WOMEN'S SCHOOLING AND NONMARKET PRODUCTIVITY: A SURVEY AND A REAPPRAISAL

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Jere R. Behrman

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17 September 1990

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Abstract

The nonmarket returns to women's schooling in developing countries are thought to be consistently high. This paper reviews existing studies, discusses future research directions, and presents policy implications on this topic. The review of existing studies suggests that standard studies tend to misrepresent the impact of women's schooling on nonmarket outcomes because of failures to control for: (1) often observed dimensions of women's endowments (e.g., heights), (2) observed community characteristics (e.g., social services); (3) unobserved individual, household and community characteristics; (4) interactions between women's and men's schooling; (5) intergenerational gender links; and (6) subsample selectivity. There is evidence in one provocative study by Pitt and Rosenzweig that subsample selectivity with regard to fertility causes an underestimate of the impact of women's schooling on child health. The available studies that consider the other five possible problems tend to suggest that standard procedures overstate substantially the impact of women's schooling on nonmarket outcomes. Future research profitably could explore the nature of interactions of women's schooling with other inputs, incorporate the effect of women's schooling quality and not just years of schooling, explore possible externalities, investigate other outcomes such as cognitive achievement, consider risk aversion and imperfect information, study inter and intra household transfers and related bargaining and insurance, show more sensitivity to possible measurement errors, and control for the factors mentioned above. The policy implications of research to date include substantial promise to further research in this area and to increasing female schooling for equity reasons. However there does not to date seem to be persuasive evidence that there are market failures that argue for substantial public subsidies for investments in female schooling for productivity reasons, even though the private returns to such investments may be considerable.
Executive Summary

Interest has been growing rapidly, if perhaps belatedly, in understanding the multiple roles of women in developing countries and the implications of those roles for the pursuit of growth, equity and other policy goals. Emphasis has been particularly strong on the role of women's schooling. Schultz (1989), for example, suggests that women's schooling not only has high returns in market activities in developing countries, but in addition has high nonmarket returns. Schultz suggests that these high nonmarket returns buttress the case for the expansion of women's schooling and raise serious doubts about the efficiency, let alone the equity, of policies in most developing countries that lead to lesser levels of schooling for females than for males. Many others have emphasized strongly the important nonmarket returns to women's schooling in the developing countries. This executive summary is organized into three parts: 1. review of the literature, 2. future research directions, and 3. policy implications.

1. Review of existing literature: Standard studies on the impact of women's schooling on nonmarket outcomes in developing countries indicate that frequently there is a significant estimated impact, that often is larger than the estimated impact of men's schooling, on such outcomes. A number of such studies, however, report no evidence of such an effect or that the impact of men's schooling is greater than is that of women's schooling. Therefore it seems, even basing conclusions only on the standard studies, that such effects may be somewhat less common and less strong than a number of studies and summaries of the literature seem to suggest. Nevertheless, the standard studies do seem to imply fairly widespread and fairly substantial effects of women's schooling on nonmarket outcomes in the developing countries.

The discussions of theoretical frameworks for investment in human resources and for household behavior and of measurement and estimation problems, however, raise the possibility of there being biases in the standard estimates. A number of studies that are reviewed in this paper explore some of these possibilities. These "nonstandard" studies suggest a number of insights:

Control for observed dimensions of women's endowments in the form of their heights: Several studies report that parental heights have significant coefficient estimates in relations for child health, with the favored interpretation of this result being that adult height is representing adult endowments. Comparisons of the estimated impact of women's schooling with and without this control for such endowments and suggest that standard estimates of the impact of women's schooling on child health without such a control are biased upward by 25 to 100 per cent (though there does not seem to be such a bias in relations for child survival in the one case for which such estimates are available).

Control for observed community characteristics: A number of studies provide some insight into the effects of controlling for
community characteristics. The majority of these studies are consistent with an interpretation that standard estimates that do not control for such community characteristics are likely to overstate the impact of women's schooling on mortality, health and on child schooling and that women's schooling can substitute for community health and educational services. But a substantial minority of these studies find no significant changes in the estimated impact of women's schooling due to control for community characteristics or positive complementarities so that the estimated effects of mother's schooling are greater if community services are better. However, none of these studies control for the possible endogeneity of choices of communities (and their social services) due to migration. The failure to control for migration is likely to mean that the impact of women's schooling is overestimated if, for example, women who have more schooling also are likely to have more unobserved characteristics relating to their productivity and tastes that favor human resource development and that lead to a greater tendency for them to migrate to communities with better social services.

Control for unobserved individual, household and community characteristics: The series of studies on a Nicaraguan sample by Behrman and Wolfe control for such characteristics using adult sister deviation fixed effects estimates or latent variable techniques. Their results suggest that standard estimates are biased upward substantially with regard to the impact of women's schooling on child health, infant child mortality, contraceptive use, fertility, child schooling, preventative and curative medical care and possibly the women's own health (as well as some market outcomes related to income generation). The biases that are suggested probably are even greater than those suggested by the studies that use women's height to control for such endowments. On the other hand, household nutrition does not seem to be biased in standard estimates by the failure to control for the common unobserved characteristics shared by adult sisters. A study with control for unobserved individual, household, and community characteristics by Rosenzweig and Wolpin reports some similar results in that the impact of women's schooling on breastfeeding is not significant at standard levels if there is control for infant biological endowments and in that failure to control for unobserved child and household endowments possibly biases upwards the estimated impact of parental schooling on infant weights. These studies are quite provocative concerning the possibility that the role of women's schooling is widely overestimated in standard estimates.

Interactions between women's and men's schooling: Women's schooling usually is emphasized in the literature on the impact of adult schooling on nonmarket outcomes, and in a number of studies men's schooling is precluded a priori. However, a number of other studies find that men's schooling also has a significant impact on such outcomes that in many cases is not significantly different
from that for women's schooling and in a few cases is more important than is women's schooling. Since there is assortative mating on schooling in most societies, this means that studies that a priori limit the impact of adult schooling to that of women are likely to have an omitted variables bias due to the failure to include men's schooling in the specification -- one study that considers this possibility explicitly reports such an upward bias in that case is about two thirds. Most of these studies have not considered interactions between men's and women's schooling. The two studies that do emphasize such interactions report significant gross substitution with regard to child schooling, no effect with regard to fertility, and significant complementarities (which may reflect bargaining within the household) with regard to anthropometric measures.

Intergenerational gender links: A few recent studies have found stronger intragender links across generations than cross-gender links for both women's and men's schooling on child schooling and child health.

Subsample selectivity: One study to date by Pitt and Rosenzweig explores the impact of selectivity in fertility decisions on child outcomes and finds that the failure to control for such selectivity results in substantial downward biases in the estimated impact of women's schooling on their children's birthweight. This result suggests that the women who choose to have children are selected inversely on unobserved biological and other characteristics, the failure to control for which in standard estimates causes a large downward bias in the estimated impact of women's schooling on their children's birthweights. This is the strongest evidence in the studies reviewed in this survey of a downward bias in standard estimates of women's schooling on nonmarket outcomes, though there are a number of suggestions of upward biases that are summarized above. When the same study considers a child outcome later in the children's lifecycles, (i.e., expected years of schooling), the apparent effect of control for selectivity of fertility on the estimated coefficient of mother's schooling is much smaller and not statistically significant. This suggests the possibility of a fading effect over the children's lifecycles.

Thus, recent studies that have go beyond the standard studies point both to the possibilities of some refinements in the characterization of the impact of women's schooling -- such as the possibility of important intragender intergenerational links and the possibility of substantial interactions between women's and men's schooling -- and suggest the possibility that the standard estimates may be biased in important respects. There are some indications of downward biases in the standard estimates due to the failure to control for complementarities with men's schooling and some community characteristics and fertility selectivity. But the totality of the evidence suggests more strongly and more robustly that the standard estimates overstate the true impact of women's schooling on nonmarket outcomes because of the failure to
control for observed and unobserved endowments of women and of their households and because of the failure to control for substitution between women's schooling and both men's schooling and community characteristics. Therefore, this review of studies suggests that probably the conventional wisdom based on standard estimates exaggerates the impact on nonmarket outcomes, though there is some counter evidence and a need for further research.

2. Future research directions: The existing nonstandard studies suggest the value of further studies to explore some effects on which current results are ambiguous and to investigate other effects that appear important in one or a very few samples.

Examples of ambiguous results are those that relate to the extent of substitution or complementarities between women's schooling on one hand and men's schooling and community characteristics on the other. In what circumstances does substitution and in what circumstance do complementarities dominate? Might more estimates of the production function relations with such interactions help to clarify the nature and the mechanisms for such interactions, particularly since the present estimates are for reduced-form demand relations in which production and taste parameters are confounded? Do the results vary according to the nature of the nonmarket outcomes or according to the nature of options that are available in markets?

Examples of topics that merit further exploration because the available results are based on one or very few samples include the role of schooling quality experienced by women in addition to their years of schooling, the impact of control for often observed endowments such as adult heights and unobserved endowments such as those shared by adult sisters emanating from their childhood, the relation between the impact of women's schooling on health-related inputs and on health outcomes, intergenerational gender links, and subsample fertility selectivity. Does the incorporation of the quality of schooling experienced by current adults change the implications of investing in schooling quantity versus quality for nonmarket outcomes, as is claimed to be the case at least in some contexts for market outcomes? What happens to the estimates of the impact of women's schooling in other samples with control for observed and unobserved endowments? How adequately do sometimes observed controls for such endowments (e.g., adult heights) seem to serve, in comparison with unobserved factors that only can be controlled through some fixed effects or residual method? To what extent do further estimates suggest that women's schooling may have a greater impact on the choice of health-care inputs than on health outcomes? Is there evidence of intergenerational gender links in other samples and for other outcomes? If so, what seems to be the underlying mechanisms for such gender links and how sensitive do they seem to be to the nature of community and market environments? Is there evidence of fertility selectivity and/or of mortality selectivity in other samples and for other outcomes? If so, does such evidence imply a fading effect over the children's lifecycles, as the one available study seems to imply? Are the effects of such sample selectivity modified if there is
control such as in the adult sisters' fixed effects estimates for unobserved abilities, motivations, and habits that originate in the childhood family background of current adult women?

The discussions of the theoretical framework and of measurement and estimation issues also suggest some possibly important issues regarding the impact of women's schooling on nonmarket outcomes that have not been explored in the studies under review. Perhaps the most important one of these, at least from the point of view of policy considerations, is the question of whether or not there are important externalities generated by women's schooling in the sense that more schooling of other women affects the nonmarket outcomes of the household of a particular woman? Another possibly very important question from a policy perspective is to what extent can other policy-related variables -- for example, training programs, extension efforts, information campaigns, communication improvements, labor market changes -- substitute for women's schooling in having desirable effects on nonmarket outcomes and what are the relative rates of return to such possibilities?

The theoretical framework also raises the question of whether there are other outcomes, the influence on which of women's schooling would be illuminating? Cognitive achievement is one example that is not covered in the studies reviewed in this paper. Most studies also are basically within a one-period framework, but approaches that incorporate time more systematically might be informative. For example, there might be important learning over time about children's inherent endowments and important substitution to cope with seasonal fluctuations and shocks, all of which may be facilitated by more schooling of women, but which have hardly been explored in studies to date. A further implication of the time dimension that is obscured in the one-period framework but that is at the heart of the investment model for human resources is what is the rate of return on investments in children in terms of the adult labor market and nonmarket outcomes that are "produced" by the allocation of women's time to nonmarket activities? Existing studies also abstract from risk aversion, but risk considerations may be important in the real world. Also changes in markets, perhaps most importantly in labor and capital markets, might have important feedbacks on the determination of nonmarket outcomes and on the roles of women's schooling in this process. Might such a role become more important, for example, if markets change more quickly due to accelerated development since schooling often is posited to help process information? Or might it become less important if increased market and governmental policy options for insurance and pensions reduce the importance of children in these roles and if increased labor market options for women increase the opportunity costs of their time in nonmarket activities? Furthermore, changes in household structure and in location due to migration might reflect and affect the roles of women's schooling, but there is almost no analysis that ties such phenomena into nonmarket outcomes in the developing country context. Also there are important transfers of resources and of children across households in some societies that might affect substantially the roles of women's schooling on nonmarket outcomes. Finally, the nature of what determines intrahousehold
allocations, how relevant are bargaining considerations and how does women's schooling fit into such processes (with control for various endowments) merits more investigation.

The discussion of measurement and estimation questions also points to some other issues that have not been explored much, if at all, in the literature. One example is the possibility of random measurement errors in measured women's schooling, which ceteris paribus might cause underestimates of the impact of women's schooling on market and nonmarket outcomes. But there also are other measurement problems, such as the possibility that there is systematic bias in self-reported morbidity that are related to women's schooling and that might bias downward the estimated impact of women's schooling on morbidity. Yet another measurement problem is that the failure to incorporate the resources that go into grade repetition and in some cases school dropouts may result in substantial understatements of the resources devoted to female (and to male) schooling in some contexts, and thus the standard estimates (as well as the nonstandard ones reviewed in this paper) may overestimate substantially the estimated returns to schooling. There also are some possible estimation problems that have not been examined, such as the impact of using selected samples (e.g., only those who report morbidity) to estimate the impact of women's schooling and of other variables on choices relating to medical treatment.

Thus, it seems that there are a number of important issues on the agenda of desired research related to women's impact on nonmarket outcomes. Further exploration of such issues should help to improve our general understanding and the bases for policy formulation.

3. Policy implications: There are important implications for policy regarding research and for policy regarding women's schooling.

For policy regarding research, there are a number of important issues about which further research might improve substantially our understanding and our basis for operational policy formulation. It appears that in this area, perhaps in part because of the relatively recent growth of interest in women and development in many international and academic institutions, there is considerable scope for value added by further research, so the rate of return to such research may be relatively high.

The implications for formulation of policy on schooling for females of the current state of knowledge has differing implications for different policy objectives.

One major policy objective of most developing countries is to increase economic growth. Investments in females' schooling are likely to have at least as great a rate of return in terms of direct economic productivity as investments in males' schooling according to the recent survey by Schultz (1989). The present survey supports in a somewhat more qualified way the position advocated by a number of commentators
that, in addition, women's schooling is likely to have larger impact than men's schooling on a number of nonmarket outcomes. But at least for relatively poor populations, there is increasing evidence that health and nutrition, among these nonmarket outcomes, may have substantial impact on economic labor productivity. The relatively great indirect impact of women's schooling on economic productivity through such nonmarket outcomes, thus, strengthens the case for investing in females' schooling at least as much (if not more) than in males' schooling.

But from a pure growth/productivity point of view, there seems to be little in the available results that suggest that there are differences in the private versus the social returns to such schooling investments. If there are gains to investing in women's schooling directly through increasing economic and labor market productivity and private returns or indirectly through improving health and nutrition with feedback on economic productivity, these seem to be private returns. There does not seem to be evidence of externalities or of other factors in most of the available estimates that justify public subsidies to female schooling because of the expected impact of such schooling on nonmarket outcomes such as health and nutrition. Given present pricing structures for most social services, however, there is at least one exception to this statement that works through fertility. There are social gains beyond the private gains that might be obtained with fertility reductions due to the public savings on social services, and such fertility reductions might be induced in part by more female schooling. For this reason, at least given present pricing policies for social services, the impact of women's schooling on fertility may warrant subsidies for female schooling from a productivity/growth/efficiency point of view. But from such a point of view the first-best resolution would be to eliminate the distortions in social sector pricing, with more female schooling being at best a second-best policy.

A second major policy objective of most developing countries is the satisfaction of basic needs or other related distributional concerns. The results that are reviewed in this study suggest that probably women's more than men's schooling aids in the pursuit of such an objective. From the perspective of the pursuit of this objective, there would seem almost for sure to be a justification for somewhat greater subsidization of female than of male schooling. This does not answer the question of whether more women's schooling induced through such subsidies is the most efficient means to pursue this objective. The judgement about effectiveness of subsidizing women's schooling as opposed to other means for pursuing such an objective is not very illuminated by the present literature, and in fact is not very often even addressed by that literature. That, despite the qualifications that are raised by the nonstandard estimates, women's schooling seems to have fairly widespread positive effects on components of human resources, however, at least raises the possibility that increased female schooling is an important means through which to pursue distributional goals.
Section 0. Introduction

Interest has been growing rapidly, if perhaps belatedly, in understanding the multiple roles of women in developing countries and the implications of those roles for the pursuit of growth, equity and other policy goals. Emphasis has been particularly strong on the role of women's schooling. Schultz (1989), for example, suggests that women's schooling not only has high returns in market activities in developing countries, but in addition has high nonmarket returns. Schultz suggests that these high nonmarket returns buttress the case for the expansion of women's schooling and raise serious doubts about the efficiency, let alone the equity, of policies in most developing countries that lead to lesser levels of schooling for females than for males. The World Bank (1980, 1981, 1990), Colclough (1982), Cochrane, Leslie, and O'Hara (1980, 1982), Chatterjee (1990), Eisemon (1988), Leslie (1989), Mensch, Lentzner, and Preston (1985), Caldwell (1986), Lomperis (1989) and many others who are concerned about human resource development, particularly for children, maintain that a major and often the most important single factor is how educated are women. A fairly broad consensus seems to exist in this literature that women's education is quite important in determining nonmarket outcomes of substantial interest in developing countries, particularly those related to human resource development of members of the same households, and that the effect of women's education in these respects is much larger than is that of men's once there is control for household income. Cochrane, Leslie and O'Hara (1982) summarize the latter point in their survey of the determinants of child health by giving the oft-cited rule of thumb that women's education is about twice as important as is men's in such household production. Many studies in this genre in fact do not even bother to explore the possible impact of men's education, but merely a priori specify that only women's schooling is relevant. Those that do include men's as well as women's schooling in such estimates, moreover, generally do not explore whether there is interaction between the two, with either complementarities or substitution as a priori might seem plausible.

The purpose of this paper is to review what we know about the impact of women's education on human resource related nonmarket

1Schultz (1989) reviews a number of studies. There also are more recent studies, such as Behrman and Deolalikar (1990c) and Khandker (1990).

2 Michael (1982) and Haveman and Wolfe (1984) also have emphasized the importance of women's education in nonmarket activities in the developed countries.

productivity in the developing world and about the relative impact of women's versus men's education, as well as possible interactions, in such processes. Since these questions are basically empirical one, this is primarily an empirical review. However it is useful to consider some modeling and measurement issues before turning to empirical estimates in order to provide frameworks for interpreting such estimates. Therefore I begin in Section 1 with a simple analytical discussion that establishes a common framework for the analysis of the questions of interest and points to some possible problems in estimation and in interpretation of estimates. In Section 2 I next discuss some measurement problems with regard to the critical variables and related estimation problems for such analysis, and discuss their implications. With this background on modeling and measurement, I then review studies on the questions of interest with regard to nonmarket outcomes such as child health, adult health, child schooling, fertility, and nutrition in Sections 3 and 4. The number of studies on some of these topics are enormous. I limit my attention to studies that are recent, that have received considerable attention and helped to shape the conventional wisdom in this area, and/or explicitly deal with some particularly interesting dimensions of the questions of interest. Finally, I conclude in Section 5 with a summary of the review and discussions of promising research directions and of policy implications.

Section 1. Framework for Analysis

A simple theoretical framework is essential in order to analyze the role of women's schooling and other determinants of the nonmarket outcomes of interest in a systematic manner and to be able to interpret related empirical studies. The nonmarket outcomes of primary interest are human resource outcomes. Human resource outcomes, such as child health and child schooling, inherently reflect important investment decisions because there often are substantial lags between the allocation of resources to the formation of such human resources and the reaping of at least some of the major returns from those allocations. Many, if not most, of the returns to investing in child education, for example, may not be realized until the children have become adults and have greater productivity in economic activities because of the investment in their education when they were children. This is not to say that there may not be important consumption benefits in the form of more immediate benefits to investing in such resources. But the investment components are likely to be critical and should shape the analytical framework. I therefore begin with a summary of the standard human capital investment model. But since the locus of many of the human capital investment decisions is the household, particularly for those in children, household decisions underlie the determination of most nonmarket outcomes of interest including human resource investment. Therefore I next turn to simple household models of what underlies the human capital investments. The household models also permit the incorporation of the consumption benefits of allocation of household resources, including the time of women, to nonmarket outcomes. Though the presentation in this section is simple and nontechnical, it points
to some important considerations for the empirical analysis of the impact of women's schooling on nonmarket outcomes. Both of these approaches are presented here within a simple one-period time perspective because that simplifies the presentation and is the form in which they usually (but not always) are used in the relevant empirical literature. But some of the issues of interest inherently have important dynamic elements to which I attempt to point when appropriate.

Section 1.1 The Supply and the Demand for Human Resources

A number of the basic ideas behind the analysis of the determinants of human resources and their relation to women's education can be illustrated within the simple Becker (1967) Woytinsky lecture framework for the "demand" and the "supply" of human capital. I put demand and supply in quotation marks the first time that I use these terms in this context because, although this is standard terminology and I therefore will use it below without using annoying quotation marks, these are not really demand and supply curves as normally defined. Instead, the so-called demand curve is the present discounted value of expected additional benefits from an additional increment of human resource investment in an individual and the so-called supply curve is the present discounted value of the expected additional costs of an additional increment of human resource investment in the same individual. Both the benefits and the costs are in expected terms to the extent that they are not known with certainty at the time of the investment decision of interest. For simplicity, I follow the standard presentation and ignore here both any risk averse behavior and learning over time. Though both could be incorporated into the conceptual framework at the cost of some complications (and it might provide some insights to do so) almost without exception currently available studies ignore such phenomena.

Figure 1.1 provides an illustration, with the solid demand and supply curves implying equilibrium human resource investment level at \( H^* \), at which level the expected marginal costs and the expected marginal benefits equal \( r^* \). Equilibrium is at the human resource investment level at which the expected marginal costs equal the expected marginal benefits, or supply equals demand. At lesser human resource investment levels than the equilibrium level, the expected marginal benefits exceed the expected marginal costs, so there is an incentive to expand human resource investments until the equilibrium level is reached (and visa

4Supply and demand curves as normally defined assume perfect competition, with individual demanders and individual suppliers small (in the sense that they can not alter the market price). In the present context there is only one "demander" and possibly only one "supplier." Therefore the curves are not the normal demand and supply curves.

5Sometimes these marginal benefits and costs are translated into marginal rates of return for benefits and marginal interest rate equivalents for costs.
Figure 1.1. Supply and Demand for Human Resource Investments in Becker's (1967) Woytinsky Lecture
versa for human resource investment levels beyond the equilibrium level).

How might women's schooling enter into the determination of human resources within such a framework? To answer this question it is useful to inquire what lies behind the demand and supply curves.

The demand curve is based on the interest rate for discounting future expected benefits back to the present, the expected "price" of one unit of the relevant expected outcome, a production relation that determines how many units of the outcome of interest are expected to be produced as a function of the human resource investment on which the analysis is focusing and of what ever else determines that expected outcome, including given endowments of the individual and previous or concurrent other human resource investments in him/her. To fix these ideas more concretely, consider human resource investment in the form of time spent by a child in school with the outcome of interest the present discounted value of expected adult productivity per unit time for that child. This adult productivity may be in time spent in the paid labor market (the case usually emphasized in the analytical literature) or in own-enterprise/family economic activity (the form of economic activity in which most individuals in most developing economies engage, particularly on family farms but also in commerce and manufacturing) or in nonmarket/household production (or particular interest here). Therefore one important way in which the relation between women's schooling and nonmarket outcomes may fit into this analysis is that the outcome of interest for undertaking investments in the human resources of girls may include importantly the impact of the expected productivity in nonmarket activities of those girls when they become women. That such an impact may motivate investments in human resources of girls, including their schooling, is important in interpreting the association of women's schooling with nonmarket outcomes and need to control for other factors such as the women's endowments, a topic to which I return below.

The present discounted value of the relevant expected adult outcome is assumed to be affected positively by the schooling investment in the child, but with diminishing marginal returns for at least three reasons. First, the longer one is in school, the longer is the period over which initial post-schooling expected outcomes are discounted back to the present. Second, the longer one is in school, the less long is the post-schooling period over which one reaps the returns from schooling. Third, eventually there are likely to be diminishing

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6See Section 1.2 for presentation of mathematical functions that underlie this curve.

7There generally is a positive association between years of schooling and life expectancy, but the latter increases less than a year for every additional year of the former.
returns to more schooling even for the outcome expected at some definite date (thus ignoring the first two considerations) because of fixed endowments (e.g. genetic abilities) and other human resource investments (e.g. pre-schooling education and nurturing at home). Because of the diminishing marginal returns to time spent in schooling, the demand curve in Figure 1.1 is sloping downward.

The considerations underlying this demand curve touch upon a number of important issues for the topic of this paper.

First, the location of the demand curve for the schooling investment in a child depends in part on characteristics of the household in which the child is raised that affect the expected return to such investments. Important among these characteristics may be the education of the mother or of other women. If mother's education, for example, is complementary with child time spent in school in producing the expected outcome of interest, then the demand curve for investment in the schooling of child is higher ceteris paribus than if the mother's schooling were lower (i.e., the solid versus the dashed demand curves in Figure 1.1). In such a case, one would expect a positive correlation between mothers' and children's schooling because of the productivity of the former.

Second, the location of the demand curve for schooling investment in a child also depends upon the child's inherent abilities and other characteristics related to learning and to subsequent adult success. For children with more of such characteristics, for example, ceteris paribus the demand curve is likely to be higher (i.e., the solid rather than the dashed curve in Figure 1.1) so that the equilibrium schooling level is higher. If there is an association between such characteristics and mothers' schooling, then in empirical estimates of the impact of mothers' schooling on child schooling (or on other outcomes) it may be important to control for these innate characteristics of the children in order to avoid omitted variable biases in the estimated impact of mothers' schooling. I am unaware of investigations of how important such factors are in developing country contexts, but some studies suggest that intergenerational correlations in intelligence and other attributes are considerable in the developed economies.\(^9\)

\(^8\)I say eventually because many think that initially there may be increasing returns to time spent in school, perhaps until the point at which basic literacy and numeracy are established. If this is a strong enough effect to offset the other two considerations, at very low schooling levels the demand curve could be sloping upwards. But a stable equilibrium probably would not occur on the upward-sloping segment of the demand curve since it would require a more steeply upward-sloping supply curve than is likely to be observed empirically.

\(^9\)For example, Behrman and Taubman (1989) present estimates for the U.S. of the decomposition of the variance in schooling attainments between genetic and environmental variance, and find that the former
Third, the location of the demand curve for the schooling investment in a child also depends in part on the larger community in which the child lives. For example, the quality of schooling may have an important impact on the expected returns to the child spending time in school. If higher quality schooling leads to higher returns to schooling, then higher quality schooling leads to higher equilibrium levels of time spent in schooling (i.e., the equilibrium associated with the solid rather than the dashed demand curve in Figure 1.1). There may be some interaction between mothers' schooling and schooling quality in the production through schooling children of cognitive abilities and other qualities of interest. A priori this could be either a complementary or a substitution relation. For instance, better schooled mothers may be better able to assure that their children benefit from special features that higher quality schools have. Or, on the other hand, higher quality schools may be able to compensate more for limited home backgrounds of their students, including limited schooling of mothers. But note that there are likely to be associations between mothers' schooling and the quality of schooling that their children experience even whether or not there is interaction between mothers' schooling and schooling quality in the production of child abilities. This is the case because more-schooled mothers and higher quality schools tend to be concentrated in more-urban areas in most developed countries. In estimates of the impact of women's schooling on their children's schooling (or on other outcomes), therefore, in may be important to control for the current quality of the local schooling (and of other social services, such as related to health) in order to avoid biases in the estimated impact of women's schooling on child schooling due to the association between women's schooling and community characteristics such as the quality of schooling. Another important example of community endowments that may be important is the stock of accumulated knowledge that is emphasized in the "new economic growth

dominates strongly. Also see Behrman, Hrubec, Taubman and Wales (1980) and the references therein.

10I here assume that the quality of schooling is exogenous to the child or the child's parents or guardians, though one could consider the quality of schooling to reflect a choice of the household. But the exogeneity assumption is likely to be valid for primary schooling for most of the poor since their only reasonable option is likely to be the local public primary school. For this reason and to avoid unnecessary complications, I proceed with the exogeneity assumption. But see Rosenzweig and Wolpin (1989).

11This association may reflect a number of factors: lower relative costs of providing higher quality schooling in more urban areas, urban bias due to political pressures, selective migration to areas with higher quality schooling by more-schooled females, more resources devoted to schooling in areas with more-educated adults both because of greater interest and more income. Whatever the mixture of the causes, such associations seem common in most developing countries.
theories" of Romer (1986, 1989a,b), Lucas (1988), Azariadis and Drazen (1990), and others in which there are important externalities to the stock of knowledge (see Behrman 1990d for a survey of this literature).

Fourth, the demand curve reflects a link between schooling (or other human resource investments) with the subsequent productivity of the time of an individual, and therefore the expected economic and other conditions that the individual will face after completing schooling. If such conditions are likely to be bad or limited because of discrimination or strong cultural norms based on sex, caste, ethnic group or whatever or because of poor prospects for the economy, the demand curve may be quite low, such as is represented by the dashed demand curve in Figure 1.1. In such a case the incentives for investing in the individual's schooling are much lower than would be the case were the demand curve where the solid one is.

Fifth, though I here am focusing on the investment motives for human resource investments, there also may be consumption benefits from such investments. More schooling, for example, may be more valued in itself because it gives status or enriches one appreciation of culture independent of its impact on the expected productivity of time use. Such consumption returns also can shift the demand curve and change the equilibrium schooling level so that the solid demand curve in Figure 1.1 reflects greater consumption returns to schooling that for the dashed line ceteris paribus. If more-schooled women are likely to have tastes that value more highly the consumption returns to schooling for their children or if the children themselves are likely to have such tastes due to the influence and role models of their parents, part of the association between mothers' schooling and their children's schooling may be due to these taste effects and not only the productivity impact of women's schooling on nonmarket outcomes. This effect would seem to be most important for the nonmarket outcome of child schooling, though it also might carry over more generally to other indicators of child quality, such as those for child health.

Sixth, the considerations that underlie the associations between investments in current child schooling and other characteristics such as their inherent endowments, their household background, preferences and the quality of local schooling and other local services also probably affected the investment in the schooling when they were children of current women. This means that estimates of the impact of these women's schooling on various outcomes, including the nonmarket outcomes of interest in this paper, may be biased if there is not control for the women's inherent characteristics, their childhood household and family background, and the quality of schooling and other community characteristics that they experienced.

Underlying the supply curve are the private opportunity costs of the resources necessary to attend school. There are a number of possibly important components of these costs: the opportunity cost of the time of the individual in activities other than in school (e.g. participation in the labor force, in household enterprises, or in
household production such as care of younger siblings), schooling fees or tuition, travel time and other travel costs (which may be con-
siderable, particularly for higher schooling levels or specialized schooling or if local schools discriminate against admission of certain types of individuals identified by ethnic group, race or sex), costs of textbooks and supplies. These costs can be summarized in the interest cost of using such resources for schooling instead of for other activities to give the solid supply curve in Figure 1.1. The more productive are the alternative uses of such resources, the higher is the marginal cost of financing incremental schooling and the further to the left is the supply curve. The dashed supply curve in Figure 1.1 is one for which the opportunity costs are higher than for the solid curve, so that, ceteris paribus, the equilibrium schooling level is lower.

Because the opportunity costs are likely to increase with more time in schooling due to increasing opportunity costs of not working and to liquidity constraints, the supply curve for a given individual is likely to be upward sloping. The nature of the capital or credit market obviously can affect this supply curve. The restraints on using human capital as collateral, for example, means that schooling usually has to be financed out of the resources of one's own household or from one's own relatives. This means that the supply curve is likely to be further to the left and possibly steeper sloped for individuals from poorer households because they are likely to have less access to credit markets, pay a higher interest rate to the extent that they do have access to capital markets, and be less able to self-finance the schooling investment. Thus, all else equal, poverty is likely to have an impact on schooling investments through the supply side since the poor are likely to have less capital market access, as well as higher transportation costs to schooling of given quality. Since there is a strong tendency for women with less schooling to be in poorer househol-
ds, in empirical estimates part of the association between women's schooling and human resource investments in their children may be due to the wealth impact through the supply side and not due to productivity effects of the women's schooling per se.

Section 1.2 Household Model

As noted above, the proximate loci for many of the decisions that reflect the interaction between nonmarket outcomes such as those related to human resources and women's schooling are the households in which indi-
viduals live.\textsuperscript{12} Underlying the demand and supply considerations that

\footnotesize{\textsuperscript{12}Households may vary substantially in structure. For the purpose of this survey the term should not be interpreted to mean a nuclear family, but instead the unit in which individuals generally live with some significant sharing of resources (though sharing across residential households may be considerable, for example in the provision of resources for children by their uncles in some West African societies). Also household structure may change, with substantial impact on the household members, although such changes are more difficult to model in an empirically tractable manner than are the decisions of existing
are discussed in Section 1.1 may be a number of household decisions. Therefore I present here a brief description of how economists model such households and what are the implications of such modeling for analyses of the impact of women's schooling on nonmarket outcomes.

For the purpose of reviewing most existing relevant empirical studies, a simple one-period model of household behavior suffices because generally such studies do not incorporate the dynamics of acquiring additional information over time.\(^{13}\) In the standard household model, parents are assumed to make the basic allocation decisions by acting as if they either maximize some agreed-upon preference function or bargain over the allocation of resources, although children -- particularly as they grow older -- presumably have an increasing say in many household decisions. While a bargaining framework appears to many to be more plausible than the maximization of unified household preferences as a motivation for economic models of the households, for most existing empirical applications the difference is moot since the estimated relations do not justify confident identification of what the allocation mechanism is within the household.\(^{14}\) The basic problem is an empirical one: most variables that are used in bargaining interpretations to represent the bargaining power of various parties (e.g. schooling, wage rates, income) also are associated with characteristics that presumably affect productivity and the opportunity cost of time.\(^{15}\) An empirical association between women's schooling and some nonmarket outcomes, for example, might reflect either bargaining or productivity considerations. Women with more schooling may have more bargaining power within the household and more interest in certain outcomes, such as those related to the human resources of their children. Alternatively, more-schooled women may be more productive and thus more able to contribute to the production of the same outcomes. Available empirical estimates of the associations between mothers' schooling and child human resources do not permit identification of which of these possibilities underlies the associations.

The preference relations that are assumed to be maximized depend on the consumption of goods and services, the time use, and the quality of households.

\(^{13}\)Rosenzweig and Wolpin (1988), reviewed below in Section 3.5, is a rare exception to this generalization.

\(^{14}\)For further discussion see Behrman (1990a,b), Behrman and Deolalikar (1988b), Folbre (1984, 1986), Rosenzweig and Schultz (1984), Schultz (1990), and Thomas (1990).

\(^{15}\)This point obviously holds for earned income since such income depends on wages and time use decisions. But it also may hold for unearned income since such income often reflects returns on savings from previous labor market earnings (e.g., capital assets, pensions, social security) and therefore any persistent heterogeneity in productivity.
the human resources of each of the household members. Economists generally presume that the preference functions are given, though some posit a dependence of preferences on childhood experiences or on consumption norms for a broader community (e.g., Easterlin, Pollak and Wachter 1980). A number of the important influences of adult human resources and of poverty on human resources of the next generation are presumed to be affected by parental preferences regarding the quality and the quantity of children, following the seminal contributions of Becker and Lewis (1973) and Willis (1973). Quantity refers to the number of surviving children, which is defined directly by births minus infant and child mortality. Quality refers to whatever child attributes are valued by the parents, though economists often focus (perhaps excessively) on those attributes that are reflected in expected labor market returns to the children's time over their lifetime. Parents may value the "services" produced by child quantity and quality for different reasons -- altruism, their contribution to household income while the children are still young, their expected support during the parents' old age, or maintenance of the family line. Which of these motives predominates may be important since in the development process the availability of alternatives to having one's own children for such services may change. For instance, governmental and private pension plans may reduce the attraction of dependence on one's children for old-age support.

16 And perhaps of other individuals outside of the household, as well, if altruism is important in interhousehold transfers, that often are substantial in developing societies. For recent analysis of the importance of such altruism and of insurance motives as an alternative explanation for such transfers, see Behrman and Deolalikar (1987b), Ravallion and Deardon (1988) and Rosenzweig (1988a). In addition to transfers of resources there may be fostering of children (e.g., see Ainsworth 1989).

17 Or the preferences of others providing resources, such as uncles in some societies.

18 If child mortality has costs beyond the time and monetary resource costs, preferences depend on child mortality experience in addition to the number of surviving children. This would imply an aversion to child mortality in the sense that parents would be better off with a given number of surviving children and no child mortality, than with the same number of surviving children and all else equal except for there having been one more birth and one child died. Since children who die absorb some resources, however, including child mortality in the preferences does not change the direction of predicted effects, just the magnitude. Empirically it is hard to distinguish to what extent parents behave as if they are averse to infant and child mortality because of resource costs versus preference costs in addition to those caused by the resource loses.
Preferences are assumed to be maximized subject to two types of constraints:

First, there is a household full-income constraint. This states that total expenditures of the household on all goods and services for consumption, health care, schooling, other investments in household members (e.g., housing), leisure, etc. must be less or equal to the value of the total resources available to the household. These expenditures include both the money cost and the time cost of all goods and services; even if a service is provided by the government at no monetary charge, the time cost may be considerable. The total value of the resources available to the household includes the total value of the time of all household members (which in turn depends on their predetermined human resources and on their options for time use) and on the value of all other assets, including any entitlements to transfers from the government or from relatives or friends. This full-income constraint reflects among other assets, women's schooling if such schooling has an impact on the productivity and therefore the value of their time in various uses, as is believed widely to be the case (e.g., World Bank 1980, 1990, Psacharopoulos 1985, 1988, Schultz 1989, Colclough 1982, Eisemon 1988).

Second, there are a set of household production functions, in each of which "outcomes" of interest to the household are determined by "inputs," some important ones of which are under the control of household members. For the present paper the input of primary focus is women's schooling, though the impact of women's schooling on various outcomes is likely to depend critically on the allocation of women's time among various activities. For the investments in human resources for children that is discussed in Section 1.2, several production functions are likely to be important. Among these is the production function for the expected marginal time productivity of the child as an adult in the activities of interest (MPi) as dependent in part on a number of intermediate outcomes such as cognitive achievement (Ci) and health (Hi) of the child that depend in part on mother's schooling, as well as expected values of other relevant variables including those related to individual, household and community endowments (Ei, Mh, Mc, X): 19

\[
(1.2.1) MPi = MP(CAi, Hi, Ei, Mh, Mc, X),
\]

\[
(1.2.2) CAi = CA(Si, Sw, Sm, QSi, QSw, QSm, Hi, Hw, Hm, Ni, Nw, Nm, Ci, Cp, Ei, Ew, Em, Ti, Tw, Tm, Mh, Mc),
\]

\[
(1.2.3) Hi = H(Ni, Nw, Nm, Hw, Hm, Ci, Cp, I, Si, Sw, Sm, QSi, QSw, QSm, Ti, Tw, Tm, Ei, Ew, Em, QH, Mh, Mc),
\]

19To avoid complicating the notation unnecessarily I do not explicitly indicate expectations in these relations, nor do I worry about the dynamic relations over time between variables such as child and adult cognitive ability and health.
where $MP_i$ is the expected marginal time productivity of individual $i$ as an adult,

$CA_i$ is the cognitive ability of individual $i$ (as a representative of all attributes produced by schooling),

$h_i$ is the health of household member $i$,

$X$ is a vector of expected values of other variables that affect $MP_i$,

$N_i$ is the nutrient intake of the $i$th household member,

$C_i$ is the consumption of household member $i$, with the superscript $p$ referring to household pure public goods,

$I$ is the number of individuals in the household,

$S_i$ is the time spent in school by the $i$th household member,

$Q_{Si}$ is the quality of schooling experienced by the $i$th household member,

$T_i$ is the time use of household member $i$,

$E_i$ is the endowment of the $i$th household member (e.g., genetic make up),

$Q_{H}$ is the quality of health care in the community,

$M$ is the endowment of the household (e.g., the immediate household environment with a superscript $h$ or the general community environment with a superscript $c$, with the latter including community human resource endowments if there are externalities as are emphasized, for example, in the "new neoclassical growth theory"),

$w$ is a subscript that refers to women (e.g., child $i$'s mother),

$m$ is a subscript that refers to men (e.g., child $i$'s father).

(All of these variables and others defined below may be vectors with multiple dimensions.)

Women's schooling and their time use enter in directly in the child cognitive ability and the health production functions, together with the time allocation and the endowments of the women. In addition there may be some indirect effects of women's schooling on child cognitive achievement and health if women's schooling increase their labor productivity and the resulting greater income induces more expenditure on nutrients and other health-related goods and services.

I now briefly discuss the other inputs in the cognitive skills and health production functions. Nutrient intakes ($N_i$) are emphasized because of their presumed importance in health determination and their direct relevance for this paper since nutritional investments are a major human resource investment that is determined primarily within the household, at least in a proximate sense. For most individuals in developing countries, it is assumed that the health impacts of $N_i$ are positive, though too great quantities can have negative effects on health. Nutrient intakes of the individual and of other household
members\textsuperscript{20} are included in both of these production functions because, in addition to the direct impact of nutrient intakes on the health of the \( i \)th individual, nutrient intakes of all household members may affect their energy levels and therefore their contributions to the household learning and health environment.\textsuperscript{21} Other consumption items (\( C_l, C_p \)) include goods and services with a range of direct effects on the learning environment (e.g., books, newspapers, radios, televisions) and health (e.g., doctor visits, drinking alcohol, driving vehicles, housing). The household size (\( I \)) is included to represent possible scale and congestion effects. The individual's and other household members' time uses (\( T_l, T_w, T_m \)) are included because the extent of leisure time and the time devoted to learning and health-related activities may have strong learning and health effects.\textsuperscript{22} The individual's and other household members time spent in school (\( S_l, S_w, S_m \)) and quality of that schooling may affect learning and health through altering the choice of learning-related and health-related practices, information and the effectiveness of the use of given learning-related and health-related inputs (e.g., more-educated parents may use the radio more for learning about national and world events, more-educated cooks may prepare food in more nutritious ways, more-educated mothers may be more likely to know the benefits of and procedures for growth monitoring).\textsuperscript{23} The health of the individual and of others in the household (\( H_l, H_w, H_m \)) are assumed to affect the productivity of time spent in learning-related activities and that of other household members to affect the productivity of time that they spend related to the health environment and therefore the health of the \( i \)th individual. The individual's and other household members' endowments (\( E_l, E_w, E_m \)) and the

\textsuperscript{20}Here and for other variables the other household members are limited to women and men in order to limit the number of arguments in the production function, but in general similar considerations might argue for the inclusion of characteristics of others in the household if such individuals affect the learning or health environment.


\textsuperscript{22}O'Connell and Mwabu (1986), for example, develop an interesting model in which rural (or, perhaps better, informal sector) workers allocate less time to health maintenance and are less healthy as a result than urban (formal sector) workers. This follows from optimizing behavior given a greater range of possibilities for productive activities for low-health workers in the former sector and, thus, higher opportunity costs for taking time from work for health maintenance for such workers.

\textsuperscript{23} Education, of course, may interact with time and goods allocated to health-related activities.
general household and community endowments (M) differ from the other variables in that they are presumed not to be choice variables of the household during the period being modeled. Examples include the individuals' ages, innate intelligence, initial health and genetic make up, and preferences regarding human resource consumption and the natural environment of the household and community—though the latter could be modified by migration. While the general cognitive ability and health production functions in (1.2.2-3) capture most of the factors emphasized in the economic literature on cognitive ability and health determinants, it is important to realize that our knowledge of the technical relations determining cognitive ability and health and the nature of interactions and lags is quite primitive.

Household production functions, such as these two examples for cognitive achievement and for health, are one of the two conceptually cleanest forms in which to investigate the impact of women's schooling on nonmarket outcomes. Numerous estimates exist of such household production functions for health (and of mortality production functions that can be viewed as a special case of relation 1.2.2 in which health status declines irreversibly below some critical level) and of some other household production functions, though I am not aware of many such estimates for cognitive ability. Four important considerations in evaluating such estimates are:

First, many of the right-side variables are determined simultaneously with cognitive ability and health by the household. However in many existing studies the right-side variables are treated as exogenous, with simultaneity biases resulting. For example, if individuals who inherently are relatively healthy for reasons that are unobserved by social scientists (e.g. their genes) are relatively well

24 Usually in empirical work these variables are treated as if they are predetermined (or ignored). However by moving or migrating, the household may change some dimensions of its immediate or community environment. See Rosenzweig and Wolpin (1989) for an investigation with endogenous migration. Since women's migration may change the community environments that they and their family members face, the general failure to consider the role of such migration may causes misunderstanding of the role of women's schooling in the determination of nonmarket outcomes.

25 If the time period of observation is short (e.g., a month or a year instead of a lifetime), the previous predetermined health status may be important in this relation, perhaps in interaction with other variables (e.g., the efficacy of nutrient intakes depends on such status).

26 The other conceptually cleanest relation is the reduced-form relation discussed below with regard to relation (1.2.3). At the end of this section I indicate why these two types of relations are conceptually cleanest to estimate.
despite their lesser use of health-related inputs, the failure to control for simultaneously-determined health inputs in the estimation of the health production function may bias downward the estimated health impact of such inputs.  

Likewise, if individuals who are inherently relatively robust consume more nutrients and perform more productively in school and in other activities, the failure to control for the simultaneous determination of their nutrient intakes may bias upward the estimated impact of their nutrient intakes on their productivity. Variables that are exogenous to the household, such as governmental policies and market prices, should be used with simultaneous estimators to avoid such simultaneity biases.

Second, there are a number of variables on the right sides of relations (1.2.2) and (1.2.3) that often are not observed, e.g. time use and endowments. If these variables are correlated with the included variables, omitted variable bias may be important. If households with better unobserved endowments tend to have more-educated mothers, for example, the estimated impact of mother's education on health and mortality is upward biased. Mother's schooling may pose a special estimation problem in this regard that is of substantial relevance for this paper. From the point of view of analysis of current outcomes, adult schooling prima facie would seem to be treated appropriately as predetermined since it usually reflects decisions taken much earlier, often primarily by an earlier generation (e.g., the parents of current adults). This treatment certainly is the most common one in empirical studies. This use is most common despite the possibility that schooling of current women would seem to be determined simultaneously with the expected outcomes affected by such schooling in the human capital models.

There also may be biases in the estimates of other parameters, but it is difficult to make any general statement about the magnitude and direction of such biases. See any standard econometrics text.

Whether some of these variables are predetermined or not depends in part on what questions are being asked and on what is the time period of relevance. Migration, for example, can change the local environment and community services of relevance to an individual's learning and health, but can be treated as predetermined unless it is undertaken in a way so that the stochastic terms in the relations for individual's learning and health are systematically associated with unobserved community environments.

Any correlation between the omitted variables and included predetermined variables (e.g., schooling in many studies) also means that the variations in the residuals are biased estimates of the variations in the unobserved variables. Thus unobserved exogenous impacts of, say, endowments can not be identified with the estimated structural residuals, as proposed in various studies (e.g., Rosenzweig and Schultz 1983, 1987), unless the unobserved variables truly are uncorrelated with right-side variables.
such as those that are summarized here and in Section 1.1. Sometimes the assumption that adult schooling is exogenous is made without comment regarding the implications of the human capital literature, but at other times this assumption is made with a comment expressing some skepticism about the lifelong decisions inherent in the human capital framework. In order to obtain an unbiased estimate of the impact of women's schooling on various outcomes, however, the issue is not exactly whether or not there was some lifetime horizon relevant for the schooling decisions when the current woman was of schooling age. The issue simply is whether women's schooling is independent of the stochastic disturbance term in the relations being estimated. It is easy to think of situations in which such independence would not seem obviously to prevail even without recourse to the assumption that the schooling decision was made in a lifetime framework. For example, there is not the necessary independence if parents of current women tended to assure more schooling for their brighter daughters and, in addition to the direct schooling effects in relations (1.2.1-3), brightness leads to better health outcomes and more productivity per unit time. In this case the standard estimates of the impact of women's schooling, without control for the brightness (endowments) of the women, tend to overestimate the impact of women's schooling because the schooling variable in part proxies for the unobserved endowments. Whether or not this is a large bias is an empirical question, but the possibility that it is important can not be dismissed effectively merely by expressing a disbelief in lifetime human capital models.

Third, the relations may differ for different types of individuals in the same household and the distribution of inputs among individuals may not be uniform. Therefore estimates based on household averages may be misleading. If, for example, there are intergenerational gender linkages so that the relation between women's schooling and human resource outcomes are stronger with the women's daughters than with their sons', examination of average outcomes for children may obscure some important relations.

Fourth, the above production functions are presented for simplicity in a one-period framework. But in empirical applications the nature of lagged responses may be critical for understanding long gestations and expectational formation or dynamic learning processes. If lagged responses in health to nutrients, to illustrate, are not well represented, empirical estimates may underestimate the health impact of marginal changes in nutrition. Such a problem is likely to be less severe, however, for right-side variables that tend to be fixed over long periods of time, such as for women's schooling in the present context.

The second type of relationship the estimation of which is cleanest conceptually is a reduced-form demand relation. To obtain these, preferences are assumed to be maximized subject to the full-income and household production function constraints noted above (and perhaps some bargaining procedures if there is bargaining within the household) to determine (perhaps with stochastic factors also playing important roles) all of the outcomes under the (usually partial) control of household
members. These outcomes include nonmarket outcomes such as the health, consumption, health care, nutrient intakes, marginal productivity of time, and time use of each individual, schooling for those of school age, and the number of births and deaths. These outcomes can be expressed as being dependent on all of the determinants of household behavior that are predetermined or exogenous to the household: prices broadly defined to include money market prices, wages, interest rates, and the availability and quality of education, health and other social services; the household and the local environments; schooling or other forms of training for all individuals for whom the gap since such time use is sufficient that they do not currently consider attending school or training programs; other predetermined assets of the household or of individuals therein; entitlements from governmental programs or from friends and relatives; and the abilities, inherent healthiness, preferences, and other endowments of all household members. Such relations are called reduced forms because they reduce the responses of the household, involving constrained maximization subject to full-income and production function constraints each of which in general depends in part on other variables determined by the household, to the relations between each outcome determined by the household and all of the exogenous variables and parameters from the point of view of the household. The reduced-form functions, thus, give the demands for nonmarket outcomes (as well as market outcomes) health, nutrients, other health-related inputs, time in school and other time use, and births and deaths for each individual in the household as a function of all the exogenous prices broadly-defined and predetermined assets broadly--
defined:

\[(1.2.4) \quad Z = f(V),\]

where

\[Z = (H_i, N_i, C_i, S_i, \ldots), \text{ a vector of endogenous variables for each } i = 1, \ldots, I \text{ for which such outcomes are endogenous (i.e., health and nutrition for all household members, schooling for children but not for adults)},\]

\[V = (S_i, E_i, M_h, M_c, P, A, \ldots), \text{ a vector of predetermined or exogenous variables for all } i = 1, \ldots, I \text{ for which such variables are predetermined or exogenous (i.e., genetic endowments for all household member, schooling for adults but not for children)},\]

\[P \text{ is a vector of relevant prices broadly defined faced by the household,}\]

\[A \text{ is a vector of household assets, and all other variables are defined above.}\]

Several characteristics of these reduced forms merit emphasis. First, the predetermined assets and endowments of all members of the household enter into the reduced-form relations for the nonmarket outcomes of interest since changes in any of the predetermined or exogenous variables that affect any one outcome for any one individual may affect the household command over resources and the allocation of
human resource among alternative uses, and thus outcomes for every individual in the household. The assets in most cases should include the schooling of women and of men (but see the further discussion below), but not of children for whom schooling attendance is a choice variable (and therefore is in Z). The problems of potential omitted variables biases in a sense may be greater for the reduced forms than for the production functions because the reduced forms include all of the predetermined variables in all of the relevant household production functions (not just those from the production function for the particular outcome being estimated) and all of the predetermined or exogenous assets and prices in the household full-income constraint. This means, for example, that the unobserved endowments of all of the household members enter into each reduced form, including of course the ones for cognitive ability, health and mortality, use of health-related inputs, and investment in child schooling. This also means that variables that do not enter into the production function for a particular outcome nevertheless should be in the reduced form for that outcome if they affect any outcome for household members, and if they are excluded they may cause omitted variable biases in the estimates of correlated included variables. A pertinent specific example is men's schooling; even if men's schooling should not be included in, for instance, the production function for child health because of complete gender specialization in health care, it should be included in the reduced form for child health if it affects any household outcome and, if it is excluded, its exclusion is likely to result in omitted variable bias in the estimated impact of women's schooling given that men's and women's schooling are correlated across households due to assortative mating on schooling. Second, the estimated impact of women's (and of men's) schooling in such reduced forms presents the same problems as are discussed above in regard to the estimation of the impact of adult schooling on household production function outcomes. Even though such schooling was determined long ago, it is not implausible a priori that it is correlated with unobserved endowments that are included in the disturbance term in most estimates, with the results being biased estimates of the schooling impact. Third, if the motive for the allocation of resources to a nonmarket outcome is a pure investment motive such as is discussed in Section 1.1 for human resource investments, income of the household or of its individual members is not necessarily one of the right-side variables in such relations. For pure investment decisions, the standard story is that investment is made until the expected internal rate of return on such investments equals the interest rate that the household faces. If such interest rates are not observed and they depend on income or if the nonmarket outcome of interest has a consumption component, however, income may be significant in such relations. Fourth, governmental policies affect human resource investments and other nonmarket outcomes primarily though prices, community endowments, and taxes and transfers. Policies acting through prices include free or subsidized provision of health services, food, and schooling and policies affecting wages, but also any other policies that affect any of the prices on the right-side of (1.2.4), such as fertilizer subsidies or import tariffs and import quotas if the
household firm/farm model is appropriate. Polices may alter community endowments through public-work programs and malaria and other disease control; to the extent that individuals can change the relevant community endowments through migration, however, these endowments are endogenous. Likewise, governmental allocations of some services across space may be in response to community endowments, which may cause biases in estimating the impact of the services unless there is control for the endowments. For example, if malaria is worse where conditions are swampier and governmental antimalarial programs that are concentrated in swampy areas reduce, but do not eliminate malaria, estimates that do not control for swampliness may indicate a negative effect of governmental antimalarial programs on malaria (or underestimate their positive effect). Tax and transfer policies, of course, work through changing

30 The predetermined assets and exogenous prices for many households in developing countries should include not only assets and prices relevant directly to consumption decisions, but also those relevant to household firm/farm market-related production. Because of incomplete markets, productivity effects of health and nutrition, or differentials in selling versus purchasing prices for food producers, it may not be possible to separate the income-generation from the consumption decisions (as is done in standard demand analysis). The most analyzed such household-firm decision-making unit is the household-farm model considered by Lau, Lin and Yotopoulos (1978), Barnum and Squire (1979), Singh, Squire and Strauss (1986) and others, but similar considerations may be important for nonagricultural family enterprises in services and industry, particularly in the informal sector. The reason for separability not being appropriate that is most emphasized in this literature is incomplete markets, but Behrman and Deolalikar (1988b) emphasize that another important reason may be productivity effects of health and nutrition, and Alderman (1987) suggests that yet another important reason may be wedges between selling and buying prices for partially own-produced foods. The situation in which separability between income generation and consumption is an appropriate assumption can be considered to be a special case of this model in which the prices, assets, and endowments that affect the income-generation side alone can be replaced by predetermined income in the health and nutrient demand relations. If the nature of one's occupation and one's productivity directly interact with one's health and nutrition, however, the separable case may not be as common as often is assumed. If so, income (including net profits from family farms and firms) is endogenous and should not appear in these reduced-form relations. The latter relations, in turn, should include all the prices and predetermined assets relevant to household farm/firm production or alternatively, if household income is included in a quasi-reduced form rather than estimating a true reduced form, it should be treated as simultaneously determined in the estimates with the predetermined assets and exogenous prices for the household farm/firm production used as identifying instruments.

31 See for example, Rosenzweig and Wolpin (1986).
the full-income budget constraint. Parallel to the comments made above about men's schooling, even if the effects of these policies do not enter directly into the production function for some outcome of interest, they should be included in the reduced forms if they affect any household outcome, and their inappropriate exclusion from such reduced forms may result in omitted variable bias in the estimated effects of correlated included variables -- which plausibly might include women's schooling. **Fifth**, these reduced forms allow for the possibility of considerable substitution in the use of goods and services and time of household members in response to changes in the right-side variables. This substitution includes the technical substitution among inputs in the cognitive ability, health and other household production functions, but goes beyond that since it may involve reallocations that change the inputs in that function. If such substitution is great, the impact of any changes in the right-side variables may be offset considerably by other changes in the household. This gross substitution (gross in the sense that it includes the overall household responses, not only technical substitution in production) may involve in some important respects women's schooling. As is suggested in Section 1.1, for example, there may be important interactions -- either substitution or complementation -- between women's schooling and men's schooling or between women's schooling and the nature of local social services. Whether or not this interactions are important, of course, is an empirical question. **Sixth**, different individuals in the same household may be affected differently by an exogenous change in prices or assets, including women's schooling, once again. Therefore analysis at the household level of aggregates may not be very informative about what happens, for example, to infant girls if women have more schooling, ceteris paribus. On the other hand, successful targeting of nutrients or other health-related policy inputs to particular individuals may be very difficult if resources are fungible within the household. **Seventh**, in empirical applications, as for the household production functions, correct specification of lag structures may be important both because of gestation periods and because of expectational formation. But as for the production function estimates, this seems to be less of a problem for the present concern with the impact of women's schooling on nonmarket outcomes than it would be for variables that change more over time. **Eighth**, if enough structure is imposed on the underlying structural relations, there may be restrictions on the reduced-form coefficients. **Ninth**, the above reduced-form relations are consistent with expected utility maximization with risk neutrality. If there is risk aversion in a multiperiod framework, not just expected values of exogenous variables, but also higher moments might enter into these relations. To my knowledge, however, no one has included such considerations in empirical explorations of the impact of women's schooling on nonmarket outcomes.

Though the household production and reduced-form demand functions conceptually are the cleanest to interpret, not infrequently hybrid relations with both reduced-form (e.g. predetermined income, prices) and endogenous production function (e.g. health-related inputs that are a matter of choice) variables are estimated. Such relations are hard to
interpret because the endogenous production function variables capture part of the effect of the exogenous reduced-form variables and the simultaneity of the right-side endogenous variables usually is not controlled.\textsuperscript{32}

Section 2. Measurement and Related Estimation Issues

The primary concern of this paper is the nature of empirical estimates of the impact of women's schooling on nonmarket outcomes in developing countries. Section 1 argues that such insight can be obtained best through estimation of production functions such as those for cognitive ability and health in relations (1.2.2-3) and through estimation of reduced-form demand relations such as for cognitive ability, health, nutrient intakes, births, death, savings, and child schooling as in relation (1.2.4). Available estimates of these relations generally are from cross-sectional socioeconomic data sets, though increasingly panel data have been used. However there are a number of estimation problems in using such data for estimation, many of which can be related to measurement problems in observing certain variables for part or all of the sample or in observing error-free indicators of such variables. Since these problems are pervasive in the estimates that are reviewed below, and in fact some of the most interesting studies available are of interest because they estimate the effect of controlling for such problems on estimates of the impact of women's schooling on nonmarket outcomes, it is useful to discuss some of the major measurement/estimation problems before turning to the estimates.

In this section I discuss some of these measurement and estimation issues with particular reference to the estimation of the impact of women's schooling on nonmarket outcomes. I give a very brief catalogue of some of the major measurement and estimation problems that are encountered in the estimates that are reviewed below. This discussion is intentionally very brief, with an effort only to indicate the flavor of these problems, and not the technical details (which are explored in any standard econometrics text). I judge that some such discussion is useful to educate the intuition of those who do not conduct research in this area so that they better can understand the evaluation below of

\textsuperscript{32} There is not a problem if an endogenous production function variable has been introduced by solving the reduced-form relation of that variable for some exogenous variable and then substituting the resulting relation into another reduced form to eliminate an exogenous variable and using the exogenous variable that has been eliminated in the process as an instrument for a simultaneous estimation. This is the quasi-reduced form approach discussed above with regard to the second point after relation (1.2.4). However this is not a common procedure (and, in fact, has no obvious advantage since it requires the same information as does the estimation of the reduced forms).
available estimates of the impact of women's schooling on nonmarket outcomes.

Random measurement error in dependent variables: The dependent variables in the relations of interest are the nonmarket outcomes of interest -- health, cognitive ability, nutrient intakes, other health-related intakes, fertility, mortality, asset accumulation, and schooling of children. Random error in these variables means errors that are independent of the right-side variables in the relation being estimated. If the relation being estimated, for example, is a reduced-form demand relation in nutrient intakes that is linear in the variables in relation (1.2.4) with an additive stochastic disturbance term, random measurement errors in nutrient intakes effectively increase the variance in the disturbance term beyond what it would have been without such random measurement errors in nutrient intakes. This means that the estimated relation "explains" less of the variance in nutrient intakes (in the sense that the R2s are smaller) than would have been the case if there were not such random measurement error in the dependent variable. But, since this error is not correlated with women's schooling or with any of the other right-side variables, it does not cause any bias in the estimated coefficient of women's schooling or of other right-side variables.

Omitted variable bias: A number of right-side variables that are included in the nonmarket outcome production functions and reduced-form demand relations in Section 1 usually are not observed. Examples include assets such as individual, household, and community endowments and many prices broadly-defined. The critical question regarding these variables is whether they are correlated with any of the included right-side variables. If they are so correlated, they cause omitted variable bias. If, for example, infant health depends only on women's schooling and on women's unobserved endowments (e.g., related to their ability, habits learned in childhood, their preferences related to having children, and/or their inherent robustness that affects both the energy that they devote to children and their breastfeeding) in a linear relation, but in the estimated relation there is no control for such unobserved endowments, the estimated impact of women's schooling on infant health is contaminated by omitted variable bias. As is intuitively appealing, the extent of this bias depends on two factors: (1) the size of the impact of the omitted women's endowment variable on infant health (i.e., omitting variables that have little or no impact in the true relation causes little or no bias) and (2) the correlation between the observed right-side women's schooling variable and the omitted women's endowment variable (since the higher is the correlation the more that the former represents in the estimates the effects of the latter).

If the omitted variables are fixed over the relevant time period, fixed effects estimates can be used in some cases. In such estimates the relation being estimated is differenced over time or across individuals for which the unobserved effect is assumed to be fixed. This permits the estimation of the coefficients of any variables that
vary over time with control for the unobserved fixed effect, such as women's endowments in the above example. Such fixed effects estimates for adult women sisters, for example, control for the impact of unobserved right-side variables that relate to their shared childhood background (e.g., household and community learning environment, habits and knowledge acquired from their mother, their common genetics) so that such estimates can be used to purge the coefficient estimates of women's schooling from omitted variable bias of the impact of such unobserved variables that emanate from the common shared childhood background of adult sisters. The estimates in Behrman and Wolfe (1984a) suggest that the standard estimates that do not control for such unobserved childhood background factors may overstate the impact of women's schooling on income in Nicaragua by a considerable amount, on the order of magnitude of 40-50%. However, very few data sets have information on adult sisters that permits estimation of the determinants of nonmarket outcomes with control for such shared common childhood family background.33 Fixed effects estimates through differencing over time require panel data, which limits the applicability of this procedure. Moreover, such a procedure does not permit the estimation of the coefficients of women's schooling since all fixed variables, observed or unobserved, are eliminated by the differencing over time and women's schooling generally is fixed over such panels.

Systematic measurement errors in dependent variables: Generally those who worry about measurement errors focus on random measurements errors (which, as noted above, do not cause biases if they are for dependent variables). However, causal observations and a few studies suggest the possibility of systematic errors in dependent variables that cause biases. For example, there are frequent conjectures that, for a given objective health state, more-schooled individuals may report greater morbidity. If this is the case, then due to this systematic measurement error the estimate of the positive effect of women's schooling on health may be biased downward with respondent-reported morbidity data because more-schooled women may be more likely to characterize a given health state as reflecting morbidity (for some empirical evidence, see Wolfe and Behrman 1984). Likewise, there is some evidence that self-reported nutrient intakes tend to approach community norms as the reporting period lengths (Ravallion 1990); in such a case, the estimated effects of women's schooling on nutrient intakes may be biased toward zero if longer reporting periods are used.

Random measurement errors in right-side variables: Random errors in right-side variables tend to cause biases towards zero in the related coefficient estimates. The intuition is that the noise due to those measurement errors tend to obscure the true effect, the more so the larger is the variance in such noise relative to the variance in the true variable. If there are random measurement errors in reported

33In fact I am aware of only one such data set -- that for Nicaraguan sisters used in the studies by Behrman and Wolfe that is reviewed in Sections 3.4 and 4.1-4 below.
women's schooling, they are likely to cause the impact of women's schooling in estimated relations that determine various nonmarket outcomes. I am not aware of estimates of the extent of measurement error in self-reported schooling by women in developing countries. Estimates for developed countries tend to indicate that such random measurement error causes downward biases of the magnitude of about 10-20 per cent. It also should be noted that the differencing to obtain the fixed effects estimators tends to increase the impact of random measurement error, for which reason there may be larger measurement error biases towards zero in the estimated coefficients for women's schooling from adult sister fixed effect estimates than from level estimates (though this observation does not indicate anything about whether this bias is larger or smaller than the omitted variable bias that the fixed effects estimates control).

Systematic measurement errors in right-side variables: As for the dependent variables, focus in the literature often is on random measurement errors, but there is some evidence that systematic measurement errors may be important and perhaps more important than random measurement errors. The right-side variable of primary interest in this paper is women's schooling. The concept of interest presumably is cognitive ability or whatever is produced by schooling (usually together with other inputs as is suggested by the production function in relation 1.2.1). As often is the case, the use of one input to represent the output of a production process may not be very satisfactory. In most of the literature reviewed in this paper, however, the time spend in schooling (or, almost equivalently, the grade attained) is used to represent women's schooling, without incorporation of the effects of other inputs in relation (1.2.1) such as the quality of schooling. The use of but one input variable (i.e., years of schooling) to represent the output of a production process can be characterized as a systematic error in the representation of women's schooling in most of the studies under review. Estimates for the impact of schooling on market outcomes in developing countries are consistent with the possibility that women's years of schooling is contaminated by systematic measurement bias of this sort. For example, the Behrman and Birdsall (1983, 1985) estimates for Brazil suggest that the impact of schooling on income is overestimated by about two-thirds if there is not control for schooling quality in the estimates. Such results raise the possibility that there may be substantial systematic error in available indicators of women's schooling, that may cause considerable biases in the estimated effects of women's schooling on nonmarket outcomes.

Subsample selection related to stochastic term in estimated

34 Or it might be viewed as an omitted variable bias problem, with the omitted variables including all of the inputs other than time in schooling in the cognitive ability production function, so that the coefficient estimate of schooling is biased if there are any correlated inputs.

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relations: If only a subsample is used for a particular estimate and the selection rule for inclusion in the subsample is related to the disturbance term in the estimated relation, then the failure to control for that selection rule tends to cause biases estimates. The most emphasized case in the literature is for the estimation of wage functions for women for whom wages are observed only for those women for whom the market wage exceeds their reservation wage so that they participate in the labor force. Consider Figure 2.1 in which the Y axis refers to women's wage rate and the X axis refers to women's schooling. The solid line refers to the estimated relation between women's wage rates and their schooling if there were observations on all women, with the slope of this curve giving the true impact of their schooling on their wage rates. But suppose that only wage rates above the reservation wage $Y^*$ are observed. In this case if there is no control for selectivity, the estimated line will be like the dashed line, which gives a biased estimate of the relation between women's wage rates and women's schooling since its slope differs from that of the true relation that is given by the solid line. The problem is that the subsample selection rule is associated with the dependent variable, so that observations with positive disturbance terms (and thus above the true line, such as point a) are more likely to be included in the subsample than are observations with negative disturbance terms (and thus below the true line, such as point b). The asymmetrical selection of disturbance terms results in an under representation of those with more negative values, and thus "twists" the estimated regression line to the dashed one with its biased estimates. Schultz (1989) reviews estimates of the impact of women's schooling on their wage rates and earnings in developing countries and concludes that control for selectivity of the subsample results in substantial biases.

There has been much less attention to subsample selectivity in the analysis of the impact of women's schooling on nonmarket outcomes in developing countries than in estimation of the impact on market outcomes. Yet the possibility of such selectivity would seem to exist in a number of cases. For example, the study of the impact of women's schooling on their children's schooling success typically is undertaken for the subsample of children who were born who survived to be of school age; if there is correlation between the disturbance terms in the infant/child mortality relation and the schooling success relation (as seems probable due to the unobserved child and maternal endowments in both of these relations, among other variables) failure to control for infant/child mortality in the schooling success relation is equivalent to selecting the subsample for the schooling success relation in a manner that is associated with the disturbance term in that relation, and thus selectivity bias is likely to result. For another example, estimates for medical treatment choices typically are made for subsamples of individuals who are reported (either self-reported or reported by others, such as the mothers of children) to have been ill; but if there is correlation between the disturbances in the morbidity determination relation and in the medicare treatment relation (as seems likely due to unobserved variables that would seem to affect both, once again), the use of such a subsample to estimate treatment choices is a
Figure 2.1 Bias Due to Subsample Selectivity with Solid True Regression Line and Dashed Line with Selected Subsample in which $Y > Y^*$
selected one (i.e., there is a higher probability of including points such as a than b in Figure 2.1 with Y now interpreted to be intensity of treatment choices), so selectivity bias results.

Control for such sample selectivity typically is by a two-step procedure such as those due to Heckman (1976) or Olsen (1980) (in which the first step is the estimation of the selectivity rule, and the second step used the results of the first step to control for the probability of being included in the selected subsample) or integrated maximum likelihood estimates (in which the selection rule is estimated together with the relation of interest). The control for selection into the subsample depends upon there being some identifying variable(s) that affects the selection rule but not the subsequent outcome of interest. As Manski (1989) emphasizes, just what serves as identifying variables in a particular context is a matter of judgement about which different people may have different judgments. In some cases, in fact, it may be difficult to rationalize that there are such identifying instruments in a data set. For example, many cross-sectional samples used for the analysis of morbidity and of medical-care treatments do not seem to have such identifying instruments since for the period of the data collection it would seem that within the household model all variables that affected morbidity also would affect medical treatment\(^{35}\) -- though one can conceive of possible identifying variables in the form of lagged exogenous and redetermined variables that affect current morbidity.

**Simultaneity bias:** Simultaneity bias arises because some of the right-side variables are determined together with the dependent variable in a relation, so they are not independent of the disturbance term in the relation.\(^{36}\) The usual procedure for eliminating the simultaneity bias is to replace the endogenous variables with their values as estimated from exogenous and predetermined variables (which, if indeed they are exogenous or predetermined, are independent of the disturbance terms in the system). To be more concrete, the question of simultaneity bias arises in the estimation of household production function relations such as those for cognitive ability and health in relations (1.2.2-3) because some variables -- such as nutrient intakes -- are determined simultaneously with the outcomes being produced. The reduced forms relations (1.2.4) indicate (conditional on the correct specification of the model) the variables that can be used to estimate the values of right-side endogenous variables.

There is an identification issue for such simultaneous estimates. The usual identification criterion is the exclusion restriction that there is at least one exogenous variable for each right-side endogenous variables in the set of variables used to estimate right-side endogenous

\(^{35}\)That is, the reduced forms for the two outcomes have the same right-side predetermined or exogenous variables, as in relation (1.2.4).

\(^{36}\)That is, they are determined by the same set of exogenous or predetermined variables in the reduced-form relations (1.2.4).
that does not appear in the relation to be estimated. The intuition behind this rule is that the effects of the right-side endogenous variables can be separated from those of the other variables in the relation of interest only if the former are independent of the latter, which in turn requires that there be at least one exogenous variable for each right-side endogenous variable so that the estimating relations for the right-side endogenous variables are linearly independent. The reasoning is parallel to the need to have at least n independent relations to be able to solve a system of equations for n variables. For a given specification of the underlying model, the possibility of identifying variables in particular relations depends on the availability of sufficient exogenous or predetermined variables in the reduced forms and thus in a sense is a data available or measurement issue. Since identification depends on the specification of the underlying model, different individuals may differ on what variables can be used to identify various relations. One big question, for example, is whether observed prices and community characteristics are predetermined or are the result of choices through migration.

Simultaneity bias has been emphasized as being quite important in many micro estimates of nonmarket outcomes by Rosenzweig, Schultz, Wolpin and others. If one accepts that women's schooling is predetermined in the relations of interest, however, it might seem that simultaneity bias is not so likely to be a problem for the estimated impact of women's schooling as for the estimated impact of other variables that are more likely to be determined simultaneously. Such intuition may be correct. But it may not be correct. If there are simultaneity problems with other variables in the specification, they may affect the estimated impact of women's schooling even if women's schooling is in fact predetermined. Moreover, since some variables such as the women's natural ability and physical robustness would seem within the framework of the model in Section 1 to have been a factor in the determination when they were children of their schooling and in their outcomes in which they are involved as adults, there is in the important sense of correlation with the disturbance term an estimation problem that might be characterized as simultaneity (or, as above, as omitted variable) bias for women's schooling as well if these unobserved factors are not controlled in the estimates.

Section 3. Review of Selected Studies of the Impact of Women's Schooling on Health, Morbidity and Mortality

In Section 1 on modeling the impact of women's schooling on nonmarket outcomes I suggest that the most fruitful empirical relations to be estimated are production functions for a subset of outcomes and reduced-form demand relations for a larger set of outcomes. In that

37The latter set of outcomes is larger than the former because there are reduced-form demand relations but not production functions (at least from the point of view of the household which is the viewpoint of
section I also discuss the specification of other variables that also arguably should be included in these relations. In that section and in Section 2 on measurement and estimation issues I point to a number of possible problems in estimating the impact of women's schooling on the nonmarket outcomes of interest. Based on the background provided by the discussion in these two sections, I now turn to review selected empirical studies of the impact of women's schooling on nonmarket production.

I limit my review to selected studies because there are a large and rapidly increasing number of studies that are related to this topic, although in many cases the question of what is the impact of women's schooling on nonmarket outcomes is not the central question in the individual studies. To review all of the existing studies would require going far beyond the scope of the present survey, and probably would result in a very boring litany concerning a number of similar studies each of which may be of interest in the particular institutional context for which it was conducted, but each of which would add very little to the overall perspective that I am trying to develop in this survey. For such reasons, I limit myself to studies that are relatively recent, well-known and influential, and/or explore in innovative manners the nature of the specification and estimation problems that I discuss in Sections 1 and 2. I also focus more on micro than on aggregate studies, though I do review some of the latter since some such studies have been quite influential in the shaping the conventional wisdom about the impact of women's schooling on nonmarket productivity and since such studies in principal might capture the externalities that play such a major role in the "new neoclassical growth literature" of Romer (1986), Lucas (1988), Azariadis and Drazen (1990) and others better than do micro studies. 38

interest given the concern in this paper with nonmarket outcomes) for certain inputs in the production functions, such as years of schooling and purchased or government-provided inputs for curative and preventative health care.

38 For a review of this literature, see Behrman (1990a). As is noted in the discussion of the specification of relations (1.2.1-4) in Section 1.2, the accumulated stock of knowledge (or of human resources) should be included in these micro relations as part of community endowments (Mc) if such externalities are important, but they have not in fact been included in empirical micro relations of which I am aware. At the macro level, in a sense, all such externalities are internalized, so such externalities may be captured. Even so, the aggregate studies that purport to focus on the impact of women's schooling do not represent the full possible effects of such externalities because to do so would require specification of initial human capital stocks as is done crudely (because of dependence on variables such as literacy rates and schooling enrollments) in studies such as those by Barro (1989a,b) and Romer (1989), but without separating the effects of women's versus men's human capital.
I now turn to the evidence on the impact of women's schooling on the nonmarket outcomes of health and mortality, nutrition, other health-related inputs, children's schooling and fertility in turn. For each outcome I first attempt to characterize the "standard" results, perhaps as summarized in some well-known study or survey. I then turn to studies that address one or more of the specification, measurement, or estimation problems that are suggested by the discussions in Sections 1 and 2.\textsuperscript{39} I begin in this section with studies that are informative regarding the impact of women's schooling on health, morbidity and mortality. I discuss at somewhat greater length these nonmarket outcomes than the other outcomes that are discussed in Section 4 for four reasons: First, these are among the nonmarket outcomes on which the impact of women's schooling is most emphasized in the literature. Second, for these outcomes there are both production function and reduced-form demand relation estimates, while for many of the other outcomes only the latter make sense conceptually. Third, there probably are more interesting studies for these than for other nonmarket outcomes that use various innovative approaches to attempt to disentangle exactly what the association between women's schooling and nonmarket outcomes is representing. Fourth, the discussions of these outcomes has some important parallels with the discussions of the other outcomes, so the latter summaries can be briefer.

The health production function in relation (1.2.3) and the reduced-form demand relation for health in relation (1.2.4) in Section 1.2 both can be considered to encompass a range of states of healthiness, from good health to illness or morbidity to mortality, with the last of these representing an irreversible state of very poor health below a critical cutoff level. I first summarize several "standard" studies of health, morbidity and mortality production functions and reduced-form relations that provide evidence on the role of women's schooling. Here and below I use the term "standard" to refer to multivariate estimates that do not investigate some of the special features that are discussed in Sections 1 and 2, such as control for observed and unobserved endowments, interactions with community characteristics, interactions between women's and men's schooling, intergenerational intragender links, dynamics, and subsample selectivity. I then turn to some studies that provide evidence on the importance of specification, measurement, and estimations problems that may or may not cause the standard estimates to be misleading.

Section 3.1 Standard Estimates

I begin with three well-known aggregate studies that have been influential in shaping current conventional wisdom about the strong impact of women's schooling on health, morbidity, and mortality. I then

\textsuperscript{39}Of course some studies address more than one of these issues. In such cases I summarize the study in the section in which in my judgement it most illuminates the issue being examined and then only briefly refer to it in other sections in which it is relevant.
summarize one other well known aggregate study (but well-known because of emphasis on the impact of expected labor market outcomes on male-female infant and child mortality rates in India) and next to a series of fairly recent standard micro studies.

Cochrane, Leslie, and O'Hara (1980, 1982), in two widely-known papers, present a thoughtful review of micro and macro studies of child-health determinants as of the end of the 1970's. Their primary conclusion is that the most robust determinant is the positive impact of women's schooling, with the impact of women's education likely to be about twice that of men's. For aggregate estimates they also regress the absolute values of the estimated education coefficients from a number of aggregate estimates on life expectancy, income, illiteracy, governmental health expenditures, time and the mortality of the uneducated (given by the intercept in the original regressions). They find R²'s of from .83 to .99 (the latter if the last variable is included), and interpret their results (with qualifications due to the small sample size) to reflect the extent to which the different estimated marginal impacts of education on mortality are sensitive to the right-side variables such as governmental health expenditures. It would seem to me that what should be emphasized from these estimates is that almost all of the variation in the estimated education impact across studies may be due to omitted variable bias. This interpretation still leaves the possibility that education is important, but possibly substantially less important than the aggregate estimates themselves suggest.

In another widely cited study, Mensch, Lentzner and Preston (1985) examine socio-economic differentials in child mortality in 15 developing countries based on time series data. The estimates suggest relatively strong effects of "sociocultural" variables such as mother's education, ethnic group, and father's education (the last only in urban areas). The authors interpret the "very considerable impact of mother's education and ethnicity... [to point] above all to the potential importance of child care practices in determining levels of child morality" (p. 289) and suggest that such results "support some of the assumptions of the primary health care movement, which emphasizes broad outreach into every home with a range of simple preventive measures" (p. 290). They do not recognize explicitly the possibility that their estimates for mother's schooling may be upward biased because of the failure to control for unobserved endowments. This last consideration means that their results must be interpreted with care, but nevertheless they are provocative in suggesting major roles for women's education and perhaps for child care.

In a study that is well-known for its emphasis on the role of differential expected labor market outcomes by gender (as represented by relative participation rates in the paid labor force of current adults), Rosenzweig and Schultz (1982b) analyze the determinants of male-female differentials in child survival rates in rural India using both household and district level data, with a focus on the expected relative returns to male and female labor. They find almost no significant
effects of parental education except that the male-female survival differential in the household data is less if the father (but not the mother) has matriculated.

DaVanzo and Habicht (1984) exploit the retroactive historical nature of their Malaysian Family Life Survey (MFLS) data to estimate a logit model for infant mortality for the 1946 through 1975 period. They find that increases in mothers' education, together with those in piped water availability (particularly for women who did not breastfeed) resulted in large declines in infant mortality that more than offset increases due to decreases in the durations of both supplemented and unsupplemented breastfeeding. When they subdivide their sample into two subsamples (i.e., 1946-60 and 1961-75), they find that the impact of mothers' schooling appears to be statistically significant only for the more recent period (though the standard error is so large for the earlier period that a t test indicates that the estimates do not differ significantly between the two periods).

Blau (1984) estimates a demand function for age-standardized height using 1977-78 Nicaraguan data on children under five years of age. He includes the mother's age, education, urban origin, other income, and predicted formal and informal sector women's wage rates (corrected for selection bias) as independent variables. With this specification women's education does not have a significant impact, though perhaps it is working through the significant positive effect of the predicted formal sector wage for women.

Simmons, et al. (1982) estimate logit conditional reduced-form relations for infant and child mortality, by age groups (e.g., first year and second and third year mortality) and by sex for 1980 children born in 1965-69 to 2064 couples living in rural areas of Uttar Pradesh in India. Their specification includes parental education, two variables related to health environment (i.e., time to hospital, village three-year survival rate), income other than from the parents (but surprisingly, not income from the parents), parity and sexual composition variables, and reported additional children desired in 1972. The estimates do not vary much between the age groups, so I summarize here the combined results. Mortality for girls (but not boys) is higher if both parents have no education. But the limited representation of observed community characteristics, the lack of control for parental income and for unobserved community and household characteristics, and the inclusion of the probably endogenous ex post desired children variables makes it necessary to qualify strongly any interpretation.

Cohen (1988) estimates the reduced-form demand relation for recent child illness for 600 urban Sudanese children under five. He finds a significantly negative impact of the household head's wage and of some

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40 Blau's rationale for separating the two types of wage rates is that female informal-sector jobs in developing countries may be combined with childcare in a way that formal-sector jobs can not.
ethnic groups, but no significant effects of other variables including mother's schooling. Such results contrast with the health production functions for anthropometric outcomes that he presents for the same sample in which maternal schooling (as well as piped water and housing) seems a significant direct or indirect (through vaccinations) determinant.

Pitt and Rosenzweig (1985) estimate an illness production function for 2,347 Indonesian farm households. They regress the average incidence of illness in a household on the average per capita household consumption of nine nutrients, the source of drinking water and the age and schooling of the husband and the wife. The wife's schooling is insignificant in these estimates, but the head's schooling has a positive impact on reported illness. The latter a priori surprising result may reflect that more-schooled individuals know and self-report more diseases than do less educated individuals. In any case, these results do not provide particular support for the importance of women's schooling in reducing morbidity.

Boulier and Paqueo (1988) estimate logits for infant and child mortality for 17,074 children 15 and under based on data from the 1975 Sri Lankan National Fertility Survey. They find that only if mother's education is 10 years or more does it have a significant impact, which contrasts with frequent assumptions that primary schooling is particularly important (e.g., Colclough 1982, Eisemon 1988). This impact is stronger on male than female survival and stronger in urban than in rural areas. There is no attempt to investigate the impact of father's schooling, nor to control for many household and community characteristics.

Barrera (1987a,b) uses simultaneous techniques and controls for truncation (due to ongoing breastfeeding) to investigate the impact on height-for-age of breastfeeding and supplementation for a sample of 498 children below 25 months of age in the 1978 and 1981 Bicol Philippines Multipurpose Survey. He finds that more-educated mothers are better able to provide wholesome substitutes to breastmilk without producing ill effects and thus breastfeed less long.

Behrman and Phananiramai (1990) analyze self-reported morbidity (both aggregate and disaggregated into major disease types) reduced-form demand logit relations for 36,611 individuals divided into five age groups based on the 1985 Thai Morbidity Survey. For adults in the 15-44 age range, their own education has a significant and substantial inverse impact on morbidity, implying an elasticity of the probability of reported morbidity with respect to own education of -0.26, with no difference between the estimates for men and for women. For adults in the over 60 age group, the estimate is significant and positive (implying an elasticity of 0.10) for own education, again with no difference between men and women (with the disaggregate estimates suggesting that this relation is primarily reflecting diseases of the circulatory system, the respiratory system, and a residual category) -- perhaps reflecting in part systematic biases in reporting morbidity.
associated with education or that education is associated with activities that increase the propensities to have such diseases (e.g., occupational stress that has lagged effects on the circulatory system). For the other age groups, own education is not significant. For all groups, women's schooling (and also men's schooling) has significant effects only on the women (men) themselves in the two adult age groups mentioned, not on others.

The standard estimates often are characterized as providing substantial support for the importance of women's schooling in the determination of nonmarket outcomes of health, morbidity, and mortality in the developing countries. Such an interpretation is given, for example, by Colclough (1982), Cochrane, Leslie, and O'Hara (1980, 1982), World Bank (1981), Mensch, Lentzner, and Preston (1985), Caldwell (1986), Chatterjee (1990) and a number of others. If one ignores the estimation and measurement problems discussed in Sections 1 and 2, a number of the standard results summarized here do seem consistent with such an interpretation. However others find suggest that men's schooling is more important than women's schooling and some find that women's schooling does not even have a significant coefficient estimate. Of course some estimation and measurement problems might lead these standard estimates to underestimate the impact of women's schooling (while others may cause biases in the opposite direction). For instance, a true impact of women's schooling on health outcomes may be underestimated because of random errors in the measured values of women's schooling or because of systematic errors of a certain type in either the indicators of health outcomes or of women's schooling (though other systematic errors might work in the opposite direction). For example, if more educated women report more morbidity for themselves or for others for the same objective health state, the impact on women's schooling on the true health state is likely to be biased downward. But, leaving aside the question of such biases, taken at face value the standard studies surveyed here seem to provide less support for the conventional wisdom about the importance of women's schooling in determining health in developing countries than many, such as in the above cited references, seem to claim.

Section 3.2 Control for Additional Observed Individual Endowments

One respect in which the standard estimates may be biased is their failure to control for individual endowments, indicators of some of which are observed in at least some samples. Several studies in the past five years have attempted to control partially for such endowments, generally by including mothers' heights in production function or reduced form relations for child health. It is hard to rationalize the inclusion of mothers' height in a health relation because taller women are more productive in producing health due directly to their height (in the sense that taller women might be more directly productive ceteris paribus in "producing" high-quality basketball). Instead a frequent interpretation is that women's heights are a proxying for the health conditions that the women experienced as children (when their adult heights basically were determined) -- for example, the nature of the
health environment, the household resources, and the nature of health practices and role models, as well as genetic robustness. That is, women's heights are a proxy for endowments that the women bring into their adulthood (i.e., $E_w$ in relations 1.2.2-4 in Section 1.2). I now review some of these studies.

Horton (1986) estimates reduced-form relations for age-standardized height of children under 15 years old in 901 households in Bicol, Philippines in 1978, with some control for usually unobserved household endowments by including mother's and father's height (both of which are significant). Father's education has significant positive effects, but mother's does not. Barrera (1987a, 1990) also presents estimates of height-by-age for 3821 children under 15 years of age in the 1978 Bicol, Philippines Multipurpose Survey and 1981 Supplementary Survey. His right-side variables include five market prices (drugs, rice, cooking oil, kerosene, milk); income (other than the mother's earnings); the mother's schooling, age, and height (the last being an indicator of genetic traits and health endowments); the child's age and sex; and six community characteristics (community wage rate for women, village versus town, travel time to least-cost child outpatient facility, predominant type of toilet used, predominant water source, and absence of excreta). Mother's schooling has significant positive effects that are larger for younger children. Mother's schooling also has greater substitutability with both a cleaner environment and health-care access for younger children. But the effect of mother's schooling is substantially less when mother's height is included (i.e., 26 to 81 per cent less, depending on the age group), which suggests that mother's education in standard estimates proxies substantially for unobserved endowments for which mother's height is a partial (but probably only a partial) control.

Several questions are raised by considering both of these two studies with the Bicol data. Why do they have such different results in regard to the significance of mother's schooling? Does its significance in the second study reflect in part the a priori constraint that father's schooling (which is significant in the first study) has no effect? Why is only height examined as a health indicator, particularly since some of the right-side variables (e.g., prices) a priori would seem to be more related to shorter-term indicators of health that are available in the data set, such as weight? Is there a selectivity problem in that anthropometric measures are not available for all children (particularly older sons) in the households? Do the included variables represent sufficiently well household and community endowments?

Sahn (1988b) estimates reduced-form demand equations for child height and weight for 3,323 children under age six in rural and urban Ivory Coast in 1986-1987 with an instrumental variable control for simultaneity of income and with some control for household and parental
endowments through including the height of the parents in the relations.\textsuperscript{41} Mother's schooling has significant effects on weight, but not on height. Father's schooling is not significant in either case. Thus the results suggest some, but limited, importance of maternal schooling on child anthropometric measures. But there is limited or no control for possibly important unobserved household and community fixed effects.

Thomas, Strauss, and Henriques (1990a) estimate relations for height-for-age for children under nine and for child survival for 41,233 households in Brazil in 1974-1975. They are quite sensitive to specification issues, estimation problems, and whether subdividing the sample differently (e.g. by child age, region, urbanization, father's presence) makes a difference. They find strong positive effects of parents' schooling on both child height and child survival, though with that for the father weaker than for the mother in the survival relation. For the urban Northeast, for example, relative to having illiterate parents, a child with a literate mother (father) is about 1.6 per cent (1.2 per cent) taller, with a mother (father) who has completed elementary school about 2.5 per cent (2.6 per cent) taller, and with a mother (father) who has completed secondary schooling or more about 4.2 per cent (4.8 per cent) taller.\textsuperscript{42} In part, however, parental schooling apparently is proxying for other parental endowments that are not controlled in their base estimates. If they include parental height, the coefficients on parents' schooling tend to drop by 20-50 per cent. Put alternatively, if the true model should include parental height to control for parental endowments, the estimates of the effects of parental schooling without this control are biased upwards by 25 to 100 per cent, a considerable bias indeed, especially since parental heights probably are imperfect controls for parental endowments. Other interesting dimensions of their results for the determination of child health are that the effects of paternal education are not significantly different from those of maternal education and that control for income does not seem to affect the estimated impact of parental schooling much.

In their survival relations there again are significant impacts of parental schooling, but with some important differences. First, the effects are not weakened significantly by including mothers' heights,\textsuperscript{43} but are reduced (usually) significantly by controlling for permanent income. Second, the maternal schooling effects are somewhat larger than are the paternal schooling effects. For both the child height and survival relations, finally, there are urbanization differences, with

\textsuperscript{41}The coefficients for parental height generally are significantly nonzero, though it is not clear to what extent these controls change the estimated coefficients of parents' schooling.

\textsuperscript{42}For the urban South the effects are slightly smaller. For the rural Northeast and South, they are significantly smaller.

\textsuperscript{43}They do not include fathers' height in these relations.
stronger parental education effects in the urban areas. This suggests that parental education is complementary with the broader range of health-related services available in urban areas. Their study has some definite limitations: the absence of prices or specific representation of community factors, the failure to control for selectivity due to missing data on children, the limited control for unobserved endowments, the failure to control for the fact that less-educated women tend to have children when they are younger so such children are exposed to more mortality risk at any given maternal age. But all-in-all it is a well-done study that suggests the importance of parental education, that this importance is overstated without control for endowments, that maternal and paternal education are about equally important for the anthropometric indicator but maternal schooling is more important for mortality, and that there may be complementarities between parental education and urban services.

Thus, this set of studies suggests that women's schooling still appears to be a significant determinant of child health if there is partial control for women's endowments through including their heights in estimates for child health, but that standard estimates that omit this control may yield substantial upward biased estimates of this effect.

Section 3.3 Control for Observed Community Factors

Parallel to the question of the control for individual factors beyond those in standard studies is the question of control for community characteristics. As is noted above in Section 1, there are several a priori reasons to believe that community factors may be correlated with women's schooling. For nonmigrants, a community which currently has good preventive and curative health services also is likely to have other good services including those related to schooling and is likely to have had relatively good services at the time current women were of school age, which is likely to have induced relatively high schooling levels for such women. Thus, the failure to control for such community characteristics may bias upward the estimated impact of women's schooling on health. For migrants, part of the story is the same: more-schooled women are more likely to migrate to areas in which health services are better. But there is the added complication that for migrants, the stochastic disturbance term may not be independent of women's schooling if migration is selective on unobserved characteristics that also lead to better health production (e.g., more motivation, greater abilities).

Rosenzweig and Schultz (1982a) study the determinants of demands for child mortality (as well as for fertility) with a four per cent sample of the 1973 population census for Colombia. They include a relatively extensive representation of community-level infrastructural variables to explain the household demand for health outcomes: the per capita number of hospital beds and clinics, family planning expenditures per capita, transportation time to the capital city, average daily temperature, food prices, and the average schooling of women aged 15 and
above in the region of residence. The community variables (with the exceptions of the food prices and the regional schooling variable) are interacted with the woman's schooling. Separate equations are estimated for each five-year age-group of women residing in rural and urban areas. In both urban and rural areas, Rosenzweig and Schultz observe a strong negative effect of women's education on child mortality. In urban (but not rural) areas, child mortality in families with less-educated mothers is strongly affected by public health and family planning programs. They thus conclude that "... urban public health institutions are substitutes for the health care knowledge and the management capacity that an educated mother brings to her family" (pp. 58-59). Though their study has a relatively extensive representation of community variables, it does not control for many household variables, such as those related to women's childhood family background.

Merrick (1985) estimates reduced-form demand relations for Brazilian child mortality in 1970 and 1976. For both years both maternal and paternal ln education have significant negative effects, with the former significantly larger in 1970 but the latter larger (though not significantly so) in 1976. He tests for interaction between mother's education and water supply, but finds no significant effects. There is limited control for other household and community characteristics, though income and the water supply are included.

In a study related to the one by the same authors discussed in Section 3.2, Thomas, Strauss and Henriques (1990b) explore how the apparent importance of mother's education on the height of 1378 children under age six in Northeastern Brazil in 1986 varies depending on other controls and attempt to identify thereby what mother's education really is representing in such relations. In their simplest ("naive") estimates, for rural areas, a child's log height increases by about 0.5 per cent with each additional year of maternal education and 0.14 per cent with each additional year of her partner's education. Inclusion of a number of other household variables (the household's nonparental income; the women's literacy, whether she regularly listens to radio, watches TV, and reads the paper) and control for observed and unobserved community fixed characteristics reduces the coefficient on mother's education to 0.056 per cent, though jointly the education, literacy and information variables are significant. They conclude that much of the effect of maternal education on child health in rural areas is "transmitted through...better information gathering or processing [and]...through the presence of health services and infrastructure in the community" (p. 17). In parallel estimates for urban areas, the "naive" results indicate less impact than in rural areas of maternal education (0.28 per cent) and more of the partner's education (0.21 per cent). In their fullest specification including fixed effects, these two coefficients fall, respectively, to 0.16 per cent and 0.15 per cent. They conclude "that failure to include indicators of community service availability and, to a less extent, income results in biased estimates of the impact of parental education on child height -- at least in rural Northeast Brazil" (p. 20) Unfortunately, with the estimates that they present, it is not possible to tell how much of the reduction in the
estimated coefficients of maternal education in their fuller specification is due to education working through the mothers' literacy and information variables and how much due to education proxying for community characteristics. Also is it not clear why in this study education seems more important in rural areas, in contrast to the results described in the other study by the same authors that is described in Section 3.2.

Thomas and Strauss (1990) further investigate the determinants of child health with a data set that starts with the same sample, but which has been extended to include municipal and state information. They find that child height is affected significantly by local infrastructure, particularly the availability of modern sewerage and piped water in urban areas and of electricity in rural areas. These effects are stronger for older children, for children of more-schooled mothers, and for children from higher-expenditure households. They also find that higher prices of sugar and of dairy products are associated with lower child height, significantly so for children of illiterate mothers. Mothers with at least elementary schooling, however, are able to counteract the deleterious impact of these prices on child height. Negative price effects, however, are largest for children in higher expenditure households. While this result is surprising since usually price responsiveness is greater for poorer households, Thomas and Strauss note that it suggest that the impact of mother's schooling on child height does not solely reflect household resource availability. They also find that in rural areas there are complementarities between schooling quality (as indicated by the number of teachers per municipal resident) and mothers' education in producing child education.

Section 3.4 Control for Unobserved Individual, Household and Community Characteristics

As is discussed in Section 2, the basic procedure for control of unobserved fixed effects is to difference the relations to be estimated across two observations for which such fixed effects are the same. This permits estimation of the impact of variables that vary across the two observations with control for fixed effects that may be hard to observed in most socioeconomic data sets.

Wolfe and Behrman (1987) estimate child health (proxied by standardized weight, height, and arm circumference anthropometric measures) and infant mortality production functions and reduced-form demand relations for a Nicaraguan adult sister sample for 1977-8. Their standard estimates (i.e., using individual data in the standard manner as in those studied reviewed at the start of this section) suggest a

“For example, see Alderman (1986), Behrman and Deolalikar (1989c), Gertler, Locay and Sanderson (1987), and Gertler and van der Gaag (1988a,b).
strong positive impact of women's schooling on child health.\textsuperscript{45} If they control for mothers' unobserved childhood-background-related characteristics through adult sister deviation estimates, however, the coefficient estimate of mother's schooling no longer is significant. This suggests that in the standard estimates mother's schooling is basically a proxy for her unobserved characteristics.

Behrman and Wolfe (1987a) use the same Nicaraguan data to estimate a latent variable simultaneous equations system including health production functions for women and their children, together with some reduced-form demand relations. Standardized height, weight, and biceps circumference are used as the observed indicators for child health, while the number of days too ill to work and the presence of parasitic diseases, medically-preventable diseases, and therapeutically-treatable diseases are used as the observed indicators for female health. Medical-care usage (which is represented by the age-standardized number of injections received by the child, the term of the mother's first pregnancy-related medical examination, and coverage in social security schemes), household nutrition (represented by standardized intakes of calories and protein by the family and by household ownership of a refrigerator), and water and sanitation facilities (represented by the absence of indoor toilets and baths) are included as endogenous inputs. Household income, the mother's initial endowments (represented by her own mother's schooling, her urban versus rural upbringing, mother present in adolescence, father present in adolescence, and number of siblings), and community endowments (represented by population, population density, number of hospital beds per 1,000 inhabitants, and the literacy rate) are some of the instruments used to identify the parameters of the production function. They find that mother's schooling (as well as medical-care usage and nutrient intakes) appears to have significant positive effects on child health if mother's childhood-family related endowments are excluded a priori, but that these coefficients become insignificant if mother's childhood-family-related endowments are included. They interpret such endowments to include health-related abilities, knowledge and habits and prior health status, all of which relate to usually unobserved (and uncontrolled) dimensions of mothers' childhood family background. Thus they conclude that the standard results about the positive health impact of mothers' schooling (as well as of nutrition, water and sanitation, and community endowments) may be misleading due to the failure to control for maternal endowments.

Behrman and Wolfe (1989), finally, compare random- and fixed-

\textsuperscript{45}Their standard estimates use ordinary-least-squares procedures. However they report that when they use simultaneous estimates for calories and length of breastfeeding, women's schooling has even less estimated impact on child health than in the ordinary-least-squares estimates, apparently because it is highly correlated with the instrumented estimates for calories and length of breastfeeding.
effects estimates with standard logit estimates of the determinants of women's disease experience. In the standard estimates, women's schooling has significantly negative effects on three of the four disease categories (and men's schooling has a significantly negative impact on the fourth). In the random-effects estimates, the schooling estimates are basically the same. In the sister deviation fixed-effects estimates, the precision is less so that the estimates are significantly nonzero only at the 10 per cent level in three cases and at the 15 per cent level in the fourth, but the patterns remain basically the same. Thus, for women's own health, as opposed to the health of their children, schooling appears possibly to be representing schooling per se, and not so much family background-related characteristics, though the imprecision of the estimates leaves the question open. But there is not evidence of a significant intergenerational effect of the women's parents' schooling on health in contrast to nutrients (see Section 3.2 below), presumably through the parents' influence on the women's upbringing, once there is control for fixed effects.

Thus these results, based on a special adult sister sample that permits control for unobserved childhood background characteristics shared by sisters, suggest that in the standard individual estimates for child health, women's schooling primarily is representing the impact of unobserved maternal endowments. These results should be qualified for at least two reasons. First, they are for a particular sample and to date have not been tested for other samples because other samples of adult sisters have not been assembled (though similar comments hold for most of the non standard studies that are reviewed in Sections 3 and 4). Second, the fixed effects estimates tend to be subject to more random measurement error in the right-side variables (in this case, women's schooling in particular) than are the standard estimates, though (as noted in Section 2 there is think that this possible source of bias is more than the bias due to omitted variables in the standard estimates). But despite such qualifications, these results are provocative in suggesting that at least for this sample most of the effect of women's schooling on child and adult health in standard estimates may be due to omitted variable bias due to the failure to control for the multiplicity of environmental and genetic endowments shared in their childhood by sisters. The studies summarized above that include women's height in such regressions as an indicator of their endowments find that such a control reduces substantially the estimated impact of women's schooling on health below the levels suggested by the standard estimates. The Behrman-Wolfe studies reviewed here, in sense, have a broader control for women's endowments and find that with this broader control the apparent impact of women's schooling on health is even weaker.

Horton (1988) also controls for unobserved individual and household endowments. She analyzes the demand for individual health outcomes with data on approximately 2,000 predominantly rural children aged 15 or less from the Philippines. To control for heterogeneity
across households, Horton explores the differences in weight-for-height and height-for-age among children within each family in terms of age, sex, and birth order. She also allows some household-specific variables to enter her health demand function indirectly by specifying that the coefficient on birth order depends on maternal education and total household expenditure per capita. Her results suggest that birth order has a significant adverse effect on both height-for-age and weight-for-height, but that maternal education significantly weakens these adverse birth-order effects.

Section 3.5 Dynamics and Control for Unobserved Endowments

As noted in Section 1, almost none of the existing studies allow for dynamics in learning and adjustment regarding nonmarket outcomes. An exception is Rosenzweig and Wolpin (1988). In this study they develop a simple dynamic model of child health that incorporates unobserved heterogeneity across households and uncertainty regarding unobserved heterogeneity in each child's health endowments prior to birth. They compare estimates using ordinary-least-squares versus fixed-effects procedures to control for heterogeneity for child health relations based on data from 109 households with two or more children under six years of age in Colombia for 1968 to 1974. The dependent variables are the age-standardized weights of the children at birth and within six months of birth. The right-side variables include birth order, birth spacing and timing, per capita family food consumption, inoculations (DPT), breastfeeding, maternal age, and child sex, all except the last of which are treated as endogenous in lagged instrumental variable fixed-effects estimates. They interpret their results to show that control for unobserved heterogeneity alters the statistical inferences substantially. They then use their estimated relations to calculate unobserved family- and child-specific endowments (by averaging over the appropriate residuals). They find that family health environments are significantly correlated with parental education (as well as with family income), which implies that estimates of child health outcomes that do not control for such endowments have upward-biased coefficients since in part such variables are proxying for the uncontrolled health endowments. These results are suggestive of possible upward biases in the parents' schooling (as well as breastfeeding and family income) estimated effects on child weight if there is not control for unobserved household and child heterogeneity. Their results are suggestive, but not conclusive even for this sample, however, for at least two reasons. First, the coefficient estimates have such large standard errors that they do not appear to differ significantly depending on the controls for heterogeneity. Thus, even though an overall test indicates that the unobserved heterogeneity is significant, it is not clear which individual coefficients are affected significantly by controlling for it. Second, the original health

46 Horton emphasizes heterogeneity in tastes with respect to child quality and quantity, but her procedure also controls for heterogeneity in abilities, environments and in any other variables across households.
production function appears to be misspecified in comparison with relation (1.2.3) due to the exclusion of maternal schooling and time; for the fixed-effects estimates, however, the impact of at least maternal schooling is controlled so that the association between the estimated household endowments and mother's schooling is not an artifact of the exclusion of schooling from the health production function.

Section 3.6 Interactions between Women's and Men's Schooling

As is noted in Section 1.2, most studies do not explore interactions between women's and men's schooling. Thomas and Strauss (1990), in a study that is reviewed in Section 3.3 above, do include such interactions. They find a significant positive interaction between mothers' and fathers' education in relations for child health, thus suggesting gross complementarity, which they note is in contrast to the earlier results of gross substitution for child education found by Behrman and Sussangkarn (1989) that is summarized in Section 4.3 below. They find that the effect is nonlinear. If the mother is illiterate, father's schooling has no effect. For all levels of father's schooling, the effect is largest if the mother has at least some elementary schooling. Schooling has the biggest impact on the heights of children if both parents have some secondary schooling. Thomas and Strauss argue that the positive interaction between mother's and father's schooling does not simply reflect the fact that more educated parents have higher income since there is control for household per capita expenditures. They speculate that this result might reflect that, in a household bargaining game, more-schooled couples might agree on allocating more resources to improving child health than couples in which one parent is, for example, illiterate.

Section 3.7 Intergenerational Gender Links

There may be reasons for the links between women's schooling to be relatively stronger with health (and other) outcomes for their daughters than for their sons (and vice versa for father's schooling). Such reasons may include gender specific preferences, role models and home teaching divisions of labor. Thomas (1990) explores such possibilities for the determinants of child health in Ghana and in Brazil (as well as in the U.S.).

For Ghana the data are 412 urban households included in the first round (1987-88) of the Ghanaian Living Standards Measurement Survey. In Ghana, women have primary responsibility for child rearing from their own resources, though fathers usually are responsible for child schooling. The reduced-form demand estimates indicate that maternal education has a significantly positive effect on their daughters' heights that declines with more schooling and that is significantly greater than the effect on their sons' height (which is not significantly nonzero). Paternal schooling has a significantly negative effect on daughters' heights and, for fathers with primary schooling, also on sons' heights -- though the latter effect is smaller than the former in absolute terms. Fathers with more than primary schooling have
a significantly greater positive effect on their sons' than on their daughters' heights. If women have more education than their husbands there is an additional significantly positive effect on their daughters' (but not on their sons') heights.

For Brazil the data used in studies described above of which Thomas is a co-author are utilized. In the Estudo Nacional da Despesa Familiar 1974-4 sample for the Northeast, none of the interactions between parental schooling and gender of the child are significantly, though schooling of both parents has a significantly positive effect on child height. For the urban Northeast for the same sample, there is evidence of such intergenerational linkages. The impact of mothers' schooling is (marginally) significantly greater on daughters' than on sons' heights. The impact of fathers' schooling is significantly greater on sons' than on daughters' heights. For boys the impact of paternal schooling is greater than is that of maternal schooling (and vice versa, if anything, for girls). For the 1986 Brazilian Demographic Health Survey for the Northeast there are significant effects for the parental schooling-child gender interactions for both rural and urban areas. In rural areas the impact of maternal schooling is significantly greater on daughters' than on sons' heights for the vast majority of mothers who have low education (though the effect is reversed for the one in six who have high enough education and it depends on nonlinearity). In urban areas maternal schooling has significantly larger effects on daughters' than on sons' heights, and the opposite is (marginally) the case for paternal schooling. For both sons' and daughters' heights in rural areas and for daughters' heights in urban areas, mothers' schooling has significantly greater impact than does fathers' schooling -- though the opposite is the case for sons in urban areas.

While these results seem to have some anomalies (most notably the significantly negative effect of fathers' schooling on daughters' heights and of fathers' primary schooling on sons' heights in Ghana), they (and similar estimates for the U.S.) suggest that in a variety of economic, social and cultural settings the intergenerational associations between parental schooling and child heights are greater within than across genders. Of course this does not answer the question of what parental schooling is representing. It may be representing purely the effects of schooling per se or it may be representing in small or large part unobserved endowments (that are not controlled in these estimates). But whatever parental schooling is representing, the effects seem often to be larger for the same gender than across gender. Perhaps this reflects own-gender preference in the allocation of resources (the interpretation that Thomas gives) or some other cause such as gender role models in health care habits.

Section 3.8 Sample Selectivity

As is discussed in Section 2, if subsamples are selected in ways so that the stochastic term in the selection rule is associated with the stochastic term in the relation that is estimated from the subsample, selectivity bias may result. Pitt and Rosenzweig (1989) explore the
possible effects of such selectivity, through conscious fertility decisions, on the estimated impact of women's schooling on child birthweight using the 1976-7 Malaysian Family Life Survey. They basically argue that fertility is selective with regard to the unobserved endowments of women, so that interventions such as family planning programs or female schooling that affect fertility can not be evaluated in terms of their outcome on child health without knowledge of the nature of the fertility selectivity. For example, if an intervention lowers fertility, then it may appear to augment the average health of children born if fertility is positively selective (or vice versa) even if there is no direct influence on the allocation or resources to children who are born. Policy conclusions about the value of such interventions therefore may be quite different if their sole effect on child health (or other outcomes) results from a reduction in the number of low-endowment children born or results solely from a shift in births from households that care little to those that care a lot about human capital (given resources). In the Malaysian sample (as in most developing country samples, see Section 4.4), more-schooled women are less likely to have children. Therefore there is selectivity with regard to observed characteristic of women who give birth. The issue for possible selectivity bias is whether there is selectivity with regard to unobserved characteristics with regard to fertility. The results summarized above with regard to change in the estimated impact of women's schooling with and without control for the women's endowments suggest that such endowments indeed are correlated with their schooling (otherwise, whether are not they are controlled would not cause omitted variable bias in the schooling coefficient estimates). Pitt and Rosenzweig compare estimates of reduced form estimates for the determinants of birthweight with and without control for selectivity due to fertility and due to mortality. Without the selectivity control the coefficient estimates of women's schooling is not significantly different from zero. With the controls for fertility and mortality selectivity (though with the former much more important), the coefficient estimate of women's schooling increases by a factor of three and a half and becomes positively significant (with control for fertility selectivity alone the increase is two and a half times and the estimate also is statistically significant). Thus these estimates suggest that the failure to control for selectivity in fertility causes a substantial underestimate in the estimated coefficient of women's schooling on child birthweight because those women with less extensive unobserved endowments are more likely to have children with the result that the coefficient estimate of women's schooling is biased downward due to omitted variable bias is there is not control for such selectivity. To what extent this effect carries over to outcomes later in children's life or offsets the predominantly downward biases that the discussions in Sections 3.2-4 suggests are important are important open questions (though some insight in regard to the former is provided in Section 4.3 below).

Section 4. Review of Selected Studies of the Impact of Women's Schooling on Nutrient Intakes, Other Health Inputs,
Child Schooling, and Fertility

Section 3 reviews available empirical evidence on the impact of women's schooling in production function and reduced-form demand estimates on health, morbidity, and mortality. Emphasis is placed on what are the "standard" estimates and how recent estimates that control for some of the specification, estimation, and measurement issues that are discussed in Sections 1 and 2 differ or not from the standard estimates. In this section I turn to briefer (for reasons that are discussed at the start of Section 3) parallel discussions for some other important nonmarket outcomes. For each outcome I first summarize briefly the standard results and the conventional wisdom, and then turn to recent studies that investigate the importance of some of the problems that are discussed in Sections 1 and 2.

Section 4.1 Nutrient Intakes

In principle there are both production functions and reduced-form demand relations for nutrient intakes, just as for health, morbidity and mortality. The production functions give the nutrients actually consumed as dependent on the foods used and the characteristics of the food purchaser and preparer, as well as perhaps other characteristics such as the water quality. Women's schooling and their endowments might play important roles in such a production function. However in existing socioeconomic data sets information is not available to estimate such a production function. To the contrary, nutrient intakes are estimated typically by using fixed-coefficient food-to-nutrient conversion factors, with little sensitivity to how such foods are prepared and what are the characteristics of the preparer. Therefore one possibly important role of women's schooling remains unexplored, and nutrient "production functions" beyond the fixed-coefficient versions given by nutritionists, remain unestimated.

Standard results: There are several reduced-form demand relations for nutrients that may be illuminating regarding the role of schooling. The World Bank (1980, 1981), Colclough (1982), Eisemon (1988), and a number of others claim that one benefit of greater education for women is improved nutrient intakes, given income and prices. However recent estimates seem somewhat mixed in supporting this claim. Ward and Sanders (1980) and Pitt and Rosenzweig (1985) find no significant effect of women's schooling on household nutrient...
consumption in Brazil and Indonesia, respectively, and Horton (1985) reports a negative impact on calories obtained per unit expenditure in Gujarati, India (though she finds a positive impact of the household head's education). But Wolfe and Behrman (1983, 1987, 1990) and Behrman and Wolfe (1984a, 1987a, 1989) find that Nicaraguan households in which women have more schooling tend to be significantly and substantially better nourished, ceteris paribus. The impact of women's schooling, moreover, is significantly greater than that of men's schooling for proteins (though not for other nutrients), providing some support for those who emphasize the special role of women in nutrient determination. For every extra year of women's (men's) schooling, calories increase by about 1.0 per cent (0.6 per cent) and proteins by about 2.8 per cent (0.9 per cent) of international standards.

Control for unobserved characteristics: The estimated effect of women's (and men's) schooling on household nutrition in the Behrman-Wolfe Nicaraguan studies persists even if there are random effects or if there is adult sibling deviation control for unobserved childhood-background related characteristics of the women, in sharp contrast to the estimated impact of women's schooling on child health and possibly on their own health (see Section 3.3) or a number of other socioeconomic outcomes (Behrman and Wolfe 1984b, Wolfe and Behrman 1986). They also report some significant evidence of an intergenerational impact of the women's parents' schooling (presumably operating through the women's abilities, habits and tastes) even if there is control for fixed effects (in contrast to the health results described above). However, women's schooling is strongly negatively associated with the length of breastfeeding, perhaps reflecting in part the opportunity cost of women's time (Wolfe and Behrman 1988).

Therefore the evidence is somewhat mixed in regard to the impact of women's schooling on nutrient intakes, though that this possibility is supported strongly (in contrast to others) for the adult sibling deviation estimates is suggestive of a strong effect that probably merits further exploration.

Section 4.2 Other Health-Related Inputs

These other health-related inputs, like nutrient intakes, may or may not involve market transactions. But I include them and nutrients in this survey because of frequent conjectures that more-schooled women use better such inputs (whether purchased on the market or not) for

47 That this effort remains robust even with adult sister deviation estimates also strengthens the basis for believing that such estimates with this sample are controlling for actual unobserved fixed effects, not just reflecting greater measurement error with deviation estimates. If the lesser relevance of women's schooling with the deviation estimates than with the standard estimates for child health (and other) outcomes were due primarily to measurement error, then the same result would be expected for the nutrient intake estimates.
household production of health or prevention of morbidity and mortality. Only reduced-form demand relations are available for these inputs into the health production process.\(^5\)

**Standard results:** The conventional wisdom, once again, is that women's schooling plays an important role, and a much more important role than does men's schooling, in improving these health inputs. However, even the standard results seem to be mixed in this regard, as the following review indicates.

In a relatively early study, Selowsky (1979) estimated demand relations for doctor visits in Colombia in 1974. He reports no significant results for rural areas, but significant estimates for urban areas: elasticities with respect to education of .18 for the household head and .08 for the spouse. That the elasticity with respect to household's head's education (generally a male) is larger than that with respect to the spouse's education (generally a female) is in contrast to the relative emphasis placed on women's education in determining health visits by many.

Cohen (1988), in his study of urban Sudanese children (see Section 3.1), estimates reduced-form relations for the number of vaccinations for children under five, which in turn are strongly associated with anthropometric measures for these children. The second most important determinant is mother's schooling, each year of which increases the number of vaccinations by 0.15 (so it would take seven years of additional schooling to have the same impact as piped water, the most important determinant).

Akin, Griffin, Guilkey and Popkin (1985) estimate multiple-choice logit models of the determinants of a household's decision to use medical services and its choice of a medical practitioner (i.e., whether public, private, or traditional) for 1,903 households from 100 barangays in the Philippines. The right-side variables include parental education; an extensive set of price variables for each of the four types of medical facilities, whether the sickness is covered by insurance; the value of household assets; gender and urban location of the patient; and the severity of the illness. They do not find evidence of significance for either maternal or paternal education. They include the demand for health outcomes (e.g., illness severity) as an explanatory variable in their demand for health-care utilization, without treating it as endogenous. They also limit their subsample to those who report themselves ill, which may result in selectivity bias if the stochastic term in the medical treatment choice relation is

\(^5\)Many of the studies of demand relations for other health-related inputs, as in the case of the studies for nutrient intake demands, are focused on price and income responses (and their interactions) and a priori exclude women's schooling (and usually men's schooling). A few studies (e.g., Mwabu 1989) include only household head's schooling (which usually refers to males).
correlated with the stochastic term in the morbidity reporting relation. Both the inclusion of a possibly simultaneously-determined variable and the use of a possibly selected subsample may introduce biases in the coefficient estimates; however, it is not obvious that either results in a bias towards zero in the effect of parental schooling.

Gertler and van der Gaag (1988) estimate discrete health-care choice determinants for 1254 Peruvian adults and 969 children in 1984 who had had recent illness symptoms or accidents and for 1030 adults and 769 children in rural Ivory Coast who had experienced an accident or illness in the four weeks prior to their 1985 survey. Their limitation of their subsample to those who report morbidity, once again, may cause selectivity bias in their estimates. Their estimates indicate significantly negative effects of travel time and significantly positive associations of consumption with all three user choices, but with [own? women's?] education causing a significant shift from clinics to hospitals and private doctors in Peru (though not in the Ivory Coast). Gertler, Locay, and Sanderson (1987) report similar results for 3412 Peruvians age 16 or over.

Control for unobserved characteristics: Behrman and Wolfe (1987a) include demand relations for medical-care usage and household water and sanitation quality in a latent variable system of estimates for Nicaragua in 1977-8 that is discussed above in Section 3.3. They find that in the standard estimates mother's schooling (as well as income and community endowments) has significantly positive effects on both medical-care usage and household water and sanitation quality, but that the estimated impact of women's schooling evaporates (as in the child health relations and possibly in the women's own health relations, see Section 3.3, but in contrast to the nutrient intake results that are discussed in Section 4.1) if there is a latent variable control for unobserved maternal endowments.

Rosenzweig and Wolpin (1988) use the residual child-specific and family household health endowments from their health production function estimates for infants in Candelaria, Colombia in 1968 to 1974 (see the discussion in Section 3.5) as right-side variables (together with family income, maternal schooling and enrollment in family planning programs) in relations that determine breastfeeding and inoculations. Maternal schooling has a significant negative effect on breastfeeding only at the 25 per cent level. They do not provide information with which to know

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Both of these variables are treated as unobserved latent variables with imperfect indicators, which include formal medical attention during pregnancy, age-standardized number of injections for children and participation in the social security system for household medical-care usage and the nature of toilets, baths, water and sewage disposal for the household water and sanitation quality.

Children with good health endowments are more likely (at a 25% significance level) to be breastfed.
if maternal schooling would appear to be significant were it not for the control for health endowments, though (as noted in Section 3.5) they note that maternal schooling is correlated with such endowments.

One final point is worth making with regard to many of the studies of demands for what presumably are health-related inputs. While the Behrman and Wolfe (1987a) study does consider the impact on health outcomes of the same reduced-form variables as are discussed above, the other studies reviewed in this section give no estimates of the health impact of the health-related goods and services under investigation. And it may be naive to think that the health effects necessarily are positive. Wolfe and Behrman (1984) report, for example, that women's schooling increases health-care usage significantly in Nicaragua, but does not affect significantly a latent variable representation of health status. While their specification can be criticized as difficult to interpret because of its hybrid nature, this result regarding women's schooling is suggestive of the possibility that increased use of health-related inputs does not necessarily lead to improved health. Thus while the studies reviewed in this subsection suggest (with some ambiguity) that demands for health-related goods and services well might increase with more schooling for women, the link to health per se is more speculative.

Section 4.3 Children's Schooling

Standard results: There are numerous results that suggest that parental schooling is positively associated with their children's schooling: Birdsall (1979) on Colombia, Wolfe and Behrman (1984) on Nicaragua, Birdsall (1985) on Brazil, King and Lillard (1983, 1987) on the Philippines and Malaysia, Behrman and Sussangkarn (1989) on Thailand, Armitage and Sabot (1987) on Kenya and Tanzania. The standard interpretation of these results is that they reflect greater household productivity of parents in home education of their children, and thus greater success of the children in school, as is reflected in the specification of the cognitive skills production function in relation (1.2.2) in Section 1.2. But such estimates need some qualifications. With the exception of the King and Lillard and the Behrman and Sussangkarn studies, they do not control for truncation due to the fact that some children are still in school at the time of the data collection. This would seem to bias downwards the estimated effect of parental schooling on child schooling. With the exception of the Birdsall and Behrman and Sussangkarn studies, they do not control for the quality of schools for the children, the failure to control for which is likely to result in an overestimate of the impact of parental schooling. And none of the above studies control for unobserved household and parental endowments.

I review a few studies of schooling determinants here which have special features pertaining to some of these estimation issues.

Control for quality of schooling experienced by the children: Birdsall (1985) estimates the determinants of schooling for 3762...
Brazilian children (subdivided by urban-rural and by age into 8-11 year olds and 12-15 year olds) based on the 1970 census. In her standard estimates (with control for ln paternal income, mother's age, child's age and sex, and recent migration), an additional year of parental schooling is associated with an additional .04 to .11 years of child schooling in urban areas and .14 to .39 years of child schooling in rural areas, with all the coefficient estimates significant and with that for mother's schooling always larger (and generally significantly so) than that for father's schooling. In alternative estimates she adds two measures of schooling quality experienced by the children -- average years of schooling of local teachers and average local teacher payments per child -- as well as an interaction term between the former and mother's schooling. This expanded specification does not alter the estimated impact of father's schooling except for a reduction from 0.14 to 0.08 for 8-11 year olds in rural areas. The estimated impact of mother's schooling, however, for urban areas is increased substantially at the sample means, though reduced to insignificance in rural areas for 8-11 year olds and unaffected for 12-15 year olds. Thus the control for quality of schooling faced by their children has mixed effects on the impact of parental schooling on their children's schooling.

Control for quality of schooling experienced by the children and by the parents and interaction between women's and men's schooling: Behrman and Sussangkarn (1989) estimate the post-primary schooling continuation rate for children who completed primary school for 2243 households in Thailand in the 1980/1 Socioeconomic Survey. By focusing on the continuation rate, they avoid the right-censoring problem that most studies (though not the King and Lillard and Pitt and Rosenzweig studies reviewed below) have. In their simplest specification (with controls for household income and relevant age) they find that the continuation rate rises by 0.023 for every year of the father's schooling and by 0.0193 for every year of the mother's schooling (both of which effects are significantly nonzero, but do not differ significantly from each other). But they find that this specification is dominated statistically by one with measures of the quality of schooling that the parents had (in the form of teachers/student) and with interaction terms among the parents' schooling indicators. These extended results suggest that parental years of schooling substitute for one another in affecting child schooling, and that control for the quality of parental schooling lessens somewhat the estimated impact of years of schooling at lower schooling levels.

Intergenerational schooling links by gender: King and Lillard (1987) present ordered probit estimates in which they control for right-hand censoring for 3170 children in the 1975-6 Malaysian Family Life Survey and 7464 children in the 1978 Bicol, Philippines Multipurpose Survey. They distinguish between Malays and Chinese in Malaysia and males and females in both samples. They estimate the impact of parental

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53That is, that students in school at the time of the survey may continue in school after the survey.
schooling, with controls for a number of child characteristics, community characteristics, and parental household characteristics (among these, income in Malaysia and land ownership in the Philippines). They find that for Malays and Chinese, mother's schooling significantly affects daughter's schooling and for Chinese and Filipinos, mother's and father's schooling both significantly affect son's schooling. Thus there seems to be some cultural differences, with relatively strong mother-daughter links in Malaysia (parallel to some of the results for health outcomes reviewed in Section 3.7). In the cases in which both parents' schooling has significant effects, there are not significant differences in the magnitudes of these effects.

King and Bellew (1988) examine the schooling determinants for different Peruvian birth cohorts using the LSMS data. They find generally significant effects for both mother's and father's schooling, but with substantial declines across age cohorts; for instance the impact on females (males) of an additional year of mother's school was 0.33 years (0.29) for the 1925-39 cohort and 0.12 (0.18) for the 1960-1966 cohort, and parallel estimates for father's schooling are 0.13 (0.25) and 0.07 (and 0.10) years. They interpret these results to reflect that the expansion of public schooling weakened the intergenerational links over time. They also note that mother's schooling was more important for females, and vice versa for males, as in the King and Lillard results just summarized and in the Thomas' results for health reviewed in Section 3.7.

Control for unobserved childhood family background related characteristics: Behrman and Wolfe (1987b) explore the determinants of schooling for two generations of Nicaraguans: current women and their children. In each case they present both standard estimates and adult sister deviation estimates that control partly (more partially for the children than for the women) for unobserved family background characteristics. The standard estimates indicate that the women had an additional 0.45 years of schooling for every additional year of their mothers' schooling and an additional 0.13 year of every additional year of their fathers' schooling, both of which are significantly nonzero; in the deviation estimates these drop respectively to 0.11 and 0.01, with the latter not significant. For the children, the parallel standard estimates are .07 and .02 (only the former is significant).\textsuperscript{54} Thus control for unobserved family background weakens substantially the apparent intergenerational schooling links. Much of what schooling seems to be doing in the standard estimates is representing family background, not the effects of schooling per se.

Sample selectivity: Pitt and Rosenzweig (1989) investigate the determinants of ln expected years of schooling for children in Malaysia as part of the study on fertility selectivity that is discussed in

\textsuperscript{54}The data on the children are right-censored so the results are not comparable across generations.
Section 3.8. Their results show how failure to control for the selectivity in fertility can lead to false acceptance of what they refer to as the efficient schooling model. Among the variables that they include in all of their estimates is mother's schooling, which they suggest may reflect endowment differences. The t tests for this variable indicates that it is significantly positive in all of the specifications. The question of particular interest, especially given the large difference in the estimated coefficient of mother's schooling that they find for birthweight (see Section 3.8), is whether they find a similarly large impact of controlling for fertility selectivity with regard to expected schooling. The answer is no. The relevant coefficient increases by less than one standard error, so apparently the change is not significant. Thus the control for fertility selectivity in their estimates of child schooling determinants, while apparently important in precluding the false acceptance of the "efficient schooling model," does not in this case seem to affect the estimated impact of mothers' schooling substantially or significantly -- in contrast to the results on birthweight that are discussed in Section 3.8. The question naturally arises, why there are differences in the results for the two outcomes? A possible answer is that the unobserved endowments of women that affect the fertility and birthweight decisions do not affect the expected schooling decision because the relevant components of those endowments differ (i.e., being more tied to biological productivity and health for the fertility and the birthweight outcomes than for expected schooling) and/or because of the difference in the timing of the two outcomes (though, since expected years of schooling are used, the difference in such timing is less than it would be if actual completed years of schooling were used). A related answer is that the endowments of the mothers are critical for the fertility and birthweight decisions, but the endowments of the children (which are related to, but not identical with, those of the mothers) are relevant for the expected schooling decisions. This suggests that the failure to control for fertility selectivity is likely to be much more important for outcomes very early in the life cycle of children when the endowments of the mothers dominate than later in the children's lifecycle when their distinct endowments (albeit, related to mothers' endowments)

55 They define the efficient schooling model to be one in which schooling is allocated according to rate of return criteria as is discussed in Section 1.2, so that variables such as those related to family planning and household sanitation do not enter into the specification. However, within the framework discussed in Section 1.2 it appears to me that such variables should enter into the efficient model if health and years of schooling interact in the production of cognitive achievement and other attributes of interest that are produced by schooling.

56 From the paper, it appears that parents were asked about their expectations regarding the years of schooling only for children aged six and above, so there was at least a six year lag between birth and the solicitation of this information.
predominate. Or, to put the matter another way, once the children are old enough, the question in not whether there was selectivity in subsamples among the previous generation in who experienced some outcome (in this case, giving birth), but whether there is selectivity in the current generation.

Section 4.4 Fertility

Standard results: There are numerous empirical studies of the determinants of fertility in the developing countries. The result that usually is characterized as being most robust in these studies is an inverse association between women's fertility and their schooling (e.g., see the surveys by Cochrane 1979 and by Birdsall 1988a).

Exploration of special estimation, specification, and measurement issues: Though the topics have been less examined that for some of the other nonmarket outcomes, there are the same possibilities of estimation, specification and measurement problems in fertility relations as in the relations for the other nonmarket outcomes that are discussed in Sections 3 and 4 of this paper. There is some limited evidence that the conventional wisdom about the inverse association between women's schooling and fertility may misrepresent the true relation due to such problems. For example, the Wolfe and Behrman (1986) adult sister deviation estimates for number of children suggest that in standard estimates women's schooling largely may be proxying for unobserved family background characteristics. Also, the Behrman and Sussangkarn (1989) estimates suggest that women's years of schooling partially is proxying for schooling quality and partially for schooling of men in the standard estimates. Most of the existing estimates of fertility determinants, finally, are for ever- or currently-married women, which may be selected subsamples if women who have tastes that are less child oriented are less likely to be married (though the extent to which this may be a problem varies tremendously across societies because of very different marriage rates for females).

Section 5. Summary, Research Directions and Policy Implications

Section 5.1 Summary of Review

The World Bank (1980, 1981, 1990), Colclough (1982), Cochrane, Leslie, and O'Hara (1980, 1982), Eisemon (1988), Mensch, Lentzner, and Preston (1985), Caldwell (1986), Leslie (1989), Chatterjee (1990), Lomperis (1989) and many others have emphasized strongly the important nonmarket returns to women's schooling in the developing countries. "Standard" studies on the impact of women's schooling on nonmarket outcomes in developing countries indicate that frequently there is a significant impact, that often is larger than the impact of men's

57"Standard" in the sense defined at the start of Section 3.
schooling, on such outcomes. A number of such studies, however, report no evidence of such an effect or that the impact of men's schooling is greater than is that of women's schooling. Therefore it seems, even basing conclusions only on the standard studies, that such effects may be somewhat less common and less strong than the above-cited studies and summaries of the literature seem to suggest. Nevertheless, the standard studies do seem to imply fairly widespread and fairly substantial effects of women's schooling on nonmarket outcomes in the developing countries.

The discussions of theoretical frameworks for investment in human resources and for household behavior in Section 1 and of measurement and estimation problems in Section 2, however, raise the possibility of there being biases in the standard estimates. A number of studies that are reviewed in Sections 3 and 4 explore some of these possibilities. In some cases, because of the special nature of the data requirements together with innovative techniques that are needed, only one study or only one data set has permitted the exploration of such issues to date. Therefore the results needed to be qualified, and further exploration and replication in future research would be valuable. Nevertheless, these "nonstandard" studies suggest a number of insights.

What are these insights? It is convenient to consider them with regard to the various issues discussed in Sections 3 and 4.

Control for observed dimensions of women's endowments in the form of their heights: Several recent studies report that parental heights have significant coefficient estimates in relations for child health, with the favored interpretation of this result being that adult height is representing the endowments that the adults bring to their adulthood. Two of these studies present comparisons of the estimated impact of women's schooling with and without this control for such endowments (i.e., Barrera 1990, Thomas, Strauss, and Henriquez 1990a). The results of these two studies suggest that standard estimates of the impact of women's schooling on child health without such a control are biased upward by 25 to 100 percent, though there does not seem to be such a bias in relations for child survival in the second of these studies.

Control for observed community characteristics: A number of studies provide some insight into the effects of controlling for such community characteristics (e.g., Rosenzweig and Schultz 1982a, Thomas, Strauss and Henriquez 1990b, Thomas and Strauss 1990, Birdsall 1985, Behrman and Chalongphob 1989, King and Bellow 1988, DaVanzo and Habicht 1984, Barrera 1990). Some of these studies are consistent with an interpretation that standard estimates that do not control for such community characteristics are likely to overstate the impact of women's schooling on mortality, health and on child schooling and that women's schooling can substitute for community health and educational services (e.g., Rosenzweig and Schultz 1982a for urban areas, Thomas, Strauss and Henriquez 1990b, Birdsall 1985 for rural areas, Behrman and Chalongphob 1989 at
lower parental schooling levels, King and Bellew 1988, Barrera 1990). But some of them find no significant changes in the estimated impact of women's schooling due to control for community characteristics (e.g., Rosenzweig and Schultz 1982b for rural areas) or positive complementarities so that the estimated effects of mother's schooling are greater if community services are better (e.g., Thomas and Strauss 1990, Birdsall 1985 in urban areas, DaVanzo and Habicht 1984 if the changes in estimates over time are interpreted to reflect improvements in community services). Therefore, while these results suggest somewhat greater evidence that the impact of women's schooling is upward biased in standard estimates and that women's schooling tends to substitute for community characteristics, there also are a number of studies that indicate no or the opposite results. Furthermore, none of these studies control for the possible endogeneity of choices of communities (and their social services) due to migration, that is likely to mean that they overstate the impact of women's schooling if, for example, women that have more schooling also are likely to have more unobserved characteristics relating to their productivity and tastes that favor human resource development and that lead to a greater tendency for them to migrate to communities with better social services.

Control for unobserved individual, household and community characteristics: The series of studies by Behrman and Wolfe (1984b, 1987a,b, 1989) and Wolfe and Behrman (1984, 1987, 1990) control for such characteristics using adult sister deviation fixed effects estimates or latent variable techniques. All of these studies use the same sample from Nicaragua. Their results suggest that standard estimates are biased upward substantially with regard to the impact of women's schooling on child health, infant child mortality, contraceptive use, fertility, child schooling, preventative and curative medical care and possibly the women's own health (as well as some market outcomes related to income generation). The biases that are suggested probably are even greater than those suggested by the studies that use women's height to control for such endowments. The indication of greater biases than in the studies that use women's heights to represent such endowments probably is not very surprising since, if indeed such endowments are important, then women's heights would seem to be an imperfect measure of them. On the other hand, household nutrition does not seem to be biased in standard estimates by the failure to control for the common unobserved characteristics shared by adult sisters. The latter result suggests that the unobserved endowments have a number of dimensions, different ones of which may affect different outcomes. It also suggests that the conclusion that the standard estimates overstate substantially the impact of women's schooling on a number of outcomes is not the artifact of the increased role of measurement error in fixed effects estimates (since, if it were, it presumably also would affect the nutrition estimates). Another study with control for unobserved individual, household, and community characteristics (i.e., Rosenzweig and
Wolpin 1988) reports some similar results in that the impact of women's schooling on breastfeeding is significantly negative only at the 25 per cent level once there is control for the (unobserved, but estimated from the residuals of the health production function) infant biological endowments. Within a dynamic context, they also find that failure to control for unobserved child and household endowments possibly biases upwards the estimated impact of parental schooling on infant weights. I see the studies summarized in this paragraph as quite provocative concerning the possibility that the role of women's schooling is widely overestimated in standard estimates. But this whole set of results depends on two special samples for two Latin American countries, so replication would be quite valuable.

Interactions between women's and men's schooling: Women's schooling is usually emphasized in the literature on the impact of adult schooling on nonmarket outcomes and in a number of studies men's schooling is precluded a priori. However, a number of studies find that men's schooling also has a significant impact on such outcomes that in many cases is not significantly different from that for women's schooling and in a few cases is more important than is women's schooling (e.g., Rosenzweig and Schultz 1982b, Pitt and Rosenzweig 1985, Horton 1986). Since there is assortative mating on schooling in most societies, this means that studies that a priori limit the impact of adult schooling to that of women are likely to have an omitted variables bias due to the failure to include men's schooling in the specification -- one study that considers this possibility explicitly reports such an upward bias in that case is about two thirds (i.e., Behrman and Sussangkarn 1989). Most of these studies have not considered interactions between men's and women's schooling. The two studies that do emphasize such interactions (i.e., Behrman and Sussangkarn 1989, Thomas 1990b) report significant gross substitution with regard to child schooling, no effect with regard to fertility, and significant complementarities (which Thomas speculates may reflect a bargaining interpretation) with regard to anthropometric measures. Thus, in a number of cases men's schooling appears to be important in addition to women's schooling so that biases may result if men's schooling is excluded a priori, and there is limited evidence of interaction, though not consistent patterns of either substitution or complementation in the few available studies.

Since I have been a co-author of a number of these studies, however, I must qualify my enthusiasm since it may reflect in part my subjective involvement.

Intergenerational gender links: A few recent studies have explored such possibilities and have tended to find stronger intragender links across generations than cross-gender links for both women's and men's schooling on child schooling and child health (Thomas 1990b, King and Lillard 1987, King and Bellew 1988). Since most other studies to date have not explored such possibilities, it is hard to be whether such effects are not much more general, but these studies are suggestive that more exploration would be useful.

Subsample selectivity: The one study to date that explores the impact of selectivity in fertility decisions on child outcomes finds that the failure to control for such selectivity results in substantial downward biases in the estimated impact of women's schooling on their children's birthweight (Pitt and Rosenzweig 1989). This result suggests that the women who choose to have children are selected inversely on unobserved biological and other characteristics, the failure to control for which in standard estimates causes a large downward bias in the estimated impact of women's schooling on their children's birthweights. This is the strongest evidence in the studies reviewed in this survey of a downward bias in standard estimates of women's schooling on nonmarket outcomes, though there are a number of suggestions of upward biases that are summarized above. When the same study considers a child outcome later in the children's lifecycles, (i.e., expected years of schooling), the apparent effect of control for selectivity of fertility on the estimated coefficient of mother's schooling is much smaller and not statistically significant. This suggests the possibility of a fading effect over the children's life cycle. The very provocative and potentially very important results in this study, as in some other cases noted above, is based on only one sample, so further replication would be valuable.

Thus, the recent studies that have go beyond the standard studies both point to the possibilities of some refinements in the characterization of the impact of women's schooling -- such as the possibility of important intragender intergenerational links and the possibility of substantial interactions between women's and men's schooling -- and suggest the possibility that the standard estimates may be biased in important respects. There are some indications of downward biases in the standard estimates due to the failure to control for complementarities with men's schooling and some community characteristics and fertility selectivity. But the totality of this evidence suggests more strongly and more robustly that the standard estimates may overstate the true impact of women's schooling on nonmarket outcomes because of the failure to control for observed and unobserved endowments of women and of their households and because of the failure to control for

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60 Mark Rosenzweig, in conversations, also has reported some preliminary estimates that mortality selectivity does not seem to affect significantly estimates of the impact of women's schooling on any outcomes.
substitution between women's schooling and both men's schooling and community characteristics. Therefore, this review of studies to date suggests that probably the conventional wisdom based on standard estimates exaggerates the impact on nonmarket outcomes, though there is some counter evidence and a need for further research.

Section 5.2 Future Research Directions

The review of existing studies, as well as the discussion of the frameworks for analysis and of the measurement and estimation issues in Sections 1 and 2, suggests important areas in which research on the impact of women's schooling on nonmarket outcomes would be valuable. I discuss first useful research follow-up on existing results and then some additional implications of Sections 1 and 2.

The existing nonstandard studies suggest the value of further studies to explore some effects on which current results are ambiguous and to investigate other effects that appear important in one or a very few samples but which merit further examination.

Examples of the ambiguous results are those that relate to the extent of substitution or complementarities between women's schooling on one hand and men's schooling and community characteristics on the other. In what circumstances does substitution and in what circumstance do complementarities dominate? Might more estimates of the production function relations with such interactions help to clarify the nature and the mechanisms for such interactions, particularly since the present estimates are for reduced-form demand relations in which production and taste parameters are confounded? Do the results vary according to the nature of the nonmarket outcomes or according to the nature of options that are available in markets?

Examples of topics that merit further exploration because the available results are based on one or very few samples include the role of schooling quality experienced by women in addition to their years of schooling, the impact of control for often observed endowments such as adult heights and unobserved endowments such as those shared by adult sisters emanating from their childhood, the relation between the impact of women's schooling on health-related inputs and on health outcomes, intergenerational gender links, and subsample fertility selectivity. Does the incorporation of the quality of schooling experienced by current adults change the implications of investing in schooling quantity versus quality for nonmarket outcomes, as Behrman and Birdsall (1983, 1985) claim is the case at least in some contexts for market outcomes? What happens to the estimates of the impact of women's schooling in other samples with control for observed and unobserved endowments of the types summarized in Section 5.1? How adequately do better observed controls for such endowments (e.g., adult heights) seem to serve, in comparison with unobserved factors that only can be controlled through some fixed effects or residual method? To what extent do further estimates suggest that women's schooling may have a greater impact on the choice of health-care inputs than on health
outcomes? Is there evidence of intergenerational gender links in other samples and for other outcomes? If so, what seems to be the underlying mechanisms for such gender links and how sensitive do they seem to be to the nature of community and market environments? Is there evidence of fertility selectivity and/or of mortality selectivity in other samples and for other outcomes? If so, does such evidence imply a fading effect over the children's lifecycles, as the available results in the one existing study seem to imply? Are the effects of such sample selectivity modified if there is control such as in the adult sisters' fixed effects estimates for unobserved abilities, motivations, and habits that originate in the childhood family background of current adult women?

The discussions in Sections 1 and 2 also suggest some possibly important issues regarding the impact of women's schooling on nonmarket outcomes that have not been explored in the studies under review. Perhaps the most important one of these, at least from the point of view of policy considerations, is the question of whether or not there are important externalities generated by women's schooling in the sense that more schooling of other women affects the nonmarket outcomes of the household of a particular woman through the production and reduced-form demand relations (1.2.1-4)? Another possibly very important question from a policy perspective is to what extent can other policy-related variables -- for example, training programs, extension efforts, information campaigns, communication improvements, labor market changes -- substitute for women's schooling in having desirable effects on nonmarket outcomes and what are the relative rates of return to such possibilities?

The discussion in Section 1 also raises the question of whether there are other outcomes, the influence on which of women's schooling would be illuminating? Cognitive achievement is one example that is not covered in the studies reviewed in this paper. The discussion in Section 1 also notes that most studies are basically within a one-period framework, but that approaches that incorporate time might be informative. For example, there might be important learning over time about children's inherent endowments and important substitution to cope with seasonal fluctuations and shocks, all of which may be facilitated by more schooling of women, but which have hardly been explored in studies to date. A further implication of the time dimension that is obscured in the one-period framework but that is at the heart of the investment model developed in Section 1 is what is the rate of return on investments in children in terms of the adult labor market and nonmarket outcomes that are "produced" by relation (1.2.1)? The discussion in Section 1 and existing empirical studies also abstract from risk.

Although there are at least two studies underway that are incorporating cognitive achievement into the analysis -- analysis of the Ghanaian LSMS at the World Bank by Paul Glewwe and collaborators and analysis of rural Pakistani data at the International Food Policy Research Institute by Richard Sabot and collaborators.
aversion, but risk considerations may be important in the real world. Also changes in markets, perhaps most importantly in labor and capital markets, might have important feedbacks on the determination of nonmarket outcomes and on the roles of women's schooling in this process. Might such a role become more important, for example, if markets change more quickly due to accelerated development? Or might it become less important if increased market and governmental policy options for insurance and pensions reduce the importance of children in these roles and if increased labor market options for women increase the opportunity costs of their time in nonmarket activities? Furthermore, changes in household structure and in location due to migration might reflect and affect the roles of women's schooling, but there is almost no analysis that ties such phenomena into nonmarket outcomes in the developing country context. Also there are important transfers of resources and of children across households in some societies that might affect substantially the roles of women's schooling on nonmarket outcomes. Finally, the nature of what determines intrahousehold allocations, how relevant are bargaining considerations and how does women's schooling fit into such processes (with control for various endowments) merits more investigation.

The discussion in Section 2 also points to some other issues that have not been explored much, if at all, in the literature. One example is the possibility of random measurement errors in measured women's schooling, which ceteris paribus might cause underestimates of the impact of women's schooling on market and nonmarket outcomes. But there also are other measurement problems, such as the possibility that there is systematic bias in self reports of morbidity that are related to women's schooling and that might bias downward the estimated impact of women's schooling on morbidity. Yet another measurement problem is that the failure to incorporate the resources that go into grade repetition and in some cases school dropouts may results in substantial understatements of the resources devoted to female (and to male) schooling in some contexts, and thus the standard estimates (as well as the nonstandard ones reviewed in this paper) may overestimate substantially the estimated returns to schooling (e.g., Behrman and Deolalikar 1990a find such biases of from 35 to 100 per cent for Indonesia). There also are some estimation problems suggested in Section 2 that have not been examined, such as the impact of using selected samples (e.g., only those who report morbidity) to estimate the impact of women's schooling and of other variables on choices relating to medical treatment.

Thus, it seems that there are a number of important issues on the agenda of desired research related to women's impact on nonmarket outcomes. Further exploration of such issues should help to improve our general understanding and the bases for policy formulation.

Section 5.3 Policy Implications

Policies, of course, have to be made on the bases of imperfect information all the time. Therefore, it is fair -- and important -- to ask what are the policy implications of this review. There are
important implications for policy regarding research and for policy regarding women's schooling.

For policy regarding research, the discussion in Section 5.2 suggests that there are a number of important issues about which further research might improve substantially our understanding and our basis for operational policy formulation. It certainly is beyond the scope of this paper to compare expected social returns from devoting more resources to research on women's schooling and nonmarket outcomes than to research on other topics. But it does appear that in this area, perhaps in part because of the relatively recent growth of interest in women and development in many international and academic institutions, there is considerable scope for value added by further research, so the rate of return to such research may be relatively high.

The implications for formulation of policy on schooling for females of the current state of knowledge\textsuperscript{62} has differing implications for different policy objectives.

One major policy objective of most developing countries is to increase economic growth. Investments in females' schooling are likely to have at least as great a rate of return in terms of direct economic productivity as investments in males' schooling according to the recent survey by Schultz (1989). The present survey supports in a somewhat more qualified way the position advocated by a number of commentators that, in addition, women's schooling is likely to have larger impact than men's schooling on a number of nonmarket outcomes. But at least for relatively poor populations, there is increasing evidence in studies that carefully control for simultaneity and other possible estimation problems that health and nutrition, among these nonmarket outcomes, may have substantial impact on economic labor productivity (e.g., Strauss 1986, Deolalikar 1988, Sahn and Alderman 1988, Behrman and Deolalikar 1989b, Bouis and Haddad 1990). The relatively great impact of women's schooling on economic productivity through such nonmarket outcomes, thus, strengthens the case for investing in females' schooling at least as much (if not more) than in males' schooling. Thus the case is strengthened that from a pure growth/productivity point of view, one would not want to have policies that discriminate against female schooling in favor of male schooling.

But note that from a pure growth/productivity point of view there seems to be little in the results that are surveyed in this paper (or in those that are surveyed in Schultz (1989) regarding labor market outcomes) that suggest that there are differences in the private versus the social returns to such schooling investments. If there are gains to investing in women's schooling directly through increasing economic and labor market productivity and private returns or indirectly through

\textsuperscript{62}This state of knowledge has varying degrees of uncertainty as discussed above. But in what follows, I do not qualify my statements repeatedly due to such uncertainties.
improving health and nutrition with feedback on economic productivity, these seem to be private returns. There does not seem to be evidence of externalities or of other factors in most of the available estimates that would justify public subsidies to female schooling because of the expected impact of such schooling on nonmarket outcomes such as health and nutrition (though if there were such evidence, it would justify the consideration of policies to address such externalities). Given present pricing structures for most social services, however, there is at least one exception to this statement that works through fertility given public subsidies for schooling and health. That is, there are social gains beyond the private gains that might be obtained with fertility reductions due to the public savings on social services, and such fertility reductions might be induced in part by more female schooling. For this reason, at least given present pricing policies for social services, the impact of women's schooling on fertility may warrant subsidies for female schooling from a productivity/growth/efficiency point of view. But from such a point of view the first-best resolution would be to eliminate the distortions in such pricing of the social sectors, with more female schooling being at best a second-best policy (and perhaps there are better policies than subsidizing female schooling aside from the possibility of eliminating the pricing distortions so that subsidizing female schooling is not even second best\textsuperscript{63}).

A second major policy objective of most developing countries is the satisfaction of basic needs or other related distributional concerns. The results that are reviewed in this study suggest that probably women's more than men's schooling aids in the pursuit of such an objective. From the perspective of the pursuit of this objective, there would seem almost for sure to be a justification for somewhat greater subsidization of female than of male schooling. This does not answer the question of whether more women's schooling induced through such subsidies is the most efficient means to pursue this objective. The judgement about effectiveness of subsidizing women's schooling as opposed to other means for pursuing such an objective is not very illuminated by the present literature, and in fact is not very often even addressed by that literature. That, despite the qualifications that are raised by the nonstandard estimates, women's schooling seems to have fairly widespread positive effects on components of human resources, however, at least raises the possibility that increased female schooling is an important means through which to pursue distributional goals.

\textsuperscript{63}That subsidizing female schooling so that current girls receive the socially optimal schooling level may create incentives for more births than socially desirable points to problems of establishing the best incentives over time by schooling subsidies.
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