

**Effects of Family Background on Earnings and Returns to Schooling:
Evidence from Brazil**



David Lam, Robert F. Schoeni

The Journal of Political Economy, Volume 101, Issue 4 (Aug., 1993), 710-740.

Your use of the JSTOR database indicates your acceptance of JSTOR's Terms and Conditions of Use. A copy of JSTOR's Terms and Conditions of Use is available at <http://www.jstor.org/about/terms.html>, by contacting JSTOR at jstor-info@umich.edu, or by calling JSTOR at (888)388-3574, (734)998-9101 or (FAX) (734)998-9113. No part of a JSTOR transmission may be copied, downloaded, stored, further transmitted, transferred, distributed, altered, or otherwise used, in any form or by any means, except: (1) one stored electronic and one paper copy of any article solely for your personal, non-commercial use, or (2) with prior written permission of JSTOR and the publisher of the article or other text.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

The Journal of Political Economy is published by University of Chicago. Please contact the publisher for further permissions regarding the use of this work. Publisher contact information may be obtained at <http://www.jstor.org/journals/ucpress.html>.

The Journal of Political Economy
©1993 University of Chicago

JSTOR and the JSTOR logo are trademarks of JSTOR, and are Registered in the U.S. Patent and Trademark Office. For more information on JSTOR contact jstor-info@umich.edu.

©2001 JSTOR

Effects of Family Background on Earnings and Returns to Schooling: Evidence from Brazil

David Lam

University of Michigan

Robert F. Schoeni

RAND

We investigate whether omitted family background variables are responsible for high returns to schooling estimated in Brazil. Returns to schooling fall by about one-third when parental schooling is added to wage equations. Surprisingly, the schooling of fathers-in-law has larger effects on wages than the schooling of fathers. On the basis of a model of assortative mating, we interpret this as evidence that parental characteristics represent unobservable worker attributes rather than nepotism in the labor market. We conclude that the “family background bias” in returns to schooling is modest and need not imply returns to family connections.

Introduction

Two stylized facts about labor markets in developing countries provide a backdrop for this paper. The first, which is supported by extensive empirical research, is that private returns to schooling are sub-

This paper has benefited from comments by Ricardo Barros, T. Paul Schultz, Guilherme Sedlacek, and seminar participants at Berkeley, Brown, Chicago, Michigan, RAND, and Yale. Support from the U.S. National Institutes of Health (National Institute of Child Health and Development grant no. R01-HD19624), the Fulbright Commission, the Program for International Partnerships of the University of Michigan, the Hewlett Foundation, and the Instituto de Pesquisa Econômica Aplicada, Rio de Janeiro, is gratefully acknowledged. Excellent research assistance was provided by Deborah Reed.

stantially higher in developing countries than in the United States and other high-income countries. The second, which is more impressionistic, is that intergenerational mobility is lower in developing countries, with family background playing a more important role in determining earnings. Many observers have suggested that there are important connections between these two characteristics of developing country labor markets, arguing that omitted family background effects are partly responsible for the apparent high returns to schooling.

This paper analyzes the effects of family background on male labor market earnings in Brazil, a country with unusually high returns to schooling and one of the most unequal distributions of income in the world. We attempt to identify the magnitude of the "family background bias" in conventional estimates of returns to schooling and to identify the direct effect of family background on earnings. We begin with a theoretical model of assortative mating and intergenerational correlations in income-related characteristics. The model demonstrates the potential information contained in characteristics of a worker's parents and parents-in-law about unobserved characteristics of the worker. We show that there are important asymmetries between the characteristics of parents and the characteristics of parents-in-law in relation to workers' earnings, asymmetries that help distinguish among alternative interpretations of observed family background effects.

Building on this model, our econometric approach is straightforward. We sequentially add measures of the schooling of workers' relatives to wage equations, analyzing both the direct effect of these variables on wages and the effect of these variables on the estimated returns to the worker's own schooling. Using a data set with over 40,000 Brazilian males aged 30–55, we are able to identify significant independent effects of the schooling of a worker's parents, wife, and parents-in-law on wages. We find that estimated returns to schooling decline by one-fourth to one-third when family background variables are included in the regression. Direct effects of parental schooling on wages are substantial, though well below the returns to a worker's own schooling. When we control for the worker's own schooling and the schooling of other relatives, for example, having a father with a university education is associated with a 20 percent wage advantage compared to having an illiterate father. Our most intriguing result is that the schooling of a worker's father-in-law has a larger effect on a worker's wage than the schooling of the worker's own father. This surprising result has a clear interpretation in our model of assortative mating and provides support for the interpretation of family background variables as proxies for unobserved worker characteristics,

rather than as evidence of returns to nepotistic family connections in the labor market.

Given the high correlations among our family background variables, we pay close attention to the potential role of measurement error bias in our results. We demonstrate that even under modest assumptions about the magnitude of measurement error in schooling, as much as 80 percent of the observed decline in returns to schooling from inclusion of family background variables may be explained by increases in measurement error bias. This factor has been widely ignored in previous studies, and our results suggest that previous researchers may have exaggerated the extent of family background bias in returns to schooling. Even ignoring the increased measurement error bias, we continue to estimate returns to schooling in Brazil of over 10 percent after controlling for a large set of family background variables.

Education, Family Background, and Economic Outcomes

A striking feature of labor markets in many developing countries is the high estimates of returns to schooling in comparison to those of the United States and other industrialized economies. Psacharopoulos (1985), summarizing estimates of returns to education for 60 different countries in the 1970s, reports an average return to schooling in developing countries of about 15 percent, compared to an average of 9 percent for high-income countries. Brazil is no exception to this pattern. Lam and Levison (1992), for example, estimate returns to schooling for separate 3-year age groups of 15–16 percent for Brazilian males, compared to 9–11 percent for the same-age males in the United States. Education alone explains 50 percent of the variation in earnings of 30–33-year-old males in Brazil, compared to less than 10 percent for the same age group of males in the United States.

One natural explanation of these high returns to schooling is that they reflect high rents due to the relative scarcity of human capital, an argument particularly salient in Brazil, where a high degree of industrialization coexists with mean schooling of less than 5 years (see Langoni 1977; Lam and Levison 1992). This interpretation has important policy implications, suggesting that appropriately designed schooling investments can have high social returns and reduce earnings inequality. Critics argue, however, that these high estimates of returns to schooling in developing countries are subject to a variety of biases that cause them to overstate the returns that would be experienced by a randomly drawn individual. Most of these biases are the same ones that have been raised in the debate over the effect of

schooling in high-income countries, including the correlation between schooling and ability (Griliches and Mason 1972; Chamberlain and Griliches 1975; Behrman and Taubman 1976) and the correlation between schooling and a variety of family and community background variables (Hauser and Sewell 1986; Corcoran et al. 1990).

Research on the role of family background in explaining earnings and returns to schooling is less extensive for developing countries. Two studies from Latin America are particularly relevant to this study. Behrman and Wolfe (1984) identified strong independent effects of family background in a study of female earnings in Nicaragua. Using a sample of 500 Nicaraguan sister pairs, they difference the data across siblings and find that returns to schooling drop by one-fourth, from 11.4 percent to 8.6 percent, leading them to conclude that standard estimates of returns to schooling are biased upward in the absence of controls for family background and unobserved ability. Heckman and Hotz (1986) estimate earnings equations for Panamanian males that include father's and mother's education as regressors. Parental education is found to have a significant direct effect on earnings, with the point estimates implying that a 1-year increase in mother's education increases the son's annual earnings by 3–5 percent. Heckman and Hotz find that estimated returns to the worker's own schooling drop by about one-third, from 11.9 percent to 8.6 percent, when father's and mother's education is included in the regression.

Assortative Mating and Intergenerational Correlations in Schooling and Earnings

The empirical strategy we adopt below is straightforward. We estimate a series of wage equations in which we begin with the schooling of the worker as a regressor and then sequentially add the schooling of the worker's parents, wife, and parents-in-law. These regressions provide a simple test of the role of "family background" in explaining the relationship between schooling and earnings in Brazil. It is clear *ex ante*, however, that several alternative interpretations can be given to such regressions. As pointed out by Schultz (1988), a number of researchers have included characteristics of parents in earnings equations, with a variety of interpretations given to the results. The inclusion of characteristics of a worker's wife and parents-in-law is more unusual. We argue that these characteristics of relatives by marriage provide important additional information that helps clarify the interpretation of family background variables.

We begin with a theoretical model of assortative mating and intergenerational correlations in earnings that demonstrates the informa-

tion captured by characteristics of parents and parents-in-law. Let Y_{hi} denote a measure of lifetime income for the i th potential husband in the population:

$$Y_{hi} = \beta_0 + \beta_s S_{hi} + \beta_a A_{hi} + u_{hi}, \quad (1)$$

where S_{hi} is years of schooling and A_{hi} is a variable that is unobservable and affects income, such as ability.¹ An analogous equation describes income Y_{wi} for the i th potential wife in the population. We are interested in the information that may be captured in wage equations by family background variables such as the schooling of husband i 's father, which we shall denote F_{hi} , and the schooling of wife i 's father, F_{wi} . Suppose that ability, A_{hi} , has positive returns in the labor market, is unobservable, and is positively correlated with schooling. It is also plausible to expect that husband i 's ability is positively correlated with the schooling of his father, F_{hi} . This correlation could result from some more fundamental correlation in ability between generations, with higher ability leading to higher schooling in each generation. Imagine an orthogonal decomposition in which we express ability as a linear function of father's education:

$$A_{hi} = \gamma_f F_{hi} + A_{hi}^u. \quad (2)$$

We could think of this as a crude decomposition of ability into an "inherited" component, $\gamma_f F_{hi}$, and an "uninherited" component, A_{hi}^u . Using equation (2), we can express income as

$$Y_{hi} = \beta_0 + \beta_s S_{hi} + \beta_a (\gamma_f F_{hi} + A_{hi}^u) + u_{hi}. \quad (3)$$

As equation (3) illustrates, parental characteristics such as F_{hi} will typically be indicators of inherited unobservables omitted from the earnings equation. To the extent that the variables they are correlated with are also correlated with schooling, inclusion of these variables in an earnings equation may reduce omitted variable bias in estimates of returns to schooling.² From equation (3), the correlation between worker's income and father's schooling will be

$$\rho_{y_h f_h} = \frac{\beta_s \sigma_{s_h f_h} + \beta_a \gamma_f \sigma_{f_h}^2}{\sigma_{y_h} \sigma_{f_h}}, \quad (4)$$

¹ We shall refer to ability here for concreteness, but the same logic applies to any unobservable characteristics that affect labor market productivity such as quality of schooling or education acquired at home.

² We shall return below to the issue of how this gain is offset by increased measurement error bias.

where σ_{shfh} is the covariance of husband's schooling and father's schooling, and σ_{fh}^2 is the variance in father's schooling. Equation (4) implies that father's schooling and son's income will be correlated even after one controls for the correlation in father's and son's schooling, and even if fathers have no direct effect on their sons' earnings. In addition to whatever other direct and indirect effects may be represented by father's schooling, it will also pick up effects of unobserved ability to the extent that γ_f and β_a are greater than zero.

Assume that there is marital sorting with respect to income Y described by the correlation in spouses' incomes ρ_{yhyw} . This marital sorting may be motivated by an economic model of the marriage market, as in Becker (1981) and Lam (1988), although the behavioral mechanisms generating the correlation in spouses' characteristics are not critical. Lam demonstrates a tendency for positive assortative mating on full income whenever household public goods are an important source of returns to marriage. The role of positive assortative mating will be important to keep in mind in our results below since it clarifies the apparent effect of the wife and wife's parents on wages. We note that spouses' characteristics are very highly correlated in Brazil, with a correlation in spouse's schooling of .77 in the sample used below.

Consider the relationship between the characteristics of a worker and the family background of the worker's spouse. Exploiting the relationship between partial correlations and simple (zero-order) correlations, we can express the correlation between husband's income and wife's family background as

$$\rho_{yhf_w} = \rho_{yhyw} \rho_{ywf_w} + \rho_{yhf_w \cdot yw} [(1 - \rho_{yhyw}^2)(1 - \rho_{ywf_w}^2)]^{1/2}. \quad (5)$$

The first term is the product of the assortative mating correlation, ρ_{yhyw} , and the intrafamily "inheritability" correlation from parents to daughters, ρ_{ywf_w} , both of which are presumably positive. The second term is an additional positive effect if high-income men tend to marry women with better-educated parents, *with wife's income controlled for*, a partial effect for which we have little prior information. An instructive special case is to assume that while spouses care about their spouses' total income, they are indifferent (and perhaps unknowledgeable) about the role of family background in determining that income. That is, prospective spouses are indifferent between a spouse who has high income because of inherited wealth and a spouse who has high income because of labor market luck that is uncorrelated with family background. Formally, think of this as an assumption that there are zero partial correlations between individuals' incomes and their spouses' family backgrounds, *with total income controlled for*, that is, $\rho_{yhf_w \cdot yw} = \rho_{ywf_h \cdot yh} = 0$. If we simplify (5) in this way and exploit the

symmetry between husbands and wives, it follows that

$$\frac{\rho_{y_h f_w}}{\rho_{y_w f_h}} = \frac{\rho_{y_h y_w} \rho_{y_w f_w}}{\rho_{y_h y_w} \rho_{y_h f_h}} = \frac{\rho_{y_w f_w}}{\rho_{y_h f_h}}. \quad (6)$$

This equation can be interpreted as meaning that the ratio of *cross-parent* correlations (husbands to wives' parents over wives to husbands' parents) is equal to the ratio of *own-parent* correlations (husbands to husbands' parents over wives to wives' parents). An intriguing lesson of equation (6) is the demonstration that it is possible, indeed quite plausible, for husbands' incomes to be more highly correlated with their wives' family backgrounds than with their own family backgrounds. This result will hold if the correlation between wives' incomes and wives' family backgrounds is higher than the correlation between husbands' incomes and husbands' family backgrounds. From equation (4), this could occur if the variance in income is greater for men than for women, $\sigma_{y_h} > \sigma_{y_w}$. This could result from $\sigma_{u_h} > \sigma_{u_w}$, implying that uninherited ability or luck is a larger component of full income for men than for women, an assumption that might be appropriate in a developing economy with low rates of female labor force participation. Suppose, for example, that $\rho_{y_w f_w} = .5$, $\rho_{y_h f_h} = .3$, and $\rho_{y_h y_w} = .8$. Then $\rho_{y_h f_w}$, the correlation between men's incomes and the schooling of their fathers-in-law, is .4, and the correlation between men's incomes and the schooling of their own fathers is only .3.

An interesting way to think about the paradoxical result that there may be a higher correlation between husband's earnings and wife's family background than between husband's earnings and husband's family background is to consider the signals contained in information about characteristics of relatives. Suppose, for example, that you want to guess a man's income and can ask for information about the schooling of his parents, wife, and parents-in-law. Equation (6) implies that there may be more information in the schooling of the man's parents-in-law than there is in the schooling of his parents.³ This will be especially true if there is a high degree of assortative mating on income-related characteristics. The schooling of a man's father and the schooling of his father-in-law can each be thought of as imperfect signals about unobservable characteristics. The schooling of his father is presumably a better signal about the inherited component of unobservable characteristics such as ability. The schooling of his father-in-law, on the other hand, will tend to be correlated with all inherited

³ This can occur under a wide set of assumptions and does not require the special case of zero partial correlations assumed above for illustration.

and uninherited determinants of earnings, including labor market luck, part of which is revealed by the time of marriage.⁴ The magnitude of the correlation will be determined by the strength of assortative mating, the timing of marriage, and the magnitude of the correlation between spouse's family background and the characteristics determining a potential spouse's value in the marriage market.

These correlations imply a variety of direct and indirect mechanisms linking the observed and unobserved characteristics of a worker with those of his parents, wife, and parents-in-law. Since we have data on the schooling of all these individuals, we consider the information provided when we include schooling of other family members in a wage equation. Consider first the schooling of parents. Since data limitations prevent us from controlling for other parental characteristics such as income and wealth, parental schooling is a proxy for a variety of family background variables. On the one hand, we shall expect a positive coefficient on parental schooling if there is a direct return to family connections, as suggested by critics such as Bowles (1972). Given returns to family connections, the inclusion of parental schooling will tend to lower the estimated returns to own schooling as long as parental income increases the schooling of children. A positive coefficient on parental schooling need not imply the kind of labor market imperfections implied by returns to nepotistic family connections, however. It may simply pick up unobserved characteristics directly related to labor productivity. Although these omitted variable effects need not imply labor market imperfections, it will still be true that inclusion of parental schooling will tend to lower the estimated returns to own schooling as long as schooling and these unobserved characteristics are positively correlated.

If we include the schooling of the wife or her parents in the husband's earnings equation, we can expect these variables to have positive coefficients, and to lower estimated returns to own schooling, under several different scenarios. As with the worker's own parents, there is the literal interpretation that increased schooling of these relatives directly increases the worker's labor earnings. This will be true if there is a return to "family connections" and if family connections of the wife and her parents are positively correlated with their schooling. Inclusion of the schooling of the wife and her parents will lower the estimated returns to the earner's own schooling in such a case as long as there is positive assortative mating with respect to

⁴ Which components of earnings are correlated with characteristics of the wife and her parents will depend on the timing of marriage. The correlation between husband's income and the schooling of parents-in-law will presumably be lower if marriage precedes the completion of schooling or the realization of labor market "luck."

schooling. As in the case of parents, however, we may estimate positive coefficients on the schooling of the wife or her parents even if there are no returns to family connections in the labor market. If husband's ability has a return in the marriage market as well as the labor market, then when one controls for the husband's own schooling, increased schooling of the wife and her parents may indicate higher unmeasured ability for the husband.⁵ If ability and schooling are positively correlated, inclusion of these variables will also tend to reduce the estimated returns to own schooling.⁶

If the schooling of the wife's parents reflects returns to "nepotistic" labor market connections, it might seem reasonable to expect that the effects of the schooling of parents-in-law would be smaller than the effects of the schooling of the worker's own parents. That is, we might expect that the worker's own father would be more willing and more able to "pull strings" for the worker than the worker's father-in-law would. Here we see the possibility for an asymmetry between the characteristics of the worker's parents and the characteristics of the worker's parents-in-law. As pointed out in the model of assortative mating above, the correlation between the worker's income and his wife's family background may actually be *higher* than the correlation between the worker's income and his own family background. In a sense, men may be more like their fathers-in-law than their fathers. In this case we might expect the apparent effect of the schooling of parents-in-law on earnings to be greater than the effect of the schooling of parents.

Omitted Variables and Measurement Error in Estimating Returns to Schooling

The previous section demonstrates how the schooling of a worker's parents, wife, and parents-in-law can have significant explanatory power in an earnings equation, even if there is no direct effect of their schooling on earnings. We are especially interested in the interpretation of these variables as proxies for unobserved worker characteristics such as ability and schooling quality. An important econometric consideration is that inclusion of those variables that are correlated with a worker's schooling may increase measurement error bias in the earnings equation, an effect emphasized by Welch (1975) and Griliches (1977). To clarify these points for the kinds of regressions

⁵ As shown in Schoeni (1990) and Korenman and Neumark (1991), marital status itself is typically associated with higher earnings, one interpretation of which is that unobserved ability provides returns in both the labor market and the marriage market.

⁶ See Behrman, Birdsall, and Deolalikar (1993) for another approach to linking marriage market processes with labor market outcomes.

we shall estimate below, we consider the properties of alternative estimates of returns to schooling β_s in the earnings equation (1) using only data on S_i , which may be measured with error, and using additional family background variables that may be correlated with both schooling and ability. Assume that we have a schooling variable S^* measured with error, $S_i^* = S_i + w_i$, where w represents pure measurement error uncorrelated with S . Let $\lambda = V(w)/V(S^*)$ represent the noise-to-signal ratio in measured schooling. If we regress Y on S^* , the probability limit of the estimated effect of schooling on earnings is

$$\text{plim } \hat{\beta}_s = \beta_s - \beta_s \lambda + \beta_a \hat{\beta}_{AS}(1 - \lambda), \quad (7)$$

where $\hat{\beta}_{AS}$ is the coefficient from a hypothetical regression of true ability on true schooling. The bias in the estimate has two well-known components. The first is a downward bias caused by measurement error in schooling, the magnitude of which depends on the proportion of the total variance in observed schooling that is measurement error. The second bias is due to the omitted ability variable and will be positive if $\beta_a > 0$ and if schooling and ability are positively correlated.

If we add some measure of family background F to the regression, the probability limit of the new estimate of returns to schooling is

$$\text{plim } \hat{\beta}_{S \cdot F} = \beta_s - \beta_s \frac{\lambda}{1 - R_{S^*, F}^2} + \beta_a \hat{\beta}_{AS}(1 - \lambda)(1 - \rho_{AF \cdot S^*}^2), \quad (8)$$

where $R_{S^*, F}^2$ is the R^2 from a regression of schooling on family background and $\rho_{AF \cdot S^*}^2$ is the squared partial correlation of ability and family background when one controls for schooling. Comparing (7) and (8), we see that adding F as a regressor changes both of the bias terms, in both cases driving the estimate of β_s downward under plausible assumptions. The second term in equation (8) shows that the downward measurement error bias increases in magnitude. As emphasized by Welch (1975) and Griliches (1977), we identify the schooling coefficient from increasingly noisy information as we control for variables that are correlated with schooling. The extent of this increase in measurement error bias will be larger the higher the correlation between schooling and the family background variables. The third term in equation (8) shows that the upward omitted variable bias is reduced by including F , the desired benefit of including proxies for unobservables.

If schooling is measured with error, then we cannot assume that estimates of returns to schooling move closer to the truth when family background variables are used as proxies for unobserved ability, even if they are good proxies. The greater the measurement error in schooling, the more likely that the inclusion of family background variables will lead to underestimates of the returns to schooling. Simi-

larly, the greater the amount of variation in schooling that can be explained by family background, the worse the measurement error bias becomes. It is important to consider the errors-in-variables problem in our analysis of earnings, schooling, and family background in Brazil, since we shall add variables to wage regressions that are highly correlated with the observed schooling of the worker. We do have some information on the extent of the measurement error bias, however. Since we can observe the change in $R_{S^*,F}^2$ as we add additional variables, we can at least make educated guesses about the increase in measurement error bias. We shall see below that even modest amounts of measurement error in schooling can translate into substantial increases in bias as we add additional variables to the regression, with important implications for the interpretation of our results.

Parental Schooling, Sons' Schooling, and Wages in Brazil

Our analysis is based on a 1982 survey of over 100,000 Brazilian households.⁷ Table 1 provides descriptive statistics for the sample and illustrates the categorical responses used to report parental schooling. The head and spouse report the schooling of their father and mother as one of seven categories: illiterate, literate, 1–3 years, 4 years, 5–8 years, 9–11 years, and university, corresponding to natural breaks in the Brazilian schooling system. For the head and spouse we have more complete data on the highest single year of schooling completed. The wage variable we use throughout the paper is the ratio of monthly earnings from all jobs divided by four times the number of hours worked per week.⁸

As seen in table 1, the sample is very large, with over 40,000 economically active married males aged 30–55 reporting complete parental education data.⁹ According to table 1, 39 percent of those sam-

⁷ The *Pesquisa Nacional por Amostra de Domicílios* (PNAD) is an annual household survey conducted by the Instituto Brasileiro de Geografia e Estatística (IBGE). It is close to a nationally representative sample, though it is not fully representative of rural areas, especially in the remote frontier regions. The 1982 PNAD added a special supplement on education that included questions on the schooling of the parents of the head and spouse.

⁸ Respondents are asked about "normal" monthly earnings and "normal" weekly hours for all jobs they held in the week prior to the survey.

⁹ We use the term "married" throughout the paper although formal legal marriage is not required. The sample consists of men with a "spouse" who are heads of their households, from the IBGE definition of a household, which may include consensual unions. The results reported throughout this paper use the sample weights provided by IBGE to produce a representative sample of individuals for the Brazilian population. Sample sizes reported refer to the unweighted number of observations. All regressions and summary statistics are calculated using the sample weights.

TABLE 1
CHARACTERISTICS OF SONS BY FATHER'S SCHOOLING, MARRIED MALES AGED 30-55 WITH POSITIVE EARNINGS, 1982 PNAD

FATHER'S SCHOOLING	UNWEIGHTED N	WEIGHTED PERCENTAGE	SON'S CHARACTERISTICS				
			Mean Schooling	Wife's Schooling	Mean Wage	Percentage White	Percentage Urban
Illiterate	14,864	38.57	1.84	2.11	193.9	46.03	58.23
Literate	8,443	21.10	3.71	3.63	308.6	59.29	68.67
1-3 years	8,082	19.75	4.88	4.64	418.3	72.67	76.93
4 years	6,035	14.22	7.89	7.10	728.6	79.35	89.26
5-8 years	1,373	2.72	10.43	9.05	1,017.8	77.86	94.31
9-11 years	968	1.95	12.53	10.78	1,510.0	84.37	98.28
University	862	1.69	13.75	11.75	1,970.6	87.95	97.53
Total	40,627	100.0	4.34	4.16	416.5	61.15	70.97

NOTE.—Means calculated using PNAD sample weights. Wage calculated as monthly earnings for all jobs in cruzeiros divided by four times weekly hours.

pled have illiterate fathers, and another 40 percent have fathers with less than 4 years of schooling. Although mean schooling remains low in the sons' generation, with mean schooling of only 4.3 years, the table indicates a substantial increase in schooling across generations. For every level of father's education except the small group with university education, the mean years of schooling of the sons are roughly 2 years higher than the education reported for fathers. As shown in Lam and Levison (1991), there have been steady increases in schooling across cohorts in Brazil in recent decades, in spite of what is generally viewed as disappointing performance of the Brazilian educational system. The statistics for schooling of the wives of the men in the sample demonstrate the high degree of assortative mating by schooling in Brazil. Mean schooling for wives is close to the mean schooling for husbands in each of the separate groups of father's education. The correlation between husband's and wife's schooling is .77 in our sample.

Table 1 also shows the strong relationship between fathers' education and the education and earnings of sons. Men with university-educated fathers have, on average, 12 years more schooling and have a mean wage 10 times greater than men with illiterate fathers. The final two columns demonstrate that schooling of fathers and sons is correlated with two other important socioeconomic characteristics in Brazil, race and urban-rural location. Only 46 percent of the men with illiterate fathers are white, compared to over 80 percent of the men whose fathers have more than 8 years of schooling. Only 58 percent of the men with illiterate fathers are urban, compared to 97 percent of the men whose fathers have more than 8 years of schooling. Since an important source of returns to schooling in Brazil occurs through internal migration, we do not include controls for location in the wage equations reported below. Because of the potential confounding influence of the high correlation between education of parents and region, however, we also report results based on regressions that include controls for region and rural-urban residence.¹⁰

¹⁰ There are several sample selection issues that might introduce bias in our results. The restriction to men with positive earnings is relatively insignificant in this sample of household heads aged 30–55. The restriction to married men is also relatively unimportant quantitatively but may introduce some systematic selection bias as discussed below. The restriction to men with complete data on the schooling of their parents and parents-in-law removes a nontrivial portion of men drawn nonrandomly from the bottom of the schooling and wage distribution. Where possible we have estimated results without restrictions to get information on potential biases. Regressions using data for all men with positive wages produce estimates of returns to schooling similar to those reported here for married men with complete data for all relatives. Regressions for all men with data on the schooling of their parents, independent of marital status, produce estimates for returns to schooling and effects of parental schooling almost identical to those in our sample of married men.

Estimated Effects of Parental Schooling on Earnings and Returns to Schooling

We have two major interests in the regressions reported below. Our first concern lies in the returns to the worker's own schooling and how those returns are affected by the inclusion of various family background variables. Our second concern lies in the direct effects of family background on wages. Social scientists have suggested that family background effects are important in Brazil, but the existence and size of these effects have not been well established empirically. In addition to estimating the magnitude of family background effects on wages, we argued above that the relative magnitude of own father's schooling effects and father-in-law's schooling effects may provide information regarding the cause of measured family background effects. If father-in-law effects are larger than own father effects, this may be evidence that family background variables are proxies for unobserved worker characteristics rather than measures of nepotistic family connections.

In order to formally analyze the strong association between parents' education and sons' wages shown in table 1, we estimate a series of wage equations with and without controls for parental education. Table 2 presents the results of five specifications of wage equations for married Brazilian males in 1982. All specifications include age and age squared and a dummy variable for white.¹¹ Below we shall also discuss results of regressions that include controls for region and urban-rural residence. In order to have maximum flexibility in the relationship between schooling and earnings, we use 17 dummy variables to represent single years of completed schooling for the worker, a specification that is empirically tractable because of our large sample size and the wide dispersion in schooling in Brazil. Regression 1 includes only the basic controls for age and race and the dummy variables for the worker's schooling. Regression 2 adds the schooling of the worker's father and mother.¹² Regression 3 omits parental schooling but adds the schooling of the wife's parents. Regression 4 uses no parental schooling variables but adds the schooling of the worker's

¹¹ We use age rather than experience because we have no direct measures of experience and find conventional proxies for potential experience unappealing when the majority of workers leave school at young ages. See Behrman and Birdsall (1983, 1985), Eaton (1985), and Lam and Levison (1992) for analyses of alternative measures of work experience in Brazilian earnings equations.

¹² For parents and parents-in-law we use the categorical data on parental schooling in the most flexible possible way by including the six dummy variables shown, with illiterate as the reference category.

TABLE 2
WAGE EQUATIONS, MARRIED BRAZILIAN MALES AGED 30-55, 1982 PNAD
Dependent Variable: Log of Hourly Wage ($N = 40,627$)

Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Own schooling:					
1 year	.2342 (.0172)*	.2140 (.0171)*	.2085 (.0169)*	.1988 (.0168)*	.1824 (.0168)*
2 years	.3650 (.0141)*	.3359 (.0141)*	.3279 (.0140)*	.3038 (.0139)*	.2830 (.0139)*
3 years	.5428 (.0130)*	.4967 (.0132)*	.4835 (.0130)*	.4490 (.0129)*	.4143 (.0131)*
4 years	.8492 (.0110)*	.7676 (.0116)*	.7492 (.0113)*	.7022 (.0113)*	.6396 (.0118)*
5 years	.8542 (.0159)*	.7468 (.0166)*	.7297 (.0162)*	.6654 (.0162)*	.5876 (.0167)*
6 years	1.1981 (.0271)*	1.0667 (.0274)*	1.0505 (.0270)*	.9516 (.0271)*	.8612 (.0274)*
7 years	1.2364 (.0277)*	1.0970 (.0281)*	1.0664 (.0277)*	.9581 (.0279)*	.8593 (.0282)*
8 years	1.4018 (.0170)*	1.2409 (.0181)*	1.2153 (.0176)*	1.0905 (.0182)*	.9805 (.0189)*
9 years	1.4426 (.0436)*	1.2753 (.0437)*	1.2509 (.0433)*	1.1269 (.0433)*	1.0113 (.0433)*
10 years	1.6184 (.0373)*	1.4312 (.0377)*	1.3896 (.0372)*	1.2228 (.0376)*	1.0977 (.0378)*
11 years	1.8246 (.0165)*	1.6114 (.0183)*	1.5786 (.0177)*	1.3982 (.0191)*	1.2571 (.0200)*
12 years	2.0217 (.0572)*	1.7827 (.0573)*	1.7135 (.0570)*	1.5050 (.0573)*	1.3358 (.0572)*
13 years	2.0684 (.0468)*	1.8258 (.0472)*	1.7966 (.0467)*	1.5606 (.0473)*	1.4089 (.0475)*
14 years	2.2191 (.0411)*	1.9512 (.0418)*	1.9166 (.0413)*	1.6602 (.0423)*	1.4920 (.0426)*
15 years	2.4615 (.0206)*	2.1692 (.0230)*	2.1203 (.0224)*	1.8709 (.0245)*	1.6782 (.0257)*
16 years	2.6673 (.0249)*	2.3375 (.0275)*	2.2810 (.0271)*	2.0561 (.0283)*	1.8258 (.0300)*
17 years	2.8127 (.0425)*	2.4613 (.0443)*	2.4001 (.0438)*	2.1367 (.0446)*	1.9005 (.0458)*
Wife's schooling				.0578 (.0014)*	.0451 (.0015)*
Father:					
Literate		.0283 (.0109)*			.0120 (.0108)
1-3 years		.0898 (.0119)*			.0499 (.0119)*
4 years		.1725 (.0157)*			.1005 (.0156)*
5-8 years		.1524 (.0271)*			.0688 (.0268)**
9-11 years		.2654 (.0319)*			.1533 (.0318)*
University		.3073 (.0355)*			.1859 (.0353)*

Mother:		
Literate		
1-3 years	.0693 (.0113)*	.0408 (.0113)*
4 years	.0716 (.0124)*	.0171 (.0124)
5-8 years	.0472 (.0161)*	.0652 (.0161)*
9-11 years	.2307 (.0289)*	.1156 (.0287)*
University	.3172 (.0324)*	.1732 (.0325)*
Father-in-law:	.1825 (.0596)*	.0383 (.0592)
Literate		
1-3 years	.0654 (.0106)*	.0401 (.0107)*
4 years	.1543 (.0111)*	.1090 (.0112)*
5-8 years	.2332 (.0143)*	.1470 (.0145)*
9-11 years	.2691 (.0253)*	.1554 (.0254)*
University	.3729 (.0303)*	.2040 (.0307)*
Mother-in-law:	.4189 (.0351)*	.2426 (.0355)*
Literate		
1-3 years	.0784 (.0111)*	.0345 (.0112)*
4 years	.0932 (.0115)*	.0313 (.0116)*
5-8 years	.1660 (.0147)*	.0623 (.0149)*
9-11 years	.2446 (.0275)*	.1031 (.0277)*
University	.2979 (.0312)*	.1105 (.0315)*
Age	.2224 (.0596)*	.0380 (.0593)
Age squared	.0686 (.0060)*	.0731 (.0059)*
White	-.0007 (.0001)*	-.0007 (.0001)*
Intercept	.1832 (.0077)*	.1767 (.0075)*
R ²	2.9176 (.1226)*	2.7323 (.1212)*
F-test 1	.5315	.5513
F-test 2	.5404	.5594
F-test 3	65.48*	16.52*
		24.47*
		2.26**

NOTE.—Standard errors are in parentheses. Omitted categories: own schooling: less than 1 year; parents' schooling: illiterate; F-test 1: all 12 own parents' schooling coefficients equal zero; F-test 2: all 24 parents' schooling coefficients equal zero; F-test 3: own father's schooling coefficients equal wife's father's schooling coefficients in each category.

* Significant at the .01 level.

** Significant at the .05 level.

wife, a single variable in years of completed schooling. Regression 5 includes the schooling of all these relatives simultaneously.¹³

Before we discuss specific coefficients, it is worth noting some general points regarding the explanatory power of these regressions. We see the typical result for Brazil that a small set of human capital variables has extremely high explanatory power, with an R^2 of .53 in the simple specification of regression 1. This explanatory power rises very little as we include a variety of family background variables known to be strongly associated with earnings. The R^2 increases only slightly, from .53 in the first regression, which includes only the worker's schooling, to .56 in the last regression, which adds the schooling of the worker's parents, wife, and parents-in-law. Although we clearly have high correlation among the regressors in the final equation, it is noteworthy that the standard errors are in general quite small. Because of the large sample we are remarkably successful in identifying separate effects for these variables.

Effect of Family Background on Estimated Returns to Schooling

In order to better visualize the returns to schooling, the coefficients on the 17 dummy variables for all five specifications in table 2 are graphed in figure 1. One of the most noteworthy features of this figure is how close the step function used in table 2 is to a simple log-linear wage equation. In fact, the R^2 for a regression that replaces the 17 dummy variables in regression 1 of table 2 with a single variable for years of schooling is .527, compared to .532 for the flexible functional form in table 2.¹⁴ An important deviation from this linearity is what appear to be substantial "sheepskin" effects associated with completion of years 4 and 8, important terminal years in the Brazilian schooling system.¹⁵ Figure 1 also shows clearly that the estimated returns to schooling fall steadily as we move across the five regressions

¹³ We restrict the sample to men with spouses (formal or consensual) in order to maintain a consistent sample across the five specifications. As shown in Schoeni (1990) and Korenman and Neumark (1991), marital status itself is typically associated with higher wages, suggesting possible selection biases in a sample of married men. We have estimated regressions 1 and 2, the two specifications that do not use wife's characteristics, on the entire set of male heads with positive wages. The results for these two regressions are robust to this sample selection, with the effects of parents' schooling being almost identical for the sample of all men and the sample of married men.

¹⁴ The results of this log-linear specification are summarized below in table 3.

¹⁵ Similar diploma effects are found by Strauss and Thomas (1991), using the same data set. Strauss and Thomas also estimate similar regressions separately for men and women and for different regions in Brazil.

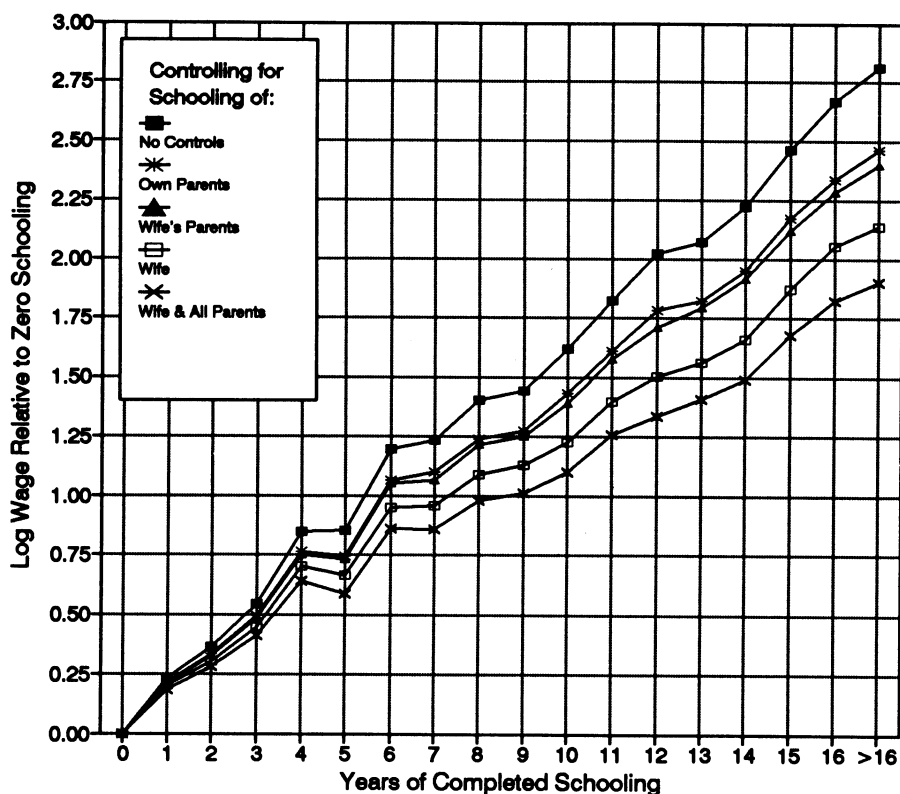


FIG. 1.—Log wage relative to 0 years of schooling, with and without controls for schooling of wife and parents, Brazilian males aged 30–55, 1982 (based on regressions in table 2).

in table 2. The lowest returns, not surprisingly, are estimated in the final regression when the complete set of family background variables is included. The next lowest returns are those estimated with the schooling of the wife included as a regressor. Especially noteworthy is that the returns estimated in regression 3, which includes the schooling of the worker's parents-in-law, are lower than the returns estimated in regression 2, which includes the schooling of the worker's parents.

The magnitude of the reductions in returns to schooling caused by including alternative sets of family background variables is summarized in table 3, which presents returns to the marginal year of schooling for several important years. In addition to the effects implied by the regressions in table 2, we also report the coefficient on years of schooling in the simple specification in which we replace the 17

TABLE 3

PREDICTED RETURNS TO MARGINAL YEAR OF SCHOOLING: PERCENTAGE INCREASE IN WAGES ASSOCIATED WITH COMPLETION OF LAST YEAR OF SCHOOLING WITH AND WITHOUT CONTROLS FOR FAMILY BACKGROUND AND REGION, MARRIED BRAZILIAN MALES AGED 30-55, 1982 PNAD

YEARS OF SCHOOLING	No BACKGROUND VARIABLES (Reg. 1)	CONTROLLING FOR SCHOOLING OF				PERCENTAGE DECREASE REG. 1 TO REG. 5
		Worker's Parents (Reg. 2)	Wife's Parents (Reg. 3)	Worker's Wife (Reg. 4)	Wife and All Parents (Reg. 5)	
		Without Controls for Region				
Year 1	26.39	23.86	23.18	21.99	20.01	24.18
Year 4	35.85	31.11	30.43	28.81	25.27	29.52
Year 8	17.99	15.48	16.06	14.16	12.89	28.36
Year 11	22.90	19.75	20.80	19.17	17.28	24.54
Year 15	27.43	24.36	22.59	23.45	20.47	25.39
Average, 1-16	18.66	16.18	15.74	14.13	12.45	33.26
Linear regression	16.32	14.31	14.02	12.41	11.08	32.11
Percentage increase	17.73	15.38	15.05	13.22	11.72	33.91
With Controls for Region						
Year 1	17.75	15.32	15.53	14.69	12.84	27.69
Year 4	25.46	21.25	21.24	19.95	16.86	33.77
Year 8	16.78	14.52	15.04	13.43	12.17	27.50
Year 11	22.87	19.98	20.96	19.43	17.71	22.56
Year 15	28.01	25.03	23.62	24.54	21.65	22.70
Average, 1-16	16.26	13.89	13.74	12.45	10.80	33.56
Linear regression	14.26	12.30	12.21	10.85	9.53	33.13
Percentage increase	15.32	13.09	12.98	11.46	10.00	34.72

NOTE.—Based on regressions in table 2 and additional unreported regressions with regional and urban-rural dummies included as regressors, and with single years of schooling variable replacing dummy variables in table 2.

dummy variables with a single variable for completed years of schooling. We also report the results for all specifications when we add a set of controls for region and rural-urban residence. When no background variables are included (regression 1), we see from table 3 that the returns to a year of schooling are 26 percent for the first year, 36 percent for the fourth year, and 27 percent for the fifteenth year, the typical year for completion of college. Note from figure 1 that the diploma years represented here are associated with the largest increases in earnings.

As a summary measure, we present the simple unweighted average of the first 16 years, a figure of 18.7 percent in the specification that does not include family background variables. We also present the estimated returns for the simpler regression using a single continuous years of schooling variable. This linear specification implies returns to schooling of 17.7 percent in regression 1. Adding the schooling of the earner's parents (regression 2) causes a decline in average single-year returns of 2.5 percentage points, ranging up to 4.7 percentage points for the fourth year. Adding the schooling of the wife's parents instead of the worker's own parents causes slightly larger declines on average, with larger declines at many, but not all, levels of schooling. Inclusion of the wife's schooling without controlling for parents' schooling (regression 4) causes a substantially larger decrease in estimated returns to own schooling than the inclusion of parents' schooling. In comparison to the standard estimates in regression 1, estimated returns drop by 4.5 percentage points on average, with a decline of seven percentage points at the fourth year. Using the schooling of all five relatives as regressors (regression 5) causes an average decline of six points, with a decline of over 10 percentage points for the returns to the fourth year.

The final column of table 3 shows the percentage decrease in the estimated returns to schooling from regression 1, the simplest regression, to regression 5, the most inclusive. The declines are remarkably similar across levels of schooling and alternative specifications, typically in the range of 25–35 percent. Regressions that include regional controls, shown in the lower panel of the table, have lower estimated returns to schooling at all levels. In spite of this lower level in the estimated returns, however, the proportional decline in the returns caused by inclusion of family background variables is almost identical in the two sets of regressions. One interpretation of the numbers in the final column of table 3, then, is that the conventional estimates of returns to schooling include a “family background bias” on the order of 25–35 percent. We shall return to this interpretation below when we consider the role of measurement error.

Direct Effects of Family Background on Earnings

We are also interested in the direct effects of family background on wages. It is important to emphasize that in spite of the high correlations between the schooling of all the family members included in the regressions in table 2, we are able to estimate statistically significant independent effects of the separate schooling variables. With the large sample size of the PNAD, we have enough independent variation in the separate schooling variables to overcome what might be expected to be an extreme multicollinearity problem. The data provide strong evidence, for example, that even after one controls for the worker's own schooling, the schooling of his parents, and the schooling of his wife, a man whose father-in-law has a secondary education has significantly higher earnings than a man whose father-in-law is illiterate. While we are left with a number of potential interpretations of this relationship, we can be reasonably confident that it is "real" in a statistical sense.

Regression 2, which includes the schooling of the worker's father and mother, shows a significant wage advantage for men with better-educated parents. When one controls for the earner's own education and that of his mother, having a university-educated father implies more than a 35 percent wage advantage over having an illiterate father.¹⁶ Having a university-educated father implies a 14 percent wage advantage over having a father with 4 years of schooling. Significant wage advantages are also associated with mother's schooling. When one controls for the earner's own schooling and that of his father, having a mother with 9–11 years of schooling implies a 37 percent wage advantage over having an illiterate mother. Several studies, including Heckman and Hotz (1986) for Panamanian males and Behrman and Wolfe (1984) for Nicaraguan females, have found that mother's schooling has a larger effect on earnings than father's schooling. Thomas, Strauss, and Henriques (1990) also find larger effects of mother's schooling on child health outcomes in Brazil. We find mixed results regarding the relative effects of father's and mother's schooling. In regression 2, mother's education has a larger effect at 5–8 years and 9–11 years, whereas father's education has a larger effect at 1–3 years, 4 years, and university.¹⁷

¹⁶ That is, from the coefficient in regression 2 of table 2, a university-educated father implies a wage that is $e^{0.3073} = 1.3597$ times the wage of a man with an illiterate father.

¹⁷ We show low estimates for the effects of university-educated mothers and mothers-in-law in a number of the regressions. We do not attach great significance to these since the number of women in these cells is quite low. Note that the effects of 9–11 years of schooling are generally as large for women as for men.

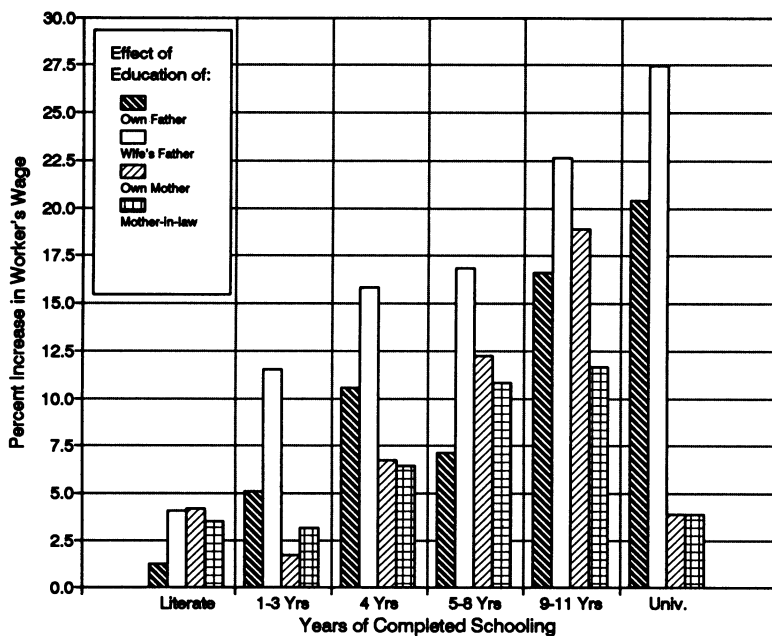


FIG. 2.—Effects of parent's schooling on earnings: percentage wage increase relative to parent being illiterate, with controls for schooling of worker and other relatives, Brazilian males aged 30–55, 1982 (based on regression 5 in table 2).

Regression 3 replaces the schooling of parents with the schooling of parents-in-law. The most striking result is that the coefficients on the schooling of fathers-in-law are larger than the corresponding coefficients on the schooling of fathers in regression 2 for every schooling category. The coefficients on the schooling of mothers-in-law are larger than the coefficients on the schooling of mothers in all but one category. This same result that the schooling of fathers-in-law has a larger effect than the schooling of the fathers is also observed in regression 5, which includes parents and parents-in-law in the same regression. The direct effects of the family background variables estimated in regression 5 are summarized graphically in figure 2. The figure shows the percentage wage increases associated with each category of parental schooling for the worker's father, mother, father-in-law, and mother-in-law, based on the final regression in table 2, the regression that includes the full set of family background variables. The figure shows the consistently larger effect of the schooling of the father-in-law compared to the schooling of the father. The wage increase associated with the father-in-law's schooling is on the order of five percentage points larger than the wage increase associated with the father's schooling. When one controls for the education of

the earner, his wife, his parents, and his mother-in-law, having a university-educated father-in-law is associated with 28 percent higher wages than having an illiterate father-in-law. Having a university-educated father is associated with a 20 percent wage advantage compared to having an illiterate father on the basis of the coefficients in regression 5. The third *F*-test, reported in table 2, shows that we can reject the null hypothesis that the schooling coefficients for father's and father-in-law's schooling are equal at the .05 level.¹⁸

The relative magnitudes of these coefficients are interesting in their own right. Moreover, we believe that the result that father-in-law's schooling has a larger effect on wages than father's schooling, a result that is very robust to alternative specifications, sheds light on the plausibility of alternative explanations for the strong association between the earnings of a worker and the schooling of his parents, wife, and parents-in-law. Specifically, the relative magnitudes of these effects lead us to believe that the effect of parental schooling is not due solely to "family connections." As demonstrated above in the theoretical model of assortative mating, it is quite plausible that a worker's unobserved wage-related characteristics would be more highly correlated with the schooling of his parents-in-law than with the schooling of his own parents. We argue that the most convincing interpretation of these family background effects is that they are proxies for unobserved worker characteristics. To the extent that these characteristics increase labor productivity, an efficient labor market should be expected to reward them. Our estimates of high returns to family background therefore need not be considered evidence of labor market imperfections.

The role of own schooling and parental schooling in explaining wages is further clarified by table 4. The table summarizes the effect on wages of changing the number of years of schooling for the earner, his wife, his parents, and his wife's parents, on the basis of the regression coefficients in the final regression of table 2. The table

¹⁸ The coefficients on parental schooling in table 2 depend on the arbitrary choice of the omitted schooling category. As inspection of fig. 2 suggests, not every marginal increase in schooling categories gives a bigger wage increase for father-in-law's schooling than for father's schooling. Increasing the father's schooling from 5–8 years to 9–11 years, e.g., implies a larger wage increase than increasing the father-in-law's schooling by the same amount. The tendency for larger effects of increases in father-in-law's schooling is predominant, however. Out of 21 possible pairwise comparisons across schooling categories in regression 5, increases in father-in-law's schooling imply larger wage increases than increases in father's schooling in 16 cases. In separate tests for significance of each of these 21 pairwise comparisons (an extremely demanding test of the data), four imply significantly larger effects for father-in-law's schooling at the .05 level and none implies significantly larger effects for father's schooling. As noted, the joint restriction that the coefficients for fathers and fathers-in-law are equal is rejected.

TABLE 4
PREDICTED WAGE INCREASE FROM INCREASES IN SCHOOLING, MARRIED
BRAZILIAN MALES AGED 30-55, 1982 PNAD

EFFECT OF	PERCENTAGE INCREASE IN EARNINGS ASSOCIATED WITH INCREASE IN SCHOOLING FROM		
	0-4 Years (1)	4-16 Years (2)	0-16 Years (3)
Own schooling	89.57	227.47	520.80
Wife's schooling	19.79	71.90	105.92
Father's schooling	10.57	8.92	20.43
Wife's father's schooling	15.84	10.03	27.46
Mother's schooling	6.74	-2.66	3.91
Wife's mother's schooling	6.43	-2.41	3.87

NOTE.—Based on coefficients in regression 5, table 2. Calculations were made at higher precision than coefficients reported in table 2.

makes it possible, for example, to compare the wage increase associated with increasing the worker's schooling from 0 to 4 years with the wage increase resulting from an increase in his father's education from 0 to 4 years.¹⁹ Consider first increasing various family members' schooling from 0 to 4 years, shown in column 1 of table 4. Raising the worker's own schooling, holding the schooling of other family members constant, raises his wage by 90 percent. Raising his wife's schooling by the same amount, holding constant the schooling of the earner and other family members, is associated with a wage increase of 19.8 percent. Raising his father's schooling from 0 to 4 years, holding the schooling of the earner and other family members constant, implies a wage increase of 10.6 percent. Raising his father-in-law's schooling from 0 to 4 years has a substantially larger effect, implying a wage increase of 15.8 percent. Increases from 0 to 4 years in the schooling of the earner's mother and mother-in-law are associated with wage increases of under 7 percent.

Column 2 shows the effect of moving from 4 to 16 years of schooling, assumed equivalent to the "university" category for parental schooling. An important result of this exercise is that the wage increase associated with having a father with 16 years rather than 4 years of schooling is smaller than the wage increase associated with having a father with 4 years rather than 0 years. We see in column 3 that the wage advantage implied by a university-educated father compared to an illiterate father is 20.4 percent. If we decompose this

¹⁹ For example, wife's father with university compared to wife's father with 4 years implies a predicted log wage difference of $.2426 - .1470 = .0956$, according to regression 5 in table 2. This implies a wage ratio of $e^{0.0956} = 1.1003$, or a percentage increase in earnings of 10.03 percent, as shown in col. 2 of table 4.

into a portion caused by the father moving from 0 to 4 years and a portion caused by the father moving from 4 to 16 years, those components are 10.6 percent and 8.9 percent, respectively.²⁰ The additional 12 or so years of schooling from 4 years to university result in a wage increase that is smaller than the increase caused by the first 4 years of the father's schooling. The effects of parental schooling on wages, then, while apparently substantial, are not associated only with those at the top of the schooling and earnings distributions. Sons of fathers with 4 years of schooling have as large a wage advantage over sons of illiterate fathers as the wage advantage that sons of university-educated fathers have over sons of fathers with 4 years of schooling. Table 4 also demonstrates that while the earnings advantages associated with parental education are substantial, they are modest compared to the returns to the worker's own education. Increasing the worker's own schooling from 4 to 16 years, for example, holding the schooling of the other five family members constant, implies a wage increase of over 200 percent. Increasing the schooling of his father or father-in-law from 4 to 16 years, whatever that may represent, implies a wage increase of only about 10 percent.

Interpretation and Consideration of Measurement Error

A number of interpretations can be given to the apparent effects of the schooling of parents, wife, and parents-in-law on wages and returns to schooling. The estimates may represent direct returns to "family connections," presumably implying imperfections in Brazilian labor markets. Alternatively, as demonstrated in our model of assortative mating, the schooling of parents, wife, and parents-in-law may be proxies for unobserved characteristics of the worker such as ability or quality of schooling. Although these two interpretations have quite different implications for labor market imperfections in Brazil, both imply that conventional returns to schooling are overestimated. Under either of these interpretations the returns to schooling estimated with family background variables included are likely to be closer to the returns that would be experienced by a randomly drawn Brazilian worker. The results imply that after controlling for all these family background variables, we are left with returns of over 10 percent at all levels. This is one-fourth to one-third lower than the returns implied by conventional wage equations, but still represent significant private returns to schooling. Our results are similar to those in previous studies from Latin America. Behrman and Wolfe (1984) estimate a family background bias of about one-quarter using sibling

²⁰ That is, from the row for father's schooling in table 4, $1.1057 \times 1.0892 = 1.2043$.

data from Nicaragua, and Heckman and Hotz (1986) observe that returns to schooling drop by one-third when schooling of the mother and father is included in the earnings equation.

One interpretation of our results, then, is that conventional estimates of returns to schooling in Brazil may be roughly one-third family background bias when family background variables are not controlled for. This estimate of one-third may overstate the bias in conventional estimates of returns to schooling, however. As emphasized above, if schooling is measured with error, then inclusion of family background variables that are highly correlated with observed schooling will increase the magnitude of the downward bias due to measurement error. To see how important measurement error can be in our results, consider the case of regressions in which worker's schooling is represented by a single linear schooling variable instead of the 17 dummy variables used in table 2. Drawing on our analysis of measurement error above, and denoting the measurement error bias by m , note from equation (8) that

$$m = \frac{-\lambda\beta_s}{1 - R_{S^*,F}^2}, \quad (9)$$

where $\lambda = V(w)/V(S^*)$, the proportion of measurement error in observed schooling; β_s is the true returns to schooling; and $R_{S^*,F}^2$ is the R^2 from a regression of measured schooling on all other included variables. As we add additional family background variables, the measurement error increases as $R_{S^*,F}^2$ increases. Since we can estimate $R_{S^*,F}^2$ for any set of independent variables F , we can get some sense of the potential increase in measurement error bias.

Table 5 shows what the measurement error bias would be for our estimates of returns to schooling when different sets of family background variables are used, given alternative assumptions about the noise-to-signal ratio λ and true returns to schooling β_s . As shown in the first row of the table, $\hat{\beta}$ falls by about one-third, from .163 to .111, when the full set of family background variables is included, consistent with our results above. The third row of the table shows $R_{S^*,F}^2$ for each set of regressors. For regression 1 the only regressors besides worker's schooling are age, age squared, and race. As shown in the table, a regression of worker's schooling on these variables has an R^2 of .098. If we assume that observed schooling is 15 percent measurement error ($\lambda = .15$) and true returns to schooling $\beta_s = .15$, then from equation (9) we can calculate that the measurement error bias in $\hat{\beta}$ in regression 1 is $-.025$.²¹ When dummies for the schooling

²¹ We can make only educated guesses about the amount of measurement error in our schooling variable. Ashenfelter and Krueger (1992) estimate measurement error

TABLE 5

INCREASE IN MEASUREMENT ERROR BIAS IN EARNINGS EQUATIONS: ALTERNATIVE SETS OF FAMILY BACKGROUND VARIABLES AND ALTERNATIVE ASSUMPTIONS OF MEASUREMENT ERROR AND RETURNS TO SCHOOLING, MARRIED BRAZILIAN MALES AGED 30-55, 1982 PNAD

	No BACKGROUND VARIABLES (Reg. 1)	CONTROLLING FOR SCHOOLING OF			
		Worker's Parents (Reg. 2)	Wife's Parents (Reg. 3)	Worker's Wife (Reg. 4)	Wife and All Parents (Reg. 5)
Estimated returns to schooling $\hat{\beta}_i$	.1632	.1431	.1402	.1241	.1108
R^2	.5265	.5360	.5421	.5460	.5550
$R^2_{S^*,F}$	.0980	.4874	.4430	.6052	.6742
$\Delta\beta_i = \hat{\beta}_i - \beta_i$		-.0201	-.0230	-.0391	-.0524
$\lambda = .15, \beta_i = .15$:					
Measurement error bias m_i	-.0249	-.0439	-.0404	-.0570	-.0691
$\Delta m_i = m_i - m_1$		-.0189	-.0155	-.0320	-.0441
$\Delta m_i/\Delta\beta_i$		94.28%	67.18%	81.96%	84.19%
$\lambda = .1, \beta_i = .15: \Delta m_i/\Delta\beta_i$		62.85%	44.78%	54.64%	56.13%
$\lambda = .1, \beta_i = .1: \Delta m_i/\Delta\beta_i$		41.90%	29.86%	36.43%	37.42%
$\lambda = .05, \beta_i = .05: \Delta m_i/\Delta\beta_i$		10.48%	7.46%	9.11%	9.35%

NOTE.—All regressions include age, age squared, and race plus family background variables indicated. All changes are relative to regression 1. λ is the noise-to-signal ratio in measured schooling; β_i is the true returns to schooling.

of the worker's father and mother are included, the R^2 of worker's schooling on all other regressors increases dramatically to .487. Including these variables in the earnings equation causes $\hat{\beta}$ to fall from .163 to .143. Continuing to assume that $\lambda = .15$ and $\beta_s = .15$, we calculate from equation (9) that the measurement error bias in $\hat{\beta}$ is $-.044$. The change in measurement error bias from regression 1 to regression 2 is $-.0189$, compared to a change in the estimate of $\hat{\beta}$ of $-.0201$. In other words, 95 percent of the observed change in $\hat{\beta}$ would be due to the increase in measurement error bias if $\lambda = .15$ and $\beta_s = .15$. From the other columns of table 5, over 80 percent of the observed decline in $\hat{\beta}$ as additional family background variables are used would be attributable to increased measurement error bias under the assumption that $\lambda = .15$ and $\beta_s = .15$.

The last three rows of table 5 show the change in measurement error bias across regressions given lower values of λ and β_s . Even given what seem to be conservative estimates for λ and β of .10, measurement error bias accounts for almost 40 percent of the observed decline in $\hat{\beta}$ across regressions. Only when both λ and β approach .05 do we see measurement error explaining less than 10 percent of the observed decline in $\hat{\beta}$. While we have little firm basis for estimating either the proportion of measurement error in schooling or the true returns to schooling, levels of 10–15 percent for both quantities seem plausible. It is clear that even modest levels of measurement error can lead to substantial increases in measurement error bias when family background variables such as the ones we use are added to standard wage equations. The conclusion that conventional estimates of returns to schooling in Latin America are one-third family background bias, then, may be too strong. Previous studies that have reached similar conclusions, such as Behrman and Wolfe (1984) and Heckman and Hotz (1986), may have overstated the extent of the bias, since they did not consider the potentially serious role of measurement error bias.

Conclusions

Using data on the schooling of an earner's parents, wife, and parents-in-law, we identify substantial effects of family background on wages

in reported schooling in the United States of about 10 percent. Since the total variance in schooling is much higher in Brazil, the proportion that is measurement error may be smaller (Lam and Levison [1992] show a variance in schooling in Brazil more than twice the variance in the United States, even though the Brazilian mean is less than half the U.S. mean). On the other hand, there may be an overall tendency for greater inaccuracy of reports in Brazil, combined with greater proportional errors due to the restriction that errors will be in integer quantities around a much lower mean.

in Brazil. When one controls for the earner's own schooling and the schooling of the other four relatives, having a father with a university education is associated with a 20 percent wage advantage compared to having an illiterate father, and a 9 percent advantage compared to having a father with 4 years of schooling. Inclusion of family background variables in wage equations lowers estimated returns to schooling by one-fourth to one-third, consistent with previous studies of Latin American labor markets.

Our analysis of the confounding influence of measurement error suggests that our estimate that conventional estimates of returns to schooling in Brazil are one-third family background bias may be overstated. Looking at the components of measurement error bias, we make alternative assumptions about the magnitude of measurement error and the true returns to schooling. Combining these assumptions with estimates of the correlations between observed schooling and our family background variables, we show that even modest assumptions about the degree of measurement error imply that increased measurement error bias accounts for a large proportion of the decline in estimated returns to schooling when family background variables are added to the wage equation. Our results suggest that failing to take account of measurement error may lead to substantial overestimates of the magnitude of the family background bias in estimates of returns to schooling.

While our results are consistent with "structuralist" models of labor markets that emphasize labor market imperfections and an important role for family connections, we find the results more consistent with alternative interpretations. A surprising and substantively important result is that the schooling of fathers-in-law has a greater effect on workers' wages than the schooling of fathers. This result, though counterintuitive, is consistent with our model of intergenerational transmission of schooling and assortative mating. We interpret the result as evidence that family background variables are proxies for unobserved worker characteristics, rather than direct determinants of earnings through nepotistic family connections.

Although we estimate nontrivial effects of the schooling of parents and parents-in-law on wages, it is important to emphasize that the effects are modest in comparison to the effects of the worker's own schooling. While having a father with 4 years of schooling implies a 9 percent wage advantage over having an illiterate father, *ceteris paribus*, increasing the worker's own schooling from 0 to 4 years implies a 90 percent increase in earnings. Even ignoring the potentially important role of measurement error bias, we continue to estimate returns to schooling of over 10 percent after controlling for the schooling of the worker's parents, wife, and parents-in-law.

References

- Ashenfelter, Orley, and Krueger, Alan. "Estimates of the Economic Return to Schooling from a New Sample of Twins." Working Paper no. 304. Princeton, N.J.: Princeton Univ., Indus. Relations Sec., June 1992.
- Becker, Gary S. *A Treatise on the Family*. Cambridge, Mass.: Harvard Univ. Press, 1981.
- Behrman, Jere R., and Birdsall, Nancy. "The Quality of Schooling: Quantity Alone Is Misleading." *A.E.R.* 73 (December 1983): 928-46.
- . "The Quality of Schooling: Reply." *A.E.R.* 75 (December 1985): 1202-5.
- Behrman, Jere R.; Birdsall, Nancy; and Deolalikar, Anil. "Marriage Markets, Labor Markets and Unobserved Human Capital: An Empirical Exploration for South-Central India." Working paper. Philadelphia: Univ. Pennsylvania, 1993.
- Behrman, Jere R., and Taubman, Paul. "Intergenerational Transmission of Income and Wealth." *A.E.R. Papers and Proc.* 66 (May 1976): 436-40.
- Behrman, Jere R., and Wolfe, Barbara L. "The Socioeconomic Impact of Schooling in a Developing Country." *Rev. Econ. and Statis.* 66 (May 1984): 296-303.
- Bowles, Samuel. "Schooling and Inequality from Generation to Generation." *J.P.E.* 80, no. 3, pt. 2 (May/June 1972): S219-S251.
- Chamberlain, Gary, and Griliches, Zvi. "Unobservables with a Variance-Components Structure: Ability, Schooling, and the Economic Success of Brothers." *Internat. Econ. Rev.* 16 (June 1975): 422-49.
- Corcoran, Mary; Gordon, Roger; Laren, Deborah; and Solon, Gary. "Effects of Family and Community Background on Economic Status." *A.E.R. Papers and Proc.* 80 (May 1990): 362-66.
- Eaton, Peter J. "The Quality of Schooling: Comment." *A.E.R.* 75 (December 1985): 1195-1201.
- Griliches, Zvi. "Estimating the Returns to Schooling: Some Econometric Problems." *Econometrica* 45 (January 1977): 1-22.
- Griliches, Zvi, and Mason, William M. "Education, Income, and Ability." *J.P.E.* 80, no. 3, pt. 2 (May/June 1972): S74-S103.
- Hauser, Robert M., and Sewell, William H. "Family Effects in Simple Models of Education, Occupational Status, and Earnings: Findings from the Wisconsin and Kalamazoo Studies." *J. Labor Econ.* 4, no. 3, pt. 2 (July 1986): S83-S115.
- Heckman, James J., and Hotz, V. Joseph. "An Investigation of the Labor Market Earnings of Panamanian Males: Evaluating the Sources of Inequality." *J. Human Resources* 21 (Fall 1986): 507-42.
- Korenman, Sanders, and Neumark, David. "Does Marriage Really Make Men More Productive?" *J. Human Resources* 26 (Spring 1991): 282-307.
- Lam, David. "Marriage Markets and Assortative Mating with Household Public Goods: Theoretical Results and Empirical Implications." *J. Human Resources* 23 (Fall 1988): 462-87.
- Lam, David, and Levison, Deborah. "Declining Inequality in Schooling in Brazil and Its Effects on Inequality in Earnings." *J. Development Econ.* 37 (November 1991): 199-225.
- . "Age, Experience, and Schooling: Decomposing Earnings Inequality in the United States and Brazil." *Sociological Inquiry* 62 (Spring 1992): 220-45.
- Langoni, Carlos Geraldo. "Income Distribution and Economic Development:

- The Brazilian Case." In *Frontiers of Quantitative Economics*, vol. B, edited by Michael Intriligator. Amsterdam: North-Holland, 1977.
- Psacharopoulos, George. "Returns to Education: A Further International Update and Implications." *J. Human Resources* 20 (Fall 1985): 583-604.
- Schoeni, Robert F. "The Earnings Effects of Marital Status: Results for Twelve Countries." Research Report no. 90-172. Ann Arbor: Univ. Michigan, Population Studies Center, 1990.
- Schultz, T. Paul. "Education Investments and Returns." In *Handbook of Development Economics*, vol. 1, edited by Hollis Chenery and T. N. Srinivasan. Amsterdam: North-Holland, 1988.
- Strauss, John, and Thomas, Duncan. "Wages, Schooling and Background: Investments in Men and Women in Urban Brazil." Paper presented at the World Bank Conference on Education, Growth, and Inequality in Brazil, Rio de Janeiro, March 1991.
- Thomas, Duncan; Strauss, John; and Henriques, Maria-Helena. "Child Survival, Height for Age and Household Characteristics in Brazil." *J. Development Econ.* 33 (October 1990): 197-234.
- Welch, Finis. "Human Capital Theory: Education, Discrimination, and Life Cycles." *A.E.R. Papers and Proc.* 65 (May 1975): 63-73.