Specialization in Single Parent Households: Evidence from Brazil

JEL J22, I20, D60

June 2004
PRELIMINARY DRAFT ONLY – DO NOT CITE
Comments Solicited

By

Andrew W. Horowitz
Department of Economics
Sam M. Walton College of Business
University of Arkansas, Fayetteville, AR 72701

and

André Portela Souza
Economics Department
Vanderbilt University and
Department of Economics
University of São Paulo – Brazil

Abstract:

Recent empirical and theoretical work has focused on the intra-household dispersion of observable human capital (OHK) across children. As expected, innate heterogeneity, birth-order, and gender are all important correlates of the intra-household distribution of OHK. However, empirical work has also identified some unanticipated correlates of the OHK dispersion. In particular, there is strong evidence that patterns of intra-household observable human capital dispersion (not levels) vary significantly with income after controlling for a host of factors. This research continues the exploration of the intra-household distribution of OHK across children by focusing on the dispersion within single parent households. The motivation for exploring these correlations is that prior research has shown that mothers and fathers may have starkly different attitudes towards the labor/education time allocation of their children. After controlling for demographics, permanent income, location, and other anticipated correlates we compare the intra-household dispersion of children's education achievement in single female-parent households with two-parent households. We find that, indeed, there are significant differences in the intra-household dispersion of academic achievement in female headed single-parent households. Specifically, we find more dispersion across children in single parent household's headed by females even after controlling for household per-capita permanent income. Moreover, we find that patterns of specialization in the single-parent household across birth-order and genders that are distinct from the two-parent households. These results are robust and suggest that single-female parents have a greater propensity to specialize specific children in either education or labor activities due to factors over and above permanent income. Stated alternatively, two-parent households tend to be more egalitarian in the time allocation of their children across labor and education. We believe these results have important policy implications for the type of interventions and incentives that target single parent households. Potential policy implications are explored in the context of these results.

Horowitz email: Horowitz@walton.uark.edu; Phone: 479-575-6228; Souza email: aps@usp.br.

I. INTRODUCTION

The seminal works of Schultz (1971) on human capital and Becker (1960) on the household has generated a vast literature on household-level human-capital investment decisions. However, the distribution of human capital *across* children *within the household* has received relatively little attention. Horowitz and Souza (2004) broach this issue by using a measure of children's academic progress to proxy the final dispersion of human-capital with the household. They find an extremely robust correlation between intra-household human-capital dispersion, and household income. Specifically, they find greater *dispersion* among children in poor households than in wealthier households. This result is consistent with a large body of empirical and theoretical work suggesting that children in poor households specialize more across education and work activities than do children in wealthy households.

This research continues the exploration of the intra-household distribution of educational attainment across children by comparing education dispersion within single parent households with the dispersion in two-parent households. The motivation for exploring these correlations is that prior research has shown that mothers and fathers may have starkly different attitudes towards the labor/education time allocation of their children. After controlling for demographics, permanent income, location, and other anticipated correlates we find that there are indeed significant differences in the intra-household dispersion of academic performance in female headed single-parent households. We find more dispersion across children in single-parent household's headed by females even after controlling for household per-capita permanent income. These results are robust and suggest that single-female parents have a greater propensity to specialize particular children in either education or labor activities due to factors over and above permanent income. Stated alternatively, two-parent households tend to be more egalitarian in the time allocation of their children across labor and education. We believe these results have important policy implications for the type of interventions and incentives that target single parent households. Potential policy implications are explored in the conclusion in context of these results.

As noted on the title page, this is a preliminary manuscript and revisions will be forthcoming. The remainder of this draft is organized as follows: Section II provides a literature review and discusses conceptual issues in light of the empirical strategy. Section III describes the data and the empirical methodology. Section IV presents the empirical results. Section V concludes and suggests additional issues to be explored in the next draft.

II. Literature Review

Analysis of child specialization within households in low-income-countries (LICs) should be viewed in the context of number of literatures. Since child specialization usually involves education and labor, the child labor literature is relevant. Important foundational theoretical works include Basu and Van (1998) and Baland and Robinson (2000). However, neither of these papers considers the dimension of intra-household specialization across children. In contrast, Horowitz and Wang (2004) specifically model parental decisions to allocate the time of their heterogeneous children between education and labor activities. They identify conditions under which the pattern of specialization implied by comparative advantage will not hold for poor households facing imperfect human capital markets.

A second literature of clear relevance to this work concerns general intra-household distribution. Browning and Chiappori (1998) explore the efficiency properties of intra-household allocation and provide empirical tests for intra-household distributional efficiency. Interestingly, and of relevance to emphasis in this paper, they find that the restrictions implied by an efficient "collective model" cannot be rejected with the data they employ. Another strand of the intra-household distribution literature of relevance to our work concerns the affect of parental decisions on the ultimate human capital stock of their children (see Behrman et al. 1995).

Horowitz and Souza (2004) provide the first empirical investigation of how intra-household specialization may manifest in the *dispersion* of academic performance across children, and how this intra-household dispersion varies across the income distribution. They identify an extremely robust negative correlation between the intra-household dispersion of academic performance and household permanent income. They do not consider, however, how these patterns might vary with *parental structure* since their sample is restricted to two-parent households. This manuscript explores how single-parent versus two-parent household structure affects the dispersion of academic performance within the household.

A final literature that warrants discussion provides evidence of intra-household child specialization in low-income-countries (LICs). Incentives for child specialization in either labor market or human capital activities include increasing returns to education, education capital market imperfections, increasing returns to labor market experience, and innate heterogeneity of children. Evidence of intra-household child specialization can be found from Botswana (Chernichovsky's 1985) to Brazil (Emerson and Souza

2002) to Pakistan (Burki and Fasih 1998). Ravallion and Wodon (2000) utilize a targeted school stipend in Bangladesh to test the extent to which child labor displaces schooling. Interestingly (and also of relevance to our result), they find that much of the displacement effect is indirect. That is, labor may first displace complementary human capital activities such as homework, before school attendance directly. Our theoretical and empirical strategies are designed to captured such indirect effects. Numerous other references to specialization in child labor-education activities can be found in Grooaert and Patrinos (1999, eds.). We now turn to construction of theoretical model that will guide empirical analysis of these issues.

III. Model

Our theoretical model is an adaptation of Horowitz-Wang (2004) that focuses on the time allocation problem of parents across heterogeneous children. Our ultimate concern in this context is with the dispersion of intra-household academic performance across children in different household structures. A clear difference between one and two parent households is the total parental time endowment. In the model which follows, a child's academic performance will depend on innate talent and parental time devoted to their educational pursuit. It is easy to imagine this as time devoted to helping a child with homework, although there are many other parental activities that could also enhance a child's academic performance. The theoretical framework is therefore one of time-allocation and we specify the following household-level time constraint:

(1) $T^j = \Sigma\, t_i + l + L, \quad f = 1, 2; \quad i = 1,2, \ldots, n$

where the j indexes whether the household has one or two parents, i indexes the number of children, l is parental leisure consumption, and L the parental labor hours.

We assume a unitary parental decision-making unit in the case of a two-parent household so that the single and two parent households' face a time allocation problem with similar structure, but with $T^1 < T^2$. That is, as noted above, the single-parent household has less total-time to allocate than the two-parent household. Looking ahead to the empirical work, the time endowment will be an indicator of a single-mother household, or not. Labor supply (L) will be reflected in household income.

As our focus is on the dispersion of education performance across children, it is important to consider child heterogeneity. To this end we assign each child (i) a unique "talent parameter," which we denote as a_i. Though we use the term "talent" throughout, the key implication of this heterogeneity is that it is associated with differential academic performance for a given parental time input. Let $e(t_i, a_i)$ be a measure of academic performance of child i. We assume e_i is increasing in a_i and t and is concave in t:

$$(2) \qquad e_t^i(t_i, a_i) \equiv \frac{\partial e}{\partial t_i} > 0, \qquad e_a^i(t_i, a_i) \equiv \frac{\partial e}{\partial a_i} > 0; \quad e_{tt}^i(t_i, a_i) \equiv \frac{\partial^2 e}{\partial t_i^2} < 0 \qquad i = 1,\ 2$$

We will assume children's academic performance matters to parents – an assumption we believe should not be viewed as controversial by most. Naturally, this concern with children's academic performance may reflect altruistic as well as self-interest motives on the part of parents. In order to gain insight into how the smaller total time endowment of single versus two-parent households may affect the *dispersion* of academic performance across children within a household, we assume the following parental objective function:

(3) $$\max_{t_i, l, L} \; V(e^1(t_1, a_1),\; e^2(t_2, a_2),\; l,\; C(L)) \quad , \text{ subject to } (1)$$

where *C(L)* is household consumption. For simplicity we will normalize the price of the consumption good to 1 and denote the wage by w so that $C(L) = wL$. Our interpretation of (3) is as a reduced form utility function that incorporates the dynamic implications of the time allocation decisions into a present-value objective function.[1]

Our principal question is how (in an optimizing model) the *dispersion* of academic achievement varies with household structure. In this simple model the indicator of household structure is the total time endowment T^i. To our answer our question we must characterize how the parents time-allocation problem varies with this parameter T^i. In particular, our interest is with the properties of the solution $t^{i*}(T^i)$.[2] The most general approach for characterizing the comparative static properties of these solutions employs the monotone-comparative static techniques developed by Topkis (1990) and Milgrom and Roberts (1994). Employing this technique requires that the optimized function exhibit both *increasing differences* and *supermodularity.* Loosely speaking, supermodularity requires that the cross-partials of the objective function are increasing in all the choice variables. This ensures that any feedback between endogenous variables associated with a parameter perturbation is monotonic. Increasing differences requires that the cross-partial of the choice variables and parameters are non-decreasing, so that the parameter perturbation has a non-decreasing affect on the marginal

---

[1] The function *V* therefore embodies the solution to all subsequent decisions – such as any later period bequests or transfers. The structure reflects the fact that parental utility is increasing the human capital of their children due to its affect on the future welfare of both the children, and the parents themselves.

[2] The complete solution would of course depend on all parameters of the system: $t^{i*}(T^i, \underline{a}, w, \underline{z})$, where $\underline{z}$ is a vector of parameters associated with the utility function. However, as we will perturb on family structure *T,* we can suppress the other parameters for notational economy.

return to endogenous variables. In our context, the optimized function is the Lagrangian (L) associated with (3) so that increasing differences and supermodularity require respectively: $L_{xT} = \partial L/\partial x \partial T \geq 0$ *for* $x = t_1, t_2, l, L$; $L_{xy} = \partial L/\partial x \partial y \geq 0$ *for* $x, y = t_1, t_2, l, L$ where $x \neq y$.[3] Increasing differences is trivially satisfied in this context, and supermodularity would be at least be weakly satisfied for virtually all standard utility functions.[4] Together, supermodularity and increasing differences imply that $\partial t^{i*}(T)/\partial T \geq 0$, where recall that $t^i*(T)$ is the optimal time allocation to children. We can use this result to explore the effect of a change in T on the dispersion of academic performance. We begin, for simplicity, with the case of a two child household and define a generic dispersion function of the form:

(4) $D(T) = f([(e^{1*}(t^1*(T)) - e^{2*}(t^2*(T))]^2)$, *where* $f' > 0$.

The interpretation of this dispersion function is that, in the two-child household, all measures of dispersion we employ are increasing in the squared difference of the academic performance of the children. Our principal empirical question therefore reduces to whether $D'(T)$ is significantly different from zero, and if so its sign. Differentiating (4) yields:

(5) $D'(T) = f' * 2[(e^{1*}(t^1*(T)) - e^{2*}(t^2*(T))]) * (e^1_{t^1} t^1_T - e^2_{t^2} t^2_T)$

---

3 In employing calculus we are technically only analyzing limitingly small perturbations to time endowment. However, we will argue that this exercise yields qualitative insights with value to the global problem.

4 We note that if hours generated direct disutility in addition to its opportunity cost in other time-uses, supermodularity would not be trivially satisfied.

where $e_{t^i}^{i*} = \partial e^{i*}/\partial t^i$ and $t_T^{i*} = \partial t^{i*}(T)/\partial T$.

First note that given the assumptions on the *e* function in *(2)*, if parents value both children's academic performance equally (i.e., e_i enters the *V* function symmetrically) and the children have identical talent ($a_1 = a_2$), then $t^{1*} = t^{2*}$ and from (5), $D'(T) = 0$ since all the arguments of the *e* functions would then be identical. Therefore, with identical children the *dispersion* of parental time across children is independent of the total time endowment. In our context this implies that single and two-parent household's with identical twins should exhibit the same (zero) *dispersion* in the academic performance of their children. The model also implies that, all else equal, the *levels* of academic achievement will differ with family structure. This is, in principle, a testable implication with a sample of identical twins. Of course, identical twins are the exception rather than the rule and with heterogonous talent we have $a_1 \neq a_2$, which given the analysis above implies $t^{1*} \neq t^{2*}$. The question, however, is the conditions under which (5) will be positive or negative, and for this we need to determine whether the optimal *e* will be different also.

Additional insight can be gained by examining the interior first-order conditions of the Lagrangian associated with (3):

(6) i. $L_{t^i} = V_{e^i} e_{t^i}^{i*} - l = 0 \quad for \quad i = 1,\ 2$.

ii. $L_{ti} = V_l - l = 0$

iii. $L_L = w\, V_C - l = 0$.

From (6i) we know that $V_{e^1} e_{t^{1i}}^{1*} = V_{e^i} e_{t^2}^{2*}$, which implies that parents allocate their time to equate the marginal *utility* returns to a unit of time investment across children. Thus, in general, it will not be the case that the academic performance of the children or the slopes of the *e* functions across children will be the same. Consequently, *D'(T)* will in general be non-zero with heterogeneous children. That is, this simple optimizing model predicts that the *dispersion* as well as the levels of education achievement will vary in single-parent and two-parent households. We now turn to empirical analysis to test this prediction.

III. Data Description and Empirical Methodology

Measuring Final Academic Achievement

Final education achievement across siblings within a family is only observable when the accumulation process is complete. Therefore, the academic profile of siblings could typically only be observed in reconstructed families, or in the atypical families that do not disperse. Though data that allows the reconstruction of households after dispersal could reveal the dispersion of siblings' initial academic achievement, there is also the problem of interrupted education – where some siblings return to school fairly late in life. However, if intra-household patterns of final academic achievement appear early, it may be possible to avoid the problems noted above by use of a proxy measure. In this paper we will present evidence that patterns of intra-household academic achievement do typically emerge early and that the *rate* of educational progress is an excellent proxy for the final dispersion of siblings' academic achievement in many low-income countries. The power of this proxy is typically far greater in low-income countries than in high-income countries because of the prevalence of delay due to grade repetition, late matriculation, and school withdrawal.

The Rate of Education Progress and Final Education Attainment

There exists a well established (inverse) correlation between delayed educational progress and final academic achievement. Indeed, this link is accepted as foundational in the education literature (for discussion and survey of this relationship in the U.S. see Meisels and Liaw 1993 and Byrnes and Yamamoto 1989). Evidence of the inverse correlation between the rate of education progress and final achievement also exists for low-income countries – see, for example, Bedi and Marshall (2002) and Barro and Lee (1999, 2001), and Lee and Barro (2001). There is also direct evidence linking grade repetition to the innate distribution of human capital within the household. For example, Currie and Thomas (1995) find that within families, higher child IQ scores are powerfully correlated (inversely) with grade repetition.[5] This strengthens the case for our proxy since the intra-household distribution of innate ability is almost certainly strongly correlated with the final distribution of academic achievement within the household (after controlling for demographic structure, including gender and birth-order effects).

Our use of the intra-household dispersion of education delay as a proxy for the final intra-household education dispersion requires an environment where the rate of progress through the education system is highly sensitive to academic performance. In the Brazilian PNAD data we employ (introduced in detail subsequently) more than 95% of seven year-old children attend school and over 90% are still attending at age 13. Though withdrawal accelerates after age 13, the decline is modest for a low-income country with 85% still attending at age 16. On the other hand, around 30% of eight-year-old children have experienced some delay and this percentage increases monotonically --

5 The precise test administered to children was the Peabody Picture Vocabulary Test (PPVT).

reaching nearly 80% for 16 year-old children. The implication for our analysis is that repetition (delay) is pervasive in Brazil while withdrawal and late matriculation are only relative small contributors to our measure of delay.[6] We present what we believe to be compelling evidence in Horowitz and Souza (2004) that Brazil constitutes a near ideal environment for application of this technique and demonstrate that delay due to repetition in Brazil is pervasive.

Data Description – The Brazilian PNAD

The data used in this study come from the 2001 Brazilian Household Surveys, called Pesquisa Nacional por Amostragem a Domicílio (PNAD), which are administered by Instituto Brasileiro de Geografia e Estatística (IBGE), the Brazilian Census Bureau. The PNAD is an annual labor force survey (similar to the Current Population Survey in the United States) that covers all urban areas and the majority of the rural areas in Brazil.[7] The sample is based on a three-stage sampling design. With the exception of the first stage, the sampling scheme is self-weighted, and the sampling varies across regions and over time. Each PNAD surveys approximately 85,000 households.

Measures of Progress/Delay and Measures of Dispersion

One of the most natural measures of the rate of educational progress is the ratio of current educational attainment and the idealized level of attainment. For example at a given time let $education_{ih}$ be the completed years of schooling for child i in a household

6 Late matriculation and early withdrawal was common in Brazil until the school expansion of the mid 1900's allowed near universal access to school. We also verify that throughout our cohort, whose oldest children first matriculated in 1992, school attendance among the seven year-old children has been at least 90%. Menezes-Filho (2003) provide additional evidence that by the beginning of the 1990's the vast majority of the Brazilian young children were attending school.

7 The principal excluded area is the rural Amazon.

h, age_{ih} the age of child *i* in a household *h*, and let *entry* denote the expected age of initial school attendance in the particular environment. Then the measure of education progress is: $P_{ih} = \frac{education_{ih}}{age_{ih} - entry}$, where the denominator represents the "idealized" education attainment. With this measure $P_{ih} = 1$ indicates idealized progress, $P_{ih} < 1$ indicates some delay, and $P_{ih} > 1$ indicates accelerated progress. Thus, this measure indicates actual progress relative to idealized progress in percentage terms.

As our ultimate concern is the intra-household dispersion of educational progress across children it is important to consider the dispersion properties of a measure of delay. Many measures of dispersion (e.g., Coefficient of variation, Theil, Gini) of the P_{ih} above exhibit scale independence in that they are insensitive to proportional scaling of all children's education level within a household. As a simple example consider two demographically identical households – each with two fifteen year old children. Suppose that in the first household the children have completed the first and second grades while in the second household they have completed the fourth and eighth grades. A scale-independent inequality index would assign the same delay dispersion (for the P_{ih} above) to both households. However, one may prefer a measure which reflects the fact that absolute inequality is greater in the second household. A generalized measure of delay that allows both scale independence and scale dependence in dispersion can be obtained by simply adding a constant to the measure above. That is, now define the measure of progress as:

(7) $$P_{ih} = K + \frac{education_{ih}}{age_{ih} - entry}, \qquad K \geq 0 \; .$$

Note that when $K = 0$ the dispersion of educational progress in the two households described above would be identical for scale independent measures such as Theil, Gini, and Coefficient of Variation. However, when $K = 1$, inequality would be greater in the second household and if $0 < K < 1$ inequality is lower in the second household. For the measure where $K = 1$ perfect delay (zero progress) implies $P_{ih} = 1$, some delay implies $1 < P_{ih} < 2$, and adequate or fast progression implies $P_{ih} > 2$. In this paper, we present results for the case where $K = 1$. However, we have also estimated regressions for the cases of $K = 0$ and $K = 5$ and the results are similar.

Regarding the other specific parameters in equation (7), Brazilian law requires that children attend school from age seven to fourteen. If a child progresses without delay, they will have completed the upper primary education by the age of 15. Given these specific institutional features our measure of school progress (the inverse of delay) is $P_{ih} = 1 + \dfrac{education_{ih}}{age_{ih} - 6}$.[8]

Empirical Methodology

As discussed above, we want to compare the dispersion of the children's school-progress between a single mother household and a two parent household, holding all else equal. To this end define

$$D_h = f(T_k; Y_h, X_h, e_h) \tag{8}$$

[8] For children not attending school we assign the highest completed years of schooling. For children attending school we assign the corresponding years of schooling for the grade the child is currently attending.

where D_h is a measure of school-progression dispersion in household h, T_k is the single mother household indicator variable, Y_h is household income, X_h is a vector of other observable variables that affect dispersion, and e_h represents unobservable factors (such as preferences). Following our theory model, our interest is with the sign of $\frac{\partial f(.)}{\partial T_h}$. Empirically, we specify *f(.)* as a linear function of the single mother household indicator variable, the household income (or our instruments for household permanent income) and a vector of other observable household characteristics. We estimate OLS regressions of the form:

$$(9) \qquad D_h = a + b_1 SM_k + b_2 HE_h + d' X_h + e_h ,$$

where the instruments of household income are the father's and mother's education. We construct indicator variables for household heads educational attainment (HE_h), which correspond to the following categories: illiterate (zero years of schooling); some lower primary or completed primary education (one to four years of schooling); some upper primary or completed upper primary education (five to eight years of schooling); some high school or completed high school education (nine to eleven years of schooling); and some college or completed college education (twelve or more years of schooling). The vector X_h consists of the number of sons and daughters by each age level, a rural area indicator variable, a metropolitan area indicator, and state indicators. By including the number of sons and daughters for each child's age by gender, we control for the complete demographic structure of the household. The parameters to be estimated are a, b*'s*, and d. We assume the error term, e_h, is i.i.d. normally distributed.

Measures of Progress/Delay and Measures of Dispersion

As discussed above, our measure of progress of child i in household h is $P_{ih} = 1 + \frac{educa_{ih}}{age_{ih} - 6}$, where $P_{ih} = 1$ indicates zero progress, some delay implies $1 < P_{ih} < 2$, and adequate or fast progress implies $P_{ih} \geq 2$.

We utilize four measures of dispersion of P_{ih} within households. The Theil Entropy Measure $\left(\frac{1}{N_h} \sum_{i=1}^{N_h} \frac{P_{ih}}{P_h} \log\left(\frac{P_{ih}}{P_h} \right) \right)$, Gini coefficient $\frac{1}{N_h(N_h - 1)P_h} \sum_{i>j} \sum_j | P_{ih} - P_{jh} |$, the coefficient of variation $\left(\frac{1}{N_h} \sum_{i=1}^{N_h} (P_{ih} - P_h)^2 \right)^{\frac{1}{2}} / P_h$, and the proportion of children with some delay in a household (pdelay) is $N_{P<2}/N_h$ where N_h is the number of children in household h, and $N_{P<2}$ is the number of the household's children with some delay.

IV. Empirical results

Sample Selection

Our unit of analysis is a household and the sample selection consists of all households with at least two children aged seven to sixteen years inclusive. Our sample restriction to households' containing at least two children reflects our focus on the intra-household distribution of education progress across children. The children's age restriction follows from the school entry age of seven in Brazil and the fact that, in principle, children are expected to have completed their fundamental education by age sixteen.[9] Finally, all observations for which the age difference between the head of the household or spouse and the oldest child is 14 years or less are excluded. The final sample consists of 16,959 households and the summary statistics are presented in Table A.1 of the appendix.

Table 1 presents the basic statistics of our four delay dispersion measures for two-parent households and single mother households, separately. There are 14,486 two-parent household observations, and 2,473 single mother household observations. That is, seventeen percent of all households in our sample are single mother households. As shown in Table 1, single mother households present a greater dispersion of school progress across children compared to two-parent households.

This finding holds to all four of our measures and is consistent to our model. However, these are unconditional means and there are other factors correlated to single mother households that also affect the delay dispersion. Among them, the household permanent income, the household composition, and the educational policy are the most plausible ones. In order to control for these factors, we run an four OLS regression where the dependent variables are our four delay dispersion measures and the independent variables are the single mother indicator variable, the household per capita income (the sum of the income of all household members divided by the number of people living in the household), the household demographic variables, and the location controls. Table 2 presents the results of these four regressions. Table 2 shows that for all measures there is a greater dispersion of school progression across children in single mother households compared to two-parent households, holding per capita household income constant (plus

9 Our results are not sensitive for the choice of upper-bound age. We replicate our estimations using fifteen and seventeen years old as alternative upper-bounds and the results are similar.

the other controls). In order to explore non-linearities across the household income distribution we also performed an alternative specification where we interacted the single mother indicator variables with the income deciles indicator variables but they were not statistically significant at any reasonable level. It seems that there is a single mother effect beyond the income effect.

As robustness check, Table 3 presents the results when the education level of the head of the household is also added. It can be that the per capita household income is not a good proxy for the household permanent income. The results are qualitatively the same. There is a single mother effect on school progression dispersion over and above the permanent income of the household.

V. Conclusions

There is significant evidence that in poor household in low-income countries, labor income form children and youth is often required to allow households to obtain a subsistence income levels. In such circumstance there is mounting evidence that some children may be obliged to specialize in either labor market or education activities. This paper explores the differential patterns of child specialization in single-mother households and two-parent households. Controlling for income and other demographic features of the environment we show that child specialization, as evidenced by the dispersion of education progress among children, is significantly greater in single-mother households. We also perform robustness checks to provide evidence that the single-mother effect exists over and above any permanent income effect. Though this manuscript is preliminary, we believe these result are intriguing. They suggest that the increased work load of children in single-mother households is not distributed uniformly across children. Again, note that since we have controlled for demographic structure, we are referring here to affects beyond the well-known *general* birth order and gender influences. Rather, this phenomenon is specific to the single-mother household structure, suggesting the presence of perhaps *specialized* birth order and gender affects in the single-mother household. Subsequent drafts will explore these issues in greater depth.

References

Baland, Jean-Marie and James A.Robinson, 2000. "Is child labor inefficient?" *Journal of Political Economy* v108, 663--679.

Barro, Robert J.; Lee, Jong-Wha, 1999. *"International Comparisons of Educational Attainment*," *The legacy of Robert Lucas, Jr. Volume 3* (1999): 532-63 Publication: Elgar Reference Collection. Intellectual Legacies in Modern Economics, vol. 3. Cheltenham, U.K. and Northampton, Mass.: Elgar; distributed by American International Distribution Corporation, Williston, Vt.

Barro, Robert J.; Lee, Jong-Wha, 2001. "International Data on Educational Attainment: Updates and Implications," *Oxford Economic Papers* v53, n3 (July): 541-63

Barros, Ricardo P.; Lam, David, 1996. "Income and Educational Inequality and Children's Schooling Attainment", in: Birdsall, Nancy; Sabot, Richard H., (1996), *Opportunity Forgone: Education in Brazil*. D.C.: IADB, 337-366.

Basu, Kaushik, 2003. "The Global Child Labor Problem: What Do We Know and What Can We Do?", *World Bank Economic Review v*17, 147-173.

Basu, Kaushik, 1999. "Child Labor: Cause, Consequence, and Cure, with Remarks on International Labor Standards." *Journal of Economic Literature* v37, 1083--1119.

Becker, Gary S. 1960. *A Treatise on the Family*. Cambridge, MA: Harvard University Press.

Bedi and Marshall 2002. "Primary School Attendance in Honduras." *Journal of Development Economics* v69, n1 (October 2002): 129-53

Behrman, Jere R. ; Pollak, Robert A. ; Taubman, Paul. 1995. *From Parent to Child: Intrahousehold Allocations and Intergenerational Relations in the United States*. (Population and Development Series). Chicago and London: University of Chicago Press,

Buchman, Claudia. 2000. "Family Structure, Parental Perceptions, and Child Labor in Kenya: What Factors Determine Who is Enrolled in School?" *Social Forces*, June 2000, 78(4): 1349-1379.

Burki, Abid and Tazeen Fasih. 1998. "Households' Non-leisure Time Allocation for Children and Determinants of Child Labour in Punjab, Pakistan," *Pakistan Development Review* v37, n4 (Winter): 899-912

Browning, Martin, and Pierre André Chiappori. 1998. "Efficient Intra-household Allocations: A General Characterization and Empirical Tests." *Econometrica* v66, n6 (November): 1241-78

Byrnes, D. & K. Yamamoto. 1989 "Views On Grade Repetition." *Journal of Research and Development in Education*, v20, pp14-20;

Chernichovsky, Dov, 1985. "Socioeconomic and Demographic Aspects of School Enrollment." *Economic Development and Cultural Change* v33, 319-332.

Currie, Janet and Duncan Thomas. 1995. "Race, Children's Cognitive Achievement and The Bell Curve," National Bureau of Economic Research Working Paper: 5240 August 1995.

Emerson, Patrick M. and André Portela Souza, 2002. Birth Order, Child Labor and School Attendance in Brazil. Vanderbilt University Working Paper No. 02-W12.

Gomes-Neto, João Batista; Eric A. Hanushek, 1994. "Causes and Consequences of Grade Repetition: Evidence from Brazil". *Economic Development and Cultural Change v*42, 117-149.

Grootaert, Christiaan and Harry A. Patrinos 1999. *The Policy Analysis of Child Labor: A Comparative Study*. New York: St. Martin's Press.

Harbison, Ralph W and Eric Hanushek. 1992. A *Educational performance of the poor: Lessons from rural northeast Brazil*. Oxford; New York; Toronto and Melbourne: Oxford University Press for the World Bank.

Horowitz, Andrew and Jian Wang. 2004. "Favorite Son? Specialized Child Laborers and Students in Poor LIC Households" *Journal of Development Economics, 73,631-42.*

Horowitz, Andrew and André Portella Souza. 2004. "The Dispersion of Intra-Household Human Capital Across Children: A Measurement Strategy and Evidence." Working paper – Sam M. Walton College of Business, University of Arkansas and Vanderbilt University.

Kassouf, Ana Lúcia. 2001. "Trabalho Infantil." In Lisboa, Marcos and Naércio Aquino Menezes-Filho, *Microeconomia e Sociedade no Brasil*, Rio de Janeiro: Contracapa.

Keane, Michael P. and Kenneth I. Wolpin 2001. "The Effect of Parental Transfers and Borrowing Constraints on Education Attainment," *International Economic Review*, Vol. 42, No. 4, Nov. p. 1051-1103

Lee, Jong-Wha; Barro, Robert J., 2001. "*Schooling Quality in a Cross-Section of Countries*." *Economica* v68, n272 (November): 465-88 .

Milgrom P. and Roberts J. (1990). "The Economics of Modern Manufacturing: Technology, Strategy, and Organization." *American Economic Review*. 80(3), 511-28.

____________ (1994). "Comparing Equilibria." *American Economic Review*. 84(3), 441-59.

Milgrom P. and Shannon, C. (1994). "Monotone Comparative Statics." *Econometrica* 62(1), 157-80.

Meisels, S. & Liaw, F. 1993. "Failure in grade: Do retained students catch up?" *Journal of Educational Research*. 87(2), 69-77.

Mello e Souza, Alberto; Silva, Nelson do Valle, 1996. "Family Background, Quality of Education and Public and Private School: Effects on School Transitions". in: Birdsall, Nancy; Sabot, Richard H., (1996), *Opportunity Forgone: Education in Brazil.* D.C.: IADB, 367-384.

Menezes-Filho, Naercio, 2003. "The Recent Evolution of Education in Brazil", University of Sao Paulo, mimeo.

Psacharopoulos, George and Eduardo Velez. 1991; "Educational Quality and Labor Market Outcomes: Evidence from Bogota, Columbia," *Sociology of Education*, Vol. 66(2), 130-145.

Ravallion, Martin and Quentin Wodon. 2000. "Does Child Labour Displace Schooling? Evidence on Behavioural Responses to an Enrollment Subsidy" *Economic Journal* v110, n462, 158-75

Schultz, Theodore W. 1971. *Investment in Human Capital* New York: The Free Press – A Division of Macmillan.

Topkis, D. M. (1979), "Minimizing the Submodular Function on a Lattice," *Operations Research*. 26(2), 305-21.

Topkis, D. M. (1998). *Supermodularity and complementarity.* Princeton, N.J. : Princeton University Press.

Table 1: Delay Dispersion Statistics

Variables	N	Mean	Std Dev	Minimum	Maximum
Households without a Single Mother					
Gini Coefficient of Age-Grade Distortion	14.486	0,063	0,065	0	0,561
Theil Index of Age Grade-Distortion	14.486	0,518	1,028	0	16,686
Coefficient of Variation of Age-Grade Distortion	14.486	9,357	9,615	0	79,334
Proportional Delay	14.486	0,518	0,390	0	1,000
Households with a Single Mother					
Gini Coefficient of Age-Grade Distortion	2.473	0,067	0,065	0	0,463
Theil Index of Age Grade-Distortion	2.473	0,540	0,985	0	11,159
Coefficient of Variation of Age-Grade Distortion	2.473	9,964	9,524	0	65,537
Proportional Delay	2.473	0,621	0,372	0	1,000

Table 2: OLS Regressions of Delay Dispersion Measures on Income Deciles for Single Mothers

	GINI			THEIL			CV			PDELAY		
Variables	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**
Single Mother	0,005	***	0,001	0,046	**	0,022	0,657	***	0,202	0,043	***	0,007
Income Deciles												
Decile One	Omitted Category			Omitted Category			Omitted Category			Omitted Category		
Decile Two	0,001		0,002	0,059	*	0,034	0,233		0,317	-0,002		0,011
Decile Three	-0,001		0,002	0,023		0,034	-0,110		0,319	-0,035	***	0,011
Decile Four	-0,003		0,002	-0,016		0,034	-0,476		0,316	-0,051	***	0,011
Decile Five	-0,005	**	0,002	-0,042		0,035	-0,725	**	0,326	-0,066	***	0,011
Decile Six	-0,009	***	0,002	-0,066	*	0,035	-1,293	***	0,329	-0,111	***	0,011
Decile Seven	-0,009	***	0,002	-0,056		0,036	-1,360	***	0,335	-0,161	***	0,012
Decile Eight	-0,013	***	0,002	-0,081	**	0,036	-1,918	***	0,340	-0,222	***	0,012
Decile Nine	-0,022	***	0,002	-0,195	***	0,037	-3,164	***	0,343	-0,303	***	0,012
Decile Ten	-0,027	***	0,002	-0,197	***	0,037	-3,853	***	0,348	-0,400	***	0,012
F(8, 16708)	30,32	***		10,59			30,36	***		241,93	***	
R-Squared	0,119			0,121			0,138			0,360		
# OBS	16.788			16.788			16.788			16.788		

Note: (i) *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(ii) The additional variables include both parents' age, rural area dummy, metropolitan area dummy, and state dummies.

(iii) The omitted regions are urban non-metropolitan areas and the State of Sao Paulo.

(iv) The F-test tests the joint equality of the decile dummy coefficients.

Table 3: OLS Regressions of Delay Dispersion Measures on Head of Household's Education Levels and Income Deciles

	GINI			THEIL			CV			PDELAY		
Variables	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**	**Coeff.**		**Est. Error**
Single Mother	0,005	***	0,001	0,050	**	0,022	0,723	***	0,202	0,052	***	0,007
Head of Household's Education												
Illiterate	Omitted Category			Omitted Category			Omitted Category			Omitted Category		
Lower Primary	-0,005	***	0,001	-0,078	***	0,022	-0,809	***	0,205	-0,062	***	0,007
Upper Primary	-0,011	***	0,002	-0,125	***	0,026	-1,568	***	0,242	-0,119	***	0,008
High School	-0,014	***	0,002	-0,138	***	0,030	-1,979	***	0,280	-0,216	***	0,010
College	-0,017	***	0,003	-0,164	***	0,042	-2,430	***	0,393	-0,264	***	0,013
Income Deciles												
Decile One	Omitted Category			Omitted Category			Omitted Category			Omitted Category		
Decile Two	0,001		0,002	0,057	*	0,034	0,213		0,317	-0,004		0,011
Decile Three	-0,001		0,002	0,027		0,034	-0,064		0,318	-0,032	***	0,011
Decile Four	-0,003		0,002	-0,009		0,034	-0,379		0,316	-0,043	***	0,011
Decile Five	-0,004	*	0,002	-0,028		0,035	-0,543	*	0,327	-0,050	***	0,011
Decile Six	-0,007	***	0,002	-0,045		0,036	-1,002	***	0,331	-0,083	***	0,011
Decile Seven	-0,007	***	0,002	-0,028		0,036	-0,964	***	0,338	-0,120	***	0,012
Decile Eight	-0,010	***	0,002	-0,044		0,037	-1,373	***	0,346	-0,164	***	0,012
Decile Nine	-0,016	***	0,002	-0,146	***	0,038	-2,379	***	0,358	-0,213	***	0,012
Decile Ten	-0,019	***	0,003	-0,128	***	0,043	-2,679	***	0,397	-0,257	***	0,014
Education: F(3, 16704)	11,73	***		2,98	**		11,42	***		146,97		
Deciles: (8, 14227)	10,90	***		4,61	***		11,07	***		73,17		
R-squared	0,123			0,123			0,141			0,383		
# OBS	16.788			16.788			16.788			16.788		

Note: (i) *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(ii) The additional variables include both parents' age, rural area dummy, metropolitan area dummy, and state dummies.

(iii) The omitted regions are urban non-metropolitan areas and the State of Sao Paulo.

(iv) The first F-test tests the joint equality of the head of household's education dummy coefficients. The second F-test tests the joint equality of the decile dummy coefficients.