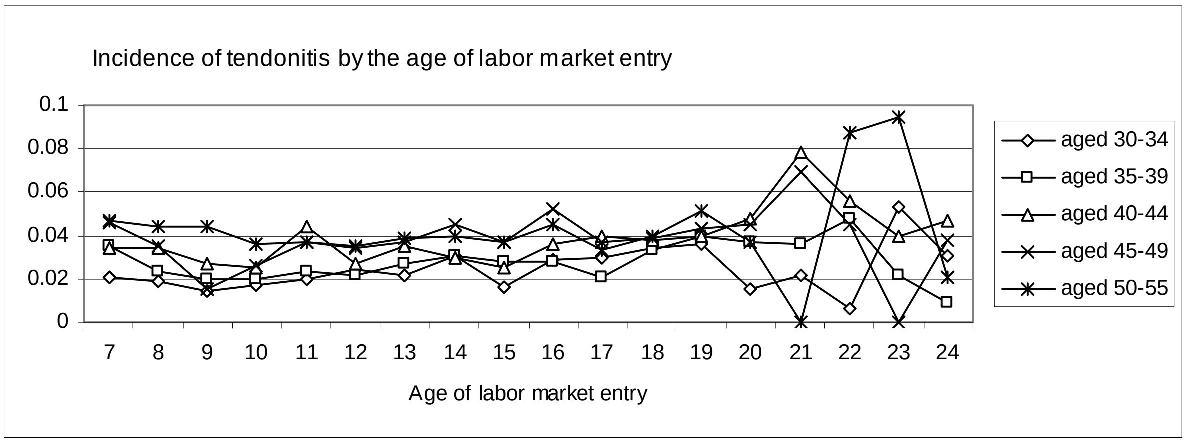

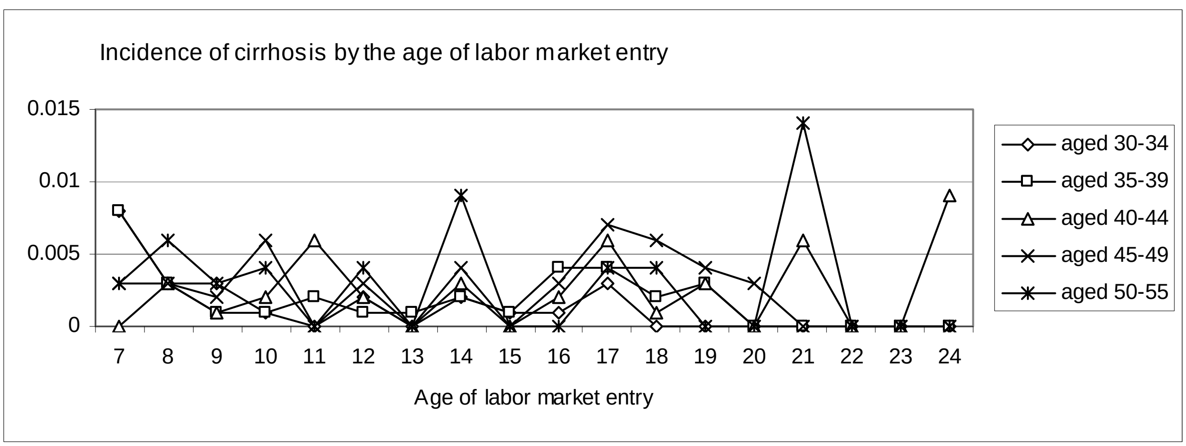

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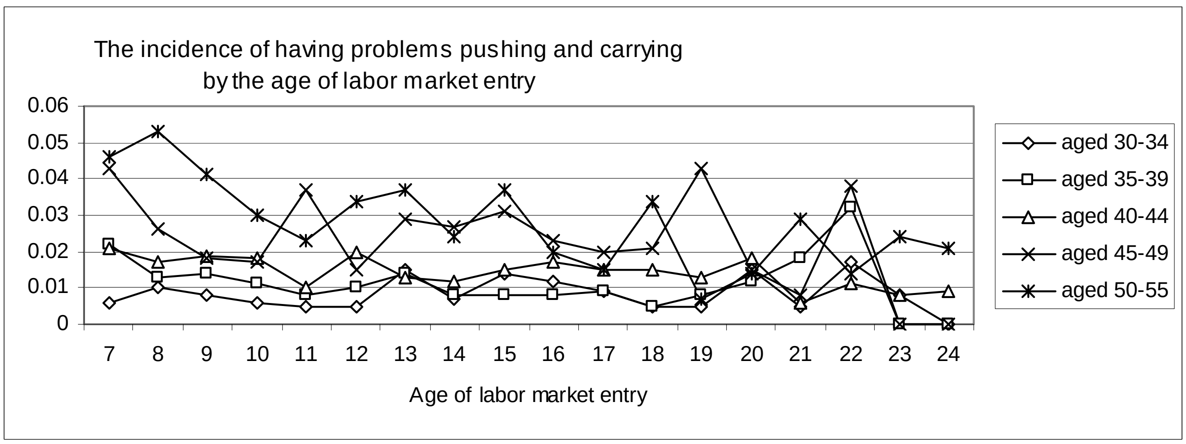

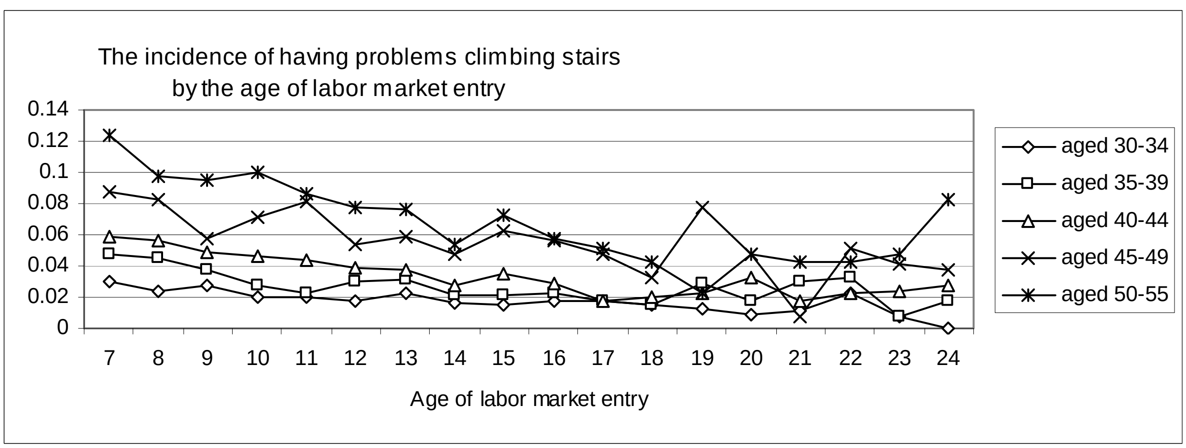

Appendix 1. (continued)