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Universidade Federal Fluminense
Faculdade de Economia
Rua Tiradentes, 17 - Ingá - Niterói (RJ)
Tel.: (0xx21) 2629-9699 Fax: (0xx21) 2629-9700
http://www.uff.br/econ

esc@vm.uff.br

School Absenteeism, Work and Health among Brazilian Children: Full information versus limited information mode[1]

Danielle Carusi Machado*
Jacques Huguenin**
Carine Milcent***

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© *Professor da Faculdade de Economia/UFF. E-mail: dani_carusi@hotmail.com or daniellecarusi@vm.uff.br.
**IEMS-Université de Lausanne (Switzerland.
***Paris-Jourdan Sciences Économiques (PSE) CNRS-EHESS-ENPC-ENS (France) & IEMS-Université de Lausanne (Switzerland).

ABSTRACT[1]

We estimate a system of three behavioral equations for Brazilian children and teenagers (school absenteeism, health status and child labor). We relieved the assumption of independence of the disturbance terms of each equation. Moreover, if causality mechanisms between these three components (school absenteeism, health status and child labor) can occur in both ways, it can also be the result of a simultaneous decision-making process. Thus, to take into account both endogenous causality aspects and simultaneity, we estimate and compare several different specifications for the three-equation model using a full information maximum likelihood estimation method.

Palavras chave: educação, crianças, saúde, trabalho, modelo de informação limitada, modelo de informação completa.

Keywords: children, education, health, work, limited information model, full information model

JEL: I12 J13 J18 J24

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Introduction

Using a novel econometric model, we study interactions between health, education and participation of children in the labor market. We expose the advantage of a full information model versus a limited information model.

Until 2005, in Brazil,[2] the educational system was compulsory for children aged 7 to 14 years. The literature (Barros et al, 2001; Barros et al, 1996; Kassouf, 2001) shows that where school resources are worse and where child labor could be an important source of income for the household, absenteeism rates are highest. Borrowing constraints are also an important factor determining withdrawal from school (Jacoby, 1994). If household income falls short of the subsistence consumption level, children are sent to work in spite of going to school or having more leisure time. In the late 1990s, a poverty-targeted social assistance program called "Bolsa Escola"[3] was implemented in Brazil. This program gives cash grants to poor families (household per capita income of less than R$90, or US$29 per month) with children aged less than 15 years. The child's participation in school is evaluated every 3 months and if, in any of these months, it is less than 85%, the household is not eligible for the program anymore.

As a matter of fact, parent's income is not the only element affecting a child's school attendance. Children's education is also influenced by household composition, standards of living, social context, children's participation in the labor market and their own characteristics, particularly children’s health. A policy that intends to increase children’s education should consider all these aspects of children’s life, which influence the well being and the quality of future life. Quality of future life is influenced by activities and investments made during childhood. These investments, chiefly in health and education, will determine productive capacity and success in the labor market, as predicted by the human capital theory (see Becker, 1964). There are many articles showing the positive relationship between health and

[2] In 1996 and 1997, reference years of our database, the compulsory age to enter elementary school in Brazil was 7 years old. Elementary education takes 8 years. Since 2005, Law# 11.114/2005 reduced the compulsory age for school admission to 6 years old.

[3] In 1995, local experiences, such as "Bolsa Escola", had been implemented in some Brazilian districts (Distrito Federal, Campinas and Ribeirão Preto). In 1997, a bill of law approved a minimum income action which emphasizes children's school attendance, and from 1998 to 2000, the poorest Brazilian districts received federal help to implement this program. In 2001, the "Bolsa Escola" program was extended to all districts which want to participate in the program.

income. Thomas and Strauss (1998) show that there is a strong and positive relationship between height and wages in Brazil, using a consumption database (ENDEF). When a child is healthy and well-nourished, those aspects could yield short-term positive influences concerning motivation and learning skills, and long-term cumulative positive effects on adult life. If a child has a poor-quality diet or is undernourished, such facts may yield negative effects not only on present school attendance (Glewwe and Jacoby, 1995) but also on future productivity in the labor market.

On the one hand, child labor can be detrimental to the acquisition of formal education, both quantitatively and qualitatively (a working child has less time to dedicate to school), causing damage to health or to other aspects that have an impact on adult human capital, leading to lower wages in the labor market. On the other hand, there can be positive pecuniary benefits to young labor, as vocational training and learning by doing, general workplace experience, professional contacts, and so on. A young laborer can acquire some working experience in his/her job. Child labor could also be a way to finance education or health services in a very poor household.

These three aspects (education, health and work) reflect household decisions that are made while taking into account preferences, costs and benefits that result from resource allocation inside the household.

So far the literature has generally focused on two of these three aspects. A large literature exists on child labor and education (Barros et al, 2001; Barros et al, 1996; Barros and Lam, 1993; Carvalho, 2000; Emerson and Souza, 2000; Kassouf, 2001; Vasconcellos, 2005). The main purpose is to study why parents prefer to send their children to work rather than to school (Basu, 1999 for an extensive survey). Concerning children's health, the literature focuses on estimations of reduced-form health demand and on which factors affect more or less this demand (Alves and Beluzzo, 2004; Kassouf, 1994; Kassouf and Senour, 1996; Thomas et al, 1991), but there are very few articles studying the interrelations between children's health and children's education or child labor.

However, children's schooling progress depends on their health situation and on the time devoted to study. Working children do not have enough time to dedicate to school. Child labor could also negatively affect children's current or long-term health situation. The working child could also evaluate his/her health negatively, since he/she feels more tired than other children who are not working. This child has probably a very busy day: school, work and homework. Moreover, children who are not in good health could have difficulties in following the educational system (Glewwe and Jacoby, 1995; Behrman and Lavy, 1994). Berger and Leigh (1989) point out that there is no consensus in economics about mechanisms through which education contributes to health improvement. Positive correlations between education and health could be explained by the causal effect of education on health or by the causal effect of health on education.

Our novel approach is to propose a full information model to assess the interactions between education, health and work, considering all possible or relevant causal and simultaneous effects between those three aspects. Our econometric specification is therefore a simultaneous equations model we can estimate by using a full information maximum likelihood (FIML) method. The results of our approach are compared with those of a limited information model.

The data come from the Living Standards Measurement Study Survey 1996/1997 (Pesquisa de Padrões de Vida – PPV). This household survey is conducted for two Brazilian regions (Northeast and Southeast), with information on health, child labor, household characteristics and education. As this survey was completed before the existence of the "Bolsa Escola" program, we assess the impact of income on school attendance and on children's health before its implementation. The next Section presents the data and some preliminary results. Section 2 presents the econometric model; Section 3 provides the results and Section 4 concludes.

1. Descriptive analysis and data information

1.1. Data information and geographical differences

The data come from LSMS Brazilian Survey – 1996/1997 (Pesquisa de Padrões de Vida – PPV), conducted in the Northeast and Southeast of Brazil[4]. We use a sample of 3,087 children aged 7 to 14 years[5].

The median household per capita income is US$72.75, but only US$57.62 in the Northeast and US$92.88 in the Southeast (see Table 1). More than 75% of children in the Northeast region are in a household where the income is less than US$49. In the Northeast region, 28.6% of children have a father or mother who is employed in an agricultural activity, compared to only 19.6% of children in the Southeast region. Wage in the agricultural sector is usually lower than in other sectors. As expected, parent's education is lower in rural areas and in the Northeast region. In general, father's education is lower than the mother's, probably because men had to enter the labor market earlier. In rural areas, 43% of children have a mother who did not go to school or who did not finish at least one year of school education (52% for fathers). In urban areas, this proportion drops to 12.5% for mothers and 14.3% for fathers. In the Northeast region, 34% of children have a father who did not go to school or who did not finish at least one year of school education and 28.2% have a mother in the same situation.

Living conditions including infrastructure facilities are better in urban areas and in the Southeast region. Not only because household income is higher, but also because these areas benefit from a better infrastructure in terms of public services. In the Northeast region, 47% of children live in households where drinking water is filtered and 27% of children live in houses with a sewage system, whereas in the The situation is even more contrasted for rural versus urban areas where 5% of children in rural areas live in a house with a sewage system versus 55% in urban areas. The availability of electric power, which may have a direct effect on school participation, is only an issue in rural areas. In rural areas, most children live on a street without asphalt or paving stone (more than 88%), in houses made of bricks without coating

[4] Published by the Brazilian Institute of Geography and Statistics (IBGE) and the World Bank

[5] The proportion of children in each region is similar to what is found in the National Household Survey, called PNAD.

or facing, or uncoated mud or rough wood. From the interviewers' opinion only, 81% of children in rural areas live in a house whose state of repair is not good.

Table 1

1.2 Health indicators

Our database provides anthropometric measurements,[6] such as weight and height. These measurements have limited value as indicators of malnutrition, in particular because they depend on both age and gender, and are affected by many intervening factors other than nutrient intake, such as genetic variation. However, even in the presence of such natural variation, it is possible to use physical measurements to assess the adequacy of diet and growth, in particular in infants and children, by comparing indicators with the distribution of the same indicators for a "healthy" reference group, and identifying "extreme" or "abnormal" deviation from this distribution. We construct two anthropometric indicators: (1) body mass index (BMI) and (2) height for age z-score. There is no consensus about the threshold of a child's body mass index, so the thresholds used are the 95th and 5th percentiles of the U.S body mass index for each age and gender (Anjos, Veiga and Castro; 1998). The great majority of children (70%) lie within the normal range, but especially in the richest areas. These differences are emphasized with child's age. The second indicator used as a variable in our econometric model reflects cumulative linear growth, and its deficit indicates past or chronic nutritional inadequacies and/or chronic or frequent illness. The ***height for age z-score*** (*fldwhohaz)* is based upon comparisons with a "healthy" reference population, and as recommended by WHO (2005), it is computed as the difference between the value for an individual (v_{oi}) and the median value of the reference population for the same age or height (*median*), divided by the standard deviation of the reference population (*sd*), as in eq. (1).

$$zscoreA/I_i = \frac{vo_i - median}{sd} \qquad \text{eq. (1)}$$

[6] Weight and height are collected in the first or in the second home visit.

Low height for age z-scores relative to a child of the same sex and age in the reference population are referred to as “shortness”. Extreme cases of low height for age z-score .where shortness is interpreted as pathological are referred to as “stunting”. According to Glewwe and Jacoby (1995), Behrman and Lavy (1994), Alderman et al. (1997) and Jamison (1986), this indicator is largely used to describe the long-run nature of nutrition and health, and is more adequate to capture the influence of health on a child’s education. Following WHO (2005), in Table 2, we present a more general classification of malnutrition, which distinguishes between mild (z-score < -1), moderate (z-score < -2), and severe malnutrition (z-score < -3).

The mean height for age z-score is negative in all geographical disaggregations, so there are average deficits in height for age in relation to a reference population. This indicates that children aged 7 to 14 years have past or chronic nutritional inadequacies. This phenomenon is aggravated in the poorest locations, such as in rural areas (-0.84) and in the Northeast region (-0.57). Table 2 also shows that 30% of the children aged 7 to 14 years were classified as suffering from malnutrition: 43% in rural areas and 34% in the Northeast region.

Table 2

1.3. Education

To analyze aspects of children's education, we focus on the compulsory education[7] for kids aged between 7 and 14 years. In our sample, the school attendance rate was 92.8%, but this percentage varies according to household income.

The time a child stays in school as well as his/her educational performance depend strongly on his/her age. We built one indicator for school attendance (*freq2*), as defined in eq. (2). This indicator is based on two questions: (i) in the last 30 days, were you ever absent from school? if so, (ii) how many days were you absent?

$$
\begin{cases} freq2 = 0 & \text{if the child is not enrolled in school} \\ freq2 = \ln\left(100 \times \left(1 - \left({days}/{32} \right)\right)\right) & \text{if the child is enrolled in school} \end{cases}
$$

[7] The ... years to school, except if the ... child follows a standard education profile, which means that the child does not repeat a grade or does not drop out of school, he/she will finish elementary and high school education at the age of 14 years.

(eq. 2)

If the child is not enrolled in school, this variable takes the value zero. The variable *freq2* increases with school attendance, and is highest for a child who was never absent from school.

Table 3 shows that 65% of children attended school in the last 30 days. This percentage increases for children living in the Southeast and in urban areas.

Table 3

1.4. Child labor

Even though Brazil has a law protecting children and teenagers[8] – work is only allowed for children aged 14 years and older, with apprenticeship available at the age of 12 – in 1999, three million children aged between 5 and 14 years, or 9% of the population at this age, were working (Kassouf. 2001). In the literature on child labor, particularly in studies involving developing countries, household decisions are important to define child's time allocation between school, work and leisure. A large part of this literature emphasizes the determinants of child labor and demonstrates the influences of parental decisions towards child labor.[9]

Looking at our database, we find that 21% of children in the poorest income class work. This percentage for the richest income class decreases to 4.5%. Table 4 shows this work rate for each region and rural/urban areas. As the majority of working children (60%) are employed in agricultural activities, it is no surprise that

[8] The federal government created the Program for the Eradication of Child Labor to target specific cases in which activities represent hazard to children (e.g.: coal mines, shoe manufacturing, sugar cane harvesting and sisal plantations). Families with children at risk of working receive some money if they keep their children at school. Coverage of this program is not so large and focuses on hazard activities.

[9] Menezes-Filho et al. (2002) analyzed time allocation decisions for children and adolescents in several Latin American and Caribbean countries. Problems with school attendance can be linked to variables reflecting the household structure in the various countries, in particular parental education and the number of young children.

children's participation in the economic activity is larger in rural areas (25.8%) and in the Northeast region (14.98%).

Economic activity influences a child's participation in the labor market. Depending on the parent's activity, children may help them in their work. In those regions where agricultural economic activity predominates, child labor is usual, particularly among younger boys.

Table 4

1.5. Interaction between health, education and child labor

The luxury axiom proposes that child labor is mainly due to poverty. The decision to push children in some productive activity is less likely to be the result of health status, even though it may cause some indirect effects on the child's participation in the labor market. On the contrary, it seems more likely that child labor affects health and also school participation decisions.

The z-score is highly dependent on child labor (Table 5). In terms of nutritional conditions, child labor seems to have a negative impact on health, probably because a working child feels more tired. Hard work, demanding a great physical activity, should be incompatible with children’s age and development.

Child labor also has a negative relationship with children’s school participation. When a child begins to work, he/she may not be successful in juggling school or study time and working time. In some cases, he/she would prefer to drop out of school. We note that children who are not working miss fewer days of school (Table 5).

Table 5

A policy aimed at decreasing incentives to child labor could be successful if it does not create difficulties for household survival. The literature emphasizes the negative effects of labor on childhood, but it also shows that child labor could be essential for household survival. In a very poor household, prohibition of child labor could be accompanied by an increase in poverty and consequently worse living conditions for the children. Satz (2003) points out that bans on child labor may drive families to choose even worse options for their children and that child labor is often a symptom of other problems (poverty, inadequate school system, and so on).

Education can allow a child to learn some basic notions of hygiene, positively influencing his/her health status in the long and short run. Concerning school attendance, child labor and health conditions may prevent the child from going to school and studying hard: the former because less time is dedicated to school, and the latter for physical reasons. Children's health is widely perceived to strongly affect schooling (Behrman and Lavy. 1994).

When we look at school participation, we note that the rate is higher for children with a height for age z-score below minus one than for children with a worse nutritional condition. For children with a height for age z-score below minus one minus two and minus three, these rates are 88.1%. 86.2% and 80.5%, respectively (Table 6).

Table 6

We also note that children with better nutritional conditions have a lower absenteeism rate. A proportion of 60.3% of the children with a height for age z-score of less than minus one were present at school during the last 30 days. For children with a height for age z-score of less than minus two and minus three, this proportion dropped to 59.6% and 51.7%, respectively.

Thus a good health status, in terms of nutritional conditions, is also important for school participation. Policies with a positive impact on children's health should have positive effects on school participation. Hence adding a health component to a policy that creates incentives to school participation could be more efficient in increasing children's welfare state in terms of health.

Interactions between these three variables are summarized in Figure 1. In the following sections, we consider all of these relations. We explore the possible correlations between these variables, and we show how interrelations affect a policy and how to take potential channels into account to increase its impact.

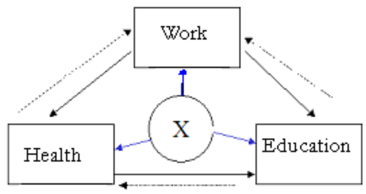

Figure 1

2. Econometric specification[10]

In this section, we explain our econometric strategy. Our model is composed of three behavioral equations for children, explaining the following endogenous dependent variables:

- Labor market participation (Have you worked during the last 7 days? Yes or No). The variable y_1^* is an unobserved continuous latent endogenous variable with which the discrete variable y_1 is associated by the relationship $y_{1n} = 1I\left(y_{1n}^* > 0\right)$, taking value 1 if working and 0 otherwise;

- The health status, denoted by y_2, corresponds to the height for age z-score, a long-term measure of health;

- School attendance, denoted b y_3, is built from the number of school days missed during the month.

2.1. A simultaneous approach

Some studies about school attendance and child labor are based on the estimation of a multinomial logit model (Menezes-Filho et al., 2002 and Corseuil, Santos and Foguel, 2001). Normally, they use four alternatives: work and study, only study, only work, no study and no work. Multinomial logit models may not accommodate some features that might seem sensitive, such as correlations of unobservable variables across alternatives that have common elements, i.e. some unobservable variables can simultaneously affect the alternatives. For example, in the cases of "work and study" and "work and no study", children's ability could affect

[10] For each equation, the independent variables and their definitions are presented in Appendix 0.

them. In addition, the multinomial logit model assumes these two variables (child labor and school attendance) to be the result of a common decision. Because we want to relieve this assumption and test it, we use the alternative approach of a simultaneous equations model. Moreover, we want to incorporate an additional dimension: health status. Furthermore, the multinomial logit approach requires the presence of dichotomous endogenous variables only, while we have a mixture of dichotomous and continuous endogenous variables.

The model can be written, for each observation *t, as*:

$$\begin{cases} y_{1t}^* = x_{1t}'\beta_1 + y_{2t}\alpha_{12} + y_{3t}\alpha_{13} + u_{1t} \\ y_{2t} = x_{2t}'\beta_2 + y_{1t}^*\alpha_{21} + y_{3t}\alpha_{23} + y_{1t}\gamma_{21} + u_{2t} \\ y_{3t} = x_{3t}'\beta_3 + y_{1t}^*\alpha_{31} + y_{2t}\alpha_{32} + y_{1t}\gamma_{31} + u_{3t} \end{cases}$$

For simplicity, the exogenous variables of equation *i* are denoted by x_{it}, with the relationship $x_{it} = s_i . x_t$, where x_t is the vector of all exogenous variables and s_i is the selection matrix corresponding to equation *i*.

However, the presence of endogenous variables on the right-hand side of some equations may yield biased or inefficient estimates, and there are possible simultaneous decision processes. To take into account both endogenous aspects and simultaneity, all three equations are estimated by full information maximum likelihood (FIML) using a simultaneous equations specification.

2.2. An FIML model

We chose FIML in contrast to limited information maximum likelihood (LIML) in part because LIML estimation does not take into account the simultaneous decision process. An FIML method provides some improvement to the quality of the estimation, allowing us to simultaneously estimate all relevant parameters, including covariance parameters, and also some improvement to the subsequent interpretation of the results.[11] We propose here to apply the exact maximum likelihood method developed by Huguenin (2004), which avoids the stochastic nature of a simulation-based method (as with simulated maximum likelihood or simulated

[11] The respective virtues and disadvantages of both approaches are well known, and will not be discussed here (see Heckman (1978) and Amemiya (1978) for early developments of the estimation of multivariate probit models).

score methods), while circumventing the difficulties arising from the necessity to numerically evaluate a great number of multivariate normal probabilities.[12] This method can be performed with all its virtues on systems of equations of relatively small dimension. For comparison, we also estimated our model using an LIML approach, where each equation is estimated separately. We show that these results lead to some misinterpretations.

The disturbance terms $u_t = \left(u'_{1t}, u'_{2t}, u'_{3t}\right)'$ are jointly normally distributed as $u_t \rightarrow N(0, \Sigma)$, and assumed to be independent across *t,* with the covariance between u_{it} and u_{jt} being σ_{ij} .

The conditions for identification require some exclusion restrictions on the exogenous variables x_{it}.[13] They also require a well-known normalization of the variances σ_1^2 of the disturbances u_{1t}, since all parameters of the first equation are only identified up to a scaling factor. As usually, for simplicity, the variance σ_1^2 is set to unit value. Given the explicit exclusion restrictions of the model, no further identification restriction is needed. As our model contains only one dichotomous endogenous variable (first equation) associated with a latent variable, the conditions for logical consistency[14] are always satisfied without further constraints.

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[12] Amongst papers estimating such multivariate probit model using FIML, most assume some constraints on the covariance parameters to simplify the multiple integration problem (Ashford and Sowden (1970), Sickles and Taubman (1986), Block and Gibbons (1996)}). Some FIML estimation procedures, following the development of techniques based on simulation (Gourièroux and Montfort (1996)) have also been implemented to overcome the difficulty arising from the numerical evaluation of multiple integrals as encountered in this context (see McFadden (1989)} for the method of simulated moments and Hajivassiliou and McFadden (1998)} for the method of simulated scores). These techniques have mainly been developed for the estimation of multinomial models, but their application to multivariate probit models is quite straightforward. Although there is no doubt about the virtues of simulation based estimations, they contain two sources of critics: first, the results are stochastic in essence; second, their implementation can be extremely time-intensive. We offer here an alternative method without resorting to simulations, by the approach of exact maximum likelihood developed by Huguenin (2004). This method can be performed with all its virtues on systems of equations of relatively small dimension, based on exact analytical results.

[13] We have some variables that affect only one y_i . For the choice of the instrumental variables, we follow the literature on economic development. More details are given in the Results Section.

[14] The problem of the logical consistency in a simultaneous equations model has been previously treated in a general framework by Gouriéroux et al (1980). Maddala (1983) proposes an approach based on the probabilities of the possible outcomes in a bivariate probit setting. Here we apply the extension of Huguenin (2004) to a general multivariate probit setting. The logical consistency of the

The estimation is performed by maximizing the log-likelihood function with respect to all parameters (first and second order). This allows estimating the marginal effects η_{ij} of the independent variable x_j on the dependent variable y_i by the average of the estimated marginal effects for each observation. The marginal effects are defined by $\eta_{ij} = \frac{\partial E(y_i)}{\partial x_j} = \frac{\partial \Pr(y_i = 1)}{\partial x_j}$ in the case of a dichotomous dependent variable y_i, and by $\eta_{ij} = \frac{\partial E(y_i)}{\partial x_j}$ in the case of a continuous dependent variable y_i.

And eventually, some cross effects ζ_{ij} of the dependent variables on each other can be estimated in the same way, with:

$$\zeta_{ij} = E\left(y_i / y_j = 1 \right) - E\left(y_i / y_j = 0 \right) = \Pr\left(y_i = 1 / y_j = 1 \right) - \Pr\left(y_i = 1 / y_j = 0 \right)$$

3. Results

Methodologically, we estimated several different forms and specifications of our model, especially in terms of exclusions of explanatory variables and constraints on the covariance parameters, and then settled for the specification displaying the highest likelihood. In this section, we present the results obtained from this "best model".

We first discuss the results from the three equations estimated by FIML (Table 7 presents the direct effects and Table 8, the marginal effects and elasticities, considering the direct and indirect effects of the variables), before turning to the comparison and differences between this method and LIML (Table 9).

model requires that the probabilities of the different possible joint values of the dichotomous endogenous variables for each observation add up to unit value. However, this discussion and subsequent conditions apply only when there is more than one dichotomous endogenous variable in the model.

3.1. Intuitive features and policy implications

Boys have a higher probability of working than do girls. This result is consistent with our descriptive analysis, which shows that the percentages of boys who work are greater for all age groups when compared to the same percentage for girls. The age variable is important to child labor. As the child becomes older, the probability of working increases.[15]

School absenteeism is explained by three education supply variables, namely, number of teachers, number of school desks and an indicator of the quality of school resources (considering the presence of libraries, books, computers, rooms, and other equipment in the school) in the geographical area where the child lives.[16]

Education supply variables, such as number of school desks (*carteira)* and number of teachers (*ofertapn*), have a significant effect on school attendance. The number of school desks has a positive effect on school attendance: as the place where the child lives have more desks in school (an indicator of a good school), the absenteeism rate is lower. The elasticity is 35% (Table 8).

As to children's health, availability of physicians has a significant effect. The elasticity of the availability of physicians is 13% (Table 8).

Economic status also affects children. The fact that the mother is an unpaid worker has a positive effect on the probability of child labor (Table 7). The marginal effect amounts to 13% (Table 8). We also show an indirect negative effect on health (of 12%) and an indirect negative effect on school attendance (of 2%), even though the latter one is not significant. An explanation could be that when the mother is active in the labor market, less of her time is dedicated to taking care of her children while she is not in a better economic condition.

With regard to income and parents' education, effects are not always so intuitive. We tested different forms of effect for income (linear, multiplicative, or more flexible effects through a polynomial form). We present here four dummy variables that appeared to be most adequate. About parents' education, only that of the mother (and not of the father) has a significant effect on some of the dependent

[15] We have tested different forms for the effect of age on our dependent variables. Results are not significantly modified.
[16] For details about the construction of these variables, see Appendix 0.

variables. The effect of parental education on child labor is not significant when we control for the type of parents' employment, parents' income and living condition. We thus decided to present the results of parents' education using the variable of mother's education only.

The direct effect of mother's education is only significant in the children's health equation. When the mother is more educated, her child has a better health status.

A more educated mother would be more conscious about factors affecting her children's human capital accumulation and, consequently, future life opportunities for her children. She could be more conscious about the importance of investment in education. A child whose mother has an incomplete lower elementary education has a higher probability of going to school compared to mothers with a lower level of education. This result confirms those obtained by Kassouf (2001) and Barros and Mendonça (1991). Mother's education is one of the principal determinants of children's health. Having a mother with the highest education level increases children's health status by 26% compared with having an illiterate mother (Table 8). If she has only elementary school (1st to 4th grade), the probability of increase is smaller (17%). Thus, mother's education seems to play an important role in two of our three dependent variables – health and education. Since these variables are not independent from each other, the impact of mother's education has a direct and indirect effect on children's health and school attendance, and an indirect effect on child labor.

Even though the coefficient is not significant in the equation of children's school attendance (Table 7), the marginal effect is significant (the coefficient reflects only the direct effect, while the marginal effect also includes the indirect effect – Table 8). As the mother's education increases, her child's school attendance increases, too. For the equation of children's probability of working, we note that only the marginal effect of a child whose mother has more than 8 years of education is significant and negative (3.6%).

Regarding per capita family income, the results are surprising. When we control for housing conditions, we observe that we do not obtain significant direct effects, except on children's health (Table 7). The marginal effect of income on children's health is around 30% and increases with the level of income. Controlling for income, the share of total per capita expenses with food is significant only at a 10% level. The income has also indirect effects on child labor and school attendance. It increases the probability of school attendance by 13% to 15% depending on the income level, but it has no significant effect on the child's probability of working (Table 8). In fact, proxies for permanent income and housing conditions can better explain child labor.

We find that the availability of filtered water in the household where a child lives affects his/her health status (11 %) positively. It highlights the importance of environment on children's health, as also shown by Deaton (2003).

Living in a rural area increases the probability of child labor by 6% (Table 8). This is consistent with the descriptive statistics. We also show a significant negative indirect effect of living in a rural area on children's health. It decreases the probability of a good health status by 8% and the probability of school attendance by 1.5%, probably because parents can ask their children to help them with their work, particularly in the case of agricultural or household work.[17]

Household infrastructure is important to children's education. It could reflect good conditions for studying and living. We find that living in a house with electric supply increases school attendance by 17%. Moreover, this proxy for living condition has an indirect positive effect on children's health (of 5%) and an indirect negative effect on child labor (of 4%).

An efficient policy of monetary transfer should not consider only one of its potential effects alone – even if that is its main target – but also its other potential effects, which may be only indirectly related. It can even be contradictory if an indirect effect cancels out the direct causal effect. A monetary transfer aiming at an improvement of the education level might not only affect a child's education, but also his/her health status and his/her probability of participating in the labor market. Moreover, in the long run, this monetary transfer could affect different aspects of children's lives, especially human capital accumulation in terms of education and health. We show that when considering a simultaneous equations model, environmental variables seem to have more impact simultaneously on children's health, child labor and school attendance.

[17] We tested a direct effect that did not appear to be significant.

3.2. Education, labor and health: full versus limited information

With the methodology applied here, we can identify interactions between our three endogenous variables since we are considering both simultaneity in the mechanisms and possible causal influences of these variables on each other. First, we can identify direct effects, for example, the impact of a child's participation in the labor market on his/her health status, or the impact of school attendance on a child's probability of working (as shown in Table 7). Second, with this method we take into account all indirect effects, presented in Table 8.

In Table 8, we present the indirect effects for our main variables, health, labor and school absenteeism, estimated by our model.

School attendance has an impact on a child’s probability of working, and child labor affects his/her health status (Table 8). Thus, school attendance may have a significant indirect effect on children’s health through the effect of child labor on health.

We obtain that the covariance between the error terms of labor and health equations, and the coefficient of education in the health equation, are both not significant.

The significance levels of the estimated covariance between the error terms of equations 1 and 3, show that the decision to work is simultaneously determined by school attendance (at the end of Table 7). We can consider that a child’s available time is composed of his/her participation in the labor market, his/her school attendance and his/her leisure time. That means that for a child to consider entering the labor market, the time he/she spends working has a direct effect on his/her school attendance. The more he/she spends time in the labor market, the more he/she reduces his/her school attendance.

Health status and decision to work do not seem to be simultaneously determined, or $\sigma12=0$. Our health variable is a long-term variable, whereas the dependent variable of child labor is a short-term variable. This may therefore explain why we do not observe a simultaneous effect.

A less intuitive result is the covariance between the error terms of the equations representing school attendance and health status. That means there is at least one variable that affects school attendance and health status and this variable is not present in our set of independent variables.

In public schools, a policy of free lunch ("merenda")[18] has been set up. Knowing that a free meal is served at school, the increased school attendance could have a simultaneous effect on health status. This variable increases both the school attendance and the probability of child labor. The latter effect is because the child is in good shape. The survey allows us to know whether a meal is served at school. But this information does not appear to be accurate enough to have a significant impact on both of these dependent variables, school attendance and health status.[19]

A child's health status is influenced by his/her participation in the labor market. It seems reasonable to assume that a painful working activity influences a child's health status. In fact, child labor has a negative impact on children's health. That could be another justification to introduce a policy against child labor. However, a child's income could be the only way to keep the household out of the poverty gap, a policy of monetary transfer could be insufficient to avoid this poverty gap. Thus, in our results, we show some evidence that decision-makers have to be very careful about the measures to be implemented and their unintended consequences.

Concerning school attendance, we observe a causal effect of the health status. This result is completely intuitive. Moreover, in poor areas, access to school could be made more difficult for different reasons, for example, that there is not transportation to school. Therefore, the difficulty of access to school is increased for a child in a bad state of health.

The participation in the labor market depends on the health status. The better is the health status, the higher the probability of participating in the labor market.

This result shows the importance of a policy by taking into account the interactions between our three dependent variables. Indeed, a policy aiming at improving health status must consider the implication for the labor market; it has to take care not to lead to an increase in the participation in the labor market. Moreover, the school attendance rate has a negative causal effect on child labor.

[18] The "merenda" does probably not constitute a good nutritional diet, and even though its serving is an obligation, it is probably not a well established norm, particularly in poor locations.

[19] We do not provide results with this variable present in the model, but these results are available upon request.

Therefore, a policy having a higher school attendance as goal improves the fight against child labor.

All these results show the importance of taking into account the interactions between child labor, health status and school attendance for a policy to be relevant.

We now propose to compare these results with those obtained in a partial, limited information model. First of all, we note that, in general, the standard errors are smaller when estimating a limited information model, which yields more significant coefficients (Table 9). We now focus on each dependent variable.

We find the same causal effect of the school attendance rate for child labor. The causal effect of the health status is not significant at the 5% level. This effect is significant and positive when estimating the full information model, which seems more intuitive.

We detect no causal effect of child labor and school attendance on health status, whereas a causal effect of child labor was highlighted in the full information model.[20] If we explain the health status by controlling for child labor, but not for school attendance, we then find the result of the full information model (at the significance level of 6%). This difference in the results could be due to a negative correlation between the school attendance rate and child labor. Note that we take the simultaneous effect into account in the full information model.

Finally, we show a causal effect of health status and child labor on school attendance. With the limited information model, it appears that child labor has a negative effect on school attendance that is not detected when estimating the full information model. However, the full information model shows a simultaneity effect between both of these variables, which is not accounted for in the limited information model, which can explain the different results.

The comparison between both limited and full information models highlights the importance of the simultaneity effect. Actually, we show that some effects that appear as causal in the limited information model are in fact simultaneous. Furthermore, the non-significance of some causal effects in the limited information

[20] We made this estimation but we do not present this result in the paper, since our FIML does not consider school attendance in health equation.

model can also be explained by the fact that simultaneous effects are not taken into account.

Table 7, 8 and 9

4. Conclusion

This study highlights the complex interactions between three components: child labor, children’s health and school attendance. An econometric estimation of only two of these three components could suffer from misspecification, especially from missing variables. Moreover, by comparing the partial, separate limited information model with the full information model, we show the importance of taking simultaneity effects into account. Several aspects influence children’s human capital. Without a good knowledge of them, any policy may not be really efficient. Our results suggest that a health policy should not only restrict attention to variables affecting children's education, but also to variables impacting directly on health evaluation and on children's decision for labor market participation.

We demonstrated that a policy aiming at an increase in human capital should focus on some aspects of school attendance and also be concerned with children’s health. In terms of household per capita income, we do not show what may be intuitively expected. A policy of monetary transfers has to be accompanied by a policy that improves living conditions. Variables focusing on mothers’ condition, especially, education, play a significant role in explaining children's health. Mother's education has a positive effect on health, and moreover, more educated mothers are more conscious about the negative effects of child labor on their future life and the importance of school attendance. Since child labor has a negative effect on education, there is an indirect effect of mothers’ education on children’s education. The same is observed through children's education. The child’s participation in the labor market is also influenced by his/her mother’s occupation. Non-remunerated occupations create incentives to child labor. since a mother could ask her children to help her.

In order to reduce child labor, and consequently, to have an impact on children’s education, an alternative could be to focus on families where the working mother is unpaid and living in rural areas. Another important instrument to increase children's health and education, and to reduce child labor, seems to be a policy that focuses on living conditions.

One of the main conclusions of our article is that the development of children's human capital should consider both health and education, and particularly local living conditions. Another important conclusion is that the estimation of a full information model allows distinguishing simultaneity effects from causal ones.

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Appendix 0: Variables

For each child, the dependent (endogenous) variables are the following:

- *work*: working status. with value 1 if the child is working. and value 0 otherwise;
- *fldwhohaz*: health indicator. measured by height for age z-score (see section 2.2 for definition);
- *freq2*: education indicator. measured by school absenteeism (see section 2.3 for definition)
- And. again for each child. the independent variables are the following:
- *age*: between 7 and 14 years;
- *sex*: value 1 for boys and value 0 for girls;
- *race*: indicator of the race as defined by being non-white with value 1 or white with value 0;
- *condlocal*: the condition or state of repair of the household, with value 1 if excellent or good. and value 0 otherwise;
- *clincome:* four classes of per capita household income: value 1 (*rfpc*<=38.443), value 2 (*rfpc*>38.443 and *rfpc*<=90.992), value 3 (*rfpc*>90.992 reais and *rfpc*<=224.3333) and value 4 (*rfpc*>224.3333), with *rfpc* being the household income in *reais* (1 US$ = 3.10 R$. or 1 R$ = 0.32 US$);
- *edm*: dummy variable for the education level of the mother (value 0 without any education, value 1 with incomplete elementary school or up to the 3rd grade of elementary school, value 2 with completed elementary school or through the 4th grade of elementary school, value 3 with incomplete lower elementary education or 5th to 7th grades of elementary school, value 4 with completed lower elementary education or completed elementary school, value 5 for those mothers who have completed at least the upper education level or incomplete high school education);
- *unpaidm*: indicator of the mother's working status, with value 1 if mother is an unpaid worker, and value 0 otherwise;
- *estabm*: indicator of the mother’s job status, with value 1 if she has a formal job (employees in the private sector with a formal registration, employers, employees in the public sector, including the military), and value 0 otherwise;

- *rural*: urbanization indicator, with value 1 for rural area and value 0 for urban area (reference);
- *north*: regional indicator, with value 1 for the Northeast region and value 0 for the Southeast region (reference);
- *food14*: socioeconomic indicator, measured by household expenses with food (per capita), in logarithm;
- *cronic*: indicator of chronic disease, with value 1 if child reports a chronic disease, and value 0 otherwise;
- *water*: living condition indicator, with value 1 if the house has filtered water, and value 0 otherwise;
- *electric*: living condition indicator, with value 1 if the house has electric supply, and value 0 otherwise.
- *med*: number of medical doctors (or similar occupations) in the area where the child lives;
- *ofertapn*: number of elementary school teachers in the area where the child lives.
- *carteira*: % of schools in the geographical area where the child lives which have at least one desk for the students in the classroom.
- *bemescol*: indicator of school resources, it is constructed from the sum of points for each positive answer to the questionnaire: if the school has books for the students (1 point). items for the students (2 points), videos for the students (4 points), TV set (8 points), computer (16 points), lab (32 points) and other equipment for education (64 points).

Table 1: Some characteristics of the sample

	Northeast	Southeast	Urban	Rural	Total
Number of households in the sample	1,008	832	473	1,367	1,840
Total sample (Children 7 to 14 years old)	1,762	1,325	2,159	928	3,087
family per capita income (mean) (in US$)	57.62	92.88	93.51	24.48	72.75
Family Characteristics					
% children whose mother or father have an agricultural occupation	28.6	19.6	4.6	71.4	24.7
% children who have an illiterate father	34.0	15.4	14.3	52.0	25.8
% children who have an illiterate mother	28.2	13.0	12.5	43.0	21.6
Family size	5.7	5.1	5.0	6.4	5.4
Average age of our sample	10.6	10.6	10.6	10.7	10.6
Standards of Living					
% children living in a house with filtered water	46.6	71.9	65.3	39.2	57.5
% children living in a house with sewage system	26.6	58.0	55.0	5.2	40.0
% children living in a house with electric supply	83.0	93.4	99.5	59.4	87.4
% children living in a house where primary material of the outside walls is finished wood	83.4	94.3	94.4	73.5	88.1
% children living in a house where primary flooring material is adequate	25.8	51.4	47.9	11.1	36.8
% children living in a house where primary roofing material is adequate	95.9	99.1	99.3	92.6	97.3
% children living in a house where the street on which the residence is located is asphalt or paving stone	40.2	58.6	65.9	6.8	48.1
% children living in a house where the garbage is collected	54.0	68.8	81.4	11.3	60.4
Mean number of rooms in the household	3.9	3.6	3.7	4.0	3.8
% children living in a house with excellent or good conditions	30.3	44.2	43.5	19.2	36.2
% children living in a house located in regulated condominium of houses and apartments or separate building	93.2	95.3	92.7	97.4	94.1

Source: Tabulation made from the 1996/1997 PPV database. Proportions were calculated using the weight and the survey sample design.

Table 2: Height for age z score - children aged 7 to 14 years

		Northeast	Southeast	Rural	Urban	All regions (a)
Sample	# obs.	1,762	1,325	928	2,159	3,087
Z-score for Height for Age	mean	-0.57	-0.21	-0.84	-0.22	-0.41
	Z-score < -1 (%)	34.11	24.45	43.21	24.27	29.96
	Z-score < -2 (%)	10.90	8.53	15.09	7.64	9.88
	Z-score < -3 (%)	2.27	3.55	3.34	2.59	2.82

Source: Tabulation made from the 1996/1997 PPV database.

Notes: (a) All regions and rural and urban areas computed together.

(b) Rural and urban areas include the southeast and the northeast regions.

(*) We excluded 20 children whose parent's economic activity was not available.

Table 3: Educational characteristics of our sample - children aged 7 to 14 years

		Northeast	Southeast	Rural	Urban	All regions (a)
Sample	# obs,	1,762	1,325	9,28	2,159	3,087
School Absenteeism (%) ***Number of days of school absence***	= 30	3.35	1.36	1.29	3.01	2.49
	< 30 and >= 20	1.25	0.91	0.86	1.20	1.10
	< 20 and >=10	2.67	1.06	2.48	1.76	1.98
	< 10 and >=1	21.06	22.87	22.20	21.68	21.83
	zero	63.00	68.53	58.41	68.36	65.37
	% not enrolled	8.68	5.28	14.76	3.98	7.22

Source: Tabulation made from the 1996/1997 PPV database.

Table 4: Child Labor - children aged 7 to 14 years

		Regions		Areas		
		Northeast	Southeast	Rural	Urban	All regions (a)
Sample	# obs.	1,762	1,325	928	2,159	3,087
Labor	# labor	264	92	240	116	356
	% labor	14.98	6.94	25.86	5.37	11.53

Source: Tabulation made from the 1996/1997 PPV database.

Notes: (a) All regions and rural and urban areas computed together.

(b) Rural and urban areas include the southeast and northeast regions

(*) We excluded 20 children whose parent's economic activity was not available.

Table 5: Relations between health, labor and education - children aged 7 to 14 years

		Children who work	Children who do not work
Height for Age z-score	mean	-0.80	-0.36
	Z-score < -1 (%)	44.14	30.61
	Z-score < -2 (%)	15.12	10.02
Education	% enrolled	83.15	94.03
School Absenteeism			
Number of days of school absence (%)	= 30	2.49	2.56
	< 30 and >= 20	1.10	1.17
	< 20 and >=10	1.98	1.61
	< 10 and >=1	21.83	21.64
	zero	65.37	67.05

Source: Tabulation made from the 1996/1997 PPV database.
Notes: (a) All regions and rural and urban areas computed together, (b) Rural and urban areas include the southeast and northeast regions. (*) We excluded 20 children whose parent's economic activity was not available.

Table 6: Relations between health, labor and education - children aged 7 to 14 years

		Children with z-score < -1	Children with z-score < -2	Children with z-score < -3
Education	% enrolled	88.1	86.23	80.46
School Absenteeism				
Number of days of school absence (%)	= 30	3.68	4.26	3.45
	< 30 and >= 20	0.97	0.66	0
	< 20 and >=10	2.7	2.62	3.45
	< 10 and >=1	20.43	19.02	21.84
	zero	60.32	59.67	51.72

Source: Tabulation made from the 1996/1997 PPV database.
Notes: (a) All regions and rural and urban areas computed together, (b) Rural and urban areas include the southeast and northeast regions. (*) We excluded 20 children whose parent's economic activity was not available.

TABLE 7 - Three-Equations Simult. Maximum Likelihood Linear-Probit Estimation

Variable	Equation #1 Dependent Variable: labor			Equation #2 Dependent Variable: health (fldhaz)			Equation #3 Dependent Variable: education (freq2)		
	Coef.	Standard error	P-Value	Coef.	Standard error	P-Value	Coef.	Standard error	P-Value
Constant	2.2828	2.0638	0.2687	-0.9057	0.2048	0.0000	3.5715	1.1900	0.0027
Age	0.2698	0.0279	0.0000	-0.0110	0.0151	0.4658	0.0215	0.0387	0.5787
Boy	0.5164	0.1150	0.0000	-0.0294	0.0454	0.5163	0.0619	0.1053	0.5565
Non white	0.2681	0.2301	0.2439	0.2731	0.0884	0.0020	-0.4186	0.3655	0.2521
The condition or state of repair of the residence is excellent/good	0.1027	0.1519	0.4990	0.1668	0.0466	0.0003	-0.2366	0.2269	0.2969
Per capita household income									
> R$ 38.44 and <= R$ 90.99	0.1728	0.1950	0.3755	0.2340	0.0520	0.0000	-0.3973	0.3160	0.2086
>R$ 90.99 and <= R$ 224.33	0.3210	0.2286	0.1603	0.3342	0.0598	0.0000	-0.5187	0.4396	0.2381
> R$ 224.33	0.3478	0.2616	0.1838	0.3768	0.0740	0.0000	-0.5822	0.5075	0.2513
Mother's education									
4 years of education	0.2306	0.2054	0.2615	0.1536	0.0527	0.0035	-0.1278	0.2055	0.5341
5 to 7 years of education	0.3442	0.2528	0.1733	0.2233	0.0734	0.0023	-0.1822	0.2841	0.5213
more than 8 years of education	-0.0712	0.2349	0.7617	0.1940	0.0685	0.0046	-0.1800	0.2678	0.5014
Mother was an unpaid worker	0.8322	0.2214	0.0002						
Mother had a formal job	0.1962	0.1367	0.1513						
Rural area	0.5345	0.1245	0.0000						
height for age z-score	0.3671	0.0957	0.0001				1.9633	1.1595	0.0904
school attendance (freq2)	-2.2703	0.6562	0.0005						
log of total expenses per capita in food				0.0006	0.0004	0.1016			
child reports a chronic disease				0.0043	0.0245	0.8613			
house has filtered water				0.0670	0.0455	0.1410			
med				0.0002	0.0001	0.0650			
child labor				-0.1408	0.0464	0.0024	0.2493	0.2362	0.2912
the house has electric light							0.1562	0.0806	0.0525
OFERTAPN							0.0000	0.0000	0.0039
CARTEIRA							1.1539	0.4679	0.0137
BEMESCOL							-0.0001	0.0004	0.7911
var				0.9103	0.0430		4.2705	4.0956	
corr1&3	0.4214	0.2391	0.0780						
corr2&3	-0.8874	0.1444	0.0000						
Log-Likelihood	-8274.0664								
Observations	2807.0000								

Source: PPV/IBGE 1996/97.

TABLE 8: Marginal Effects and elasticities for the variables of the Model

Three-Equations Simult. Maximum Likelihood Linear-Probit Estimation

	Marginal Effects				**Elasticities**			
Variable	**LABOR**	**FLDHAZ**	**FREQ2**	**Total**	**LABOR**	**FLDHAZ**	**FREQ2**	**Total**
Age	0.025	-0.049	-0.007	-0.015	6.035	1.766	-0.023	22.805
	0.002	*0.008*	*0.009*	*0.003*				
Boy	0.046	-0.100	-0.009	-0.030				
	0.007	*0.035*	*0.036*	*0.007*				
Non white	0.010	0.259	0.115	0.043				
	0.017	*0.084*	*0.073*	*0.018*				
	-0.004	0.173	0.092	0.025				
The condition or state of repair of the residence is excellent/good	*0.009*	*0.044*	*0.037*	*0.007*				
Per capita household income								
> R$ 38.44 and <= R$ 90.99	0.012	**0.217**	0.059	0.032				
	0.011	*0.050*	*0.066*	*0.009*				
>R$ 90.99 and <= R$ 224.33	0.013	**0.315**	**0.134**	0.049				
	0.013	*0.057*	*0.061*	*0.012*				
> R$ 224.33	0.013	**0.358**	**0.154**	0.056				
	0.017	*0.070*	*0.059*	*0.015*				
Mother's education								
4 years of education	-0.010	0.169	0.177	0.024				
	0.008	*0.049*	*0.056*	*0.007*				
5 to 7 years of education	-0.013	0.245	0.261	0.032				
	0.011	*0.066*	*0.055*	*0.010*				
more than 8 years of education	-0.036	0.259	0.213	0.037				
	0.010	*0.056*	*0.049*	*0.008*				
Mother was an unpaid worker	0.134	-0.118	-0.023	-0.123				
	0.029	*0.032*	*0.077*	*0.031*				

Mother had a formal job	0.020	-0.028	-0.005	-0.011				
	0.012	*0.019*	*0.017*	*0.008*				
Rural area	0.060	-0.076	-0.015	-0.040				
	0.020	*0.029*	*0.052*	*0.016*				
	0.000	0.001	0.001	0.000	-0.519	-0.320	0.036	-2.960
log of total expenses per capita in food	*0.000*	*0.000*	*0.000*	*0.000*				
child reports a chronic disease	-0.002	0.007	0.009	0.001				
	0.009	*0.038*	*0.048*	*0.008*				
house has filtered water	-0.027	0.106	0.139	0.025				
	0.006	*0.041*	*0.042*	*0.008*				
Med	0.000	0.000	0.000	0.000	0.208	0.128	-0.015	1.186
	0.000	*0.000*	*0.000*	*0.000*				
the house has electric light	-0.041	0.050	0.166	0.026				
	0.016	*0.027*	*0.065*	*0.014*				
OFERTAPN	0.000	0.000	0.000	0.000	0.548	0.124	-0.036	1.804
	0.000	*0.000*	*0.000*	*0.000*				
CARTEIRA	-0.244	0.373	1.226	0.125	-5.374	-1.218	0.349	-17.692
	0.088	*0.210*	*0.340*	*0.058*				
BEMESCOL	0.000	0.000	0.000	0.000	0.010	0.002	-0.001	0.034
	0.000	*0.000*	*0.000*	*0.000*				
LABOR		0.245	-0.065	-0.156				
		0.004	*0.001*	*0.060*				
FLDHAZ	0.000		0.041	0.334				
	0.000		*0.000*	*0.042*				
FREQ2	0.000	0.038		-0.006				
	0.000	*0.000*		*0.002*				

Source: PPV/IBGE 1996/97.

Note: standard errors are on the second line of each variable with a small letter.

TABLE 9: Limited Information Model

Single Equation Maximum Likelihood Estimation

Variable	Probit Estimation Dependent Variable: labor			Linear Estimation Dependent Variable: health (fldhaz)			Linear Estimation Dependent Variable: education (freq2)		
	Coeff.	**Standard error**	**P-Value**	**Coeff.**	**Standard error**	**P-Value**	**Coeff.**	**Standard error**	**P-Value**
Constant	-2.360	1.330	0.075	-0.670	0.159	0.000	3.538	0.523	0.000
Age	0.231	0.023	0.000	-0.031	0.012	0.011	0.071	0.020	0.000
Boy	0.430	0.089	0.000	-0.072	0.040	0.072	0.135	0.049	0.006
Non white	0.362	0.170	0.033	0.261	0.085	0.002	-0.027	0.087	0.760
The condition or state of repair of the residence is excellent/good	0.068	0.109	0.536	0.156	0.043	0.000	0.005	0.050	0.926
Per capita household income									
> R$ 38.44 and <= R$ 90.99	0.210	0.126	0.095	0.228	0.049	0.000	0.001	0.075	0.987
>R$ 90.99 and <= R$ 224.33	0.300	0.153	0.050	0.325	0.054	0.000	0.045	0.080	0.572
> R$ 224.33	0.330	0.186	0.076	0.364	0.068	0.000	0.049	0.085	0.560
Mother's education									
4 years of education	0.088	0.116	0.447	0.158	0.050	0.001	0.096	0.059	0.107
5 to 7 years of education	0.173	0.168	0.303	0.227	0.066	0.001	0.109	0.063	0.081
more than 8 years of education	-0.170	0.163	0.298	0.221	0.059	0.000	0.015	0.069	0.826
Mother was an unpaid worker	1.040	0.109	0.000						
Mother had a formal job	0.193	0.104	0.064						
Rural area	0.522	0.099	0.000						
log of total expenses per capita in food				0.001	0.000	0.051			
child reports a chronic disease				0.102	0.068	0.132			
house has filtered water				0.129	0.040	0.001			
med				0.000	0.000	0.117			
the house has electric light							-0.022	0.118	0.854
OFERTAPN							0.000	0.000	0.550
CARTEIRA							-1.181	0.623	0.058
BEMESCOL							-0.001	0.000	0.011
child work				-0.063	0.034	0.062	-0.179	0.055	0.001
height for age z-score	-0.551	0.322	0.087				0.563	0.175	0.001
school attendance (freq2)	-0.811	0.396	0.041						
Log-Likelihood	-666.123			-3768.866			-3857.667		
Observations	2807			2807.000			2807		

Source: PPV/IBGE 1996/97.