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WAGES, SCHOOLING AND BACKGROUND:

INVESTMENTS IN MEN AND WOMEN IN URBAN BRAZIL

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Abstract

Numerous empirical regularities of the urban Brazilian labor market are documented using the 1982 *Pesquisa Nacional por Amostra de Domicílios* (PNAD). Using a semi-parametric approach, special attention is paid to the shape of the relation between wage and years of schooling. We focus on heterogeneity in this relationship: by gender, region, choice of sector of employment, age-cohort and race. We also examine the role of family background in wage determination, both directly and through its influence on labor market participation choices.

The effect of education on both (the logarithm of) wage and sectoral choices is neither linear nor smooth. Returns to post-primary schooling tend to be far higher than returns to less schooling. This gap exists for both market and self-employment work. It is greater in the Northeast than the South and has been increasing over time. Furthermore, additional years of schooling sometimes have either no effect or even a negative impact on expected wages. The heterogeneity in the shape of the wage-education function suggest that the lack of smoothness cannot be explained by credentialism but rather indicates self-selection among those who choose to continue at school.

Family background factors are found to play an important role in wage determination, though of far less magnitude than own education. Unobserved characteristics of those entering the wage versus self-employment sectors or not participating in the labor force at all are also found to affect log-wages in plausible ways, suggesting that workers are sorting according to their comparative advantage.

1. INTRODUCTION

Many studies, covering a wide variety of countries, have calculated *the* return to education in the labor market; see, for example, reviews by Psacharopoulos, (1985) and Psacharopoulos and Woodhall (1985). Our aim in this paper is to examine the *heterogeneity* in returns to schooling. Using a very large dataset from Brazil, we begin by documenting the facts regarding the shape of the relationship between wages and education. The vast majority of studies in the literature have estimated linear (or possibly quadratic) wage functions; in contrast, we estimate semi-parametric functions which place no restrictions on the magnitude of the return to education for each year of completed schooling. We demonstrate that, in Brazil, wage functions are neither linear nor smooth but are, instead, convex and characterized by steps. This turns out to be true for men and for women and also when we stratify on region of residence. Furthermore, the shape of the wage function is not the same for each of these groups. The implications of these results for models describing the labor market and also for inequality in Brazil are discussed.

In addition to describing the facts, we attempt to explain the observed heterogeneity in returns to education. First, wage functions are estimated separately for those who choose to work in the market and self-employment sector, treating sector of employment as the outcome of a set of individual choices. The factors that lead men and women to make these choices are described together with the influence on measured wages of the composition of sectoral labor forces with respect to unobserved characteristics.

An issue which has received a good deal of attention in the literature, at least in the United States, is the extent to which heterogeneity in estimated returns can be explained by variation in family background (see, for example, the review by Willis, 1986).¹ In developing countries, there has traditionally been concern with inter-generational mobility and, in Brazil, social mobility has been a key area of research in the social sciences. There have, however, been rather few studies of labor market outcomes in developing economies which take account of family background characteristics.² In this paper, we examine the impact on labor market outcomes

¹Researchers have estimated earnings functions and examined how robust estimated returns to education are to information on siblings (Griliches, 1979; Behrman, Hrubec Taubman and Wales, 1980; Bound, Griliches and Hall, 1986 and Hauser and Sewall, 1986) and to information on parents (Leibowitz, 1974; Featherman and Hauser, 1978; Pananicolau and Psacharopoulos, 1979; Solon, 1989a, 1989b; Solon *et al.*, 1991; Willis and Rosen, 1979; Altonji, 1988; and Corcoran *et al.*, 1989, 1990).

²In one of the first of these studies, Carnoy (1967) finds that, in Mexico, father's occupation is strongly related to his child's wages as an adult. Behrman and Wolfe (1984) estimate household income functions for adult women in Nicaragua, using parental education as controls. Father's schooling is significantly positive. Heckman and Hotz (1986) estimate male earnings functions for Panama and find positive effects for both mother's and father's schooling, with the mother's effect being larger. Using the World Bank's Living Standards Measurement

of background, as measured by parental education, and link its role to patterns in returns to education. Again we focus on the differences in impacts on men and women, across regions and sectors of the economy and again we find the effects vary over the distribution of education.

Finally, focusing on the poorest region of Brazil, the Northeast, wage functions are estimated separately for three age groups in order to draw inferences about the dynamics of returns to education. We also document differences in returns to schooling for three racial groups.

A handful of recent studies of returns to schooling in Brazil have examined nonlinearities in wage or earnings functions, albeit to a limited extent. Considering only males, Dougherty and Jimenez (1991) and Tannen (1991) use the 1980 Population Census and allow education to have different effects at lower primary, upper primary, secondary and post-secondary levels. Both papers find that marginal returns are higher at secondary and post-secondary levels than for primary education levels. Lam and Schoeni (1990) and Haller and Saraiva (1991) use the 1982 PNAD to analyze earnings for men and also find increasing returns.³ Dougherty and Jimenez use a spline function for education and also allow dummy variables for the last year of each level in order to test for certification effects.⁴

To examine the impact of background on returns to schooling, Pastore (1982) and Medeiros (1982) use the 1973 *Pesquisa Nacional por Amostra de Domicilios* (PNAD) and include indices of father's occupation in male earnings functions. This work has recently been updated (Pastore and Zylberstajn, 1990) with the 1982 PNAD, focusing on mobility across social classes. Haller and Saraiva (1986, 1991) and Saraiva, Pahari and Haller (1986) also use the 1982 PNAD and include father's occupational status in earnings functions for males and females, stratified by region. All these studies find positive effects of father's occupation which is interpreted as an indicator of the socioeconomic status of the respondent's family. Lam and Schoeni (1990) also use the 1982 PNAD to analyze earnings of married men and instead of father's occupation, include parental schooling as well as the schooling of the spouse and parents-in-law. They find positive impacts of parents' and parents'-in-law

Survey from Peru, Stelcner, Arriagada and Mook (1987) report similar results for males in the market sector. Sahn and Alderman (1988) find an effect of father's predicted wages on wage outcomes in Sri Lanka. Armitage and Sabot (1987) interact own education with parents' education, finding sharply rising marginal rates of return in Kenya and to a lesser extent in Tanzania.

³Haller and Saraiva also analyze female wages, but do not account for nonrandom selection into the labor force.

⁴The authors argue they find evidence for certification effects although it is not clear that their strategy can distinguish between certification effects and unobserved heterogeneity in school dropouts.

education and important interactive effects with own education (the marginal return rising with better family background).

In this paper, we attempt to bring together the facts regarding the relationship between schooling and wages in Brazil. Rather than focus on a particular demographic or geographic group, we exploit the tremendous diversity in Brazil and compare men with women, people in the Northeast and South, blacks with whites, older cohorts with younger cohorts and also those who choose to participate in the wage sector with those in the self-employed sector. All of these comparisons are made with minimal parametric assumptions on the shape of the wage-schooling function. This permits us to draw conclusions about how the differences we observe vary across the distribution of education. In addition to describing the facts, we find evidence to support the view that schooling is not just a credential but is probably associated with productivity enhancements which are rewarded in both the market and self-employed sectors. There is evidence, however, that a good understanding of the returns to investment in schooling needs to take account of each individual's choice of the number of years spent at school.

2. DATA

The data for this study are drawn from the 1982 *Pesquisa Nacional por Amostra de Domicílios* (PNAD). An annual labor force survey, much like the Current Population Survey in the United States, the PNAD contains a special supplement in each year: in 1982 the focus was on education. Each household head and spouse reported the educational status of both their own parents.⁵ Furthermore very detailed information was gathered on schooling attendance and attainment for all household members over 7 years.

The PNADs are from a stratified probability sample that is nearly national in scope.⁶ Information was collected on some 112,000 households, accounting for over half a million individuals. Approximately 74,000 households are located in urban areas and are the subject of this study.

The richness of the 1982 PNAD is exploited in three dimensions which are key for this study. First, the very large sample size permits semi-parametric wage functions which place no restrictions on the returns to education for each year of completed schooling. Second, we stratify the data in multiple dimensions to permit

⁵Occupational status of the father was reported, but only for those respondents who are currently active in the labor force.

⁶Rural areas in the north region of the country are not sampled for cost reasons. The urban sample is national.

flexibility in the effect of education on wages across a range of socio-economic and geographic groups. Third, the survey provides detailed information on the education of each individual's mother and father, as well as the education of the spouse and the spouse's parents. These characteristics are included as indicators of family background to determine the extent to which they can explain the heterogeneity in returns to education.

In addition to estimating the determinants of total wages (measured by total income for the previous month divided by total reported hours for that month), we also distinguish wages earned in the market sector from wages in the self-employment sector treating selection into these sectors as endogenous.⁷

Using data only from urban Brazil, three sets of log wage functions and sectoral choice functions are estimated separately for men and women, stratified into three macro-regions which we refer to as the South,⁸ Northeast⁹ and Center-North.¹⁰ We restrict ourselves to household heads and spouses, since those are the individuals for whom we have information on the education of the mother and father. We further restrict the sample to those aged 25-60 years, to avoid sample selection issues that would arise if we were to use young and old household heads. In our sample, there are 62,087 female and 58,687 male urban dwellers, aged 25-60, who are household heads or spouses; sample means and standard deviations are reported in Appendix Table 1.

The distribution of completed education for the urban Northeast and South regions are displayed in Figure 1 for males and females separately. The large proportions of urban Brazilians who have no schooling is striking although there are dramatic differences across regions. Whereas almost one third of men and women in the Northeast have no education, in the South about one sixth of women and one eighth of all men have not attended school. There are a series of spikes in the distribution of completed years which identify the completion of a grade or level of schooling: at four years for lower primary, eight year for upper primary, eleven years for

⁷The PNAD collects information on primary and secondary jobs, but the job classification is only known for the primary job. For this reason, while total wage is defined as total (primary plus secondary) monthly earnings divided by total monthly hours, market wage and self-employment wages are defined using primary job information only. Less than four percent of the sample reports any secondary employment.

⁸Rio de Janeiro, Sao Paulo, Brasilia, Parana, Santa Catarina, Rio Grande do Sul, Minas Gerais and Espirito Santo.

⁹Maranhao, Piaui, Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe and Bahia.

¹⁰Actually this includes both the center-west and north: Amazonas, Amapa, Acre, Para, Rondonia, Roraima, Matto Grosso, Matto Grosso Sul and Goias.

secondary and fifteen years for an undergraduate or technical degree.¹¹ Only 18% of Northeast males and 16.5% of Northeast females have had more than primary education (eight years of schooling). Larger, but still small proportions of people in the South have gone beyond primary school (23% and 20% for males and females, respectively). Nevertheless, because the sample size is very large, even lower frequency cells have substantial numbers of observations. For example, the fifth and ninth years of schooling turn out to be important below: in the South, there are 2,856 and 368 men who have spent exactly this amount of time at school, respectively; while in the Northeast the respective cell sizes are 1,133 and 117 men. These large cell sizes allow us to estimate effects of individual years of education with precision.

3. REGRESSION RESULTS

We estimate a series of semi-parametric wage functions in which we place no restrictions on the shape of the relationship between wages and years of education by including a dummy variable for each of seventeen years of education; (see Hungerford and Solon, 1987, for a similar application using the United States data). In addition, the wage function regressions include age (and its square) and race of the respondent together with the education of the respondent's mother and father.¹² Separate regressions are estimated for three macro regions and state dummies are included in each of the regressions in order to permit flexibility in the returns in education due to heterogeneity across regions in the demand for labor¹³ and the quality of education.¹⁴ We also stratify on gender of the respondent.

Each regression includes controls for self-selection into the labor market and also into the market or self-employment sectors.¹⁵ We estimate wage functions rather than earnings functions, in order to abstract from

¹¹Prior to the mid 1970s, lower primary level was a distinct grade but since then, lower and upper primary school grades have been combined. The PNAD questionnaire asks which level and grade was the highest completed, distinguishing the old from the new system. We have converted these into years completed.

¹²The regressions are semi-parametric in the sense that while there are no parametric restrictions on the form of the log wage-education function, a series of additional characteristics are included in a particular parametric form.

¹³Sedlacek and Barros, (1989), Heckman and Hotz, (1986), Lam and Levison, (1991b).

¹⁴Behrman and Birdsall, (1983), (1984); Behrman, Birdsall and Kaplan, (1991); Birdsall, (1985); Card and Krueger, (1990).

¹⁵Approximately 9-10% of men do not participate in the labor market in either market wage or self-employment activities; we do control for self-selection for males as well as for females.

labor force participation and labor supply decisions. This is important from the point of view of identification of the self-selection terms; we assume valid instruments include household unearned income and assets (which should affect the decision to participate but not directly affect an individual's wage).¹⁶ In our base specification we also exclude from the wage equations existence of a spouse and education of the spouse and spouse's parents, while allowing these variables to influence participation decisions. We later examine the robustness of the wage equations to this identification assumption. Of course, if husbands and wives make joint labor supply decisions, then it would be inappropriate to treat spouse's characteristics as exogenous in an earnings function, as opposed to the wage functions that we estimate.

(a) Wage functions: inter-sectoral and inter-regional comparisons

Our semi-parametric estimates of the conditional expectation of the logarithm of wages are presented in Figures 2 through 5: the slope between any two years is the marginal return to that year of education. Our discussion focusses on graphical presentation of the results; coefficient estimates and standard errors underlying these figures are reported for men and women in Appendix Tables 2A and B.

Figure 2 compares the returns to *total* wages between regions, by gender and between gender, by region. Figures 3 and 4 distinguish market and self-employment wages, using the same comparisons as in Figure 2, while in Figure 5 market and self-employment wages are directly compared. Since magnitudes of returns are quite difficult to determine from the pictures and there are a very large number of estimates in Appendix Tables 2A and B, Table 1 summarizes the results by reporting the average return to schooling for each level.

Perhaps the most striking fact emerging from Figure 2 is that the conditional log wage functions are clearly not linear but appear to be convex. The conditional expectations are, however, not smooth but are characterized by a series of steps; relative to the semi-parametric estimates, even a polynomial function will provide an inferior fit to the data and fail to capture these important differences in returns across the education distribution.

Among men in the South, the average annual return to the first four years of schooling is about 12% and much of this is due to a significantly higher return to completing the fourth year (first part of primary schooling) relative to the previous three years. Those who leave school the following year or one year before

¹⁶Assets include dummy variables for characteristics of the dwelling such as type of walls, floors, sewerage, garbage disposal and roof; source of water and ownership of a water filter or refrigerator.

the end of primary school (the seventh year) gain nothing (in terms of wages) from the last year at school and the average return to the second half of primary school is lower (10%). The return to secondary schooling (9-11 years) is higher (over 13%) and is especially high for the last year. Post-secondary schooling yields a similar return (13%) with larger returns for the first and fourth years.¹⁷

Relative to the South, men are paid less in the Northeast across the entire education distribution. The returns to education are smaller for primary schooling (about 11% *per annum*), increases to 15% for men who attended secondary school and to 16% at post-secondary levels. As in the South there is an increase in returns to higher levels of education, and while the log wage functions are convex in both regions, the convexity is greater in the Northeast so that at the top of the education distribution, the differences in wages of men in the Northeast and South are small.

At the bottom of the education distribution, men in the Center-North are paid just under the levels of the South but, since returns to primary schooling are lower than in either of the other two macro-regions, men with some secondary schooling are paid about the same as men in the Northeast. Thereafter, the returns are very similar for men in the North and Northeast.

Among women, the conditional log wage function is even more convex than that for men. Average returns to the first four years of primary school are lower than for men -- 10% in the Northeast and 11% in the South -- but returns to post-primary schooling are higher -- being 16% in the South and almost 20% in the Northeast. In both regions returns rise from secondary to post-secondary levels.

Returns in the North are lower than in the other two regions for secondary school, but track those in the Northeast at post-secondary levels. Thus, as is the case for men, much of the interregional gap in wages at the bottom of the education distribution has disappeared at the top, and women in all regions earn about the same wage.

The lower panel of Figure 2 compares conditional wage functions across gender. In the South, returns to education are about the same for men and women until the last part of primary education (around 6 years);

¹⁷The fourth year of university education (15 years total) is usually the last. Since samples are often relatively small at the top of the education distribution (over 15 years), we will pay less attention to those returns. Note, however, that in polynomial models these observations often have a very large influence on estimated returns. In our semi-parametric specification, of course, these observations do not contaminate estimated returns elsewhere in the education distribution.

thereafter returns for women are, on average, about 15% higher than returns for men.¹⁸ The relative patterns are similar in the Northeast, although females earn higher returns earlier (half way through primary school), which drop off between 7 and 9 years, but then rise quite dramatically towards the end of secondary school. The difference in the average rate is slightly higher in the Northeast (16%), but much higher for post-primary education (30%) and so while the wage gap narrows with higher education in both the South and Northeast, catch up is greater in the poorer Northeast.

If the conditional wage functions were convex then a quadratic would fit the data well. There is, however, evidence that an additional year at school is not associated with a higher wage for every year of schooling and, in some cases, the returns to schooling are even *negative*. This is, perhaps, most noticeable for those people who complete only one year of a schooling level: that is one year more than lower primary (five years), upper primary (nine) and secondary school (twelve years of schooling). While true for both men and women, it is by no means generally true across all regions. Furthermore, there are some cases where returns to education are zero for a *final* year of a particular grade (such as women in the Northeast who complete eight years of primary school). These flat regions are not simply a function of random noise in the data; as discussed below, this has importance implications for interpretation of the impact of schooling on income.

Figures 3 and 4 are similar to Figure 2, except they treat market and self-employment wages separately, accounting for self-selection into each sector. The patterns for market wages and total wages are similar, but the conditional *market wage* functions are less convex. Returns are higher for both men and women in the Northeast, relative to the South, particularly at post-primary levels. Thus, among men with little or no education, those in the South earn a higher wage than those in the Northeast, however towards the top of the education distribution men in both regions earn about the same wage. The same is true for women in the two regions. There is, it seems, little incentive for the well-educated to migrate from the poorer Northeast.¹⁹ Furthermore, relative to total wages, the gap between the market wages of men and women is narrower but still persists.

Returns to education in the self-employment sector, in Figure 4, are somewhat different. For both men and women, relative to the South, returns are higher in the Northeast for primary and secondary school, but are

¹⁸The average return for 8-17 years of schooling is 15% for women and 13% for men.

¹⁹If prices are lower in the Northeast, then there might be some incentive for people to migrate from the South to the Northeast. Since there is little evidence of migration in this direction, the higher prices of the South are presumably compensated by better services.

quite close for post-secondary education. Returns (and wages) in the Center-North track those in the South very closely. In both the Northeast and South narrowing of the gender gap does not occur until the very top of the education distribution. In the South, among those with no education who choose to work in the self-employment sector, women earn just over half a man's wage; at the top of the education distribution earnings of women are about two thirds that of men.

Returns in the market and self-employment sectors are compared in Figure 5: broadly speaking there is a jump in returns for the (log) market wage functions which occurs at post-primary levels; while for the self-employment functions there is a jump, but not until post-secondary levels. Returns for men and women are lower in the self-employment sector through the secondary level, but rise substantially and are higher for post-secondary schooling. For instance, in the Northeast, at the bottom of the education distribution, wages of men who choose to work in the self-employment sector are slightly higher than those in the market sector, but returns to education are higher in the market sector, especially for secondary school. This then reverses for post-secondary levels; thus wages are very close at higher levels of education. In the two sectors, women in the Northeast earn about the same wage and return to schooling, until secondary school, at which point returns are higher in the market sector. Among women in the South, however, the (log) market wage function is convex through secondary school, after which it becomes linear. The self-employment wage function, on the other hand, displays near linearity through primary school, after which it becomes convex. Expected wages and returns in the two sectors are about the same for primary school, but higher in the market sector for secondary education, and then very high in the self-employment sector for post-secondary levels. At the very top of the education distribution, then, wages of women in the South are the same independent of their choice of sector of employment.

(b) Wage functions: discussion

There are, therefore, large differences in the returns to education across regions: this is, by now, well understood.²⁰ Among people with little or no education, expected wages are higher in the more developed South but higher *average* returns to schooling in the Northeast result in wages at the top of the education distribution being approximately the same in the two regions. There are also significant differences across gender although

²⁰See, for instance, Behrman and Birdsall (1983), (1984) and Birdsall (1985).

this gap also declines with education. Little attention, however, has been paid to the differences in returns across the market and self-employment sectors and, perhaps most importantly, to how all these differences vary over the distribution of education.

Two important aspects of the nonlinearity of the conditional wage functions stand out from the discussion so far. Firstly, the conditional wage functions are convex and so returns to education increase with the level of education. Secondly, the wage functions are characterized by flat and sometimes downward sloping regions: smoothing over the differences (with parametric functional forms) misses an important dimension of the wage-education function.

What might explain the increasing returns to schooling? It is possible that they reflect quality of schooling (see Behrman and Birdsall, 1983; Birdsall, 1985 and Birdsall *et al.* 1990) if there is a higher percentage of lower quality schools at the primary level than at post-primary levels. Higher quality schools may charge fees, which if credit constraints exist, could ration out some children. It is also possible that the structure of labor demand plays an important role. For both these reasons, we include controls for (current) state of residence of the respondent. However the shape may also reflect differences in unobserved qualities of individuals who choose to continue to higher levels of education.²¹ If so, the increasing returns may not reflect the potential experience of a given individual faced with the choice of whether to further his or her education. In any case, the convexity of the log wage functions suggests that as the level of education increases in Brazil, inequality will also increase.

What might explain the jumps and flats in the wage functions? Since the coefficients in the wage functions are estimated with precision (see Appendix Table 2), sampling error is unlikely to be the explanation. Noting that returns tend to peak in the last year of each education level, and then decline, Saraiva *et al.* (1986) and Dougherty and Jimenez (1991) argue that the jumps in the wage functions reflect credentialism or sheepskin effects (although they admit that other factors might also matter). Among market wage earners in the South there are indeed higher returns to schooling in the last year of each schooling level (lower primary, upper primary and secondary at 4, 8 and 11 years respectively) for both men and women. There are, however, also jumps in the log wage function at 6 and 12 years of schooling (as well as significantly higher returns to 13 through 15 years): it is hard to see how these can be attributed to credentialism. In the Northeast, there is a

²¹See, for example, Griliches and Mason, (1972); Griliches, (1977).

jump in the market wage function at the lower primary school (4 years) for women but not for men. On the other hand there is a jump at 8 years (the end of upper primary) for men but not for women. If credentialism is at work, we would expect it to matter for both men and women and also to matter in all regions. Furthermore, there is no reason for credentials to be rewarded in the self-employed sector. Yet in the South we do see jumps in self-employment wages at 4 years for both men and women, at 8 years for men and at 11 years for women. We also see jumps at 6 and 12 years for men and at 7 years for women. It is very hard to see how these facts can be explained by credentialism or sheepskin effects.

Furthermore, parts of the log-wage functions are flat or downward sloping indicating, perhaps, that particular years of schooling are just not very productive or even counter-productive. Among men in the market wage sector, the return to education is significantly smaller than in the preceding year at the beginning of upper primary school (5th year) and in the 13th year (the second year of university) in the South. In the Northeast, returns *decline* in the first year of secondary school (9th year) and third year of university education (14th year). Among self-employed men in the South, returns *decline* in the 5th, 7th, 13th and 14th years at school; among women, returns decline in the 3rd, 8th, 10th and 11th years. In the Northeast, however, returns in the self-employed sector decline in the 6th, 9th, 13th, 14th and 16th years for men and in the 6th, 8th and 10th years for women. It seems very unlikely that particular years of schooling are inherently unproductive since this argument should apply equally to men and women and, for that matter, across regions. There exists far too much heterogeneity in the years when schooling returns decline or are negative to support the argument. Furthermore, it is very difficult to see how credentialism can explain the flats and declines.

We suspect, instead, that the jumps, flats and declines in the estimated wage functions reflects, at least in part, unobserved heterogeneity in the types of people who leave school prior to completing a level (or just after starting a new level) (Chiswick, 1973). As noted above, this may also partly explain the increasing returns to schooling over the distribution of education.

This potential education selectivity is usually ignored in wage function estimates (see Griliches, 1977; Griliches, Hall and Hausman, 1978; Chamberlain, 1978 and Willis and Rosen, 1979 for exceptions); it becomes starkly apparent when we allow flexibility in the log wage-education function. To adequately control for education selectivity requires additional data on (opportunity) costs of education or the invocation of strong

assumptions.²² Willis and Rosen (1979), for example, assume that parental characteristics affect wages only through educational attainment so that years of completed schooling captures all human capital characteristics, of the respondent. If other dimensions of human capital investment, not captured by years of schooling, are important then this will not be an adequate identifying assumption. For instance, in the absence of measures of educational quality, this is unlikely to be a good assumption in Brazil (see footnote 14). Nevertheless, attempts to treat educational attainment and current wages as jointly determined would seem to be a very worthwhile research task.

(c) Labor force participation and self-selection in wage functions

The characteristics of those men and women who choose to participate in the labor force and their choice of sector (market or self-employment) is not likely to be random both in terms of observables and also unobserved factors which also affect wages. We account for this explicitly by modeling selection into the labor force (for total wages) and into the labor force, by sector (for the market vs. self-employment distinction) by the method of Lee (1983) based on estimation of a multinomial logit sectoral choice model in which education is, once again, allowed to affect each outcome without parametric restrictions.²³ Predicted probabilities from these regressions by year of education are presented in Figure 6.²⁴ Appendix Tables 3A and B report for men and women the multinomial logit coefficients and asymptotic normal scores for the background characteristics of each individual, household non-wage income and assets.

Own education is critical in allocating women between participation and non-participation. As women with higher education enter the labor market, they tend to go into market employment. As is true for predicting log-wages, the effects of education are neither linear nor smooth. In the South, predicted market work rises from 13% for those with no education to only 17% with four years of education and then jumps a little, to 27% at completion of primary school. Post-primary education makes a very large difference, however. For those who complete secondary school, predicted probabilities rise to 55% (with a large jump for completion of the last year)

²²Panel data can also be helpful (eg. Chamberlain, 1978 and Griliches, Hall and Hausman, 1978).

²³To reiterate, household non-labor income, household assets, spouse and spouse parents' characteristics serve to identify the selection effects.

²⁴Non-education variables are evaluated at sample mean values. Note that because of the non-linearity of the logit specification that this is not the same as the sample mean prediction.

and to 84% for those with 15 years of schooling (an undergraduate degree). In the Northeast, predicted probabilities for market work and labor force participation increase even more dramatically among women with some secondary schooling: market work probabilities rising from 32% at 10 years of education to 63% at 11 years and then to 88% by the completion of an undergraduate degree (15 years).

Self-employment probabilities are fairly stable for women through primary levels of education both in the South and Northeast. Predicted probabilities fall with secondary schooling in both regions, but in the South they rise with completion of post-secondary schooling. This suggests that some better educated women enter professional types of self-employment. This rise in the probability of self-employment at the highest levels of education does not occur in the Northeast (though sample sizes in these education groups are much smaller).

For males the relationship between employment and education is quite different. The probability of labor force participation rises slightly with education (from 92% for those with no education to 99% for those completing 15 years in the South). There is a larger increase in predicted probabilities of market work, but by nowhere the amount as for women. This is because predicted participation in market wage employment for people with very low levels of education is much higher for males; at the top of the education distribution predicted probabilities for market work are similar by gender. For example, in the South predicted probabilities of market work rise from 65% for men with no education to 85% for those who complete 15 years. In the Northeast the increase is from 51% to 89% for these two groups.

Much of the expansion of market work for men is at the expense of the self-employment sector. This is especially true in the Northeast, where predicted self-employment probabilities fall from 43% for those with no education to 23% at completion of primary schooling, to 18.6% by the end of secondary school and to just over 10% at 15 years or greater. In the South, probabilities of male self-employment fall with education until completion of university, when they rise. As for women, this may indicate professional types of self-employment.

As shown in Appendix Table 3B, existence of a spouse is associated with lower labor force participation rates among women. Further, higher levels of spouse education also lead to lower probabilities of female participation, consistent with a positive income effect swamping substitution effects. The effects of non-wage income are similarly negative, both for market and self-employment work, though with a decreasing marginal effect. These effects all tend to be stronger for market work than for self-employment. Effects of parent's and spouse parent's education are much weaker than the spouse effects. In the South, post-primary levels of parental education are associated with women being less likely to be in market employment than not participating at all,

but more likely to be in self-employment than not in the labor force. The spouse's mother's education has a similar effect. In the Northeast, however, both parents' and spouse's parents' education have essentially no effect on labor force decisions of women.

For men, non-wage income also has a strong impact, leading to lower probabilities of labor force participation. As for women the effects are somewhat stronger for market work and they are stronger in the Northeast. Existence of a spouse has a very different effect on men than on women. Being married raises probabilities of work, especially market work, for men. Higher education of the spouse raises the chances of going into self-employment, although at post-primary levels of spouse education probabilities of market employment are also raised. Parental and spouse's parents' education has little effect on male participation decisions except that in the South, having a highly educated father-in-law does raise the probability of both market and self-employment work.

Having briefly discussed factors related to employment choices we are now in a position to return to a discussion of selectivity effects on log-wages; these are reported in Appendix Tables 2A and 2B. Women who work in either the market or self-employment sector have, on average, significantly higher log-wages than would a randomly selected woman. In the Northeast, for example, log-market wages are 30% higher for an average woman who participates in that sector than for an average woman, holding observable characteristics constant. In the self-employment sector the differential is 27%. In the South the differential is only 12% in the market sector, but 85% in the self-employment sector. In the South, then, controlling for own education, parents' education and the other variables in the log-wage equations, women who select into the self-employment sector have a very large comparative advantage.

For men, the selection effects are quite different. Most men participate in one of the two labor sectors (although 9% do not participate in either). Men working in the market sector have larger log-wages, conditional on observed characteristics, than the "average" Brazilian male in the particular region, while men in self-employment have lower log-wages. Again, all these effects are significant. In the South, men in the market sector have an estimated 13% advantage over men with the same level of measured characteristics, but average with respect to unmeasured factors. In the self-employment sector there is a disadvantage of 70%. Similar magnitudes exist in the Northeast.

(d) Wage functions: direct background effects

While background characteristics can affect labor force and sectoral participation choices, they may also affect log-wages directly.²⁵ It is therefore of interest to examine the direct effects of background on log-wages. As noted, the 1982 PNAD has information on completed education of parents of heads of households and their spouses (if married). In our base set of specifications we use education of both parents as controls for background of the worker.²⁶ Coefficient estimates appear in Appendix Table 2 for the three macro-regions, separately for market and self-employment wages.

In the Northeast we see that mother's education has large, significant positive effects on the log-market wages of daughters. Daughters with mothers having greater than primary school education enjoy a 30 percent market wage advantage over daughters of illiterate mothers. Although this effect is small compared to the own education effect, it is still sizeable. Mother's education also affects the wages of sons, though by a smaller amount. In the South, the direct influence of mother's education on daughters is only half that in the Northeast. Sons having a mother with a second-half of primary education have market wages 15% higher than those with illiterate mothers, while the advantage to sons whose mothers have greater than primary education is over 27%.

Father's education also has a significant impact on both sons' and daughters' log market wages in all three regions. It has been noted that relative to fathers', mothers' education has a bigger effect on labor market outcomes of children;²⁷ this is also true in the Center-North, the Northeast and among sons in the South. It is not, however, a universal fact. Among daughters in the South, the reverse is true: the influence of fathers' education is greater than that of the mother.

The effects of parental education on self-employment wages are somewhat different. Fathers with post-primary education in general have a larger proportionate effect on self-employment wages than on market wages. In the Northeast, for example, self-employment wages of men whose fathers have greater than primary levels of

²⁵Years of completed schooling may be only an imperfect measure of a worker's human capital. Some investments in children, correlated with background variables, may be only partly controlled for by education measures. Background may also be related to quality of education, which we do not control for. In addition, self-employment wages are really a return to labor and to fixed capital; background factors may affect resource availability, which can shift these returns.

²⁶And a dummy for those mothers and fathers whose education is not reported.

²⁷Heckman and Hotz (1986) present results for earnings of men in Panama; Behrman and Wolfe (1984) present results for schooling achievement and household income for women in Nicaragua.

education are 50% greater than sons of illiterate fathers. This may result from resources being made directly available to such enterprises. Exceptions exist for men in the South and women in the Center-North.

(e) Wage functions: robustness to background controls

All the estimated returns to education discussed so far have included parents's education as controls for the background of the worker. While not usually included in wage or earnings functions (see Lam and Schoeni, 1990, for an exception), spouse and spouse parents characteristics may also affect wages directly. Self-employment wages include the return to self-employment capital, which is likely to be enhanced in households with better access to resources. While not usually included in market wage functions, spouse and spouse parent characteristics may also have an effect, if, for example, there is job queueing or other forms of market segmentation. Also, given that we are not able to measure job-specific experience, returns to women are likely to depend on the degree of labor force attachment, which may be related to both husband's and possibly parents-in-law characteristics. Finally, these variables will in part pick up effects of marital sorting, together with the fact that own parents' characteristics only imperfectly measure family background.

It is of interest to compare returns to education with these sorts of background controls and without any. Many other studies, particularly using US data, have demonstrated substantial declines in estimated returns. How do estimated returns in Brazil change when spouse's education and spouse's parents' education are added to the regressions? What happens to returns when no background variables are included? The results are presented in Figures 7 and 8.²⁸ The comparison for males (ignoring regional heterogeneity and sectoral choice) is discussed in the context of earnings (rather than wage) functions in Lam and Schoeni, (1990).

For males, estimated returns from regressions which have controls for spouse and spouse's parents characteristics are smaller than the base set of returns (using only parents characteristics) in all cases. The declines in marginal returns are greater for self-employment and, in the South, at the higher end of the education distribution. For example, in the South returns to the first four years of primary school fall by 12% and returns to post-primary education by 21% when spouse and spouse parents education are added to the log-wage equation. In the Northeast, returns to male self-employment fall 30% for the first four years and 19% for post-

²⁸All specifications use the same set of identifying variables for sectoral work choice, which include all the background variables.

primary levels.²⁹ In the market sector male returns also fall when spouse and spouse parents education are added to the specification, but not as much. The proportional declines are in this case greater for lower levels of education: by 18.5% in the South and 16.5% in the Northeast for the first four years.

For women returns to self-employment are also lowered by the addition of spouse and spouse parents education and in a highly nonlinear fashion. In both the South and Northeast returns to self-employment decline by only a very small amount for the first four years of schooling, but by 30% for post-primary levels. nl In contrast to the other results, in the market sector returns for women are actually greater when spouse and spouse characteristics are added; an anomalous and curious result especially in view of the fact that we are estimating wage rather than earnings functions. In the South, the returns are the same (at 10%) for the first four years, but rise by 18% for post-primary schooling. In the Northeast the returns are slightly higher at low levels and rise from 21% to over 27% for post-primary education. Predicted female wage levels actually rise above male wages at the upper tail of the education distribution when this specification is used.

This anomaly for women in the market sector apparently results from lack of robustness in the identification of who goes into the market and self-employment sectors. Adding spouse and spouse parents characteristics to the log-wage equations does not materially affect the selection effects for men, although the coefficient for self-employed workers becomes somewhat more negative. For women, however this is not the case. The magnitudes of the selection coefficients are dramatically different across the two specifications; increasing by threefold for log-market wages and four-fold for self-employment. The standard errors also increase, suggesting multicollinearity of regressors. In contrast, when no background variables are included in the log-wage equations the selection coefficients for women change, but not by an order of magnitude, and the standard errors are close to the regressions based on only own parents' characteristics.³⁰ Thus, while for men,

²⁹Returns in the South are 10% for early primary education with all background variables and 11% using only parents' education. For post-primary education the returns are 10% and 12% respectively. In the Northeast returns fall from 12% to 9% for the first four years and from 19% to 16% for post-primary schooling.

³⁰For log-market wages without any background, the selection coefficient is .322, compared to .269 when parents characteristics are included. Standard errors are comparable, around .04. Intuitively, it makes sense that the measured effect of selection should decrease as we add relevant measured characteristics to the log-wage equation. That the opposite occurs when spouse and spouse parents characteristics are added is another indication that this specification is a poor one.

adding variables related to the spouse and spouse parents can be supported empirically, for women, it cannot be given the resulting difficulties in identifying selection of labor force and sector participation.³¹

Removing all background characteristics raises the returns to education from the base specification (including only own parents' education) for both men and women and in both sectors. In the Northeast, male market returns rise by 12-13% when no background variables are used and by larger amounts (18% for the first four years and 25% for post-primary) for self-employment. In the South, market returns measure 11% higher at early primary levels and increase by 24% at upper levels. Self-employment returns jump by 11% and 16% in the South and Northeast respectively for the first four years and by 20% and 24% for post primary education. Thus, again, the effects of adding background variables are nonlinear, having greatest impact at higher levels of education.

In sum, the inclusion of background characteristics has rather different effects on measured returns to education for labor market outcomes depending on the gender, region and sector of employment of workers as well as their own levels of education. The differences also depend on exactly which set of background variables are included. In general, adding background variables reduces measured returns more for those with higher levels of education. Yet, as we have seen, the returns functions remain convex, with higher returns for the better educated, even when background controls are included. Furthermore, the inclusion of background controls does not remove the jumps, flats or even declines in the conditional wage functions.

Figures 7 and 8 show the robustness of returns to education when additional background controls are used in the log-wage equations. Figure 9 takes a somewhat different view, using the base specification with parents' education, and stratifies the sample on the level of the father's education; implicitly allowing for interactions between own and father's education levels. In order to avoid small sample sizes we aggregate observations across all regions and estimate an all Brazil set of equations. For males, lower levels of paternal

³¹Lam and Schoeni (1990) point out that the education of parents-in-law have a dramatic effect on the earnings of married men. It turns out that there also exist effects on (the wages of) women. However these influences vary across gender, region and sector of employment. Father-in-law's education has positive, significant effects on market wages of males in the Northeast, but not on the market wages of females. Furthermore, the magnitude of the effects of the education of fathers-in-law on log-market wages of men is of the same order of magnitude as the effect of the man's *own* father, though this is not true for self-employment wages. Mothers-in-law have positive impacts on market wages of both men and women in the Northeast. For the case of self-employment wages, there are strong effects of mother-in-law's education, at higher levels, on male, but not female wages. There exist little in the way of influence of father-in-law's education on self-employment wages, except for a marginally significant effect at post-primary levels.

education lowers the level of log-market wages across the education distribution; marginal returns are not affected. For self-employment, returns to the first four years are quite similar across the different levels of father's education (*levels* are lower for children with illiterate fathers), but then returns become higher for the upper level of primary school (four to eight years) for children whose fathers have at least one year of education. At secondary levels a distinction appears between children of fathers with 4 or more years of education and with 1-3 years and post-secondary log-wages of all children grow at similar rates.

For women, log-wage levels of those whose fathers have 4 or more years are consistently higher while those whose fathers are illiterate have consistently lower log-wages than others. Marginal returns don't, however, seem to differ much across these groups. The same patterns tend also to be true for self-employment wages, although there is much more noise in these returns.

(f) Wage functions: cohort and race comparisons in the Northeast

Family background clearly plays an important role in determining labor market outcomes. This role varies significantly by region, by sector of employment and by gender of the child. It also varies by the education of the parent. We turn next to study the Northeast in more detail, reporting differences in returns and in background effects after stratifying the sample on age cohorts, in the first case, and on race in the second.

Younger age-cohorts have higher levels of completed education, with a very pronounced decrease in the proportion of those with no schooling.³² Figure 10 presents the distribution for completed years of education for three age-cohorts: younger (25-34 years), middle (35-44) and older (45-60). Among males, the proportion with no education falls from 35% for 45-60 year olds to 19% for 25-34 year olds. For women, the drop is even greater, from 40% to 19%. Most of the shift has been to the upper-primary, secondary and post-secondary levels. For instance the proportion completing primary school rises from 18% for the oldest male cohort to 31% for the youngest. Male completion rates for secondary school rise from 11% to 19%. Among urban women in the Northeast increased schooling levels are more dramatic; primary school completion rises from 14% to 32% from the oldest to youngest cohorts, while secondary school completion rises from 8% to 22%.

³²Note that it is not possible to map this shift into a shift in the Brazilian educational system since many Brazilians, particularly in the older cohort may have immigrated into the country and received their schooling elsewhere. Also internal migration may affect the educational composition of the cohorts.

The estimated conditional wage functions are presented in Figure 11 for the same three age groups. Stratification by age-cohort allows flexible interactions between education and age; generally returns decline with age. In the market sector, for the first half of primary school, the middle and older groups earn the same returns which are about double those of the younger cohort. In the second half of primary school, however, the returns for the older cohort take off and so the average return to the first years of schooling is a very high 15% for the older cohort, about 90% of that for the middle cohort (14%) and less than 2/3 that for the younger cohort (9%).³³ After primary school, returns for the younger cohort take off and they roughly double (to 17% for secondary school and 21% for four years post-secondary school). Since returns for the middle cohort also increase and those for the older are slightly lower, inter-cohort differences in wage levels are narrower at the top of the education distribution than at the bottom. The patterns for women are similar with the older cohort enjoying much higher returns to the second half of primary school but returns for the younger and middle cohort take off during secondary school.

In the self-employment sector, the differences are less obvious. The middle cohort seems to do worst and earns lower returns than both the younger and older cohorts for the first half of primary school although they catch up to the younger (but not older) cohorts by the beginning of secondary school.

Selection effects for women vary in a very interesting way among age-cohorts. The effects are strongest for the oldest cohort; they are significant only for market wages for 35-44 year olds and are not significant at all for the younger cohort. Presumably this reflects a much greater labor force participation among younger women. For men, selection effects in self-employment are stronger for the younger two cohorts, though for market wages selection disappears for the youngest cohort.

Returns to schooling are apparently changing dramatically over time in Brazil. As education opportunities have expanded and more children have completed primary school, economic returns to the first years of schooling have declined. Going beyond primary school, however, reaps large returns and these returns are greatest for the most recent cohorts. This increase in the non-linearity of the log-wage education function has very important implications for the path of income inequality in Brazil (Lam and Levison, 1991a; Dos Reis and Barros, 1991).

³³For the older cohort, the return to the eighth year of school is negative: the average return to the first seven years is a massive 19%.

Conditional expectations of log wages are presented in Figure 12 based on regressions estimated separately for blacks, mulattos and whites (including Asians). In the market sector, returns to education (and wages) are about the same for men in the three groups who have four years or less of schooling but the returns to the second half of primary school are higher for whites and by secondary school, returns for mulattos have also taken off, leaving the blacks behind. In the self-employment sector, returns for whites are somewhat higher after four years of education, while returns trail off for blacks at completion of secondary school; this leaves a substantial gap at post-primary levels. For women in the market sector returns are quite similar for all races through primary school, but are higher for whites and mulattos with secondary schooling. In the self-employment sector, white women are consistently better rewarded for education than either mulattos or blacks (although these estimates are quite imprecise). Differential returns by race, it appears, is greatest for men in the market sector and is especially large in the upper half of the education distribution; for women, it is apparent in the market sector after primary levels and in the self-employment sector it persists throughout the education distribution.

Selection effects are very similar to those discussed above, for whites. For mulattos, selection is significant only for males in the self-employment sector, where they are also negative, and for women in the market sector. For blacks, selection coefficients are never significant (which could be in part because of small samples).

3. CONCLUSIONS

We have documented numerous empirical regularities of the urban Brazilian labor market using the 1982 PNAD. We focus on heterogeneity in outcomes: by gender, region, sector of employment, age-cohort and race. We pay special attention to non-linearities in the conditional (log) wage function across the educational distribution. We also allow family background factors to play a role in wage determination, both directly and through their influence on labor market participation choices.

Among the principal findings are that the impact of education on both participation decisions and on log-wages is neither smooth nor linear; a polynomial model will provide an inferior fit to the data. Returns to post-primary schooling tend to be much higher than returns to primary schooling or less. This gap exists for both market and self-employment work. It is greater in the Northeast than the South and, perhaps most disturbing, has been increasing over time. This suggests that as education is expanded in Brazil, inequality might rise.

Particular years of schooling are associated with significantly higher returns than the year before or the year after. This often occurs at the end of a schooling level and might be construed as evidence for sheepskin or credential effects. Other years, however, are associated with no increase in expected wages or even a decline in the expected wage. Since the years in which the jumps, flats and declines in the conditional wage function occur are not uniform across gender or region, credentialism seems an unlikely explanation. Furthermore, since these patterns are observed in both the market and self-employment sectors (at different years), we think the evidence for credentialism is very weak.

Instead, we argue that both the convexity of the conditional wage function and the jumps, flats and declines may partly reflect different unobserved characteristics of those who complete different levels of schooling. This schooling selection problem has been prominent in the U.S. literature, but has been all but ignored in studies of developing economies. Unfortunately, either very rich data or strong assumptions are needed to address the problem; the assumption used in the United States (that parents' education only affects log-wages through participation decisions) is likely to be rejected in Brazil.

What causes the convexity of the conditional wage function and why are people not taking advantage of this situation by getting higher levels of schooling? Answers to both questions may be a function of educational quality differing for different levels of schooling. Also, existing characteristics of one's family may constrain how well a child does in school as well as the quality and quantity of schooling one receives. In addition, there is also likely to be an influence on the wage structure of factors related to labor demand. Given the very serious implications of this nonlinear structure of wages for income inequality, these twin questions deserve more attention.

REFERENCES

- Altonji, Joseph. 1988. The Effects of Family Background and Social Characteristics on Education and Labor Market Outcomes. mimeo.
- Altonji, Joseph and Thomas Dunn. 1990. Effects of parental characteristics on the returns to education and labor market experience. Mimeo.
- Armitage, Jane and Richard Sabot. 1987. Socioeconomic Background and the Returns to Schooling in Two Low-income Economies. *Economica*, 54: 103-108.
- Barros, Ricardo and David Lam. 1990. Income inequality, inequality in education and the demand for schooling in Brazil. Mimeo.
- Behrman, Jere and Nancy Birdsall. 1983. The quality of schooling: Quantity alone is misleading. *American Economic Review*, 73:928-46.
- Behrman, Jere and Nancy Birdsall. 1984. Does Geographic Aggregation Cause Over Estimates of the Returns to Schooling? *Oxford Bulletin of Economics and Statistics*, 46: 55-72.
- Behrman, Jere and Nancy Birdsall. 1985. The quality of schooling: Reply. *American Economic Review*, 75:1202-5.
- Behrman, Jere, Nancy Birdsall and Robert Kaplan. 1990. The quality of schooling in Brazil and labor market outcomes: some further explorations. Mimeo.
- Behrman, Jere, Z. Hrubec, Paul Taubman and Terrence Wales. 1980). *Socioeconomic Success: A Study of the Effects of Genetic Endowments, Family Environment and Schooling*. Amsterdam: North Holland.
- Behrman, Jere and Barbara Wolfe. 1984. The socioeconomic impact of schooling in a developing country. *Review of Economics and Statistics*, 66.2:296-303.
- Birdsall, Nancy. 1985. Public Inputs and Child Schooling in Brazil. *Journal of Development Economics*, 18:67-86.
- Boissiere, M., John Knight and Richard Sabot. 1985. Earnings, Schooling, Ability and Cognitive Skills. *American Economic Review*, 75: 1016-1030.
- Bound, John, Zvi Griliches and Bronwyn Hall. 1986. Wages, Schooling and IQ of Brothers and Sisters: Do Family Factors Differ? *International Economic Review*, 27: 77-105.
- Carnoy, Martin. 1967. Earnings and Schooling in Mexico. *Economic Development and Cultural Change*, 15:408-419.
- Card, D. and A. Krueger. 1990. School quality and Black/White relative earnings: A direct assessment. Mimeo, Princeton University.
- Chamberlain, Gary. 1978. Omitted Variable Bias in Panel Data: Estimating the Returns to Schooling. *Annals de l'INSEE*, 30/31: 49-82.
- Chiswick, Barry R. 1973. Schooling, screening and income. In Lewis C. Solomon and Paul J. Taubman, (eds.) *Does College Matter?*, New York:Academic Press.

- Corcoran, M., R. Gordon, D. Laren and G. Solon. 1990. The effects of family background and community background on economic status. *American Economic Review*, 80: 362-366.
- Corcoran, M., R. Gordon, D. Laren and G. Solon. 1989. The effects of family background and community background on economic status. National Bureau of Economic Research Working Paper No. 2896.
- Dos Reis, Jose and Ricardo Barros. 1991. Wage inequality and the distribution of education: a study of the evolution of regional differences in inequality in metropolitan Brazil. *Journal of Development Economics*, 36: 117-143.
- Dougherty, C. and E. Jimenez. 1991. The specification of earnings functions: tests and implications. *Economics of Education Review*, 10: 85-98.
- Featherman, D. and R. Hauser. 1978. *Opportunity and Change*. New York: Academic Press.
- Fields, G. 1977. Who benefits from economic development? A reexamination of Brazilian growth in the 1960's. *American Economic Review*, 67: 570-582.
- Fishlow, A. 1972. Brazilian size distribution of income. *American Economic Review*, 62: 391-402.
- Griliches, Z. 1977. Estimating the returns to schooling: some econometric problems. *Econometrica*, 45: 1-22.
- Griliches, Z.. 1979. Sibling models and data in economics: beginnings of a survey. *Journal of Political Economy*, 87: S37-S64.
- Griliches, Z. and W. Mason. 1972. Education, income and ability. *Journal of Political Economy*, 80: S74-S103.
- Griliches, Z., B. Hall and J. Hausman. 1978. Missing data and self-selection in large panels. *Annals de l'INSEE*, 30/31: 137-176.
- Haller, A and H. Saraiva. 1986. Income and education: Brazil, 1982. Mimeo, University of Wisconsin, Madison.
- Haller, A. and H. Saraiva. 1991. The Income Effects of Education in a Developing Country: Brazil- 1973 and 1982. Mimeo. Presented at 1991 meetings of the Population Association of America, Washington D.C. University of Wisconsin, Madison.
- Hauser, R. and W. Sewell. 1986. Family Effects in Simple Models of Education, Occupational Status and Earnings: Findings from the Wisconsin and Kalamazoo Studies. *Journal of Labor Economics*, 4: S83-S115.
- Heckman, James J.. 1974. Shadow Prices, Market Wages and Labor Supply. *Econometrica*, 42:679-694.
- Heckman, J.. 1979. Sample Selection Bias as Specification Error. *Econometrica*, 47:153-162.
- Heckman, J. and J. Hotz. 1986. The sources of inequality for males in Panama's labor market. *Journal of Human Resources*, 21.4:507-42.
- Heckman, J. and R. Robb. 1985. Alternative Methods for Evaluating the Impact of Interventions. In James Heckman and Burton Singer eds., *Longitudinal Analysis of Labor Market Data*. Cambridge: Cambridge University Press.
- Heckman, James and Guilherme Sedlacek. 1985. Heterogeneity Aggregation and Wage Functions: An Empirical Model of Self-Selection in the Labor Market. *Journal of Political Economy*, 93:1077-1125.
- Hungerford, Thomas and Gary Solon. 1987. Sheepskin Effects in the Returns to Education. *Review of Economics and Statistics*, 69: 175-177.

- King, Elizabeth and Rosemary Bellew. 1989. Gains in the education of Peruvian women in 1940's-1980's -- Patterns and explanations. Mimeo. PHR, World Bank.
- King, Elizabeth and Lee Lillard. 1987. Education policy and schooling attainment in Malaysia and the Philippines, *Economics of Education Review*, 6.2:167-81.
- Lam, David and Deborah Levison. 1991. Declining inequality in schooling in Brazil and its effects on inequality in earnings. *Journal of Development Economics*, forthcoming.
- Lam, David and Deborah Levison. 1991. Age, experience and schooling: Decomposing earnings inequality in the U.S. and Brazil. *Pesquisa e Planejamento Economico*, forthcoming.
- Lam, David and Robert Schoeni. 1990. Effects of family background on earnings and returns to schooling: Evidence from Brazil. Mimeo, University of Michigan.
- Langoni, Carlos. 1973. *Distribuicao de Renda e Desenvolvimento Economico do Brasil*. Rio de Janeiro: Editora Expressao e Cultura.
- Langoni, Carlos. 1977. Income Distribution and Economic Development: The Brazilian Case. in Michael Intriligator (ed.), *Frontiers of Quantitative Economics*, Volume B. Amsterdam: North Holland Press.
- Lee, Lung-Fei. 1983. Generalized econometric models with selectivity. *Econometrica*, 51: 507-512.
- Leibowitz, Arleen. 1974. Home Investments in Children. in T. W. Schultz (ed.), *Economics of the Family*. Chicago: University of Chicago Press.
- Medeiros, Jose. 1982. Alcance e Limitacoes de Teoria do Capital Humano: Diferencas de Ganhos no Brasil em 1973. Serie Ensaio Economicos, Volume 17, Instituto de Pesquisas Economicas, Sao Paulo.
- Olneck, Michael. 1979. The effects of education. In Christopher Jencks, et al. (eds.) *Who gets ahead?*, New York: Basic Books.
- Papanicolau, J. and George Psacharopoulos. 1979. Socioeconomic Background, Schooling and Monetary Rewards in the United Kingdom. *Economica*, 46: 435-439.
- Pastore, J. 1982. *Inequality and social mobility in Brazil*. Madison: University of Wisconsin Press.
- Pastore, J. and H. Zylberstajn. 1990. Social mobility in Brazil 1973-82: The role of education in status determination. Mimeo, University of Sao Paulo.
- Psacharopoulos, George. 1985. Returns to Education: A Further International Update and implications. *Journal of Human Resources*, 20: 583-604.
- Psacharopoulos, G. and Maureen Woodhall. 1985. *Education for Development: An Analysis of Investment Choices*. Oxford: Oxford University Press for the World Bank.
- Sahn, David and Harold Alderman. 1988. The Effects of Human Capital on Wages, and the Determinants of Labor Supply in a Developing Country. *Journal of Development Economics*, 29: 157-184.
- Saraiva, H, A. Pahari and A. Haller. 1986. Beyond credentialism: The productivity of ideology and the ideology of productivity. Mimeo, University of Wisconsin, Madison.
- Schultz, T. P.. 1988. Education Investments and Returns to Economic Development. in Hollis Chenery and T. N. Srinivasan (eds.), *Handbook of Development Economics*, Volume 1. Amsterdam : North Holland Press.

- Sedlacek, Guilherme and Ricardo Barros (eds.). 1989. *Mercado de Trabalho e Distribuicao de Renda: Uma Coletanea*. Instituto de Planejamento Economico e Social, Instituto de Pesquisas, Monografia No. 35, Rio de Janeiro.
- Solon, G. 1989a. Intergenerational income mobility in the United States. Institute for Research on Poverty Discussion Paper No. 894-89, University of Wisconsin.
- Solon, G. 1989b. Biases in the estimation of intergenerational earnings correlations. *Review of Economics and Statistics*, 71: 172-174.
- Solon, G., M. Corcoran, R. Gordon and D. Laren. 1991. A longitudinal analysis of sibling correlations in economic status. *Journal of Human Resources*, 26: 509-534.
- Stelcner, Morton, Ana-Maria Arriagada and Peter Moock. 1987. Wage Determinants and School Attainment Among Men in Peru. Living Standards Measurement Study Working Paper No. 38. Washington D.C.: World Bank.
- Tannen, M. 1991. New Estimates of the Returns to Schooling in Brazil. *Economics of Education Review*, 10: 123-135.
- Tinbergen, Jan. 1951. Remarks on the Distribution of Labor Incomes. *International Economic Papers*, 1:195-207.
- Willis, Robert. 1986. Wage Determinants: a Survey and Reinterpretation of Human Capital Earnings Functions. In Orley Ashenfelter and Richard Layard eds. *Handbook of Labor Economics*, Volume 1. Amsterdam; North Holland Press.
- Willis, Robert and Sherwin Rosen. 1979. Education and Self-Selection. *Journal of Political Economy*, 87: S7-S36.

Figure 1
Distribution for Years of Completed Schooling: By Region

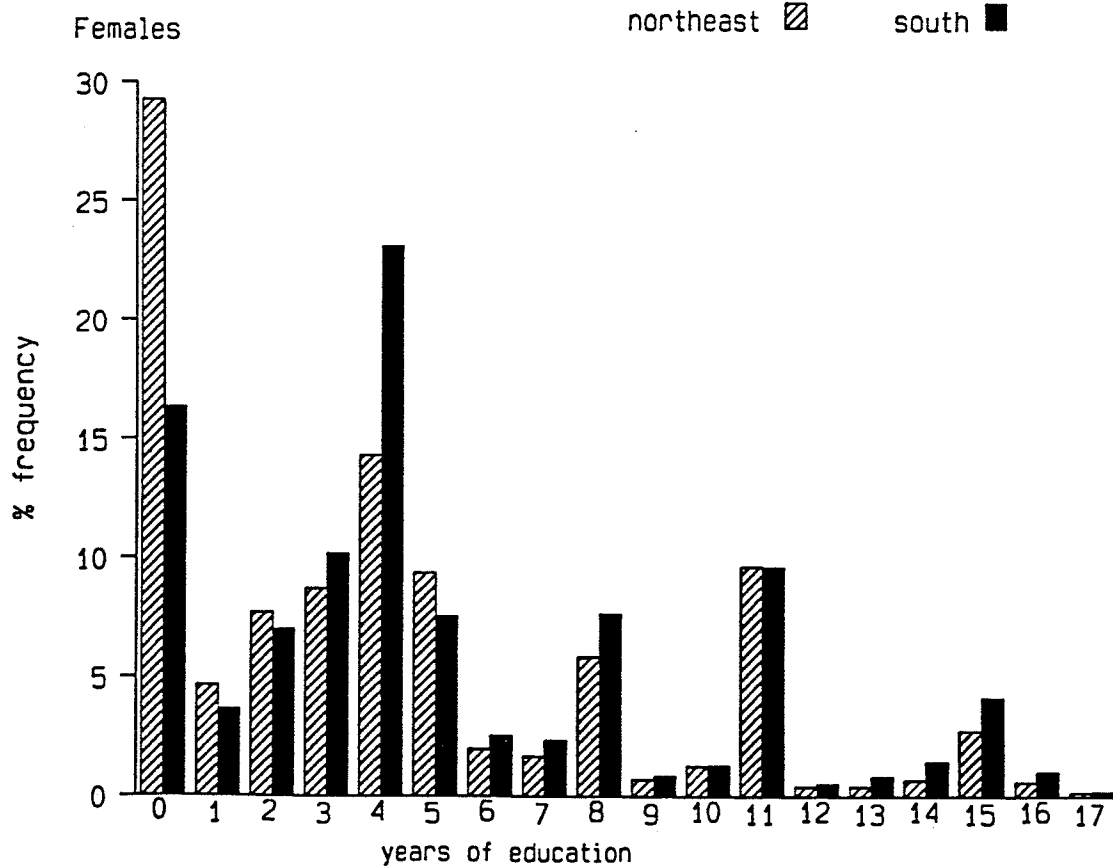
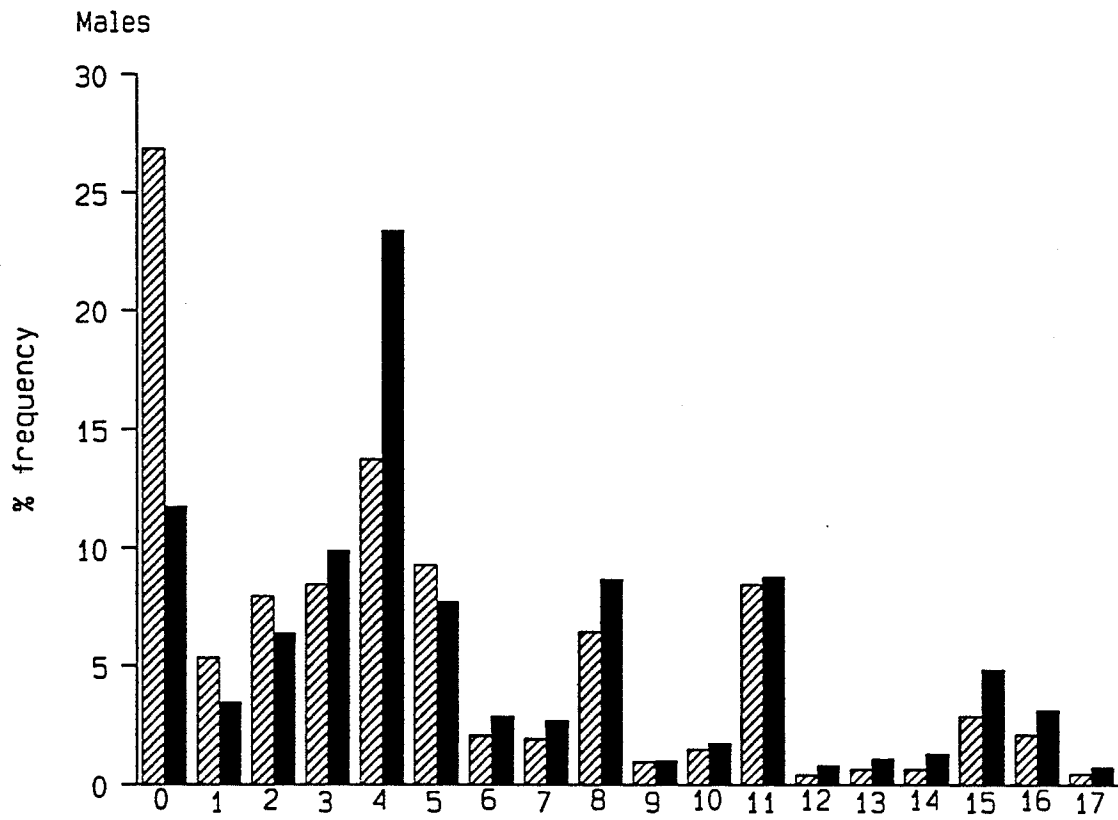
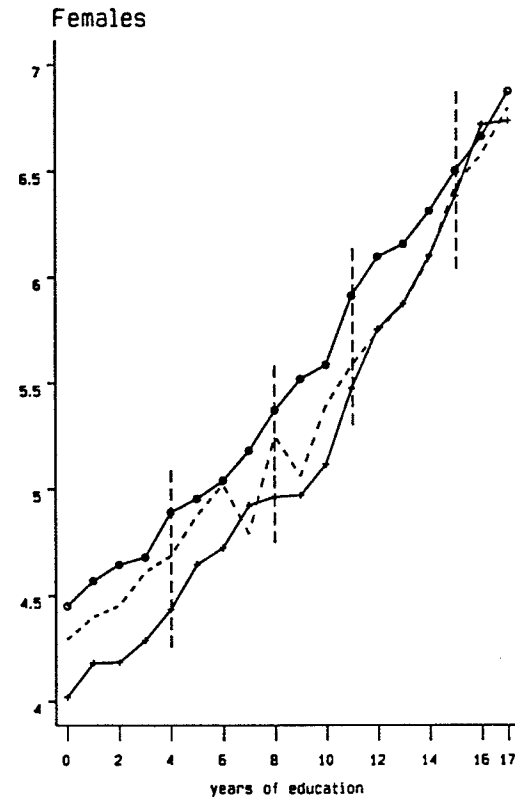
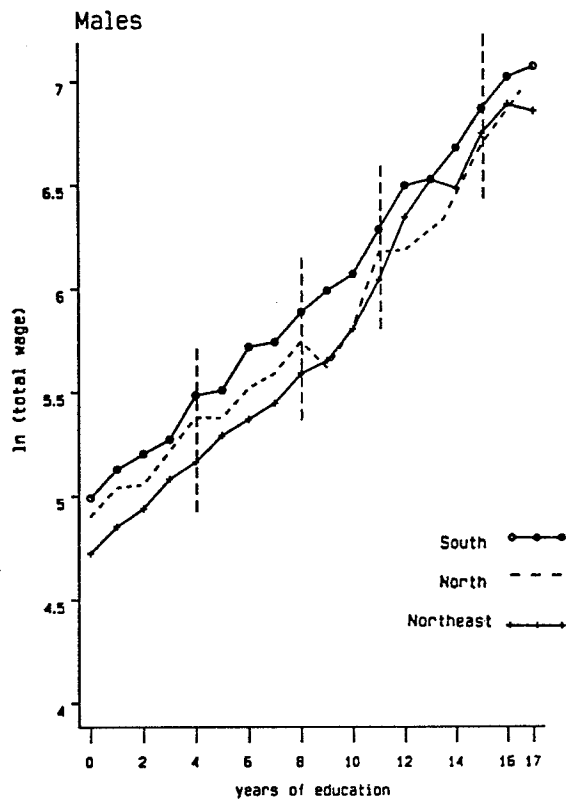


Figure 2
Returns to Education: In (total wage)

(a) by region



(b) by gender

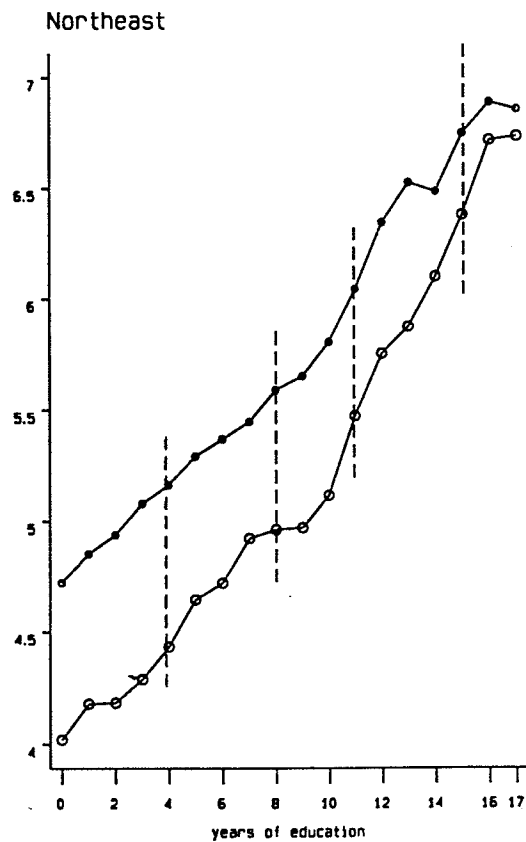
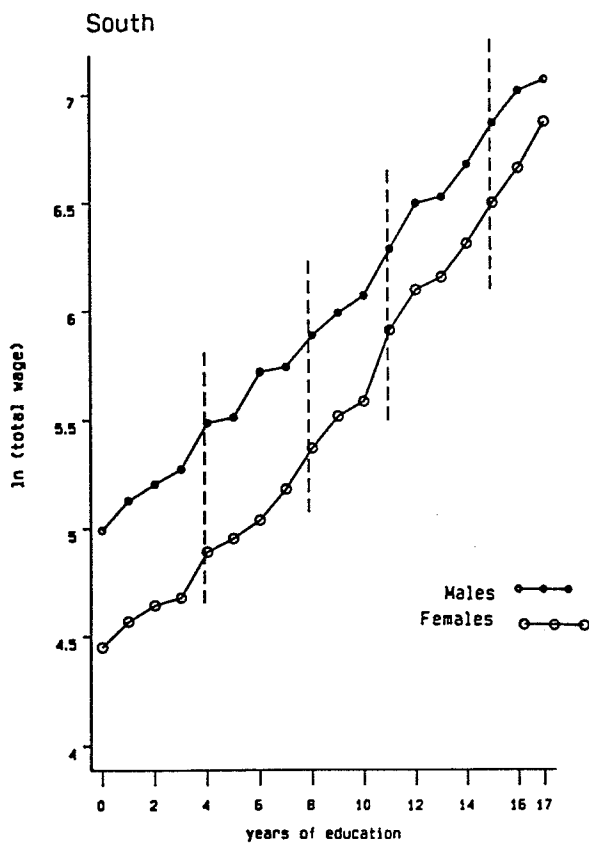
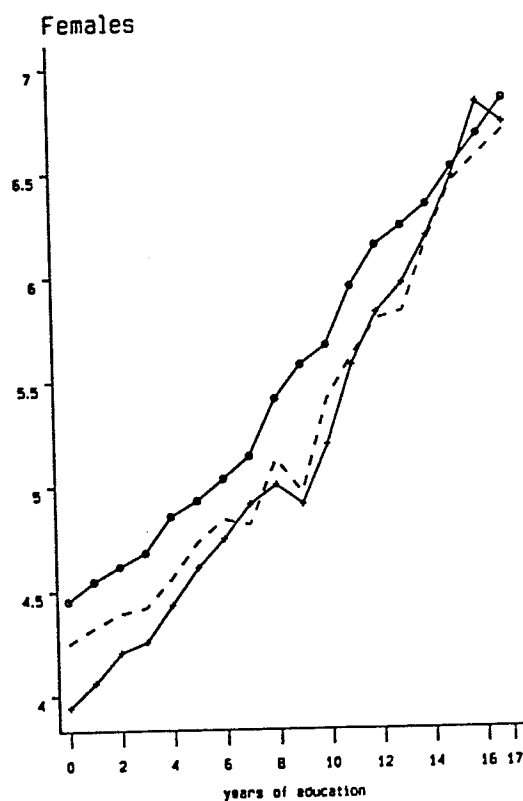
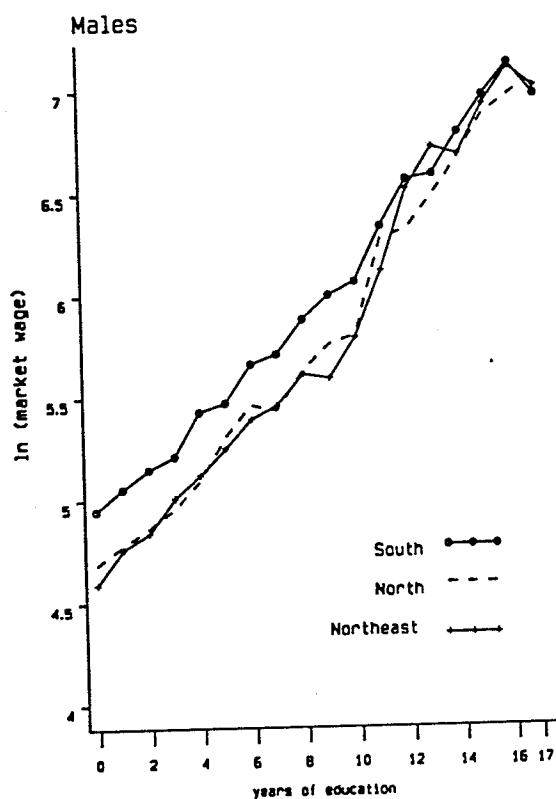


Figure 3
Returns to Education: In (market wage)

(a) by region



(b) by gender

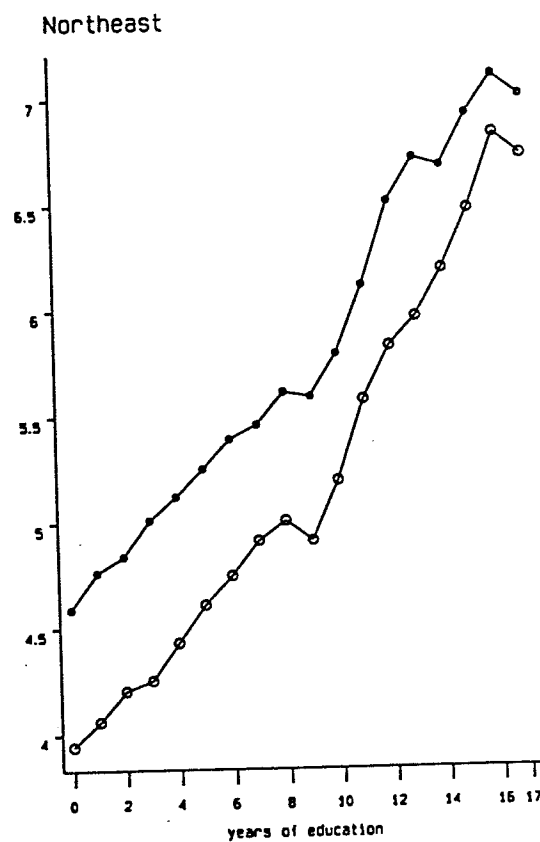
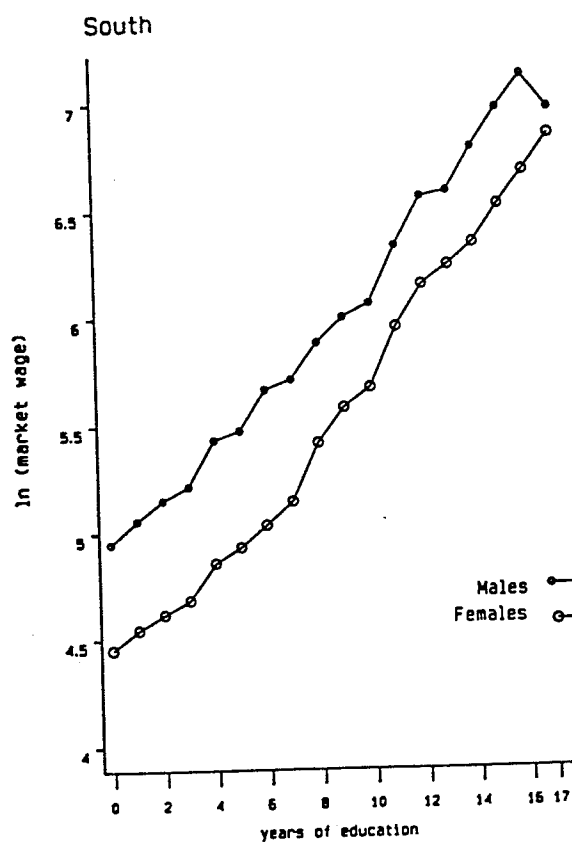
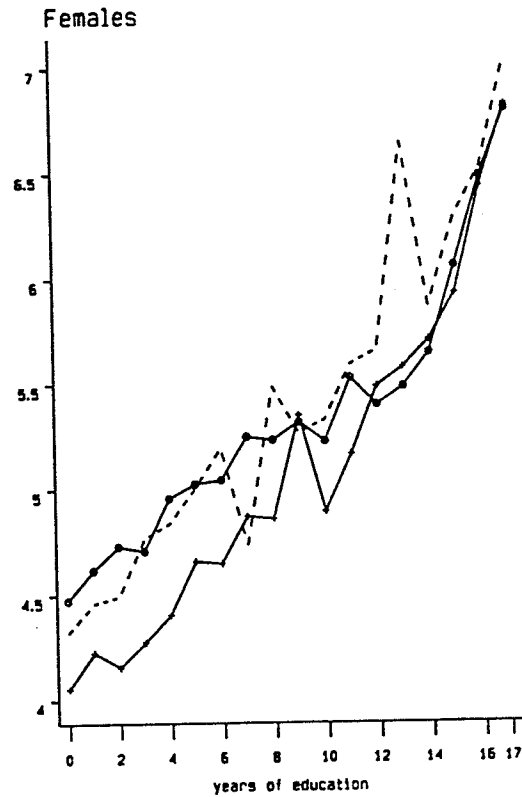
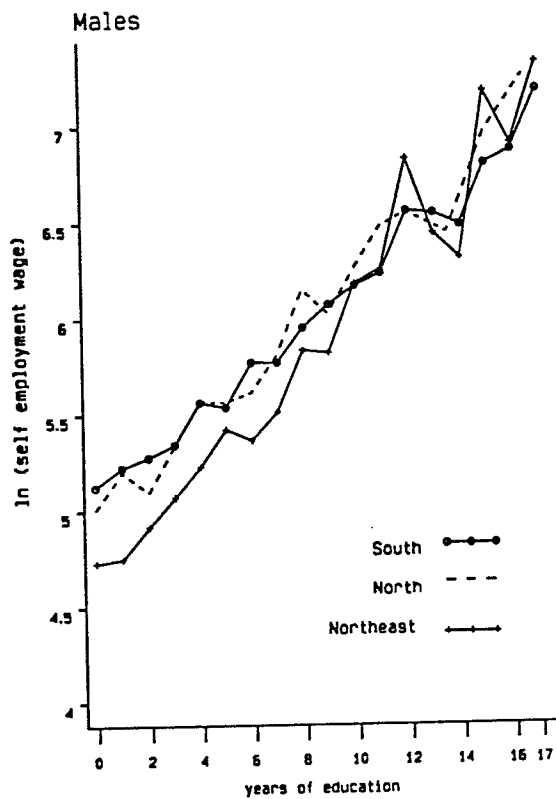


Figure 4
Returns to Education: In (self employment wage)

(a) by region



(b) by gender

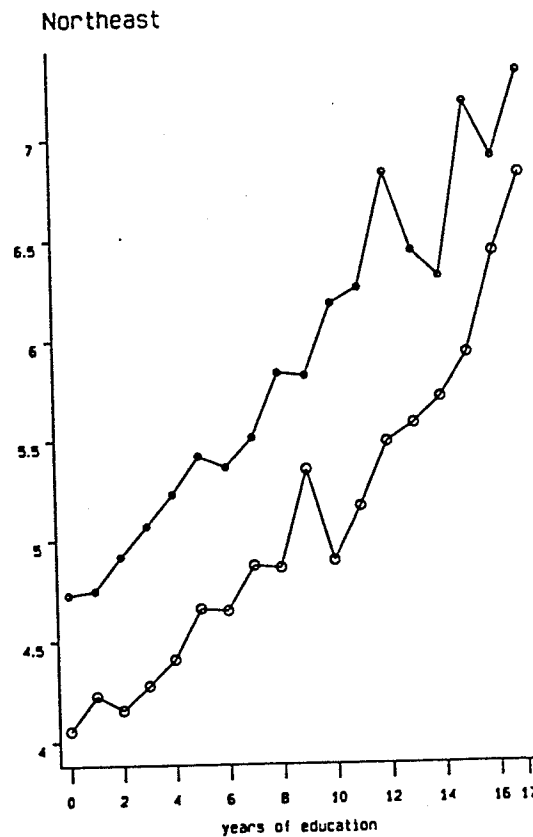
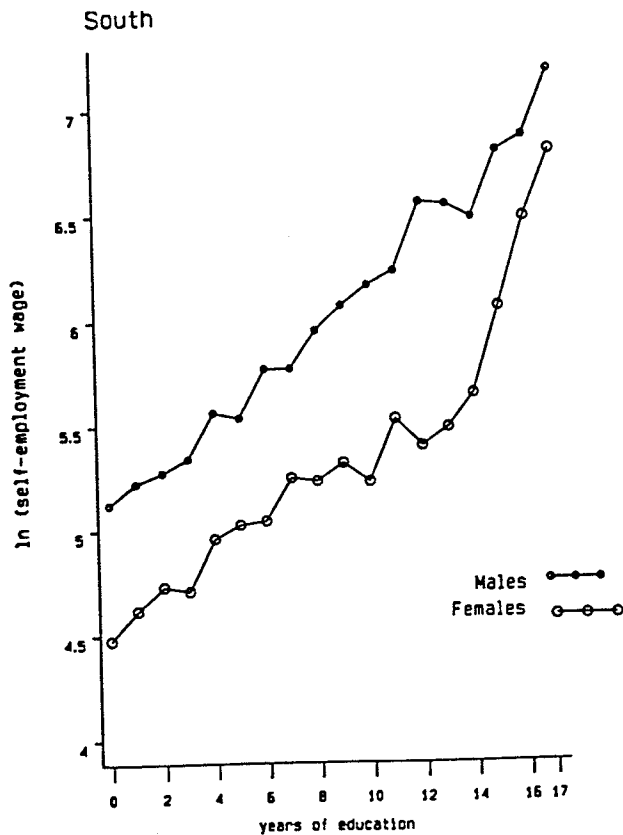
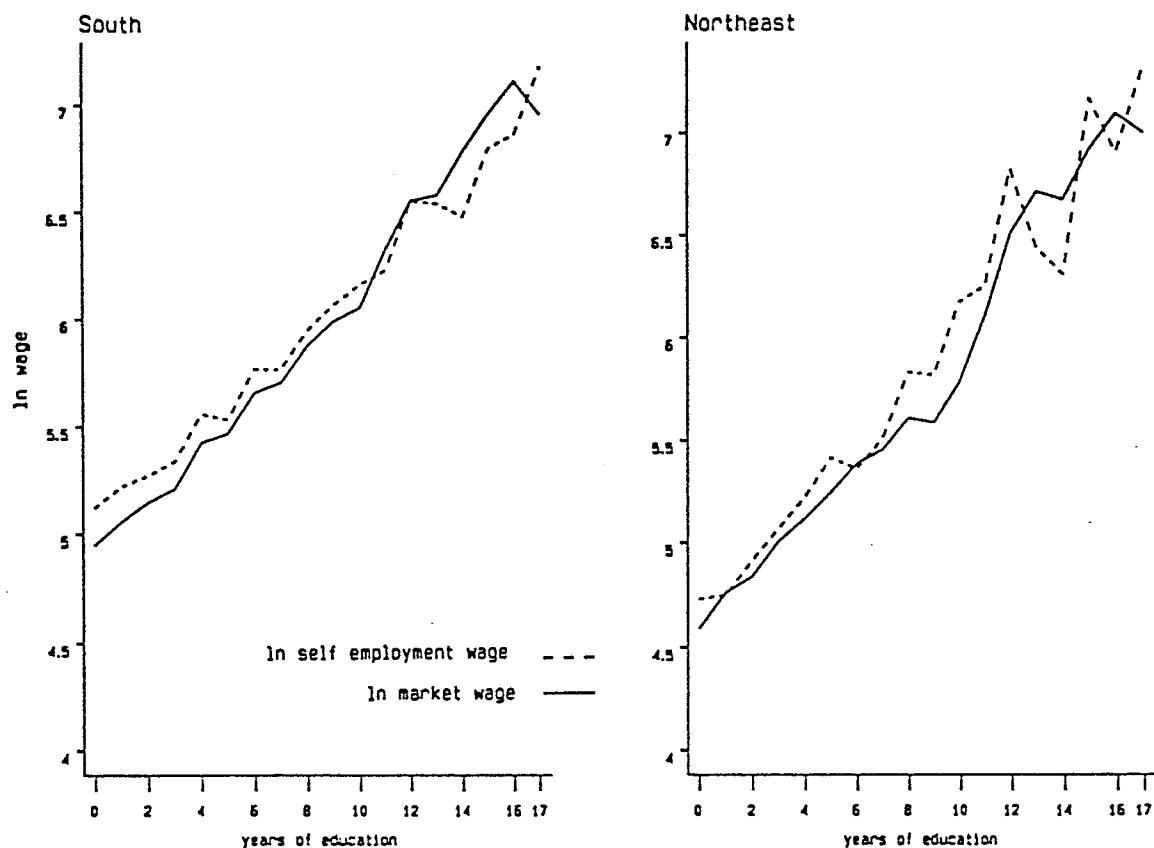


Figure 5
Comparison of Returns to Education in market and self-employment sectors

Males



Females

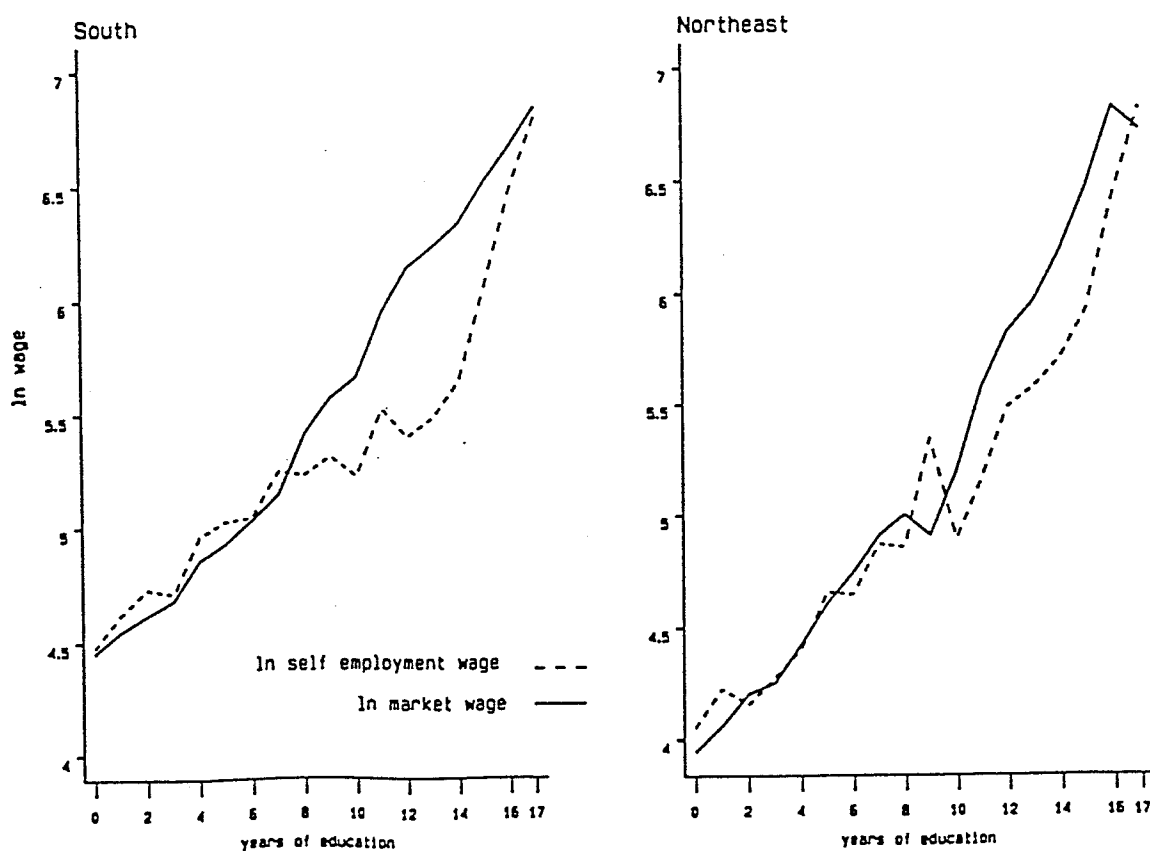
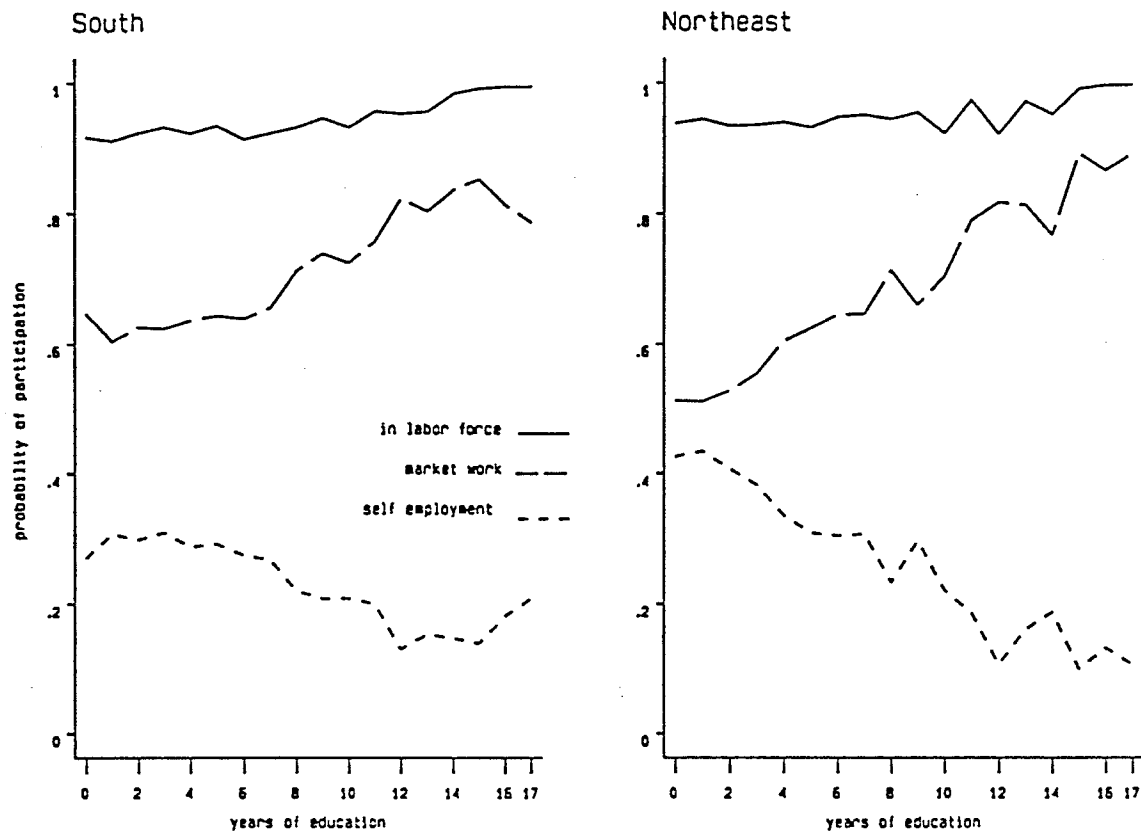


Figure 6
Probability of Labor Force Participation

Males



Females

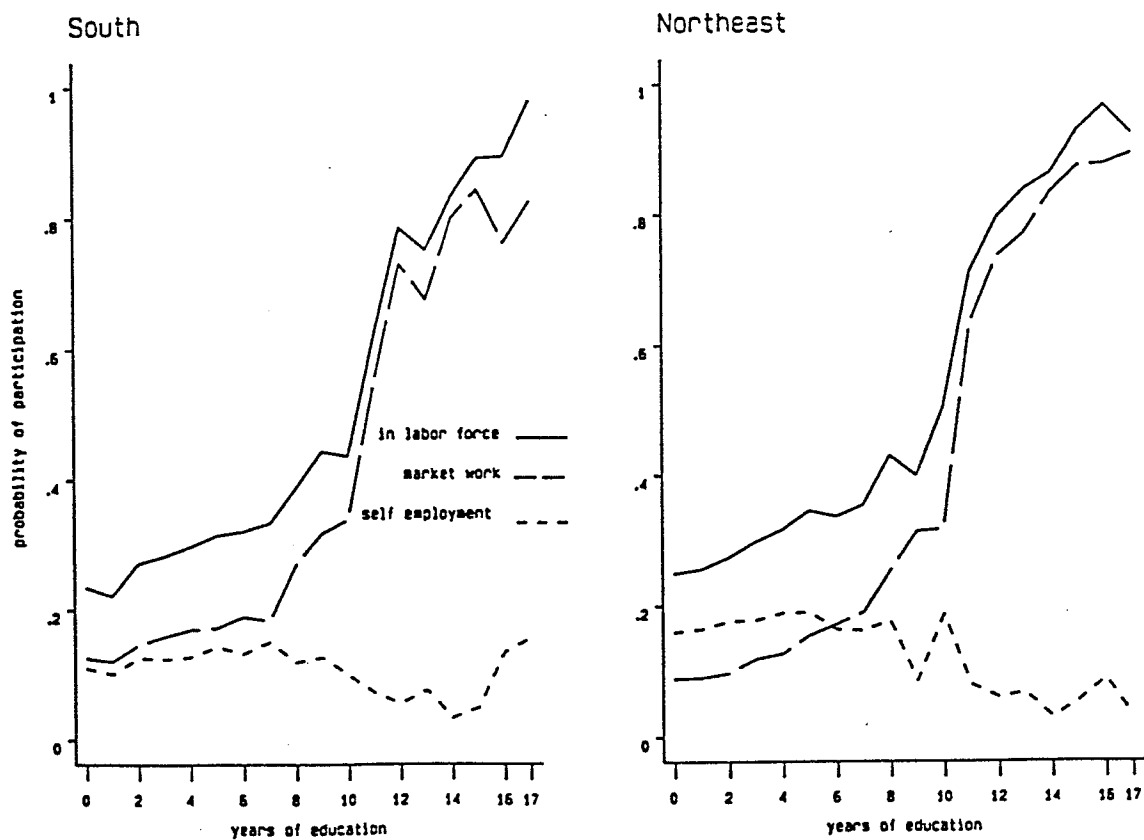
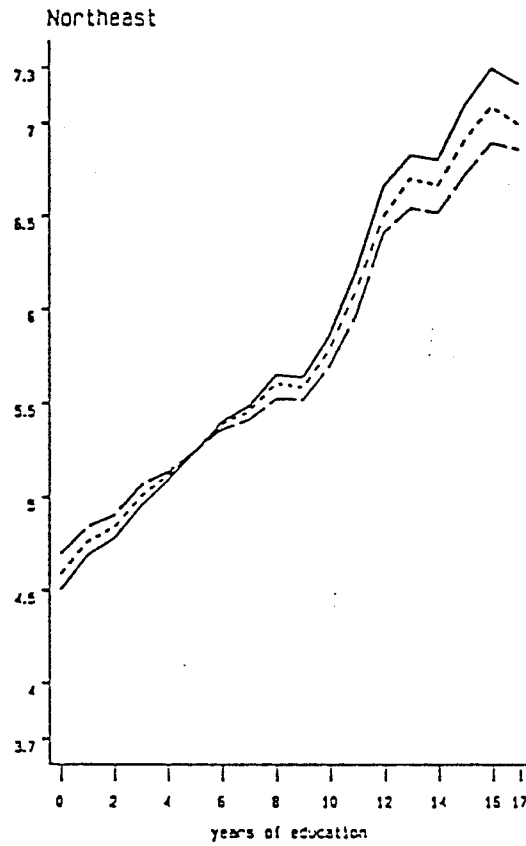
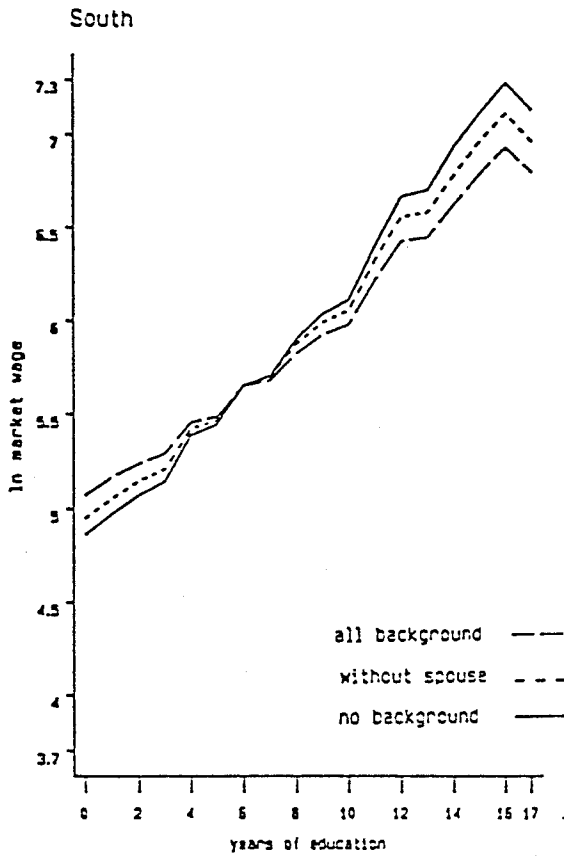


Figure 7
Returns to Education: Effect of Controlling for Background
(In market wage)

Males



Females

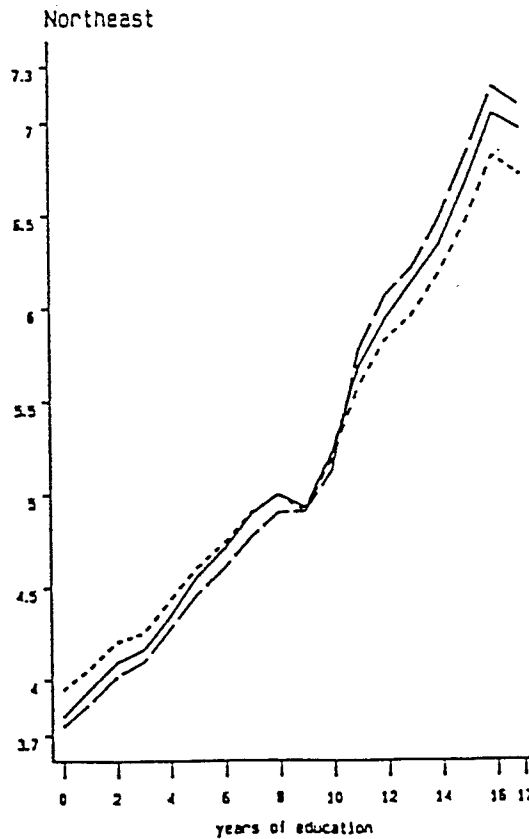
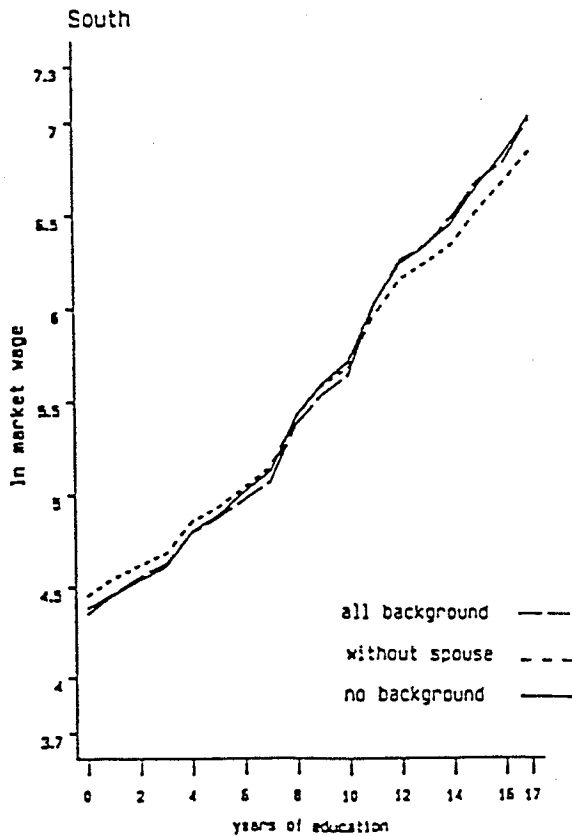
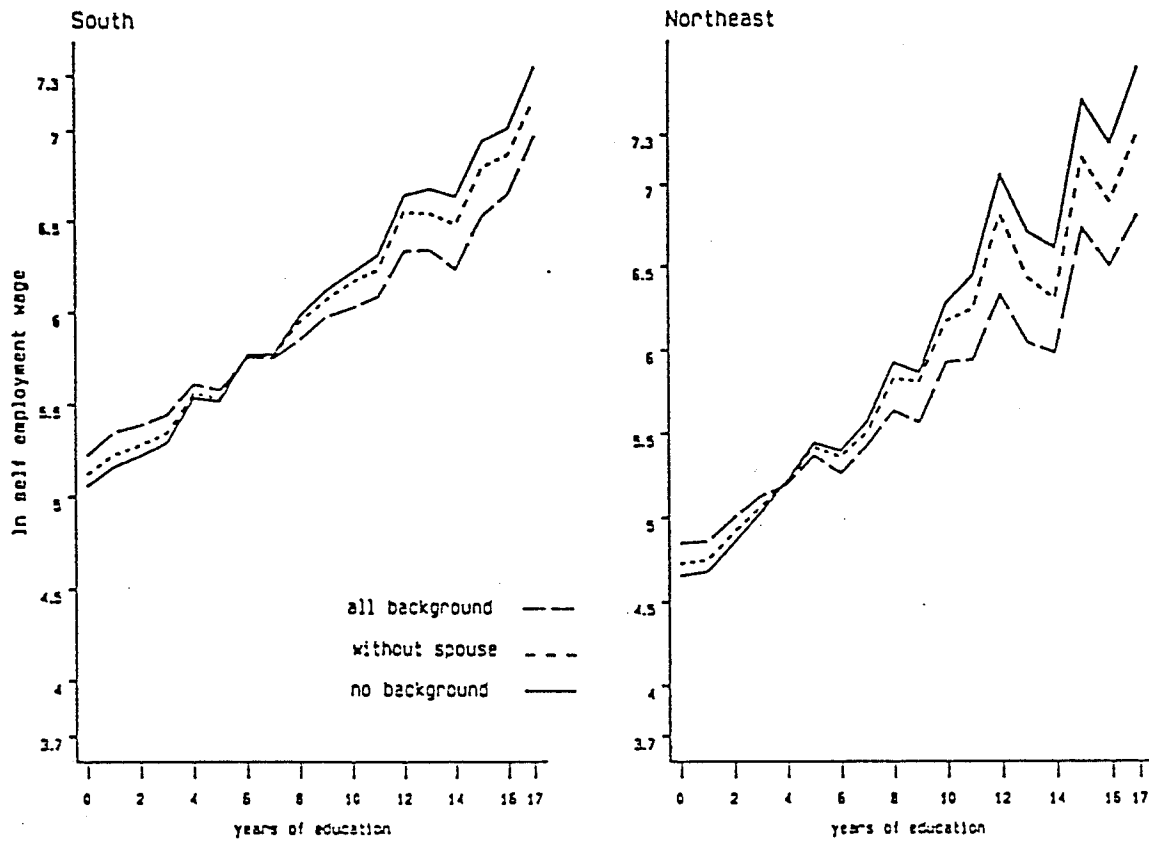


Figure 8
Returns to Education: Effect of Controlling for Background
(In self employment wage)

Males



Females

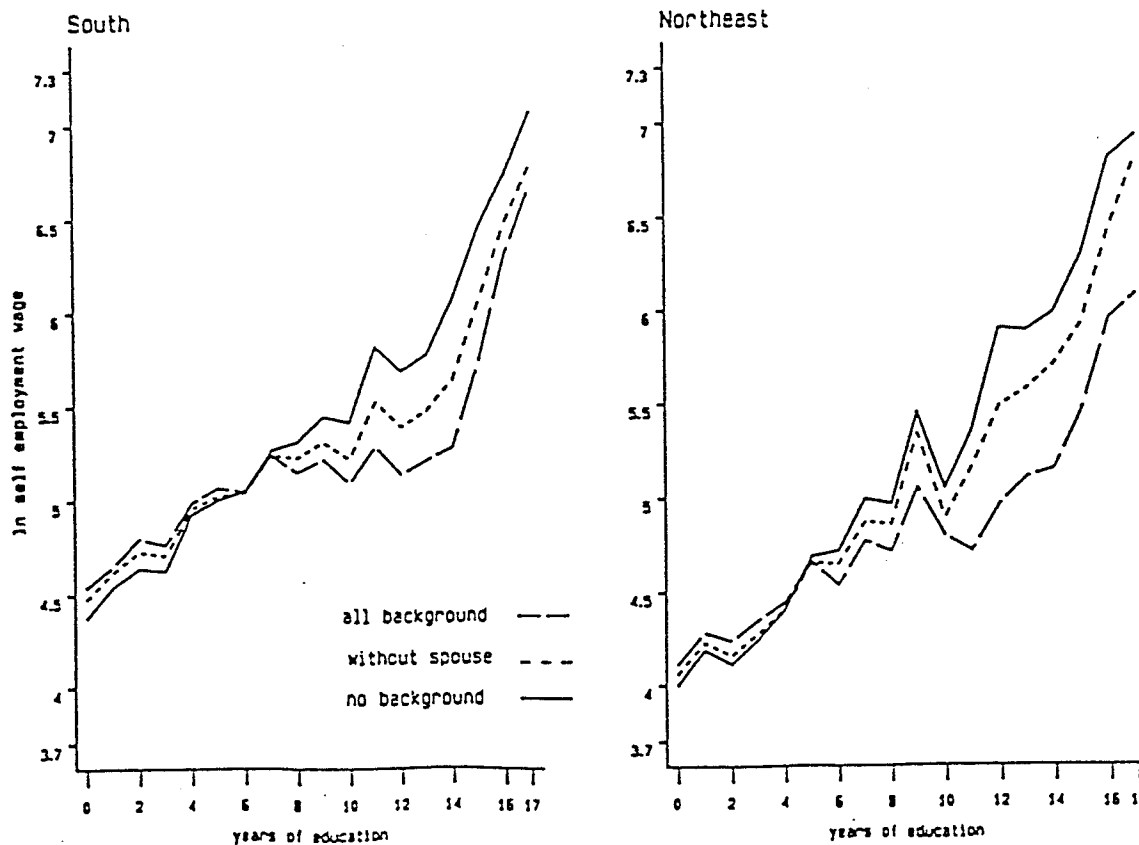
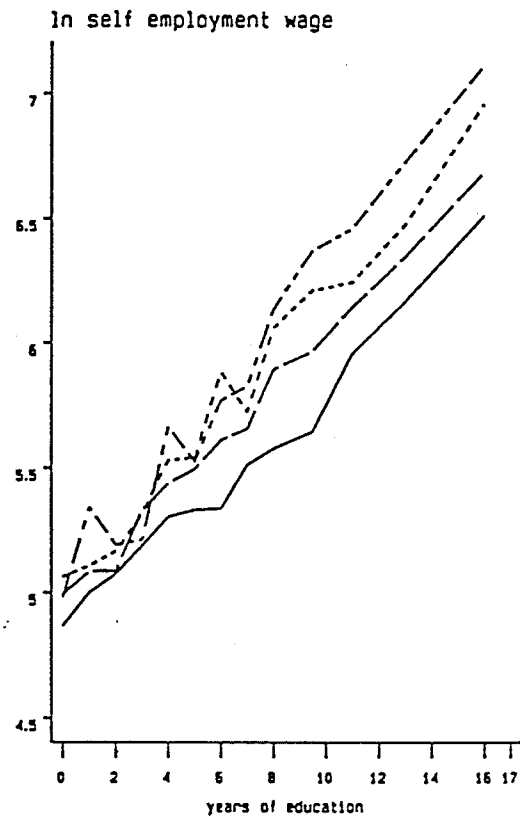
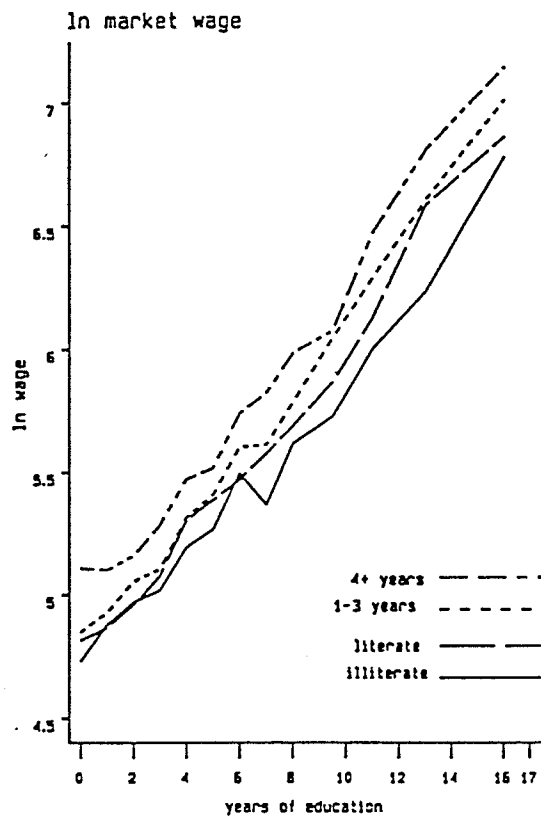


Figure 9
Returns to Education (all Brazil): Effect of Controlling for Father's Education

Males



Females

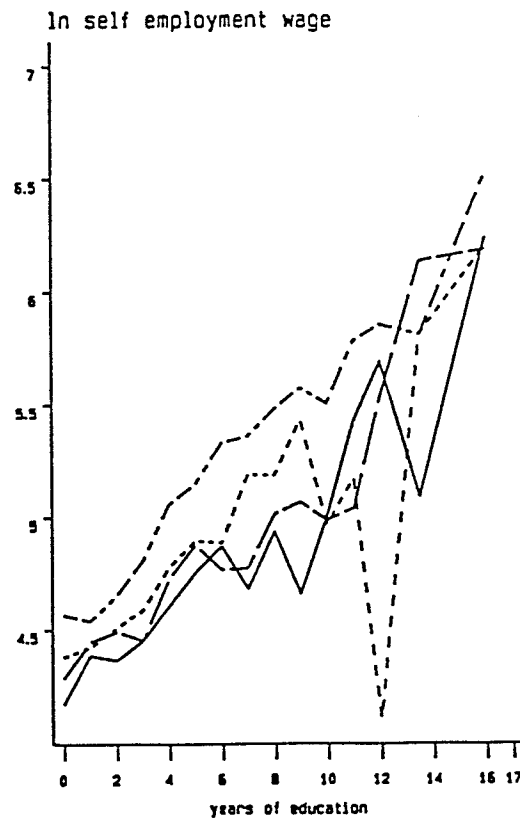
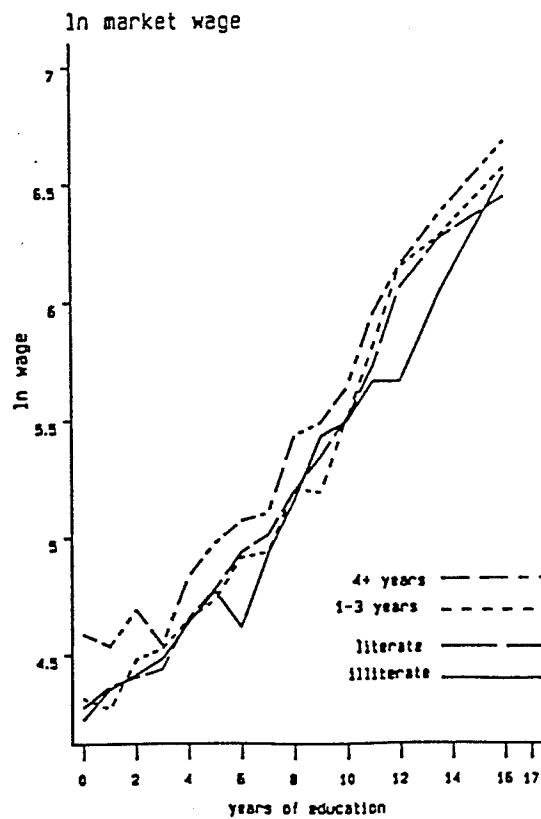


Figure 10
Distribution for Years of Completed Schooling: Northeast, By Age-Cohort

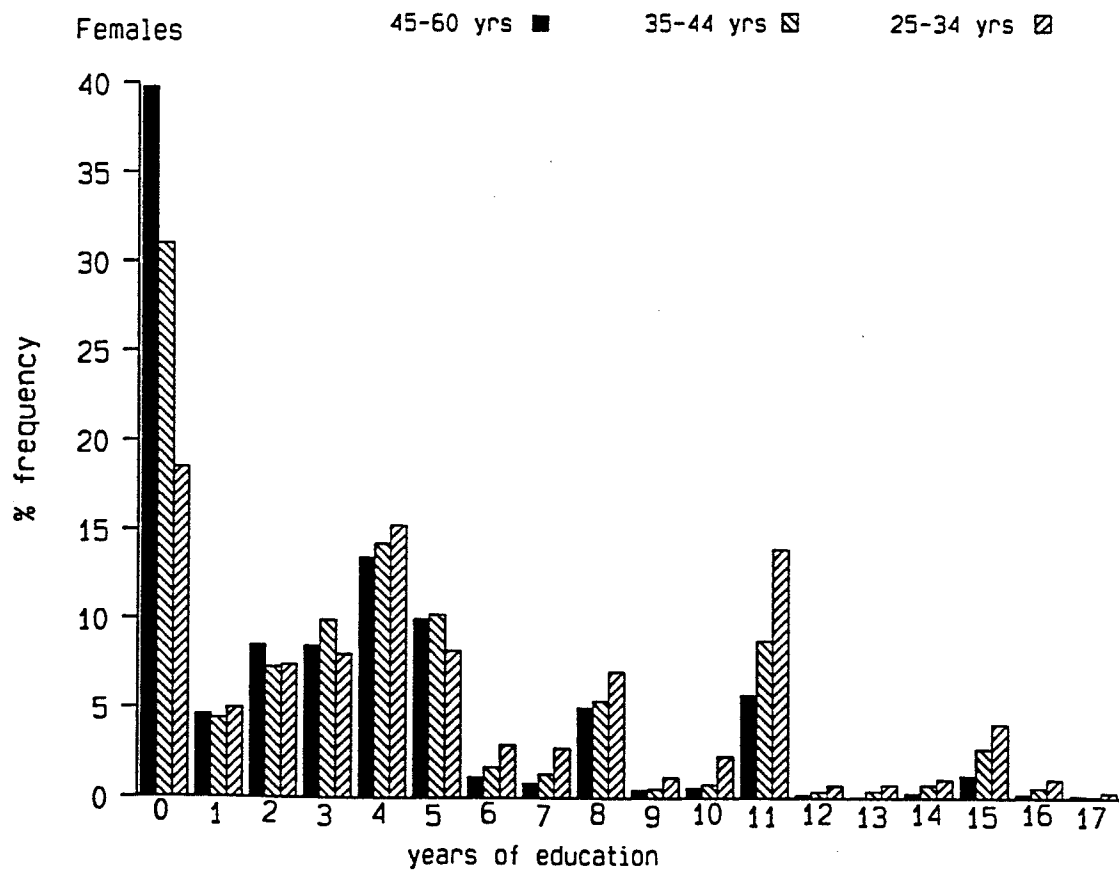
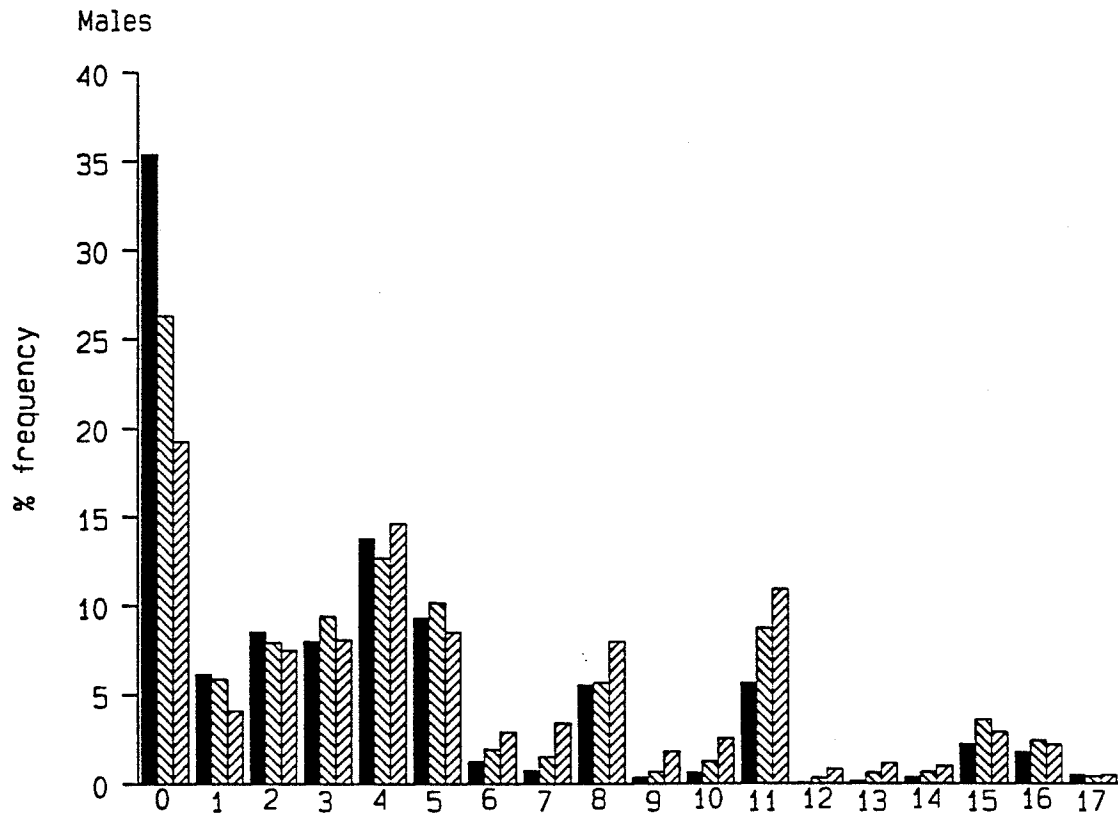
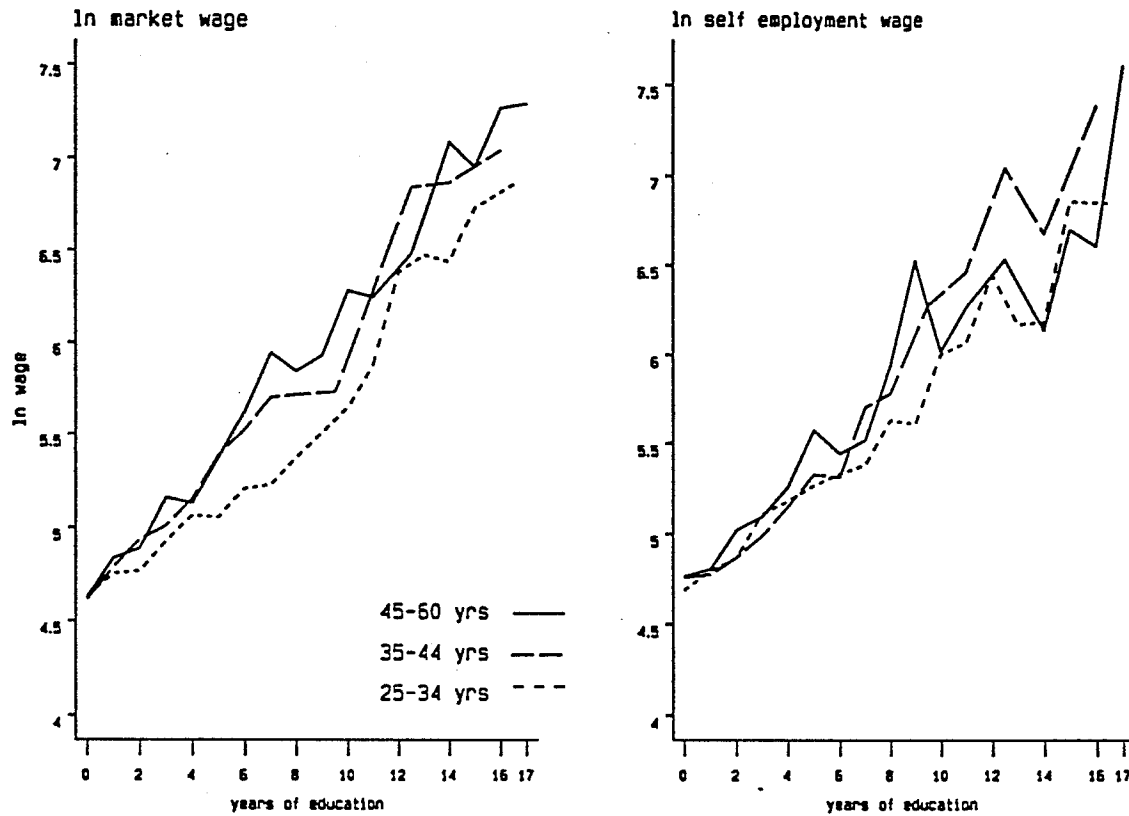


Figure 11
Returns to Education: Northeast, By Age-Cohort

Males



Females

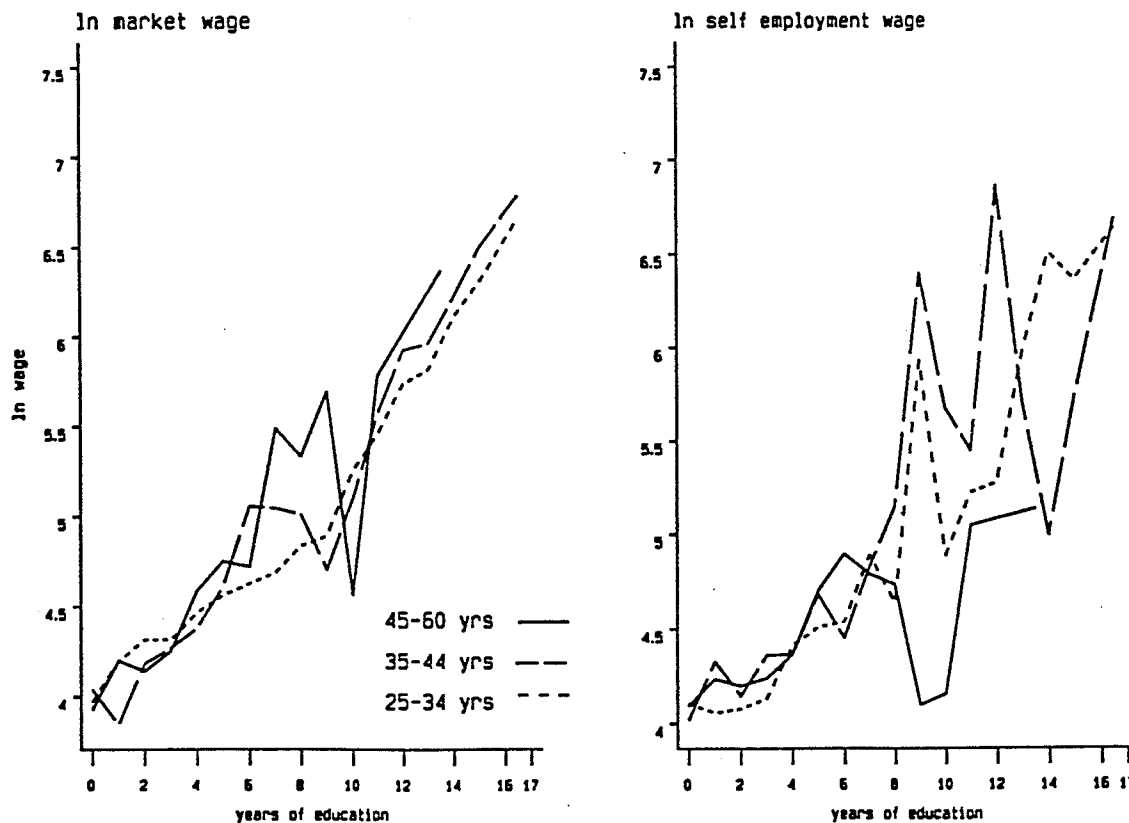
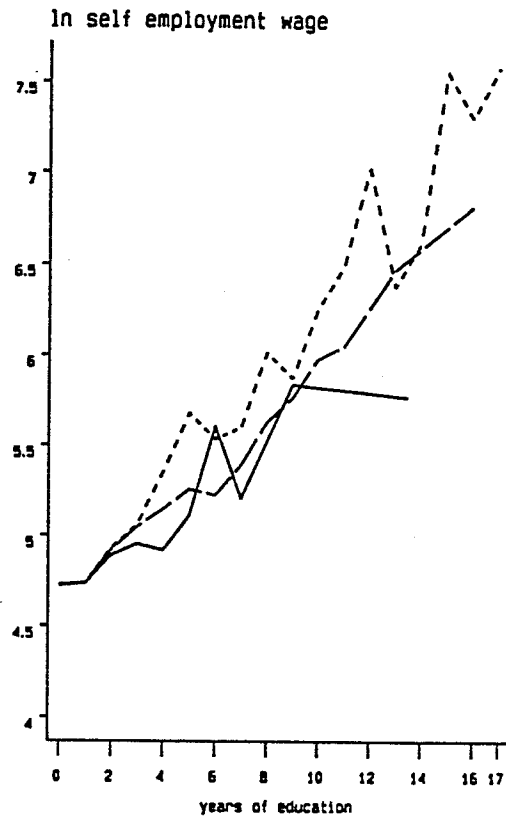
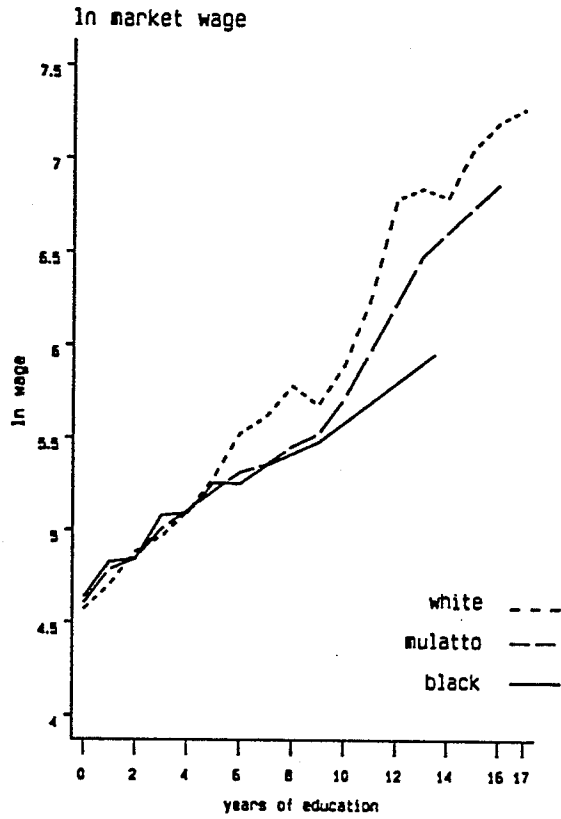


Figure 12
Returns to Education: Northeast, By Race

Males



Females

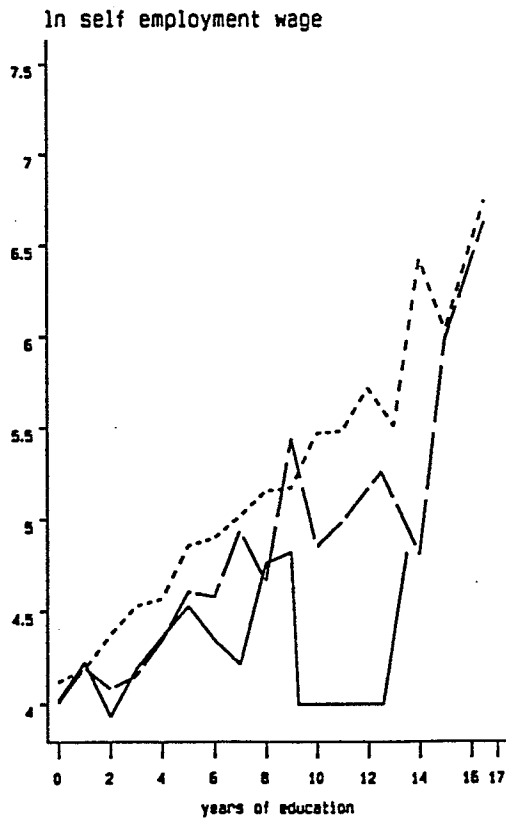
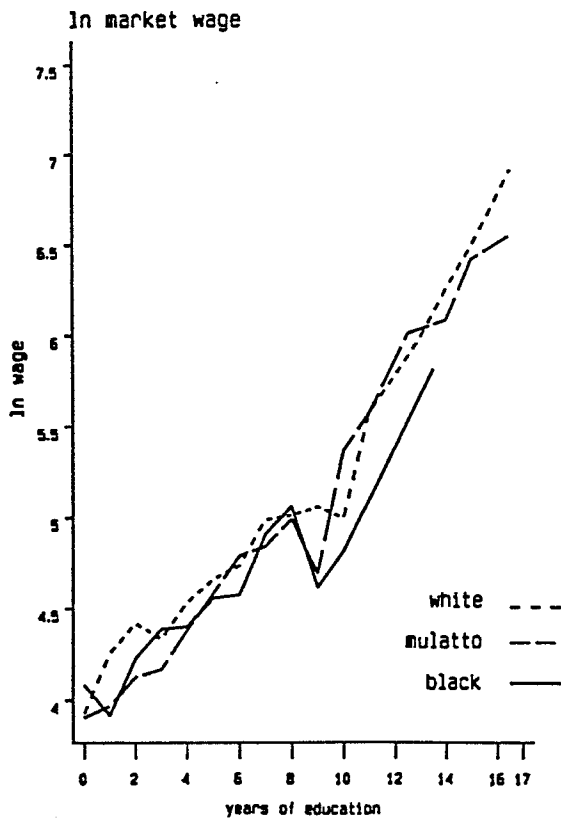


Table 1
Marginal Effects of Completed Education on
on Log-Wages: By Level of Schooling

	Men		Women	
	South	Northeast	South	Northeast
Total Wage:				
1st half primary (0-4 yrs)	12.4	11.0	11.0	10.4
2nd half primary (4-8 yrs)	10.0	10.7	12.0	13.2
Secondary (8-11 yrs)	13.3	15.1	18.1	17.1
Post-secondary (11-17 yrs)	13.1	16.1	13.6	21.0
Market Wage:				
1st half primary (0-4 yrs)	12.0	13.2	10.0	12.1
2nd half primary (4-8 yrs)	11.3	12.3	14.0	14.3
Secondary (8-11 yrs)	15.0	16.7	17.9	19.0
Post-secondary (11-17 yrs)	10.6	14.8	14.9	19.2
Self-employment wage:				
1st half primary (0-4 yrs)	11.0	12.4	12.0	8.8
2nd half primary (4-8 yrs)	9.8	15.2	6.8	11.5
Secondary (8-11 yrs)	9.3	14.1	9.8	10.1
Post-secondary (11-17 yrs)	15.8	17.8	21.2	27.6

Note: From semi-parametric regressions, with dummy for each year of completed education, underlying Figures 1-4. Numbers are mean returns to schooling within the specified level.

Appendix Table 1
Education and Wages of Urban Brazilians

	South		North		Northeast	
	Males	Females	Males	Females	Males	Females
#25-60 year old household heads and spouses	37,299	39,035	9,149	9,373	12,239	13,679
% with:						
0 years education	11.5	16.1	17.6	21.9	26.7	29.2
1-3 yrs education	19.7	20.7	25.4	25.4	21.8	21.1
4-8 yrs education	45.3	43.2	37.8	36.0	33.4	33.1
≥ 9 yrs education	11.5	11.7	11.5	11.9	10.9	11.6
12+ yrs education	12.0	8.3	7.7	4.6	7.3	5.1
% participating on job	90.3	38.0	94.1	36.7	90.9	38.5
for market wage	65.9	26.4	55.4	21.8	59.1	21.1
for self-employment	24.5	11.6	38.7	12.7	31.8	17.4
Mean log total wage of participants (standard deviation)	5.69 (0.94)	5.23 (0.99)	5.45 (0.90)	4.93 (0.95)	5.27 (0.96)	4.69 (1.09)
Mean log market wage of participants (standard deviation)	5.69 (0.94)	5.34 (0.98)	5.37 (0.89)	5.02 (0.92)	5.30 (0.97)	4.96 (1.08)
Log self-employment wage of participants (standard deviation)	5.70 (0.93)	4.96 (0.97)	5.54 (0.92)	4.78 (0.97)	5.19 (0.95)	4.37 (1.00)

Appendix Table 2A
Male Log-Wage Functions: Total, Market and Self-Employment

	Total Wage			Market Wage			Self-Employment		
	South	Co-efficients	A	South	Co-efficients	A	South	Co-efficients	A
Own Education:									
1 yr	.137 [.022]			.107 [.025]			.100 [.050]		
2 yrs	.211 [.018]	.074 [.024]		.200 [.020]	.094 [.027]		.152 [.041]	.052 [.053]	.186 [.074]
3 yrs	.280 [.016]	.069 [.018]		.264 [.018]	.063 [.021]		.218 [.037]	.067 [.040]	.339 [.055]
4 yrs	.494 [.014]	.214 [.013]		.478 [.015]	.215 [.016]		.438 [.032]	.220 [.029]	.496 [.051]
5 yrs	.519 [.018]	.025 [.015]		.521 [.020]	.043 [.018]		.412 [.040]	.027 [.033]	.888 [.062]
6 yrs	.727 [.024]	.208 [.024]		.711 [.027]	.190 [.028]		.647 [.055]	.236 [.054]	.632 [.113]
7 yrs	.750 [.024]	.023 [.029]		.759 [.028]	.048 [.034]		.647 [.056]	.001 [.066]	.779 [.150]
8 yrs	.895 [.017]	.145 [.024]		.929 [.019]	.171 [.027]		.829 [.041]	.182 [.056]	1.102 [.126]
9 yrs	.998 [.037]	.103 [.036]		1.045 [.040]	.116 [.040]		.948 [.093]	.120 [.092]	1.089 [.166]
10 yrs	1.079 [.029]	.081 [.043]		1.110 [.032]	.065 [.047]		1.043 [.071]	.095 [.109]	1.449 [.203]
11 yrs	1.295 [.018]	.216 [.028]		1.379 [.020]	.269 [.031]		1.109 [.042]	.066 [.070]	1.525 [.145]
12 yrs	1.506 [.041]	.211 [.040]		1.608 [.044]	.230 [.043]		1.433 [.120]	.324 [.119]	2.096 [.323]
13 yrs	1.536 [.036]	.030 [.050]		1.632 [.039]	.024 [.054]		1.421 [.096]	.011 [.147]	1.708 [.383]
14 yrs	1.687 [.033]	.151 [.044]		1.835 [.037]	.203 [.048]		1.360 [.087]	.061 [.120]	1.580 [.287]
15 yrs	1.879 [.022]	.191 [.033]		2.015 [.036]	.180 [.036]		1.676 [.096]	.315 [.089]	2.443 [.223]
16 yrs	2.028 [.025]	.150 [.024]		2.167 [.028]	.152 [.028]		1.745 [.056]	.069 [.060]	2.172 [.156]
17 yrs	2.079 [.042]	.050 [.044]		2.013 [.049]	.154 [.051]		2.057 [.093]	.311 [.096]	2.594 [.273]

NOTE: Estimates and standard errors from OLS regressions with selectivity correction computed using Lee's (1983) algorithm from multinomial logit equations. Standard errors are corrected for using an estimated regressor. State dummy variables are also included in the regressors, but are suppressed here.

Appendix Table 2A (continued)
Male Log-Wage Functions: Total, Market and Self-Employment

	Total Wage		Market Wage		Self-Employment	
	South	Northeast	South	Northeast	South	Northeast
Selection coefficient	-.048 [.027]	-.049 [.045]	.256 [.030]	.404 [.058]	-.494 [.053]	-.964 [.111]
Father's education: Literate	.037 [.013]	.018 [.020]	.035 [.015]	.008 [.026]	-.011 [.030]	-.036 [.045]
1-3 yrs	.053 [.012]	.080 [.024]	.047 [.014]	.071 [.030]	.012 [.029]	.081 [.056]
4-8 yrs	.113 [.014]	.189 [.030]	.118 [.016]	.140 [.037]	.073 [.033]	.254 [.071]
9+ yrs	.194 [.022]	.360 [.046]	.188 [.025]	.293 [.054]	.177 [.050]	.535 [.118]
Mother's education: Literate	.083 [.013]	.078 [.021]	.055 [.015]	.030 [.026]	.110 [.030]	.083 [.046]
1-3 yrs	.102 [.012]	.118 [.024]	.073 [.014]	.106 [.030]	.094 [.028]	.075 [.057]
4-8 yrs	.180 [.014]	.186 [.031]	.151 [.016]	.192 [.037]	.137 [.032]	.118 [.073]
9+ yrs	.315 [.024]	.245 [.051]	.274 [.027]	.146 [.060]	.312 [.056]	.140 [.133]
Father's educ. missing	.034 [.016]	-.010 [.027]	.049 [.018]	.011 [.033]	.033 [.038]	.025 [.063]
Mother's educ. missing	.044 [.017]	.089 [.029]	.032 [.019]	.097 [.036]	.090 [.041]	.059 [.066]
Age	.078 [.004]	.071 [.006]	.084 [.004]	.073 [.007]	.038 [.009]	-.010 [.016]
Age squared	-.001 [.000]	-.001 [.000]	-.001 [.000]	-.001 [.000]	-.000 [.000]	-.000 [.000]
White/Asian	.126 [.009]	.103 [.014]	.081 [.011]	.043 [.018]	.129 [.024]	-.006 [.035]
Black	-.060 [.016]	-.025 [.022]	-.057 [.017]	.028 [.027]	-.003 [.041]	.094 [.056]
Constant	3.009 [.071]	3.144 [.122]	2.873 [.077]	2.897 [.144]	4.665 [.229]	6.018 [.403]
R ²	0.53	0.54	0.59	0.62	0.40	0.42
Sample Size	33,553	11,093	24,447	7,216	9,103	3,872

Appendix Table 2B
Female Log-Wage Functions: Total, Market and Self-Employment

	Total Wage			Market Wage			Self-Employment Wage		
	South	Co-efficients	Δ Co-efficients	South	Co-efficients	Δ Co-efficients	South	Co-efficients	Δ Co-efficients
Own Education:									
1 yr	.119 [.035]								
2 yrs	.193 [.026]	.074 [.038]	.005 [.067]	.093 [.039]	.163 [.046]	.071 [.043]	.141 [.070]	.172 [.083]	.070 [.097]
3 yrs	.229 [.023]	.036 [.027]	.104 [.055]	.228 [.026]	.308 [.056]	.065 [.031]	.233 [.047]	.221 [.064]	.120 [.081]
4 yrs	.440 [.020]	.212 [.021]	.146 [.047]	.401 [.022]	.484 [.049]	.173 [.024]	.481 [.041]	.350 [.057]	.129 [.072]
5 yrs	.504 [.026]	.063 [.024]	.211 [.046]	.475 [.029]	.663 [.055]	.074 [.027]	.547 [.053]	.603 [.066]	.253 [.071]
6 yrs	.589 [.040]	.085 [.041]	.077 [.089]	.578 [.044]	.799 [.100]	.103 [.046]	.566 [.082]	.593 [.145]	.010 [.149]
7 yrs	.731 [.041]	.142 [.051]	.200 [.118]	.688 [.047]	.963 [.105]	.110 [.059]	.769 [.083]	.815 [.158]	.222 [.204]
8 yrs	.920 [.027]	.189 [.042]	.039 [.097]	.960 [.029]	1.056 [.063]	.273 [.048]	.753 [.059]	.802 [.092]	.013 [.169]
9 yrs	1.068 [.059]	.148 [.059]	.009 [.140]	1.123 [.061]	.963 [.136]	.162 [.061]	.838 [.139]	1.292 [.329]	.489 [.334]
10 yrs	1.136 [.049]	.068 [.072]	.146 [.160]	1.216 [.050]	1.246 [.162]	.093 [.073]	.748 [.127]	.836 [.174]	.455 [.363]
11 yrs	1.462 [.026]	.326 [.048]	.357 [.094]	1.496 [.029]	1.627 [.060]	.281 [.048]	1.048 [.073]	1.106 [.115]	.270 [.191]
12 yrs	1.648 [.059]	.185 [.056]	.279 [.131]	1.693 [.057]	1.879 [.133]	.197 [.052]	.920 [.234]	1.429 [.443]	.323 [.440]
13 yrs	1.707 [.052]	.059 [.070]	.121 [.179]	1.784 [.051]	2.015 [.132]	.091 [.065]	1.006 [.167]	1.519 [.438]	.091 [.603]
14 yrs	1.862 [.041]	.155 [.056]	.227 [.157]	1.885 [.042]	2.243 [.106]	.101 [.052]	1.168 [.185]	1.650 [.507]	.131 [.650]
15 yrs	2.050 [.033]	.188 [.037]	.280 [.104]	2.064 [.036]	2.526 [.081]	.179 [.034]	1.583 [.102]	1.870 [.191]	.220 [.519]
16 yrs	2.212 [.047]	.162 [.041]	.338 [.101]	2.219 [.048]	2.880 [.113]	.155 [.041]	2.006 [.111]	2.377 [.278]	.507 [.306]
17 yrs	2.425 [.082]	.213 [.084]	.017 [.212]	2.388 [.084]	2.779 [.186]	.169 [.085]	2.322 [.201]	2.762 [.861]	.385 [.900]

NOTE: Estimates and standard errors from OLS regressions with selectivity correction computed using Lee's (1983) algorithm from multinomial logit equations. Standard errors are corrected for using an estimated regressor. State dummy variables are also included in the regressors, but are suppressed here.

Appendix Table 2B (continued)
Female Log-Wage Functions: Total, Market and Self-Employment

	Total Wage		Market Wage		Self-Employment	
	South	Northeast	South	Northeast	South	Northeast
Selection coefficient	.150 [.020]	.261 [.039]	.115 [.020]	.269 [.044]	.525 [.101]	.194 [.104]
Father's education:						
Literate	.033 [.020]	.021 [.034]	.025 [.022]	.011 [.043]	.061 [.041]	.031 [.053]
1-3 yrs	-.021 [.019]	-.002 [.047]	.042 [.020]	-.027 [.046]	-.008 [.040]	.026 [.061]
4-8 yrs	-.102 [.020]	.152 [.047]	.125 [.022]	.138 [.053]	.089 [.044]	.122 [.086]
9+ yrs	-.213 [.030]	.235 [.072]	.209 [.031]	.187 [.076]	.422 [.076]	.333 [.153]
Mother's education:						
Literate	.021 [.020]	.074 [.035]	.031 [.022]	.121 [.043]	-.029 [.043]	.026 [.055]
1-3 yrs	-.059 [.018]	.180 [.039]	.031 [.020]	.195 [.046]	.097 [.039]	.173 [.065]
4-8 yrs	-.150 [.020]	.224 [.048]	.095 [.021]	.244 [.054]	.257 [.044]	.241 [.088]
9+ yrs	-.202 [.032]	.299 [.079]	.153 [.033]	.319 [.083]	.287 [.084]	.338 [.172]
Father's educ. missing	.073 [.027]	.030 [.051]	.081 [.029]	-.034 [.063]	.081 [.059]	.057 [.083]
Mother's educ. missing	.025 [.031]	.091 [.058]	-.010 [.033]	.142 [.069]	.085 [.070]	.102 [.097]
Age	-.056 [.005]	.062 [.011]	.053 [.006]	.045 [.013]	.066 [.013]	.062 [.020]
Age squared	-.001 [.000]	-.001 [.000]	-.001 [.000]	-.000 [.000]	-.001 [.000]	-.001 [.000]
White/Asian	-.090 [.014]	.088 [.024]	.103 [.015]	.045 [.028]	.068 [.032]	.164 [.043]
Black	-.005 [.022]	.044 [.036]	.021 [.024]	.066 [.045]	-.070 [.049]	.013 [.057]
Constant	2.881 [.117]	2.403 [.240]	2.944 [.126]	2.619 [.279]	1.984 [.361]	2.374 [.498]
R ²	0.59	0.54	0.67	0.66	0.36	0.29
Sample Size	14,770	5,246	10,254	2,871	4,515	2,373

Appendix Table 3A
Male Sectoral Choice Equations

	South		Northeast	
	Market	Self-	Market	Self-
	Work	Work	Work	Work
Own education:				
1 yr	-.129 [1.29]	.069 [0.62]	.117 [0.70]	.139 [0.82]
2 yrs	.050 [0.60]	.182 [1.96]	-.030 [0.22]	-.107 [0.76]
3 yrs	.175 [2.23]	.347 [4.04]	.039 [0.28]	-.149 [1.03]
4 yrs	.061 [0.88]	.137 [1.79]	.195 [1.54]	-.211 [1.61]
5 yrs	.244 [2.55]	.325 [3.14]	.112 [0.75]	-.407 [2.61]
6 yrs	-.045 [0.33]	-.019 [0.13]	.434 [1.41]	-.135 [0.42]
7 yrs	.105 [0.71]	.081 [0.51]	.510 [1.49]	-.050 [0.14]
8 yrs	.318 [3.14]	.011 [0.10]	.472 [2.37]	-.467 [2.24]
9 yrs	.597 [2.06]	.202 [0.66]	.604 [1.19]	-.010 [0.02]
10 yrs	.338 [1.66]	-.034 [0.16]	.111 [0.29]	-.865 [2.17]
11 yrs	.842 [6.88]	.381 [2.94]	1.356 [5.44]	.094 [0.37]
12 yrs	.830 [2.41]	-.141 [0.38]	.242 [0.33]	-1.613 [1.94]
13 yrs	.866 [2.80]	.077 [0.24]	1.325 [1.38]	-.112 [0.11]
14 yrs	1.898 [5.49]	1.034 [2.94]	.691 [1.17]	-.536 [0.88]
15 yrs	2.535 [10.61]	1.593 [6.57]	2.733 [5.70]	.725 [1.48]
16 yrs	2.949 [9.91]	2.319 [7.79]	4.183 [6.29]	2.486 [3.73]
17 yrs	3.027 [4.84]	2.572 [4.13]	4.520 [3.71]	2.574 [2.08]

Appendix Table 3A (continued)
Male Sectoral Choice Equations

	South		Northeast	
	Market Work	Self- Employment Work	Market Work	Self- Employment Work
(1) if father: literate	-.008 [0.12]	.066 [0.90]	-.035 [0.30]	.065 [0.54]
1-3 yrs education	.083 [1.20]	.187 [2.52]	-.096 [0.67]	-.073 [0.49]
4-8 yrs education	.099 [1.22]	.102 [1.18]	-.363 [1.95]	-.295 [1.53]
≥ 9 yrs education	.169 [1.10]	.194 [1.24]	-.168 [0.49]	-.254 [0.71]
(1) if mother: literate	-.020 [0.28]	.049 [0.65]	-.061 [0.51]	.003 [0.03]
1-3 yrs education	-.163 [2.33]	-.043 [0.58]	.223 [1.44]	.279 [1.75]
4-8 yrs education	-.082 [0.99]	.161 [1.83]	.145 [0.72]	.127 [0.61]
≥ 9 yrs education	-.334 [1.83]	-.119 [0.64]	.847 [1.71]	1.192 [2.39]
(1) if spouse: exist	.588 [6.85]	.129 [1.34]	.534 [3.76]	.189 [1.29]
1-3 yrs education	-.083 [1.29]	.117 [1.62]	.168 [1.55]	.259 [2.31]
4-7 yrs education	-.091 [1.35]	.198 [2.63]	.166 [1.45]	.229 [1.93]
8-10 yrs education	.055 [0.52]	.495 [4.35]	.348 [1.72]	.388 [1.86]
≥ 11 yrs education	.350 [2.88]	.913 [7.22]	.628 [2.77]	.861 [3.73]
(1) if spouse's father: literate	-.021 [0.31]	.075 [1.01]	-.081 [0.72]	.047 [0.40]
1-3 yrs education	.096 [1.42]	.177 [2.44]	.128 [0.93]	-.051 [0.36]
4-8 yrs education	.119 [1.53]	.133 [1.60]	.299 [1.52]	.180 [0.89]
≥ 9 yrs education	.678 [3.69]	.720 [3.86]	.443 [1.10]	.560 [1.38]
(1) if spouse's mother: literate	-.064 [0.90]	.043 [0.56]	.205 [1.68]	.200 [1.59]
1-3 yrs education	.062 [0.90]	.089 [1.22]	-.036 [0.26]	.116 [0.79]
4-8 yrs education	.060 [0.74]	.119 [1.39]	.361 [1.72]	.467 [2.17]
≥ 9 yrs education	.114 [0.54]	.175 [0.83]	.274 [0.56]	.478 [0.96]
(1) if data missing for: father's education	.084 [0.98]	-.021 [0.22]	.106 [0.66]	.005 [0.33]
mother's education	.183 [1.91]	.168 [1.62]	.054 [0.32]	.055 [0.31]
spouse's father education	-.087 [0.11]	-.016 [0.14]	-.279 [1.51]	-.383 [1.97]
spouse's mother education	-.115 [0.12]	-.086 [0.66]	.036 [0.17]	.208 [0.95]

Appendix Table 3A (continued)
Male Sectoral Choice Equations

	South		Northeast	
	Market Work	Self- Employment Work	Market Work	Self- Employment Work
(1) if race:				
White/Asian	.004 [0.08]	.253 [4.47]	.106 [0.73]	.005 [3.80]
Black	-.096 [1.24]	-.289 [3.24]	.176 [1.44]	-.164 [1.26]
Age	.054 [2.83]	.146 [2.06]	.147 [4.42]	.254 [7.32]
Age ²	-.002 [7.15]	-.002 [2.35]	-.002 [6.01]	-.003 [8.07]
Non-labor income/1000	-17.601 [31.17]	-9.541 [20.06]	-51.239 [22.49]	-44.143 [19.42]
(Non-labor income/ 1000) ²	—	—	83.947 [14.14]	77.362 [13.04]
(1) if possess:				
Mason walls	.093 [1.43]	.178 [2.56]	.179 [1.41]	.175 [1.32]
Cement floor	-.067 [1.22]	-.136 [2.31]	-.658 [2.80]	-.966 [4.07]
Tile floor	-.124 [1.46]	-.003 [0.03]	-.493 [2.17]	-.540 [2.37]
Dirt floor	-.132 [1.04]	.032 [0.22]	-.603 [2.26]	-.861 [3.18]
Public water-no pipe	.161 [1.79]	-.008 [0.08]	.110 [0.90]	.068 [0.55]
Well water	.037 [0.50]	.138 [1.71]	-.002 [0.02]	.094 [0.86]
Septic tank	.006 [0.11]	.062 [1.00]	-.484 [2.50]	-5.92 [3.03]
Rustic sewerage tank or none	-.024 [0.35]	.063 [0.86]	-.620 [3.27]	-.576 [3.00]
Garbage burned or buried	-.045 [0.67]	-.052 [0.71]	.141 [0.82]	.112 [0.64]
Garbage thrown on street	-.032 [0.50]	.024 [0.32]	.165 [1.88]	.085 [0.93]
Mudshingle roof	-.107 [2.11]	.056 [1.05]	-.129 [0.89]	-.080 [0.54]
Water filter	.065 [1.33]	.112 [2.13]	.249 [2.97]	.294 [3.40]
Refrigerator	.233 [4.00]	.328 [5.08]	.060 [0.65]	.188 [1.94]

Note: Coefficients and asymptotic normal statistics estimated by multinomial logit maximum likelihood. Nonparticipation is the omitted category. State of residence dummy variables were also included, but are not reported here.

Appendix Table 3B
Female Sectoral Choice Equations

	<u>South</u>		<u>Northeast</u>	
	Market	Self-	Market	Self-
	Work	Employment	Work	Employment
	Work	Work	Work	Work
Own education:				
1 yr	-.064	-.104	.003	.036
	[0.78]	[1.07]	[0.20]	[0.31]
2 yrs	.192	.179	.126	.131
	[3.03]	[2.46]	[1.12]	[1.39]
3 yrs	.289	.179	.362	.173
	[5.09]	[2.70]	[3.49]	[1.90]
4 yrs	.373	.225	.453	.259
	[7.26]	[3.74]	[4.89]	[3.11]
5 yrs	.413	.365	.699	.310
	[6.15]	[4.74]	[6.57]	[3.18]
6 yrs	.516	.297	.789	.150
	[5.28]	[2.57]	[4.22]	[0.76]
7 yrs	.501	.442	.917	.171
	[4.85]	[3.80]	[4.59]	[0.81]
8 yrs	.971	.297	1.326	.379
	[13.93]	[3.40]	[10.29]	[2.80]
9 yrs	1.236	.457	1.483	-.408
	[8.58]	[2.34]	[5.62]	[0.99]
10 yrs	1.286	.200	1.682	.568
	[10.70]	[1.13]	[7.88]	[2.35]
11 yrs	2.163	.273	2.920	.254
	[30.68]	[2.75]	[24.01]	[1.65]
12 yrs	3.027	.584	3.412	.330
	[17.17]	[1.79]	[10.34]	[0.57]
13 yrs	2.801	.751	3.695	.670
	[19.20]	[3.15]	[10.67]	[1.16]
14 yrs	3.363	.313	3.947	.021
	[27.62]	[1.26]	[14.05]	[0.03]
15 yrs	3.855	1.134	4.643	1.296
	[39.47]	[7.83]	[23.46]	[4.74]
16 yrs	3.774	2.164	5.415	2.543
	[24.24]	[11.32]	[13.58]	[5.28]
17 yrs	5.447	3.91	4.599	.643
	[10.51]	[7.18]	[8.07]	[0.58]

Appendix Table 3B (continued)
Female-Sectoral Choice Equations

	South		Northeast	
	Market Work	Self- Employment Work	Market Work	Self- Employment Work
(1) if father: literate	-.096 [1.99]	-.002 [0.03]	-.123 [1.55]	-.090 [1.23]
1-3 yrs education	-.051 [1.11]	.034 [0.60]	-.154 [1.70]	-.029 [0.34]
4-8 yrs education	-.116 [2.29]	.129 [2.09]	.037 [0.34]	-.016 [0.13]
≥ 9 yrs education	-.274 [3.37]	.301 [2.83]	.056 [0.32]	.248 [1.15]
(1) if mother: literate	-.019 [0.39]	-.095 [1.58]	.081 [1.00]	-.048 [0.63]
1-3 yrs education	.012 [0.26]	.073 [1.31]	.268 [2.92]	-.001 [0.00]
4-8 yrs education	-.075 [1.49]	.020 [0.32]	-.130 [1.14]	.021 [0.17]
≥ 9 yrs education	-.178 [2.01]	.024 [0.20]	-.270 [1.42]	.239 [1.01]
(1) if spouse: exist	-1.369 [23.87]	-.870 [12.78]	-1.542 [18.35]	-1.054 [13.83]
1-3 yrs education	-.184 [3.29]	-.097 [1.51]	-.195 [2.09]	-.012 [0.16]
4-7 yrs education	-.293 [5.28]	-.278 [4.24]	-.040 [0.44]	-.133 [1.57]
8-10 yrs education	-.456 [6.38]	-.487 [5.46]	-.277 [2.11]	-.247 [1.77]
≥ 9 yrs education	-.825 [11.21]	-.645 [6.92]	-.571 [4.32]	-.347 [2.33]
(1) if spouse's father: literate	.034 [0.62]	.092 [1.39]	.046 [0.47]	.038 [0.43]
1-3 yrs education	.037 [0.69]	.020 [0.30]	-.016 [0.13]	-.094 [0.84]
4-8 yrs education	.076 [1.26]	.022 [0.29]	.255 [1.86]	-.097 [0.64]
≥ 9 yrs education	.032 [0.35]	.146 [1.21]	-.042 [0.21]	.040 [0.17]
(1) if spouse's mother: literate	.054 [0.98]	.032 [0.48]	.166 [1.70]	-.224 [2.36]
1-3 yrs education	.040 [0.76]	.099 [1.52]	-.059 [0.50]	-.088 [0.77]
4-8 yrs education	.015 [0.25]	.068 [0.91]	-.134 [0.96]	-.084 [0.54]
≥ 9 yrs education	-.231 [2.35]	-.057 [0.41]	-.143 [0.65]	.048 [0.18]
(1) if data missing for: father's education	.243 [3.58]	.250 [3.01]	.187 [1.53]	.056 [0.41]
mother's education	.127 [1.60]	.009 [0.10]	.134 [0.98]	-.170 [1.23]
spouse's father education	.139 [2.09]	.120 [1.49]	-.064 [0.48]	.346 [3.02]
spouse's mother education	-.173 [2.37]	-.151 [1.69]	.048 [0.35]	-.156 [1.25]

Appendix Table 3B (continued)
Female-Sectoral Choices

	South		Northeast	
	Market Work	Self-Employment Work	Market Work	Self-Employment Work
(1) if race:				
White/Asian	-.256 [7.13]	-.072 [1.64]	-.213 [3.78]	-.276 [4.86]
Black	.491 [8.84]	.295 [4.28]	.302 [3.47]	.199 [2.46]
Age	.270 [20.84]	.209 [13.27]	.289 [12.01]	.275 [11.68]
Age ²	-.004 [22.38]	-.003 [13.46]	-.004 [12.44]	-.003 [11.66]
Non-labor income/1000	-7.673 [16.71]	-4.141 [7.86]	-14.963 [10.66]	-10.085 [6.88]
(Non-labor income/ 1000) ²	1.411 [10.89]	.680 [1.82]	13.017 [5.25]	11.214 [5.08]
(1) if possess:				
Mason walls	-.145 [3.38]	-.045 [0.83]	-.148 [1.59]	-.120 [1.39]
Cement floor	.170 [4.54]	.117 [2.55]	.086 [0.77]	.250 [1.88]
Tile floor	.081 [1.40]	.080 [1.12]	-.097 [0.94]	.166 [1.29]
Dirt floor	-.123 [1.23]	.108 [0.93]	-.097 [0.66]	.199 [1.27]
Public water-no pipe	.077 [1.21]	-.126 [1.61]	.058 [0.68]	-.026 [0.32]
Well water	-.028 [0.51]	-.130 [1.99]	.076 [1.02]	.007 [0.10]
Septic tank	-.059 [1.52]	-.052 [1.08]	.265 [2.68]	.061 [0.53]
Rustic sewerage tank or none	-.101 [2.11]	-.003 [0.05]	.202 [1.99]	.188 [1.64]
Garbage burned or buried	-.096 [1.99]	.016 [0.28]	.152 [1.28]	.298 [2.94]
Garbage thrown on street	-.073 [1.46]	-.052 [0.86]	.093 [1.52]	-.003 [0.05]
Mudshingle roof	-.002 [0.06]	.099 [2.41]	.138 [1.65]	.044 [0.50]
Water filter	-.312 [9.34]	-.081 [1.93]	-.080 [1.37]	.062 [1.12]
Refrigerator	.076 [1.79]	.064 [1.23]	-.181 [2.66]	.078 [1.25]

Note: Coefficients and asymptotic normal statistics estimated by multinomial logit maximum likelihood. Nonparticipation is the omitted category. State of residence dummy variables were also included, but are not reported here.