Income Composition, Endogenous Fertility and Schooling Investments in Children

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Abstract

This paper studies how the composition of income between mothers and fathers affects fertility and schooling investments in children, using data from the 1976 and 1996 PNAD, a Brazilian household survey. Income composition affects the time cost of fertility because mothers and fathers allocate different amounts of time to child-rearing. These effects are in turn transmitted to investments in children through a tradeoff between quantity and quality of children. The main contribution of this paper is twofold. First, it derives new implications about the relationship between household income composition and schooling investments in children. Second, this paper devises and implements an empirical approach to assess these implications, using two cross-sections of fertility and schooling data from Brazil. The main empirical findings of the paper can be summarized as follows. First, the empirical analysis shows that a larger negative effect of the mother's labor income on fertility in 1996 is associated with a larger positive effect on the adult child's schooling, reflecting the interaction between quantity and quality of children. Second, the larger negative effect of the mother's labor income on fertility in 1996 is associated with a reduction in the effect of other determinants of number of children. This suggests that an increase in the relative importance of time costs of fertility may be an important determinant of variations in fertility over time in Brazil and other developing countries.

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1. INTRODUCTION

This paper studies how the composition of income between mothers and fathers affects fertility and schooling investments in children, based on a theory of the tradeoff between quantity and quality of children.

Several studies have investigated the relationship between fertility decisions and the composition of income or human capital among mothers and fathers. Theoretical studies include Willis (1973), De Tray (1973), and Galor and Weil (1996), among others. Empirical studies include Mincer (1963), Willis (1973), De Tray (1973), Ben-Porath (1973), Wahl (1985) and Mulligan (1993). These papers have found that the mother's labor income typically has a larger negative effect on fertility than the father's labor income. This finding has been interpreted as evidence that mother's income has both income and substitution effects on number of children, whereas father's income has primarily an income effect on fertility.

Theoretical analysis of the quantity-quality tradeoff has focused on how number of children affects the cost of human capital investments per child, and how investments in turn affect the price of fertility. This line of research includes Becker and Lewis (1973), De Tray (1973), Becker and Tomes (1976), Tomes (1978) and Becker, Murphy and Tamura (1990). The empirical literature on the quantity-quality tradeoff includes De Tray (1973), Tomes (1978), Rosenzweig and Wolpin (1980) and Mulligan (1993). These studies have found that the number of siblings has a negative effect on each adult child's schooling and income.

The main contribution of this paper is twofold. First, it combines these two strands of research and derives new implications about the relationship between household income composition and schooling investments in children. Second, this paper devises and implements a new empirical approach to assess these implications, using two cross-sections of fertility and schooling data from Brazil.

I construct a simple model relating the composition of household income between mothers and fathers to fertility and schooling investments in children. Mothers allocate their time between work and child-rearing. Fathers allocate their total time endowment to work. This difference in the allocation of time between mothers and fathers generates differences in the effects of mothers' and fathers' incomes on fertility. The effect of household income composition on fertility is in turn transmitted to investments in children's schooling through a tradeoff between quantity and quality of children.

The theoretical model yields four implications that are assessed in detail in the empirical analysis. First, the model predicts that the negative effect of mother's full-time labor income on fertility is larger than the effect of father's labor income. This reflects the stronger impact of mother's income on the time cost of children.

The second implication of the model is that the elasticity of fertility with respect to mother's labor income is positively related to the fraction of total fertility costs accounted for by time costs. This implication follows from the fact that the mother's labor income affects fertility primarily through its effect on the time cost of children.

The third prediction is that, if the mother's labor income reduces fertility, then it should increase investments in schooling per child, reflecting the quantity-quality tradeoff. The fourth implication of the model is that the larger the negative effect of mother's full-time labor income on fertility, the larger the positive effect on adult child's schooling. This prediction is also derived from the interaction between quantity and quality.

The empirical analysis is conducted on the 1976 and 1996 Pesquisa Nacional de Amostra Domiciliar (PNAD), a Brazilian household survey. The PNAD is a series of cross-sections that have been collected annually by the Instituto Brasileiro de Geografia e Estatistica (IBGE). Each cross-section is a representative sample of the Brazilian population and contains over 100,000 observations on households, and over 300,000 observations on individuals.

The choice of this data set is motivated by the fact that developing countries in general, and Brazil in particular, display a significant negative correlation between fertility and family income.[1] This suggests that fertility decisions may be important determinants of schooling investments in children in developing countries.

[1] Kremer and Chen (1998) present evidence that developing countries typically display larger differences in fertility among educated and uneducated families than developed countries. Lam (1986) provides evidence of a strong negative correlation between fertility and family income in Brazil.

Also, women's labor force participation has increased considerably in Brazil in the last two decades. More specifically, women's share in the total labor force increased from 26 percent in 1977 to 35 percent in 1994.[2] This makes Brazil particularly suitable for an empirical study of the importance of the mother's value of time for children's schooling.

Another advantage of the PNAD data set is its large number of observations. This is especially important in an empirical study of fertility behavior, where there is usually a strong degree of collinearity among the explanatory variables.

I provide evidence on the four theoretical implications by estimating fertility and adult child's schooling equations for both 1976 and 1996. The regression results for the 1996 and 1976 cross-sections show that, as predicted by the model, mother's labor income has a larger negative effect on number of children than father's labor income, even when parental education is controlled for. The finding that household income composition affects fertility is consistent with the first implication of the model.

In order to assess the second implication of the model, I compare the elasticities of fertility with respect to mother's income for the 1976 and 1996 regressions. The larger negative effect of the mother's labor income on number of children in 1996 is associated with a reduction in the effect of other determinants of fertility, including mother's education. This suggests that, as implied by the model, the effect of mother's labor income on fertility captures the relative importance of the value of time.

In order to provide evidence on the third theoretical implication, I compare the regression coefficients on mother's labor income across the fertility and adult child's schooling regressions, for each cross-section. I found that the signs of the coefficients on mother's income are reversed across the two regression equations, in both 1976 and 1996, as predicted by the model. Specifically, mother's labor income has a significant positive effect on adult child's schooling, even when the effect of mother's education is controlled for.

I provide evidence on the fourth theoretical implication by comparing the elasticities of fertility and adult child's schooling with respect to mother's labor income obtained from the 1976

[2] See World Bank (1996).

and 1996 regressions. I found that the larger negative effect of mother's labor income on number of children in 1996 is associated with a larger positive effect of mother's income on adult child's schooling. This is consistent with a quantity-quality tradeoff.

This paper is organized as follows. Section 2 presents a simple model designed to capture the relationship between income composition among mothers and fathers, fertility and schooling investments in children. Section 3 describes the data and presents summary statistics. Section 4 presents the empirical analysis of the PNAD data. Section 5 concludes and provides directions for future research.

2. THE MODEL

Consider a family consisting of a father, a mother and their children. Each person lives for two periods: childhood and adulthood. Parental variables are indexed by t, while children variables are indexed by $t+1$. Parents have preferences described by a single utility function, defined over parental consumption, c_t, number of children, n_t, and human capital investments per child, h_{t+1}, defined by:

$$U = U\left(c_t, n_t, h_{t+1}\right) = \alpha \log c_t + \gamma \log n_t + \beta \log h_{t+1}$$

where $\alpha, \gamma > 0$, $0 < \beta < 1$ and $\gamma > \beta$. This specification of the utility function assumes that parents derive utility directly from their bequests, rather than from their children's utility.[3]

Parents are endowed with one unit of time, and allocate their time between work and child-rearing. I assume that fathers spend all their time endowment working, while mothers spend λ units of time per child raising children, so they work $1-\lambda n_t$ units of time.[4]

[3] Banerjee and Newman (1991), Borjas (1992) and Galor and Zeira (1993) use a similar approach in the context of models of intergenerational mobility.

[4] Leibowitz (1974) presents evidence that mothers spend a fraction of time to child-rearing four times larger than fathers'. The assumption that only mothers devote time to child-rearing is thus a simplification, but a realistic one. A more general assumption would be that both mothers and fathers spend some time raising children, but mothers account for a higher fraction of total household time devoted to children.

The mother's wage rate, w_t, is assumed to depend on her human capital, h_t, according to the following functional specification:

$$w_t = Ah_t^{1-\varepsilon}$$

where $A > 0$ and $0 < \varepsilon < 1$.

In addition to mother's time, child-rearing is assumed to require ϕ_t units of goods per child.[5] Let y_t^F denote father's income. It may include nonlabor income in addition to father's earnings. Parents are assumed to solve the following maximization problem:

$$\begin{aligned}&\max_{c_t, n_t, h_{t+1}} \left\{\alpha \log c_t + \gamma \log n_t + \beta \log h_{t+1}\right\}\\&s.t.\\&c_t + n_t\left(\phi_t + h_{t+1}\right) = Ah_t^{1-\varepsilon}\left(1-\lambda n_t\right) + y_t^F\end{aligned}$$

The budget constraint captures the quantity-quality tradeoff through the term $n_t h_{t+1}$. Let $y_t \equiv Ah_t^{1-\varepsilon} + y_t^F$ and $y_t^M \equiv Ah_t^{1-\varepsilon}$ denote the family's full income and mother's full labor income, respectively. Then we can restate the parental problem as follows:

$$\begin{aligned}&\max_{c_t, n_t, h_{t+1}} \left\{\alpha \log c_t + \gamma \log n_t + \beta \log h_{t+1}\right\}\\&s.t.\\&c_t + n_t\left(\phi_t + h_{t+1} + \lambda y_t^M\right) = y_t\end{aligned} \tag{1}$$

where y_t is full income of generation t, and y_t^M denotes mother's full labor income. This formulation makes explicit the fact that mother's full-time labor income, y_t^M, is a component of the cost of children.

The first-order conditions imply:

[5] In general, ϕ_t will depend on several variables, such as knowledge about contraceptive methods, child mortality and on whether the child is raised in an urban or rural area. ϕ_t in general depends on t because its determinants may vary across generations. The effect of these variables on fertility will be considered in the empirical analysis in section 4.

$$n_t = \frac{\gamma}{\alpha+\gamma}\left(\frac{y_t}{\phi_t + h_{t+1} + \lambda y_t^M}\right) \tag{2}$$

$$h_{t+1} = \frac{\beta}{\alpha+\gamma}\left(\frac{y_t}{n_t}\right) \tag{3}$$

Solving (2) and (3) for n_t and h_{t+1}, we obtain equations relating optimal fertility and human capital investment to household income composition:

$$n_t = \frac{\gamma-\beta}{\alpha+\gamma}\left(\frac{y_t}{\phi_t + \lambda y_t^M}\right) \tag{4}$$

$$h_{t+1} = \frac{\beta}{\gamma-\beta}\left(\phi_t + \lambda y_t^M\right) \tag{5}$$

Notice from (5) that h_{t+1} depends only on mother's labor income, y_t^M. This implication is specific to the assumption of a logarithmic utility function.[6] However, the result that household income composition will have an effect on h_{t+1} is robust to generalizations of the utility function. The reason is that mother's income always has a price effect on fertility and investments per child, in addition to its income effect, while father's income only has income effects.

Let $y_{t+1}^C \equiv Ah_{t+1}^{1-\varepsilon}$, where y_{t+1}^C denotes the labor income of each adult child. Using (5), we obtain

[6] The reason for this result is that the positive income effect on h_{t+1} is cancelled out by the negative effect on h_{t+1} due to the income effect on fertility, and the resulting increase in the price of h_{t+1} implied by the interaction between quantity and quality. Becker and Barro (1988) obtain the same result with a different (but sharing the same properties) utility function. Alvarez (1994) analyzes the features of the Becker-Barro model that are necessary for this result to obtain.

$$y_{t+1}{}^{C} = \left(\frac{A^{\frac{1}{1-\varepsilon}} \beta}{\gamma - \beta} \right)^{1-\varepsilon} \left(\phi_t + \lambda y_t{}^{M} \right)^{1-\varepsilon} \tag{6}$$

For both theoretical purposes and for the empirical analysis that will follow, it is convenient to express the model variables in logarithms. Taking logs in (4) and log-linearizing around parental generation means of y_t, y_t^{M} and ϕ_t, we obtain:

$$\log n_t = cons + \log y_t - \left(\frac{\lambda \overline{y}_t{}^{M}}{\overline{\phi}_t + \lambda \overline{y}_t{}^{M}} \right) \log y_t{}^{M} - \left(\frac{\overline{\phi}_t}{\overline{\phi}_t + \lambda \overline{y}_t{}^{M}} \right) \log \phi_{\mathrm{t}} \tag{7}$$

where $\overline{\phi}_t$ and $\overline{y}_t{}^{M}$ denote parental generation means of the goods cost of fertility and mother's labor income, respectively.

Equation (7) states that fertility is positively related to household's full income, $\log y_t$, but negatively related to mother's full labor income, $\log y_t{}^{M}$. The coefficient on $\log y_t{}^{M}$ is the share of the time cost in total fertility costs, excluding expenditures in human capital per child, h_{t+1}. The coefficient on $\log \phi_t$ is the share of goods cost in total fertility costs. Notice that these coefficients are not time-invariant, since they depend on generation means of the time and goods cost of fertility.

The equation describing optimal human capital investments per child may be rewritten in logs as

$$\log h_{t+1} = cons + \left(\frac{\lambda \overline{y}_t{}^{M}}{\overline{\phi}_t + \lambda \overline{y}_t{}^{M}} \right) \log y_t{}^{M} + \left(\frac{\overline{\phi}_t}{\overline{\phi}_t + \lambda \overline{y}_t{}^{M}} \right) \log \phi_{\mathrm{t}} \tag{8}$$

Notice that the coefficients on $\log y_t{}^{M}$ in (7) and (8) are equal in absolute value, but have opposite signs. This results from the interaction between number of children and human capital investments per child.

Equation (6) may be rewritten in logs as

$$\log y_{t+1}{}^{C} = cons + (1-\varepsilon)\left(\frac{\lambda \bar{y}_t{}^{M}}{\bar{\phi}_t + \lambda \bar{y}_t{}^{M}}\right)\log y_t{}^{M} + (1\text{-}\varepsilon)\left(\frac{\bar{\phi}_t}{\bar{\phi}_t + \lambda \bar{y}_t{}^{M}}\right)\log \phi_t \tag{9}$$

The effect of mother's labor income on adult child's earnings has two components. The first term, $(1-\varepsilon)$, reflects the concavity of the wage function. The second term, $\frac{\lambda \bar{y}_t{}^{L}}{\bar{\phi}_t + \lambda \bar{y}_t{}^{L}}$, is the fraction of child costs accounted for by the time cost of fertility, and results from the interaction between quantity and quality of children. In general, the effect of father's labor income on adult child's labor income is different from the mother's, because they affect the time cost of fertility differently. In the log preference case, described by (9), the effect of father's income is zero.

Equations (7), (8) and (9) are the main equations of the model which will be estimated in section 4. They embody four theoretical predictions, which will be assessed in the empirical section. First, income composition matters for household choices, in the sense that mother's and household full income have different effects on fertility, adult child's schooling and labor income. In particular, the effect of mother's labor income on fertility, $\log y_t{}^{M}$, is negative, while the effect of household full income, $\log y_t$, is positive.

In this particular model, household income has no effect on adult child's schooling and labor income, but in general that is not the case. In particular, if the income effects on fertility and adult child's schooling are different, household income would appear in the schooling and labor income equations, (8) and (9). In this case, it is not possible to establish a priori whether the coefficient on $\log y_t{}^{M}$ is larger than the one on $\log y_t$ in the quality equations.

The second prediction of the model is that, as can be observed from (7), the effect of $\log y_t{}^{M}$ on fertility depends on the share of time costs in total fertility costs, $\frac{\lambda \bar{y}_t{}^{M}}{\bar{\phi}_t + \lambda \bar{y}_t{}^{M}}$. Notice that these coefficients depend on t, since the relative importance of the value of time may vary across generations. Hence, the model predicts that the higher is the share of time costs, the larger should be the negative effect of mother's labor income on fertility.

The third theoretical implication states that variables that do not enter both the fertility and human capital investment equations should appear with opposite signs in the quantity-quality equations. In particular, the sign on $\log y_t^M$ should be reversed across equations (7)-(9).

The fourth implication of the model states that the larger is the negative coefficient on $\log y_t^M$ in the fertility equation, (7), the larger is the magnitude of the coefficient on $\log y_t^M$ in the human capital and labor income equations (8) and (9), respectively.

The empirical analysis in section 4 will assess these implications using data from the Brazilian PNAD data set.

3. PNAD DATA

3.1 SAMPLE SELECTION AND VARIABLE DESCRIPTION

In this section, I describe the samples from the PNAD data set used in the empirical analysis, and the choice of empirical counterparts to the model variables. A more detailed discussion is available in the appendix.

The empirical analysis will be conducted on the 1976 and 1996 PNAD surveys of Brazilian households. The Pesquisa Nacional de Amostra Domiciliar (PNAD) is a series of cross-sections that have been collected annually since 1973 (except for 1980, 1990 and 1991) by the Instituto Brasileiro de Geografia e Estatistica (IBGE). Each cross-section is a representative sample of the Brazilian population and contains over 100,000 observations on households, and over 300,000 observations on individuals[7]. The PNAD is mainly concerned about labor market outcomes, but it also has information on some individual demographic variables, including fertility for some specific years.

The empirical analysis uses a total of four subsamples. I constructed two subsamples for each year, consisting of data on fertility and adult child's schooling, respectively. The fertility

[7] The PNAD is close to a nationally representative sample, though it is not fully representative of rural areas, especially in the remote frontier regions.

subsample for 1996 consists of about 17,000 married women with spouse present aged 45 years and over in 1996. Only women with nonzero fertility are included, since childless families cannot affect intergenerational mobility.[8]

The PNAD 96 has information on schooling achievement of the parents of household heads and their spouses, which makes it possible to estimate the effect of parental income composition on the adult child's schooling.

Ideally, one would like to use the same sample to run both the fertility and schooling regressions. However, since the PNAD does not have information on the number of siblings of household heads, this would be possible only for children still living with their parents. Since this procedure might generate selection bias, I used a broader schooling subsample, consisting of about 40,000 respondents aged 21-30 in 1996.[9] This age bracket was chosen to obtain a measure of completed schooling. The schooling subsample also has information on the adult child's full-time labor income, which will be used to estimate the effects of parental income composition on adult child's labor income.

The fertility subsample for 1976 consists of about 18000 married women with spouse present aged 45 years and over in 1976. The schooling (labor income) subsample for 1976 was drawn from the PNAD 96, and consists of about 30,000 respondents aged 41-50 in 1996. The rationale for the choice of the latter age range is that it corresponds to the cohort aged 21-30 in 1976, for which we want to gather education and labor income information.[10] I will also report results for the sample in which children still live with their parents, which uses fertility and schooling information for the same families in 1976.

The PNADs 76 and 96 have data on number of children-ever-born and number of children alive at the time of the survey. The latter is closer to the fertility variable in the model, since the first one is clearly affected by child mortality. However, since I will use several

[8] See Mulligan (1997) for a discussion of differences in fertility behavior when childless families are included
[9] In section 4 I will also report results for the sample in which children live with their parents.
[10] Lam and Levison (1992) use a similar procedure to analyze the evolution of the schooling distribution in Brazil across generations. This procedure is appropriate if the sample is truly representative and if differential effects of mortality and emigration for different schooling groups are negligible for these cohorts. Lam and Levison (1992) provide evidence that these conditions are met for the PNAD.

variables to control for child mortality, and since number of children-ever-born is the fertility measure most commonly used in the empirical literature, I will use the latter as the fertility measure, computed for married women aged 45 years and older.

I will use several variables to control for child mortality, including several health-related household categorical and dummy variables, such as quality of house construction materials, quality of sewage facilities, type of garbage collection, type of water supply, and availability of filters.[11].

Mother's and father's education will be used as proxies for ϕ, the goods cost of fertility. The interpretation is that higher parental education is associated with more knowledge about contraceptive methods, which in turn reduces fertility. In this sense, higher parental education may be viewed as increasing ϕ. [12] Parental education is also commonly associated with health expenditures on children, and in this sense education may serve also as a control for child mortality. Mother's education is also commonly used as a proxy for the time cost of fertility. The fact that I include parental education and income variables in the same regressions strengthens the interpretation that the coefficient on mother's labor income captures the effect of the time cost of fertility.

The measure of full-time labor income for both mothers and fathers used in this paper will be the log of the average of labor income among individuals working on average 40 hours per week during the year, grouped according to some characteristics.[13] This measure is computed for individuals working full-time, and is assigned to all individuals sharing the same characteristics.

I will also use interaction and quadratic functions of the income variables, in order to control for the fact that married women who work may have a demand for children different from the fertility schedule for married women who do not work. In particular, Willis (1973)

[11] See Meltzer (1992) for a discussion of the effects of child mortality on fertility choices.

[12] See Willis (1973) for a discussion of how knowledge about contraceptive methods may be interpreted as increasing the cost of fertility.

[13] I computed different averages of full-time labor income for men and women, grouped according to some characteristics, such as education, region of residence, and whether they live in an urban or rural area. Zimmerman (1992) uses 30 hours per week as his measure of full time labor supply, but less developed countries typically have longer workweeks.

shows that higher income of the husband reduces labor force participation of married women and increases the effect of women's labor income on number of children. [14] All interaction and quadratic variables are measured in logarithms.

Years of schooling of children aged 21-30 will be used as the measure of the adult child's human capital. I construct the adult child's labor income measure by first computing different averages of labor income for men and women working on average 40 hours per week during the year, grouped according to their education, region of residence, and whether they live in an urban or rural area. These full-time labor income averages are then assigned to men and women aged 21-30, according to their characteristics.[15]

I will use several control variables, including age and age squared of the husband, wife and oldest child, and the sex of the oldest child.[16] I also use dummy variables for region of residence and for whether the family lives in an urban or rural area. The latter may be viewed as an additional proxy for the goods cost of fertility, ϕ, since cost of living is higher in urban than rural areas.

3.2. SUMMARY STATISTICS

This subsection presents summary statistics for the PNAD data. I present basic measures of association between fertility, adult child's schooling and parental income, and compare them to other data sets. In section 4, I proceed to the empirical analysis of the theoretical predictions derived in section 2.

Table 1 presents summary statistics on fertility and mother's education for the PNAD 96 sample. In addition to total means and standard deviations, Table 1 displays means and standard

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[14] Willis (1973) shows that, for married women who do not work, the effect of lifetime mother's labor income on fertility is zero, whereas the effect on number of children for married women engaged in the labor force is negative.

[15] The same procedure is used to construct the human capital measure for children in the 1976 PNAD, but the computations are made for adults aged 41-50 in 1996, as explained in the text.

[16] For families that have more than one child meeting the sampling criteria, the eldest child will be retained in the schooling regressions. This preserves independence across observations and attempts to reduce the potential life-cycle bias by retaining the child farthest out on his earnings life cycle. Zimmerman (1992) and Solon (1992) use a similar procedure.

deviations for each quintile of the distribution of income among household heads for the 1996 fertility subsample.

Table 1 shows that in 1996 there was a large variation in the number of children-ever-born across income classes in Brazil, ranging from 7.1 in the poorest quintile, to 3.5 in the richest. There is also high variation in mother's schooling across quintiles. The 20 percent poorest mothers have on average 1.8 years of schooling, whereas the richest 20 percent have about 8 years of schooling. This pattern is consistent with the sharp decline in fertility as income increases across quintiles.

As can be observed from Table 2, this pattern was similar in 1976. For example, the average number of children ever born was 6.1. This figure is only slightly higher than the corresponding one for 1996, which may at first seem at odds with the evidence on the demographic transition that Brazil has been experiencing in the last three decades. However, we should expect the measures of fertility used in this paper to lag behind official fertility measures, since the latter usually incorporate the fertility choices of women aged 15-45, while the measure used in this paper includes only women aged 45 and over, whose behavior will tend to reflect past determinants of fertility.

A convenient way to summarize the cross-section association between income, fertility and investments in children is to regress number of children-ever-born, adult child's schooling and labor income on father's labor income[17]. Table 3 presents OLS regression results for 1996, using controls for age, urban areas and state of residence.[18]

Table 3 shows that a doubling of father's labor income reduces the number of children-ever-born by 2.1. The effect of father's schooling on adult child's schooling (column 3) is 0.55. This coefficient is significantly larger than the degree of regression to the mean in schooling estimated for the United States in the intergenerational mobility literature, which is usually around 0.3.[19]

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[17] Child mortality controls are not included in these regressions, in order to make them comparable to other regressions estimated in the literature.
[18] All regressions in this paper use sample weights provided by IBGE. I report only the unweighted number of observations.
[19] See, for example, Mulligan (1993, 1997), Solon (1992) and Zimmerman (1992).

The coefficient on father's labor income in column 4 corresponds to the degree of regression to the mean in earnings estimated in the intergenerational mobility literature. As observed for schooling, there is significant persistence in labor income across generations in the PNAD data, to the extent that the coefficient on father's labor income is 0.67 and hence relatively close to one. The most recent estimates for the intergenerational correlation in earnings in the United States average between 0.4 and 0.5.[20]

Table 4 presents analogous regression results for 1976. A doubling of father's labor income reduces the number of children-ever-born by 2.7. The degrees of regression to the mean for schooling and labor income of 0.65 and 0.76 are both higher in 1976, and are considerably larger than the ones obtained in mobility studies using data for the United States.

Tables 1-4 display high correlations between father's labor income, fertility, adult child's schooling and labor income for Brazil in 1976 and 1996. The empirical analysis in the next section will examine the patterns underlying these correlations to assess the validity of several theoretical implications regarding the relationship between composition of income among mothers and fathers, fertility, adult child's schooling and labor income.

4. EMPIRICAL ANALYSIS

4.1. EMPIRICAL MODEL

In this section I analyze the empirical implications of the model developed in section 2. In particular, I will assess the empirical validity of the four implications of the theoretical model.

The econometric model that will be used to analyze the effect of household income composition on fertility and schooling investments in children is derived from (7)-(9), and is described by the following equations:

[20] See, for example, Behrman et. al. (1995), Mulligan (1993, 1997), Solon (1992) and Zimmerman (1992).

$$n_t = a_n + b_n \log y_t^F + c_n \log y_t^M + d_n \phi\left(X_t\right) + f_n Z_t + \varepsilon_t^n \qquad (10)$$

$$h_{t+1} = a_h + b_h \log y_t^F + c_h \log y_t^M + d_h \phi\left(X_t\right) + f_h Z_t + \varepsilon_t^h \qquad (11)$$

$$\log y_{t+1}^C = a_y + \rho \log y_t^F + c_y \log y_t^M + d_y \phi\left(X_t\right) + f_y Z_t + \varepsilon_t^y \qquad (12)$$

where $\varepsilon_t^i, i = n, h, y$, are disturbances with mean zero and variance $\sigma^2{}_i$, assumed to be uncorrelated with the explanatory variables.

As in the theoretical model, n_t and h_{t+1} denote fertility and adult child's schooling, respectively.[21] Adult child's, father's and mother's full-time labor income are respectively denoted by $\log y_{t+1}^C$, $\log y_t^F$ and $\log y_t^M$. Father's labor income, $\log y_t^F$, is used as a proxy for household full income, $\log y_t$. This choice is motivated by two reasons. First, it expresses the regression equations in terms of the composition of income between mothers and fathers, which are the explanatory variables this paper is concerned about. Second, this makes the regressions comparable to similar regressions that have been estimated in the literature. Since father's labor income accounts for the bulk of household income, this is a reasonable approximation.

X_t is a vector of variables that may affect the goods cost of fertility, ϕ_t, including parental education, geographical and child mortality variables. Z_t is a vector of control and additional income variables, including parental income interaction terms and demographic variables.

The four theoretical predictions may be stated in terms of restrictions on the coefficients in (10)-(12) as follows. The first implication states that $c_n < b_n$ in (10).

The second prediction states that the coefficients on $\log y_t^M$ and $\phi\left(X_t\right)$ in (10) depend positively on the share of time costs and other fertility costs on total fertility expenditures, respectively. Hence, if c_n is larger in a particular year, d_n should be smaller.

[21] Notice that, even though income variables are expressed in logs, both fertility and education are not. One reason for this specification is that the use of logs of schooling would require the elimination of parents with no education, which are a significant fraction of the total. Another reason is that I want to make the regressions comparable to similar regressions in the literature, which measure fertility and education in levels rather than logs.

The third prediction states that c_n in (10) and c_h in (11) have opposite signs. The sign of c_y in (12) is also the opposite of c_n.

The fourth prediction is that, if c_n in (10) is larger in absolute value, then c_h and c_y in (11) and (12) are also larger.

4.2. REGRESSION RESULTS

In this subsection, I present empirical evidence on the four theoretical predictions for the PNAD data. First, I will use both cross-sections individually to analyze the evidence on the first and third implications. Then I will compare the 1976 and 1996 cross-sections to provide evidence on the second and fourth predictions.

a) 1996 Sample

Table 5 reports results for ordinary least-squares (OLS) regressions of fertility, adult child's schooling and labor income on father's and mother's full-time labor income, parental education, and several control variables, for the 1996 sample. The regressions also include interaction and quadratic variables involving mother's and father's full-time labor income.

The direct effect of mother's and father's labor income on fertility is always negative and significant both statistically and economically. A doubling of mother's labor income corresponds to 7.9 less children-ever-born, while a doubling of father's income implies 5.5 less children-ever-born.

The result that father's labor income has a negative effect on fertility, even after controlling for father's education, suggests that the former has a negative substitution effect on fertility, in addition to any possible positive income effect.

Table 5 shows that the negative effect of mother's labor income on fertility is always larger and significantly different from the father's, consistent with the first prediction of the model.[22]

Both parental income variables have a strong and significant positive effect on adult child's schooling and labor income. A doubling of mother's and father's labor income increases adult child's schooling by 2.6 and 3.4 years, respectively. The partial regression coefficients on parental income variables are similar in the schooling regression, but they are significantly different from each other in the labor income regression.

Notice that the effect of father's labor income on adult child's schooling and labor income is larger than the effect of mother's labor income. At first, this result may seem to be at odds with the assumption that mother's labor income is a better proxy for the time cost of fertility, as suggested by the fertility results. However, as was observed in section 2, the theoretical prediction is that the coefficient on father's income should capture the income effects on schooling (net of the income effect on fertility), while the coefficient on mother's income should capture the effect of the value of time on fertility, together with the interaction between quantity and quality. A priori, it is not possible to predict which effect will be larger. That prediction is possible for the fertility equation because, in that case, income and substitution effects have opposite signs.

The fact that the regression coefficient on mother's labor income is statistically significant in all regressions, despite the inclusion of parental education variables, provides evidence that mother's labor income captures the time cost of fertility[23].

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[22] The results are qualitatively equivalent and quantitatively similar when we use number of children currently alive as the fertility measure. The same is true when we use simple labor income averages instead of averages for full-time workers as the measure of lifetime full labor income. The main difference in comparison to the results for children-ever-born and full-time labor income is that the negative effect of parental labor income on fertility tends to be smaller and the regression coefficients less significant when children currently alive and/or simple labor income averages are used. These results are available from the author upon request.

[23] As discussed in the text, the inclusion of interaction and quadratic labor income variables is intended to control for the fact that the PNAD sample includes both mothers who work and who do not. In general, the coefficient on mother's labor income would include the effect on fertility and child's schooling for mothers that are not in the labor force. However, since this effect is zero for non-working mothers, this coefficient will tend to capture the substitution effect for working mothers, which is the effect we are interested in estimating. See Willis (1973) for a discussion of differences in the effect of mother's labor income on fertility between working and non-working mothers.

These results provide evidence on the first implication of the model, to the extent that mother's and father's labor incomes have different effects on fertility, adult child's schooling and labor income. Moreover, the negative effect of mother's income on fertility is larger than the father's income effect, which is also consistent with the model.

Table 5 also shows that all regression coefficients have their signs reversed once we move from quantity to quality regressions, as can be observed by comparing the results in columns 1 to columns 2-3. The finding that the signs of the coefficients on parental income variables, especially the mother's, are reversed when we move from the quantity to the quality regressions is consistent with the third prediction of the model. The fact that this finding is also observed for parental education variables is also consistent with the model, even though it is not necessarily a prediction.

The analysis above compares the direct effects of father's and mother's labor income on fertility, adult child's schooling and labor income, as captured by the partial regression coefficients on parental income variables, excluding the effect of the interaction variables. This procedure seems to be reasonable, since we are interested in computing the effect of parental income variables on the endogenous variables for families in which both parents work, as assumed in the model. The introduction of interaction and quadratic income variables is intended to control for the fact that income variables alter the likelihood that mothers will work, and in principle their effect should not be considered for evaluating the model.

In any case, it is useful to present results which take into account the effect of interaction and quadratic variables, both for robustness purposes and to make it easier to compare the results in this paper to others in the literature. Table 6 displays elasticities of fertility, adult child's schooling and labor income with respect to father's and mother's labor income in 1996. These elasticities were obtained from the regression results in Table 5 and are evaluated at sample means of the parental income variables.

Table 6 shows that the elasticities of fertility with respect to mother's and father's labor income in 1996 are equal to -0.48 and -0.32, respectively. Both elasticities are larger than the ones usually estimated in the fertility literature.[24] Notice that the schooling and labor income elasticities are both positive, and different for mothers and fathers.

The results displayed in Table 6 thus confirm the predictions that household income composition affects fertility, adult child's schooling and labor income. Moreover, the sign reversal observed across quantity-quality equations provides evidence that the relationship between income composition and both child's schooling and labor income are significantly affected by the interaction between quantity and quality of children.

b) 1976 Sample

I next present results for the 1976 sample, which are analogous to the ones obtained above for the 1996 sample. These results are presented to provide further evidence on the first and third predictions of the model, and also because they will be later compared to the results obtained for 1996 in order to test the second and fourth theoretical implications.

Table 7 reports results for OLS regressions of fertility, adult child's schooling, and labor income on father's and mother's full-time labor income, as well as their education and control variables, for the 1976 sample. The regressions also include interaction and quadratic variables involving mother's and father's full-time labor income.

As observed in 1996, the direct effect of mother's and father's labor income on fertility is always negative and significant both statistically and economically. A doubling of mother's labor income corresponds to 3.5 less children-ever-born, while a doubling of father's income implies 2.1 less children-ever-born. Table 7 thus shows that the effect of mother's income on fertility is larger in absolute value and significantly different from the father's.

Both parental income variables have a strong and significant positive effect on adult child's schooling and labor income. A doubling of mother's and father's labor income increases

[24] Ben-Porath (1973) estimates elasticities of fertility with respect to mother's and father's labor income to be -0.33 and -0.22, respectively, using data from Israel. Willis (1973) estimates a value of the father's elasticity around -0.1 for the U.S. Willis does not estimate the elasticity of mother's labor income, but he does obtain an elasticity of mother's education equal to -0.4.

adult child's schooling by 1.1 and 2.4 years, respectively. The partial regression coefficients on parental income variables are similar in the schooling regression, but they are significantly different from each other in the labor income regression.

These results confirm the qualitative findings obtained from he 1996 sample. In particular, they provide evidence on the first implication of the model, since mother's and father's labor incomes have different effects on fertility, adult child's schooling and labor income. Moreover, the negative effect of mother's income on fertility is larger than the father's income effect, which is also consistent with the model.

Table 7 also shows that the partial regression coefficients on parental income variables have their signs reversed once we move from quantity to quality regressions, as can be observed by comparing the results in columns 1 to columns 2-3. This finding is consistent with the third prediction of the model.

Table 8 displays elasticities of fertility, adult child's schooling and labor income with respect to father's and mother's labor income for 1976. These elasticities were obtained from the regression results in Table 7 and are evaluated at sample means of the parental income variables.

Table 8 shows that the elasticities of fertility with respect to mother's and father's labor income in 1976 are equal to -0.35 and -0.22, respectively. The results displayed in Table 6 thus confirm the predictions that household income composition affects fertility, adult child's schooling and labor income. Also, the sign reversal observed across quantity-quality columns provides evidence of a tradeoff between quantity and quality of children.

c) Comparison between 1976 and 1996 samples

The comparison of the regression results for 1976 and 1996 allows for an assessment of the second and fourth theoretical implications. In the last two decades, there have been significant changes in several determinants of fertility behavior in Brazil. For example, women's share in total labor force increased from 26 percent in 1977 to 35 percent in 1994. During the same period, infant mortality declined from 79 deaths per thousand born children to 55.8 deaths per thousand born children. Also, the degree of urbanization, measured by the fraction of urban population in total population, increased from 63.2 to 77.5. Average years of schooling of adults aged 25 years and older increased from 4 in 1977 to 7 in 1994.[25]

The sharp increase in women's labor force participation suggests that the relative importance of time costs in total fertility costs may have increased between 1976 and 1996. On the other hand, the increase in both urbanization and average schooling and the decline in infant mortality also contributed for a reduction in fertility throughout this period, so it is not clear how the share of time costs in total costs, $\frac{\lambda \bar{y}_t^M}{\bar{\phi}_t + \lambda \bar{y}_t^M}$, varied during this period.

In any case, the second implication of the model is that the elasticity of fertility with respect to mother's labor income and the elasticity of fertility with respect to other determinants of the cost of fertility such as mother's education and degree of urbanization should have varied in opposite directions between 1976 and 1996. The reason is that the elasticity of fertility with respect to mother's labor income is positively related to the share of time costs in total fertility costs, while the elasticities with respect to education and urbanization are positively related to the goods share in total fertility costs, as can be observed from equation (7).

One way to assess this implication of the model is to compare the regression coefficients on mother's labor income, mother's education and degree of urbanization between the 1976 and 1996 cross-sections. A comparison of Tables 5 and 7 shows that the absolute value of regression coefficients on mother's labor income are larger in 1996. The same is true for the coefficients on father's labor income, which is consistent with the interpretation that the latter partly captures a negative substitution effect on fertility.

A comparison between Tables 5 and 7 also shows that the absolute value of the effect of mother's education on fertility declines from 0.18 in 1976 to 0.11 in 1996. As for the effects of urbanization, these are not displayed in Tables 5 and 7, but they confirm the findings above. Controlling for all explanatory variables, urban areas had 1.5 less children in 1976, whereas they had only 0.5 less children in 1996. Both effects are significantly different from zero at the one-percent level.

[25] See World Bank (1996).

Tables 6 and 8 show that the absolute value of the elasticity of fertility with respect to mother's labor income is larger in 1996, which confirms the findings for the partial regression coefficients. The absolute value of the elasticity of fertility with respect to mother's education declined from 0.2 to 0.08 between 1976 and 1996, consistent with the second prediction of the model.[26]

I now turn to the fourth implication of the model. It states that the larger is the negative effect of mother's labor income on fertility, the larger should be its effect on adult child's schooling and labor income.

Consistent with this prediction, Tables 5 and 7 show that the smaller reduction in fertility in face of a doubling in mother's labor income in 1976 (-3.5, as opposed to -7.9 in 1996) is associated with a smaller increase in adult child's schooling (1.1, as opposed to 2.6 years in 1996) and labor income (0.75, as opposed to 0.9 in 1996).[27]

The coefficient on father's labor income is also smaller in 1976 (-2.1, as opposed to -5.5 in 1996). The effects of father's labor income on child's schooling and labor income are correspondingly smaller in 1976 (2.4 and 0.54 for schooling and income, respectively, as opposed to 3.36 and 1.1 in 1996).

The same pattern arises when we compare elasticities between 1976 and 1996. Tables 6 and 8 show that the larger elasticity of fertility with respect to mother's labor income in 1996 (-0.48, as opposed to -0.35 in 1976), is associated with larger adult child's schooling and labor income elasticities in 1996. In particular, the schooling elasticity with respect to mother's labor income is 0.38 in 1996 and 0.26 in 1976, whereas the elasticities for adult child's labor income are respectively 0.43 in 1996 and 0.35 in 1976.

Notice that the same pattern arises when we compare the elasticities with respect to father's labor income between 1976 and 1996. This finding supports the interpretation that the

[26] See Espenshade (1977, 1984) for estimates of the relative importance of time costs and goods costs in total expenditures in children in the U.S.

[27] A Chow test rejects stability of the regression coefficients on mother's labor income between 1976 and 1996 at the five-percent level, for both the fertility and schooling regressions.

negative effect of father's labor income on fertility arises in part due to the effect of father's income on the time cost of fertility.

In summary, the comparison of Tables 5-8 provides considerable evidence that the tradeoff between quantity and quality of children is an important determinant of family decisions regarding fertility and investments in children's schooling in Brazil.[28]

5. CONCLUSION

The empirical findings in this paper show that the composition of household income between mothers and fathers is an important determinant of fertility and investments in children's schooling, using two cross-sections from the PNAD, a Brazilian household survey. Moreover, the results strongly suggest that the relationship between household income composition and schooling investments in children is affected to a large extent by the tradeoff between number of children and investments per child.

These findings may be summarized by four pieces of evidence, which provide support for the theoretical model constructed in this paper. First, the negative effect of the mother's labor income on number of children is larger and significantly different from the father's.

Second, the negative effect of mother's labor income on fertility is larger in 1996, while the effect of other determinants of the cost of children is smaller. This suggests that the effect of mother's labor income on number of children is positively related to the share of time costs in total fertility costs, as implied by the model.

Third, I found that the signs of the regression coefficients on mother's labor income are reversed across the quantity-quality regression equations, both in 1976 and 1996, as predicted by the model. More specifically, mother's labor income has a significant positive effect on adult child's schooling, even when the effect of mother's education is controlled for. This provides

[28] These results are confirmed for the subsamples that include only families in which children live with their parents. The main difference is that the magnitude of the effects of mother's labor income on both fertility and adult child's schooling is greater when the sample is restricted to these families. These results are available from the author upon request.

evidence that the relationship between schooling investments in children and household income composition is affected by the relation between income composition and fertility, on the one hand, and the interaction between number of children and child investments, on the other.

Fourth, I found that the larger negative effect of mother's labor income on number of children in 1996 is associated with a larger positive effect of mother's income on adult child's schooling and labor income. This is another evidence of the importance of the quantity-quality interaction in generating a relationship between household income composition and adult child's schooling and labor income.

Even though the empirical findings in this paper are very encouraging, they suggest possible ways in which they may be refined. First, in the empirical analysis, I controlled for the behavior of non-working mothers by using interaction and quadratic variables, based on Willis (1973). It would be interesting to model explicitly the behavior of non-working mothers, and analyze in detail the implications for the relationship between parental income, fertility and adult child's schooling.

Also, the data suggest that father's labor income may also increase the time cost of fertility. This suggests that it would be promising to construct a model in which fathers allocate some of their time to child-rearing, instead of assuming that they devote all their time to work.

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APPENDIX

A. Detailed description of empirical counterparts to model variables.

The empirical analysis presented in this paper focus on the 1976 and 1996 PNADs. There are two main reasons for analyzing two cross-sections from the PNAD. First, the comparison between two cross-sections can be used to assess the second implication of the model, which states that the elasticity of fertility with respect to mother's labor income is an increasing function of the share of time costs in total fertility costs.

Second, I want to explore the fourth implication of the model, which states that the magnitudes of the coefficients on mother's labor income in the fertility and schooling regressions are related in a special way. In particular, the larger is the negative effect of mother's labor income on fertility, the larger should be the positive effect on the adult child's schooling. It is possible to test this implication by comparing the regression coefficients of both equations for two different years. This prediction can be interpreted as another way to provide evidence on the interaction between quantity and quality of children.

There are several reasons for the choice of these particular years. First, both years have information on number of children-ever-born and number of children alive at the time of the surveys. Also, the 1996 PNAD added a special supplement on mobility (both intra and intergenerational), which included questions about schooling of the parents of the family head and spouse.

Second, both theoretical models and the empirical evidence suggest that the importance of the value of time as a determinant of fertility behavior tends to increase as a country develops, especially in association with the secular increase in women labor force participation (see Schultz (1993)). As discussed in the text, several important determinants of fertility have changed considerably in the last two decades in Brazil, which makes the period 1976-96 especially convenient to test the implications of the model.

There are several issues involved in finding empirical counterparts for the model variables. The PNADs 76 and 96 have data on number of children-ever-born and number of children alive at the time of the survey. The latter is closest to the fertility variable in the model, since the first one is clearly affected by child mortality. However, since I use controls for child mortality, and since children-ever-born is the measure of fertility most commonly used in the literature, I use the latter in the empirical analysis.

The choice of empirical counterparts for the lifetime full income variables is subject to severe conceptual and econometric problems. I will not discuss these issues in detail in this paper, since they have been discussed elsewhere (see Schultz (1974) and Willis (1973)). Among these problems, I should mention the difficulty in obtaining a lifetime measure of income, especially when only one year worth of data for each individual is provided, as is the case with the PNAD. The use of current income data is likely to generate measurement error bias. Also, current labor income is an endogenous variable in the model, since it depends on hours worked, which in turn is affected by the number of children (especially for the mother). Another issue is that labor income is not observed for parents who do not work, which is a problem especially for married women.

The main measure of full-time labor income used in this paper is the log of the average of labor income among individuals working on average 40 hours per week during the year, grouped according to their education, region of residence, and whether they live in an urban or rural area. This measure is computed for individuals working full-time, and is assigned to all individuals sharing the same characteristics. The use of data for full-time workers is intended to address the endogeneity problem by considering only individuals who work the same number of hours on average. The use of averages aims both at providing a measure closer to lifetime income, and at obtaining proxies of lifetime income for individuals (especially women) who do not work.

I also use interaction and quadratic functions of the income variables, in order to control for the fact that married women who work may have a demand for children different from the fertility schedule for married women who do not work. All interaction and quadratic variables are measured in logarithms. All income variables are expressed in 1996 prices, using the Consumer Price Index from IBGE as the price deflator.

Education of the father and mother will be used as proxies for ϕ, the goods cost of fertility. In the context of the theoretical model presented in section 2, parental education may be interpreted as a measure of ϕ, the goods cost of fertility. Parental education can affect fertility through several channels, including variation in the time cost, household productivity effects, and knowledge about contraceptive methods (see Michael (1974). To the extent that it affects health expenditures, parental education can also proxy for child mortality. In this paper, I do not attempt to identify all of these different channels, but I do try to separate the time cost effect of education from the other effects, by including parental labor income and education variables in the same regressions.

I also use several control variables, including age and age squared of the husband, wife and oldest child, the sex of the oldest child, dummy variables for region of residence and for whether the family lives in an urban or rural area. All regressions use sampling weights provided by IBGE.

Table 1- Summary Statistics - PNAD 96		
quintile (household head income)	number of children-ever-born (mean)	mother's schooling (mean)
bottom quintile	7.13	1.84
second quintile	6.62	2.1
third quintile	5.49	3.17
fourth quintile	4.44	4.75
top quintile	3.5	8.12
total (mean)	5.47	3.97
total (standard deviation)	3.74	3.12
number of observations (total)	17410	17410

Table 2- Summary Statistics - PNAD 76		
quintile (household head income)	number of children-ever-born (mean)	mother's schooling (mean)
bottom quintile	7.37	0.81
second quintile	6.75	1.45
third quintile	6.27	1.97
fourth quintile	5.47	2.99
top quintile	4.5	5.22
total (mean)	6.1	2.5
total (standard deviation)	4.24	2.04
number of observations (total)	18261	18261

Table 3 : OLS Regression of fertility, adult child's schooling and labor income (full-time) on father's labor income (full-time) and schooling - PNAD 96

independent variables	number of children-ever-born	adult child's schooling	adult child's schooling	adult child's labor income
father's labor income	-2.10 * (0.04)	3.59 * (0.04)		0.67 * (0.004)
father's schooling			0.55 * (0.01)	
adjusted R squared	0.27	0.29	0.39	0.47
N	12598	46865	42051	46865

Notes: (a) All income variables are measured in logs. Standard errors in parentheses. All regressions use sample weights provided by IBGE. N refers to the unweighted number of observations.
(b) The full-time concept of labor income is defined as average labor income for men who are household heads and work 40 hours per week on average. Different income averages are calculated for each possible combination of education category, state of residence and whether the individual lives in a urban or rural area.
(c) A constant, the mother's age, its age squared, the father's age, its age squared, the oldest child age, its age squared, the oldest child's sex, a dummy variable for urban areas and a dummy variable for the state in which the family resides are included in each regression.
(e) * significant at the one-percent level

Table 4: OLS Regression of fertility, adult child's schooling and labor income (full-time) on father's labor income (full-time) and schooling - PNAD 76

independent variables	number of children-ever-born	adult child's schooling	adult child's schooling	adult child's labor income
father's labor income	-2.7 * (0.04)	4.1 * (0.06)		0.76 * (0.006)
father's schooling			0.65* (0.01)	
adjusted R squared	0.18	0.26	0.42	0.46
N	13384	20539	18598	20539

Notes: (a) All income variables are measured in logs. Standard errors in parentheses. All regressions use sample weights provided by IBGE. N refers to the unweighted number of observations.
(b) The full-time concept of full labor income is defined as average labor income for men who are household heads and work 40 hours per week on average. Different income averages are calculated for each possible combination of education category, state of residence and whether the individual lives in a urban or rural area.
(c) A constant, the mother's age, its age squared, the father's age, its age squared, the oldest child age, its age squared and the oldest child's sex, a dummy variable for urban areas and a dummy variable for the state in which the family resides are included in each regression.
(e) * significant at the one-percent level

Table 5 : OLS Regression of fertility, adult child's schooling and labor income (full-time) on father's and mother's labor income (full-time)- PNAD 96

independent variables	number of children-ever-born	adult child's schooling	adult child's labor income
mother's labor income	-7.86 * (0.63)	2.63 * (0.37)	0.90 * (0.06)
father's labor income	-5.52 * ++ (0.69)	3.36 * ++ (0.40)	1.10 * + (0.07)
mother's education	-0.11 * (0.01)	0.20 * (0.007)	0.0004 (0.001)
father's education	-0.11 * (0.02)	0.27 * (0.01)	0.001 (0.002)
adjusted R squared	0.33	0.46	0.56
N	10305	33782	33782

Notes: (a) All income variables are measured in logs. Standard errors in parentheses. All regressions use sample weights provided by IBGE. N refers to the unweighted number of observations.
(b) The full-time concept of full labor income is defined as average labor income for men (women) who are household heads (or spouses of household heads) and work 40 hours per week on average. Different income averages are calculated for each possible combination of education category, state of residence and whether the individual lives in a urban or rural area.
(c) A constant, the mother's age, its age squared, the father's age, its age squared, the oldest child age, its age squared, the oldest child's sex, a dummy variable for urban areas and a dummy variable for the state in which the family resides are included in each regression.
(d) The variables used to control for child mortality include several health-related household categorical and dummy variables, such as quality of house construction materials, quality of sewage facilities, type of garbage collection, type of water supply, and availability of filters.
(e) * significant at the one-percent level
** significant at the five-percent level
(f) + significantly different from coefficient on mother's labor income at the one-percent level
++ significantly different from coefficient on mother's labor income at the five-percent level

Table 6 : Computed elasticities of fertility, adult child's schooling and labor income (full-time) with respect to father's and mother's labor income (full-time) from Table 5- PNAD 96

independent variables	number of children-ever-born	adult child's schooling	adult child's labor income
mother's labor income	-0.48	0.38	0.43
father's labor income	-0.32	0.3	0.34

Note: All elasticities are evaluated at parental income variable means.

Table 7 : OLS Regression of fertility, adult child's schooling and labor income (full-time) on father's and mother's labor income (full-time) - PNAD 76

independent variables	number of children-ever-born	adult child's schooling	adult child's labor income
mother's labor income	-3.46 * (0.86)	1.1 (0.82)	0.75 * (0.12)
father's labor income	-2.09 ** ++ (0.98)	2.4 * ++ (0.73)	0.54 * + (0.11)
mother's education	-0.18 * (0.02)	0.29 * (0.01)	0.02 * (0.002)
father's education	-0.11 * (0.02)	0.35 * (0.02)	0.007 * (0.003)
adjusted R squared	0.23	0.53	0.59
N	12951	15602	15602

Notes: (a) All income variables are measured in logs. Standard errors in parentheses. All regressions use sample weights provided by IBGE. N refers to the unweighted number of observations.
(b) The full-time concept of full labor income is defined as average income for men (women) who are household heads (spouses of household heads) and work 40 hours per week on average. Different income averages are calculated for each possible combination of education category, state of residence and whether the individual lives in a urban or rural area.
(c) A constant, the mother's age, its age squared, the father's age, its age squared, the oldest child's age, its age squared, the oldest child's sex, a dummy variable for urban areas and a dummy variable for the state in which the family resides are included in each regression.
(d) The variables used to control for child mortality include several health-related household categorical and dummy variables, such as quality of house construction materials, quality of sewage facilities, type of garbage collection, type of water supply, and availability of filters.
(e) * significant at the one-percent level.
** significant at the five-percent level.
(f) + significantly different from coefficient on mother's labor income at the one-percent level.
++ significantly different from coefficient on mother's labor income at the five-percent level.

Table 8: Computed elasticities of fertility, adult child's schooling and labor income (full-time) with respect to father's and mother's labor income (full-time) from Table 7 - PNAD 76

independent variables	number of children-ever-born	adult child's schooling	adult child's labor income
mother's labor income	-0.35	0.26	0.35
father's labor income	-0.22	0.18	0.27

Notes: All elasticities are evaluated at parental income variable means.