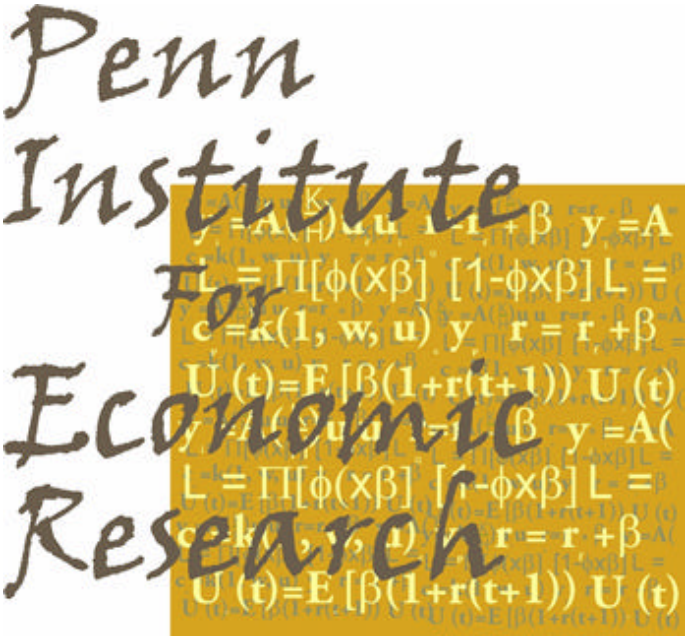

Penn Institute for Economic Research
Department of Economics
University of Pennsylvania
3718 Locust Walk
Philadelphia, PA 19104-6297
pier@econ.upenn.edu
http://www.econ.upenn.edu/pier

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"Mother's Schooling and Child Education: A Survey"

by

Jere R. Behrman

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MOTHER'S SCHOOLING AND CHILD EDUCATION:

A SURVEY

by

Jere R. Behrman*

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Address: Jere R. Behrman, Professor of Economics, McNeil 160, 3718 Locust Walk, University of Pennsylvania, Philadelphia, PA 19104-6297, USA; telephone 215 898 7704, fax 215 573 2057, e-mail: jbehrman@econ.sas.upenn.edu

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Abstract

Conventional wisdom is that: (1) mother's schooling has widespread positive substantial effects on child education; (2) these effects tend to be much larger than those of father's schooling; and (3) therefore, ceteris paribus, there is a stronger efficiency case (given education externalities) for subsidies for female than for male schooling. This paper first discusses a general framework for thinking about the impact of mother's schooling on child education and then surveys what we know on the basis of all 237 estimates that have been located. Examination of available estimates in light of this general framework suggests that knowledge on the impact of women's schooling on child education generally could be improved with more clarity about what model is estimated, roles of possibly important unobserved variables such as preferences and abilities, distinctions between particular and more-general total effects, and use of broader indicators of both mother's and child's education that capture outcomes rather than primarily time-in-school inputs.

Taken at their face value the central tendency of current estimates is consistent with the "widespread" and "positive" part of point 1 of the conventional wisdom, but not with the "substantial" part of point 1, nor for the claim that the effects of mother's schooling tend to be much greater than those of father's schooling -- and therefore not with a efficiency argument for large subsidies for female schooling, nor for larger subsidies for female than for male schooling.

Most studies, however, include among right-side variables some that possibly are determined partially by mother's schooling. On the basis of a priori considerations, a few studies that explore the effects of such procedures, and new estimates that characterize all estimates that have been located, the usual specifications lead to a substantial underestimate of the total effect of mother's schooling and a smaller upward bias in the estimated relative impact of mother's versus father's schooling, with control for income and less so school characteristics biasing the estimated effects towards mother's schooling and control for number of children and community characteristics biasing the estimates somewhat less towards father's schooling. In future work within the assumptions of the standard specification it would be desirable to explore how sensitive estimates of the impact on child education of mother's schooling are to the inclusion of other controls that arguably are determined by women's schooling.

Most existing studies do not control for possible biases in the estimated effects of mother's schooling due to unobserved (by analysts) abilities and preferences that directly affect child education and that are correlated with mother's schooling. A few studies suggest that unobserved preference and ability endowments may affect importantly the estimated impact of mother's schooling on child education, with estimates generally (though not always) biased upwards by the failure to control for these endowments. They also suggest that marriage market considerations may be critical for analyzing the impact of mother's schooling on child education, and that such considerations at least in some contexts increase the estimated impact of mother's relative to father's schooling. But these studies also point to the sensitivity of the results to how such endowments are controlled, including the limitations of partial controls through observed indicators. Therefore it is critical for interpretation that the underlying model be spelled out explicitly and used directly as a guide to the estimation method because estimates using behavioral data are necessarily conditional on particular assumptions about the underlying model and explicit modeling makes it clear on what the interpretation is based.

Women's schooling is widely thought to have important nonmarket effects additional to any effects on market productivity. Scholarly studies and the applied policy literature have stressed that for such reasons female schooling is an important factor in poverty alleviation and economic development strategies in a wide range of economies, as is reflected in the following quotations from diverse scholars and operational organizations: [1]

> "...once all the benefits are recognized, investment in the education of girls may well be the highest-return investment available in the developing world....Increased schooling has similar effects on the incomes of males and females, but educating girls generates much larger social benefits." Summers (1993, p. v)

> "As is now well known, educating women has a powerful multiplier effect on the well-being of families and on a society's general level of human development. As women become literate, fertility rates fall, infant and child health improves, children's educational level increases and household nutritional and sanitary conditions improve." UNDP (1996, p. 110).

> "Many, though certainly not all, studies have demonstrated that maternal education has a bigger impact on child human capital outcomes than that of fathers." Thomas, Schoeni and Strauss (1996, p. 14)

> "Such evidence would seem to indicate the importance of the mother in providing a learning environment for her child. It demonstrates a potentially important nonmarket benefit of mother's education that should be evaluated in assessing the value of subsidies to women's education." Heckman and Hotz (1986, p. 532)

> "...perhaps the most fundamental economic factor [in the determination of children's education] is the human capital of the parents, typically measured by the number of years of schooling attained. This variable ... is included in virtually every study [reviewed in this survey]; it is statistically significant and quantitatively important, no matter how it is defined. The human capital of the mother is usually more closely related to the attainment of the child than is that of the father." Haveman and Wolfe (1995a, p. 1855).

> "An important intergenerational effect of women's education is improved educational outcomes for children. In many cases, mother's education has been found to have a larger impact than father's education on children's schooling, even though father's education may also capture a beneficial income effect." Hill and King (1995, p. 25)

> "The economic and social returns to education for women are substantial; the latter are on the whole probably greater than those for men. Education raises the productivity and earnings of both men and women....Educated mothers have more educated children....Thus by educating its women, a country can...offer its children a better future. Yet, paradoxically, many countries spend less in educating women than they do in educating men." Herz, Subbarao, Habib and Raney (1991, p. iii).

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[1] Also see Behrman and Stacey (1997), Haveman and Wolfe (1984, 1993, 1994, 1995b), King and Hill (1993), Michael (1982), Schultz (1993b), World Bank (1990, 1991, 1995) and the many references therein.

> "In most studies of children in high-income countries, the mother's education has a larger effect than the father's, even though the father's education implies a larger effect on the family's income because he tends to receive a higher wage and to work more hours." Schultz (1993a, p. 74)

Among the more important possible nonmarket effects of women's schooling that often are mentioned explicitly in such claims are the positive effects of mothers' schooling on their children's education. The conventional wisdom is that the effects of mothers' schooling on children's education are positive, pervasive, substantial and tend to be much greater than the effects of father's schooling, with some claims that there are intergenerational gender links so that there are relatively large effects on daughters' education in comparison with those on sons' education. These effects are potentially very important because children's education is thought to shape in major ways not only their own economic and other options, but also how the broader society fares in attaining distributional and growth goals because of alleged important knowledge externalities. Therefore it is informative to know, for better understanding, prediction and policy, to what extent mother's schooling plays a major role in determining children's education.

In this paper I survey what we know about the effects of mother's schooling on child education. Section 1 begins with consideration of simple models within a set of stylized stages of child development during which mother's schooling may affect child education. This provides a framework with which to consider the existing empirical literature. It distinguishes *a priori* between different types of effects and different types of relations that might be estimated to ascertain the importance of various possible effects. It suggests how different market failures, perhaps conditional on the extent of economic development, may play critical roles in these processes. It also indicates that it may be difficult to estimate the causal impact of mother's schooling on child education versus the association of mother's schooling with child education.

Section 2 first presents the "data" used in the rest of the study -- all the studies that I have been able to locate on the impact of mother's schooling on child education -- and then considers both significance of coefficient estimates and the estimated magnitudes of these effects, whether they tend to differ depending on the level of development, the relative magnitude of effects of mother's versus father's schooling on child education and the relative magnitudes of mother-daughter, mother-son, father-daughter and father-son links. Section 3 considers some evidence, based on these same studies, about possible estimation biases due to subset of inappropriately included variables. Section 4 turns to more detailed consideration of a subset of studies that attempt to deal with some of the estimation problems related to usually unobserved variables and endogeneity of mother's schooling that are noted in Section 1. Section 5 concludes with a summary of what we know, what we do not know, and what are the possible policy implications of what we know.

Section 1. Framework for Analysis of Impact of Mother's Schooling on Child Education

Schooling is not identical with education if education means acquiring knowledge, including learning how to learn. Other factors than just schooling, such as the home and community environment, also affect education. But schooling generally is thought to be central for the education of children. Most of the available studies of the impact of mother's schooling on child education focus on indicators of child education related to schooling. Therefore it is useful to consider three stylized stages or periods of child development: pre-school years, school years, and post-school years. Mother's schooling may be associated with her child's education in any or all of these three stages, as well as with transitions from one stage to the next stage. There are some conjectures that the impact of family background, presumably including mother's schooling, is likely to fade over the child's life cycle because of the impact more and more of extra-familial factors (e.g., Featherman and Hauser 1978, Behrman, Hrubic, Taubman and Wales 1980). But for some educational input indicators, such as child school enrollment in high-enrollment societies, the margin for mother's schooling having an effect may only be reflected in behaviors of older children. In such cases the observed effects may be nonlinear, first increasing until the point of marginal educational decisions and then fading as the child ages further.

The effects of mother's schooling on child education may be direct, such as through increasing child cognitive achievement because of time that a more-schooled mother spends educating her children. Or the effects may be indirect because more-schooled mothers may have influence on other factors, from books available in the home to the quality of schools, that directly affect child education. Estimation of structural relations such as cognitive achievement production functions in principle can permit identification of direct effects. Estimation of reduced-form decision rules or demand relations in principal can permit identification of the total -- direct plus indirect -- effects. In Subsection 1.1 I consider both of these types of relations. In Subsection 1.2 I turn to some measurement and estimation problems.

Subsection 1.1 Relations that Might Be Estimated to Assess Impact of Mother's Schooling on Child Education

Structural Relations: Structural relations include the preference and production functions that are used to model behaviors, in this case those related to child education. Child education can be represented by a vector of capabilities that are produced by choice and predetermined variables in production processes that can be represented directly by production functions -- technical relations between "inputs" and "outputs." For example, cognitive achievement (CA) of a child at a point in time is one such capability that is widely hypothesized to be produced by vectors of variables such as: innate individual abilities and other genetic endowments (G) of that child, the child's health and nutrition status (H), the time that that child spends in learning at home (T^h) and at

school (T^s) and in other activities (T^o), the time of the mother (T^m) and of other household members (T^{oh}) in interaction with that child, schooling of the mother (S^m) and of other household members (S^{oh}), innate individual abilities and other genetic endowments of the mother (G^m) and of other household members (G^{oh}) that directly affect the education of that child, aspects of the home environment (e.g., availability of books) that affect child education (E^h), characteristics of schools that the child attends (E^s), characteristics of other environments to which the child is exposed that affect education (E^o) and chance events (e). These can be summarized by a production function that relates the various inputs to the output of interest, cognitive achievement (CA) in this example, of the general form:

(1) $CA = f(G, H, T^h, T^s, T^o, T^m, T^{oh}, S^m, S^{oh}, G^m, G^{oh}, E^h, E^s, E^o, e)$.

Time subscripts are not included explicitly. But each of the variables/vectors in this production function in general refers to the whole history of the child to the point at which the cognitive achievement of the child is measured. If this production function is to be estimated for a particular delimited period of time instead of the whole lifetime of the child to the point at which the child's cognitive achievement is measured, it is necessary to control for the initial values of the child's cognitive development (and other dimensions of educational development) at the start of that period, perhaps by focusing on the change in cognitive achievement during the period of interest.

Mother's schooling (S^m) enters directly into the production function as written in relation (1) because a major possible direct role of mother's schooling on child education is that mother's schooling may affect the effectiveness of any of the other inputs. Most emphasized in the literature on child development is that more schooled-mothers use the time that they spend with their children more effectively in terms of educating their children than do less-schooled mothers. That is, if time that the mother spends with the child is measured in "efficiency units" that reflect the marginal effectiveness of that time in educating the child (analogous to the use of efficiency units of labor to represent the productivity impact of heterogenous human capital in other processes), the number of efficiency units that the mother spends with the child depends in part on the clock time that she spends with the child and in part on her schooling. But a more-schooled mother may make more effective use of any of the inputs, not just the time that she spends with the child. For example, a more-schooled mother may provide guidance and supervision so that books and other learning materials in the home are used more effectively in child education. Direct estimation of production functions for various dimensions of child education could illuminate to what extent mother's schooling enhances the effectiveness of the time that she spends with the child and of other inputs into the production of these dimensions of child education. To explore this question the empirical specification of the production functions would have to allow for interactions between mother's schooling and other inputs into child education.

Dynamic Decision Rules or Reduced-Form Demand Relations: Underlying the determination of the

inputs into educational production functions are behavioral choices. If mother's schooling affects the choice of these inputs, as in general it would seem that mother's schooling would, the total effect of mother's schooling includes the direct effect through the production function as in relation (1) plus the indirect effects through changing the other inputs.

The usual formulation for what determines the choice of inputs into such production functions is consistent with parents maximizing in each period or stage an objective function subject to production function constraints (such as in relation 1), actual and expected market prices (P_t, P^e_t), and assets as of the end of the previous period (A_{t-1}). The objective function itself may reflect some implicit or explicit bargaining among household members with different preferences and different control over resources.[2] The objective function depends, *inter alia*, directly (e.g., because of parental altruism) or indirectly (e.g., because of expected intergenerational transfers from the child to the parents in the latter's old age) on child education. Mother's schooling (as well as her innate abilities and preferences and other assets and attributes that she bought to the household) are among the predetermined variables for this maximization that are included in the end-of-previous-period assets. Dynamic decision rules are implied for all of the choice inputs into child education (as well as inputs into other production processes) and for all choice outcomes for this period including child education (C_t), with the realization of these outcomes also dependent on a vector of stochastic terms (u_t):

(2) $C_t = h(P_t, P^e_t, A_{t-1}, u_t)$.

These reduced-form decision rules could be estimated to find the effect of mother's schooling during the period of interest on inputs used to produce child education and on indicators of child education. An alternative is to substitute into relation (2) the previous period determinants of these outcomes -- including, presumably, previous period prices and expected prices and mother's schooling and her abilities and capabilities that are part of the household's initial conditions (A_0):

(3) $C_t = h(P_t, P^e_t, P_{t-1}, P^e_{t-1}, \ldots A_0, u_t, u_{t-1}, \ldots)$.

This changes what is estimated from the impact of mother's schooling on current child education to the cumulative impact of mother's schooling on child education.

Unbiased estimates of the decision rules for educational inputs may yield significant effects of the indirect effects (i.e., those on choices of production inputs rather than on the production process) of mother's schooling

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[2] In principle one could incorporate the household formation process into the analysis, as Foster (1996) emphasizes. This process may involve matching in part on unobserved variables relating to capabilities or preferences for educating children. I am unaware of studies other than Foster's that attempt to estimate empirically the impact of marriage market matching on estimates of child education, so I put aside this discussion until I discuss his paper in Section 4.

for a number of reasons: (1) more-schooled mothers may be better at choosing appropriate educational inputs than are less-schooled mothers given uncertainties about qualities and effectiveness of heterogenous educational inputs; (2) more-school mothers may assess expected prices, including those for future returns to education, better than do less-schooled mothers; (3) more-schooled mothers may be able to deal better with shocks than less-schooled mothers;[3] (4) more-schooled mothers may add more to household resources than less-schooled mothers (either through adding to income and/or through reducing pressures on given resources by having fewer children) and child education either is a normal consumption good or child educational investments depend on household income because of capital market imperfections for human resource investments; (5) more-schooled mothers may assure that a larger proportion of any given level of household resources go to child education than do less-schooled mothers because they have more bargaining power over intrahousehold allocations than do less-schooled women and are likely to have more pro-child-education preferences than their husbands (or other relevant household decision makers); and (6) more-schooled mothers serve as role models who, by virtue of their example, elicit more intensive educational effort from their children.

Unbiased estimates of the decision rules for child educational outcomes may yield significant effects of mother's schooling for all the reasons listed in the previous paragraph plus the reasons discussed above with respect to educational production functions. These are the total effects -- including both the direct effects in the production process and the indirect effects through the choice of production inputs.

Relations (2) and (3) both point explicitly to the role of prices and therefore markets, which relate to the question of why mother's schooling may vary substantially at different stages of child development and in different contexts even if the underlying production relations for child education are identical.

The relative importance of various educational production function inputs tends to vary across the development stages of the child. For very young children, the individual and household inputs are likely to be relatively important because markets are unlikely to be very developed for the types of inputs needed, particularly if they are needed at irregular intervals over long hours. Once the child goes to pre-school, school or to work, the time spent in those activities and the nature of those environments are likely to increase in relative importance in comparison with the home environment.

Markets and the relative actual and expected prices also very substantially across societies and, within societies, across regions -- particularly between rural and urban areas in developing countries. There is a tendency for markets to be more developed in higher-income societies and in urban areas of developing

[3]This possibility is related to the point about education helping individuals deal with innovations that was emphasized long ago by Welch (1970) and Schultz (1975) and for which Rosenzweig (1995) summarizes some recent systematic empirical evidence.

countries, including markets for goods and services related to child development. Where such markets are more developed, the alternatives to using mother's schooling for child education tend to be greater and less costly, so there is more substitution of these alternatives for mother's schooling than where such markets do not exist or are less developed so that households and families must perform more functions (e.g., Ben-Porath 1980, Pollak 1985). Likewise, where markets are more developed there tends to be greater options for more-schooled women in market activities, which means that the opportunity costs of mothers spending time in time-intensive child educational activities is higher. Where markets are more developed, there also are likely to be more emphasis on secondary and tertiary education, at which levels the direct impact of the home environment is likely to be less than for pre-school and primary education. Further with the process of development and more emphasis on brain relative to brawn, the relative gains from women specializing in household production tends to decline. For all of these reasons, *a priori* it would seem that mother's schooling would tend to be less important in child education in more developed economies. On the other hand in more developed economies, or perhaps in more rapidly changing and developing economies, the information processing role of mother's schooling may become more important. Also if there is a tendency for reductions in the importance of extended households with the process of development, this implies a decline in the availability within the household of alternatives to the parents (e.g., grandparents) for the home dimensions of child education.

Subsection 1.2 Measurement and Estimation Problems

Making confident inferences about causal effects of the impact of mother's schooling on child education from the types of behavioral data that usually are available to social scientists is difficult because of data and estimation limitations. I now turn to some of these problems.

1. Random measurement error in observations on mother's schooling: As is well known, random measurement error in a right-side variable tends to bias the estimated effect of that variable towards zero. Recent estimates for the United States, for example, suggest that survey-reported years of schooling may have a noise-to-signal ratio of about 0.10 and thus underestimate the impact of schooling by about that order of magnitude.[4] Arguably the noise-to-signal ratio for women's schooling is somewhat bigger than that for men's schooling in samples in which the primary respondents are household heads (often defined to be males if prime-age adult

[4]These studies focus on the role of schooling in determining earnings, but the point regarding the underestimate of the impact of schooling due to random measurement error (including the exacerbation of the bias in "within" or fixed effects estimates) holds equally for nonmarket outcomes. See Ashenfelter and Krueger (1994), Ashenfelter and Zimmerman (1997), Behrman, Rosenzweig and Taubman (1994) and the references therein.

males are present and not incapacitated) because, rather than self-reports as for the household heads, the reports are second-hand. Using transcript-based schooling attainment rather that self reports presumably would eliminate most of this measurement error, but collecting such data often is very expensive. The impact of random measurement error can be controlled by using predicted mother's schooling rather than actual mother's schooling in estimates of relations (1)-(3) if (a) there are predictors (instruments) the errors in which are independent of the measurement error in mother's schooling and (b) these predictors are not correlated with the disturbance terms in the relations being estimated (with the latter condition being related to unobserved predetermined variables, which are discussed next). Candidates for such instruments include reports on mother's schooling from other individuals (which arguably satisfy (a) but probably not (b)) and price shocks her childhood household faced when the mother was of school age (which is likely to satisfy both (a) and (b)). It is of interest to note that if male household head's report women's schooling with random measurement error that is uncorrelated with the measurement error in the schooling that the women themselves would have reported, the reported women's schooling used in the estimates effectively serve as a good instrument for the true level of women's schooling for the purpose of eliminating the bias due to measurement error even if the noise-to-signal ratio for the reports of the male household heads is larger than that that would result were women to report their own schooling.

2. Unobserved predetermined variables that are correlated with mother's schooling and that enter directly into the relation being estimated: Such variables cause biases in the estimated effects of mother's schooling because in the estimates mother's schooling partially proxies for the correlated part of the unobserved variables. The direction of the bias depends on the signs of the correlations and on the signs of the true effects of the unobserved or omitted variables. Important candidates for such variables in production function estimates with most data sets include the mother's innate ability and other endowments (G^m), the child's ability and other endowments (G) that are correlated with those of the biological mother through genetic transmission, and school and community characteristics (E^s, E^o) that are affected/elected in part by community residents. Any such variables that affect the production function estimates also affect the reduced-form decision rule estimates. In addition there are other important candidates for unobserved variables in the reduced-form decision-rules. For example, more-schooled mothers may assure that a larger proportion of any given level of household resources go to child education than do less-schooled mothers because they have more pro-education preferences than do less-schooled women (and/or be matched in marriage markets with men who have more-schooled preferences). The examples given here of unobserved abilities and other endowments, and preferences are likely to lead to biases away from zero in the estimated impact of mother's schooling (though as Foster 1996 emphasizes, taken in isolation the covariances in unobservable preferences between spouses can in some contexts cause a downward bias in the estimated impact of mother's schooling -- see Section 4 below).

Such biases would be avoided if, instead of behavioral data, experimental data were used in which mother's schooling were randomly assigned. Such experiments of course are not conducted. But it is useful to state that that is one resolution of the problem to point out the questionableness of the usual (and usually implicit) assumption that mother's schooling is randomly distributed with respect to whatever is in the disturbance term of the relation being estimated. Such biases also might be avoided if mother's fixed effects estimates can be made in which mother's schooling changes over time (and thus her relevant schooling changes for the same child development stage for different children of the same mother), but such data rarely are available (see Section 4 for discussion of Rosenzweig and Wolpin 1994, the one example of which I am aware). These biases also could be avoided by using instrumental variable estimates in which the identifying instruments for the first stage estimates are (i) sufficiently good predictors of mother's schooling[5] and (ii) not correlated with the disturbance term in the relation being estimated. These may be difficult conditions to satisfy. Price shocks that the household in which the mother was raised faced when she was of school age are a possibility that satisfy (ii), but may or may not satisfy (i).

3. Unobserved choice variables that enter into the relation being estimated: Estimates of production functions usually are made under the assumption that all the relevant choice variables are observed. If some choice variable is not observed in the data, the failure to control for that variable may cause biases in the estimated coefficients for the observed variables in an indeterminant direction. Effectively estimates of the impact of the observed right-side variables may include not only their true direct impact but also part of the impact of the reduced-form determinants -- that include mother's schooling -- as they are transferred in reality through the choice variables that are not observed by the analyst. For an explicit example, in most data sets the time spent by mothers with their children in educational activities is not observed. The time that the mother spends with the child in most contexts is likely to be inversely associated with her schooling because the opportunity cost of such time in other activities is likely to increase more with schooling than her productivity in child care.[6] Therefore the direct productive effect of women's schooling in the estimation of relation (1) is likely to be underestimated *ceteris paribus* because the observed mother's schooling is inversely associated with the unobserved time that

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[5]See Bound, Jaeger and Baker (1995), Nelson and Startz (1990a,b) and Staiger and Stock (1997) for discussions of problems if the instruments are not good predictors of the variable being instrumented.

[6]In some contexts, however, the labor market returns to women's schooling are very low or nil (e.g., much of rural South Asia, see Behrman, Foster, Rosenzweig and Vashishtha 1997, Foster 1996, and Foster and Rosenzweig 1996), so the opportunity cost of mothers' time apparently does not increase with their schooling.

the mother spends with the child. Dealing with the possibility of unobserved choice inputs in estimates of production functions is difficult. Even experimental data do not solve this problem. It would seem that the best that can be done is to bring to bear *a priori* information in the form of other relevant estimates -- e.g, the subset of production function parameters that relate to the unobserved variables. Behrman and Lavy (1997) provide more detail and an illustration in which estimates of preferences determining intrahousehold allocations help to bound the implied true parameters of observed production function parameters in the presence of unobserved choice variables.

Unobserved current period choice variables are not a problem with properly specified decision rule estimates, though unobserved choice variables at the end of the previous period are a problem if relation (2) is to be estimated.

4. Imperfect indicators of child education: The most commonly used indicators of child education in the empirical literature reviewed below pertain to time in school -- school attainment, current enrollment, age of initial enrollment and of completing school, and probabilities of transitions among school grades or levels, grade repetition and dropping out. For children still in school, school attainment is right-censored, which may cause a bias in the estimated impact of mother's school (probably downward). Subject to distributional assumptions, statistical techniques can be used to control for this censoring (e.g., King and Lillard 1987). More generally, time in school is not identical with child education. As is indicated in relation (1), time in school perhaps is better viewed as an input into the educational process rather than the outcome of that process. From this perspective, time in school is a good indicator of child education only under some strong assumptions about the production technology and the efficiency of the production process -- e.g., that the production technology has fixed coefficients so that other inputs are not substituted for time in school, that the technological coefficients for time in school are independent of the time in school, and that time in school is binding in the production process. These seem very strong assumptions indeed. *A priori* and on the bases of a number of studies it would seem that individual characteristics, aspects of home and community environment and school characteristics (school "quality") can substitute considerably for time in school. If so, then the impact of mother's schooling on time in school, while of interest in itself because this in an important educational input, may not give a very good indication of what the impact of mother's schooling is on child education outcomes.[7] The ideal resolution if this

[7]Behrman and Knowles (1997b) provide an illustrative example of how the associations of educational inputs and educational outcomes with particular variables may vary considerably. They report, using Vietnamese data, cognitive achievement elasticities with respect to household income of only about a sixth of the school attainment elasticities with respect to household income. They conjecture that some combination of differential selectivity regarding who drops out of school (relating to income-ability interactions) and inefficiency in education production may reconcile these differences.

problem is to have good indicators of educational outcomes, not only of time in school, for the analysis.

5. Controlling for choices in other right-hand variables in the relation: If there is not control for the right-side choice variables in relations (1) and (2), simultaneity bias may contaminate the estimated impact of mother's schooling. This bias may be in either direction, depending on the exact details of the underlying true relations. To eliminate this bias, simultaneous estimation methods can be used, conditional on the structure of the overall behavioral model (and the assumptions at the end of the second point above).

Aside from the question of simultaneity, there is the question of whether the estimates that are attained are estimates of the total or of some partial effect of mother's schooling. As noted in Subsection 1.1, unbiased estimates of relation (1) yield estimates of the direct effect of mother's schooling on the production process outcome and unbiased estimates of relation (2) yield the total within-period effect of mother's schooling conditional on the (partially-choice) assets at the end of the previous period. These are interesting estimates, but it must be kept in mind that they do not reflect the total effects of mother's schooling if mother's schooling affects the other inputs in relation (1) or the end-of-the-previous-choice variables in relation (2). For the available literature this observation raises the question whether the total impact of women's schooling often may be misrepresented in estimates of what apparently are considered reduced-form decision rules because women's schooling may affect other right-side variables that commonly are included in the estimates -- household income, number of children, and school and community characteristics.

6. Mother's schooling versus mother's education: Presumably what is of real interest is the impact of mother's education on child education. But the empirical literature uses only mother's schooling attainment for investigations, so I refer to "mother's schooling" rather than "mother's education" in most of this paper. However, as noted with respect to child education in relation (1) in point 4 above, the time that mothers spent in school is only one input in mothers' education. Other factors, including the home and community environment and the quality of the schooling, also probably mattered. Therefore years or grades of schooling is an imperfect proxy for mother's education that may be partially but only imperfectly representing other factors. Because mother's schooling attainment is likely to only partly represent other factors that determined her education, the use of mother's schooling to represent her education is likely to misrepresent the total association between mother's and children's education.

Were this misrepresentation random -- i.e, were it the case that mother's education equals mother's schooling attainment plus a random term -- the use of mother's schooling to represent her education would be a case of classical measurement error, with the classical result of biasing towards zero the estimated effects of

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But, whatever the explanation, in this case the schooling attainment response would be quite misleading regarding the cognitive achievement response.

interest that is discussed in point 1.

But *a priori* and on the basis of estimates relating to economic outcomes, it would appear that mother's schooling attainment is correlated with other factors that affected her schooling but that are not observed in the data (e.g., better quality schools might have increased the education of mothers and induced them to attend school longer, Behrman and Birdsall 1983; children with greater genetic endowments have more and better schooling, Behrman, Rosenzweig and Taubman 1994, 1996). If so, *ceteris paribus* the estimated association between mother's schooling attainment and child education does not reflect the causal impact of mother's schooling attainment alone but also the other correlated determinants of her education due to the unobserved predetermined variable problem noted in point 2 above.

The net result on the estimated impact of mother's schooling is unclear. The true effect of mother's education may be underestimated or overestimated. Likewise the true effect of mother's schooling attainment probably is misrepresented as well, with the direction depending on the effects of random measurement error in point 1 versus that of correlated missing variables such as ability, school quality, and preferences regarding schooling.

To resolve this problem better measures of mother's education should be used. Studies of the impact of women's schooling on nonmarket outcomes should follow studies of the impact of schooling on labor market outcomes by shifting to measures of education (e.g., cognitive achievement) or the inclusion of school characteristics additional to school attainment, rather than limiting the representation of mother's education to her schooling attainment.

Section 2. Survey of Empirical Estimates of the Impact of Mother's Schooling on Child Education

Now I turn to the existing literature on the impact of mother's schooling on child education. Subsection 2.1 first introduces the "data" used in the rest of the paper -- the estimates from all of the studies that I have been able to locate -- and some general characteristics of the underlying studies. Subsection 2.2 turns to what these data imply about various dimensions of the magnitude of the estimated effects of mother's schooling on child education.

Subsection 2.1 "Data" and Some General Properties of the Estimates

This survey covers the 237 estimates from 85 micro studies that I have been able to locate on the impact of mother's schooling on child education.[8] These studies are summarized in three appendix tables. Appendix

[8]Undoubtedly there are many studies that are not included in this survey. In a few cases that is because I consciously selected one of several related studies by the same author(s) to represent a body of work. In some cases that is because, in order to keep this survey of manageable length, I have not

Table A1 summarizes 193 estimates of the marginal effects of mother's schooling on 14 indicators of inputs into child education that are presented in rough order of child age/development: (1) Mother's Home Time Use, (2) Ever Enrolled Probability, (3) Enrollment Age, (4) Current Enrollment Probability, (5)Time in School Given Enrolled, (6) School Choice, (7) Grade Repetition Probability, (8) Failed Grades, (9) On-Time Promotion Probability, (10) Grades Attained to Time of Survey, (11) Dropout Probability, (12) Probability of Progression to Next School Level, (13) Dropout Age, and (14) Completed Schooling Grades/Years. By "marginal effects" I mean the estimate of how much the child educational indicator changes with an additional year of mother's schooling attainment. Appendix Table A2 summarizes 37 estimates of elasticities of two child schooling indicators -- Household Educational Expenditure and Cognitive Achievement -- with respect to mother's schooling. Appendix Table A3 summarizes 7 estimates of the percentage impact of marginal changes in mother's schooling on earnings from earnings functions that control for *inter alia* for the child's schooling attainment and work experience. All three tables include information on other variables included in the multivariate estimates. In all three tables the significance and sign of the estimates are given even if the desired marginal effects, elasticities or percentage effects cannot calculated from the information provided in the study.[9] If more than one estimate is presented in a study, I include the estimate that I understand is the preferred one (and comment in the notes if alternative approaches change significantly the estimated impact of mother's schooling).

Before turning to the estimates themselves, the following general points related to the discussion in Section 1 merit emphasis:

First, most micro studies of the determinants of child education that I have been able to locate include mother's schooling attainment among the determinants. However there are exceptions. I have found 11 recent (all but three in the 1990s) studies for 18 different countries with dependent variables such as those that are included in Tables A1 and A2 that use data that apparently include mother's school attainment but that do not

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pursued related literatures on how mother's schooling might work through aspects of early child biological, cognitive and personality development to have an indirect effect on child education (though I note that in principle these effects can be substituted out --e.g., with estimates of relations of type (3) rather than of type (2) -- so that the total effects on subsequent indicators of child education are not missed). In still other cases I am sure that I have missed relevant studies because I am unaware of them. My knowledge of studies undoubtedly is much greater in the economics literature than in other literatures such as those in sociology, psychology, and education and much greater for developing countries and the United States than for other economies. I appreciate obtaining copies of additional related studies (or references to such studies) that I have not covered.

[9]Most of these are cases in which some limited dependent variable estimator (e.g., probit or logit) is used for the estimates in Table A1 or in which means are not given with which to calculate the elasticities in Table A2.

report a specification that yields an estimate for the separate impact of mother's schooling.[10] Thus a significant minority of recent investigators of the determinants of indicators of child education such as those in Tables A1 and A2 did not consider the role of women's schooling sufficiently important for the questions that they are asking to include it separately in their specifications.[11] For the myriad of earnings function studies, the vast majority *a priori* have excluded mother's schooling from the specification (in many of these cases the data used probably do not include mother's schooling). I have only been able to identify seven exceptions, which are summarized in Table A3.[12] Thus most analysts of earnings functions have not considered the possibility that mother's schooling might have a direct role in addition to any indirect role through adult children's schooling.

Second, rather than being limited to one country, such as the United States, these studies are on 23 countries, in a number of cases with separate estimates for rural versus urban areas. This permits considering a wider range of institutional settings and market development, among which arguably the roles of women's schooling in nonmarket activities, may vary than would be the case if it were limited to one country.

Third, almost all the estimates in Tables A1 and A2 are of the form of reduced-form decision rules, generally of a specification akin to relation (2) or (3). The only exceptions are three studies that are summarized in Table A2 that include estimates of cognitive achievement production functions and one in Table A1 related to time use of mothers and of children. This means that most of the estimates in Tables A1 and A2 focus on some aspect of the "total" effects, and therefore do not provide a basis for identifying which of the possible six or seven mechanisms noted in Subsection 1.1 through which mother's schooling might affect child education is important. A necessary qualification to this statement is that about four-fifths of the estimates in Tables A1 and A2 (79 percent) include some representation of household income, four fifths include community characteristics (83

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[10]Only father's schooling is included in Asby (1985), Boulier and Rosenzweig (1984), Jamison and Lockheed (1987), Psacharopoulos and Velez (1992), and Psacharopoulos and Yang (1991); neither father's nor mother's schooling is included in Datcher-Loury and Garman (1995) and Kingdon (1996a); only household head's schooling (with no differential effect by gender of household head) is included in Case and Deaton (1996), Chernichovsky (1985), Lloyd and Blanc (1995), and Stash and Hannum (1997); Anh, Knodel, Lam and Friedman (1996) include parents' average schooling without distinguishing between mother's and father's schooling.

[11]If mother's schooling is not correlated with the variables of interest in these studies, the lack of mother's schooling in their specifications does not cause biases in the estimates of interest for these studies. But some of these studies have stated interest in the effects of some determinants, such as family background and school quality, with which it would seem *a priori* in many data sets mother's school is correlated.

[12]In addition I have located two studies that include father's, but not mother's schooling: Featherman and Hauser (1978) and Lam and Schoeni (1994).

percent), the majority include the number of children (or related measures, 54 percent), and the majority include school characteristics (55 percent) among the right-side variables. Therefore, if women's schooling affects household income, the number of their children, school characteristics and/or community characteristics, part of the total effect of women's schooling may be captured by these variables. Probably their inclusion biases downward the estimated impact of mother's schooling as a representation of the true total effect. In any case many of the estimates in these tables are not really of "total" effects, but of total effects net of effects that operate through these other right-side variables. I return to explore the importance of this point in Section 3.

Fourth, the specifications used for the estimates summarized in Table A3 in contrast, can be characterized as wage production functions (though the inclusion of variables such as parental income in some cases means that the rationale for the specification is not clear) that are conditional on child schooling. The rationale for including mother's schooling in these earnings function might be that mother's schooling might cause child education beyond that represented by child schooling or that more-schooled mothers can process better information regarding future prices (and jobs and earnings) than less-schooled mothers. These interpretations are conditional on the assumed functional form so that mother's schooling is not just proxying for some nonlinear aspect of the impact of adult child's schooling that has not been included in the specification. It should be noted that the logic of the discussion in Section 1 implied that child schooling should be treated as endogenous in these studies, but in none of them is there this treatment (though one controls for unobserved childhood family fixed effects, Behrman and Wolfe 1984).

Fifth, all of the estimates in all three of these tables use mother's schooling attainment as the only indicator of mother's education. As discussed in Subsection 1.2, this is likely neither to be a good representation of mother's education more broadly construed nor is it likely to result in an unbiased coefficient estimate for the causal effect of changing mother's schooling attainment on her child's education. Only four of the studies that are summarized in the three tables, even concern themselves with possible endogeneity of mother's schooling and/or random measurement error (see Section 5). If the only estimation problem is random measurement error in mother's schooling, the use of actual mother's schooling attainment in almost all of these studies is likely to result in an underestimate of the causal impact of mother's schooling. But because there are likely to be omitted variables biases that probably work in the opposite direction, the net effect is unclear.

Sixth, most of these studies focus on the child schooling stage and the transitions into and out of that stage. The only exceptions are one study in Table A1 on mother's home time use (and possibly the second study in this category), one study in Table A2 on child cognitive achievement that includes pre-school children (age 3-8), and the studies in Table A3 on post-school earnings.

Seventh, most of these studies have as dependent variables what would seem to be inputs in the

production of child education within the framework of Subsection 1.1. The exceptions are the seven estimates in Table A3 in which ln earnings is the dependent variable and the 28 estimates in Table A2 in which cognitive achievement is the dependent variable -- just 15 percent of the total estimates in the three tables. Therefore, for this reason alone, the literature may be less informative about the impact of mother's schooling on child education -- as opposed to inputs used in child education -- than usually is assumed.

Eight, very few of the studies are concerned with any of the estimation problems that are discussed in Subsection 1.2. Those that explore such concerns are discussed in Sections 3 and 4.

Subsection 2.2. Basic Patterns in Empirical Estimates of Impact of Mother's Schooling on Child Education

I now turn to basic patterns in the estimates in the literature of the impact of mother's schooling on child education. In this summary, except where explicitly qualified, I discuss the estimates as if there are no estimation problems such as are discussed in Subsections 1.2 and 2.1 and Sections 3 and 4.

Signs, significance, and magnitudes of estimated effects: Table 1 summarizes the distributions of estimates for the different child education indicators with the medians, ranges and the percentage of the estimates with *a priori* significantly and insignificantly correct signs. Among the 237 estimates, 94 percent have the correct signs and 70 percent have significantly nonzero correctly-signed coefficient estimates.[13] Thus the available empirical estimates support the widespread view that mother's schooling is widely positively associated with child education. These effects seem to be widespread across most indicators for which there are more than a handful of estimates with (in descending order of the number of estimates) 86 percent positively significant and 97 percent positive for completed schooling, 76 percent positively significant and 100 percent positive for grades attained to time of survey, 58 percent positively significant and 95 percent positive for current enrollment probability, 57 percent positively significant and 93 percent positive for cognitive achievement, and 50 percent positively significant and 81 percent positive for ever-enrolled probability. Nevertheless there seems to be some tendency for the estimates to be substantially more likely to be significantly positive for the indicators of time in

[13]By "correct" I mean what usually is presumed *a priori* to be a positive relation between mother's schooling and child educational inputs and outcomes. However the relations that are estimated in most of these studies do not specify what combination of production and preference parameters interact with mother's schooling in the relation estimated. So, conceivably, a negative coefficient in the relation estimated is consistent with a positive direct production function effect of mother's schooling because there are more than offsetting negative effects through behaviors such as mother's time use or through preferences. In what follows, for simplicity, I use "correct" without further qualifications.

school (i.e., 86 percent for completed schooling, 76 percent for grades attained to time of the survey) than for cognitive achievement (57 percent) or earnings (43 percent). Therefore there seems to be more precision of the estimates for the child time inputs into child education than for the two child educational outcome indicators.

What are the magnitudes of the estimates? At the medians the estimates suggest that one more year of mother's schooling increases the grades attained by the time of the survey by 0.14 grades, the probability of progression to the next school level by 0.07, the completed grades by 0.19 grades, household educational expenditures by 1.0 percent, cognitive achievement by 0.5 percent, and earnings by 0.0 percent.[14] Within most samples the standard deviation in mother's schooling attainment is 3-4 grades, so a one standard deviation change would imply effects 3-4 times these magnitudes. Whether there are large or small effects is somewhat in the eye of the beholder. In my judgement, all in all the medians of these estimated effects do not seem at that large, particularly for the educational outcome measures -- cognitive achievement and earnings -- that would seem to be of primary underlying interest.

Stages/ages of child development: There are suggestions in the literature, as noted, that mother's schooling is likely to be particularly important in the earlier stages of child development but also there are suggestions that, at least in higher-education societies, the effects may be nonlinear, first increasing and then decreasing with child age. The estimates that are summarized in the appendix tables, as observed in Subsection 2.1, are quite concentrated in the child schooling stage, with almost nothing for the pre-school stage and relatively little for the post-school stage. That limits the extent to which they provide a basis for considering patterns in the effects of mother's schooling related to these stages.

But some crude insight might be obtained by considering whether the effects differ systematically depending on child age. Table 2 summarizes information similar to that in Table 1 (plus some information that is referred to below with regard to differences in estimated effects of mother's versus father's schooling), but with the studies subdivided into two groups: those in which the children in the sample primarily were 12 years old or younger (31 percent of the total) and those in which the children in the sample primarily were over 12 years age. Comparisons of the median estimates for mother's schooling for the four educational indicators that such comparisons can be made or simple counts of the total number of *a priori* "correct" significant coefficient estimates or of the total number of *a priori* "correctly-signed"coefficient estimates do not indicate much in the way of differences in effects between these two groups of studies. A formal test of whether the estimates differ between these two groups of studies (that allows for a complete set of interactions for the 17 different categories of child educational indicators as well as additive differences among categories) rejects decisively such

[14]The two percentages for household expenditures and cognitive achievement are under the assumption that mother's schooling is 10 years so that a one-year increase is 10 percent.

differences ($F(5, 96) = 0.11$, Prob > F = 0.99). Similar results are obtained if samples are separated into those for which the children are primarily nine or younger versus the older than nine or if other variables are added as controls (see note b to Table 8).

Nonlinear effects of mother's schooling: The effects of mother's schooling may be nonlinear in a manner that is related to the differential impact of mother's school at different stages of child development. If, for example, mother's schooling primarily facilitates the acquisition of basic literacy and numeracy through pre-school and primary school ages of children, there may be little in the way of effects of higher levels of mother's schooling. For other possible effects, however, higher levels of mother's schooling may play a role -- e.g., for processing information about educational choices for their children, particularly those regarding higher levels of child education, or for political advocacy of better schools. Over a sixth of the estimates that are summarized in the appendix explicitly explore such nonlinearities. The general result is that lower levels of mother's schooling are more likely to be significant and/or to have larger effects than higher levels of schooling. For the developing countries generally this means that mother's primary schooling or basic literacy is more important than higher levels of her schooling.[15]

For the United States there seems to be some tendency, in the same spirit, for mothers having completed high school to have larger and/or more frequently significant effects than mothers' college education. Thus there seems to be a tendency for mother's basic schooling to be more important in child's education than higher levels of mother's schooling, with an increase in what is meant by "basic" with economic development.

Stages of economic development and cross-country and urban-rural differences: Because market options and governmental activities tend to increase with the process of economic development, as noted in Section 1, the importance of mother's schooling in child education may change with economic development. The data that are summarized in Tables A1-A3 do not permit a very calibrated measure of the relevant economic development for different samples because many of the samples are selected for particular subpopulations rather than being nationally representative. However about a fifth of the estimates are for the United States, and the rest are for countries that generally are characterized as developing countries.[16] Therefore, as a crude approach to exploring whether the level of development matters, I first consider whether the estimates for samples from the United

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[15]These seems to be a similar tendency for father's schooling, though with exceptions for Pakistan and Zimbabwe in the sense that only higher levels of father's schooling are significant (Alderman, Behrman, Ross and Sabot 1996, Nyagura and Riddell 1993).

[16]There are two estimates for 10-29 year olds in Taiwan in 1989 for whom arguably educational decisions were made in the context of a developed economy. But the patterns summarized below are not sensitive to how these estimates are classified.

States differ much from those from other countries (Table 3).

Perhaps somewhat surprisingly, there does not seem to be much of a pattern that distinguishes the overall summary of the estimates from United States' samples in Table 3 from other samples. The incidence of significant and correctly-sign estimates, for example, is about the same (74 percent for the United States versus 69 percent for other countries). But the estimates for the two country groups are distributed very differently across the educational indicators -- for the United States' samples 69 percent of the estimates are for completed grades/years of schooling and 20 percent are for cognitive achievement, in comparison with 14 and 9 percent respectively for these two indicators for the other countries. For the two educational indicators for which there are at least five estimates for each of these country groups, again completed grades/years of schooling and cognitive achievement, there also does not seem to be much of pattern. The median estimates indicate stronger effects for the United States' samples for cognitive achievement (an elasticity of 0.10 versus 0.04), but weaker ones for completed grades/years of schooling (a marginal effect of 0.13 versus 0.23).

To investigate whether underlying Table 3 are some more systematic patterns, Table 4 presents a regression to test statistically whether the estimates differ systematically between the United States' and developing countries' samples. Though most of the individual point estimates have considerable imprecision, an F test rejects restricting all the United States' sample coefficients to zero at the 0.0008 level.[17] The point estimates indicate in United States' samples the estimates for the base category, completed schooling grades/years, is -0.22 below those for other countries -- a magnitude that is about the same as the overall median for all the estimates in Table 1. For cognitive achievement estimates for the United States' sample tend to be about 0.05 higher and for earnings about -2.50 lower than for the other countries.

A related possibility is that there may be important rural-urban differences in market alternatives for child education. Almost 40 percent of the estimates in the appendix tables are identified as being for either rural or urban samples, all in developing countries. Table 5 is similar to Table 3, but with the distinction in Table 5 between rural and urban samples. For the one educational indicator for which there are at least 10 estimates for both rural and urban areas -- grades attained to time of survey -- the median estimate of the impact of mother's schooling for rural areas is over twice the magnitude of that for urban areas (marginal effects of 0.29 versus

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[17]This result, however, is not robust to the inclusion of the other controls considered below in Table 8 (see note b to that table). Therefore in Table 4 the indicator for United States' samples may be proxying for some combination of the controls in Table 8. The Spearman rank correlations between the indicator for the United States' samples and these controls are -0.38 for income ($Pr > |t| = 0.0000$), 0.13 for number of children ($Pr > |t| = 0.0512$), -0.01 for father's schooling ($Pr > |t| = 0.9071$), -0.26 for school characteristics ($Pr > |t| = 0.0000$), and -0.37 for community characteristics ($Pr > |t| = 0.0000$).

0.13). This is consistent with the possibility that mother's schooling makes more difference for child education in rural areas than in urban areas because educational markets and public schools are less developed or because a higher proportion of mothers do not have basic schooling in rural areas than in urban areas. But there is not much else in this table that permits exploration of such a pattern because there are so few estimates the magnitudes of which can be compared across studies for the other educational indicators. Moreover, with regard to simple significance of estimates there is not much difference between rural and urban areas (though the incidence of significance is a little higher for the urban samples). Finally, if relations are estimated parallel to those in Table 4 but with the urban-rural distinction rather that the United States-other country distinction, an F test indicates that the urban-rural distinction is not significant ($F(4,20) = 1.31$, Prob > F = 0.30).

Mother's schooling effects relative to father's schooling effects: As noted in the introduction, it is widely claimed that the effects of mother's schooling on child education tend to be greater than the effects of father's schooling. In part this is a common perception because in all societies mothers tend to spend much more time with their younger children than do fathers, though in many societies fathers spend more time with older children (particularly males) than with younger children. This perception is strong enough that in almost a tenth (8.9 percent) of the estimates summarized in the appendix tables, father's schooling is not included in the specification.

But the *a priori* reasons why mother's schooling might affect child education that are discussed in Section 1 also would seem to hold for father's schooling. And some of these -- including those related to generating household resources and processing information -- do not necessarily depend on the parent spending a lot of time with the child. In terms of generating household resources, in fact, it often is claimed that father's schooling tends to be more important than mother's schooling. Therefore it is not clear *a priori* that the total effects on child education are larger for mother's schooling than for father's schooling, though it would seem that those that depend on time spent with the children are likely to be larger for mother's than for father's schooling. It also would seem to be the case that for some of the effects -- e.g., those related to assessing information -- there would be considerable substitution possibilities between mother's and father's schooling, but this possibility is almost not considered in the literature.[18]

Table 6 summarizes the distributions of a measure of the impact of mother's relative to father's schooling on the different indicators of child education that are included in the appendix tables: the estimated mother's

[18]The one exception that I have noted is Barros and Lam (1996), who report positive interaction effects (if significant) in their study of Brazil, which suggests gross complementarities rather than gross substitution between mother's and father's schooling. Otherwise generally such possibilities are not mentioned; an exception is Behrman, Foster, Rosenzweig and Vashishtha (1997) who explicitly assume perfect substitution between mother's and father's schooling in child education through the efficiency units of time that parents spend with their children.

impact minus that for fathers as a percent of their average estimated impact. If the mother's schooling impact on child education is greater than that of the father's schooling, this measure is positive -- and vice versa if that of father's schooling is greater. For each child education indicator is given the mean, the percentage of positive values, the median, and the interquartile range for this measure.

For the overall distribution, the standard deviation is 654 percent and the interquartile range is -40 to 56 percent, suggesting a wide range of estimates with a substantial numbers that are negative as well as positive. The overall mean, in fact, is -36 percent, implying that the impact of father's schooling on the average is substantially greater than that of mother's schooling. Of course the mean may reflect too great influence of outliers, so other measures of central tendency may be more relevant. The primary mode is 0 percent and the secondary modes are -10 and 10 percent -- suggesting a tendency for relatively equal estimates of impacts of mother's versus father's schooling. Slightly more than half (52 percent) of the values of this measure are positive, with the median at 10 percent. The patterns are similar for the distributions of this measure for the four individual categories of child education indicators for which there are the greatest number of estimates -- with medians of 9 percent for completed schooling grades/years, 0 percent for grades attained to time of survey, 5 percent for current enrollment probability, and 0 percent for cognitive achievement. Therefore these estimates suggest that there is a lot of variance across estimates, but the central tendency is for mother's and father's schooling to be about equally important in affecting child education. Thus the distributions in Table 6 do not particularly support the conventional wisdom that mother's schooling tends to be much more important in child education than father's schooling.

Of course is it possible that there are systematic differences by subsamples of estimates that are obscured in the overall estimates. For that reason the medians of the distributions of the same measure of mother's minus father's estimated effects relative to their average are included in the tables that summarize the estimates by subsamples of estimates defined by whether the sample primarily is from children 12 and under (Table 2), from the United States (Table 3) and from urban versus rural areas in developing countries (Table 4). For the last two of these, there is no systematic pattern ($F(1, 197) = 0.22$, $Prob > F = 0.634$ and $F(1, 61) = 0.00$, $Prob > F = 0.950$, respectively). However for the division by child age there does seem to be a systematic difference regarding the relative impact of mother's versus father's in the two age groups (and, therefore, of the estimates for father's schooling given that the estimated effects of mother's schooling do not differ significantly between the two age groups). Mother's schooling tends to have a somewhat greater impact relative to father's schooling for the samples that are primarily children 12 and under and vice versa for the samples that are primarily children over 12. For the younger sample 68 percent of the values of the measure for the mother's-minus-the-father's estimated effects relative to their average are positive, which is significantly greater than the 46 percent for the

older sample ($chi^2(1) = 7.60$, Pr = 0.006).[19] The overall median of this measure is 29 percent for the former and -11 percent for the latter. For all but two of the nine different sets of educational indicators for which there are estimates of this measure for both of these age groups, moreover, the median for the former is greater than that for the latter. One exception, time in school given enrolled, is based on only three estimates and therefore should not be given much emphasis. The second, exception, cognitive achievement, is important and, as noted, is one of only two indicators of educational outcomes (as opposed to inputs) on which the studies summarized in the appendix provide evidence. In this case the median with that for the samples with children primarily over 12 years of age (8 percent) slightly greater than that for samples with children primarily 12 and under (0 percent).

Thus, though the estimated impact of mother's schooling does not change between the two groups of estimates identified by child age and the estimated effect of mother's minus father's schooling does not tend to differ much from zero for the overall set of estimates, the estimated importance of mother's relative to father's schooling tends to be greater for educational inputs for the younger samples.

Intergenerational gender links: *A priori*, as noted in Section 1, there may be stronger educational links between parents and children of the same gender than across genders because, e.g., parental role models serve to elicit more effort from children of the same than of the opposite sex. For such reasons a number of researchers have estimated child educational relations separately for females (daughters) and males (sons) -- dating back in published studies at least to Datcher (1981) for the United States and King and Lillard (1987) for other countries. Appendix Tables A1 and A2 include 128 estimates, accounting for a little over half of the estimates that are summarized in the appendix, for either daughters and or sons (most of these are pairs of separate estimates for daughters and for sons using the same samples and specifications).

Table 7 summarizes the implications of these pairs of estimates for intergenerational gender links. The estimates under the three columns headed by "mother's schooling" refer to the median point estimates, number of correct significant signs, and total number of correct signs, respectively, for the impact of mother's schooling on daughter's education versus the impact of mother's schooling on son's education. The estimates under the three columns headed by "father's schooling" similarly refer to the impact of father's schooling on son's education versus the impact of father's schooling on daughter's education. For these six columns, thus, values greater than

[19]This result also is reflected in a logit of the sign of mother's - father's estimated effects on an indicator for samples primarily for children 12 and under. The logit result is robust to the inclusion of the other controls explored in Section 3 below (i.e., income, number of children, school characteristics, community characteristics), as well as a control for United States' samples. However the indicator for samples primarily for children 12 and under is not significant even at the 50 percent level in regressions with the values of mother's - father's estimated effects relative to their average as the dependent variable, whether or not controls are included.

one indicate positive intergenerational gender links -- i.e., a central tendency for mother's schooling to have a greater association with daughter's than with son's education and for father's schooling to have a greater association with son's than with daughter's schooling. The last two columns give the median ratios of estimated mother's to father's schooling effects, relative to their average, for daughters versus sons.

This table indicates strong intergenerational gender links for females. Overall: (1) the median estimate for the association of mother's schooling with daughter's education is 20 percent higher than the median estimate for the association of mother's schooling with son's education; (2) the number of correctly-signed significant coefficients is about 40 percent higher for the association of mother's schooling with daughter's education than for the association of mother's schooling with son's education;[20] and (3) for daughters the median ratio of the estimated mother's minus father's schooling effects indicates that the former is 18 percent greater than their average.[21] There are variations, but generally the patterns are similar for most of the individual educational indicators; the one notable exception is that for grades attained to time of the survey the median ratio of the estimated mother's to father's schooling is 0.7.

The intergenerational gender links for males, in contrast, on seem weaker. For all estimates: (1) the median estimate for the association of father's schooling with son's education is only 10 percent higher than the median estimate for the association of father's schooling with daughter's education; (2) the number of correctly-signed significant coefficients is only 10 percent higher for the association of father's schooling with son's education than for the association of father's schooling with daughter's education; and (3) for sons the median of the estimated mother's minus father's schooling effects, relative to their average, indicates that the latter is only 10 percent greater. For most of the individual educational indicators, moreover, the median estimate of the father's schooling for son's relative to daughter's education is smaller or more not likely significant than the median estimate of the mother's schooling for daughter's relative to son's education. For grades attained to the time of the survey and for household educational expenditures, in fact, the median estimate of father's schooling for son's education is less than for daughter's education.

Thus female intergenerational "solidarity" in the sense of strong educational associations apparently is

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[20]The total number of correctly-signed coefficients of mother's schooling in relations for daughter's education is only slightly greater than that for son's education, however. This reflects that over nine tenths (94 percent) of the coefficients of mother's schooling have correct signs even though only seven tenths are significantly nonzero at the five percent level (Table 1).

[21]Further, for matched pairs of estimates the mother's minus the father's estimated effects relative to their average is positive 58 percent of the time for daughters but only 36 percent of the time for sons, which is a significant difference ($chi^2(1) = 4.63$, Pr =0.031).

stronger than that of males.

Section 3. Impact of Specification Choices Regarding Usually Observable Variables

A few studies that are summarized in the appendix tables explicitly are use specifications that permit the estimation of some direct effect of mother's schooling on some child educational input or outcome. But these are very few in number -- namely three studies that estimate cognitive achievement production functions (Behrman and Lavy 1997, Glewwe, Jacoby and King 1996, Rosenzweig and Wolpin 1994) and one study that examines the impact of mother's schooling on her home care time use and on time of her children studying or in school (Behrman, Foster, Rosenzweig, Vashishtha 1997). Almost all of the rest of the studies are of general form of relation (2) -- reduced-form decision rules that are conditional on a set of variables that include the outcomes of past (or perhaps current) decisions. Among these behavioral outcomes are several that usually are observed in the type of data sets that have been used for these studies and that arguably depend on mother's schooling: income, number of children, father's schooling, school characteristics, and community characteristics. If so, these studies do not yield estimates of the total effects of mother's schooling even though they generally seem to be interpreted that way (as if relation 3 rather than relation 2 were being estimated). Instead they yield estimates of the effects conditional on these other outcomes -- which likely is an underestimate of the total effects of mother's schooling though in principle the bias could be in either direction. Moreover they may lead to biases in the estimated effects of mother's versus father's schooling on child education.

In this section I consider what are the implications of estimating these conditional relations rather than unconditonal relations for the estimates of the total effects of mother's schooling on child education and for the relative effects of mother's versus father's schooling. I consider explicitly the five groups of often-observed (in data sets used) variables mentioned above -- i.e., income, number of children, father's schooling, school characteristics, and community characteristics. For each I summarize (1) what the small proportion of the studies in the appendix that consider such questions find about the impact on the estimated effect of mother's schooling and of mother's versus father's schooling of including such variables and (2) the implications, based on the total set of estimates.

For (2), Table 8 gives a regression with the estimated impact of mother's schooling as the dependent variable and Table 9 gives a logit for mother's schooling having significantly correct signs, a regression for the estimated impact of mother's schooling minus father's schooling relative to their average, and a multinomial logit for mother's schooling having a significantly correct sign minus father's schooling having a significantly correct sign. In Table 8 the basic estimates in panel 8.1.A are for completed schooling grades/years, which is the child educational category for which there is the largest number of estimates. Panel 8.1.B includes estimates of how

the other categories differ from the basic estimates (which *a priori* they may because of differences in units).[22] The individual parameters are estimated with limited precision, but the overall relation and the parameter groups (i.e., all those involving income, all those involving number of children, all those involving community characteristics) are significantly nonzero at least at the 0.002 level. A chi^2 test indicates that the multinomial logit in Table 9 is significantly nonzero at the 5 percent level, but chi^2 and F tests indicate that the other two relations in this table are significantly nonzero only at the 10 percent level.

Household income: As is noted in Section 1, mother's schooling may have impact on child education in part through affecting household income. But most (78 percent) of the studies that are summarized in the appendix include some indicator of household income. If part of the effect of mother's schooling is through household income, the usual specification may underestimate the total effect of mother's schooling. On the other hand, estimates with and without household income might be of interest because, under certain assumptions, they would help to identify the extent to which mother's schooling worked through income. But most of the studies do not give estimates with and without income controls.

An exception is Hill and Duncan's (1987) estimates for completed schooling in the United States. They report that the coefficient on each parent's schooling drops over 35 percent in the relation for grades completed for the child as the same gender (and about half as much for the child of the opposite gender) if income is added to the specification. Their estimates, thus, indicate that, at least in this sample: (i) income may be an important channel through which mother's (and father's) schooling affects child education; (ii) an important part of the total effect of mother's (father's) schooling would be missed if income is included in the estimates and the impact through income is ignored; (iii) the impact of including income on estimates of the total effects is about the same effect on average for the estimated impact of mother's as for father's schooling (rather than greater for the latter, as often conjectured); and (iv) the intergenerational gender links would be underestimated if income is included in the estimates.

It is hard to know to what extent such results may generalize to other samples for two reasons. First, most of these studies use current income or expenditures, rather than some longer-run income measure at the time of critical schooling decisions as Hill and Duncan use (i.e., average income when the child was 14-16 years old). Behrman and Knowles (1997a) provide illustrations for one sample that suggest that the use of current expenditures or current income captures only a limited portion of the true longer-run household resource

[22]In the discussion below I focus on five of the child educational indicators for which the number of observations is relatively large. For the other indicators the interaction terms were dropped by the estimation program because there was not evidence of sufficient difference in the effect from that of the base indicator (perhaps because of too few estimates in the category).

constraint on child education. If this result generalizes, most of the studies that are summarized in the appendices that have some control for income may not underestimate the total effect of mother's and father's schooling as much as is indicated in Hill and Duncan's study. Second, institutions and behaviors differ considerably across locales that have been studied. In contexts in which women contribute smaller shares of household income than in United States, for example, the underestimate of the total effect of women's schooling from controlling for household income may be less and the underestimate of the total effect of men's schooling more than in the Duncan and Hill study.

What impact does including income have in the overall set of estimates? Regression 8.1 suggests including an income control reduces the estimated impact of mother's schooling on completed schooling grades/years by -0.14 (which is over 70 percent in absolute magnitude of the median in this category in Table 1), on grades attainted to time of survey -0.09 (which is over 60 percent in absolute magnitude of the median in this category in Table 1), on cognitive achievement by -0.04 (which is over 70 percent in absolute magnitude of the median in this category in Table 1), and on earnings by -3.73 percent (the median in this category in Table 1 is 0.0 percent). Logit 9.1 indicates that including income in the specification significantly reduces the probability that mother's schooling has a significantly correct sign. Multinomial logit 9.3 indicates that there is not a significant difference in the impact on the probability of correctly-signed significant coefficient estimates for mother's versus father's schooling. However regression 9.2 indicates that there is a significant positive effect (at the 10 percent level) of 2.2 percent on the estimates of mother's minus father's schooling effects relative to their average (which is about a fifth of the median of for this measure in Table 6). Thus, including household income as a control apparently reduces by a fair amount the estimated total impact of mother's schooling and the probability that the estimate is significant with the correct sign, but causes the total impact of mother's schooling relative to father's schooling to be overstated.

Number of children: A little over half of the studies (53 percent) control for number of children (or a related variable such as family). But none of them explore how the estimates of the impact of mother's schooling on child education change depending on whether mother's fertility is included in the specification. This is somewhat surprising because there is a large literature that claims that the strongest determinant of human fertility is (inversely) women's schooling (see Birdsall 1988 for references). If so, then controlling for number of children (sibling, family size) without incorporating the choice aspect of the determination of family size in the analysis presumably leads to an underestimate of the total effect of mother's schooling on child education, as well as a missed opportunity to estimate to what extent the effect of mother's schooling is transmitted through fertility decisions.

The overall set of estimates (regression 8.1) suggests including a control for number of children reduces

the estimated impact of mother's schooling on completed schooling grades/years by -0.16 (which is over 80 percent in absolute magnitude of the median in this category in Table 1), on grades attainted to time of survey -0.09 (which is over 90 percent in absolute magnitude of the median in this category in Table 1), on cognitive achievement by -0.04 (which is over 70 percent in absolute magnitude of the median in this category in Table 1), and on earnings by -7.10 percent (the median in this category in Table 1 is 0.0 percent). Regression 9.2 suggests somewhat (at the 20 percent level of significance) that there is a negative effect of -1.2 percent on the estimates of mother's minus father's schooling effects relative to their average (which is about a tenth in absolute value of the median of for this measure in Table 6). The other estimates for this variable in Table 9 are not significantly nonzero even at the 25 percent level. Thus, including number of children as a control apparently reduces by a fair amount -- if anything, more than including income -- the estimated total impact of mother's schooling and may cause the total impact of mother's schooling relative to father's schooling to be understated (rather than overstated as for income).

Father's schooling: If the interest really is in the total effect on the education of children of a particular woman of increasing her schooling, part of that effect pertains to how she fares in the marriage market, including the characteristics of the spouse that she obtains. From this perspective her schooling may affect the quality of the time that her spouse spends educating their children just as it may affect the quality of other inputs into the education of her children or it may affect the resources available for child education -- both through the schooling of her spouse.[23] But most of the literature abstract from this effect. Over 90 percent of the studies in the appendix include father's schooling.

The only one of these studies that explores the impact of including father's schooling is Heckman and Hotz's (1986) study of educational attainment in Panama. In this case the estimated impact of mother's schooling is over 70 percent higher if father's schooling is dropped from the specification than if father's schooling is included. The estimates in Table 8 indicate an impact on the estimated mother's schooling effects that is of the same magnitude as those for household income and number of children, though more imprecisely estimated. More generally, based on the observation that on the average in the studies that include both mother's and father's schooling the estimates are about the same and that the correlation between husband's and wife's schooling in most data sets is about 0.5 to 0.6, the standard omitted variable bias formula implies that the impact

[23]It might appear that, from a social point of view, for a given cohort of eligible males in the marriage market this is a zero-sum game -- if one woman attracts a more-schooled spouse then some other woman ends up with a less-schooled spouse. But this seems no different than the question, for example, of whether having a more-schooled mother increases the probability of entrance into an elite school that is filled to capacity. In both cases in the short run there may be a zero-sum game, but in the longer run possibilities of adjustments in response to changing demands.

of women's schooling is overestimated by about 50-60 percent. Thus, conditional on these assumptions, the bias in the estimated total impact of mother's schooling by including father's schooling may be substantial.

School and community characteristics: A substantial proportion of the estimates that are summarized in the appendix includes among the right-side variables observed school characteristics (54 percent) or other observed community characteristics 82 percent). If school and community characteristics are distributed so that they are not correlated with mother's schooling (and other family characteristics), such controls make no difference. But casual observations and political economy analysis and migration possibilities all suggest that school characteristics and community characteristics are responsive to characteristics of families that use the schools and live in the communities, possibly including mother's (and father's) schooling. If so, then inclusion of these school and community characteristics in the estimated relations may cause biases in the estimated total impact of mother's (and father's) schooling. The direction of the biases, moreover, is not obvious *a priori* because, leaving aside migration for the moment, it depends on the extent to which the social welfare function used by those who allocate school and community resources is strongly anti-poverty (and therefore allocates more to areas with poorer families with less-schooled parents) or is more responsive to political pressures from more effective (higher income, more-schooled) parents (Rosenzweig and Wolpin 1986).

I am aware of only a few empirical studies that explore how these allocations relate to parental schooling, directly or indirectly through household income, for the most part using aggregate data. DeTray (1973) reports that public school expenditures across 555 randomly-selected counties in the United States are significantly positively related to median schooling of women 25 and older, but not to that for men. This result suggests that controlling for school characteristics would cause a downward bias in the estimated impact of mother's schooling, but would not cause a bias in the estimated impact of father's schooling. Behrman and Birdsall (1988) present an explicit model that permits estimation of the social welfare parameters for the allocation of schooling resources among regions in Brazil; their results indicate significant equity-productivity tradeoffs in those allocations, with some favoring of higher-income (and higher parental schooling?) areas. Gershberg and Schuermann (1994) apply a similar approach to Mexican data and again find significant equity-productivity tradeoffs. Behrman and Knowles (1997b) report that school characteristics generally favor higher-income households (with more parental schooling) in Viet Nam, though with some exceptions for direct school fees and school congestion. Thus these studies are consistent with the possibility that allocations of public school resources are responsive to local conditions, including ones directly or indirectly related with parental schooling. Is so controlling for school characteristics in micro regressions of the determinants of child education may cause biases in the estimated total impact of mother's and father's schooling.

At least four of the micro studies on child education that are summarized in the appendix also provide

information with which to assess this impact more directly. (1) Birdsall (1985) presents estimates of the determinants of completed schooling for Brazilian children age 8-11 with and without a set of school and community characteristics (i.e., mean years of teachers' schooling in area, mean teachers' income per school-aged child in area, regional dummy variables). Her results indicate that the estimated impact of mother's schooling in urban areas is reduced by about two-fifths at the sample means if the school and regional characteristics are dropped from the specification. There are not significant changes in the estimates for father's schooling nor for mother's schooling in rural areas. (2) King and Bellew (1988) investigate grades attained in Peru with and without school characteristics. They find that if the school characteristics are dropped from the specification, the estimated impact of mother's schooling on daughter's grades attained increases by 51 percent and on sons' attainment increases by 6 percent; the estimated impact of father's schooling increases by 136 percent on daughter's grade attained and by 75 percent on son's grade attained. (3) Neal and Johnson (1996) report for a United States' sample that the estimated impact of mother's schooling on child cognitive achievement increases an average of 47 percent if school characteristics are dropped from the specification, and that of father's schooling increases an average of 13 percent. (4) Behrman, Ii and Murillo (1995) present estimates with and without control for community fixed effects (that include local school characteristics) in urban Bolivia. Their estimates indicate that the estimated impact of mother's schooling on grades attained to time of survey increase 111 percent and those of father's schooling increase 67 percent if the community fixed effects are dropped from the specification. (5) In addition to these micro studies, Pitt, Rosenzweig and Gibbons (1993) present relevant estimates for average schooling attendance using average data for 3,043 Indonesian subdistricts (*kecamatan*). They find that dropping subdistrict fixed effects controls has no significant impact on the estimated effect of mother's schooling on female attendance, but reduces substantially (i.e., to a third or a sixth, depending on the specification) the estimated effect of mother's schooling on male attendance. The estimated impact of the household head (usually male), in contrast, triples for females and more than quadruples for females if the subdistrict fixed effect is dropped.

The estimates in Tables 8 and 9 based on all the studies in the appendix give a somewhat mixed picture regarding the impact of controlling for school and community characteristics, perhaps in part because the specificity and the extent of the controls vary greatly cross studies in comparison, e.g., with the controls for income and number of children. With regard to the estimates of mother's impact on child education (regression 8.1), the control for school characteristics has a negative but very insignificant effect, so it has been dropped from the estimates in the table. The control for community characteristics has a positive effect of 0.12 on the estimate for completed schooling grades/years (over 80 percent of the median for the distribution of this estimate in Table 1) and a positive effect on the estimate for earnings of 1.45 percent, but a negative effect of -0.08 on the

estimate for cognitive achievement (large in absolute magnitude relative to the median of the distribution of 0.05 for this indicator). This suggests that the estimated total effects are biased downward if there are community controls for cognitive achievement estimates, but upwards for the other indicators. The estimates in Table 9 suggest imprecisely that controlling for community characteristics reduces and controlling for school characteristics increases the probability of mother's schooling having significantly correct signs (logit 9.1) and the estimated mother's minus father's effects relative to their average (regression 9.2), all significant only at 0.25 to 0.30 levels. The multinomial logit (9.3), however, indicates that controlling for schooling significantly reduces the probability of mother's schooling having significant correct-signed estimates relative to the father, which is opposite in spirit (though not necessary inconsistent with) to these last results.

Section 4. Studies that Address Endogeneity and Omitted Variable Bias Estimation Problems

The vast majority of the studies in the appendix tables simply present estimates of what might be interpreted to be reduced-form dynamic decision rules for children's education in which mother's schooling is among the right-side variables, though usually the model from which these relations are derived is not presented explicitly, which raises questions of interpretation, including those addressed in Section 3. A small minority of the studies, however, do explore some of the assumptions that are maintained without question in the others. In this section I review some of these studies and their implications.

Control for unobserved individual and family characteristics and the endogeneity of mother's schooling: Most of the studies that are summarized in the appendix do not concern themselves with usually unobserved (by analysts) individual and family characteristics such as "endowments" related to innate abilities and preferences or with the possible endogeneity (in the statistical sense that there is correlation with the disturbance term in the relation being estimated) of mother's schooling. But, as discussed in Section 1, it would seem that these usually unobserved characteristics may play a considerable role in the determination of child's schooling and be correlated with mother's schooling (perhaps because of intergenerational genetic links). Thus, the failure to control for them may cause biases in the estimated impact of mother's schooling -- probably in an upward direction.

The exceptions are the four studies that use instrumental variables[24] for mother's schooling (the fourth of

[24]Instrumenting also may control for classical random measurement error, as is discussed in Subsection 1.2. The changes in the estimates in the four studies summarized below, with and without instrumenting, in some cases are towards zero and in other cases away from zero but of quite large magnitudes. Therefore controlling for classical random measurement error (which in itself would be expected to increase the estimates on the order of magnitude of 10 percent or so, perhaps somewhat more in the fixed effects estimates) must be a small part of what the instrumenting is doing.

which also controls for unobserved family background endowments of fathers) and two that control respectively for unobserved individual or childhood family background endowments of mothers.

Three studies use schooling of a relative as an instrument for mother's (and for father's) schooling. (1) Behrman and Taubman (1985) use mother's sister-in-law's schooling as an instrument in estimates of schooling attainment for the United States. They explicitly control for intergenerationally-transmitted endowments using data on three generations, and then use instrumenting to eliminate a correlation between parents' schooling and their unobserved market luck that is introduced into the disturbance term in their manipulation to eliminate endowments. Conditional on their specific functional form assumptions, thus, their estimates control for endowments. This results in an estimate over twice as large as with OLS for females (daughters). For males (sons), the use of the same instrument changes what appears to be to a significantly positive estimate with OLS to a negative estimate. Instrumenting father's schooling with his twin brother's schooling results in increases in the estimated effect of 35 percent for males and 40 percent for females. (2) Lillard and Willis (1994) instrument parent's schooling using grandparents' schooling in estimates of the probability of progressing to the next school level in Malaysia in order to control for possible endogeneity; the estimates drop about 30 percent for both mother's and father's schooling with this instrumenting. (3) Barros and Lam (1996) in estimates for schooling attainment in Brazil likewise instrument parents' schooling with grandparents' schooling. They explicitly consider two alternatives -- one in which endowments are controlled by including grandparents' schooling in the specification and the other in which grandparents' schooling is posited to work only through parents' schooling and thus is used as an instrument for parents' schooling. (Lillard and Willis (1994) effectively make the latter assumption.) These assumptions push back the concern with unobserved endowments, but still basically make strong assumptions about the relation between schooling and unobserved endowments: in the former case it is assumed that grandparents' schooling represents all aspects of endowments that otherwise would be in the disturbance term that are correlated with parents' schooling and in the latter case it is assumed that grandparents' schooling is uncorrelated with all aspects of endowments that are in the disturbance term that are correlated with parents' schooling. These quite different (and inconsistent) assumptions permit some test of how robust the estimates are to different approaches to controlling for unobserved endowments. Unfortunately the Barro and Lam results suggest that, at least in that sample, the estimates vary a lot -- individually they increase by 6-170 percent -- depending on which of these assumptions is used.

Behrman, Foster, Rosenzweig and Vashishtha (1997) present household fixed effect estimates, controlling for unobserved characteristics of father's household, for Indian farm household children daily school and study hours with and without instrumenting mother's schooling (literacy). In this case the instruments are local technological shocks when the father was of marriage age that they argue are independent of the

disturbance term in the within household estimates for time that children spend studying or in school.[25] The instrumented estimates indicate an impact of mother's literacy that is more than double the uninstrumented estimates. Also of interest is the impact of the control for the father's family endowments by using within household estimates in a context in which extended households make possible such estimation. OLS estimates of the determination of children's school and study hours yield significant effects of mother being literate and of father having primary schooling. But within household estimates, while still yielding estimates that imply that mother being literate has a significantly positive effect of about the same magnitude (with the exact magnitude depending on the instrumenting discussed above), yield estimates of the effect of father's primary schooling that are less than a fifth of the OLS estimate and that are very imprecisely estimated (and would not be judged nonzero even at the 50 percent level of significance). That is, in this case, the apparent direct effect of father's schooling of more-or-less the same magnitude as of mother's schooling in standard OLS estimates evaporates in within-household estimates while the estimated effect of mother's schooling is robust to the estimation alternatives considered. Thus in the OLS estimates the estimated direct impact of father's schooling on child educational time use is strongly contaminated and biased upwards by proxying for household preferences regarding time use and possibly household resources. To the extent that the within-household estimates of the effect of father's schooling differ from the OLS ones because of the control for household resources, of course, father's schooling still may have an important indirect effect. However the authors downplay this possibility because, if there were such an effect, it also would seem to be reflected in subhousehold allocations of household resources so that father's schooling would still seem to be important even in the within household estimates.

Another of the studies that is surveyed in the appendix also controls for childhood family effects, in this case for the mothers, by using data on adult sisters and half-sisters in Nicaragua (Behrman and Wolfe 1984). For completed schooling for females the within estimates of mother's schooling are 30 percent of OLS estimates and the within estimates of father's schooling are 40 percent of the OLS estimates. For household income the within estimates of mother's schooling are significantly negative in contrast to insignificant negative estimates for OLS, while the within estimates of father's schooling are 70 percent greater than the OLS estimates (and significantly positive). These results are suggestive that controlling for mother's endowments also may affect the estimates importantly, and in some cases as much or more so for mother's as for father's schooling effects. But generalizing from these estimates is somewhat risky because of their dependence on half-sisters to obtain within effects. Also they do not control for measurement error, the effects of which, as is well-known, are exacerbated

[25]As the authors note, if mothers' preferences related to child schooling are heterogenous and known at the time of marriages, then the instruments used may not be independent of the disturbance term in the child's time use relation.

with within estimates, though the result that the within estimates are larger in absolute magnitude in several cases could not come from the classical measurement error model.

One last study that is reviewed in the appendix controls for individual fixed effects using longitudinal data from the United States that includes achievement tests for multiple young children within a family in which the mother obtained more schooling between the births of the children (Rosenzweig and Wolpin 1994). Estimates of the effect of mother's schooling that control for the mother's unobserved endowments by using the information on mother's schooling between the births of her children are preferred, according to statistical tests. They also are much different than estimates obtained with no such control or with partial control using observed test scores (Armed Force Qualifying Tests) to attempt to control for such endowments. The one for the Peabody Individual Achievement Test Mathematics Assessment and Reading Recognition Assessment is 60 percent higher than the estimate that does not control for these endowments, but much more imprecisely estimated (and not significantly nonzero at standard levels). The one for the Peabody Picture Vocabulary Test is about two thirds of the one without control for endowments, and not significantly nonzero.

Incorporation of marriage market considerations: Almost all of the studies that are surveyed in the appendix take as given a particular father and mother with their observed (including schooling) and unobserved characteristics. This does not cause bias if marriage/mating is random. But casual observation and correlations of observed variables such as schooling suggest that it is not random. If marriage market outcomes reflect choices that are based in part on unobserved preferences and abilities related to child education, the usual practice is likely to lead to biases in the estimated impact of mother's schooling. Very few studies that consider the impact of mother's schooling on child education deal at all with these issues.[26]

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[26]There are a few studies that do not deal directly with child education, but deal with related questions regarding unobservables and marriage. For example, Boulier and Rosenzweig (1984) investigate the simultaneous determination of women's schooling, age of marriage, spouse's earnings, and number of children ever born in the Philippines. They find that consideration of these behaviors as simultaneous in the presence of unobserved characteristics that affects women's marriage market outcomes reduces the estimated impact of women's schooling on age of marriage and number of children ever born and that the residual from the women's education relation is positively correlated with the residual in the age of marriage relation but negatively correlated with the residual in the spouse's earnings relation (which they interpret to mean that more attractive women has less education and marry when younger to higher-earnings spouses). Brien and Lillard (1994) likewise allow for correlated residuals among relations for women's schooling, age of marriage, and timing for first conception using Malaysian data. They find negative correlations between residuals for age of marriage and education and for education and fertility (the former significant). Thus both of these studies suggest that women's unobserved endowments may affect simultaneously their schooling and marriage decisions as well as possibly other outcomes that may affect child education (e.g., fertility, spouse income), though neither presents estimates that also integrate directly the determinants of child

One study that has been discussed above that is sensitive to the marriage market issues is the Behrman, Foster, Rosenzweig and Vashishtha (1997) study for rural India. This study develops an explicit model of household schooling investment incorporating individual decision-making consistent with household bargaining models, differential preferences for child schooling between men and women, and marital choice. Maternal schooling is endogenously chosen by grooms and their families in the marriage market, affects longer-run household income, and affects a woman's bargaining position, in addition to potentially augmenting child schooling in production. Key features of the Indian setting (e.g., no returns to women's schooling in rural labor markets, dowries at marriage) permit tests that identify the mechanisms by which increases in the schooling of women affect the schooling of children. The estimates indicate that despite the absence of any evident increase in employment activities by women in sectors in which schooling is rewarded and the lack of participation by women in farm decisions associated with the new technologies, the demand for literate wives increased more rapidly in the high agricultural growth areas, where returns to evidently male-dominated farm management skills rose. Consistent with the interpretation of this as derived demand for female schooling as an input in the production of child schooling, estimates that exploit the extended structure of Indian households to reduce the influence of male preferences for schooling, variation in market returns to schooling, and wealth effects indicate significantly higher levels of study hours among children with literate mothers as noted above. Estimates of the determinants of dowries indicate that, consistent with female literacy having value to men rather than providing an improved post-marriage bargaining position for women, literate women command a premium in the marriage market. Schooling achievement by women beyond levels that enable literacy, however, are not associated with higher levels of child study nor with enhanced value in the marriage market. The results from the Indian green revolution experience, which suggest that literate mothers are better teachers for children in the home, thus imply not only that investments in female schooling payoff where there are returns to schooling anywhere in the market sector, no matter how segmented by sex, but help explain why after the onset of the green revolution in India there was increased investment in both boys and girls schooling at approximately the same rates, despite very low returns in the labor market to investments in girl's schooling. As noted above, these estimates are robust to a range of assumptions for the impact of mother's schooling on child time spent studying and in school and on mother's time in home care, but the estimates for father's schooling are not -- suggesting in this case that the latter proxy for unobserved household preferences or assets. But the data do not permit testing the possibility that mother's schooling is representing in part her idiosyncratic (that is, those that differ from the household average) preferences or abilities related to child education if they are correlated with her schooling or, if not correlated,

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education (and neither considers women's endowments that are correlated with their schooling).

were known by her husband at the time of the marriage decision.

In another paper Foster (1996) argues that estimates of parental schooling on child education can be seriously biased if marriage partners self-select on the basis of unobserved characteristics. To deal with this issue, he develops a model of the marriage market in which potential mates care about the human capital of their offspring (a public good within marriage) as well as their own private consumption. Under the assumption of transferable utility, child investment is shown to depend on the income and tastes for offspring schooling of each of the marital partners. The problem in estimating the decision rule is that, with selective marriages, the unobserved traits of existing marital partners are not orthogonal. The paper develops a simulation method for correcting for the selection bias that involves explicitly solving approximately for the marriage market equilibrium. Using data from rural Bangladesh, the estimates indicate that marital selection is quantitatively important, significantly diminishing the effect of husband's traits by 35-55 percent and augmenting the effect of wife's traits by 13-16 percent on the desired schooling of children.[27] This effect is separate from biases due to mother's schooling being a proxy in part for her own unobserved tastes and productivity in child education, which are not considered in this study.

Section 5. Conclusions

Conventional wisdom held broadly by many scholars and policymakers is that: (1) mother's schooling has (a) widespread, (b) positive and (c) substantial causal effects on child education; (2) these effects tend to be much larger than those of father's schooling on child education; and (3) therefore, *ceteris paribus* there is a stronger efficiency case (given externalities in education) for public subsidies for female than for male schooling.

In this paper I first discuss a general framework for thinking about the impact of mother's schooling on child education and then survey what we know on the basis of all the estimates that I have been able to locate. The general framework suggests that it is important to be clear about what is the model being estimated, to distinguish between possible particular and more-general total effects of mother's schooling on child education, to recognize the possibly-important effects of controlling for unobserved variables such as preferences and abilities,

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[27]Foster shows that these directions of bias can occur when the unobservable component of assortative mating is large relative to the observable component for women and there is no unobservable component for men (say, because they primarily are income earners based on observed characteristics). The intuition is that, in this case, the husband's schooling is positively correlated with the wife's unobservable so that, in estimates that do not control for marriage selection, the estimated effect of the husband's schooling is overstated. This effectively means that there is in the disturbance term an expression equal to the true minus the estimated effect of husband's schooling times the wife's unobservable, which is negative so that the wife's schooling effect is underestimated.

and to use appropriate indicators of both mother's and child's education rather than focusing on one or a few inputs -- usually related to time in school -- into the educational process. The nature of the current literature suggests that considerable improvements are possible in future research in all these respects (Subsection 2.1, Sections 3 and 4).

My conclusions from taking the whole set of estimates at their face value (Subsection 2.2) are: (1) there are widespread positive associations between mother's schooling and child education, (2) the central tendencies of these estimates indicates that these effects of mother's schooling on child education are not substantial, (3) the estimated magnitudes of the impact on the one indicator of child educational outcomes, cognitive achievement, tend to be smaller than for some of the child education inputs such as grades in school,[28] (4) there are not significant differences in the estimated impact of mother's schooling between samples based primarily on children 12 and under and samples based on older children, (5) there are some systematic differences in the estimates between samples for the United States and for developing countries (though not between rural and urban areas in the latter), with the estimated effects for the United States tending to be smaller for the educational inputs and earnings, but perhaps larger for cognitive achievement, (6) overall there is not a tendency for much greater impact of mother's schooling than of father's schooling on child education outcomes, though there is some such tendency for educational inputs (not outcomes) for younger children, and (7) there are strong intergenerational gender linkages, particularly for females. Therefore, there seems to be support in existing estimates taken at their face value consistent with the "widespread" and "positive" part of point 1 of the conventional wisdom, but not with the "substantial" part of point 1, nor for the claim in point 2 of the conventional wisdom that the effects of mother's schooling tend to be much greater than those of father's schooling. Because point 3 of the conventional wisdom follows from the first two points, the existing estimates taken at their face value do not support a general efficiency argument for dedicating substantial public resources to female schooling, nor for dedicating substantially greater resources to female than to male schooling. Of course there is considerable variance among existing estimates, and in some cases they support the conventional wisdom. But in about an equal number of cases they contradict the conventional wisdom regarding the "substantial" effects and that the effects are much greater for mother's than for father's schooling.

Most of the studies in the literature, however, include among the right-side variables some that would seem to be determined in part by mother's schooling. On *a priori* grounds, on the basis of the relatively small number of studies that explore the effects of such procedures, and on the basis of the new estimates (Section 3),

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[28] At the medians the elasticity of completed grades of child schooling with respect to mother's schooling is about 0.2 if mother's and child schooling are about the same, which is four times the estimated elasticity of child cognitive achievement with respect to mother's schooling.

the usual specifications lead to a substantial underestimate of the total effect of mother's schooling. At the same time it leads to a mixed effect on the estimated relative impact of mother's versus father's schooling on child education, with control for income and less so school characteristics biasing the estimated effects towards mother's schooling and control for number of children and community characteristics biasing the estimates in the other direction. Thus, there is more support for point 1 in the conventional wisdom than the estimates taken at face value imply if the usual estimates are adjusted to eliminate the influence of observed variables that would seem to be affected by mother's schooling. The same adjustment, however, if anything probably weakens further the support for point 2 regarding the alleged much larger impact of mother's than of father's schooling. It would be informative in future work, within the assumptions of the standard specification, to explore more extensively how sensitive estimates of the impact on child education of mother's schooling are to the inclusion of indicators of household income, number of children, father's schooling, school characteristics and community characteristics. This would lead to better understanding of what are the total effects of mother's schooling, what are the relative effects of mother's schooling in comparison with those of father's schooling, and how important these channels are for such effects.

Most existing studies do not control for possible biases in the estimated effects of mother's schooling due to unobserved (by analysts) abilities and preferences that directly affect child education and that are correlated with mother's schooling. The limited number of available studies suggest that unobserved preference and ability endowments may affect importantly the estimated impact of mother's and father's schooling on child education, with estimates generally (though not always) biased upwards by the failure to control for these endowments (Section 4). These also suggest that incorporation of marriage market considerations may be critical for analyzing the impact of mother's schooling on child education, and that such considerations at least in some contexts increase the estimated impact of mother's relative to father's schooling on child education. But these studies also point to the sensitivity of the results to how such endowments are controlled, including the possible limitations of partial controls through observed indicators. Therefore it is critical for interpretation that the underlying model be spelled out explicitly and used directly as a guide to the estimation method because estimates using behavioral data are necessarily conditional on particular assumptions about the underlying model and explicit modeling makes it clear on what the interpretation is based. Our future understanding of the impact of mother's schooling on child education will be enhanced if more studies carefully lay out the model of behavior that is being estimated for a particular context that includes possibly important unobserved variables such as preferences and abilities and carefully estimate the effects in a manner that is consistent with the model that is presented.

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Table 1. Summary of Estimated Effects of Women's Schooling on Child Education by Major Educational Indicators[a]

Educational Indicator	Number of Estimates	Estimated Effects		Percentages of Estimates with "Correct" Signs[b]	
		Median	Range	Sig. at 5%	Total
Marginal Effects (Table A1)					
Mother's Home Time Use	2	--	--	100	100
Ever Enrolled Probability	16	--	--	50	81
Enrollment Age	3	--	--	100	100
Current Enrollment Probability	38	c	c	58	95
Time in School Given Enrolled	3	0.044[d]	0.012-075.[d]	67	100
School Choice	4	--	--	25	75
Grade Repetition Probability	2	--	--	100	100
Failed Grades	1	0.001	0.001	0	0
On-Time Promotion Probability	1	--	--	100	100
Grades Attained to Time of Survey	49	0.14	0.02 to 0.65	76	100
Dropout Probability	2	--	--	50	100
Prob. Progress to Next School Level	8	0.07	0.04 to 0.10	89	100
Dropout Age	1	--	--	0	100
Completed Schooling Grades/Years	63	0.19	-0.04 to 1.03	86	97
Estimated Elasticities (Table A2)					
Household Educational Expenditure	9	0.10	0.02 to 0.18	75	100
Cognitive Achievement	28	0.05	-0.01 to 0.60	57	93
Percentage Effects (Table A3)					
Earnings	7	0.0	-4.4 to 3.4	43	43
Total Educational Indicators and Earnings (Tables A1-A3)	237	--	--	70	94

Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. "--" means that information not available.

"Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition. Among those "incorrect" only those for earnings are significantly nonzero at the 5 percent level.

Only two of the estimates are interpreted in terms of effects on probabilities and they are insignificant so they do not give much of a sense of the range and median.

Days per week.

Table 2. Summary of Estimated Effects of Women's Schooling on Child Education by Child Age and Major Educational Indicators[a]

Educational Indicator	Children Primarily 12 and Under					Children Primarily Over 12				
	No. of Est.	Median		Percentage "Correct" Signs[b]		No. of Est.	Median		Percentage "Correct" Signs[b]	
		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total
Marginal Effects (Table A1)										
Mother's Home Time Use	2	.65	111	100	100					
Ever Enrolled Probability	16	--	37	50	81					
Enrollment Age	3	--	52	100	100					
Current Enrollment Probability	14	-.04	33	57	93	24	--	-5	58	96
Time in School Given Enrolled	1	.075[c]	137	100	100	2	.012[c]	1000	50	100
School Choice	2	--	-35	50	100	2	--	-68	0	100
Grade Repetition Probability	1	--	82	100	100	1	--	--	100	100
Failed Grades						1	.001	-257	0	0
On-Time Promotion Probability	1	--	d	100	100					
Grades Attained to Time of Survey	23	.14	26	78	100	26	.16	-19	73	100
Dropout Probability	1	--	e	100	100	1	--	e	0	100
Prob. Progress to Next School Level	3	.078	27	100	100	6	.056	-5	83	100
Dropout Age	1	--	-11	0	100					
Completed Schooling Grades/Years	14	.15	21	86	100	49	.20	0	86	96
Estimated Elasticities (Table A2)										
Household Educational Expenditure	4	.10	24	75	100	4	--	-13	75	100
Cognitive Achievement	11	.05	0	45	91	17	.05	8	65	94
Percentage Effects (Table A3)										
Earnings						7	0.0	-94	50	50
Total Educational Indicators and Earnings (Tables A1-A3)	99	--	29	68	94	138	--	-11	71	94

[a] Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. Children primarily under (over) 12 refers to the children's age at the time of the indicated behavior, and therefore includes in the under 12 category all of the estimates for the first three educational indicators in Table A1 (i.e., Mother's Home Time Use, Ever Enrolled Probability, and Enrollment Age). For the other indicators the assignment is made depending on whether the majority of the ages covered in the sample are 12 and under or not.

[b] "Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition.

[c] Days per week.

[d] Only two of the estimates are interpreted in terms of effects on probabilities and they are insignificant so they do not give much of a sense of the median.

[e] No estimates that include father's schooling.

Table 3. Summary of Estimated Effects of Women's Schooling on Child Education by United States vs. Other Countries and Major Educational Indicators[a]

Educational Indicator	Samples Not From United States					United States Samples				
	No. of Est.	Median		Percentage "Correct" Signs[b]		No. of Est.	Median		Percentage "Correct" Signs[b]	
		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total
Marginal Effects (Table A1)										
Mother's Home Time Use	1	.65	177	100	100	1	--	46	100	100
Ever Enrolled Probability	16	--	37	50	81					
Enrollment Age	3	--	52	100	100					
Current Enrollment Probability	38	d	5	58	95					
Time in School Given Enrolled	3	0.044[e]	569	67	100					
School Choice	4	--	-50	25	75					
Grade Repetition Probability	2	--	82	100	100					
Failed Grades	1	0.001	-257	0	0					
On-Time Promotion Probability	1	--	f	100	100					
Grades Attained to Time of Survey	49	0.14	0	76	100					
Dropout Probability	2	--	f	50	100					
Prob. Progress to Next School Level	8	0.07	0	89	100					
Dropout Age	1	--	-11	0	100					
Completed Schooling Grades/Years	26	0.23	2	96	100	37	0.13	10	78	95
Estimated Elasticities (Table A2)										
Household Educational Expenditure	4	0.10	24	75	100	4	--	-13	75	100
Cognitive Achievement	17	0.04	40	53	88	11	0.10	-22	64	100
Percentage Effects (Table A3)										
Earnings	6	0.4	-146	50	50	1	-2.6	216[c]	0	0
Total Educational Indicators and Earnings (Tables A1-A3)	183	--	7	69	93	54	--	10	74	94

Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally.
'Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition.
Positive sign here because mother's schooling estimates less in absolute value than father's schooling estimate though both negative.
Only two of the estimates are interpreted in terms of effects on probabilities and they are insignificant so they do not give much of a sense of the median.
Days per week.
Not defined because no estimates for father's schooling.

Table 4. Estimated Effects of Women's Schooling Related to Controls for United States Samples[a]

4.1 Regression of Estimates of Mother's Schooling Effects

4.1.A. Basic Estimates for Completed Schooling Grades/Years

United States' Sample	-0.22 (1.04)
Constant	0.35 (2.29)
Summary Statistics	F(12, 96) = 1.76, Prob > F = 0.065, Adj R^2 = 0.078, RMSE = 0.65

4.1.B. Differences from Basic Estimates for Other Child Educational Indicators

Other Child Educational Indicators	**Interactions with Indicator for United States' Sample**	**Additive Term**
Mother's Home Time Use		0.30 (0.45)
Current Enrollment Probability		-0.39 (0.81)
Time in School Given Enrolled		-0.31 (0.64)
Failed Grades		-0.35 (0.53)
Grades Attained to Time of Survey		-0.18 (0.93)
Prob. Progress to Next School Level		-0.29 (0.79)
Household Educational Expenditure		-0.25 (0.71)
Cognitive Achievement	0.27 (0.63)	-0.27 (1.21)
Earnings	-2.72 (3.65)	-0.01 (0.04)

[a]Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. In parentheses to right of point estimates are absolute t values. F (3, 96) = 6.02, Prob > F = 0.0008 for dropping all terms involving United States' sample indicator.

Table 5. Summary of Estimated Effects of Women's Schooling on Child Education by Rural vs. Urban Samples and Major Educational Indicators[a]

Educational Indicator	Rural Samples					Urban Samples				
	No. of Est.	Median		Percentage "Correct" Signs[b]		No. of Est.	Median		Percentage "Correct" Signs[b]	
		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total		Est.	(Moth-Fath)/ Av (%)	Sig. 5%	Total
Marginal Effects (Table A1)										
Mother's Home Time Use	1	.65	177	100	100					
Ever Enrolled Probability	9	--	40	56	89	6	--	45	50	83
Enrollment Age	1	--	52	100	100					
Current Enrollment Probability	18	-.04[c]	26	56	89	8	--	-97	63	100
Time in School Given Enrolled[d]	1	.08	137	100	100	1	.01	1000	0	100
School Choice						1	--	e	100	100
Grade Repetition Probability						1	--	e	100	100
Failed Grades						1	.001	-257	0	0
Grades Attained to Time of Survey	11	.29	32	73	100	14	.13	44	79	100
Dropout Probability						1	--	e	0	100
Completed Schooling Grades/Years	3	.11	-47	100	100	1	--	e	100	100
Estimated Elasticities (Table A2)										
Household Educational Expenditure	2	.03	166[c]	50	100	2	.17	24	100	100
Cognitive Achievement	2	.00	205	0	50	5	.05	139	80	100
All Educational Indicators (Tables A1 and A2)	47	--	43	63	92	41	--	40	68	95

Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. "--" means no interpretable estimate available.
'Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition.
Only two interpretable estimates.
Days per week.
Not defined because no estimates for father's schooling.

Table 6. Summary of Estimated Effects of Women's Schooling on Child Education Minus Estimated Effects of Father's Schooling on Child Education, Relative to Their Average Estimated Effects, by Major Educational Indicators[a]

	Number of Estimates		Mother's - Father's Estimated Schooling Effects, Relative to Average			
	Total	No Father's Schooling	Mean (%)	% Positive	Median (%)	Interquartile Range (%)
Marginal Effects (Table A1)						
Mother's Home Time Use	2		111	100	111	46 to 177
Ever Enrolled Probability	16		-41	58	37	-182 to 109
Enrollment Age	3		73	100	52	46 to 120
Current Enrollment Probability	38	4	-1	50	5	-67 to 57
Time in School Given Enrolled	3	1	569	100	569	137 to 1000
School Choice	4	1	-57	0	-50	-86 to -35
Grade Repetition Probability	2	1	82	100	82	82 to 82
Failed Grades	1		-257	0	-257	-257 to -257
On-Time Promotion Probability	1	1	--	--	--	--
Grades Attained to Time of Survey	49	2	2	49	0	-41 to 62
Dropout Probability	2	2	--	--	--	--
Prob. Progress to Next School Level	9		20	44	0	-18 to 52
Dropout Age	1		-11	0	-11	-11 to -11
Completed Schooling Grades/Years	63	2	-4	56	9	-67 to 26
Estimated Elasticities (Table A2)						
Household Educational Expenditure	8	2	59	67	14	0 to 31
Cognitive Achievement	28	5	43	48	0	-40 to 125
Percentage Effects (Table A3)						
Earnings	7		-1539	33	-94	-360 to 100
Total Educational Indicators and Earnings (Tables A1-A3)	237	21	-36	52	10	-40 to 56

[a]Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. "--" means that information not available.

Table 7. Summary of Intergenerational Gender Links Related to Child Education for Major Educational Indicators[a]

Educational Indicator	No. of Est.	Mother's Schooling			Father's Schooling			Median Ratio of Estimated Mother's - Father's Schooling Effects Relative to Av. in %	
		Med. Est. for Daughter/ Med. Est. for Son	"Correct" Signs Daughters/ "Correct" Signs Sons [b]		Med. Est. for Son/ Med. Est. for Daughter	"Correct" Signs Sons/ "Correct" Signs Daughters[b]		Daughters	Sons
			Sig. at 5%	Total		Sig. at 5%	Total		
Marginal Effects (Table A1)									
Ever Enrolled Probability	10	--	4.0	1.3	--	2.0	1.0	115	-164
Current Enrollment Probability	23	--	1.6	0.9	-	1.0	1.1	26	-22
Grades Attained to Time of Survey	34	1.6	1.4	1.0	0.9	1.3	1.1	-12	-14
Prob. Progress to Next School Level	6	2.1	2.0	1.0	1.5	0.7	1.0	8	-39
Completed Schooling Grades/Years	38	1.2	1.1	1.1	1.3	1.1	1.0	22	-3
Estimated Elasticities (Table A2)									
Household Educational Expenditure	8	1.3	2.0	1.0	0.9	1.0	1.5	18	10
Cognitive Achievement	6	--	1.5	1.0	--	1.0	1.0	52	-22
Percentage Effects (Table A3)									
Earnings	6	-11.0	0	0	0.3	0.6	1.0	-9000	-42
All Educational Indicators and Earnings (Tables A1- A3)	128	1.20	1.4	1.0	1.06	1.1	1.1	18	-11

[a]Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. "--" means no estimates that permit a comparison. Because some of the estimates do not permit comparisons, the number of estimates in each category for which significance is summarized in some cases is greater than the number for which the median estimates are compared. Also one of the pairs for household educational expenditures includes only the impact of mother's, not father's, schooling.

[b]"Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition.

Table 8. Estimated Effects of Women's Schooling Related to Controls for Income, Number of Children, and Father's Schooling[a]

8.1 Regression of Estimates of Mother's Schooling Effects

8.1.A. Basic Estimates for Completed Schooling Grades/Years

Income Control	-0.14 (1.17)
Number of Children Control	-0.16 (1.36)
Father's Schooling Control	-0.15 (0.97)
Community Characteristics Control	0.12 (0.84)
Constant	0.32 (2.05)
Summary Statistics[b]	F(22, 86) =14.94, Prob > F = 0.0000, Adj. R^2 = 0.74, RMSE = 0.35

8.1.B. Differences from Basic Estimates for Other Child Educational Indicators

Other Child Educational Indicators	**Interactions with**			**Additive Term**
	Income Control	**Number of Children Control**	**Community Characteristics Control**	
Mother's Home Time Use				0.52 (1.45)
Current Enrollment Probability		0.40 (0.76)		-0.39 (1.05)
Time in School Given Enrolled				-0.08 (0.32)
Failed Grades				-0.29 (0.78)
Grades Attained to Time of Survey	0.05 (0.21)	0.03 (0.16)		-0.16 (0.79)
Prob. Progress to Next School Level				-0.06 (0.30)
Household Educational Expenditure				-0.03 (0.15)
Cognitive Achievement	0.10 (0.42)	0.12 (0.63)	-0.20 (0.8)	-0.15 (0.60)
Earnings	-3.59 (8.56)	-6.94 (13.76)	1.45 (3.42)	0.82 (3.24)

[a]Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. In parentheses to right of point estimates are absolute t values.

[b]F tests for the variables that are included with the interactions with the group indicators are: for income F(4, 86) = 22.20 and Prob > F = 0.000; for number of children F(5, 86) = 42.57 and Prob > F = 0.0000; and for community characteristics F(3, 86) = 5.40 and Prob > F = 0.0019. F tests for the variables with their interactions that are not included are: for school characteristics F(3, 83) = 0.82 and Prob > F = 0.487 for sample primarily with children 12 and under F(4, 83) = 0.56 and Prob > F = 0.6915; and for United States' samples F(2, 84) = 1.15 and Prob > F = 0.3227.

Table 9. Estimated Effects of Women's Schooling Minus Father's Schooling Related to Controls for Income and Number of Children[a]

	9.1 Logit for Mother's Schooling Having Significantly Correct Sign[b]	9.2 Regression of Estimates of Mother's Schooling Effects minus Father's Schooling Effects, Relative to Average	9.3 Multinominal Logit for Mother's Schooling Having Significantly Correct Sign minus Father's Schooling Having Significantly Correct Sign[b, c]	
			-1	1
Income Control	-1.04 (2.38)	2.22 (1.93)	0.81 (1.21)	0.58 (1.11)
Number of Children Control	-0.11 (0.35)	-1.22 (1.28)	0.69 (1.60)	0.20 (0.49)
Father's Schooling Control	-0.01 (0.12)	--	--	__
School Characteristics Control	0.35 (1.17)	1.14 (1.16)	0.98 (2.06)	-0.87 (2.08)
Community Characteristics Control	-0.45 (1.05)	-1.39 (1.13)	0.27 (0.44)	0.45 (0.83)
Constant	1.94 (3.80)	-0.97 (1.28)	-3.53 (4.25)	-2.06 (3.41)
Summary Statistics	$Chi^2(5) = 10.28$, Prob > Chi^2 =0.0676, Pseudo $R^2 = 0.04$	$F(6, 192) = 1.82$, Prob > F = 0.0788, Adj R^2 =0.03 , RMSE = 6.45	$Chi^2(8) = 19.40$, Prob > Chi^2 =0.0129, Pseudo $R^2 = 0.06$	

[a]Based on estimates that are summarized in Appendix Tables A1-A3 with each estimate weighted equally. In parentheses to right of point estimates are absolute t values for regression estimates and absolute z values for the multinomial logit estimates.

[b] "Correct" means positive for all the educational indicators and earnings except negative for enrollment age, grade repetition.

[c]$Chi^2(2)$ tests for the two coefficients being constrained to zero are 2.45 for income (Prob > chi^2 = 0.2937), 2.61 for number of children (Prob > chi^2 = 0.2714), 10.21 for schooling characteristics (Prob > chi^2 = 0.0061), and 0.80 for community characteristics (Prob > chi^2 = 0.6701). $Chi^2(1)$ tests for the two coefficients being significantly different are 0.08 for income (Prob > chi^2 = 0.7775), 0.79 for number of children (Prob > chi^2 = 0.3741), 10.15 for schooling characteristics (Prob > chi^2 = 0.0014), and 0.06 for community characteristics (Prob > chi^2 = 0.8117).

Table A1. Summary of Studies on Marginal Impact of Mother's Schooling on Child Education[a]

Sample Characteristics (Country, Region, Year, Sample Size (N), Age, Sex)	Marginal Effects of		Ratio of Mother's to Father's Schooling Effects	Controls for				Notes	Source
	Mother's Schooling	Father's Schooling		Income or Wealth	Other Individual/ Household Features	School Features	Community Features		
1. Mother's Home Time Use									
India 1981/2, 1452 farm households with two children in 7-14 age range	0.65*	0.04	16.3	husband primary wealth claimant (also interacted with household wealth), hh fixed effects	mother primary school, father literacy, mother's age, child age/sex composition, hh fixed effects	hh fixed effects	hh fixed effects	mother's daily hours in home care; est. here for dichotomous var. for where 3 grades assumed for lit.; hh FE IV	Behrman, Foster, Rosenzweig and Vashishtha (1997)
United States, 1980 (18776 high school sophomores and seniors)	(+)*	(+)*	1.6	family income	age, sex, race, no. sibs, sib composition	no	no	recall data in rough categories of frequency of pre-school reading	Powell and Steelman (1990)
2. Probability of Ever Enrolled in School									
Ghana (rural), 1987				income per capita	age, sex, no. sibs	distance, prices, personal, facilities	wage, transportation, extension agent, co-op	parental primary school sig and used for ratios here; post-primary not sig.	Lavy (1996)
1733 age 5-12	(+)*	(+)*	1.5						
1226 age 7-12	(+)*	(+)*	1.0						
Egypt 1980				net income per capita	age, parental educational aspirations, share of income from family business, children under age 13	no	urban, upper Egypt		Cochrane, Mehra and Osheba (1986)
576 rural females 6-14	(+)*	(+)*	not comparable because literacy used for mothers and schooling for fathers						
633 rural males 6-14	(+)	(+)*							
465 rural females 15-25	(+)*	(+)*							
467 rural males 15-25	(+)	(+)*							
565 urban females 6-14	(+)	(+)	1.8						
586 urban males 6-14	(-)	(+)	-0.5						
541 urban females 15-25	(+)*	(+)	39.0						
505 urban males 15-25	(+)	(+)*	0.1						
Nepal (Terai), 1977/81 (350 children age 5-11)	ns	(+)*	0?	land, crop value	age, sex, caste, anthrop., no. sibs, occ. aspirations	in village	district		Moock and Leslie (1986)
Pakistan 1994/5 (Lahore low & mid income)				expenditure	sex	no	yes	first stage in which second stage is private versus public school	Alderman, Orazem, and Paterno (1996)
828 females 6-10	(+)*	(+)	3.7						

940 males 6-10	(+)*	(+)*	1.4						
Pakistan (rural), 1989 (1129 age 10-25)	ns	(+)*	0?	instrumented household income	age, sex, ability	travel time, book cost	village fixed effects	only "father middle school or more" sig and only for females	Alderman, Behrman, Ross and Sabot (1996)
Pakistan (rural), 1986-92 (800 households, age 6-7)	(+)**	(+)	4.5	3-year av. household expenditure	age, sex, mother's age, health (IV)	travel time, book cost	district, prices		Alderman, Behrman, Lavy and Menon (1997)
Peru (rural), 1985/6 (1622 age 9-14)	(+)*	(+)*	3.2	household expenditures, durables	sex, oldest child, children under 5, farm, elderly	fees, misc. costs, desks, books, food, in same community	no		Ilon and Moock (1991)
3. Enrollment Age									
Ghana, 1988/9 (1757 age 6-15)	(-)*	(-)*	1.6	insturmented expenditures per capita	age, sex, height, no. sibs, parental schooling, tribe	teacher & school characteristics, travel time	rural, semi-rural		Glewwe and Jacoby (1995)
Ghana, 1988/9 (1636 age 11-20)	(-)*	(-)	4.0	instrumented expenditures per capita	age, sex, ability, religion	primary & middle school teacher & facilities	rural, region		Glewwe and Jacoby (1994)
Peru (rural), 1985/6 (878 age 6-8)	(-)*	(-)*	1.7	household expenditures, durables	sex, oldest child, children under 5, farm, elderly	fees, misc. costs, desks, books, food, in same community	no		Ilon and Moock (1991)
4. Probability Currently Enrolled									
Brazil (rural low-income) 1972/4 (age 7-14 in about 500 households)	.02	.00	18.8	household income, capital assets, land	no. children, time use, farm inputs	distance from household	no	dep. var. proportion children enrolled	Singh (1992)
Côte d'Ivoire, 1985-7				expenditure per adult	age, sex, ethnicity	no	region	only primary sig. for rural areas	Montgomery and Kouamé (1993)
5067 rural age 5-30	(+)*	no	no						
3108 urban age 5-30	(+)*	no	no						
Egypt 1980				net income per capita	age, parental educational aspirations, share of income from family business, children under age 13	no	urban, upper Egypt		Cochrane, Mehra and Osheba (1986)
589 rural females 6-14	(+)*	(+)*	not comparable because literacy used for mothers and schooling for fathers						
636 rural males 6-14	(+)	(+)*							
475 rural females 15-25	(+)	(+)*							
469 rural males 15-25	(+)	(+)*							
572 urban females 6-14	(+)	(+)*	0.3						
587 urban males 6-14	(+)	(+)*	0.3						
546 urban females 15-25	(+)*	(+)	9.0						

505 urban males 15-25	(+)	(+)*	0.4						
India (rural) 1968/71 (children > 5 in 4000 households)	(+)*	(+)*	1.7 to 1.8 (1.8 for primary)	farm land area	mother's age	presence of local primary and middle schools	presence of local health and water facilities	dep. var. household age-sex standardized attendance	Rosenzweig and Wolpin (1982)
India (rural Tamil Nadu) 1980-1 (642 households)	-0.10	0.33*	-0.03	non-earnings income, land owned	parental age, yrs. married, pred. wages, caste, mother's health, nuclear	distance	district	proportion of children age 5-16 enrolled in school	Duraisamy (1988)
Indonesia, 1987				nonlabor income	parental ages, sex of head	local schools	urban, transportation	No sig. effect of mother's schooling if she head (but some of father's); no sig. dependence on child sex	Deolalikar (1993)
36690 age 6-11	(+)*	(+)*	1.1						
16517 age 12-14	(+)*	(+)*	0.5						
13800 age 15-17	(+)*	(+)*	0.5						
22082 age 18-23	(+)*	(+)*	0.8						
Jamaica 1989 (age 13-19)				predicted expenditure per capita	age, sex, female household head, distance to bus stop	no	rural	second set of estimates are conditional on enrollment	Handa (1994)
685 females	(+)*	(+)	3.5						
758 males	(+)*	(+)*	0.7						
418 females in high sch.	(+)	(+)*	0.4						
410 males in high sch.	(+)	(+)	2.6						
Malaysia, 1976 (age 12-18)				income, own farm, own business	age, sex, ethnicity, parental age and presence	distance to secondary school	city, urban, transportation	no sig. differences by sex or urban/rural; not sig. for ages 6-11 (for which almost universal attendance)	De Tray (1984)
540 Chinese	(+)*	(+)*	1.7						
217 Indian	(+)	(+)	1.0						
633 Malays	(+)**	(+)**	1.4						
Pakistan (rural)1979 (age 10-16)				household income, land owned, tractor owned, tenure status	sex, dependency ratio, household size	presence in village of schools (by level)	village literacy	parental education nonlinear by levels (ratio of mother to father is average effect)	Burney and Irfan (1994)
962 farm females	(-+)	(+)*	0.7						
1193 farm males	(+)	(+)*	0.8						
628 nonfarm females	(+)*	(+)*	1.3						
704 nonfarm males	(+)*	(+)*	1.3						
Pakistan 1991 (age 7-14)				household expenditure decile, land cultivated, business owned	age, sex, no. sibs, sib rank, no. adult males & females, female head	school distance	province		Sather and Lloyd (1994)
1056 urban girls	(+)*	(+)*	not comparable (mother ever attended versus father's literacy)						
1061 urban boys	(+)*	(+)**							
1025 rural girls	(+)*	(+)*							

1070 rural boys	(+)**	(+)							
Paraguay (Asunción), 1990 (525 children 12-19)	(+)*	no	no	family income, household head occupation	age, sex, no. sibs, language, hhold head sex	no	rural		Patrinos and Psacharopoulos (1995)
Peru (rural), 1985 (718 age 10-18)	(+)*	(+)	0.9 local 1.6 distant	household expenditure	sex, children age 13-17	distance, price, teachers present	no	nested multi. logit for choice among local, distant or no school	Gertler and Glewwe (1990)
Peru (rural), 1985/6 (age 6-14 ever enrolled)				household expenditures, durables	sex, oldest child, children under 5, farm, elderly	school fees, misc. costs, desks, books, food, in same community	no		Ilon and Moock (1991)
1101 females	(+)*	(+)	3.2						
1061 males	(+)*	(+)	2.0						
Peru 1985/6 (2387 girls age 10-19)	(+)	no	no	family income, land area	age, hh. struct., mother's age, phone, water	school costs, time, open	urban		Levison and Moe (1997)
5. Time in School									
India 1981/2, subset of 2532 farm households with two children in 7-14 age range	0.075*	0.014	5.3	household wealth *(father primary claimant), hh fixed effects	age, sex, mother primary school, father primary school, hh fixed effects	hh fixed effects	hh fixed effects	hours in school and studied; est. here for dichotomous var. for lit/(3*8) where 3 grades assumed for lit. & 8 hrs. per day; hh FE IV (OLS suggests fath prim sch sig)	Behrman, Foster, Rosenzweig and Vashishtha (1997)
Peru 1985/6 (2387 girls age 10-19)	(U-shaped)*	no	no	family income, land area	age, hh struct., mother's age, phone, water	school costs, time, open	urban	hrs. in sch.; mother's presence reduces girls' time in school	Levison and Moe (1997)
Bolivia (urban), 1990 (8892 age 6-30)	0.012**	-0.008	+∞?	per capita income	age, sex, ethnicity, parents present	no	community fixed effects	mother's down 17% father's down 50% w/o community FE	Behrman, Ii and Murillo (1995)
6. School Choice									
Ghana, 1988/9 (1636 children age 11-20)	(-+)	(+)**	-0.3 to 1.1	IV expenditures per capita	age, sex, ability, religion	primary & mid. school teacher & facilities	rural, region	+ means choice of more-distant, higher-quality school	Glewwe and Jacoby (1994)
India 1991, (928 students 13-14 in 30 urban schools, Uttar Pradesh)	(+)*	no	no	weighted average of consumer durables assets	sex, ability, religion, caste, no. sibs,	no	no	choice among public, private added and private unaided (best); mother's schooling selects private aided and then public	Kingdon (1996a)
Jamaica, 1990 (1067 children in school)	(-)	(-)*	0.7	expenditure per capita	age, sex	distance to nearest school	parish	all-age versus primary only	Glewwe, Grosh, Jacoby and Lockheed (1995)

Thailand 1989 (14801 adult children av. age 25)	(+)	(+)*	0.6	assets, primary income source from agriculture	sex, age, parents present, fem. headed, par. age	teachers per student	urban	parental schooling associated with increased probability of private school	Behrman, Sussangkarn, Hutaserani and Wattanalee (1994)
7. Probability of Grade Repetition									
Paraguay (Asunción), 1990 (283 children 12-19 in school)	(-)*	no	no	family income, household head occupation	age, sex, no. sibs, language, head female	no	rural		Patrinos and Psacharopoulos (1995)
Peru, 1985/6 3641 age 6-12	(-)*	(-)*	2.4	income, expenditures, assets	age, sex, sib composition, par. schooling	teachers per grade, textbooks, writing facilities	no		Jacoby (1994)
8. Number of Failed Grades									
Bolivia (urban), 1990 (8892 age 6-30)	0.001	-0.008**	-0.2	per capita income	age, sex, ethnicity, parents present	no	community fixed effects		Behrman, Ii and Murillo (1995)
9. Probability of On-Time Promotion									
Brazil (Northeast), 1983/7 (1506 2-4th grade)	(+)*	no	no	no	age, sex, Port. & math tests, family size, farmer, ag. productivity	number of students, education program	county		Harbison and Hanushek (1992)
10. Grades Attained to Time of Survey									
Bangladesh 1980/1 (children 5-19 of 1382 married women)	0.11*	1.07*	0.1	father's income and occupation	age, sex, mother's childhood urban, child wage	primary and secondary schools present	health and water facilities	average household age-sex standardized attainment	Hossain (1989)
Bangladesh (rural), 1990 (14716 children age 8-15)	0.65*	0.55*	1.2	owned land	age, sex, parent's age	time to schools	time to road & bank, family planning policies	tobit estimates 1.7 and 2.0 times OLS	Foster and Roy (1993)
Bolivia (urban), 1990 (16179 age 6-30)	0.18*	0.21*	0.9	per capita income	age, sex, ethnicity, parents present	no	community fixed effects	mother's up 111% father's up 67% w/o comm. fixed effects	Behrman, Ii and Murillo (1995)
Brazil 1970 (3762 children age 8-15)				father's income	age, sex, mother's age, migration	av. local primary and secondary teachers' schooling; av. local primary and secondary teachers' income per local child age 7-13	state, frontier	mother's schooling (but not father's) interacted with teacher's schooling (neg. sig. in urban, not in rural); w/o school and area variables both parents' schooling effect down in urban but up in rural	Birdsall (1985)
urban age 8-11	0.14*	0.05*	2.8						
urban age 12-15	0.19*	0.10*	1.9						
rural age 8-11	0.18*	0.08*	2.3						
rural age 12-15	0.29*	0.21*	1.4						

Brazil (urban areas) 1982 (2345 age 14)				household head's income	age	no	state	convex par. schooling & interactions (+ if sig); par. schooling instrumented by their parents' schooling (increases est. 6-170%)	Barros and Lam (1996)
Sâo Paulo (820)	0.48*	0.11*	4.6						
Northeast (1525)	0.35*	0.36*	1.0						
Brazil 1982				no	age, sex	no	region	nonlin. school effects; here effects for 4 years of parents' sch./ 4; male-female diff. not sig; mother-father diff. sig; father (mother) bigger impact on son (daugh.) with family fix. effect.	Thomas, Schoeni and Strauss (1996)
South (34979 7-14)	0.16*	0.10*	1.6						
Northeast (16353 7-14)	0.14*	0.11*	1.3						
South (16609 15-18)	0.39*	0.27*	1.4						
Northeast (7233 15-18)	0.41*	0.30*	1.4						
Côte d'Ivoire, 1985/7				instrumented expenditures per capita	age, sex	distance to schools	wages, rural	primary school completion IV probit	Tansel (1997a)
3628 females age 16-36	0.039*	0.074*	0.5						
2983 males age 16-36	0.035	0.057*	0.6						
2862 females age 19-36	0.16*	0.28*	0.6					middle school attainment double limit tobit	
2205 males age 19-36	0.23**	0.35*	0.7						
1688 females age 25-36	0.12	0.26*	0.5					post-middle school attainment double limit tobit	
1172 males age 25-36	0.06	0.32*	0.2						
Egypt 1980				net income per capita	age, parental educational aspirations, share of income from family business, children under age 13	no	urban, upper Egypt		Cochrane, Mehra and Osheba (1986)
298 rural females 6-14	(+)	(-)	not comparable because literacy used for mothers and schooling for fathers						
492 rural males 6-14	(+)	(+)							
141 rural females 15-25	(+)	(+)							
316 rural males 15-25	(+)*	(+)*							
471 urban females 6-14	0.029*	0.025*	1.2						
520 urban males 6-14	0.022	0.014	1.6						
389 urban females 15-25	0.109**	0.053	2.1						
453 urban males 15-25	0.114**	0.144*	0.8						
Ghana (rural), 1987				income per capita	age, sex, no. sibs	distance, prices, personal, facilities	wage, transportation, ex. agent, co-op	par. prim. school sig & used for ratios here; post-prim. not sig.	Lavy (1996)
1733 age 5-12	(+)*	(+)*	1.3						
1226 age 7-12	(+)*	(+)*	0.6						
Ghana, 1988/9 1636 age 11-20	(+)*	(+)*	0.7	instrumented expenditures per capita	age, sex, ability, religion	prim. & middle school teach. & facilities	rural, region		Glewwe and Jacoby (1994)

Ghana, 1987/9				instrumented expenditures per capita	age, sex	distance to schools	wages, rural	primary school completion IV probit	Tansel (1997a)
4015 females age 16-36	0.021*	0.030*	0.7						
3366 males age 16-36	0.016*	0.013*	1.2						
5027 females age 19-36	0.24*	0.27*	0.8					middle school attainment double limit tobit	
3439 males age 19-36	0.08*	0.16*	2.0						
2083 females age 25-36	0.18*	0.27*	0.7					post-middle school attainment double limit tobit	
1616 males age 25-36	0.13*	0.15*	0.9						
Malaysia 1975/6 (1100 households)				household income, whether farm or business income	birth cohort, sex, first born, father present,	secondary school in town/district	region, urban	ordered probit with control for right censoring	King and Lillard (1987)
859 female Malays	(+)*	(+)	6.7						
848 male Malays	(+)	(+)	2.6						
709 female Chinese	(+)*	(+)	0.6						
754 male Chinese	(+)*	(+)*	1.0						
Nepal (Terai), 1977/81 (51 children age 5-11)	.05	-.09	+∞?	land, crop value	age, sex, caste, anthrop., no. sibs, occ. aspirations	school in village	district		Moock and Leslie (1986)
Pakistan 1991 (1924 child. age 10-14 ever enrolled)				household expenditure decile, land cultivated, business owned	age, sex, no. sibs, sib rank, no. adult males & females, female head	school distance	province	primary school completion	Sather and Lloyd (1994)
503 urban girls	(+)*	(-)	not comparable (mother ever attended versus father's literacy)						
617 urban boys	(+)*	(-)							
249 rural girls	(+)*	(-)							
558 rural boys	(+)*	(-)							
Paraguay (Asunción) 1990 (525 children 12-19)	0.11*	no	no	family income, household head occupation	age, sex, no. sibs, language, head female	no	rural		Patrinos and Psacharopoulos (1995)
Philippines 1978 (1500 households in Bicol)				land ownership and operation	age, sex, sib order, sib sex composition, parental age	primary and secondary school distances	electricity, rural	ordered probit with control for right censoring; estimates differ slightly if parent(s) dead	King and Lillard (1987)
3583 females	(+)*	(+)*	0.9						
3881 males	(+)*	(+)*	0.8						
South Africa, 1993 (616 Africans 6-24)	0.17*	no	no	household durables	sex, age	pupil/class, dist., travel costs	city dummies		Moll (1996)
11. Probability of Dropout									

Brazil (Northeast), 1983/7 (535 2-4th graders)	(-)*	no	no	no	age, sex, Port. & math tests, family size, farmer, ag. productivity	number of students, education program	county		Harbison and Hanushek (1992)
Paraguay (Asunción), 1990 (242 children 12-19 not in school)	(-)	no	no	family income, household head occupation	age, sex, no. sibs, language, head female	no	rural	started but did not complete primary school; sample reported as all not in school but must be all	Patrinos and Psacharopoulos (1995)
12. Probability of Progression to Next School Level									
Indonesia 1989				per capita income, consumer durables	age, sex, head's age, household size	fees, local school availability (public, private)	urban, % heads literate, local returns to schooling, child wage & labor force participation rate	nonlinear parental schooling effects; ratios reported here are for having 1-5 years of school as opposed to no schooling.	King (1995)
into prim., 16520 8-12	(+)*	(+)	2.9						
into low. sec., 11344 age 13-18, completed prim.	(+)*	(+)*	1.7						
into up. sec., 7116 age 16-25, completed low. sec.	(+)*	(+)*	1.0						
Malaysia 1988, 1777 adult respondents; 4794 "children" age 8-50				father's earnings, farming occupation	sex, ethnicity, birth cohort, no. older & no. younger sibs	school availability in own language	urban	If parents' schooling treated as endogenous using grandparents' schooling, estimates drop by about 30%; including other variables further weakens estimated effects.	Lillard and Willis (1994)
respondents' daughters	0.077*	0.014	3.6						
respondents' sons	0.035	0.042**	0.8						
female respondents	0.104*	0.079*	1.3						
male respondents	0.052*	0.097*	0.5						
Malaysia 1988, 3395 women from birth cohorts between 1920 & 1970 (?)	(+)*	(+)*	0.9 (primary) 0.6 (sec. and beyond)	father's earnings, occupation	sex, ethnicity, birth cohort, no. older & no. younger sibs	school availability in own language, education policy	urban	Not much impact on est. whether ed. & marriage treated as joint or each predetermined for other	Brien and Lillard (1994)
13. Dropout Age									
Ghana, 1988/9 1399 age 6-15	(+)	(+)**	0.9	insturmented expenditures per capita	age, sex, height, no. sibs, parental schooling, tribe	teach. & school characteristics, travel time	rural, semi-rural		Glewwe and Jacoby (1995)
14. Years/Grades of Completed Schooling									

Brazil 1982, age 25-54				no	age, sex	no	region	nonlin. school effects; here effects for 4 years of parental schooling/4; male-female diff. sig; mother-father diff. sig (lessen with ed); father bigger impact on son than on daughter (not mother-daughter) more for younger cohort.	Thomas, Schoeni and Strauss (1996)
South, 43116 females	0.77*	0.56*	1.4						
South, 41233 males	0.79*	0.67*	1.2						
Northeast, 19437 females	1.03*	0.80*	1.3						
Northeast, 17617 males	0.99*	0.96*	1.0						
Côte d'Ivoire, 1985-7				expenditure per adult	age, sex, ethnicity	no	region	only primary sig. for rural areas; ordered probit with control for right censoring (for rural OLS yields insig.)	Montgomery and Kouamé (1993)
5067 rural age 5-30	(+)*	no	no						
3108 urban age 5-30	(+)*	no	no						
Kenya 1980, 1438 age 20 and up	0.17*	0.16*	1.0	landholding, father's occ.	age, sex, no. sibs, tribe	no	no		Gomes (1984)
Panama 1983				no	no	no	region, urban	with only one parent estimates are 0.75 and 0.60 for mother's and 0.66 and 0.57 for father's schooling.	Heckman and Hotz (1986)
4153 male hh heads 25-64 with earnings	0.29*	0.31*	0.9						
oldest sons of above	0.26*	0.24*	1.1						
Peru 1985-6				parent blue/white collar, no job	age, sex, co-resident with mother when 10	books, furniture, free food, no. teachers & grades	urban	if school characteristics dropped, father's est. up 136% for f. & 75% for m. (mothers' 51% & 6%); est. tend to decline for younger	King and Bellew (1988)
5644 females 20-60	0.26*	0.12*	2.2						
4840 males 20-60	0.24*	0.19*	1.2						
Nicaragua 1977/8, 991 females 15-45	0.11*	0.08**	1.4	no (except in childhood family fixed effects)	no. sibs, parents' presence	no (except in childhood family fixed effects)	population, % literate, capital city	lower est. control for childhood family FE using adult sisters	Behrman and Wolfe (1984)
Phillippines (rural), 1989 (795 age 17+)				inherited land (except in family fixed effects)	sex, age, first-born, grandparents' schooling and land ownership	no	no	father's effect sig. different for sons versus daughters (not mother's except in fixed effects estimates)	Quisumbing (1997)
females	0.09*	0.31*	0.3						
males	0.13*	0.11*	1.2						
Taiwan, 1989				father's income & occupation	sex, birth order, sibship size, mainland	no	urban youth	for youngest group(s) some still in school so right censoring	Parrish and Willis (1993)
547 age 40-49	0.21	0.38*	0.6						
907 age 30-39	0.22*	0.31*	0.7						
1608 age 20-29	0.20*	0.26*	0.8						
3638 age 10-19	0.13*	0.22*	0.6						

Thailand 1989, adult children av. age 25				assets, primary income source from agriculture	sex, age, parents present, female head, parents' age	teachers per student	urban	father's schooling effects sig. larger than mother's (5% level for females, 10% for males)	Behrman, Sussangkarn, Hutaserani and Wattanalee (1994)
6778 females	0.22*	0.33*	0.7						
7437 males	0.23*	0.28*	0.8						
Turkey 1994				predicted log expenditures per adult, sector employment	sex, age, parents absent	no	urban, squatter settlement, undeveloped street, population density, distance to metro center and to Istanbul	ordered probits with 3 choices for 14-19 age (0, 2, 5 or more grades), 4 choices for 16-19 age (0, 2, 5, 8 or more grades) and 5 choices for 19-20 age (0, 2, 5, 8, 11 or more grades).	Tansel (1997b)
7225 females 14-19	(+)*	(+)*	0.5						
7427 males 14-19	(+)*	(+)*	1.6						
4361 females 16-19	(+)*	(+)*	0.9						
4668 males 16-19	(+)*	(+)*	1.0						
1438 females 19-20	(+)*	(+)*	1.2						
1716 males 19-20	(+)*	(+)*	0.8						
United States 1940, top 1% of California children in 1921				estimated family income	sex, birth order, no. sibs, first born (for females only), IQ, home instruction	no	no	no sig. difference for 1950 or if home instruction dropped; claims mother's schooling works through IQ but does not treat as endogenous	Leibowitz (1974)
606 females	0.16*	0.09*	1.9						
780 males	0.12*	0.11*	1.1						
United States 1979, 915 employed males 23-32	0.13*	0.14*	0.9	parental family income, father's occupation	race, religion, no. sibs, female head	no	population of nearest city, South		Corcoran and Datcher (1981)
United States, 1978 (male heads 23-32				parental family income	race, age,	no	urban and Southern origin, av. neighborhood income and % white	including educational aspirations for children	Datcher (1982)
196 blacks	-.019	.172*	-0.1						
356 whites	.098**	.085*	1.2						
United States 1978				father's occupation	sex, race, age, no. sibs	no	rural, South	general patterns similar for decomposition into college attendance and years of schooling for those who did not go to college	Datcher (1981)
244 black females 25-34	0.32*	0.04	8.6						
181 black males 25-34	0.01	0.21*	0.0						
544 white females 25-34	0.19*	0.16*	1.2						
494 white males 25-34	0.12*	0.17*	0.7						
263 black females 45-64	0.21*	0.14*	1.5						
151 black males 45-64	0.19*	0.32*	0.6						
575 white females 45-64	0.20*	0.13*	1.5						
574 white males 45-64	0.18*	0.18*	1.0						

United States 1972-1980 (High School Class of 1972)				parents' income, father's occupation	sex, no. sibs, aptitude, grades, home ed. resources, exp. ed., friend's col. plans	academic or voc. high school, teacher's encouragement,	residence in South	difficult to interpret given choice variables on right; father's ed 1.7 larger for males than fem.; mother's ed. 1.8 larger for females than males	Teachman (1987)
4904 females	(+)*	(+)*	2.0						
4698 males	(+)*	(+)*	0.7						
United States 1981, av. age 28				no	age, sex	no	no	IV est.: father's brother's sch. for father (ups est. 35-40%); mother's sister-in-law's for mother (up 108% for fem, but down for male)	Behrman and Taubman (1985)
1323 females	0.25*	0.28*	0.9						
1144 males	-0.04	0.23*	-0.2						
United States 1981, av. age 28				parental earnings	age, sex, birth order, religion, no. sibs	no	no		Behrman and Taubman (1986)
1069 females	.085*	.16*	0.5						
913 males	.055**	.16*	0.3						
United States, 25-7				av. total parental income when 14-16, father's SEI	sex, religion, race, no. sibs	no	city size. South	coef. on father's schooling drops 16 and 36% with income (mother's 38 & 19%)	Hill and Duncan (1987)
456 females	0.05	0.10*	0.5						
398 males	0.17*	0.09*	1.9						
United States				no	sex, race, prob. of family disruption	no	no	prob. of high school graduation; parents' schooling. 2 dichotomous variables (high school grad, more than high school grad); bivariate probit for disruption	Mclanahan and Sandefur (1994)
1986 (HSB) 10400 high school sophomores in 1980	(+)*	(+)*	2.2 h sch 0.9 > h sch						
1988 (NLSY) 1450 24-31	(+)*	(+)*	1.1 h sch 1.2 > h sch						
late 1980s (PSID) 2000 25-35	(+)*	(+)*	0.9 h sch 1.1 > h sch						
United States 1987, 1258 age 19-23	(+)*	(+)*	1.0 to 1.1 (higher for higher parental schooling levels)	years in poverty, years receiving AFDC	race, sex, rel., birth order, no. sibs, mother worked, child care, moves, marital history	no	no	probits for probability of high school completion	Haveman, Wolfe and Spaulding (1991)
United States (NLSY)				no	sex, race, two-parent family, parents prof, home reading material	Catholic	population, share of population on welfare, share Catholic	nonlinear effects of parental schooling (hs=high school grad; col=college grad)	Neal (1997)
2626 whites, high school graduation	(+)* (hs) (+)**(col)	(+)*(hs) (+)(col)	1.1 (hs) 2.4 (col)						
2434 bl/hisp, high school graduation	(+)* (hs) (+)**(col)	(+)*(hs) (+)(col)**	1.9 (hs) 1.3(col)						

2626 whites, college graduation	(+)* (hs) (+)*(col)	(+)*(hs) (+)*(col)	1.1 (hs) 1.3 (col)						
2434 bl/hisp, college graduation	(+)* (hs) (+)*(col)	(+)(hs) (+)*(col)	11.7 (hs) 1.7 (col)						

[a] The marginal effects mean the impact of additional year of parental schooling. In a number of studies (e.g., those that use probits or logics) it is not possible to know what the marginal effects are with the information provided even though it is possible to compare the effects of mother's versus father's schooling. * means underlying coefficient estimate significant at 5% level. ** means underlying coefficient estimate significant at 10% level. (-) or (+) mean that information is not provided to estimate marginal effect, but the sign is as is indicated in parentheses. ns means insignificant and dropped from specification. For ratios of estimates for mother's to father's schooling effects, "-" means that the estimate for mother's schooling has the wrong sign, but that for father's has the correct sign and "+∞?" means the opposite. For the text presentation the ratios of mother's to father's effects are translated into the mother's minus the father's estimated effects relative to their averages in order to have a symmetrical measure.

Table A2. Summary of Studies on Elasticities of Child Education with Respect to Mother's Schooling[a]

Sample Characteristics (Country, Region, Year, Sample Size (N), Age, Sex)	Elasticity of Schooling Indicator with respect to		Ratio of Mother's to Father's Schooling Elasticities	Controls for				Notes	Source
	Mother's Schooling	Father's Schooling		Income or Wealth	Individual and Other Household Features	School Features	Community Features		
15. Household Educational Expenditure									
Pakistan 1991, 1967 age 7-14				household expenditure decile, land cultivated, business owned	age, sex, no. sibs, sib rank, no. adult males & females, female head	school distance	province		Sather and Lloyd (1994)
524 urban girls	0.18*	0.15*	1.2						
592 urban boys	0.15*	0.11*	1.4						
295 rural girls	0.04*	-0.00	+∞?						
556 rural boys	0.02	0.02	1.0						
United States 1977-81, av. age 28				family income	age, sex, birth order, no. of sibs, parental ages	no	no	parental support for college education	Behrman, Pollak and Taubman (1989)
533 females	(+)*	no	no						
503 males	(+)**	no	no						
United States 1972-1980 (High School Class of 1972)				parents' income, father's occupation	sex, no. sibs, aptitude, grades	no	residence in South	father's ed for males =0.9 that for females; mother's ed. 1.5 larger for males than females.	Teachman (1987)
4904 females	(+)*	(+)*	0.7						
4698 males	(+)*	(+)*	1.1						
16. Cognitive Achievement Test Scores									
Brazil (Northeast) 1983/7, 3856 2-4th graders				No	age, sex, family size, child works, homework	school type, teacher/stud. by sex, facilities, hardware, teacher characteristics	proportion farm households, large landholders	mother's schooling not significant in some specifications	Harbison and Hanushek (1992)
mathematics	.02*	.03*	0.7						
Portuguese	.02*	.02*	1.0						
Ghana, 1988/9, 1636 children 11-20				instrumented expenditures per capita	age, sex, ability, religion	primary and middle school teacher and facilities	rural, region		Glewwe and Jacoby (1994)
mathematics	0.10*	-0.01	+∞?						
reading	0.14*	0.16	0.9						

Ghana 1988/9, 910 children 9-17	0.04	0.07*	0.6	no	age, sex, ability, height	no	no	prod. function estimates with child sch. endog.); if child sch. dropped, 0.086* and 0.073*	Behrman and Lavy (1997)
India (urban Lucknow, UP) 1991, 902 age 13-14				weighted av. of consumer durables	age, sex, ability, no. sibs, caste, religion, time use of child & others	teacher, facility & student characteristics	no		Kingdon (1996b)
mathematics	0.03*	ns	+∞?						
reading	0.03	ns	+∞?						
Jamaica 1990, 355 children in school				expenditures per capita	age, sex	numerous school facility, instructional material, teacher, organization variables	urban, capital city	control for selectivity due to school choice	Glewwe, Grosh, Jacoby, and Lockheed (1995)
mathematics	0.04	-0.00	+∞?						
reading	0.02	0.03	0.7						
Pakistan (rural) 1989, 316 age 10-25				instrumented household income	age, sex, ability	travel time, book cost	village fixed effects	not sig. at 25 % level; father's sch. nonlinear but only primary used here for comparison with mother's sch.	Alderman, Behrman, Ross and Sabot (1996)
numeracy	-0.01	(+)	-3.7						
literacy	0.01	(+)	1.9						
Pakistan (Lahore low & mid- income) 1994/5, 263 age 6-10				income	sex	instructional expenditure, pupil-teacher ratio, (predicted) private sch.	yes		Alderman, Orazem, and Paterno (1996)
mathematics	0.06*	0.04	1.5						
language	0.05*	0.02	2.5						
Philippines (Metro Cebu) 1983-95, 2192 children at least 6.5	0.60*, [b]	no	no	no	age, sex, height-for-age	school average score	no	production function estimates, sibling sample to control for endogenous height	Glewwe, Jacoby and King (1996)
South Africa 1993, 616 Africans 6-24	0.08**	no	no	household durables	sex, age	pupil/class, distance, travel costs	city dummies	total score (comprehension + computation)	Moll (1996)
United States, 1767 children av. age 5.5	(+)**	no	no	Av. family income over 2 years	race, sex, age, family structure, mother's AFQT score, mother's family background	no	SMSA size, southern, underclass neighborhood	notes that expect father's characteristics to be highly correlated with mother's (p. 1079)	Hill and O'Neill (1994)

United States 1972-1980 (High School Class of 1972				parents' income, father's occupation	sex, no. sibs, aptitude, grades, home ed. resources	no	residence in South	grades; father's ed 2.5 larger for males than females; mother's ed. 1.7 larger for females than males.	Teachman (1987)
4904 females	(+)*	(+)	4.3						
4698 males	(+)**	(+)**	1.0						
United States				family income	sex, race, no. sibs, sib composition	no	no	very similar results for seniors and for high school grades combining sophomores and seniors	Powell and Steelman (1990)
9246 High School sophomores 1980, mathematics	0.05*	0.08*	0.6						
9246 High School sophomores 1980, verbal	0.06*	0.08*	0.8						
United States				Tests are Peabody Picture Vocabulary Test and Peabody Individual Achievement Test; within-mother estimates, which stat. tests indicate are preferred; coefficients appear sig. (the first 60% larger & the second 2/3s as large) if women's endowments ignored; time in first 3 years women in school also positive (sig. at 10% in first estimate) and also appears slightly larger (and sig. in first case) if no control for endowments					Rosenzweig and Wolpin (1994)
703 age 3-8	0.14	no	no						
404 age 3-8	0.26	no	no						
United States 1990/1, age 26-29				parents professional	race, no. sibs, reading materials	student/teacher ratio, disadvantaged student ratio, dropout rate, turnover rate	no	mother's effects up by av. of 47% if school char. dropped & by further 27% if in addition home reading & no. sib dropped (for father's, 13% & 20%)	Neal and Johnson (1996)
926 females	(+)*	(+)*	1.7 hs 0.8 col						
954 males	(+)*	(+)*	0.8 hs 0.3 col						
Zimbabwe 1990, 6927 grade 7 pupils	ns	(+)*	0?	no	age, family size, mother's schooling	fees, teacher characteristics, texts	no	only father's A-level or higher sig. for math; also junior cert. sig. for Eng	Nyagura and Riddell (1993)

[a] Elasticities are given for what appears to be the preferred estimates, if there are multiple estimates, if the information is provided in the study with which to calculate elasticities. In a number of studies that information is not provided, but there is sufficient information to indicate the relative effects of mother's versus father's schooling. * means underlying coefficient estimate significant at 5% level. ** means underlying coefficient estimate significant at 10% level. (-) or (+) mean that information is not provided to estimate marginal effect, but the sign is as is indicated in parentheses. For ratios of estimates for mother's to father's schooling effects, "-" means that the estimate for mother's schooling has the wrong sign, but that for father's has the correct sign and "+∞?" means the opposite. For the text presentation the ratios of mother's to father's effects are translated into the mother's minus the father's estimated effects relative to their averages in order to have a symmetrical measure.

[b] Based on mean of score of 1.0 provided in private correspondence by Hanan Jacoby.

Appendix Table A3. Summary of Studies on Percentage Impact of Mother's Schooling on Child Earnings[a]

Sample Characteristics (Country, Region, Year, Sample Size (N), Age, Sex)	% Impact of One More Year of		Ratio of Mother's to Father's Schooling Effects	Controls for				Notes	Source
	Mother's Schooling	Father's Schooling		Years of Schooling	Experience	Parental Income	Other		
Brazil 1982, 40627 married males 30-55 with wages				yes	yes (age)	no	race, wife's and in-laws' schooling	6 exclusive categories for parents' schooling; based on summary in Table 4 with the values given for each range divided by midpoint for years in range.	Lam and Schoeni (1993)
	3.4*	5.2*	0.7, 0-4 yrs						
	-0.4*	1.4*	-0.3, 4-16 yrs						
	0.4*	2.6*	0.2, 0-16 yrs						
Kenya 1980, 1438 age 20 and up	ns	ns	?	yes	yes	father's occupation, landholding	tribe		Gomes (1984)
Nicaragua 1977-8, 991 sisters with one in each family in 15-45 age range	-4.4*	4.6*	-1.0	yes	yes (age)	no	no. sibs, parents present in youth, comm. char. in youth	dep. var household income; effects at mean; for within fam. est. (ind. est. .3 and .6 as large)	Behrman and Wolfe (1984)
Panamá 1983, 4153 male household heads age 25-64 with earnings	2.7*	0.9	2.9	yes	yes (age)	no	training, employment intensity, region, urban	without regions est. are 4.3* & 2.3*; with only one parent & no regions, est. are 5.9* & 4.8* respectively	Heckman and Hotz (1986)
United States, top 1% of California school-age males in 1921, ln earnings in 1950	-2.6*	0.10	-34.7	yes	yes	estimated family income	IQ	no sig. difference for 1940 or 1960 (though not sig for these years); claims mother's schooling works through IQ but does not treat as endogenous	Leibowitz (1974)

[a] * means underlying coefficient estimate significant at 5% level. ** means underlying coefficient estimate significant at 10% level. ns means that information is not provided to quantify an insignificant effect. For the text presentation the ratios of mother's to father's effects are translated into the mother's minus the father's estimated effects relative to their averages in order to have a symmetrical measure.