The Action of Human Resources and Poverty on One Another
What We Have Yet to Learn

Jere R. Behrman

OCTOBER 1990
LSMS Working Papers


No. 5 Conducting Surveys in Developing Countries: Practical Problems and Experience in Brazil, Malaysia, and the Philippines

No. 6 Household Survey Experience in Africa

No. 7 Measurement of Welfare: Theory and Practical Guidelines

No. 8 Employment Data for the Measurement of Living Standards

No. 9 Income and Expenditure Surveys in Developing Countries: Sample Design and Execution

No. 10 Reflections on the LSMS Group Meeting

No. 11 Three Essays on a Sri Lanka Household Survey

No. 12 The ECIEL Study of Household Income and Consumption in Urban Latin America: An Analytical History

No. 13 Nutrition and Health Status Indicators: Suggestions for Surveys of the Standard of Living in Developing Countries

No. 14 Child Schooling and the Measurement of Living Standards

No. 15 Measuring Health as a Component of Living Standards

No. 16 Procedures for Collecting and Analyzing Mortality Data in LSMS

No. 17 The Labor Market and Social Accounting: A Framework of Data Presentation

No. 18 Time Use Data and the Living Standards Measurement Study

No. 19 The Conceptual Basis of Measures of Household Welfare and Their Implied Survey Data Requirements

No. 20 Statistical Experimentation for Household Surveys: Two Case Studies of Hong Kong

No. 21 The Collection of Price Data for the Measurement of Living Standards

No. 22 Household Expenditure Surveys: Some Methodological Issues

No. 23 Collecting Panel Data in Developing Countries: Does It Make Sense?

No. 24 Measuring and Analyzing Levels of Living in Developing Countries: An Annotated Questionnaire

No. 25 The Demand for Urban Housing in the Ivory Coast

No. 26 The Côte d'Ivoire Living Standards Survey: Design and Implementation

No. 27 The Role of Employment and Earnings in Analyzing Levels of Living: A General Methodology with Applications to Malaysia and Thailand

No. 28 Analysis of Household Expenditures

No. 29 The Distribution of Welfare in Côte d'Ivoire in 1985

No. 30 Quality, Quantity, and Spatial Variation of Price: Estimating Price Elasticities from Cross-Sectional Data

No. 31 Financing the Health Sector in Peru

No. 32 Informal Sector, Labor Markets, and Returns to Education in Peru

No. 33 Wage Determinants in Côte d'Ivoire

No. 34 Guidelines for Adapting the LSMS Living Standards Questionnaires to Local Conditions

No. 35 The Demand for Medical Care in Developing Countries: Quantity Rationing in Rural Côte d'Ivoire

No. 36 Labor Market Activity in Côte d'Ivoire and Peru

No. 37 Health Care Financing and the Demand for Medical Care

No. 38 Wage Determinants and School Attainment among Men in Peru

No. 39 The Allocation of Goods within the Household: Adults, Children, and Gender

(List continues on the inside back cover)
The Action of Human Resources and Poverty on One Another

What We Have Yet to Learn
The Living Standards Measurement Study

The Living Standards Measurement Study (LSMS) was established by the World Bank in 1980 to explore ways of improving the type and quality of household data collected by statistical offices in developing countries. Its goal is to foster increased use of household data as a basis for policy decisionmaking. Specifically, the LSMS is working to develop new methods to monitor progress in raising levels of living, to identify the consequences for households of past and proposed government policies, and to improve communications between survey statisticians, analysts, and policymakers.

The LSMS Working Paper series was started to disseminate intermediate products from the LSMS. Publications in the series include critical surveys covering different aspects of the LSMS data collection program and reports on improved methodologies for using Living Standards Survey (LSS) data. More recent publications recommend specific survey, questionnaire, and data processing designs, and demonstrate the breadth of policy analysis that can be carried out using LSS data.
The Action of Human Resources and Poverty on One Another

What We Have Yet to Learn

Jere R. Behrman

The World Bank
Washington, D.C.
The action of human resources and poverty on one another: what we have yet to learn / Jere R. Behrman.

p. cm.——(LSMS working paper ; no. 74)
Includes bibliographical references.
1. Poverty—Developing countries. 2. Income—Developing countries.
3. Human capital—Developing countries. 4. Economic development—
Effect of education on. 5. Education—Economic aspects—Developing
countries. 6. Economic development projects—Developing countries.
I. Title. II. Series.
HD59.72.P6B44 1990
362.5'09172'4—dc20 90-19379
CIP
ABSTRACT

Poverty in the developing world is a major challenge. Investments in human resources are considered critical elements of efforts to alleviate poverty; better health and nutrition are thought to raise labor productivity and improve the performance of students. Education, particularly at the primary level, is claimed to have very high rates of return in terms of productivity, income, and non-economic success in the developing world.

On the other hand, inadequacies in human resources often are thought to be manifestations of poverty. Malnutrition and poor health, for example, often are ascribed primarily to inadequate incomes. UNICEF has argued strongly that structural adjustment programs often have very negative effects on the human resources of the poor, and increasing attention is being given to that possibility by the World Bank and other international organizations.

Therefore there appear to be major ties between human resources and poverty. Moreover, there may be important interactions among investments in various human resources, with education in particular widely thought to improve the results of investments in other human resources.

But while the hypothesized relationships between human resources and poverty appear important, they also appear complicated. Precisely because they are complicated and because of the informational difficulties of socioeconomic research, much of what is presumed about these interactions may be based on poor empirical foundations. Since major policies and development strategies often are based on what is known in this area, the possible lack of strong empirical foundations about these interactions may be costly.

This paper attempts to sort out relationships between human resources and poverty, based on recent studies. Since this paper deals primarily with behavior at the individual or household level, and since simple economic theory provides guidelines for empirical research at that level, it begins with brief descriptions of the human capital investment model and the household model. It then turns briefly to some measurement issues. Next it considers the impact of human resources on the income of poor people, and the determinants of human resource investments. It then takes up allegations of deleterious effects of structural adjustment programs on the human resources of the poor. Next, it considers some macroeconomic issues, including macroeconomic models that focus on human resources.

Finally, it offers conclusions about relationships between human resources and poverty. These conclusions question a number of the strong assertions about the strong links between human resources and poverty. For instance, in many cases schooling appears in substantial part to be a proxy for other characteristics, such as ability and motivation and family background, rather than representing purely the effects of schooling per se. Also the economic impact on human resource investments of the poor appears to be more through price effects and less through income effects than often is
claimed. For one last example, the UNICEF-type claim about the deleterious effects of adjustment programs on the human resources of the poor seems to be based on very weak empirical foundations. The conclusions also point to a number of areas related to human resource-poverty links in which further research might have a high payoff in terms of understanding and in terms of policy formulation.
ACKNOWLEDGMENT

The author thanks Harold Alderman, International Food Policy Research Institute (IFPRI); Howarth Bouis, IFPRI; and Jacques van der Gaag, Welfare and Human Resources Division, World Bank, for useful comments on various parts of this paper.
# TABLE OF CONTENTS

Introduction ............................................................................................................. 1

1. Framework for Analysis .................................................................................. 3
   1.1 The Supply and the Demand for Human Resources ..................................... 3
   1.2 Household Model .......................................................................................... 8

   2.1 Measurement Problems Regarding Poverty ............................................... 20
   2.2 Measurement Problems with Human Resources .......................................... 23
      2.2.1 Measurement of Health Status ................................................................. 24
      2.2.2 Measurement of Nutrient Intakes .............................................................. 26
      2.2.3 Measurement of Education ...................................................................... 30
   2.3 Measurement of Other Important Variables ................................................. 31

3. Impact of Human Resources on Income of Poor People .................................. 32
   3.1 The Impact of Schooling on Poverty .............................................................. 32
      3.1.1 Schooling Impact on Labor Productivity .................................................. 32
      3.1.2 Schooling Impact on Household Productivity .......................................... 41
   3.2 Impact of Health and Nutrition ...................................................................... 59
      3.2.1 Impact of Health and Nutrition on Labor Productivity .............................. 59
      3.2.2 Impact of Health and Nutrition on Household Productivity ..................... 62

4. The Impact of Poverty on Human Resource Investments .................................. 68
   4.1 Impact of Poverty on Health .......................................................................... 69
   4.2 Nutrient Reduced-Form Demand Relations ................................................ 80
   4.3 Reduced-Form Demand Relations for Other Health-Related Goods and Services ......................................................... 91
   4.4 Reduced-Form Demand Relations for Child Schooling ............................... 93

5. The Impact of Economic Adjustment Programs on Human Resources of the Poor ................................................................. 96
   5.1 Implications of Economic Theory for Analysis of Adjustment Policies .......... 97
      5.1.1 Impact of Major Macro Adjustment Policies on the Poor ....................... 97
      5.1.2 Impact on Human Resources of Changes in Income of, and Prices Faced by, Poor Households ......................................................... 103
   5.2 Empirical Evidence on the Impact on the Poor and on Their Human Resources ................................................................. 104
      5.2.1 The Effectiveness of Macro Adjustment Policies on Macro Outcomes in the Developing Countries ................................................................. 104
      5.2.2 Changed Composition of Governmental Expenditures in Adjustment Programs ................................................................. 107
      5.2.3 Household Responses to Income and Price Changes .............................. 112
      5.2.4 Country Studies on the Evaluation of the Impact of Structural Adjustment Programs on the Poor and their Human Resources ................................. 113
6. Other Macro Considerations

6.1 Structural Macroeconomic Models with Endogeneous Human Resources

6.2 The New Neoclassical Growth Models and Cross-Country Evidence

7. Conclusions

7.1 Summary of Studies Reviewed

7.2 Directions for Desirable Research

References

LIST OF FIGURES

Figure 1.1 Demand and Supply for Human Capital in Becker's Woytinsky Lecture

Figure 1.2 Two Alternative Income Streams with Schooling Equal to s_0 (0) Years and s_1 Years and Fixed Post-Schooling Work Life of n Years, but No Post-Schooling Human Capital Investments

Figure 3.1 Geographical Aggregation Bias in Estimated Schooling Returns Due to Inappropriately Combining Two Regions (Belgium and Afghanistan) with Widely Different Complementary Production Factors into One "Belgistan" Sample
INTRODUCTION

Poverty in the developing world is a major challenge. Investments in human resources are considered critical elements of efforts to alleviate poverty; better health and nutrition are thought to raise labor productivity and improve the performance of students. Studies by the World Bank (1980, 1981), Colclough (1982), Psacharopoulos (1985, 1988), Eisemon (1988), and many others claim that education, particularly at the primary level, has very high rates of return in terms of productivity, income, and non-economic success in the developing world. On the other hand inadequacies in human resources often are thought to be a manifestation of poverty. Malnutrition and poor health, for example, were ascribed by the 1981 World Bank World Development Report primarily to inadequate incomes. UNICEF has argued strongly that structural adjustment programs can have very negative effects on the human resources of the poor, and increasing attention is being given to that possibility by the World Bank and other international organizations. Therefore there appear to be major ties between human resources and poverty. Furthermore, there may be important interactions among investments in various human resources, with education in particular widely thought to improve the results of investments in other human resources.

The hypothesized relationships between human resources and poverty appear both important and complicated. Precisely because they are complicated and because of the informational difficulties of socioeconomic research, much of what is presumed about these interactions may be based on poor empirical foundations. Since major policies and development strategies often are based on what is known in this area, the possible lack of strong empirical foundations about these interactions may be costly.

In this paper I attempt to sort out relationships between human resources and poverty. This is difficult, since the number of related studies is enormous and rapidly increasing, and because the resources (both human and otherwise) available for the paper are quite limited. I make no effort to review all the literature in this area, but focus on the most relevant studies. I also focus on recent studies, since they are most likely to be based on more recent data and more satisfactory research strategies than earlier ones. Because of my focus on studies published in the major economic journals, or that have come to my attention in pre-publication form, there may be an undercoverage of studies written in languages other than English, of those undertaken outside of the United States, and of those in the noneconomics literature.

---

1. I review the related literature on human resource led growth in Behrman (1990d).

2. I apologize for any consequent omissions. While I have attempted to be fair in my judgments and in regard to the studies covered and their interpretations, undoubtedly some personal limitations in understanding have affected the paper. I also apologize for any exclusions or misinterpretations. Finally, the lags in the editorial and publication process mean that some very recent studies are not reviewed since considerable time passed between the writing of this survey and its publication, for which I again apologize.
Since this paper deals primarily with behavior at the individual or household level, and since simple economic theory provides guidelines for empirical research at that level, I begin with brief descriptions of the human capital investment model and the household model as frameworks for analysis. I then turn briefly to some measurement issues. Next I consider the impact of human resources on the income of poor people, and the determinants of human resource investments. I then take up allegations of deleterious effects of structural adjustment programs on the human resources of the poor. Next I consider some macroeconomic issues, including macroeconomic modeling, focusing on human resources. Finally, I offer conclusions about relationships between human resources and poverty.
1. FRAMEWORK FOR ANALYSIS

A theoretical framework for the determinants of human resources and their impact upon productivity is essential for a systematic, empirical study. The empirical analyses reviewed in this paper best can be summarized with reference to two simple models -- one for the supply and demand for human capital, and the other for the household behavior that shapes the demand and influences the supply. While these models obviously are interrelated, it is useful to discuss them separately. Both of these approaches are presented here within a single time period, because that simplifies the presentation and because that is the style of most of the relevant empirical literature.

1.1 The Supply and the Demand for Human Resources

A number of the determinants of human resources and their relation to poverty are found in the simple Becker-Woytinsky lecture framework for the "demand" and the "supply" of human capital. I put these terms in quotation marks in this context because these are not really demand and supply curves as normally defined. Instead, the demand curve is the present discounted value of the additional benefits derived from an increment of human resource investment in an individual, and the supply curve is the present discounted value of the additional costs of an increment of human resource investment in the same individual. 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 marginal costs and the marginal benefits equal $r^*$. Equilibrium is the human resource investment level at which the marginal costs equal the marginal benefits, or supply equals demand. At human resource investment levels below the equilibrium level, the marginal benefits exceed the marginal costs, so there is an incentive to expand human resource investments (and the contrary for human resource investment levels beyond equilibrium).

The critical questions pertain to what lies behind the demand and supply curves.

3Supply and demand curves as normally defined assume perfect competition, with individual demanders and individual suppliers too small to alter the market prices. 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.

4Sometimes these marginal benefits and costs are translated into marginal rates of return for benefits and marginal interest rate equivalents for costs.
marginal costs, marginal benefits

Figure 1.1 Demand and Supply for Human Capital in Becker's Woytinsky Lecture

income

Figure 1.2 Two Alternative Income Streams with Schooling Equal to \( S_0 (=0) \) Years and \( S_1 \) Years and Fixed Post-Schooling Work Life of \( N \) Years, But No Post-Schooling Human Capital Investments
The demand curve is determined by several factors: the interest rate for discounting future benefits back to the present; the price of one unit of the relevant outcome; and the number of units of the outcome attributed to previous or concurrent human resource investments in the individual. The most-analyzed case is that of investment in the form of time in school with the outcome being the present discounted value of labor market earnings per hour worked. The present discounted value of earnings is affected positively by the schooling investment, but with diminishing marginal returns for at least three reasons. First, the longer one is in school, the longer the period over which initial post-schooling earnings must be discounted back to the present. Second, the longer one is in school, the shorter the post-schooling period over which one reaps the returns from schooling. Third, there are likely to be diminishing returns to lengthy schooling even in terms of the wage expected because of fixed endowments such as natural abilities, and other human resource investments such as pre-school education and nurturing at home. Because of the diminishing marginal returns to time spent in school, the demand curve in Figure 1.1 slopes downward.

This demand curve touches upon a number of important issues. First, it reflects a link between the most-emphasized human resource investment, schooling, with subsequent income and therefore standard of living. Second, it points to the importance of the labor market conditions that the individual will face after schooling. If they are unpromising because of discrimination due to sex, caste, ethnic group or some other characteristic, or because of poor prospects for the economy, the demand curve may be quite low, as is the dashed demand curve in Figure 1.1. In such a case the incentives for investing in schooling are much weaker than would be the case were the demand curve the solid one. Third, the demand curve is influenced by factors besides time in school. These include pre-school background, other human resource investments (for example, nutrition and other health-related factors), the quality of the schooling, and the natural endowments relating to ability and

---

5In developing countries many individuals do not work for wages but as unpaid family workers on farms and in other enterprises. For such individuals, the notion of labor market earnings used here includes the marginal product of their work.

6If hours worked vary with schooling (as they seem to), an exclusive focus on earnings would not reflect the value of leisure. An alternative would be to consider the individual's full earnings, with all of his/her time valued at the appropriate marginal wage.

7I 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.
motivation. If an individual is from a poor household, s/he is likely to receive from the household and from the surrounding community only limited quantities of a number of these other factors. As a result, the individual's demand curve is likely to be low -- say the dashed line again -- with limited incentives for extended schooling. Thus there are likely to be transgenerational poverty links due to limitations in human resource investments. Fourth, it may be very difficult to estimate the impact of schooling separately from other factors. Fifth, it is important to consider who is making the schooling investment decision and whose interests are at stake. Poverty may be so pressing that poor parents discount future earnings very heavily. This may limit the human resource investment in their children and reinforce transgenerational poverty links.

Underlying the supply curve are the private opportunity costs of the resources necessary to attend school. There are a number of important costs: the opportunity cost of activities (e.g. working outside the home or in household enterprises, or caring for younger siblings), school fees; travel time and other travel costs; and the cost of textbooks and supplies. These costs may be summarized as the cost of using the resources for schooling instead of for other activities (the solid supply curve in Figure 1.1). The more productive the alternate uses of such resources, the higher the marginal cost of financing schooling and the further to the left 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, other things being equal, the equilibrium schooling level is lower.

Because opportunity costs increase along with 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. Schooling usually has to be financed by one's own household or relatives. This means that the supply curve is likely to be further to the left and possibly more steeply sloped for poor people, who have limited access to credit markets, pay high interest rates if they can borrow at all, and are in general less able to pay for schooling. 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.

Perhaps the most-widely used special case of this model is that of Mincer (1974). In the simplest version of the Mincer model, an individual decides between alternative schooling levels by choosing the schooling level that maximizes the present discounted value of earnings given the opportunity costs of time spent in school instead of in the labor market and the rate of interest. Figure 1.2 illustrates a simple choice between two income streams, \( Y_0 \) and \( Y_1 \), associated with two different schooling levels, \( S_0 = 0 \) and \( S_1 \), with no post-schooling human capital investment and a fixed post-schooling working life of \( N \) years. Given a fixed interest rate, \( r \), in equilibrium each individual is indifferent as to the two schooling levels so that:
This expression implies:

\[
\ln \frac{Y_{s_1}}{Y_{s_0}} = \ln Y_{s_1} + rt
\]

This is the familiar Mincerian semilog earning relation (except that the usual quadratic for experience is not included for simplicity due to the assumption that there is no post-schooling investment in human capital). Under the Mincer assumptions the coefficient of schooling is the private rate of return to the time that an individual spends in schooling. Several characteristics of this relation merit mention. First, this relation is not an income production function, but just an equilibrium relation. The income production function underlies the different levels of \(Y\) associated with different schooling levels, but in general this production function depends on other characteristics, such as natural talent and motivation and capital with which a worker works. Second, the coefficient of schooling in this relation is just the market rate of interest (which, under the Mincer simplifying assumptions is the private rate of return to time spent in school instead of in the labor force). Third, within this framework, schooling and expected income are determined simultaneously. Fourth, an unbiased estimate of the private rate of return to schooling is likely only if other possibly relevant factors (for example, ability, motivation, human capital investments other than schooling, schooling quality, interest rates, discrimination in schooling or in labor markets) are distributed randomly with respect to schooling. But the supply and demand curves in Figure 1.1 suggest that such factors are associated with the years of schooling, and therefore have to be controlled to obtain an unbiased estimate of the impact of schooling. Fifth, in this simple Mincer model, time worked is fixed. If time worked depends systematically on schooling, the estimate of the simple semilog earnings function results in a biased estimate of the impact of schooling on the value of time (and on productivity if the wage equals the marginal product of labor). To prevent such biases from confusing labor supply effects and wage effects, it probably is preferable to estimate wage functions instead of earnings functions.

Although the Mincer interpretation often is given for the semilog earnings relation in 1.1.2, the alternative interpretation of this relation as

---

8 The direction of the bias depends upon whether hours worked increase or decrease with the wage rate, reflecting in turn whether the price effect dominates (that is, the price of leisure increases with the wage) or the income effect dominates (that is, if leisure is a normal good the demand for it increases with income).
a hedonic price index -- as developed and emphasized by Tinbergen (1951, 1956), Rosen (1974), and Sallinger (1980) -- also is common. The advantage of this interpretation is that it is less restrictive, but the disadvantage is that it does not obtain directly the rate of return to schooling from the estimated coefficient of schooling. In general, of course, there is no reason to limit the hedonic price index to the linear term in schooling and a quadratic in experience as often is done. Instead one can think of the hedonic price index as a quadratic or higher-order approximation of the dependence of wages on schooling, experience, ability, motivation and other factors. Such considerations point to the possible importance of interactions and higher-order terms. They also point to probable bias in the estimated schooling and experience coefficients if, as is usually the case, the ability, motivation, and other terms are restricted a priori to zero. Thus comments parallel to the last three in the previous paragraph also hold for a hedonic interpretation if earnings or income is the dependent variable and the right-side variables are restricted to the usual terms -- years of schooling and experience.

1.2 Household Model

Many decisions that relate human resources to poverty are made in households. I present here a brief description of how economists model households and the implications of such modeling for analyses of the relations between human resources and poverty.

Most empirical analyses are based on a simple one-period model of household behavior, even though some interactions between human resources and poverty involve decisions over time in an uncertain world, as is recognized in a (very) few studies. In the standard household model, parents are assumed to make the basic allocation decisions by acting as if they have common preferences or bargaining over the allocation of resources, although children, particularly as they grow older, seem to have a say in many household decisions. While a bargaining model appears more plausible than the unified household preferences model, the difference is generally moot since the estimated relations do not justify confident identification of what the allocation mechanism is within the household. The basic problem is that

---

9Households 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 live with significant sharing of resources. The decisions made in changing households are more difficult to model clearly than are the decisions of stable households.

bargaining power variables (for example schooling, wage rates, and income) also generally are associated with productivity and the opportunity cost of time. For convenience in what follows I refer to the accomplishment of household goals as the "maximization of household preferences," though I do not wish that terminology to preclude the possibility that the outcomes are from an intrahousehold bargaining processes.

The preference levels involved depend on the consumption of goods and services, the use of time, and the quality of the human resources of each of the household members. Economists generally presume that the preference functions are given, though some (for example Easterlin, Pollak and Wachter, 1980) suggest that preferences may derive from childhood experiences or from consumption norms of a broader community. A number of the important influences of adults on human resources of the next generation are parental preferences regarding the quality and the quantity of children, as described by 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 on the basis of altruism, or the children's contribution to household income, or potential support during the parents' old age, or maintenance of the family line. Development may bring alternatives to dependence on one's children for such services; for instance, governmental and private pension plans may reduce dependence on one's children for old-age support.

Preference levels are maximized subject to two types of constraints:

First, there is household full-income constraint; total expenditures of a household on goods and services for consumption, health care, schooling, housing, leisure, and so on, must be less than or equal to the value of the

---

11 This point obviously holds for earned income, which depends on wages and time use decisions. But it also holds for unearned income since such income often reflects returns on previous earnings (e.g., capital assets, pensions, social security) and therefore any persistent heterogeneity in productivity. Some recent studies (for example Schultz 1988b, Thomas 1990) are aware of this problem, but it still may contaminate their estimates.

12 They may also depend on the human resources of individuals outside of the household if altruism is important in interhousehold transfers, as may be the case in developing societies. For recent analyses 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).
total resources available to the household. 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 some of the interactions and tradeoffs between human resources and poverty. If a household has limited human resources, it is likely to be poor and face painful tradeoffs of its very limited resources for the development of human resources that have a future payoff at the cost of reduced current consumption.

Second, there is a set of household production functions whose "outcomes" are determined by "inputs," of which some important ones are under the control of household members. The most relevant of these for this paper are health production functions and various time productivity relations. I discuss these in some detail since they are fundamental to many of the empirical analyses of interrelations between human resources and poverty discussed below.

The household health production function is the technological/biological relation that determines the health of each individual in the household as related to the health-related "inputs" relevant for each individual household member:

\[ H_i = H(N_i, C_i, G_i, I_i, S_i, S_m, T_i, T_m, E_i, M), \]

where

- \( H_i \) is the health of household member \( i \),
- \( N_i \) 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,
- \( I_i \) is the number of individuals in the household,
- \( S_i \) is the education of the \( i^{th} \) household member (with the superscript \( m \) referring to the person (often the mother or wife) who makes critical health-related decisions and implements them within the household),
- \( T_i \) is the time use of household member \( i \),
- \( E_i \) is the endowment of the \( i^{th} \) household member (e.g., genetic makeup), and
- \( M \) is the endowment of the household (e.g., the general environment).

\[ ^{13} \] All of these variables and others defined below may be vectors with multiple dimensions.
In this health production function, possible interactions between human resources and poverty are represented indirectly in that poverty may affect some of the inputs and the health output may affect productivity (as is discussed further below with reference to relation 1.2.2) and thus poverty. Some possible interactions among human resources are indicated directly by the explicit inclusion of nutrition and schooling. In addition there may be some indirect effects of human resources on health underlying this production function if, for example, human resource investments increase labor productivity and the resulting greater income induces more expenditure on nutrition and other health-related goods and services.

I now discuss some features of the indicated inputs in this health production function.

Nutrient intakes (N1) are emphasized because of their presumed importance to health and their direct relevance for this paper since nutritional investments are major ones. For most individuals in developing countries, the health impacts of N1 are positive, although overeating can have negative effects on health. The health production function often is treated as encompassing fixed nutrient standards (given age and gender), though this has been questioned recently (see Subsection 2.2.2). Other consumption items (C1, CP) include goods and services with direct effects on 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 time use (T1) is included because the nature of his or her occupation, the extent of leisure time and the time devoted to health-related activities may have important health effects. The time use of the individual and the nature of occupational and other activities, for instance, affect energy use and thus the health impact of nutrient intakes. The individual's education (S1) and that of the key person in the household concerned with health-related decisions and implementation (S^m) may affect health through the choice of health practices, better information, and health-related inputs (e.g., better-educated cooks may prepare food in more nutritious ways, better-educated mothers may know the benefits of and procedures for growth monitoring). The individual's endowment (E1) and the

14O'Connell and Mwabu (1986), for example, develop an interesting model in which rural workers allocate less time to health maintenance and are less healthy as a result than urban workers. This follows from optimizing behavior given a greater range of possibilities for productive activities for low-health workers and, thus, higher opportunity costs for taking time from work for health maintenance for such workers.

15Education, of course, may interact with time and goods allocated to health-related activities.
household endowment (M) differ from the other variables in that they are not choices of the household during the period being modeled. Examples of such endowments include an individual's age, initial health, genetic makeup, and the natural environment of the household.

Relations for the value or marginal productivity of time in various activities usefully may be seen as household production relations if they depend in part on concurrent investments in health, nutrition or education. The broad range of activities wherein health and nutrition are claimed to have productivity impacts for poor people include: labor market, own firm/farm, and household production and schooling activities. Therefore I allow for the possibility that the marginal productivity of an individual's time depends on his/her health, nutrient, and educational status and endowments, and other relevant factors:

\[(1.2.2) \quad \text{MPT}^i = \text{MPT}(N^i, H^i, S^i, E^i, M, \ldots)\]

where \(\text{MPT}^i\) is the marginal productivity of time of the \(i\)th individual, and the other variables are defined below relation 1.2.1.

The other relevant factors that are not indicated explicitly in relation 1.2.2 vary, depending on the nature of the time use and the other inputs associated with that time use. For productivity in own-farm labor, for example, the level of complementary and substitute inputs such as land and water control might be important.

The household production functions for health and the marginal productivity of time use are one of the two conceptually cleanest forms in which to investigate the relationships between human resources and poverty.

---

16If they do not depend on concurrent human resource investments, then they are not affected by current household decisions and are not an endogenous part of the current household decisions and outcomes. However, there may be bias in estimation of the impact of these human resources even if they are predetermined, as discussed in the third point below relation (1.2.2).


18The 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 the cleanest to estimate.
There are numerous estimates of household production functions for health (and of mortality production functions that can be viewed as special cases of relation 1.2.1 in which health status declines irreversibly below some critical level) and of the value of time production functions (see Section 3). Five important considerations in evaluating such estimates are set out below.

First, many of the right-side variables are determined simultaneously with health or with the marginal product of time 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 are healthy for reasons (for example, their genes) other than health-related inputs, the failure to control for simultaneously-determined health inputs in the estimation of the health production function may understate the health impact of such inputs. Likewise, if individuals who are relatively robust inherently consume more nutrients and perform more productively, the failure to control for the simultaneous determination of their nutrient intakes may exaggerate the 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 1.2.1 and 1.2.2 that often are not observed, such as time use in the former and endowments in both. If these variables are correlated with the included variables, omitted variable bias may be important. If households with better unobserved endowments tend to have better-educated mothers, for example, the impact of mothers' education on health and mortality will be exaggerated.

---

19 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.

20 Whether some of these variables are seen as predetermined or not depends in part on the questions asked and the time period of relevance. Migration, for example, can change the local environment and community services of relevance to an individual's health, but it can be treated as predetermined unless it results in changed prices that are correlated with unobserved endowments.

21 Any correlation between variables omitted and predetermined variables that are included (such as schooling, in many studies) also means that the estimated residuals are biased estimates of the unobserved variables. Thus unobserved exogenous impacts of, say, endowments cannot be identified with the estimated structural residuals, as proposed in various studies (for example, Rosenzweig and Schultz 1983, 1987), unless the unobserved variables truly are uncorrelated with right-side variables.
Or if there is no analytical control for the time used in energetic activities, and those who spend more time in such activities also consume more nutrients, the health impact of nutrition will be understated. Or if better endowed children have better health and do better in school, the impact of health on their schooling performance may be exaggerated.

Third, adult schooling may pose a special estimation problem of substantial relevance for this paper, since a major issue here is the impact of schooling on other human resource investments and on poverty. Adult schooling seems to be predetermined since it usually reflects decisions taken much earlier, often by the parents of current adults. This treatment certainly is the most common one in empirical studies, despite the possibility that schooling of current adults would seem to be determined simultaneously with its consequent effects, in the human capital models such as those that are summarized in Subsection 1.1. Sometimes the assumption that adult schooling is exogenous is made without comment regarding the implications of the literature on human capital, 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 adult schooling on various outcomes, however, we need only determine whether adult schooling is independent of the stochastic disturbance term in the relations being estimated. Even without the assumption that the schooling decision was made in a lifetime framework, it is easy to think of situations in which such independence would not prevail. For example, there is not the necessary independence if parents of current adults provided more schooling for their brighter daughters and if, in addition to the direct schooling effects in relations 1.2.1 and 1.2.2, brightness leads to better health and more productive use of time. In this case the standard estimates of the impact of women's schooling, without control for the brightness (endowments) of the women, overstate the impact of the schooling because the schooling variable in part is a proxy for the unobserved endowments. The possibility that this is a significant bias cannot be dismissed merely by deprecating lifetime human capital models.

Fourth, the relations may differ for different types of individuals in the same household and the distribution of inputs among individuals may not be uniform, so estimates based on household averages may be misleading. If, for example, marginal nutrient increases are consumed primarily by prime-age adult males (either because of power relations within the household or because of relatively high productivity returns), average household nutrient demand relations are not very informative as to changes in nutrient intakes, say, for prime-age females or infant girls if household income increases.

Fifth, the production functions above are presented in a one-period framework for simplicity. In empirical applications, however, understanding the nature of lagged responses may be critical. If lagged responses in health to nutrients, to illustrate, are not well represented, empirical estimates may understate the health impact of marginal changes in nutrition. Such a problem is all the more severe if there are considerable intrapersonal variations in nutrition, and the period of observation on nutrition is short.
Sixth, measurement errors may be substantial in both the indicators of outcomes and observed inputs. As is well-known, random measurement errors in the outcomes do not cause biases, but random measurement errors in the inputs tend to cause biases towards zero. Systematic measurement errors in outcomes or inputs may cause errors either towards or away from zero, but often are ignored in empirical analysis.

The second type of relationship whose estimation is cleanest conceptually is a reduced-form demand relation. To obtain such a relation, we posit that a household has maximized its preference level subject to the full-income and household production function constraints noted above (perhaps with stochastic factors also playing important roles) to determine all of the outcomes under the control of the household. The outcomes include 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 dependent on all of the determinants of household behavior that are predetermined or exogenous to the household: market prices; wages; availability of health and other services; the local environment; schooling or other forms of training for all those who consider that they have completed school or training programs; predetermined assets of the household or of individuals therein; entitlements from governmental programs or from friends and relatives; and the abilities and other endowments of all household members. Such relations are called reduced forms because they reduce the responses of the household that are subject to full-income and production function constraints to depend only on the exogenous or predetermined variables and parameters from the point of view of the household (and not on other variables currently determined by the household). The reduced-form functions give the demands for health, nutrients, other health-related inputs, time use, and perhaps the marginal value of time for each individual in the household as a function of all the exogenous prices, broadly-defined, and predetermined assets, broadly-defined:

\[ (1.2.3) \quad Z = f(V), \]

where \( Z = (H^i, N^i, C^i \ldots) \) for each \( i = 1, \ldots I \),
\( V = (S^i, E^i, M, P, A \ldots) \) for all \( i = 1, \ldots, I \),
\( Z \) is a vector of endogenous variables,
\( V \) is a vector of exogenous and predetermined variables,
\( P \) is a vector of relevant prices broadly-defined faced by the household,
\( A \) 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 a household enter into the reduced-form relations for human resource investments, time use and possibly the marginal value of time of each individual since a change in such variables for any one individual may affect
the whole household. The assets include the schooling of adults (but see below), but not of children, for whom school attendance is a choice variable (and therefore is in Z). Bias due to omitted variables may be greater for the reduced forms than for the production functions because the reduced forms include all predetermined variables in all relevant household production functions (not just those for the outcome being estimated) and all predetermined or exogenous assets and prices in the household's full-income constraint. This means, for example, that each reduced form contains all of the household's unobserved endowments, including ones related to health and mortality, use of health-related inputs, investment in children's schooling, and the values of time use.

Second, the predetermined assets and exogenous prices for many households in developing countries should include not only assets and prices related to consumption decisions, but also those relevant to any market-related production of household firms or farms. Because of incomplete markets, productivity effects of health and nutrition, or differences between sale and purchase prices for food producers, it may not be possible to separate income-generation decisions from consumption decisions (as is done in standard demand analysis). If it is not possible to separate the decisions, income (including net profits from family farms and firms) should be treated as endogenous and should not appear in the reduced-form relations. Those relations should include all the prices and predetermined assets relevant to household farm/firm production; alternatively, if household income is included

---

22 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 non-agricultural family enterprises in services and industry, particularly in the informal sector. Incomplete markets is the most commonly cited reason why separability is not appropriate, but Behrman and Deolalikar (1988b) also cite productivity effects of health and nutrition, and Alderman (1987) mentions differences between selling and buying prices for foods. The possibility of separating income and consumption is an appropriate assumption in 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 one's occupation and one's productivity are closely related to one's health and nutrition, however, the separability assumption may not be appropriate.
in a quasi-reduced form rather than in an estimate in a true reduced form, it should be estimated as simultaneously determined, with the predetermined assets and exogenous prices for the household farm/firm production used as identifying instruments.

Third, if wages are exogenous to household decisions, they should be included among the broadly-defined exogenous prices faced by the household, since the wages represent the value of an important asset owned by the household -- the time of its members. If wages are endogenously affected by health and nutrition as is suggested as a possibility in relation 1.2.2, however, they should not be included on the right side as exogenous variables in the reduced-form relations, although there may be some important determinants of local wages that should be included (for example, governmental employment schemes).

Fourth, estimating in such reduced forms the impact of adult schooling presents the same problems discussed above in regard to the estimation of the impact of adult schooling on household production functions. Even though such schooling was determined long ago, it may be correlated with unobserved endowments that are included in the disturbance term in most estimates, with the result that the estimates of the schooling impact are biased.

Fifth, governmental policies affect human resource investments and outcomes related to poverty primarily though prices, community endowments, and taxes and transfers. Policies that act through prices include free or subsidized provision of health services, food, and schooling, as well as policies affecting wages. They also include any other policies that affect any of the prices on the right-side of 1.2.3, such as fertilizer subsidies or import tariffs and import quotas (for a household firm/farm model). Policies may alter community endowments through public work programs and disease control; to the extent that individuals can change the relevant community endowments through migration, however, the endowments are endogenous. Likewise, governmental allocations of some services may be shaped by community endowments; there will be biases in estimates of the impact of the services

---

23 In a true reduced form all of the right-side variables are exogenous or predetermined. A quasi-reduced form or a conditional demand function can be obtained by solving the reduced form for one endogenous variable (in this case, income) in terms of exogenous variables (in this case, the set of exogenous variables that affect household farm/firm revenues), and then using this relation to substitute for the exogenous variables in another reduced form (in this case, those for health and nutrition). The result is a quasi-reduced form in terms of some exogenous and predetermined variables (in this case, prices and assets related directly to consumption) and the endogenous variable introduced through the substitution (in this case, income).
unless there is control for these endowments. For example, if malaria is worst in swampy areas, and governmental antimalarial programs are concentrated in swampy areas reduce but do not eliminate malaria, estimates that do not control for swampiness may indicate a negative effect of governmental antimalarial programs on malaria (or underestimate their positive effect).24

Sixth, the reduced forms allow considerable substitution in the use of goods and services and time of household members in response to changes in the right-side variables. This includes the technical substitution among inputs in the health and other household production functions, but additionally 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.

Seventh, different individuals in the same household may be affected differently by an exogenous change in prices or endowments. Therefore analysis at the household level of aggregation may not be very informative about what happens, for example, to infant girls. On the other hand, targeting of nutrients or other health-related inputs to particular individuals may be very difficult if resources are fungible within the household.

Eighth, in empirical applications such as estimation of household production functions, correct specification of lag structures may be important. For example, investment in children's health may be undertaken partly because of the expectation of labor market returns when the children become adults. If so, some representation of the exogenous determinants of expected returns needs to be included among the right-side variables in the reduced-form relations.

Ninth, if enough structure is imposed on the underlying relations, there may be restrictions on the reduced-form coefficients. For example, consider the situation in which all households receive subsidized food rations that they cannot resell in the open market. Then the households can be classified into three groups: those that buy their entire food ration and buy more food in the open market, those that buy just the rationed amount, and those that buy only a part of their ration. If there is a small increase in the ration allotment, the first type household has just an income effect, the second buys just the increased ration, and the third is unaffected. Thus, the same change in the exogenous ration produces different responses in these three household groups because of the preclusion of resale of the rationed food. Either the resale preclusion needs to be included in the reduced-form relations

---

24 See for example, Rosenzweig and Wolpin (1986).
explicitly, or relations of the three household groups need to be estimated separately if the impact of ration changes is to be explored.\textsuperscript{25}

Tenth, the reduced-form relations mentioned above are consistent with expected utility maximization, with risk neutrality. If there is risk aversion in a multiperiod framework, expected values of exogenous variables and higher moments might enter into these relations. To my knowledge, however, no one has included such considerations in empirical studies of human resource-poverty relations.

Although the household production and reduced-form demand functions are conceptually the cleanest to interpret, not infrequently hybrid relations with both reduced-form variables (such as predetermined income, prices) and endogenous production function variables (such as optional health-related inputs) 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{26}

\textsuperscript{25}This example was suggested originally by T.N. Srinivasan and is presented in Behrman and Deolalikar (1988b). However in most studies such structure is not imposed, so a reasonable research strategy may be to allow fairly flexible reduced forms as an approximation of the true relation.

\textsuperscript{26}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, which is then used as an instrument for a simultaneous estimation. This is the quasi-reduced form or conditional demand function approach discussed above with regard to the second point after relation 1.2.3. However this is not a common procedure (and, in fact, has no obvious advantage since it requires the same information as the estimation of the reduced forms).
2. MEASUREMENT ISSUES

The primary concern of this paper is the nature of empirical relations between human resources and poverty and among various human resources. Section 1 points to a number of apparently important variables. The discussion in Subsection 1.2 emphasizes that some possibly important variables, in particular some of the individual and community endowments, may not be observed at all, which may cause biases in estimates of the impact of some of the observed variables. In a sense, this might be an extreme example of a measurement problem that limits relevant empirical analysis. Many studies ignore this problem, and consequently may have omitted variable biases as a result. A few studies attempt to control for it by using panel data or sibling data. These studies, as discussed in some detail in Sections 3 and 4 below, suggest that the failure to control for such unobserved endowments often causes considerable biases.

But aside from the extreme measurement problem due to the lack of direct observations on variables such as the endowments, there are a number of other measurement problems with variables, including indicators of poverty and human resources, which the relevant literature usually treats as observed. I briefly discuss some of these problems here as background for the survey of relevant studies found in Sections 3 and 4.

2.1 Measurement Problems Regarding Poverty

Despite efforts to define poverty objectively, operational definitions ultimately depend on value judgements as to what constitutes such inadequacy of command over resources as to constitute a state of poverty. It would not be very fruitful to review here the various debates on the nature and measurement of poverty.

But I believe it useful to emphasize that the empirical determination of who is experiencing poverty is not a trivial matter. This is so because the various proposed indicators are not necessarily highly correlated. Glewwe and van der Gaag (1988) illustrate problems of correlation in a provocative study of proposed poverty indicators in the data collected by the World Bank's Living Standard Measurement Study (LSMS) survey for the Côte d'Ivoire. They focus on household indicators of poverty, but they acknowledge that individual indicators would be preferable for some purposes. They argue that the best indicator is household consumption per equivalent adult, even though this indicator ignores the value of leisure.27 They investigate the extent to

---

27I also note that this indicator ignores the value of children or, more precisely, indicates that, ceteris paribus, a household is poorer if it chooses to consume part of its income in the form of more children than if it consumes such income in other ways.
which this indicator places the same households in poverty as other indicators do. They ask to what extent the 30 per cent of households designated as poorest by this indicator overlap with the 30 per cent of households identified as poorest by other indicators. The results are striking. In terms of per capita household consumption, the overlap is considerable -- 26.1 per cent of the households in urban areas and 26.4 per cent of the households in rural areas. But for all of the other indicators except per capita food consumption, the overlap is less than two-thirds. These include (with the overlaps indicated in parentheses first for urban and then for rural areas) household consumption (17.7 per cent, 19.9 per cent), per capita income (16.8 per cent, 17.7 per cent), food share of expenditures (14.2 per cent, 10.2 per cent), adult schooling attainment (13.4 per cent, 11.2 per cent), agricultural land per capita (n.a., 11.9 per cent), per capita housing area (13.3 per cent, 7.6 per cent), child weight-for-height (9.0 per cent, 9.6 per cent), and child height-for-age (8.7 per cent, 10.8 per cent). Note that for income the overlap is less than 18 per cent, which suggests that households adjust to substantial transitory income fluctuations through savings and dissavings.28 Note also that the associations between the poverty measure preferred by Glewwe and van der Gaag and indicators of human resources are relatively low (and not even statistically significant for the anthropometric measures).29 Thus Glewwe and van der Gaag emphasize the importance of survey data having good information on consumption so as to help identify households in poverty; they contend that other indicators do not identify such households as well.

A number of other studies suggest that the phenomena emphasized by Glewwe and van der Gaag are widespread. For example, Walker and Ryan's (1990) examination of transitory and permanent income in rural south India indicates that the transitory variations are relatively large, so data on cross-sectional annual income do not adequately reflect variations in permanent income or in consumption that depends on permanent income. Also, the correlations among income, consumption, and human resource indicators generally are far below one for the studies surveyed below in Sections 3 and 4. These results suggest that the Glewwe and van der Gaag conclusions probably are not particular to their sample, but hold for most other samples as well.

28 Note that this implies that liquidity constraints are not so severe as to preclude maintaining substantial consumption during periods of decreased income.

29 Since nutrient intakes are usually considered good indicators of poverty, it is unfortunate that Glewwe and van der Gaag are not able to include them in their study (since data are not available).
If the Glewwe-van der Gaag study’s results hold for other populations, do they vitiate most efforts to explore the relations among human resources and poverty? I answer with a qualified no. On one hand such results suggest that it is more difficult than generally assumed to identify from statistical data who lives in poverty; that many of the normal indicators are not very good identifiers of the impoverished; and that income and human resources in particular may not be very good indentifiers of the poor. On the other hand, the purposes of this survey may not require clear identification of those in extreme poverty. For the purpose of this study we need to know about the ongoing interrelations among human resources and variables such as low wages, expenditure and income that are associated with poverty. Since the poverty cutoff depends on value judgments, the assumption of continuity in the relations between those in poverty and the near-poor does not seem strong. Estimates of the interrelations between the human resources of the poor and their command over other resources probably are informative for this survey, although attention to possible non-linear effects is warranted, particularly since the poorest of the poor generally are underrepresented in data sets. The Glewwe-van der Gaag results demand care in interpreting income effects, since they may have large transitory components whose apparent impact on expenditure may be disguised considerably by savings and dissavings. To the extent that there are random measurement errors in current income variables, it may be preferable to use expenditure data or instrumented (estimated) income to represent income effects. That could reduce the underestimation of income effects due to random measurement error in reduced-form determinants of human resources.

There also may be systematic errors in income measurements. If there are systematic components that understate the income of the poor because of the omission of in-kind income such as that derived from hunting and gathering, there is a systematic underestimate of income effects. To lessen some of these problems, some studies use expenditure data instead of income data, or use some longer-run income measures. But while such data possibly compensate for random measurement errors, it is not clear that they eliminate systematic measurement problems. Expenditure data, for example, may not adequately represent income obtained from activities such as hunting. To the extent that such activities are associated with skills and knowledge not well-represented in data sets, the systematic measurement errors are not eliminated by averaging or using instrumental variables to obtain longer-run income measures.

---

30 Some of these individuals, for example, do not have permanent residences. Surveys based on random samples of residences, therefore, tend to underrepresent them.
2.2 Measurement Problems with Human Resources

The usual emphases of studies of human resources are on education, health, nutrition, and other health-related inputs. While some proxies are available for those variables in the data sets used for the studies that are surveyed below, measurement errors probably are common. I first discuss a general problem pertaining to the measurement of the quality of human resources, and then turn to other issues more specific to each of the major human resources.

As is well-known, if measurement errors are distributed randomly for dependent variables, they do not distort estimates. But if they are distributed randomly for the right-side variables, they cause a bias towards zero in the estimated coefficients. However, the presumption of random measurement errors may be strong in many respects. A major cause of measurement errors, for example, is that indicators of qualities are not available or are fairly limited. The social scientist may know that an individual attended primary school or had access to a local clinic, but not know, or only know imperfectly, the quality of the services provided by the institutions. As argued in Subsection 1.2 above, the quantity of a service demanded often is associated positively with its quality. Therefore the lack of information on service quality is likely to cause a systematic measurement error, not a random one. If the observed indicator of the quantity of the service (e.g. years of schooling, number of medical treatments) is positively associated with the unobserved (to the social scientist, but observed to the individuals in the sample) service quality, the estimated demand for that service is likely to have biases towards zero in the coefficients of the right-side variables and the demonstrated impact of that service on outcomes is likely to be biased. For example, suppose that in response to an increase in household income there is a decision to increase investment in the schooling of children, partly by extending their years in school but also by improving the quality of their schooling (assuming that schooling quality is a choice variable). Then the estimated elasticity of the demand for schooling with respect to household income is downward biased if years of schooling is used as the dependent variable without control for schooling quality. For another example, suppose that schooling quality is not a choice variable. The years of schooling demanded, within the human capital investment framework outlined in Subsection 1.1, is positively associated with the (unobserved) schooling quality. Therefore estimates of the impact of years of schooling on subsequent outcomes (for example, the value of time; health; nutrition) are likely to be upward-biased because of failure to control for schooling quality.

One last point concerning measurement error relates to the use of deviation estimates to control for unobserved fixed effects. Commonly used deviation estimates include differences between siblings (or other household or community members), or changes over time. Such deviation estimates, as is well known, increase the bias towards zero due to random measurement error. But what often is not appreciated is that if there is systematic measurement
error among the variables being differenced -- for instance, error due to the
failure to control for the quality of human resources in deviation estimates
for siblings who experienced similar qualities of such resources -- the bias
towards zero may be greater for the standard estimates than for the deviation
estimates (see Behrman 1984).

2.2.1 Measurement of Health Status

Health status is not directly observed by social scientists.
Representation of health status in micro empirical studies generally is by:
(i) clinical measures of bodily attributes, (ii) anthropometric measures
(e.g., height, weight, triceps skinfold thickness, arm circumference), (iii)
respondents' reports of disease symptoms, mortality histories, and health
evaluations, and (iv) reports of loss of capacity for normal activities.
Representation of health status in aggregate estimates usually is through life
expectancies or mortality rates. These measures differ significantly in their
collection costs and measurement errors. They also refer to different
dimensions of health status, rather than unidimensional constructs, so
measurement error may depend on the aspect of health status under study.

The four cited categories of micro health status measures are indicated
above in order of generally decreasing data collection costs. Rarely do
significant socioeconomic data sets have clinical health-status measures, due
in part to the collection costs. Anthropometric measures are somewhat more
common, but still relatively rare, again due in part to collection costs. More
common than clinical or anthropometric data are the self-assessments (or
reports on other individuals, such as children) for the last two categories,
for which the collection costs are about the same as for other respondent-
reported socioeconomic census or survey data. Although some measure of health
seems increasingly common in socioeconomic surveys, most existing
socioeconomic data sets include little or no representation of health status.
Conversely, in most health-oriented data sets, data on socioeconomic variables
needed to estimate relations such as discussed in Section 4 below are limited
or nonexistent. Wage rates, for example, often are not collected, so it is
difficult to represent the value of time. Tradeoffs obviously exist among
sample size, data completeness, sample variance and accuracy, but many
existing data sets lack the balance needed for analyzing the interactions
among human resources and poverty.

There are probably fewer measurement errors in the first two categories
than in the others, although such errors are unavoidable even for clinical
readings and anthropometric measurements. Moreover, the relation between
accurately measured bodily attributes and health status probably is looser
than often presumed, and may be culturally determined (Low, 1984). Further,
the anthropometric measures and some of the other measures of bodily
attributes often are interpretable as indicators of health status only in
comparison with some reference group, but such comparisons raise questions
about appropriate standards. Some studies use sex/age standards defined from
the sample data themselves, which permits comparisons within the sample but
not indications of health status relative to other populations. Other studies use the sample statistics from supposedly healthy populations, such as healthy individuals in industrial market economies, although the tendency in recent years has been to develop standards for populations similar to those under study. But the use of standards such as those based on industrial market-economy samples raises the question, for example, of whether European height and weight distributions indicate desirable standards for Asians, Africans or Latin Americans. The answer may depend on the time period of reference. Fogel (1987), for instance, argues that for a given adult height, there is a range of healthfulness reflected in the body mass index (BMI, weight/height$^2$), which may be described by a U-shape for mortality and morbidity (the Waaler, 1984, curve). In the context of BMI, the use of reference standards for height and weight may overstate health problems of contemporary adults in the developing countries. But Fogel also argues that from a longer-run viewpoint European height standards are appropriate since only when Europeans grew to such heights did their mortality and morbidity decline and their productivity increase to current levels. In a shorter-run analysis, McGuire and Austin (1987) argue that a relatively short adult population reflects traits that lead to high mortality and morbidity among children.

The use of European standards, even if misleading with regard to the incidence of malnutrition or health problems, may not be misleading regarding the determinants of health or the impact of health on various outcomes. If, for example, the reference used were always exactly 120 per cent of the appropriate standard, its use would not cause biases in estimates of elasticities. On the other hand, if the difference between the standards used and the appropriate standards varies systematically with sex or age and if other observed characteristics in the estimated relations are associated systematically with sex or age, the coefficients of such characteristics could be biased by the standardization procedure. Moreover, for relations that explore the impact of health, even if the standardization error is random across sex and age categories, it tends to bias the estimated health impact towards zero. Further, regardless of what standards are used, there is a question for multivariate regression analysis (as opposed to characterizations of health status) of whether the marginal relations between such indicators and true health status are captured by the functional form used in regression analysis, e.g., constant over the range of observations in the linear case, as often is assumed in such analysis. That is, is someone at 160 per cent of the weight standard twice as well off as someone at 80 per cent of the standard? The answer would seem to be negative. Finally, seasonality in health (and nutrients) may result in biases in measured health status if it results in disproportionate measurements in "good" seasons when the normally isolated poor are more accessible, as suggested by Chambers, Longhurst and Pacey (1981) and others.

Respondents' reports are subject to better-known measurement errors due to incorrect self-diagnosis of health status and to recall errors (e.g., Butler, et al. 1987, Glewwe and van der Gaag 1988, Haaga 1988). Such diagnoses may be conditioned, for example, by education, as suggested by the
results presented by Wolfe and Behrman (1984) and Haaga (1988), or by culture, as emphasized by Low (1984). What is "normal" or "good" health in Chad or Haiti might not be normal or good in Hong Kong. Moreover, within a given culture, some of these responses are likely to be conditioned by socioeconomic status. Whether one is healthy enough to perform normal duties, for example, is likely to be endogenous, so that an individual with a given objective health status is more likely to try to perform normal activities if he or she is from a poor household than if he or she is from a richer household, due to diminishing marginal utility of commodity consumption relative to leisure. If so, self-assessments underestimate the extent of health problems among the poor, understate the health improvements that occur with income gains, and probably cause biases in estimates of both the determinants of and impact of health.

These problems with the micro representations of health status point to caution regarding their use. Since such health indicators are inherently imperfect, these problems also suggest benefits from using a multiplicity of them to represent health status in empirical analysis. Studies by Wolfe and Behrman (1984, 1988), Behrman and Wolfe (1987a), Behrman (1988b) and Behrman and Deolalikar (1988a) are recent examples in which this strategy has been followed in analysis of health in developing economies, using latent variable representations of unobserved health status with a number of imperfect indicators. The results suggest that the latent variable representation of health status may lead to an understanding of the determinants of and role of health different from the understandings derived from many of the frequently used anthropometric and respondent-reported indicators of health status used in isolation. Such results, of course, are conditioned by the model specifications and the available health indicators, so further investigations with different health indicators for different populations might be useful.

For aggregate studies, as noted above, the most commonly used basic indicators of health status are life expectancies (particularly at birth) and mortality rates (particularly for infants and children). These data are constructed from census and survey micro data and standard demographic procedures. While health status is related positively to life expectancy rates and negatively to mortality rates, the relationships are not likely to be perfect. For given life expectancies it is easy to conceive of very different levels of health, deriving from very different morbidity experiences. It would be of value to explore the associations between these aggregate indicators of health status and micro indicators such as those discussed above, but I am unaware of any such explorations.

2.2.2 Measurement of Nutrient Intakes

There is some ambiguity about what is meant by nutritional status. Some use nutritional status to refer to nutrient intakes and others to refer to anthropometric and clinical measures. If indeed anthropometric measures have many non-nutrient determinants, such as water supply, individual and household endowments, community endowments, time devoted to health-related activities, health-care inputs related to preventative and curative medicine, and
education, then the latter usage seems misleading. Why should only some of a multitude of inputs in the production of anthropometric measures be characterized as representing those measures? In fact if nutrient intakes are allocated to compensate for endowment differentials and such compensation is strong, nutrient intakes may not closely correlate with anthropometric or other health outcomes. Though it is primarily a matter of definition, therefore, in what follows I use "nutrient intake" or "nutrients" instead of "nutritional status" to refer to nutrient inputs, and I attempt to avoid the term "nutritional status."

There are several measurement problems for nutrient intakes. One reflects the use of fixed conversion factors for food with heterogeneous nutrient qualities. There is substantial heterogeneity in nutrient quality among foods defined as narrowly as "rice." Yet in some studies fixed nutrient-to-food conversion factors are used at much more aggregate levels, such as for grains or meats. This practice may lead to substantial misrepresentation of the impact of changed income on nutrient intakes. Shah (1983) and Behrman and Wolfe (1984a) hypothesize that nutrient elasticities with respect to income calculated by applying fixed conversion factors to aggregate food group elasticities may overstate substantially true nutrient elasticities since, for marginal food expenditures, other food attributes -- taste, appearance, status value, degree of processing -- may be much more important than nutrients. A number of recent estimates are consistent with this hypothesis (see Subsection 4.2 below).

A second nutrient measurement problem is that certain critical data are available only on, or at least used only on, an aggregate level. Most striking in this regard are the studies, such as those by Reutlinger and Selowsky (1976), and Berg (1981) that characterize malnutrition for large groups of people based on a comparison of their estimated nutrient intakes with average nutrient requirements. Such studies fail to recognize that there are distributions of nutrient intakes and requirements so that even if the mean intake meets the nutrient standard, there are likely to be substantial numbers of individuals above and below the appropriate standard. Clearly a report of average food intakes may misrepresent whether or not many members of a given developing country group meet the nutrient requirements. While there obviously is such a problem with aggregate data for nations, regions, or other large groups, there also may be a problem on a smaller scale for many micro data sets. Such data usually refer to total household nutrient intakes, but there appear to be substantial intrahousehold variations in nutrient intakes in the relatively few data sets that have such measures (see Behrman and Deolalikar 1988a, Behrman 1988a,b, Bouis and Haddad 1989a, Harriss 1987, Horton 1986, 1988, Garcia and Pinstanp-Andersen 1987, Pitt and Rosenzweig

---

31 For evidence that such compensation is quite strong, at least in the relatively surplus season in rural south India, see Behrman (1988a,d).
1990, Pitt, Rosenzweig, and Hussain 1990 and the references therein). Of course the data on individual nutrient intakes probably have considerable measurement error, which may be systematically associated with characteristics such as age or the level of education of the respondent. Therefore, such data may only give rough indications of true nutrient distributions within households.

A third measurement problem relates to the relevant level of energy expenditure. Beaton (1983) claims, for example, that the major difference in aggregate estimates of the extent of malnutrition — that vary by a factor of almost three — is in the criterion of adequate energy intake: whether inadequate energy intake means an intake that is too low to meet even maintenance needs (FAO standards) or a higher level of activity (FAO/WHO committee recommendations).

A fourth set of measurement issues pertains to defining nutritional "norms," "requirements" or "standards," and therefore "malnutrition." Such definitions are important in assessing the nature and extent of malnutrition in the developing world and in analyzing the determinants of and the impact of nutrition. Payne and Cutler (1984) distinguish between two paradigms for defining nutrition requirements.

(1) The "genetic potential model" assumes that the body is self-regulating and self-optimizing; that the "optimal" diet depends on inherent genetic characteristics that differ among individuals; that the "optimal" diet for given genetic characteristics may be determined from the diet of those whose food choices are unconstrained in well-fed populations; and that malnutrition may be measured in a straightforward manner by shortcomings in comparison with such "optimal" diets. Estimates of calorie deficiencies based on this approach suggest massive malnourishment in the developing world.

(2) The "individual adaptability model" assumes that individuals adapt to their environments, with differences in their capacities to adjust to environmental stresses and in the efficiency with which they convert food to energy; substantial intrapersonal and interpersonal variations; productivity dependent on nutrition as well as vice versa; and no fixed optimal levels. Adaptation includes shorter-run adjustment to variations in energy intakes and expenditures around unchanging means (homeostasis) and longer-run adjustment to changed means through altered body weight. The term "nutrient requirements" has a much less precise meaning within this paradigm than with the genetic potential paradigm since there is no true optimum. The nutrient intakes of healthy Europeans, the standards used in many studies, are not obviously appropriate standards for all populations. There is the

32Partly due to genetic differences, but also due to the accumulative effects of past adjustments.
implication, therefore, that malnutrition estimates based on the genetic potential paradigm are likely to be substantially overstated because of their failure to recognize individual adaptability.

Empirical evidence to distinguish between the two paradigms is very limited. Sukhatme (1977, 1982), Srinivasan (1981, 1985, 1990), Payne (1975, 1990), and Seckler (1980, 1982) interpret limited evidence to support the notion of individual adaptations to the nutritional situation, although in many cases sample sizes are quite small and not obviously representative. If such adaptations do occur even on a limited basis, their existence raises questions about the use of international standards for characterizing the extent of malnutrition and, as Srinivasan has emphasized, the identification of malnourished segments in a population (see the fifth problem discussed below). Which paradigm is appropriate, however, would seem to depend in part on the time horizon, as in the discussion above about health standards. For an adult of short stature and a given activity level, the best nutrient intake well might be below standards for northern Europeans (in fact the Waaler 1984 curves for BMI and mortality suggest that on the average it is). This seems consistent with the emphasis on adaptability. From a longer point of view, however, it might be better in terms of mortality and morbidity if individuals in developing countries had more lifetime nutrition so that they were taller, in line with the genetic potential paradigm.

Errors in establishing requirements may, or may not, cause biases in our understanding of the impact of nutrients and in the determination of nutrient intakes, parallel to the discussion in Subsection 2.2.1 about standardizing health status indicators for age and sex.

A fifth measurement problem pertains to the length of the observation period for micro nutrition data. Observations of nutrient intakes in micro data sets typically are based on fairly short measurement periods -- a day or a week -- because of the high cost of collecting such data for longer periods. The use of short recall periods probably lessens recall measurement errors. On the other hand, if a person's nutrient intakes vary substantially, data for a short period may be very misleading as to the extent of actual malnutrition. One respect in which the data may be misleading is that observations may not be random over seasons, but concentrated in good seasons due to greater accessibility of the subjects to the researchers. Such seasonality probably tends to result in upward biases in the characterization of nutrient intakes of rural residents. Another respect in which variations in an individual's food intake, and short time periods of observation may lead to substantial

---

33 This assumes that good seasons in which subjects are more accessible to researchers also are good in the sense of relatively great nutrient availability. Such an assumption seems plausible to the extent that both senses of "good" depend on transportation ease.
overestimates in the extent of malnutrition may be seen in the following simple example. Assume that the nutrient requirement of each individual is an average of 2400 calories per day, that each individual has average daily nutrient intakes of 2400 calories, and that there is random variation in daily nutrient intakes that are normally distributed with a standard deviation of 300 calories per day and independent across persons. In this situation a survey of caloric intakes on a given day will indicate that on that day half of the population consumes less than the longer-run requirement. But it would be wrong to deduce that half the population is malnourished in a longer-run sense since by assumption no one is malnourished. Yet frequently estimates are made of the extent of malnutrition, and of the extent of poverty, by counting all the individuals who are below the nutrient standards in such a fashion (see Dandekar and Rath 1971, Bardhan and Srinivasan 1974, Greer and Thorbecke 1986, Kakwani 1987). Sukhatme (1977), for example, calculates that the incidence of poverty in India declines from 50 to 25 per cent in urban areas and from 40 to 15 per cent in rural areas if allowance is made for variations in individual calorie requirements instead of using a poverty line based on average calorie requirements. Dasgupta and Ray (1986) and Kakwani (1987) have tried to reverse the spirit of Sukhatme's calculations by asking what the probability is that the observation that an individual's nutrient intake in a short period of time is below the requirement by a certain amount could be drawn from a distribution the mean of which is at or above the requirement? But it is difficult to conclude much about the longer-run extent of malnutrition from the available information on the distribution of nutrient intakes for a short period of time if intrapersonal variations in those intakes are large (and even more so if there is individual adaptability in such requirements). And, as the above example shows, some widely-used procedures may overstate vastly the extent of malnutrition and poverty. Repeated observations on nutrient intakes of poor individuals over longer periods are needed in order to address the intrapersonal variability issue.

A sixth measurement problem concerns the difference between nutrient acquisitions by a household and nutrient intakes by household members. As Bouis and Haddad (1989a) emphasize, such a difference may be considerable and may be associated systematically with income. The sources of this difference include food provided to workers and guests and preparation and plate wastes. If there is not control for food uses, the nutrient intake-income relation may be overstated considerably (see Subsection 4.2).

2.2.3 Measurement of Education

The biggest problem with measured schooling in micro data sets may be that years or grades of schooling are reported, but usually not the schooling quality. This may cause biases such as those discussed at the start of this section. Another problem that may be serious in a number of developing countries is that the reported grades of schooling, or even worse, completed levels of schooling, may substantially underestimate the time and resources spent on schooling if there are significant dropout and repetition rates. If education is interpreted more broadly than formal schooling, then typically
the measurement problems increase substantially with regard to the same basic issues: the representation of quality and of time and other inputs. Tying together all of these problems is the usual lack of observations on true educational output, rather than input measures such as time in schooling.

On an aggregate level, often adult literacy rates are utilized to represent education. On the positive side, these at least purport to be outcome rather than input measures, though even on this level other outcomes (e.g., numeracy) also may be relevant. Also, of course, there are well-known problems about what level of literacy at what time is required for a person to be characterized as literate. Further, particularly beyond initial economic development, what may be important is the extent of skills beyond basic literacy rather than just literacy.

2.3 Measurement of Other Important Variables

Other important variables in the analysis of the interactions among human resources and poverty include other direct determinants of health (see relations 1.2.1 and 1.2.3): those aspects of consumption that affect health; time use; home and work environment; inherent robustness; knowledge and skills concerning health practices; and market conditions and policies that affect human resource incentives. For the analysis of the impact of human resources, productivity in various activities also must be represented.

While some of these variables are readily observable, there are considerable measurement problems with a number of them. Observations on market prices and governmental policies often are not available, or vary little in cross sections. Even if they are available, they often do not indicate the time costs to users nor the quality of the goods and services. Wage (and therefore income) data often are fraught with measurement error, particularly for the poor because of the irregularity of their income and transfers and because often significant proportions of wages and transfers may be in kind. Productivity in various activities may be difficult to observe, particularly for non-wage activities. Time-use data, while increasingly available, often do not identify very well some of the time uses that are most likely to be associated with health and informal education. Joint production, such as combining child care with food preparation, further limits the usefulness of time-use observations. Data on knowledge and skills related to health practices are usually scarce. Usually data on household and work environments are quite limited at best, as are data on inherent healthiness and motivation. Quite often lagged variables are not available, so it may be very difficult to estimate processes with long gestations.
3. IMPACT OF HUMAN RESOURCES ON INCOME OF POOR PEOPLE

One major topic of this review is the extent to which investments in human resources affect poverty, or rather reduce poverty. In this section I review some recent studies on the effect of human resources on wages, earnings, income, or labor productivity, and thus on poverty. I first consider the impact of schooling since that is the most studied human resource investment. I then turn to the impacts of health and nutrient intakes.

3.1 The Impact of Schooling on Poverty

The major direct effect of schooling on reducing poverty is in increasing labor productivity, and thus increasing incomes and reducing poverty. I consider this topic first. Then I consider the impact of schooling on household productivity, increases in which may reduce poverty indirectly.

3.1.1 Schooling Impact on Labor Productivity

Surveys by the World Bank (1980, 1981), Colclough (1982), Psacharopoulos (1985, 1988), Eisemon (1988) and others emphasize strongly the critical role of schooling in increasing labor productivity, as well as other effects. In part because of these and earlier studies, there have been considerable resources devoted to schooling in recent decades in developing regions. For example, the mean of the years of schooling of a synthetic cohort in developing countries for which data are available increased by the considerable increment of two-thirds between 1960 and 1981, according to calculations in Behrman (1987c). Numerous studies have attempted to understand the determinants of investment in schooling, and many other studies have sought to estimate the private and social rates of return to schooling. The latter studies generally find that the returns are fairly high, particularly for primary schooling.

The standard procedure for estimating the economic rate of return to schooling has been to start with the correlation between earnings and years of schooling (usually controlling for work experience) from cross-sectional data, which gives an estimate of the private rate of return to the time spent in school. Then adjustments are made for other costs such as the time of teachers and the costs of school books and buildings, in order to obtain an estimate of the social rate of return to investments in schooling.34 Of

34 Note that these social rates do not include externalities, which usually are assumed to be positive for schooling. If they are positive, the standard social rates of return are underestimates of the true social rates. Birdsall (1988b) argues that ignoring externalities causes underestimates of the social rates of return particularly to some higher schooling levels. Also note that the usual procedure does not measure productivity effects of schooling unless an assumption is made that productivity is proportional to earnings (or wages). There are some direct estimates of productivity effects, particularly in agriculture (see Jamison and Lau, 1982).
course, for the purpose of estimating the impact of schooling on alleviating poverty, the private rates of return may be more important than the social rates of return (at least given the way the latter usually are calculated).\textsuperscript{35}

The World Bank (1980: Table 5.4) summarizes such social rates of return to schooling. These rates of return tend to be high, particularly for primary schooling. For all developing countries, the average estimated social rates of return are 24.2 per cent for primary schooling, 15.4 per cent for secondary schooling, and 12.3 per cent for post-secondary schooling. The estimated social rates of return for primary schooling suggest an attractive investment opportunity.\textsuperscript{36} They also suggest that schooling is likely to reduce poverty, since the returns are highest for the lower schooling levels (and the private returns exceed these social returns) and the extension of primary schooling is likely to benefit primarily poor children.

But correlations do not necessarily demonstrate causality. One possible problem with the standard estimates is that the returns attributed to schooling by a cross-section study may reflect in part high scarcity returns to a few more-educated individuals -- an element that may not persist if there is an increase in the number of more highly educated individuals due to increased investment in schooling. The estimates of the World Bank (1980) present some evidence relevant to this possibility. The comparison across the country groups is a comparison among societies in which the degree of scarcity of highly educated individuals varies substantially, being great in the low-income countries, and small in the industrial countries. The estimates across these country groups decline as one moves from the lower to the higher per capita income groups: for primary schooling, from 27.3 per cent for low-income countries to 22.2 per cent for middle-income countries; and for secondary schooling, from 17.2 per cent in low-income countries to 14.3 per cent in middle-income countries to 10.0 per cent in industrialized countries. While such declines suggest that cross-sectional country estimates may overstate the expected returns from schooling investment in developing countries over time due to the difference between cross-sectional and dynamic results, the changes across the country groups are not so great to make this a

\textsuperscript{35}If there are externalities to schooling of the sort emphasized by Romer (1986), Lucas (1988), and Azariadis and Drazen (1990), investments in the schooling of those who are not so poor may increase the productivity and incomes of the poor. See Section 6.2. There also may be similar increases in the incomes of the poor due to investments in schooling of others if the time of the poor in production is complementary (and not a substitute) for the time of others in production, even if there are no externalities.

\textsuperscript{36}This argument may be reinforced by reference to similar positive associations between schooling and outcomes such as nutrition and health and negative associations with outcomes such as fertility and infant and child mortality (e.g., Colclough 1982, World Bank 1981, Eisemon 1988).
major qualification. The small scarcity effect may reflect the fact that both
the supply of, and the demand for more highly educated individuals expand
substantially in the process of development.

There are a number of other possible pitfalls in the standard estimates
of the returns to schooling: the failure to control for family connections,
ability and motivation that may affect schooling and earnings, leading to an
exaggeratedly positive correlation between schooling and earnings; the failure
to distinguish between the years (or quantity) of schooling and the quality of
schooling; the failure to control for geographical aggregation biases (such as
regional price variations, or the blending into single samples of poor areas
with limited physical capital and low schooling together with better-off areas
with extensive physical capital and high levels of schooling -- for example,
Northeastern and Southeastern Brazil, Assam and Kerala in India, Lagos and
northern Nigeria); the failure to control for school dropouts and class
repeaters; and the failure to control for unobserved household and community
variables. Most of these long have been recognized as possible problems in
the standard estimates of the return to schooling. But whether or not they
are serious problems is an empirical question, and data and procedures
suitable for exploring their importance in developing economies have not been
available until recently.

In the past several years there have been a series of micro studies of
whether the standard estimates of the returns to schooling in developing
countries are subject to substantial biases for reasons such as those
mentioned above. These studies have been mostly based on special procedures
and/or special data; I now briefly review some of them.

Behrman and Birdsall (1983, 1985) explore the incorporation of schooling
quality into the standard analysis for males in Brazil. The basic notion of
this approach is discussed in Subsection i.1. The solid downward sloping line

37 Over a decade ago Griliches (1977), in a survey on estimated returns to
schooling, concluded that empirical biases in standard estimates are not
particularly large. However his survey did not include studies from the
developing countries, nor all of the possible biases that I discuss below, nor
any of the studies that I summarize below (all of which were undertaken well
after Griliches' survey). Moreover his empirical evaluation depreciating
sibling control for unobserved childhood background variables (see the Behrman
and Wolfe (1989) study reviewed below) is based on work with Chamberlain
which, while methodologically important and interesting, depends on peculiar
samples. In Chamberlain and Griliches' (1977) own words, one study was based
on a sample that is "rather odd and nonrepresentative" and another represents
earnings by "median earnings...in the occupation expected (desired) at age 30"
as reported at about age 20. For such reasons it seems inappropriate to
conclude from Griliches' survey that there are not substantial biases in
standard estimates of the rates of return to schooling in developing
countries.
in Figure 1.1 gives the demand for schooling for a particular individual, given the quality of schools provided by the government. Were poorer quality schooling provided, the same individual's demand for schooling would be lower, as indicated by the dashed line. This simple consideration has two important implications. **First**, for a given level of schooling (say, \( H^* \)), the rate of return to years of schooling is a positive function of the schooling quality (\( r^{**} \) for the dashed demand rather than \( r^* \) for the solid demand); therefore if schooling quality is important it should interact multiplicatively with years of schooling. **Second**, if the marginal cost of funds is not vertical, individuals (or their parents) who maximize invest in more years of schooling if quality is higher (\( H^* \) instead of \( H^{**} \)), so there is a positive association between an individual's years of schooling and schooling quality; therefore, if schooling quality is important, the failure to include it in standard estimates results in an upward bias in the estimated return to years of schooling since this estimated rate of return incorporates in part the return to schooling quality.

In this Brazilian sample, using the standard procedure and the Mincerian (1974) interpretation discussed in Subsection 1.1, the estimated private rate of return to years of schooling is 20.5 per cent, about the same rate indicated in studies by the World Bank (1980) and Psacharopoulos (1985). However, statistical tests indicate that the relation is misspecified if schooling quality is constrained to have no effect, as in the usual estimates. Once schooling quality is incorporated into the analysis, the estimated private return to years of schooling falls to 11.0 per cent. This means that if schooling quality is important, as is suggested by these empirical estimates, the standard procedure (which ignores schooling quality) overstates the private rate of return to years of schooling by over 80 per cent. Moreover, within the quality-inclusive model the social rate of return to schooling quality is as high as or even higher than the social rate of return to years of schooling. Further, schooling quality and years of schooling interact; higher quality increases the returns to years spent in school and vice versa. As a result, there is an equity-productivity tradeoff in the sense that there are greater productivity gains for society if years of schooling and schooling quality are concentrated among fewer individuals instead of spread broadly. This in turn implies that there are circumstances in which societies might be better off to extend secondary rather than primary schooling, contrary to the views of Colclough (1982), Eisemon (1988), and the

---

38 Given the predominance of primary schooling in Brazil at that time.

39 Schooling quality is represented by the average number of years of formal education of teachers in the area in which an individual was schooled. The original study discusses at some length the advantages and disadvantages of this proxy for schooling quality.

Behrman and Wolfe (1984b) use special data on Nicaraguan adult sisters to control for unobserved components of ability and motivation deriving from family background by estimating the difference in outcomes associated with adult sisters. The individual endowments (E) treated in Subsection 1.1 as possibly affecting both schooling (S) and subsequent labor market success may be considered to enter linearly in the income/wage/earnings/labor productivity (Y) relations:

\[(3.1.1) \quad Y = aS + bE + \ldots\]

If endowments and schooling are positively correlated, the failure to control for the endowments results in an upward bias in the estimated impact of schooling since schooling in part serves as a proxy for the unobserved endowments. However if the differences in outcomes between the adult sisters are estimated:

\[(3.1.2) \quad \Delta Y = a \Delta S + \ldots\]

then the endowments are controlled to the extent that they originate in the shared childhood background of the sisters, since that shared component drops out. Such control suggests for this sample that, if the true model should have these childhood background variables, standard estimates overstate the economic return to schooling by about 50 per cent.

Boissiere, Knight and Sabot (1985) analyze the impact of schooling in urban Kenya and Tanzania with special data from an urban enterprise-based survey, that permit control for innate reasoning ability and for cognitive achievement. They report that the addition of the cognitive achievement variable to standard earnings functions reduces the coefficient of schooling by about 60 per cent, but that schooling remains significant for the Kenyan sample. They interpret this result as supportive of the human capital theory of schooling, since cognitive achievement is produced by schooling (and by innate ability, among other inputs), and the labor market is primarily

---

40 These estimates also suggest that most of the difference between earnings functions for migrants and for non-migrants in standard estimates disappears if there is control for schooling quality.

41 Which probably results in samples that are not representative of labor force participants because of the underrepresentation of small enterprises. But the comparison of the results with and without the cognitive achievement control still is of interest.
rewarding such achievement. But that still leaves the other 40 per cent of the schooling coefficient in standard estimates. This other 40 per cent apparently reflects other factors, some of which may be produced by schooling -- for example, motivation or positive work attitudes. But some of these other factors, such as family connections, may not be produced by schooling. To the extent these other factors influence the coefficient estimate, standard procedures overstate the social returns to education in their sample by as much as two thirds.

Birdsall and Behrman (1984) observe that the standard cross-sectional schooling rate of return estimates may have an upward "geographical aggregation bias." Geographical bias could reflect the failure to control for migration costs, higher opportunity costs of attending school for children in rural than in urban areas, and simultaneity bias if local resources finance schools and if there is strong intergenerational correlation in income across regions. Such bias also can arise because of failure to control for a number of factors that could be associated positively with schooling, such as regional price differences and differences across regions in concentration of complementary production inputs such as physical capital together with disequilibrium in labor markets across space. Figure 3.1 illustrates this last possibility with reference to two areas, say Belgium and Afganistan, with much different capital stocks. In both areas the marginal effects of schooling are significant, but modest, as indicated by the solid sloped lines. But if the two areas are combined into one "Belgistan" sample for the standard regression analysis there is no control for complementary capital stocks. As a result a regression line such as the dashed one is obtained, suggesting an unjustifiably high estimated return to schooling. When Birdsall and Behrman control for geographical aggregation bias by allowing the parameters in a standard earnings function to be dependent on where an individual was schooled and on where he works, they obtain estimated returns to education for males in Brazil only about three-fifths as high as those obtained for the same data by the standard procedure. Thus their estimates suggest that standard estimates overstate by about two-thirds the true returns to schooling due to the failure to control for geographical aggregation bias.

Behrman and Deolalikar (1988c) combine data from the Indonesian 1986 Labor Force Survey with information on class repetition and school dropout rates in Indonesia, in order to investigate the impact of the latter on time spent in school and thus on the rate of return to school. The basic notion is quite simple; it is that correlating grades or levels of schooling completed with wages is likely to overstate the rate of return to schooling if extra resources are devoted to schooling because of class repeaters or school dropouts (see Subsection 2.2.3). A priori, ignoring repeaters and dropouts

---

42 Though its application in a manner consistent with the Labor Force Survey data is somewhat tedious.
Figure 3.1 Geographical Aggregation Bias in Estimated Schooling Returns Due to Inappropriately Combining Two Regions (Belgium and Afghanistan) with Widely Different Complementary Production Factors into One "Belgistan" Sample
biases upward the estimated rates of return to schooling, though it is an empirical question whether such biases are large enough to be a matter of concern. This study suggests that the biases may be considerable for the lower schooling levels -- in the range of 38 to 114 per cent for subprimary and primary schooling completers -- depending in part upon whether class repeaters and dropouts are distributed randomly among those who enter a particular grade or are concentrated among those who do not move to the next schooling level as seems more likely. The estimated biases are substantial, but much lower for higher schooling levels.

Behrman and Deolalikar (1988f) use the same Indonesian data to explore the impact on estimates of wages, hours worked and earnings, of controlling for unobserved household and community endowments. Arguments for the proposition that household endowments have an effect are that there are shared work ethics and ability levels within a household and that there are shared household environments that may be correlated with schooling levels and that may affect labor productivity and therefore wages. They find that standard estimates that do not control for such possibilities bias substantially upwards the estimated private returns to schooling for the lower schooling levels -- by 29 to 70 per cent for subprimary and primary school completers. Once again the effects are much less marked for higher schooling levels, which Behrman and Deolalikar suspect reflects the fact that those with higher schooling levels tend to come from household environments that are positive enough to overcome marginal differences in schooling, and that persons with more formal education are able to participate in a geographically broader labor market so that regional characteristics are not very important. One other interesting dimension of these results is that they include explicit estimates for wage rates, which are direct representations of the value of time, rather than for earnings or income, which may confuse the availability of labor with the value of workers' time or with workers' productivity. The empirical estimates indicate that the distinction is important, with lower estimated rates of return using wages than using earnings, particularly for the lower schooling levels since hours worked tend to increase more per additional unit of lower schooling than per additional unit of higher schooling (suggesting that the income effect becomes increasingly important relative to the price effect as schooling and income increase).

King (1988) presents selectivity-controlled estimates for the returns to schooling for women in Peru using the 1985/6 LSMS (Living Standards Measurement Study) data. Van der Gaag and Vijverberg (1989) present wage estimates for wage-earners in Côte d'Ivoire using the 1985 LSMS data.\textsuperscript{43} Both studies find that the addition of dichotomous variables for graduation from

\textsuperscript{43} This study does not control for selectivity, so there may be some selectivity bias. However, the comparison on which I focus here does not seem to be distorted by selectivity.
school increases significantly the consistency of the model with the sample experience and reduces the apparent effects of schooling. For the latter study, for example, introducing the control for diplomas reduces the estimated rate of return from 11.9 to 2.3 per cent for elementary schooling, from 20.9 to 8.8 per cent for junior high school, from 20.8 to -3.2 per cent for senior high schooling, and from 22.7 to 20.8 per cent for university schooling (with the estimates for elementary and senior high school not significantly different from zero once there is a control for diplomas). Thus a large part (but not all) of the estimated returns to schooling without the controls for receiving diplomas appears to reflect credentialism.

These recent studies, most of which use special data or special methods beyond those utilized in the standard estimates summarized in World Bank (1980) and Psacharopoulos (1985), indicate that the wage/labor productivity rates of return to schooling are overstated substantially in the standard estimates, particularly for the lower schooling levels. Certainly some qualifications are in order in regard to these results. For one thing, random measurement error in years of schooling may cause a downward bias in the estimated returns to schooling (although, as noted in Subsection 2.2, systematic measurement error, such as not controlling for schooling quality, may cause a substantial bias in the other direction). For another, although some of these studies control for the possible association of schooling with disturbances in the wage/earnings/income relations due to unobserved endowments, most of them do not control for the simultaneous determination of schooling with expected wage rates implied by the human capital model of Subsection 1.1. The absence of this control may cause simultaneity bias in an unknown direction. Moreover, there may be other effects of schooling that indirectly reduce poverty through household productivity (to which I turn next).

These recent studies seem to me to imply that the standard estimates used by the World Bank (1980) and Psacharopoulos (1985) overstate substantially the returns to schooling, particularly the returns to primary schooling in developing countries. In a way, that is hardly surprising, since the mean social rate of return to primary schooling of 24.2 per cent implies that, with reinvestment of the proceeds, the capital stock can be doubled in less than three years, and the higher private returns imply an even shorter period in which the value of an individual's human capital may be doubled through primary schooling.

\[\text{Hausman and Taylor (1981)}\] report, moreover, that for the United States the failure to control for simultaneity may cause a substantial downward bias in the estimated return to schooling, though Griliches (1977) often is cited for an earlier review in which he claims that empirically simultaneity does not seem to be a big problem for U.S. estimates.
This is not to say that schooling investments are not relevant for reducing poverty, but rather that the standard estimates overstate substantially the potential of such investments to do so. And of course it must be remembered that the most important impact of investing in schooling is not immediate, but comes only in adulthood.

3.1.2 Schooling Impact on Household Productivity

In addition to improving directly labor productivity and the value of time an individual spends in economic activities, schooling may improve the situation of those in poverty indirectly by improving household productivity. A person's schooling may have positive effects on health, nutrient intakes, and other health-related activities, as well as on the number of children and their schooling -- all of which might enhance the welfare of those living in poverty. Many researchers associate schooling, particularly schooling of women, with such outcomes in positive ways. To understand such associations, one needs to know what roles schooling plays in the estimates. To what extent, for example, is schooling reflecting better choices of purchased inputs, more productive use of such inputs or is it simply a proxy for unobserved endowments related to ability, motivation, habits, and tastes? Only with such knowledge can one assess the strong advocacy for increased women's schooling in the studies of Cochrane, Leslie and O'Hara (1980), the World Bank (1981), Colclough (1982), Mensch, Lentzner and Preston (1985), Schultz (1988b), and others.

I now turn to the impact of adult schooling on the adults' health and mortality, nutrition and other health-related inputs; and then to the impact on the next generation's schooling and on fertility. The emphasis in the literature is on women's schooling.

Health and mortality: As I explain in Subsection 1.2, there are two types of relations that permit clean interpretations of the impact of schooling on health and mortality: production functions and reduced-form demand relations. And although adult schooling often seems predetermined from the point of view of such relations, there is a real possibility of bias due to failure to take into account the unobserved endowments of ability, motivation, habits, and tastes. However, only empirical estimates can reveal whether any bias is important.

I first summarize several studies of health and mortality production functions that provide evidence on the role of schooling, and then turn to some reduced-form relations that provide similar evidence.

DaVanzo and Habicht (1984) use the historical recall data of their Malaysian Family Life Survey (MFLS) to estimate logit relations for infant mortality for the period 1956-1975. They find that increases in mothers' education, together with increased availability of piped water (particularly for women who did not breastfeed) resulted in large declines in infant mortality that more than offset increases due to shortened periods of
breastfeeding (both supplemented and unsupplemented). By estimating the model in first-differences in the same way that the first differences between adult siblings are estimated in relation 3.1.2 above, they purge their estimates of the effects of any influences derived from unobserved household health management and taste elements that are constant over time. Thus their finding that increasing mothers' schooling reduces infant mortality implies an important effect with control for additive unobserved endowments. However, the researchers do not present estimates without the control, so one cannot know what difference the control makes.

Wolfe and Behrman (1987) estimate child health (using the anthropometric measures of weight, height, and arm circumference) and infant mortality production functions for a sample of Nicaraguan adult sisters for 1977-8. Their standard estimates (i.e., using individual data in the standard manner) suggest a strong positive impact of women's schooling on their children's health.\footnote{Their standard estimates use ordinary-least-squares procedures. However they report that simultaneous estimates for calories and length of breastfeeding suggest that women's schooling has even less impact on child health than indicated by the ordinary-least-squares estimates, apparently because women's schooling is highly correlated with the instrumented estimates for calories and length of breastfeeding.} If the researchers control for mothers' unobserved childhood characteristics through adult sister deviation estimates as in relation 3.1.2, 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 system of latent variable simultaneous equations, including health production functions for women and their children, together with some reduced-form demand relations. Standardized measurements of height, weight, and biceps circumference are used as the indicators for child health, while the number of days when the women were too ill to work and the presence of parasitic diseases and other preventable diseases or treatable diseases are used as the indicators for female health. Medical care (represented by the number of injections received by the child, the time of the mother's first medical examination in pregnancy, 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 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 or rural upbringing, her mother's presence during her adolescence, her father's presence during her adolescence, and the number of her siblings); and community endowments (represented by population, population density, the 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 mothers' schooling (as well as medical care and nutrient intakes) appears to have significant positive effects on children's health if mothers' childhood-family-related endowments are excluded, but that these effects become insignificant if mothers' childhood endowments are included. The researchers interpret such endowments as including health-related abilities, knowledge and habits, as well as prior health status, all of which relate to usually unobserved (and uncontrolled) dimensions of mothers' childhood family background. Thus they conclude that the standard conclusions 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) compare random- and fixed-effect estimates with standard logit estimates of the determinants of disease among women. 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-effect estimates, the effects of schooling are basically the same. The sister deviation fixed-effect estimates are less precise, so the estimates are significantly non-zero only at the 10 per cent level in three cases and at the 15 per cent level in the fourth (although the patterns remain basically the same). Thus, with regard to the determinants of women's health, schooling appears to represent schooling per se rather than incorporating family background characteristics, although the imprecision of the estimates leaves the question open. But there is no evidence of a significant effect of the women's parents' schooling on the health of the women, in contrast to the effect attributed to nutrients (see below), once there is control for fixed effects.

There is a striking difference between the DaVanzo/Habicht results, in which women's schooling has a strong effect on infant mortality even with control for fixed effects over time, and the Behrman/Wolfe results, in which the impact of women's schooling on child and perhaps maternal health is not strong with control for fixed effects between adult siblings. There are at least two possible explanations for these differences: they may stem from differences in the contexts of the two studies, or they may reflect greater measurement error in the MFLS retrospective data associated with schooling. Further exploration of the effect of women's schooling would be valuable, not only to clarify this difference, but to evaluate the Behrman/Wolfe claim that the standard estimates substantially overstate the positive impact of women's schooling on health and mortality.

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 ages and levels of schooling of the husband and the wife. The wife's schooling is insignificant in these estimates, but the husband's schooling shows a positive impact on reported illness, which suggests that more schooled individuals know and report more about their diseases than do less educated individuals.
Boulier and Paqueo (1988) estimate logits for infant and child mortality for 17,074 children aged 15 and under, based on data from the 1975 Sri Lanka National Fertility Survey. They find that only if a mother's education is of 10 years duration or more does it have a significant impact, which contrasts with frequent assumptions that primary schooling is particularly important in reducing child mortality (see Colclough 1982). The impact is stronger on male than on female survival and stronger in urban than in rural areas. (This study made no attempt to investigate the impact of fathers' 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 its supplementation in a sample of 498 children below 25 months of age in the 1978 and 1981 Bicol Philippines Multipurpose Surveys. He finds that better-educated mothers can provide wholesome substitutes to breastmilk without producing ill effects; consequently, they do not breastfeed for as long as less educated mothers do.

Rosenzweig and Wolpin (1988) develop a simple dynamic model of child health that incorporates unobserved heterogeneity among households and uncertainty regarding unobserved heterogeneity in each child's health endowments prior to birth. They compare estimates using ordinary-least-squares versus fixed-effect procedures to control for heterogeneity in child health relations based on data from 109 households with two or more children under six years of age in Colombia for the period 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, DPT inoculations, breastfeeding, maternal age, and the sex of the children, all except the last of which are treated as endogenous in lagged instrumental variable fixed-effect estimates. The researchers interpret their results to show that control for unobserved heterogeneity alters 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 such variables are partially proxies for the uncontrolled health endowments. These results are suggestive of possible upward biases in the estimates of the effects of parents' schooling (as well as breastfeeding and family income) on child weight if there is no control for unobserved household and child heterogeneity. Their results are suggestive but not conclusive even for this sample, 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 production function appears to be
misspecified in comparison with relation (1.2.1) due to the exclusion of maternal schooling and time; for the fixed-effect estimates, however, the impact of at least maternal schooling is controlled so that the correlation between the estimated household endowments and mothers' schooling is not due to the exclusion of schooling from the health production function.

Rao (1988) uses cross-country data from the International Comparison Project (with its consistent treatment of prices, quantities and purchasing power parity incomes) and the World Bank to estimate aggregate health production functions for life expectancy at birth, life expectancy at age five, and child and infant mortality for 57 countries (including 43 developing countries) in 1980. Each of the production functions includes adult literacy rates; per capita consumption of vegetables, dairy products and eggs; per capita consumption of meat and poultry; per capita consumption of staples; and per capita consumption of public and private medical services. The four food consumption variables are treated as simultaneously determined, with prices and income used as instruments.\(^{46}\) The estimates suggest a significant positive effect of the literacy of adults on the life expectancy at birth and during infancy and early childhood, but not on life expectancy at age five. Unfortunately, the aggregate data available for this study do not permit testing for differences between the impacts of women's and men's literacy.

There also are several studies of reduced-form demand relations for health and mortality in developing countries that give some further insight into the role of schooling.

Sahn (1988b) estimates reduced-form demand equations for child height and weight for 3,323 children under age six in rural and urban Côte d'Ivoire in 1986-1987 with an instrumental variable control for simultaneity of income. Inclusion of height of parents in the relations provides a control of sorts for household and parental endowments.\(^{47}\) Mothers' schooling is shown as having significant effects on weight, but not on height; fathers' schooling is not significant for either. Thus the results suggest some limited importance of maternal schooling on children's anthropometric measures. But there is little or no control for unobserved household and community fixed effects.

Horton (1986) estimates reduced-form relations for age-standardized height of children under 15 years old in 901 households in Bicol, Philippines

\(^{46}\) A number of the estimates differ in apparent importance when ordinary-least-square procedures are used.

\(^{47}\) 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.
in 1978, providing some control for usually unobserved household endowments by
including mothers' and fathers' height (both of which are significant).
Fathers' education has significant positive effects, but mothers' does not, in
contrast to many expectations. 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 (for drugs, rice, cooking oil, kerosene,
and milk); income other than mothers' earnings; mothers' schooling, age, and
height (the last being an indicator of genetic traits and health endowments);
children's age and sex; and six community characteristics (community wage rate
for women, village versus town, travel time to outpatient facility,
predominant type of toilet used, predominant water source, and absence of
excreta residues). Mothers' schooling has significant positive effects that
are largest for younger children. Mothers' schooling also has greater
substitutability with both clean environment and health-care access for
younger children. But the effect of mothers' schooling is substantially less
when mothers' height is included (i.e., 26 to 81 per cent less, depending on
the age group), which suggests that mothers' education in standard estimates
serves in part as a proxy for unobserved endowments.

Several questions are raised by considering these two studies with the
Bicol data. Why do they have such different results in regard to the
significance of mothers' schooling? Does its significance in the second study
reflect the assumption that fathers' schooling (which is significant in the
first study) has no effect? Why is only height included as a health indicator
since some of the right-side variables (e.g., prices) seem to be more closely
related to shorter-term indicators of health, such as weight, that are
available in the data set? Is there a selectivity problem in that
anthropometric measures unavailable for certain children (such as older sons)
in the households? Do the included variables adequately represent household
and community endowments?

Thomas, Strauss, and Henriques (1990) 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 breaking the sample down by child
age, region, urbanization, or father's presence makes a difference. They find
strong positive effects of parents' schooling on both child height and child
survival, although schooling of fathers seems less important than schooling of
mothers in terms of child survival. For the urban Northeast, for example, the
child of a literate mother (or father) is about 1.6 per cent (1.2 per cent)
taller than the child of illiterate parents; the child of a mother (father)
who has completed elementary school is 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. In part, however, parental

48For the urban South the effects are slightly smaller. For the rural
Northeast and South they are significantly smaller.
schooling apparently is a proxy for parental endowments not controlled in the base estimates. If the estimates are changed to include parental height, the coefficients on parents' schooling tend to drop by 20-50 per cent. Put alternatively, if a model, to be accurate, 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. This is a considerable bias indeed, especially since parental heights are imperfect controls for parental endowments. Other interesting dimensions of this study's determination of child health are that the effects of paternal education are not significantly different from those of maternal education (contrary to conventional wisdom), and that control for income does not seem to affect much the estimated impact of parental schooling. In terms of child survival, the study shows significant impacts of parental schooling, but with some important differences. First, the effects are not weakened significantly by including mothers' heights, but are reduced, usually significantly, by controlling for permanent income. Second, the effects of maternal schooling are somewhat larger than the effects of paternal schooling. Both the child height and survival relations show stronger effects of parental education for urban areas; this suggests that parental education is complementary with the broader range of health-related services available in urban areas.

This study has some definite limitations: the absence of prices, or specific representations of community factors; the failure to control for selectivity due to missing data on children; the limited control for unobserved endowments; and the failure to control for the fact that since less-educated women tend to have children when they are younger, such children are exposed to more mortality risk at any given maternal age. But all in all, the study is an interesting one that suggests the importance of parental education; that this importance is overstated without control for endowments; and that there may be complementarities between parental education and urban services.

Thomas, Strauss and Henriques (1988) explore the correlation between mothers' education and their children's height in a study involving 1378 children under age six in Northeastern Brazil in 1986. The researchers conclude that the correlation varies depending on other controls, and they attempt to identify what mothers' 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 woman's literacy; whether she regularly listens to radio, watches TV, and reads the paper), and inclusion of control for observed and unobserved community fixed characteristics reduce the coefficient for mothers' education to 0.056 per cent, although when taken jointly, the education, literacy and information variables are significant.

---

49 The study does not include fathers' height in these relations.
The researchers 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, the "naive" results show that there is less impact in urban areas than in rural areas of maternal education (0.28 per cent) on children's height, but more impact 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. The researchers 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 acting as a proxy for community characteristics. Also it is not clear why in this study education seems more important in rural areas than is suggested by the results for the same sample by the same authors described in the previous paragraphs.

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. This formulation does not show that women's education has a significant impact on children's height, although perhaps the role of education is represented in 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/third year mortality) and by sex for 1980 children born in 1965-69 to 2064 couples in rural areas of Uttar Pradesh in India. The possible determinants in this study include parental education, two variables related to health (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 the couples' reported desires in 1977 to have additional children. 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 (possibly endogenous) variable for additional children desired make it necessary to qualify strongly any interpretation.

---

50Blau's rationale for separating the two types of wage rates is that female informal sector jobs in developing countries may be combined with child care in a way that formal sector jobs can not.
Merrick (1985) estimates reduced-form demand relations for Brazilian child mortality in 1970 and 1976. For both years both maternal and paternal education have significant negative effects, with the former significantly larger in 1970 but the latter larger (though not significantly so) in 1976. Merrick tests for interaction between mother's education and water supply, but finds no significant relationship. There are only limited controls for other household and community characteristics, although income and water supply are included.

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 belonging to certain ethnic groups, but no significant effects of other variables including mothers' 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 determinant directly or indirectly (through vaccinations).

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 infrastructure variables to explain 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 variables) 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 inverse correlation between women's education and 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 backgrounds.

Wolfe and Behrman (1988) present reduced-form estimates for infant and child mortality in Nicaragua as part of a larger latent variable system described above. They find a significant effect of mother's education. In an earlier study with the same sample, Wolfe and Behrman (1987) estimate the demand determinants of anthropometric indicators of child health. Standard estimates for individuals are compared with fixed-effects estimates in which data on the individuals' adult siblings are used to control for their mothers' unobserved abilities and motivations from childhood family backgrounds ("maternal endowments"). Women's schooling appears important in the standard estimates, but has insignificant (at the 5 per cent level) coefficient estimates in the fixed-effect estimates. Thus these results suggest that in
the standard individual estimates for child health, women's schooling represents primarily the impact of unobserved maternal endowments.

Horton (1988) also analyzes the demand for individual health outcomes with data on approximately 2,000 predominantly rural Filipino children aged 15 or less. To control for family preferences (particularly with respect to child quality and quantity), 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 significant effects on both height-for-age and weight-for-height, but that maternal education significantly weakens those effects.

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 comparative 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 if the mother) has attended school.

Probably the best known of the multi-country studies that might be given a health demand interpretation are those by Preston (1980, 1986a). Preston (1980) estimates the determinants of life expectancy using cross-country data for 1940 and 1970. Adult literacy (as well as per capita income) is a highly significant determinant of life expectancy for both periods, with the coefficient estimates of a 1.7 to 2.1 year increase in life expectancy at birth for a 10 per cent increase in adult literacy. One possible problem with Preston's study is that prices and endowments are not taken into account, which seems inappropriate in view of the reasoning that leads to relation 1.2.3; if prices and endowments are associated with income or literacy (as seems plausible), the coefficient estimates for the included variables are biased because they represent in part the excluded ones. However, when Preston estimates the life expectancy equation in first differences for a smaller sample of countries for which data are available for both 1940 and 1970, his results are largely unchanged, so apparently there is no bias due to unobserved fixed effects (though this procedure does not control for unobserved variable factors).

Wheeler (1980) uses a sample of 54 countries to estimate the relationship between changes in life expectancy between 1960 and 1970 and changes over the

---

51 In another cross-country study, Hill (1984) focuses on a small group of developing countries for which the mortality data are relatively reliable and finds more or less constant effects of per capita income and education over time, but less evidence of a slow down in mortality declines between the 1950s-60s and the 1960s-70s (and actually an acceleration in Asia) than suggested by some observers.
same period in per capita GDP, adult literacy, per capita calorie availability, number of inhabitants per doctor, and number of inhabitants per nurse. The first three right-side variables are treated as endogenous, with the 1960 levels of per capita calorie availability and literacy, the 1960-70 change in primary school enrollment, and the 1960-70 changes in (physical) capital and labor inputs used as instruments. All explanatory variables also are interacted with the level of life expectancy in 1960 (which is assumed to be exogenous). The fit of the model is generally poor and all coefficients are estimated imprecisely. Only the increase in adult literacy has a significant positive impact on life expectancy (but even this declines at higher initial levels of life expectancy). The intercept term is statistically significant and indicates an exogenous increase in life expectancy of 9.6 per cent between 1960 and 1970. While such results are suggestive, Wheeler's analysis suffers from arbitrariness in the choice of exogenous variables and in his identification restrictions. Change in the quantity of labor input in the production function is treated as exogenous, for example, at the same time as variables related to changes in the quality of that input (e.g., life expectancy, calorie availability, and literacy) are treated as endogenous.

Mensch, Lentzner and Preston (1985) examine socio-economic differentials in child mortality in 15 developing countries based on time series data. The estimates suggest strongly determinative effects of "sociocultural" variables such as ethnic group, mothers' education, ethnic group, and fathers' education (the last only in urban areas). The authors interpret the "very considerable impact of mothers' 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 mothers' schooling may be upwardly biased because of their failure to control for unobserved endowments. This consideration means that their results must be interpreted with care; nevertheless, the results are provocative in suggesting major roles for women's education and perhaps for child care.

Cochrane, O'Hara and Leslie (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 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 $R^2$'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 seems to me that what these estimates demonstrate is that almost all of the variation in estimates of the impact of education across studies may be due to bias because of omitted variables. This interpretation still leaves open the possibility that while education is important, it is apparently substantially less important than the aggregate estimates suggest.

The estimated reduced-form health and mortality demand relations, like the estimated health and mortality production functions, leave open some questions about the role of schooling. They often suggest that schooling is important -- somewhat more so for women than for men. But the studies of the one sample that permits adult sibling control for unobserved fixed effects of current adults' childhood endowments suggests (as for the health production functions) that schooling is largely representing unobserved parental endowments rather than schooling per se. Other studies using parental height as partial control for usually unobserved parental and household endowments suggest some, but reduced (as compared with standard estimates without such control) effects of parental schooling. In contrast to the conventional wisdom, in a number of cases the impact of paternal schooling is shown as about the same as that of maternal schooling. Finally, in these studies there seems to be some ambiguity about whether parental schooling complements or substitutes for community health services.

Nutrient Intakes: In principle there are both production functions and reduced-form demand relations for nutrient intakes, just as for health and mortality. The production functions show nutrients actually consumed as dependent on the foods used and the characteristics of the food purchaser and preparer, as well as perhaps other factors such as water quality. Women's schooling and their endowments might play important roles in such a production function. However existing socioeconomic data sets do not have enough information to permit researchers to estimate such a production function. To the contrary, nutrient intakes are typically estimated by using fixed-coefficient food-to-nutrient conversion factors, with little sensitivity as to how such foods are prepared and 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.

There are several reduced-form demand relations for nutrients that may illuminate 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. 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 of expenditure on food in Gujarati, India (though she finds a positive impact on nutrient intake of the household head's education). But Wolfe and Behrman (1983, 1987, 1988) and Behrman and Wolfe (1984a, 1987a,
1989) find that in Nicaraguan households, the more schooling the women have, the better nourished are the households, other things being equal. The impact of women's schooling, moreover, is significantly greater than that of men's schooling on households' consumption of proteins (though not other nutrients), which gives some support to those who emphasize the special role of women in household nutrition. For every extra year of women's (men's) schooling, caloric intake shows an increase of about 1.0 per cent (0.6 per cent) and proteins by about 2.8 per cent (0.9 per cent) of international standards. Furthermore, this effect persists even if there are random effects or if there is control, based on the study of adult siblings, for unobserved childhood background-related characteristics of the women.\footnote{That this effect remains robust even with adult sister deviation estimates indicates that such estimates are controlling for actual unobserved fixed effects, not just reflecting measurement error. If the fact that women's schooling seems to have a smaller impact in terms of the deviation estimates than in terms of 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.} This result contrasts sharply with the estimated impact of women's schooling on child health (see the discussion above) and on a number of other socioeconomic outcomes (Behrman and Wolfe 1984b). Finally, there is 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 has a strongly inverse relationship 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, although since a positive correlation is strongly indicated in the adult sibling deviation estimates, it probably merits further exploration.

Other health-related inputs: Only reduced-form demand relations are available for these inputs into the health production process.

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. The fact that the elasticity with respect to the education of the households' heads (generally male) is larger than that with respect to the education of their spouses (generally female) contrasts with the emphasis that many people have placed on women's education in determining health visits.

Behrman and Wolfe (1987a) include demand relations for medical care and household water and sanitation quality in a latent variable system of

\footnotetext[52]{That this effect remains robust even with adult sister deviation estimates indicates that such estimates are controlling for actual unobserved fixed effects, not just reflecting measurement error. If the fact that women's schooling seems to have a smaller impact in terms of the deviation estimates than in terms of 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.}
estimates for Nicaragua in 1977-8. They find that in the standard estimates mothers' schooling (as well as income and community endowments) has significant positive effects on both medical care and household water and sanitation quality, but that the estimated impact of women's schooling disappears, as it did in the child health relations discussed above, 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 the period 1968 to 1974 (see above) as right-side variables (together with family income, maternal schooling and enrollment in family planning programs) in a study of the determinants of breastfeeding and inoculations. Maternal schooling has a significant negative effect on breastfeeding only at the 25 per cent level. The researchers do not provide information on whether maternal schooling would appear to be significant were it not for the control for health endowments, though (as noted above) they do find that maternal schooling is correlated with such endowments.

Cohen (1988), in his study of urban Sudanese children, estimates reduced-form relations for vaccinations for children under five, which are strongly associated with the children's anthropometric measurements. The second most important association is with mothers' 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 decisions to use medical services and type of medical practitioner (public, private, or traditional) for 1,903 households from 100 barangays in the Philippines. The right-side variables include parental education; price variables for each of 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 paternal education. They include the intensity of desire for treatment (illness

---

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; and the nature of toilets, baths, water and sewage disposal for household water and sanitation quality.

Children with good health endowments are more likely (at a 25% significance level) to have been breastfed.
severity) as an explanatory variable without treating it as endogenous. This may introduce bias in the coefficient estimates of the price terms; however, it is not obvious that it results in a bias towards zero in the effect of parental schooling.

Gertler and van der Gaag (1988b) estimate discrete health-care choice determinants in 1984 for 1254 Peruvian adults and 969 children who had had recent illness symptoms or accidents, and for 1030 adults and 769 children in rural Côte d'Ivoire who had experienced an accident or illness in the four weeks prior to the researchers' 1985 survey. Their estimates indicate significantly negative effects of travel time and significantly positive associations of consumption with all medical care choices, but with increased education correlated with a significant shift from clinics to hospitals and private doctors in Peru (although not in Côte d'Ivoire). Gertler, Locay, and Sanderson (1987) report similar results for 3412 Peruvians age 16 or over. The limitation of the samples to people who have been sick in these two studies may cause selectivity bias in the estimates.

Mwabu (1989) estimates logit functions for patients' choices among six types of health facilities (governmental clinics, mission clinics, private clinics, governmental hospitals, pharmacies or shops, and traditional clinics) for 479 patients from 339 households selected in a random stratified procedure from Eastern Kenya. While his focus is on the time and income effects (see Subsection 4.3), he also controls for the education of the household head by allowing for interactions between education and clinic types. He finds no significant effects of the education terms. He suggests that this might be because the education of the household head, not of the patient, is used. However one can argue that, as in relation 1.2.3, the education of the household head or the household head's spouse should be included, perhaps in addition to that of the patient. Moreover there typically is high correlation among schooling levels of household members. Therefore, his result concerning the lack of significance of education should not be dismissed too easily. This study also may suffer from sample selectivity bias.

While the Behrman and Wolfe (1987a) study does consider the impact on health of the same reduced-form variables as discussed above, the other studies reviewed in this subsection 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 are necessarily positive. Wolfe and Behrman (1984) report, for example, that women's schooling increases resort to health care significantly in Nicaragua, but does not affect significantly a

55He refers to t tests for each of the relevant education interaction terms. Even though none of these is greater than one, the whole set of education interactions terms might be significant, but he does not test for this possibility.
latent variable representation of health status. While their specification may be criticized as difficult to interpret because of its hybrid nature, the result regarding women's schooling suggests 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 parental schooling, the link to health itself is more speculative.

Children's schooling: There are numerous results that suggest that parental schooling is positively associated with their children's schooling: Wolfe and Behrman (1984) on Nicaragua, Birdsal (1985) on Brazil, King and Lillard (1987) on the Philippines and Malaysia, Behrman and Sussangkarn (1989) on Thailand, Armitage and Sabot (1990) on Kenya and Tanzania. The standard interpretation of these results is that they reflect greater success of parents in home education of their children, and thus greater success of the children in school. 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 since 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 -- a failure that 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.

At this point I shall review a few studies of schooling determinants that have special features pertaining to some of these estimation issues.

Birdsal (1985) estimates the determinants of schooling for 3762 Brazilian children (subdivided by urban-rural and into 8-11 and 12-15 year age groups) based on the 1970 census. In her standard estimates (with control for 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 the one for mother's schooling always larger (generally significantly so) than the one for father's schooling. In alternative estimates she adds two measures of schooling quality -- average years of schooling of local teachers, and average salary of local teachers per child -- as well as an interaction term between teachers' 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 children's schooling shows mixed effects in terms of the impact of parental schooling on their children's schooling.
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 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, mothers’ schooling significantly affects daughters’ schooling, and for Chinese and Filipinos, both mothers’ and fathers’ schooling significantly affect sons’ schooling. Thus there seem to be some cultural differences, with relatively strong mother-daughter links in Malaysia. In the cases in which both parents’ schooling has significant effects, there are not significant differences in the magnitudes of these effects.

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 (except for King and Lillard) have. In their simplest specification (with controls for household income and relevant age) they find that a child’s continuation in school 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 non-zero, but not significantly different from each other). But this specification is dominated statistically by one with measures of the quality of the parents’ schooling (represented by the teacher/student ratio and other indicators for parents’ schooling. These extended results suggest that years of schooling of one parent may substitute for those of the other in their effect on a child’s schooling, and that control for the quality of parental schooling lessens somewhat the estimated impact of years of their schooling at lower schooling levels.

Behrman and Wolfe (1987b) explore the determinants of schooling for two generations of Nicaraguans, contemporary women and their children. For each group 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 for the women indicate an additional 0.45 year of schooling for every additional year of their mothers’ schooling and an additional 0.13 year for every additional year of their fathers’ schooling, both of which are significantly non-zero; 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

56 That is, that students in school at the time of the survey may continue in school after the survey.
Thus control for unobserved family background weakens substantially the apparent intergenerational schooling links. Schooling in the standard estimates seems to represent in large part family background, rather than the effects of formal education.

King and Bellew (1988) examine the schooling determinants for different Peruvian birth cohorts using the LSMS data. They find generally significant effects for both mothers' and fathers' schooling, but with substantial declines across age cohorts; for instance the increase in the period of schooling of females (males) attributable to an additional year of mothers' schooling was 0.33 years (0.29) for the 1925–39 cohort and 0.12 (0.18) for the 1960–1966 cohort; parallel estimates for fathers' schooling were 0.13 (0.25) and 0.07 (and 0.10) years. King and Bellew interpret these results as indicating that the expansion of public schooling weakened the intergenerational links over time. They also note that mothers' schooling was more important for females, and fathers' for males.

Fertility: Given most definitions of poverty, if a poor family has an additional child, it is more likely than before to be counted as in poverty, since the same family resources (at least initially, before the child can contribute to production) must be shared with another individual. (As I note in Subsection 2.1 above, this does not seem to be very satisfactory categorization, since a poor household which is nonetheless slightly above the poverty line may prefer to have more children instead of somewhat higher consumption of other goods and services, thereby reclassifying itself into poverty.)

There are numerous empirical studies of the determinants of fertility in the developing countries. Probably the strongest result of these studies is the inverse association between women's fertility and their schooling (for example, see the surveys by Cochrane 1979 and by Birdsall 1988a). It is far beyond the scope of this paper to review this large literature systematically, and the surveys just cited already provide such reviews. But it is useful to indicate what women's schooling in these studies might represent, since the predictions one makes about possible developments and about the welfare implications of the effect of schooling on fertility depend in part upon what schooling is representing in these studies. The Wolfe and Behrman (1986) deviation estimates suggest that in standard estimates women's schooling may be largely a proxy for unobserved family background characteristics. The Behrman and Sussangkarn (1989) estimates also suggest that women's years of schooling are a partial proxy for schooling quality and for schooling of men in the standard estimates that exclude the latter.

---

57 The data on the children are right-censored so the results are not comparable across generations.
3.2 Impact of Health and Nutrition

Health and nutrition, like schooling, may impact on poverty both directly, on labor productivity and wages, and indirectly, through household productivity.

3.2.1 Impact of Health and Nutrition on Labor Productivity

There are a large number of studies that consider the impact of health and nutrition on labor productivity; the focus of the micro studies is agriculture. But most of the available studies suffer from possible simultaneity bias and do not convincingly investigate the impact of health and nutrition on productivity (and therefore on income) rather than vice versa. Thus I limit my review to a few studies. I begin with micro studies that attempt to investigate the impact on direct measures of productivity, then within a production function framework, and then on wages.

Immink and Viteri (1981) use experimental data from the INCAP nutritional supplementation project to compare increments in harvests for two similar groups of Guatemalan sugar-cane workers, one of which received a high-energy supplement and the other a low-energy one. Immink and Viteri find that productivity of both groups rose during the supplementation period, but that there was hardly any difference between the productivity gains of the two groups. Their results suggest that whatever additional energy expenditure the supplement permitted was dissipated in heat or spent on activities other than work. Why productivity rose for both groups is a puzzle; it might be due to rapidly diminishing productivity effects of nutrients or simply the stimulation of participating in the experiment. In a similar approach,

58 The reader interested in other studies should consult surveys by Gwatkin (1983), Barlow (1979), Strauss (1985), and Martorell and Arroyave (1984).

59 Some macro estimates are reviewed in Subsection 6.2.

60 Behrman and Deolalikar (1988b) criticize the inclusion of total calorie intake (for which they obtain an insignificant coefficient estimate) because it is simultaneously determined and simultaneous estimators are not used. But it is not clear that this variable obscures the possibility of a real productivity differential.

61 Energy supplementation was found to raise the energy intake and expenditure of workers.
Wolgemuth et al. (1982) regress gains in labor productivity in Kenyan road construction on total calorie intake from a supplementation diet with workers randomly assigned to treatment groups. The results indicate a large positive (but only marginally significant) effect of calories (a calorie output elasticity of 0.5). Both of these studies thus suggest some nutritional impact on labor productivity, but in a limited way due to the lack of differentiated effects for the two groups in the former study and the marginally significant calorie coefficient estimate in the latter.

Strauss (1986) estimates the effect of a family's average intake of calories per adult consumer-equivalent on the productivity of on-farm family labor in Sierra Leonean agriculture. He estimates a log-linear agricultural production function and treats calories as simultaneously determined. One of his inputs is "effective family labor," which is a nonlinear function of actual on-farm family labor hours and the average availability of calories per consumer-equivalent in the household. Effective family labor has a statistically significant coefficient estimate in the agricultural production function, and effective family labor increases significantly, at a diminishing rate, with available calories, calculated on a per consumer-equivalent basis. Strauss estimates the output elasticity of available calories on a per consumer-equivalent basis to be 0.33 at the sample mean, 0.49 at 1,500 calories a day, and 0.12 at 4,500 calories a day. His estimates imply that an increase in caloric intake results in a substantial increase in the efficiency of an hour of labor (e.g. a laborer who consumes 4,500 calories a day is 20 percent more productive than one who consumes 3,000 calories a day). Strauss' finding of a link between agricultural labor productivity and calorie consumption per consumer-equivalent appears to be robust to several alternative specifications and to changes in the instruments used for his first-stage calorie estimates.

Deolalikar (1988) investigates the impact of nutrition and health on the agricultural productivity of a sample in rural south India. He estimates a fixed-effects, instrumental variable, log-linear, farm production function in which family labor is a log-linear function of the number of hours worked and the weighted averages of calorie intake and weight-for-height of family farm workers. Cultivated area is treated as a fixed factor of production. All

62 Strauss (1986) criticizes their inclusion of labor supply (for which they obtain a negative and apparently significant coefficient) because it is an endogenous choice variable. But their results concerning the productivity impact are robust to the elimination of the labor supply variable from the specification.

63 The weighting is in terms of the shares of total hours of on-farm family labor contributed by each family member.
other inputs are treated as household choice variables, for which food prices are used as instruments. Although the relationship between productivity and the health/nutrition variables may be non-monotonic, Deolalikar assumes a monotonic relationship by his choice of a log-linear function, since in the observations of calorie intakes and weight-for-height in this sample, he finds no evidence of non-monotonicity. He argues that it is important to include both energy intake and weight-for-height in the agricultural production function since the two may fulfill different needs in agricultural operations. Weight-for-height is associated with endurance and strength, while calorie intake is associated with energy expenditure. Some agricultural tasks, such as harvesting or weeding, require sustained periods of energy expenditure but relatively little strength, while others, such as ploughing, require substantial strength. His results show a significantly positive effect of weight-for-height, but not calorie intake, on farm output. The output elasticity of weight-for-height is estimated to be 1.9. Deolalikar also estimates a wage equation from workers participating in casual agricultural labor markets in first differences, treating individual calorie intake and weight-for-height as endogenous variables (instrumented by food prices and the value of farm assets). The results show significant effects of weight-for-height, but not calorie intake, on wages.

Deolalikar's results are fairly convincing for three reasons. First, he uses simultaneous estimates for health and nutrition, with some exploration of the sensitivity of his results to variations in the first-stage instruments. Second, differencing does not reduce the coefficients of weight-for-height and calorie intake towards zero, as might be the case if there were substantial random measurement errors in these variables. Third, he obtains quite similar estimates of the effect of weight-for-height and calorie intake on both market wage rates and family farm output. He speculates that the strong observed effect of weight-for-height and the lack of effect of calorie intake on agricultural productivity may be the results of greater adaptability of the human body to low energy intakes, but lack of such adaptability in performing strenuous tasks with low levels of strength and endurance.

Behrman and Deolalikar (1989a) further explore the labor market effects of health and nutrition in the same rural south Indian sample with a focus on seasonality, within a simultaneous framework. They find that there are nutrient and health (weight-for-height) effects only for males, with the former more important in the peak season (when greater sustained energy expenditure is required for tasks such as harvesting) and the latter more important in the slack season (when innate strength may be relatively important).

---

64Howarth Bouis has suggested in private correspondence, however, that height would be a better control for strength.
Sahn and Alderman (1988) also estimate wage determination relations with household calories as a simultaneously determined right-side variable for 2125 men and 625 women in rural Sri Lanka with data from the 1980/81 Labor Force and Socioeconomic Survey. They report a statistically significant elasticity of real wages with respect to calories of about 0.20 for men that is robust to different estimation approaches, but an insignificant elasticity for women. Perhaps this reflects gender specialization in tasks, as suggested for India by Behrman and Deolalikar (1989a). Sahn and Alderman also report that they made similar estimates for urban areas which yielded significantly positive coefficient estimates for both men and women, but these estimates were not very robust to changes in estimation technique. This is the only effort to my knowledge to estimate such effects for urban areas.

All of the studies mentioned above focus on relatively immediate effects of nutrition and productivity, or on longer-run effects for which anthropometric indicators such as height are good proxies. There also has been the suggestion that some nutrition effects are very long run, most notably that mental skills critical to basic learning are impaired by childhood malnutrition, with long-run effects on labor market and other productivity (for example, Birsch and Gussov 1970, Pan American Health Organization 1972, Selowsky and Taylor 1973). However, there are at least two difficulties with the evidence that purports to support such conclusions. First, the available studies do not control for non-food characteristics of the childhood environment (such as intellectual stimulation) which may be true causes of impaired mental development (see Cravioto and de Llardie 1973 and Sirilaksana 1982). Second, the available studies do not demonstrate convincingly whether or not recovery from the effects of malnourishment, particularly for mild cases, is possible (see Johnston and Clark 1979, Selowsky and Taylor 1973, and Sirilaksana 1982).

Thus, though the studies that attempt to control for simultaneity are limited and not without their problems, there is growing evidence of positive effects of health and nutrition on labor productivity of at least poorer individuals in developing countries. Those effects provide an argument for concern with the health and nutrition of the poorer members of a society, not only because health and nutrition are of value in themselves, but also because improving them can lead to productivity gains. The studies also point to the need to adopt the household farm/firm model more broadly for analysis (see Subsection 1.2) since, even if markets are complete, the effects of health and nutrition on labor productivity preclude separating income generation from consumption decisions.

3.2.2 Impact of Health and Nutrition on Household Productivity

Schooling productivity: Health and nutrition may influence the productivity of students just as it may affect labor productivity. At least three recent studies claim to find this productivity effect to be significant.
Sirilaksana (1982) estimates school grade production functions for 582 children aged 7-13 in Northeastern Thailand. She finds significant positive coefficients for age-standardized height and weight.

Moock and Leslie (1986) estimate schooling enrollment probits and ordinary-least-squares grade attainment equations for a sample of approximately 350 children from the Terai region of Nepal. The researchers find that the ratio of a child's height to age has a significant positive influence on the probability of the child's enrollment in school and position these (in terms of completed grades) relative to other children of the same age, but that other anthropometric indicators (such as the ratio of weight to age) are not significant.

Jamison (1986) studied over 3,000 children from both urban and rural areas in China and also found a strong association between the ratio of height to age and grade attainment. Like Moock and Leslie, Jamison also finds height-for-age to be a much better predictor of schooling performance than weight-for-age or weight-for-height. Since height is affected by malnutrition over a period of time, the Moock and Leslie and Jamison studies suggest that chronic malnutrition -- but not transitory fluctuations in it -- adversely affects schooling performance.

All three of these studies are suggestive, but none is very persuasive since none controls for simultaneity in health determinants nor for selectivity in the sample. Better-endowed children might do better in school and have better health, without the latter causing the former. Selectivity bias in the productivity effects may arise from the fact that school performance is observed only for those children who actually enroll in school and do not drop out. Since children who drop out are likely to be those who perform poorly, studies that exclude such children may exaggerate the effect of health/nutrition on performance. It is impossible to know from the material presented in these studies whether the results would have been substantially different if there had been control for health endogeneity and sample selectivity.

Health: A number of studies of the determinants of child health and mortality are summarized in Subsection 3.1.2 on the schooling impact on health and mortality, and in Subsection 4.1 on the impact of poverty on health. Some of those studies include among the right-side variables anthropometric measures of the parents. Usually these variables have significant coefficients. A possible interpretation of these coefficients is that parental health is affecting directly child health. Certainly there may be transmission of certain contagious diseases among household members. But the health indicators used for children in such estimates generally are anthropometric rather than drawn from the experience of diseases. My intuition is that parental anthropometric measures of their children's health general household and parental endowments (both genetic and environmental) rather than only contagious disease. Most of the studies that use those variables also give this interpretation. To the extent that this is the case,
then they reflect less the impact of parental health on child health than of the general household and parental endowments on child health. I do not review these studies again here, but refer the reader to other relevant parts of this paper.

There are a few available estimates of health production functions in which health is posited to depend, inter alia, on nutrient intakes. Health production function studies that are experimental investigations include those based on the INCAP project in Guatemala (conducted between 1969 and 1971) and the Naragwal project in Punjab, India (conducted between 1968 and 1973), which attempted to analyze the effect of nutrition supplement programs by comparing the morbidity of individuals in villages benefiting from such programs to those in villages not having them (Martorell and Ho 1984). Using the INCAP data, Clark (1981) found that the growth of infants (weight gain up to 12 months) was associated significantly with the number of calories of atole (a high protein-high calorie diet supplement introduced in one of the villages) consumed and with the length of breastfeeding. Using the Naragwal project data, Taylor et. al. (1978), controlling for age, gender, caste, season, and number and composition of siblings, found that children in villages receiving nutritional care, whether or not combined with medical care, had the highest weights and heights, those in villages with only medical-care had the next highest, and those in control villages had the lowest. Chernichovsky and Kielmann (1977) used the same data as Taylor et al. in an analysis using two-stage least squares with controls for age and sex to measure the impact of calorie intake on children aged 6-36 months, and found a significant positive effect of calories on weight.

Notwithstanding the studies just cited, most of the health production function studies of which I am aware are based on socioeconomic survey data. A number of these studies are reviewed in Subdivision 3.1.2 on health and nutrition. I here elaborate on one example also mentioned there, because of its emphasis on the impact of nutrition on health. Pitt and Rosenzweig (1985) estimate an illness production function for 2,347 Indonesian farm households. They regress the incidence of household illness on the average per capita household consumption of nine nutrients, as well as the source of drinking water, and the ages and schooling of the husband and wife. In single-equation Tobit estimates, none of the coefficients is significant at the 5 per cent level. In an instrumental-variable Tobit equation in which nutrients are treated as endogenous, 65 five of the nine nutrients have statistically significant coefficients, which suggests that the failure to control for simultaneity in the single-equation Tobit analysis understates the impact of nutrients on illness. But this evidence in favor of simultaneous estimates must be qualified, since in the instrumental-variable Tobits, several

---

65 Prices of food and nonfood items and access to infrastructural facilities (such as hospitals, drinking water, etc.) are used as instruments, although the use of arbitrary exclusion identifying restrictions could lead to inconsistent estimates.
nutrients, including protein, fat, and carbohydrates, have a significant estimated positive impact on illness.

Also worth mentioning in this context is work in progress by Howarth Bouis at IFPRI. He has preliminary results that indicate that the increment in men's (but not women's) weight in his Philippine sample is significantly positively responsive to caloric intake for a time interval, once there is control for the significantly negative impacts of energy expenditure and illness, with caloric intake and energy expenditures treated as simultaneously determined. These results are the only ones to my knowledge that control for energy expenditure in a health production function, and thus avoid the downward bias in the estimated caloric effect that would result if energy expenditure is correlated with caloric intake but not controlled. The results suggest that other health production function studies underestimate the impact of nutrients because they fail to control for energy expenditures.

Fertility: Some have argued that there is a biological link between health and nutrition and human fertility (Frisch 1978), though reviews of the literature by Bongaarts (1980) and Menken, Trussel and Watkins (1981) conclude that the evidence for a very substantial impact on fertility of a physiological mechanism is not persuasive except under conditions of near starvation.

Whether or not there is a biological mechanism, there may be a behavioral mechanism, frequency of intercourse. In any case, Easterlin and his collaborators in the development and use of the "synthesis" fertility model have posited that at low levels of development natural fertility (i.e., without conscious efforts to limit conception) increases with per capita income due to better health and nutrition (Easterlin, Pollak and Wachter 1980, Easterlin and Crimmins 1985).

Easterlin and Crimmins present estimates that are consistent with such a possibility, with both contraceptive use and births increasing with per capita income in Kerala in Indian, though Schultz (1986) has been critical of the identifying assumptions. In an earlier study, Anderson and McCabe (1977) report a significant inverse impact of nutrient consumption on intervals between births in Kinshasa, Zaire. Wolfe and Behrman (1988) also present latent variable system reduced-form estimates for Nicaragua in 1977-78 that are consistent with a possible health/nutrition-fertility link in that increased income causes increases in nutrition, contraceptive use and fertility. Such studies, although far too few to support generalizations based on them, suggest that, at least in the initial stage of development, improved health and nutrition may increase fertility and therefore increase pressures on resources, with consequent decline in per capita income and increase in poverty. But, at least within the Easterlin synthesis framework, such a result should not be a cause for despair because individual welfare will increase since couples are better able to attain their desired family size. One would have to compare the gains to social net costs of higher fertility in order to judge whether the fertility impact is good or bad from asocial point of view.
Health is also thought to affect fertility and poverty through the response of parents to infant and child mortality -- a response that has both biological and behavioral components. Biologically, the survival of infants who are being breastfed can lengthen the duration of postpartum amenorrhea and thereby delay subsequent births. However, according to Schultz (1978), if empirical estimates of the derivative of births with respect to deaths exceed 0.1 or at most 0.2, the excess is likely to reflect behavioral responses of parents rather than biological factors. Behavioral responses often are classified into a replacement effect whereby a dead infant is replaced ex post by another birth, and a hoarding effect whereby parents respond ex ante to anticipated deaths by having more children. If health improvements reduce infant and child mortality and thereby replacement fertility, the resources (broadly defined) of pregnancy/birth/initial infant consumption/ and infant mortality are saved for other uses. If they reduce hoarding births, the possibility of actual surviving numbers of children exceeding the wanted and expected number is reduced.

Schultz (1978) attempts to explore replacement fertility in four samples, three based on urban household surveys in 1964 in Rio de Janeiro, San Jose, and Mexico City, and one on a survey of rural households in India in 1970. He regresses a women's cumulative fertility on the number of deceased children (normalized for the number of births, the age pattern of fertility, and an appropriate life table) and a set of control variables (age, education, income, and urban origin). He finds that in all four samples the level of fertility is positively associated with child mortality, although the derivative of births with respect to deaths varies widely from 0.8-1.4 in Rio de Janeiro to 0.2-0.3 in Mexico City. To explain this wide variation in fertility responses to child mortality across populations, Schultz (pp. 212-214) proposes that "... couples react to their child mortality experience by changing their reproductive performance, to the extent that they are aware of a general downtrend in mortality in their segment of society.... thus, individual reproductive responses to child mortality increase to full compensating levels (i.e. the derivative of births to deaths is one) only in those populations where child survival has markedly improved."

However, Williams (1977), Mauskopf and Wallace (1984) and Olsen (1983) have shown that a strong effect of mortality on fertility cannot be inferred from a regression of household fertility on child deaths. The correlation between micro mortality and fertility data is spurious because families with more births tend to have more deaths simply because they have more children at risk. Further, since infant mortality is a variable subject to household choices (and influenced by inputs such as breastfeeding, nutritional supplementation, and utilization of health-care services), the alleged strong effect of mortality on fertility simply may reflect the fact that higher fertility results in shorter periods between births, significantly increasing the probability of infant deaths.

Rosenzweig and Schultz (1982a) estimate fertility and child mortality demand functions conditional on each other with merged data on Colombian
households and communities. To identify the effect of child mortality on fertility, they use per-capita community expenditure on family planning as an instrument, arguing that it is a proxy for the price of contraceptives and can be excluded from the child mortality (but not the fertility) instruments. Their results indicate a positive effect of child mortality on fertility among mothers at all ages, with implied response derivatives of births with respect to deaths ranging from 0.14 to 0.44 for different age groups of women.

Olsen (1983) estimates the impact of infant mortality on fertility, using Malaysian household data and controlling for the spurious correlation between the two variables and for family-specific fixed effects. The Olsen paper perhaps is the most thorough attempt to distinguish among the replacement, hoarding, and biological effects of child deaths on births. Olsen finds that, if the biases of simple regression procedures are eliminated, there still is a sizeable replacement response of fertility to mortality of about 30-40 per cent. Replacement due to hoarding accounts for 14 per cent; the biological impact of a death via lactation adds another 12 per cent to the rate of replacement; and direct behavioral replacement is between 5 and 15 per cent. Interval regressions suggest that the behavioral response to a death is fairly immediate. Thus, children who die soon after birth are replaced to a greater extent than older children who die, which implies that "...apparently replacement is more complex than just a simple attempt to achieve a goal for live children" (Olsen, p. 25). Olsen (1987), in a similar study, finds that Colombian parents replaced directly 0.2 of children who had died, but further compensated by having an extra 0.14 children.

Thus, there is some limited evidence that improved health and nutrition, by reducing infant and child mortality, save resources associated with replacement births and hoarding births, and reduce ex post unwanted fertility due to the latter.

66 However, since all of the exogenous variables should enter into all of the reduced-form relations for all of the endogenous variables, as indicated in relation 1.2.3, this rationale for identification appears arbitrary.
4. THE IMPACT OF POVERTY ON HUMAN RESOURCE INVESTMENTS

The major direct impact of poverty on human resource investments is through the determinants of the reduced-form demand relations discussed in Subsection 1.2. Of course the most obvious direct determinant in these relations is income; but other determinants also may differ importantly between those in poverty and those who are better off. For example, prices, both in nominal terms and in a broader sense that includes the availability of human resource-related services, often vary systematically with income. These prices may differ in part because of policy design (e.g., subsidies for basic staples, special health or food programs for the poor, subsidies for university education and high technology curative health care that favor mostly the better off) that may be related to location (e.g., many of the poor live in relatively isolated rural communities with poor health services). The direct impacts of income and nominal prices are seen only in the estimates of the reduced-form demand relations, but the impact of prices defined to include the availability of human resource services and community endowments also may be revealed in estimates of household production functions.

In this section I consider estimates of the impact of poverty on health, nutrition, other health-related inputs, and schooling. In each case I focus on the direct impact of income (or close proxies for income), but also consider other possible determinants of poverty. Two general observations are relevant for most of the estimates that are reviewed. First, although the samples are generally low-income people in the developing countries, they are not limited to people normally classified as in poverty, and the poorest of the poor are underrepresented because of usual difficulties of obtaining information about them. Thus the validity of the estimates for those in poverty requires that the functional forms used for the estimated relations hold well for those in poverty. For this reason, some studies are concerned explicitly with nonlinearities, but most cases are not explicitly concerned

67 The distribution of public human resource-related services may reflect an underlying social welfare function with equity-productivity trade-offs. Behrman and Birdsall (1988) take such an approach formally and find a considerable concern for equity rather than a pure investment strategy in the geographical allocation of schooling resources in Brazil. Both the costs and the benefits of policies may vary with location. Costs, for instance, may be greater in relatively remote areas in which residents tend to be relatively poor. Benefits may depend on often unobserved (to social scientists) characteristics, such as the disease environment (see Rosenzweig and Wolpin 1986).

68 Also some predetermined human resource levels may reflect poverty and affect other human resource investments (e.g., parental schooling may affect investments in the health and education of their children). The discussion of such effects, however, is left to Section 3.
with this issue. Second, as is discussed in Subsection 2.1, problems in the measurement of the relevant resource constraint may make a significant difference. Current income, for example, often is used in empirical studies, but it may be affected considerably by transitory components and measurement error and thus be an erroneous indicator of ongoing poverty. Random measurement errors in current income lead to underestimates of the impact of poverty on human resources. If the income of the very poor is understated because of the problems of evaluation of inkind income or production for a household's own consumption, on the other hand, the impact of changes in income on human resources may be overstated.

4.1 Impact of Poverty on Health

As noted in Subsection 1.2, estimates for health outcomes may be made of either household production functions or of reduced-form demand relations, although the latter are required to obtain direct estimates of the income and nominal price effects. In certain respects, in fact, estimates of reduced-form health relations are more promising than estimates of health production functions. There may be fewer data problems, since, for example, data on nutrients are not required. Simultaneity bias is not a problem for true reduced forms, although denominating variables such as income as exogenous may not be warranted (see Subsection 1.2). Moreover, since most of the demand studies are based on cross-sectional data, few of them explicitly include market prices as explanatory variables. I review first micro studies based on household data and then some aggregate cross-country estimates.

Harbert and Scandizzo (1982) estimate health demand relations for weight and height from data on 1551 children 19 and younger in 400 rural and urban households in central Chile in 1974-5, controlling for age and sex and parental anthropometric characteristics. They are able to include parents' height or weight for a subsample of 827 children. They find a significant impact of income on height, but not on weight. The income effects on both the weight and height appear larger (and significant) once parental anthropometric characteristics are included. This is somewhat surprising since in the full sample it seems that income is a proxy in part for genetics and household environments, so the coefficient estimates might be biased upward. Of course the result also might reflect the nature of the selectivity for having anthropometric information on the parents; unfortunately Harbert and Scandizzo do not provide any information about such a possibility. Aside from income and parental anthropometric variables, their representation of demand determinants is fairly sparse. They do not control for prices, except for residence, wherein they find that urban residence is associated significantly with greater height, but not weight. (The residence result might reflect poverty-related differences in access to health services.) They also include family size, which has a significant negative coefficient in three of the four regressions, and which might be given a poverty-related interpretation since a larger family for a given income reduces per capita income. But there may

---

69 Though not necessarily parental welfare if parents elect to have such children (see Subsection 2.1).
be problems with simultaneity, since parents may determine at the same time the quality and number of their children, which factors are not controlled in these estimates, so the true effects of the family size variable are unclear.

Sahn (1988b) estimates reduced-form demand equations for child height and weight for 3,323 children under age six in rural and urban Côte d'Ivoire in 1986-1987 with an instrumental variable control for simultaneity of income, and with control for parental schooling and height. The use of instrumented income presumably lessens downward biases in the income effects due to random measurement error and transitory income fluctuations. Sahn finds strong income effects for height with an elasticity of 0.87 for the poorest quintile of households in urban areas and of 0.28 for the poorest quintile of households in rural areas, but he finds no significance for weight. That the income effects are larger for urban than for rural areas might reflect that there is a diversity of health-related options in urban areas, but that such options are more limited in rural areas. Thus the results suggest some importance of household income. But there is no control for possibly important unobserved prices and other household and community characteristics.

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 controls, in the form of schooling and height, for parental human resources. She finds no significant effect of assets on the average height of the children in a household, but, somewhat peculiarly, a significant (though small) impact on individual children. Several community variables are insignificant, but the nature of water supply (which arguably might be endogenous) has positive effects. Since the quality of water supply tends to vary inversely with poverty, this result probably reflects a negative effect of poverty.

Barrera (1987a, 1990) presents estimates of height standardized 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 (for drugs, rice, cooking oil, kerosene, and 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 vs. town, travel time to least-cost child outpatient facility, predominant type of toilet used, predominant water source, and absence of excreta). He finds almost no evidence of income or market price effects on height.

Thomas, Strauss, and Henriques (1990) estimate relations for height-for-age for children under nine and for child survival for 41,233

---

The results for the schooling and parental anthropometric measures in this and in most of the rest of the studies in this subsection are summarized above in Subsection 3.1.2.
households in Brazil in 1974-1975, with control for parental schooling and height (see Subsection 3.1.2). Household unearned income has a significant effect in urban (but not rural) areas for child height and in the poorer Northeast (but not the South) for child survival. As an alternative to measured current unearned income, instrumented household expenditure also is used. This variable has no impact on child height, but has some impact on survival probabilities in the Northeast, with a doubling of expenditure increasing such probabilities by 4.8 per cent and 6.4 per cent in the urban and rural Northeast, respectively.

In a 1988 study, Thomas, Strauss and Henriques focus on the role of mothers' education in the determination of the height of 1378 children under age six in Northeastern Brazil in 1986, with controls for other determinants. These include a household's nonparental income and control for observed and unobserved community fixed characteristics. In rural (only) areas, the impact of income seems to be positive and robust, but not large. A 10 per cent income increase apparently implies an increase of about 0.1 per cent in ln child height. Most of the effects of the community variables on child height, moreover, are due to the unobserved variables controlled in the fixed-effects estimates. Among 12 observed community characteristics (about half pertaining to health services), only a strong negative association of the proportion of households with earth floors in dwellings in rural areas is significant at the standard 5 per cent level.

Blau (1984) estimates a demand function for age-standardized height using 1977-78 Nicaraguan data on children under five years of age. He includes formal and informal sector wage rates for women (corrected for selection bias) and other income as well as mothers' age, education, and urban origin among his independent variables. The variable for other income does not have a significant effect. Blau's rationale for separating the wage rates by sector is that informal sector jobs for women in developing countries may be combined with the care of the women's children in a way that formal sector jobs can not. Thus the substitution effect of the mother's formal sector wage rate on child health should be negative and that of the informal sector wage rate should be zero. After a positive income effect is taken into account, the gross impact on child health of the informal sector wage rate should be greater than that of the formal sector wage rate. Blau's results, however, indicate the opposite; the mother's (predicted) formal sector wage rate has a significant positive effect on child health and the informal sector wage rate has an insignificant though positive effect. The formal sector wage result by itself suggests that a strong income effect is overriding the wage effect through childcare, but the insignificance of the informal sector wage is puzzling and calls for caution in interpreting the formal sector wage estimate as a strong income effect.

---

The instruments are unearned income, unearned income squared and some monthly dummy variables. Thus this instrumented variable may be purged of some transitory components.
Simmons, et al. (1982) estimate logit conditional reduced-form relations for infant and child mortality, by age groups and by sex, for 1980 children born in 1965-69 in a sample of 2064 couples living in rural areas of Uttar Pradesh in Northern India. Their specification includes income other than from the parents (but surprisingly, not income from the parents), two variables related to the community health services and health environment (i.e., time to hospital, village three-year survival rate), parental education, parity and sexual composition variables, and parents' reports of additional children desired in 1972. The estimates do not vary much between the age groups, so I discuss the combined results. There are some differences between experiences for males and those for females. Mortality for boys (but not girls) is less if village post-neonatal survival rates are high and if there is "much" support from other family members. Mortality for girls (but not boys) is less if there is "some" support from other family members. Thus the community characteristics appear to have limited effects, and only on males. 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 variable for desired children makes it necessary to qualify strongly any interpretation.

Merrick (1985) presents reduced-form estimates of 1970 and 1976 Brazilian child mortality that suggest that household income and piped water supply have inverse impacts on infant mortality, with a significant interaction between the two seen in 1976 figures. The effects of community endowments other than piped water, and of household endowments other than parental education, are not considered.

Cohen (1988) estimates the reduced-form demand relation for recent child illness for 600 urban Sudanese children under five. He finds a significantly inverse impact of the household head's wage (and of membership in some ethnic groups), but no significant effects of other variables including piped water, mother's schooling, and type of housing (representing wealth). Such results contrast with the health production functions for anthropometric outcomes that he presents for the same sample in which piped water, maternal schooling, and housing seem significant direct or indirect (through vaccinations) determinants.

Rosenzweig and Schultz (1982a) study the joint determinants of demands for fertility and child mortality with a four per cent sample of the 1973 census of Colombia. The researchers include numerous community-level infrastructural variables, most of which can be interpreted as health-care prices broadly defined, to explain the household demand for health outcomes: the number of hospital beds and clinics per capita, 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-level variables, with the exception of the food prices and the regional schooling variables, are interacted with women's schooling. Separate equations are estimated for each five-year age-group of women residing in rural and urban areas. As I discuss in Subsection 3.1, the researchers find that, in urban areas, child mortality
in families with less-educated mothers is strongly affected by public health and family planning programs. The researchers 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). In this sense the wealth of the community can offset the poverty in terms of parental human resources in the household. They also find that in urban areas, clinics are a more cost-effective means of lowering child mortality than hospitals. For rural areas, in contrast, they find little effect of health and family planning programs on child mortality. They attribute this to the greater dispersion of health and family planning programs in rural areas. Though their study has a relatively extensive representation of community variables, it does not control for many household variables.

Wolfe and Behrman (1988) present reduced-form estimates for infant and child mortality in Nicaragua as part of a larger latent variable system. They find a significant, inverse impact of income. But in contrast to Rosenzweig and Schultz, Wolfe and Behrman find no significance for six indicators of community endowments (including literacy rates, hospital beds per capita, and indoor plumbing). With the same sample, Wolfe and Behrman (1987) estimate the demand determinants of anthropometric indicators of child health. They compare standard estimates for individuals with fixed-effects estimates in which their special adult sibling data control for unobserved abilities and motivations of the mother from her childhood family background ("maternal endowments"). Income is not found to be significant. Behrman and Wolfe (1989) compare standard, random-effects, and fixed-effects estimates for the incidence among women of four diseases. Income is not found to be a significant determinant. Two community characteristics (literacy rates and population size) that appear not to be significant in the standard and random-effect estimates, do appear significant in the fixed-effects estimate. For example, larger population is associated with a lower incidence of disease preventable by public policy, but with a higher incidence of disease that is treatable. Thus there is some evidence that the limited nature of the impact of community effects on health in standard estimates may be due to failure to control for fixed effects (also see Rosenzweig and Wolpin 1986). And, as suggested above, community characteristics often are associated with poverty.

Most of the above studies mentioned above are not very sensitive to variations in health within a household, or to the different responses of the health of different household members to prices and income, even though some of the studies treat children and adults separately. Most studies also are not sensitive to the fact that a large proportion of households in less-developed countries are farm households; the omission of farm input prices and farm assets from the health demand functions for farm households is tantamount to making very restrictive assumptions about product and labor markets and about the relationship between health and nutrient inputs on one hand and productivity on the other (see Subsection 3.1). Two recent studies that incorporate both these concerns are those of Pitt and Rosenzweig (1985) and Behrman and Deolalikar (1988a).
Pitt and Rosenzweig use data on 2,347 Indonesian farm households to estimate separate "illness demand" functions for husbands and wives. The right-side variables in these functions are the prices of thirteen consumption goods (foods and nonfoods); source of drinking water; availability of hospitals, family-planning clinics, public lavatories, and clinics; land ownership; farm profits; and the age and education of the husband and the wife. Using ordered probit equations, the researchers find relatively few significant determinants of health, and no significance of farm profits or land ownership. Among the community variables, only the presence of public lavatories (with a positive impact on wives' illness) is significant. The authors attribute the lack of precise estimates to measurement problems: illness was reported by the sick themselves (or by the household head or spouse), and hence subject to differences in sensitivity to symptoms and in propensities to report them (see Subsection 2.1.1) and was recorded over a period of only one week.

Behrman and Deolalikar (1988a) use panel data on rural south Indian households and anthropometric indicators to estimate joint reduced-form health and nutrient demand relations, allowing for differences in the responses of different household members to prices and incomes, while controlling for individual, household and community fixed effects. They use a latent variable representation of unobserved health status, for which they have three observed (but imperfect) indicators: (age/gender) standardized arm circumference, triceps fat, and weight-for-height. They find two of the four food prices (i.e., of rice and milk) to have significant positive effects on health status. However, they find neither a significant income effect nor significant differences in price or income responses for all household members. The price effects in real terms, i.e., with incomes constant, on health may be surprising, but they are consistent with strong cross-price substitution effects in the underlying food demand equations toward foods with high nutrient-to-food conversion factors (see Subsection 4.2). If the price of, say, milk increases, a sufficiently large increase in the demand for other foods (and thereby in nutrient intakes and health) may be induced so that the adverse effect on health of reduced milk consumption is more than offset by the increased consumption of other lower-nutrient-cost foods.

Horton (1988) also analyzes the demand for individual health outcomes with data on approximately 2,000 predominantly rural Filipino children aged 15 or under. To correct for the differing tastes (particularly with respect to child quality and quantity) in households, Horton explores the differences in weight-for-height and height-for-age among children within each family in terms of age, gender, and birth order. She also allows some household-specific variables to enter her health demand function indirectly by having the coefficient on birth order depend on maternal education and household expenditure per capita. Her results suggest that birth order has a

---

72 Farm profits are treated as predetermined since a Wu-Hausman test does not reject such treatment.
significant adverse effect on both height-for-age and weight-for-height, but that maternal education significantly weakens these adverse birth order effects.

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. They argue that the male-female survival differential depends upon the expected relative returns to male and female labor, because those expectations influence parental investments in sons and daughters. The researchers use predicted employment rates of men and women as proxies for the economic returns to male and female labor, arguing (not entirely persuasively) that wage rates may not accurately reflect the value of time as well as do employment rates because cultural factors such as religion and caste may prevent women from equalizing the marginal products of market and household labor. In both the household and the district level samples, the authors find predicted female (but not male) employment rates to be a significant negative determinant of the male-female child survival differential. They interpret these results to imply that children who seem likely to become more economically productive adults receive a greater share of family resources and therefore have a greater propensity to survive than other children. These results are symptomatic of poverty since the expected returns depend on the prosperity in the local community.

In more recent work using the same 1974/5 ENDEF Brazilian data used in those studies summarized above of which he is co-author, Thomas (1990) explores whether there are different effects of men's and women's unearned income on child survival rates and anthropometric measures for children. The estimates indicate a much larger effect on child survival and child anthropometric measures of women's unearned income than of men's, with some further gender differentiation in that mothers' unearned income has greater impact on daughters than on sons, while fathers' unearned income has greater impact on sons. Unearned income (not wages) is used and parents' education is controlled in order to focus on the income effects alone, without the price effects that wages would entail. Thomas concludes that these results undermine the unified preference model of households often used for economic analysis, and suggest that mothers' income is much more important in shaping children than is fathers' income. Such results are provocative, and seem to support many earlier claims, such as those by Folbre (1984, 1986). However they are not entirely persuasive, since it is not clear that unearned income does abstract from the price-of-time effect. The sources of non-wage income

73 These estimates are only for urban areas because in these data all of the income of a family farm is attributed to the household head.

74 There are some anomalies, such as the indication that unearned income of non-parents has much greater impact on anthropometric measures for boys than either mothers' or fathers' unearned income.
in the Brazilian data used by Thomas apparently are largely pensions and social security, both of which are related to past wages and productivity. Therefore unearned income may in part represent productivity in labor market activities associated with household activities pertaining to health and nutrition. If so, these results do not mean that shifting income to women would have more positive effects on child health than shifting equal income to men, but simply that more productive women have more positive effects on their children's health.

Probably the best known of the cross-country studies that might be given a health demand interpretation, as noted in Subsection 3.1.2, are those by Preston (1980, 1986a). Preston (1980) estimates the determinants of life expectancy using cross-country data for 1940 and 1970. Per capita income and adult literacy are highly significant determinants of life expectancy for both periods, with very similar coefficient estimates.75 To assess the contribution of increases in per capita gross domestic product, literacy, and caloric availability to the increase in life expectancy between 1940 and 1970, Preston calculates what life expectancy would have been in less-developed countries if no structural changes had occurred. The difference between actual life expectancy in 1970 and that predicted if the 1940 rates had persisted to 1970 indicates the change attributable to structural shifts in the life expectancy equation. Preston finds that approximately half of the total gain in life expectancy during the 30 years was unrelated to changes in per capita income, literacy, or caloric availability. One possible problem with Preston's study is that prices and endowments are not included. But when Preston estimates the life expectancy equation in first differences for a smaller sample of countries for which data are available for both 1940 and 1970, his results are largely unchanged. The fact the manipulation by first differences should purge the estimates of unobserved country-specific fixed effects76 means that the problem of omitted variables was not severe for such fixed effects. (Though there is no discussion of the unobserved variables that changed over these three decades).

Since the measures of per capita GDP used in Preston (1980) are based on international exchange rates, which are subject to many distortions, Preston (1986a) reestimates the relationship between life expectancy and income using

75However, average per capita daily calorie availability is not significant for either period. This may be appropriate since, if a reduced-form demand interpretation is given to Preston's estimates, calories probably should be excluded since they are determined in part endogenously through household food demands.

76These might include some cross-country differences in the measurement and definition of life expectancy, and income distribution differences (the last of which are emphasized by Dyson, Bell and Cassen (1978) in their simulations).
the International Comparisons Project (ICP) measures of per capita gross domestic product, which are based on purchasing power parities of various currencies. He estimates the life expectancy equation for 1965-69 and 1975-79 with the two measures of income (with literacy rate and excess caloric availability as control variables) and finds that the coefficient of income in the ICP-based regressions is 50 per cent larger than that in the regression based on exchange rates. Behrman and Deolalikar (1988e), like Preston, find that the use of ICP income results in greater consistency with the cross-country mortality and life expectancy data, and yields higher health elasticities with respect to income than do standard income data. However, they find that even greater consistency with country-wide experience, and higher elasticities, are obtained with ICP income predicted by physical and human capital stock, a more permanent income measure. They also report that the effects are largely on infants and small children, so that life expectancy at age five is relatively unaffected by income.

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 mothers' education, ethnic group, and fathers' education (the last only in urban areas), and much weaker effects of "socioeconomic" variables such as per capita income, occupational status, sanitary facilities, and urban-rural residence. They also ignore price changes, which the estimates in Subsection 4.2 suggest may be more important than income changes; the exclusion of price changes may bias downward the income coefficient estimates (since food prices tend to increase with development).

Horton, Kerr and Diakosavvas (1988) estimate a demand relation for infant mortality from pooled cross-country and time-series data for 1966-1981 for 34 developing countries. This study includes the innovation of the "price of cheap calories," i.e., the average of ICP-adjusted retail prices of rice, maize, wheat, millet, and sorghum from data supplied by the Food and Agriculture Organization (FAO). This study's cross-country estimates suggest significant price elasticities for mortality of between 0.2 to 0.6. Separate time-series demand equation estimates for each country suggest that nine of the 34 countries have significantly negative income elasticities of infant mortality, while six have significantly positive price elasticities. But seven countries have the "wrong" signs (significantly positive) for income elasticities and eight have the "wrong" signs (significantly negative) for price elasticities (but see the discussion on price effects on nutrient intakes in Subsection 4.2). The country-by-country results thus are ambiguous and permit no generalizations.

The estimated reduced-form health demand relations, thus, shed some light on the relationship of poverty to health and mortality. They suggest some positive associations of per capita income and health, but often do not control for the possible simultaneous determination of income, nor for the possibility that income may be serving as a proxy for unobserved health infrastructure, and for individual and community endowments. Observed community endowments often appear important, perhaps more than a literal reading of the estimates would suggest, because in a number of studies,
particularly the more aggregate ones, per capita income might be acting as a proxy for unobserved endowments.

As noted in the introduction to this subsection, health production function estimates may give some insight into the impact of community characteristics on health, and such characteristics often are associated with poverty. I therefore now review the implications of a few health production function studies for such community characteristics.

Sirilaksana (1982, 1986) estimates production functions for child health in 582 households, with 1006 preschool children and 410 school children aged 7-13, in 12 villages in Ubon Rachathani in Northeast Thailand. (Unfortunately, she clouds the interpretation of some of these functions by including household income among the determinants for the incidence of disease.) She notes possible simultaneity bias, and treats as simultaneously determined many variables (but not food intake) that seem to be determined by the household. She finds that community health programs and prenatal care are insignificant in the disease relations. Her most interesting finding is that the predicted hours mothers worked in the formal sector have a significant and substantial negative effect on their children's health (as represented by anthropometric indicators), while the predicted mothers' participation in the informal sector induced a significant and substantial improvement in child health. She concludes that informal sector work (generally in the home) can be combined easily with child care, but formal sector work cannot. On the other hand, informal sector work is more likely to be performed by people in poverty, so there may be a tradeoff between the impact of direct maternal attention on child health and the indirect effect of women's using time to generate income. Her time-use results are further reinforced by her finding that predicted mothers' wage has a significantly negative impact on household food consumption, which she sees as the negative impact on nutrient intakes of higher opportunity cost of women's time. This is perhaps the most impressive

77 Such studies also may have implications for variables such as parental schooling, which may be associated inversely with poverty, on health. Such implications are discussed in Section 3.

78 Sirilaksana does not include mothers' education explicitly in the estimates for anthropometric indicators (it is insignificant in probit estimates for disease incidence), so one might wonder whether the time use variables in part are not proxies for mothers' education, which is one of the instruments used for their predictions. But since in the first-stage estimates a mother's education enters negatively into both her formal sector hours and her informal sector participation, bias due to the exclusion from the production functions of a variable for mothers' education does not seem to explain the importance of time use in the researcher's estimates.
DaVanzo and Habicht (1984) exploit the retroactive historical nature of their data on Malaysia to estimate a fixed-effects logit model for infant mortality, with focus on breastfeeding and maternal education, subjects discussed in Section 3. They find that the availability of piped water resulted in large declines in infant mortality, particularly for infants who were not breastfed, over the 1956-60 to 1971-5 period, more than offsetting the impact of reduced breastfeeding. By estimating the model in first-differences, DaVanzo and Habicht purge their estimates of the effects of unobserved household and community factors.

Behrman and Wolfe (1987a) use Nicaraguan adult sister data from 1976-77 to estimate some reduced-form demand relations in a latent variable simultaneous equations system including health production functions for women and their children. Standardized height, weight, and biceps measurements are used as the observed indicators for child health, while the number of days when women were 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. Some of the instruments used to estimate the production function are household income, the mother's initial endowments (represented by her own mother's schooling; her urban versus rural upbringing; the presence/absence of her mother during her adolescence; the presence/absence of her father during her adolescence; and the number of her siblings), and community endowments (represented by population; population density; number of hospital beds per 1,000 inhabitants; and the literacy rate). Behrman and Wolfe find that community endowments appear to have significant positive effects on mothers' health if mothers' childhood-family-related endowments are excluded, but that the coefficients become insignificant if mothers' childhood-family-related endowments are included. They interpret such family-related endowments to include health-related abilities, knowledge, habits, and prior health status, all of which relate to usually unobserved (and therefore uncontrolled) dimensions of mothers' childhood family environment.

Pitt and Rosenzweig (1985) estimate a health 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. They find no evidence that the community variables associated with the water source significantly affects reported illness.

The studies mentioned above lead to some limited insights into the determinants of health and their relation to poverty, as reflected in community characteristics. There is limited evidence that improved water and sanitation improves health.

Of course the limited nature of our knowledge of the health production function in developing countries in part probably reflects data inadequacies...
in the analysis. Some of the health and nutrient indicators, for example, are for very short periods and thus likely to be very noisy. In many cases data on the environment and on community endowments are quite limited or nonexistent. As Behrman and Deolalikar (1988b) emphasize, moreover, specifications for the estimated health production functions do not include the individual’s use of time (though Sirilaksana 1982 includes the mother’s use of time), in contrast to the specification in relation 1.2.1; thus the functions fail to reflect that better nutrition may result in increased productivity without necessarily affecting longer-run health indicators. Likewise, the well-known impact of diseases such as diarrhea on the capacity of the body to utilize nutrient intakes is not incorporated into most analysis, though Sirilaksana (1982) does include predicted values for disease and finds them insignificant except for fever. Finally, estimation problems regarding simultaneity, unobserved variables, and lagged effects may be considerable in many studies.

4.2 Nutrient Reduced-Form Demand Relations

There have been a number of recent estimates of nutrient demand functions that basically approximate relation 1.2.3 above. These studies may be summarized most clearly by considering in turn each of the major sets of right-side variables.

Income/Expenditure: There has been considerable controversy recently about the extent to which income affects nutrition. One widely held view is that malnutrition will disappear only with the improvements in income that accompany the development process. The World Bank (1981: p. 59) articulates this view forcefully: "There is now a wide measure of agreement on several broad propositions.... Malnutrition is largely a reflection of poverty: people do not have income for food. Given the slow income growth that is likely for the poorest people in the foreseeable future, large numbers will remain malnourished for decades to come.... The most efficient long-term policies are those that raise the income of the poor." On the other hand, estimates of the income/expenditure elasticities (hereafter referred to as income elasticities) for calories vary widely from below 0.1 for Nicaragua (Wolfe and Behrman 1983, Behrman and Wolfe 1989), Sri Lanka (Scandizzo and Knudsen 1980, Sahn and Alderman 1988), the rural Philippines (Bouis and Haddad 1989a,b), upper-income households in Morocco (Mateus et al. 1986), rural south India (Behrman and Deolalikar 1987a, 1990b, Deaton 1988b) and rural Indonesia (Pitt and Rosenzweig 1985) to 0.9 for rural Sierra Leone (Strauss 1984) and 1.2 for

---

79 The World Bank, however, hardly has been monolithic in this view. In a well-known World Bank study, for example, Reutlinger and Selowsky (1976: p. 7) concluded: "Malnutrition is unlikely to disappear in the normal course of development."
lower-income households in Morocco (Mateus et al.). Estimates of the income elasticity of proteins estimates which are far fewer than calorie income elasticity estimates also range from 0.0-0.1 for small children and infants in rural India (Levinson 1974), for high income households in Morocco (Mateus), and for rural households in Indonesia (Pitt and Rosenzweig), to 0.6-0.8 for rural Bangladesh (Pitt 1983) and rural Karnataka, India (Alderman 1987), and 1.2 for low-income households in Morocco (Mateus et al.).

One possible explanation for these ranges of estimates that is consistent with the notion that income has a considerable effect on the nutrition of the poor is that nutrient elasticities with respect to income are inversely associated with income. A number of studies that have examined such a possibility have found empirical support for it (for example, Pinstrup-Andersen and Caicedo 1978, Timmer and Alderman 1979, Murty and Radhakrishna 1981, Williamson-Gray 1982, Mateus et al. 1986, Behrman and Wolfe 1984a, Behrman and Deolalikar 1988d, Ravallion 1989, Sahn 1988a). But in some studies no inverse association of the nutrient elasticity with respect to income is found (see, for example, Behrman and Deolalikar 1987a, 1989d, Strauss 1984a), and in many of the studies in which it is found, it is not prominent enough to explain the wide range of estimates for calorie income elasticities cited in the previous paragraph. And in at least one study (Reutlinger 1984), the calorie elasticity increases significantly with income, though inversely with initial caloric adequacy.

Another explanation for the wide range of these income elasticity estimates is the level of aggregation at which nutrient conversion factors are applied to obtain the estimates. In some cases, most notably the more sophisticated food expenditure system estimates to which nutrient conversion factors are applied (Murty and Radhakrishna 1981, Pitt 1983, Strauss 1984, 82).

80According to Thomas (1990: p. 19), for Brazilian households work in progress by Strauss and Thomas (1990) indicates that "the income-calorie relation is apparently quite steep at low incomes but switches to a flat slope higher in the income distribution."

81Though in at least one case, Mateus et al.'s (1986) estimate for Morocco, the inverse association between nutrient elasticities with respect to income and income is sufficient to explain the wide range of estimates.

82In these studies food expenditure systems are estimated with the imposition of cross-equation restrictions and with relatively broad food aggregates, and then nutrient conversion factors are applied to the results, which practically guarantees nutrient elasticities as large as overall food expenditure elasticities, which for poor populations typically are 0.6 to 0.8 or higher. Pitt suggests that the aggregate food expenditure system route is superior to direct estimates of nutrient reduced forms, apparently because of greater efficiency due to the cross-equation restrictions, but he does not discuss possible problems due to aggregation, measurement error, selectivity, etc.
Alderman 1987), foods are aggregated to relatively few categories (usually fewer than ten) before nutrient-to-food conversion factors are applied. In other cases conversion factors are applied at much more disaggregated levels. Behrman and Deolalikar (1987a) demonstrate that, if there is substantial substitution among disaggregated foods and if prices paid per nutrient as a result increase substantially as income increases, the application of nutrient conversion factors at a more aggregate level may overstate considerably the true nutrient elasticity with respect to income. After citing evidence from several sources that nutrient prices paid increase substantially with income, they analyze a sample from rural South India to compare nutrient elasticities obtained from application of nutrient conversion factors to food elasticity estimates for six food groups, versus direct nutrient reduced-form estimates with the conversion factors applied for 120 more disaggregated foods (in both cases using simultaneous estimates for income). The former (more aggregated) procedure implies calorie elasticities with respect to income of 0.8 to 1.2 (depending on whether fixed effects are controlled); the latter (disaggregated) procedure yields calorie elasticities of 0.2 to 0.4 (and not significantly different from zero). A number of other recent studies report similar results with food expenditure elasticities about twice the magnitude of calorie elasticities: Greer and Thorbecke (1984) for Kenya, Garcia and Pinstrup-Andersen (1987) for the Philippines, Kumar (1987) for Kerala in India, Alderman (1987) for Karnataka in India, and Reutlinger and Selowsky (1976) and Behrman and Deolalikar (1988d) for cross-country samples. Thus, even for very poor populations, calorie elasticities with respect to income appear to be positive, but much smaller than food expenditure elasticities and perhaps substantially smaller than suggested by the quotation above from the World Bank (1981) and by others who suggest that income is critical in determining nutrient intakes.

A third explanation for the wide range of estimated nutrient elasticities with respect to income, proposed by Bouis and Haddad (1989a), is measurement errors, including the failure to distinguish between food obtained by the household and nutrients consumed by household members quantities which may

---

83 Using 1970-71 data from the Indian National Sample Survey, Radhakrishna (1984) calculates that the average cost of calories from each of six broadly-defined food groups increases consistently with total expenditure for both rural and urban households. Pitt (1983) reports that in a Bangladeshi sample, the 25th percentile household spent 22 per cent more per gram of protein, 15 per cent more per calorie, and 44 per cent more per milligram of iron than did the 90th percentile household. Williamson-Gray (1982) estimates the income elasticity of the average price paid per calorie to be 0.3 even for relatively malnourished households in her Brazilian sample. Behrman and Deolalikar (1988d) estimate the income elasticity of the average price per calorie to be 0.4 or 0.5 for the lower income levels in their cross-country sample. In contrast Bouis and Haddad (1989b) find almost no such pattern for rice, corn, and other basic staples in their rural Philippine sample, though they do find such a pattern for calories from all foods.
differ if food is provided to guests or laborers, and if there is waste. Bouis and Haddad demonstrate that these possibilities might result in important biases in estimated nutrient elasticities. Then they present estimates (for a rural Philippine sample) that vary for these reasons, as well as because of possible biases due to simultaneity and to the failure to control for fixed effects. The estimates vary by a factor of about ten, with their preferred estimate of the nutrient elasticity with respect to income equal to 0.06 (while some others are over 0.50). The authors do not test their explanation against the aggregation one offered by Behrman and Deolalikar (1987a). In Behrman (1988c) I suggest that another measurement problem may underlie some of the high nutrient elasticities of expenditures of very poor respondents to surveys about expenditures over a short period. I illustrate that if purchases of staples are lumpy, nutrient elasticities with respect to expenditures for poor people may seem to increase (perhaps above 1.0, as reported by Lipton 1983b and Edirisinghe 1987) even though the true income elasticities are constant or declining.

A fourth explanation might be that nutrient intakes respond little to current income fluctuations since such basic consumption is protected from income fluctuations by adjustments to other consumption and by savings, but respond strongly to longer-run income changes.84 The range of available estimates thus may reflect how well the income or expenditure measure approximates permanent income. Behrman and Deolalikar (1989d) test this possibility by contrasting the estimates for nutrient responses to changes in current and permanent income (with the latter based on almost a decade of data). Bhargava (1988) tests it by allowing for dynamic adjustments in nutrient intakes in response to income changes. Neither study finds evidence in a rural south Indian sample that the response to longer-run income is much greater than to current income.

A fifth possible explanation, suggested by Thomas (1986), pertains to sample selectivity at very low income levels. Because household units are included in household surveys only if they are living in identifiable structures, very poor households that spend relatively large shares of their resources on housing and relatively small shares on food may be overrepresented. If so, cross-sectional estimates of elasticities of expenditures on food (and therefore nutrients) with respect to total expenditure or income are biased upwards in the low income range. Thomas presents some evidence that such an effect is significant for Sri Lankan 1980-1 data.

Thus nutrient elasticities with respect to income often are fairly low in developing countries, and the much higher estimates sometimes presented may be biased substantially upwards due to a combination of aggregation problems and

84But Thomas (1986) makes the opposite conjecture -- that food shares may adjust more to transitory income fluctuations if there are committed expenditures such as on housing, together with capital market imperfections.
the positive association of prices per nutrient with income; differences between household purchases and household members' consumption, that are positively associated with income; and measurement errors. In any case, there does not seem to be compelling evidence for the World Bank (1981) position that demand for basic nutrients -- particularly calories -- generally increases rapidly with income. 5

Why might calorie/income elasticities be substantially lower than food/income elasticities? Reutlinger and Selowsky (1976), Shah (1983), Behrman and Wolfe (1984a), Bouis and Haddad (1989a), Bouis (1989) and others have conjectured that the reason may be that at the margin people select foods for reasons other than just the caloric value of foods. Such reasons include the attraction of noncaloric nutrients, food texture, status value, appearance, taste, aroma, preparation, composition, and the provision of food for guests and laborers. Many of these elements are not measured in most socioeconomic data sets and therefore their relevance is difficult to assess systematically.

However, several studies do present evidence on some of the considerations mentioned. For example, Reutlinger and Selowsky (1976) present age/sex specific elasticities for calories, proteins, vitamin A, iron and calcium for a sample of poor people in Calcutta. While the elasticities for calcium and vitamin A in this study generally are higher than those for calories, they are not as high as food expenditure elasticities. Behrman and Deolalikar (1987a, 1988d) also present estimates for both micro data for rural south India and for a cross-country sample for the income elasticities of nutrients other than calories (e.g., proteins, calcium, iron, carotene, thiamine, riboflavin, niacin, ascorbic acid, vitamin C, fat). They find that in the case of poor people, the income elasticities are higher for some of the other nutrients (for fat, calcium, riboflavin and vitamin C in the cross-country estimates) than for calories, which suggests that part of the explanation for the low elasticities for calories is compositional shifts at the margin to foods that are not high in calories. But for none of these

---

85Ravallion (1989) argues that even if the calorie elasticities with respect to income are low, if there are large numbers of individuals with calorie intakes close to requirements, the elasticity of some measure of undernourishment (e.g., a head count measure) with respect to income may be high. He demonstrates such a possibility for East Java in Indonesia. His insight means that the measurement of malnutrition dependent on some arbitrary cutoff may be fairly sensitive to income. His results do not mean, however, that household calorie intakes are very responsive to income. Moreover his illustration may overstate the responsiveness of the malnutrition measure to income because in his underlying estimates of household nutrient responses to income he is not able to control for some of the problems just discussed.
other nutrients is the income elasticity as high as that for food, so the preference at the margin for non-calorie nutrients is only a limited part of the explanation for the low-income elasticities for calories. Pitt and Rosenzweig (1985) in their Indonesian study report higher elasticities with respect to farm income for most other nutrients than for calories, but all of their nutrient elasticities with respect to farm income are so small (less than 0.03) that shifts towards non-calorie nutrients can be only a very small part of the explanation for the low calorie elasticities. Bouis and Haddad (1989a) present evidence, as noted above, that the discrepancy between household food purchases and food consumed by household members increases with income in the rural Philippines.

Behrman and Deolalikar (1989c) also conjecture that part of the explanation for the relatively low elasticity for expenditures on calories, as compared with food, lies in an increasing desire for variety as income increases; as income increases, there is a move away from low-cost foods to greater food diversity.\footnote{Bouis (1989) makes a similar point, though he uses somewhat different terminology. He focuses on the demand for food variety in explaining the high price elasticities of food demand of the poor.} They argue that the desire for variety may be associated with two characteristics of preference curves defined over various foods: (1) the sharpness of the curvature, which as it increases indicates the consumption of a more diverse food basket at a variety of food prices (rather than primarily the relatively cheap foods); and (2) the centrality of the preference curves since people with low incomes are likely to have food preferences located close to the axis for the traditionally cheapest nutrient source, but as income increases the preferences may become more centrally located (i.e., closer to symmetric around 45\degree rays from the origin).\footnote{Behrman, Deolalikar, and Wolfe (1988) note a third respect in which variety can be associated with preference curves. Assume that there is a minimum nutrient constraint at low food intake levels, on which preference curves effectively collapse for the very poor, who consume the food that provides calories most cheaply. Then, as income of the poor increases over a range, they maximize their preferences while consuming the same number of calories while changing the composition of their food intake (i.e., increasing variety) so that the nutrient elasticity with respect to income is zero as long as the nutrient constraint is effective. Once income increases enough so that the nutrient constraint no longer is effective, the two dimensions of the desire for variety discussed in the text become relevant.} The researchers test to see what happens to both of these preference characteristics as income increases, in a sample for 1975 and 1980 for 66 countries, using the International Price Comparison project's carefully constructed prices and incomes. They find that starting from low incomes both
preference dimensions of the desire for variety increase as income increases. They therefore conclude that part of the explanation for the low income elasticities for calories (and possibly for other nutrients) is an increasing desire for food variety even at low income levels.

In almost all studies that explore the impact of income on nutrient demands, income is not differentiated by recipient. Thomas (1990) is an exception. In his study of the demand for nutrients of Brazilian urban households in 1974-75, a study partially summarized in Subsection 4.1 above, he distinguishes among unearned income from women, men, and other sources. He reports that the estimated effects of both women's and men's unearned income are positive, but decline as income increases. But the estimated impact of women's unearned income is about seven times that for men's, for both calories and proteins. Subject to the assumption that unearned income represents only an income effect, and not a price/productivity effect, these results provide strong support for the proposition that increases in women's income have much greater positive impact on nutrient intakes than do those for men. But, as is the case for Thomas's estimates for health outcomes (summarized in Subsection 4.1), unearned income may be representing in part price/productivity effects, rather than income effects, since unearned income apparently reflects past labor market earnings (through pensions and social security).

Prices: Traditional demand analysis focuses on market prices in addition to income. A number of studies have estimated nutrient responses to market prices (even though only a relatively few studies have included such prices explicitly in the health reduced-form demand relations discussed in Subsection 4.1). Frequently, the estimated elasticities for nutrients with respect to prices are substantial. Perhaps more surprising, often the nutrient elasticities for prices of major foods are positive, indicating that increases in these food prices improve nutrient intakes.

Pitt (1983), controlling for income, finds that calorie demand in Bangladesh has positive elasticities with respect to the prices of five of the nine foods he considers -- pulses, fish, mustard oil, onions, and spices. Alderman (1987) (also controlling for income) reports positive elasticities for calories and proteins with respect to prices for milk, meat and grain and negative ones for rice, ragi and other food in his fixed effect estimates for rural Karnataka in India. Behrman and Deolalikar (1988f), in their rural south Indian sample, also find positive food price effects except for the price of sorghum, the basic staple, on the individual nutrient consumption of all household members, even with controls for income and individual-specific fixed effects. Sahn and Alderman (1988) report more significant positive than

88In the household demand relation for calories, other unearned income has a puzzling negative estimated impact, declining with income.
negative price elasticities (eight versus six) in calorie demand relations for rural Sri Lanka. Finally, Pitt and Rosenzweig (1985) also find a large number of positive price effects on nutrient demand for a sample of Indonesian farm households even with farm income held constant. The only food price which has a consistently negative (income-constant) effect on all nutrients in this study is the price of milk.

Thus there is evidence of substantial positive income-compensated food price effects on nutrient consumption, at least with respect to prices other than those for the basic staple of the poor. Although most observers would accept the theoretical possibility that if two foods are substitutable, and the price of the high cost nutrient source increases there may be a sufficient shift to the low-cost nutrient source that nutrient consumption increases, the frequency in actuality of this result may surprise those who assume that an (income-compensated) increase in the price of, say, rice must lower poor people's consumption of nutrients.

Another interesting question regarding the price responses is whether they differ with income levels. A survey by Alderman (1986) of 15 nutrient demand studies notes that the majority, including those by Pitt (1983) and Strauss (1984) reviewed above, find that (absolute values of) own-price elasticities of food demand decline with income or expenditure. Sometimes the trend is pronounced, as in the study by Williamson-Gray (1982), who observes a compensated own-price elasticity of cereal demand among Brazilians of -0.74 for the poor, -0.16 for the middle income, and not significantly different from zero for the rich. Behrman and Deolalikar (1989c) and Bouis (1989), as noted above, attempt to rationalize these patterns within a preference framework by referring to increasing desire for variety as income rises. A few studies, such as Williamson-Gray and Timmer and Alderman (1979), also observe systematic relationships between the absolute value of cross-price elasticities and the level of income or expenditure. In his study on rural Karnataka in India, with control for fixed effects, however, Alderman (1987) finds that the cross-price elasticities differ substantially, which suggests that the cross-price effects should be interpreted with caution.

The results noted above refer to interhousehold differences in nutrient responses to prices, but there is much less evidence about intrahousehold differences in nutrient responses to prices, despite frequent conjectures and some evidence that intrahousehold nutrient distributions tend to favor males over females and older over younger children (Harriss 1987, Behrman 1988a,b, 1990c). One reason for the absence of such evidence is that most of the studies reviewed above are based on data on household, not individual, nutrient intakes. An exception is the Behrman and Deolalikar (1990b) study for rural south India which estimates separate nutrient demand relations for men, women, girls and boys. These estimates suggest that nutrient price responses are significantly smaller algebraically for females than for males. This means that females eat less when food is scarce and the marginal value of food is high, even if there are corresponding increases in their food intake when food prices are low (but when the marginal value of nutrients also is lower).
Another dimension of nutrient price responses that may be important, but which has been little explored in regard to price elasticities, is seasonality. A number of authors in Chambers, Longhurst and Pacey (1981) and in Sahn (1989) claim that seasonal effects are very important in determining nutrition and health. Prices fluctuate substantially by season, as has been documented widely for developing societies. Yet another possibility is that nutrient demand price elasticities vary substantially seasonally, which to my knowledge has been examined only by Behrman and Deolalikar (1989a), who estimate separate nutrient demand equations for individuals for seasons of scarcity and of surplus (defined by food availability) in rural south India. They obtain significantly negative food price elasticities of demand for calories and proteins in the lean season, but elasticities that are close to zero or even slightly positive in the surplus season. On the other hand, the estimated wage elasticities of calories and proteins are significantly positive for the lean season, but much smaller for the surplus season. The authors conjecture that this pattern of estimates occurs because the farm households are net suppliers of food but net buyers of labor in the surplus season and net buyers of food but net sellers of labor in the lean season. As a result, an increase in food prices in the surplus (lean) season exerts a positive (negative) income effect on nutrient demand which mitigates or overwhelms the negative substitution effect.

The Behrman and Deolalikar explanation of these results rests on the assumption that farmers cannot adequately store food or food purchasing power across seasons. Given that most of the foods they study are cereals -- rice, sorghum, millet -- this assumption seems strong. Of all foods, these are among the easiest to store. If valid, there may be important implications of the study's results for seasonal price stabilization or storage policies. If not, there is a puzzle as to why they obtain such strong seasonal differences. One possibility that they do not discuss is that the parameters in the reduced-form relations change because of unobserved seasonal changes in the environment or because of seasonal changes in the ways in which time is spent, affecting health through the health production function as is posited in relation 1.2.1.

For infants, finally, mothers' milk is a critical source of nutrients. There is some evidence of important price responses for breastfeeding. Sirilaksana (1982, 1986), for example, reports that in her rural Northeastern Thailand sample, breastfeeding decreases as women's predicted wages increase. Her controls for income and various wealth indicators and for contact with a modern medical program, reinforce her interpretation of this variable as representing the opportunity cost of women's time.

Other Determinants: I discuss the impact of schooling, particularly of women, on nutrient intakes in Subsection 3.1.2. Horton and Miller (1987) explore a related issue: whether females are more interested in nutrition than males. They compare estimates for 83 male-headed and female-headed households in Jamaica in 1983-4. Their analysis of broad expenditure shares and of food subgroup shares do not unambiguously support the common belief that females orient their expenditures more towards basic needs (including nutrition) than men do. In fact, in their sample female-headed households allot larger shares
to luxury foods than male-headed households do. However, female-headed households choose higher quality foods (defined with reference to nutrients other than calories). Such results are provocative though, as the authors acknowledge, the small and non-random nature of the sample makes generalization risky.

Household size and composition are considered as a predetermined determinant of nutrient demand in relation 1.2.3. Behrman and Wolfe (1984a) argue that not only the sign, but the magnitude of the household size elasticity relative to the household income elasticity is important, since it reflects returns to scale with respect to household size. They, as well as Ward and Sanders (1980) and Wolfe and Behrman (1983), obtain statistically significant negative effects of household size on nutrient demand. The estimates presented in all three of these studies imply considerable increasing returns to scale. Iyenger, Jain, and Srinivasan (1968) also estimate economies of scale in the consumption of "necessities" such as cereals, but not in the consumption of "luxuries" such as milk and clothing. However, all of these estimates may as be biased since fertility, and hence household size, may be endogenous variables that are determined jointly with nutritional choices, but not treated as such in these studies. Therefore the coefficient for estimated household size may represent in part unobserved pro-fertility determinants (for example, the parents' desire for children), which may correlate with less investment in nutrition. If so, the estimated household size coefficient understates the returns to scale. Pitt and Rosenzweig (1985) do not include household size as a determinant of per capita nutrient intakes, but do include household composition (treated as endogenous) and find it to be a significant determinant of per capita nutrient intakes. In particular, per capita consumption of calories, proteins, carbohydrates, and phosphorous all are observed to increase with mean household age.

Community endowments also are included in relation 1.2.3, although few studies control for such endowments in their estimated nutrient demand relations. Sirilaksana (1982, 1986) reports a significantly negative impact of one community endowment, village contact with a health program, in her estimates for breastfeeding in Northeast Thailand. She ascribes this to better information among women who have had contact with health programs about normal weaning times and the need for infant food supplements. Wolfe and Behrman (1988) also report a negative effect of community endowments positively associated with urbanization on the length of breastfeeding, which may reflect similar considerations. Pitt and Rosenzweig (1985) find very few significant community endowments in their nutrient intake demand relations. Behrman and Wolfe (1987a) report a significant positive impact of population density, literacy and hospital beds per capita. Their community endowment variables might seem to represent the greater range of food options and greater knowledge of nutrition in more urban and more literate areas. However, if a latent variable indicator of women's unobserved endowment is added, the community endowment variable becomes significantly negative; a possible interpretation is that the above-mentioned indicators of community endowments are inversely associated with food prices. In Behrman and Wolfe
(1989), in contrast, the significant impact of community endowments (negative for population, positive for literacy rates) in standard and random effect estimates is intensified in fixed-effects estimates. But the lack of robustness with the latent variable representation of women's endowments in Behrman and Wolfe (1987a) leads to doubts that community endowments are important.

Summary: The estimated nutrient reduced-form demand relations lead to a somewhat more positive appraisal of the state of our knowledge than do the relations discussed in Subsection 4.1 for health determination. Income effects appear to be common and larger for poorer than for better-off people, although substantially smaller than suggested by the World Bank (1981) and many others. This indicates that even very poor people value a number of non-nutrient food attributes, including food variety. This means that the impact of development, or of redistribution of income, to the poor, is substantially less -- maybe less than half as much -- as often assumed. On the other hand, that the poor seem to value non-nutrient attributes of food relatively highly at the margin, assuming that they are making informed choices, suggests that they do not perceive themselves to be so malnourished as many outside observers do, which lends support to the revisionist nutritionist interpretation of Sukhatme, Payne, Srinivasan and others discussed in Subsection 2.2.2.

Nutrient responses to food prices often seem to be substantial. But they are often positive for prices of foods other than the basic staple (even controlling for income), and even more likely to be positive for rural residents if their incomes are positively correlated with food prices. The poor also tend to have larger absolute price responses than do better-off individuals. Thus effective price policies apparently can have substantial effects on nutrient intakes, but the fact that the effects may be positive as well as negative means that the design of price policies may be tricky for demand reasons, in addition to the need for care with regard to supply responses. The impact of fixed effects on price elasticities in the two cases in which they have been explored for nutrient demand relations (Alderman 1987, Behrman and Deolalikar 1988a, 1990b), however, suggest some need for caution in interpreting the estimated price responses.89

For the other determinants of nutrients that have been investigated, the evidence is less persuasive because there are fewer studies, greater variance

89Deaton (1989a) emphasizes as well problems with a number of food demand relations that use household-specific prices that can cause substantial biases due to food quality variations. He also shows, in a study of a sample from Côte d'Ivoire, that the impact of controlling for unobserved food quality fixed effects may be large. His point carries over to the nutrient and health demand relations that use household prices -- not all of the above reviewed studies do -- to the extent that food quality reflects characteristics other than just nutrients (as I have argued above).
of estimates, and more measurement problems. Economies of scale appear important, so nutrient intakes may decline with the decline of household sizes usually induced by development. But the available estimates may be misleading due to the failure to control for the endogeneity of household size, and this probably causes downward bias in the estimated returns to scale. Improved community endowments may increase nutrient intakes in tandem with development, but very few studies have included community endowments. In some cases, finally, adult schooling has substantial effects. But results about the impact of schooling or of information on nutrients are mixed, and further studies would seem warranted.

4.3 Reduced-Form Demand Relations for Other Health-Related Goods and Services

In addition to nutrients, other goods and services enter into the health production function in relation 1.2.1. Some of these are widely presumed to be related to choices regarding health (given prices), such as the use of formal medical services furnished by different types of practitioners, the use of medicine, and possibly the types of household water supply and sewage disposal. Reduced-form demand relations in the same general form as relation 1.2.3 exist for these goods and services. A few estimates of them have been made recently and are reviewed now.

Behrman and Wolfe (1987a) include demand relations for medical-care usage, and the quality of household water and sanitation in a latent variable system of estimates for Nicaragua in 1977-8. They find that income, mothers' schooling, and community endowments all have significantly positive effects on both medical-care usage on the quality of household water and sanitation.

Akin, Griffin, Guilkey and Popkin (1985) study 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), applying multiple-choice logit models for adults and children to data on 1,903 households from 100 barangays in the Philippines. Extensive explanatory price variables for each of the four types of medical facilities, including the cash price of using the facility, the transport time and cost in reaching the facility, and the drug costs involved, are included in the demand functions for health services. In addition, variables such as insurance coverage; the value of household assets; sex, education, and location (urban or rural) of patients; and severity of illness are included in the demand equations. The

90Both of these variables are treated as unobserved latent variables with imperfect indicators, which include formal medical attention during pregnancy, age-standardized number of injections of children, and participation in the social security system for household medical-care usage; and the nature of toilets, baths, water and sewage disposal facilities for household water and sanitation quality.
authors obtain an almost total lack of statistical significance of any of the economic (price, time) variables. Since the costs of medical care are not trivial in the sample, results which indicate that costs are not significant determinants of the choice of practitioner are surprising. Unfortunately, Akin et al. include the demand for health outcomes (in the form of the severity of illness) as an explanatory variable in their demand for health-care utilization, without treating it as an endogenous variable. Indeed, they find that it is the most important (and only significant) determinant of practitioner choice. The fact that in some circumstances individuals have the choice of allowing their illnesses to become severe may bias the estimated price effects; it could be that health-care prices matter in determining the demand for health-care utilization and practitioner choice by influencing the degree to which individuals ignore their initial symptoms and allow their illnesses to become severe.

Birdsall and Chuhan (1986) also estimate a multiple logit system for the demand for type of curative health services in Mali. Unlike Akin et al., they find significant effects of a number of dimensions of prices — i.e., distance and quality measures. The latter refer to the prior training of personnel and the availability of drugs. They also find a significant impact of remittance income leading to a choice of modern over traditional services.

Mwabu (1989) estimates logit functions for the choice among types of health facilities (see Subsection 3.1.2) for 339 households in a stratified random sample in Eastern Kenya. He finds a significantly positive impact of income on the use of mission clinics and governmental hospitals relative to four other alternatives. He also finds significantly negative effects of both the monetary and time costs (relative to those for traditional clinics), with the latter significantly higher in the wet season, when the opportunity cost of time is greater. Therefore he argues that improving access to facilities and reducing time costs, particularly in relatively poor rural areas, may have large positive effects on health care. Like Akin et al., Mwabu includes illness severity without control for simultaneity, which again raises questions of interpretation.

Gertler, Locay and Sanderson (1987) estimate discrete healthcare choices in 1984 for 3412 Peruvians age 16 or over who had had recent illness symptoms or accidents, in what in two respects is one of the more sophisticated available studies of health-care choices. (1) They observe that if health is a normal good, as income rises, at a given health level the marginal rate of substitutiuon for health must decline, which means that rich individuals are less price elastic than poor ones — but that most (if not all) previous studies precluded such a possibility. (2) They present nested multinomial logit estimates using hedonic price indices.\textsuperscript{91} Their estimates indicate

\textsuperscript{91}These are more general than the multinominal logit estimates used in many previous studies because they allow correlation between consumer utilities that share common attributes. They therefore do not suffer from the assumption of the independence of irrelevant alternatives.
significantly negative effects of travel time and significantly positive associations of consumption with the three health care options (clinics, hospitals, or private physicians); however, education is correlated with a significant shift from clinics to hospitals and private doctors as noted in Subsection 3.1.2. The own-price elasticities are negative for all treatment choices, and more so for the bottom income quintile (up to -1.5) than for the top income quintile (about -0.1). Gertler and van der Gaag (1988b) similarly 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 Côte d'Ivoire who had experienced an accident or illness in the four weeks prior to a 1985 survey. The researchers' estimates indicate significantly negative effects of travel time and significantly positive associations of consumption with all three choices (but with education causing a significant shift from clinics to hospitals and private doctors in Peru, although not in the Côte d'Ivoire). The own-price elasticities are negative for all treatment choices, and are much stronger for the bottom income quartile (up to -2.8) than for the top income quartile (up to -0.7). The estimated price responses, furthermore, tend to be stronger for children (with own-price elasticities up to -2.82) than for adults (a maximum of -1.83). Therefore health care for children, particularly those in poorer households, is quite responsive to changes in prices (including time costs) of health care. Alderman and Gertler (1988) use a similar approach to study the substitution between private and public health care providers for the treatment of child illness in urban Pakistan. They also find larger price elasticities for lower income groups (with a wider range of elasticities for the services of clinics and pharmacies than for private doctors' services) and higher elasticities of substitution among professional care options than between professional care and self-care.

I repeat the observation made at the end of the subdivision on health in Subsection 3.1.2: evidence of effects on health care is not equivalent to evidence on effects of health, and most of the studies reviewed in this paper do not consider the latter.

4.4 Reduced-Form Demand Relations for Child Schooling

Much of the focus of these relations has been on the intergenerational schooling effects that I review in Subsection 3.1.2. Here I return to some of the same studies with regard to the impact of income and community characteristics.

In her Brazilian study, Birdsall (1985) finds that the effects of household income on schooling drop significantly and substantially for 8-11 year olds (but not for 12-15 year olds) if she controls for local schooling quality. The local schooling quality indicators, in turn, have a strong positive impact on years of schooling for children in rural areas and probably in urban areas (though for the latter the evidence is less clear because of negative signs on an interaction term between the length of mothers' schooling and the length of schooling for local teachers). Thus, part of the effect
attributed to parental income in standard estimates apparently depends on the quality of local schools, which may be more directly influenced by public policies than is income.

King and Lillard (1987) find a significant impact of income on children's schooling for Malays, but not for Chinese. If a family had farm income or business income, the length of schooling increased significantly for Malay sons and for Chinese daughters; it fell significantly for Chinese males if there was farm income. For the Philippines, there is no income variable in the King/Lillard data, but there is an association between the time sons and daughters spent in school and the value of the land owned by their families. There also is evidence of greater school attendance by children in more urban areas, and an inverse relationship between school attendance and distance to school.

Behrman and Sussangkarn (1989) estimate post-primary schooling continuation rates for a sample of 2243 Thai households from the 1980/1 Thai Socioeconomic Survey. They find a significantly positive impact of income, but at a declining rate. At the mean points of the samples, their estimates imply that one additional standard deviation in income would add 4.6 per cent to the post-primary schooling continuation rate. This does not seem to be a very major change for such an income increment. The estimate for the effect of income does not vary significantly with changes in the extent of controls for parental schooling. The controls for community characteristics in these estimates are fairly limited.

Behrman and Wolfe (1987b) estimate the impact of household income on children's schooling with their Nicaraguan data. The deviation control for mothers' common childhood background reduces the estimated income coefficient by about two-thirds, suggesting that income in fact is a proxy for other background characteristics. But in neither the standard case nor the deviation case is the estimated income effect very large or even significant.

King and Bellew (1988), in their examination of schooling determinants for different Peruvian cohorts, are not able to control for household income. But they do control for whether mothers and fathers were blue-collar or white-collar workers. For females, mother having no job is significantly positive for the 1925-39 and 1940-44 cohorts, father having a white-collar job is significantly positive for the 1925-39, 1945-49, and 1950-54 cohorts, and father having a blue-collar job is significant for the 1960-64 cohort; but none of these occupational variables is significant for cohorts after 1965. For males, interestingly, in the older cohorts only father having white-collar jobs is significantly positive, but over time, although the coefficient for father's occupation being white collar declines, those for the other occupational categories increase. It is not clear why these parental occupational effects tend to fade for females but increase for males.

King and Bellew also control for whether the individual lived in a city at ages 8 and 13 and for some specific characteristics of the schools (e.g.,
had reading and/or math books, number of grades in school, had furniture, served free lunches, and number of teachers). Living in a city at age 13 increased significantly the schooling of four age cohorts for males, but only one for females (although in the youngest and the oldest cohorts schooling increased significantly for females living in the city at age 8). School characteristics, primarily the number of grades and secondarily the availability of reading and/or math books, increased significantly the years of schooling for most cohorts of females and males.
5. THE IMPACT OF ECONOMIC ADJUSTMENT PROGRAMS ON HUMAN RESOURCES OF THE POOR

Most developing economies face periodic macroeconomic problems of imbalances between aggregate demand and supply; inflation; unemployment; and foreign exchange shortages. The affected countries often undertake macroeconomic adjustment programs to attempt to resolve the problems. These adjustment programs may be developed and undertaken by the countries themselves or in collaboration with the International Monetary Fund (IMF) and (at least implicitly) with important international lenders. Adjustment programs typically involve currency devaluations, government budget reductions, monetary restrictions, freeing of previously controlled prices, and wage restraints. This section focuses on the impact of the economic adjustment programs undertaken by the developing countries on human resources of the poor in those countries.

Some observers, such as Jolly (1985); Jolly and Cornia (1984); UNICEF (1984); the Inter-American Development Bank (1985); the World Food Council (1985) and Cornia, Jolly and Stewart (1987, 1988), have concluded that recent economic recessions and associated macro adjustment programs in developing economies have had substantial deleterious effects on the human resources of the poor in these societies. Jolly (1985) summarizes the results of these studies as follows:

As it mostly operates at the moment, adjustment policy...transmits and usually multiplies the impact on the poor and vulnerable. The result, as shown in many countries, is rising malnutrition in the short run and in the long run, reinforcement of a style of development which will primarily rely on accelerated growth and trickle down, if it works at all, to reduce malnutrition in the future.

Based on this kind of generalization, UNICEF (1984), Jolly and Cornia (1984), and Jolly (1985) call for what Cornia, Jolly and Stewart (1987, 1988) call "adjustment with a human face," with recognition of the possible impact of adjustment programs on the human resources of the poor, policies to limit such effects, and monitoring to be sure that such policies are successful. Despite confident assertions in such studies, however, in my judgement considerable uncertainty remains about the impact of economic adjustment programs on health, nutrition and schooling in developing countries. In this section I

---

92 This section builds upon material in Behrman (1988b) and Behrman and Deolalikar (1988, 1990a). Section 5.1.1. draws on material in Addison and Demery (1985), which is presented in similar but reduced form in Demery and Addison (1987).
attempt to assess what we currently know about the impact of economic adjustment in the developing economies on human resources.

5.1 Implications of Economic Theory for Analysis of Adjustment Policies

Economic theory provides frameworks for analyzing many of the possible links between adjustment programs, the poor, and their human resources. Such structures are useful for understanding these complex phenomena, given the very imperfect state of relevant information. But before sketching the implications of economic theory for this topic, I want to note some limitations of economic theory concerning it. First, for some links in the process there is considerable controversy about which of several alternative theories (for example, some of the macro specifications) is most relevant. Second, in many contexts economic theory leads to clear-cut predictions regarding the direction of changes only by abstracting from some possibly relevant characteristics of the particular situations. Third, often the net effect of macro shocks and macro policies depends on which of several conflicting responses is most important, which is an empirical, not a theoretical, question. Fourth, even if the direction of an effect is predicted clearly by economic theory, the magnitude is still an empirical matter and may be controversial (for example, the size of nutrient elasticities with respect to income, discussed in Subsection 4.2). Fifth, economic theory is most useful regarding comparative statics between equilibrium outcomes, but has very little to say concerning the nature or the lag in adjustments between equilibria. For all of these reasons, economic theory often leads more to useful questions about the income and price changes caused by economic adjustment policies than to very precise answers.

With such caveats in mind, I begin with a discussion of the impact of the major components of standard stabilization programs on resources of poor people, and then I turn to household behavior.

5.1.1 Impact of Major Macro Adjustment Policies on the Poor

A nation's macroeconomy determines its aggregate supply and demand of goods and services, overall price and employment levels, aggregate balance of trade in goods and services, and financial flows with the rest of the world. In the simplest model, the short-run equilibrium aggregate output (income) level and price level are determined by the intersection of short-run aggregate demand and aggregate supply. Aggregate demand depends on private and governmental consumption and investment, and net foreign investment (i.e., exports minus imports). These major demand components, in turn, depend primarily on real permanent income and wealth (and probably the distribution of each among members of society), governmental expenditure minus revenue, prices of international goods and services relative to prices of domestic goods and services, and credit availability and/or interest rates. In the recent adjustment experiences of a number of developing countries, retrenchments in governmental activities, reduced prices and increased imports, restricted governmental credit, and higher interest rates have tended to shift the
aggregate demand curve to the left, though increased exports might have pulled it in the opposite direction.

Expectations also may affect aggregate demand and may cause behavioral responses that frustrate policy changes, as in the so-called Phillips curve tradeoff between inflation and unemployment. In a context of given inflationary expectations, an economy can be subjected to a tradeoff between inflation and unemployment by contractionary policy. However, such policy may reduce inflationary expectations (causing the Phillips curve to shift downward) so that there is little impact on output and employment. Some hold an extreme position regarding rational expectations, arguing that private expectations offset any anticipated policy change, rendering economic adjustment policies largely ineffective. The available evidence does not seem to me to support such an extreme position, but it does seem to be the case that expectations can affect significantly the results of policy.

Returning to the aggregate demand curve, if interest rates or inflationary expectations rise, the curve representing aggregate demand is likely to shift to the left. This causes a decrease in equilibrium real output and the aggregate price level, with the balance between price and output changes depending on whether initial equilibrium was on a more vertical or more horizontal segment of the aggregate supply curve. In many sectors in many developing economies in the 1980's there seemed to be excess capacity, so the changes might have been mostly concentrated in quantities of goods and services produced, instead of their prices.

Short-run aggregate supply reflects the conditions in short-run variable input markets (primarily for labor), intermediate inputs, and financing, at given capacity production levels. The short-run supply curve is likely to shift to the left, resulting in a higher price level and lower output (and income) level, if wages, intermediate input prices, or interest rates rise; if rationed credit becomes less available (assuming that the parallel or "curb" financial market is not well developed); or if production becomes less efficient. Often adjustment programs attempt to restrain wages and to increase productivity through greater exposure to world markets, both of which shift the aggregate supply curve to the right. However, increased costs of imported inputs due to devaluation and higher interest rates work in the opposite direction. In the longer run, aggregate supply tends to shift to the right with increased physical and human capital, improved technology, and improved institutions. A critical question in each situation is, how long is the long run?

The modeling of all of these processes and the impact of policy changes must take into account the markets for the relevant products, production factors (labor, capital, land, intermediate inputs), and financial instruments. Addison and Demery (1985) provide a diagram that illustrates these complexities. Conceptually, an economy-wide model that is appropriately specified (e.g., to include the rigidities) in the computable general equilibrium (CGE) class may be useful for organization and analysis (see, for
example, Dervis, deMelo and Robinson 1982, Adelman and Robinson 1988), although such an approach usually does not adequately incorporate expectations, monetary phenomena, or adjustment phenomena.

With this background, let us now consider the distributional effects of the major components of stereotypical economic adjustment programs.

Currency devaluation usually is a key component of adjustment programs. The wisdom of devaluation, however, has been the subject of much debate because of controversy over its effectiveness in eliminating supply-demand imbalances, because of its inflationary effects, and because of its distributional and related political consequences.

Devaluation increases the costs of imports and the prices of exports in terms of domestic currency. The impact of devaluation on the balance of payments, as well as on those in poverty (of major concern here) depends upon the extent of expenditure switching and the extent of expenditure changes.93

The increase in the prices of internationally traded goods relative to nontraded goods causes expenditure switching. Such shifts benefit the inputs used relatively intensively in traded-good production and the consumers (relatively) of nontraded goods under strong simplifying assumptions (perfect competition, profit maximization, no externalities, well-behaved production functions). Given such assumptions, the implications for the income of the poor in a particular country depend on the factor intensity of production and the nature of consumption patterns.

If tradeable goods and services largely are produced in capital-intensive industries, for example, the factor-intensity effect tends to favor profits, increase income inequality, and probably work to the disadvantage of the poor. However, to the extent that tradeables are basic foods produced largely by poorer members of society as in some economies (for example, Thailand) but not in others (for example, Jamaica), the factor intensity effect is beneficial to the poor. Likewise, the consumption effect depends on the nature of the traded goods and the people who consume them. To the extent that imports are staple foods of poorer members of society, as in Jamaica, the consumption effect is likely to worsen the position of the poor (though poor farmers and landless rural laborers producing competing staples may be net gainers if for them the factor-intensity effect outweighs the consumption

93 If the country is a large enough actor in any international market to affect international prices, there is a further question about the impact of devaluation. However, this factor is of no importance for most products of most developing countries, since the exports involved are usually small relative to world markets (though there are a number of exceptions). I maintain this "small country" assumption throughout this subsection.
effect). In specific cases, these considerations lead to questions about relative factor intensities and relative marginal consumption propensities.

The more one moves away from the simplifying assumptions noted above, the weaker are predictions about the effects on distribution and on the poor of expenditure switching due to devaluation. If the formal/informal sector distinction is important, for example, the above results hold if and only if factors of production are mobile. But, as Knight (1976) demonstrates, if factors are not completely mobile between the formal and informal sectors, there are no unambiguous predictions. Returns to the factor(s) used relatively intensively in the production of traded goods and services increase in response to devaluation, but products of both the formal and the informal sectors may have very different factor intensities (i.e., capital-intensive in the formal sector and labor-intensive in the informal sector, as, perhaps, in tourism or textile production).

Devaluation of a country's currency also may induce changes in aggregate real expenditures, with consequences for distribution and the poor. The conventional wisdom is that eventually exports expand and imports decline in response to relative price changes; this eventually improves the balance of payments in international currencies and probably increases aggregate demand (assuming some unused capacity and/or efficiency inducements of devaluation) and income. However such a process may be quite slow, particularly if the country's exports are goods for which production periods are long (e.g., tree crops such as palm oil and cocoa, minerals such as copper) and for which production capacity is more or less fully utilized at the time the devaluation occurs. There also are offsetting factors that may cause a devaluation to contribute to a contraction of the country's economy. On the demand side, the net trade component of aggregate demand in domestic currency may fall (particularly before exports respond) if there is an initial large deficit; consumption and investment may decline if wealth declines (due to an increase in net foreign debt in terms of domestic currency), or if income falls (due to more rapid induced inflation than changes in factor payments); and investment may be reduced because of higher prices for tradeable investment goods. On the aggregate supply side, contractionary factors include the increasing costs of noncompetitive, imported intermediate imports, and wage indexation, both of which shift the aggregate supply curve to the left with devaluation. Many observers believe that these contractionary demand and supply factors dominate the short-run response to devaluation. If they do so dominate, the aggregate reduction in real expenditure is likely to reduce the real purchasing power of many poor people, as a result of reduced demand for the services and products of the informal sector. In addition, workers who otherwise might have been employed in the formal sector may move into the informal sector, along with people who enter the labor force because other household members have lower earnings or have lost work. This labor supply increase, along with reduced demand, would increase unemployment and reduce labor returns in the informal sector.

Contractionary fiscal and monetary policies are part of most structural adjustment programs since excess demand is perceived to be at the heart of the
imbalance that requires an adjustment program.\textsuperscript{94} Supply expansion takes time, so demand restraint is thought to be essential in the short run. Among the major tools for restraining aggregate demand are contractionary fiscal and monetary policies, which are likely to shift aggregate demand and aggregate supply curves to the left initially, causing a fall in equilibrium output and income and an ambiguous change in the equilibrium price level. (The extent of these effects, however, may depend upon how private expectations respond to the fiscal and monetary policy changes.) Assuming that contractionary policies have some negative impact on output, the balance of payments is likely to improve due to the decreased real purchasing power of the economy, which reduces imports and increases exports. If prices are sufficiently flexible, this effect is reinforced by a decline in the relative prices of nontraded goods and services. Such output reductions and the related declines in labor demand probably lessen the real income of the poor for reasons discussed above.\textsuperscript{9}

The duration and extent of the negative impact of fiscal and monetary contraction on the poor depend on several considerations beyond the extent of the initial leftward shifts in the curves for aggregate demand and supply. Important considerations, of course, are the extent of, and time required for, a longer-run positive supply shift. The larger and the quicker such a response, the less the likely toll on the real income of the poor. Another consideration is the means chosen by the government to cut expenses and increase revenue. Reductions in credit subsidies to capital-intensive manufacturers or increases in income taxes are not likely to have much negative impact on poorer households, but reductions in public health expenditures, food stamps, school lunches or subsidies for staple foods may have significant negative effects on many of the poor. To the extent that the main asset of the poor is their human capital, cuts in health, nutrition and education programs from which they benefit are likely to have negative long-term effects on their current and future resources.

Direct wage and/or price policies often are part of adjustment programs. Since wage increases could offset the impact of economic adjustment policies by shifting the aggregate supply curve to the left, adjustment policy packages often include some limitation on wage increases for governmental and formal-sector employees. If effective, such policies reduce the real income of individuals who would have been employed in the affected occupations.

\textsuperscript{94}In most developing countries monetary authorities do not have much independence from fiscal authorities (in part because of poorly developed financial markets), so the two are considered together here.

\textsuperscript{95}There are possible exceptions with respect to some components of labor income. For example, if prices fall but nominal wages in the formal sector do not fall, workers who receive those wages may experience an increase in real income. However, such workers are not likely to be among those in poverty.
without the wage controls. This may increase overall income inequality, but it is not likely to have a strong negative effect on most of the poorer members of society because the poorer people are not likely to have been in such occupations if there were no wage policy. In fact, to the extent that the limitation on wages is effective, highwage occupations are likely to be more accessible to the poorer members of society than in the absence of effective wage controls.

Price policies as part of structural adjustment programs are likely to involve increases in, or freeing of, previously controlled prices (such as those for transport, fuel, and food staples) in order to induce supply expansion, reduce government subsidies, and discourage demand. If price controls were effective prior to an adjustment program, lifting the controls would be likely to reduce the real incomes of consumers of these items, particularly in the case of an "asymmetrical" price policy, in Foxley's terms (1981: p. 206), of restraining wages while prices are increasing.9

Policies to limit the use of foreign exchange and to encourage the earning of foreign exchange are often part of economic adjustment packages. In addition, under adjustment programs imports commonly are liberalized, with reductions in quantitative import restrictions and tariffs.

Reduced import tariffs have at least three types of effects on income distribution. First, in developing economies such tariffs are a major source of governmental revenues. Unless reduced tariff rates encourage imports very strongly, revenues from tariffs fall, partially offsetting the effect of contractionary fiscal policy. Second, reduced import tariffs change the relative price structure to favor production for export. Within the simplest trade model, a country exports goods which make the most use of resources which are relatively abundant in the country (presumably unskilled and semi-skilled labor for a developing country trading with a developed economy). Third, there is an impact on consumer prices that depends upon the marginal propensities to consume imports rather than alternatives. If the imports are luxury goods consumed mainly by the rich, then the reduced tariffs improve the relative position of the rich. Reduced nontariff import barriers (such as quantitative restrictions) have the second and third effects just noted, but not the first. Instead, the loss of a degree of exclusivity in access to the goods whose availability is restricted by the quotas is likely to be felt primarily by the administrators and recipients of the quotas. Neither group is likely to include many poor people.

96If the price controls were not effective to begin with, removing price controls or raising price ceilings would have little distributional impact except for reducing the incomes of the members of the price control and monitoring organizations (who are not likely to be among the poorer members of society.
5.1.2 Impact on Human Resources of Changes in Income of, and Prices Faced by, Poor Households

Structural adjustment programs ultimately affect individuals or households by altering their incomes or the prices that they face. In this section, as above, prices are broadly defined to include the total costs to an individual or household of goods or services, whether from a private supplier or a governmental agency. If, for example, health clinic services are cut back as part of structural adjustment programs, so that patients have to wait longer for "free" (in monetary terms) services, the price of those services increases.

Households make decisions about their use of time and money, given their assets and the prices they face for the use of those assets and to buy goods for consumption, as is discussed in Subsection 1.2. For the poor households of interest here, the primary asset is labor, with varying but limited skills. (That means that wages and employment options are particularly important in determining household income.) But many poor households also have land (e.g., subsistence households and small farmers) and capital (e.g., households in the manufacturing or maintenance parts of the informal sector, as well as farm households), so returns to assets other than labor may be important in determining their income. The consumption prices of obvious direct importance to human resources are those for the goods and services that determine human resources most directly -- food, potable water, schooling, preventive health measures, curative health care, housing, sewage, and clothing. But since the actual use of such items by poor people depends on relative prices and on poor people's real income (which depends on all prices for goods and services in the consumption basket of the poor), other prices may be important as well.

The impact on a household of structural adjustment programs depends on (a) how the exogenous and predetermined variables in the reduced-form demand relations discussed in Sections 1 and 4 are altered (particularly the relevant returns on assets and prices broadly-defined, but possibly also community endowments) and (b) how the alterations are filtered through the household. With regard to the latter, there are a number of critical questions. How responsive are individuals or households to relative price differentials? If the price of nutrients from important foods increases due to an economic adjustment program, for example, is there very much shifting to cheaper nutrient sources? How much fungibility is there among individuals in the use of returns from assets? To what extent, for instance, is the loss of a formal-sector job due to an adjustment program by one member of the household offset by increased activities of other members of the household in the informal sector or elsewhere? Does it make a difference whose returns to assets are affected (e.g., women's or men's)? If women are induced by changes in the economic environment to participate more in the labor force, what are the tradeoffs between their increased command over market resources and reduced time in household activities pertaining to child health, nutrition and education? To what extent and for how long (note the long adjustment experiences of a number of countries) can a household draw down existing assets in order to tide its members over a transitory bad period? At what point are changes in the economic environment likely to lead to disintegration of a household, to the possible disadvantage of some of the more vulnerable members?
5.2 Empirical Evidence on the Impact of Adjustment Programs on the Poor and on Their Human Resources

No available studies examined the links between adjustment programs in developing countries, with theoretical frameworks such as those outlined in the previous section, and with careful empirical control of all relevant factors. But some studies haveconsidered systematically the critical links in the process, and in which intervening links have been collapsed to simplify the analysis. A number of these studies are reviewed below, roughly following the order in which they were presented in Subsection 5.1, starting with studies on policy in developing countries, then some that treat household responses to economic recessions or adjustments and more fundamentally country studies focusing on education, nutrition, and other direct measures of education, health, and nutrition.

5.2.1 The Effectiveness of Adjustment Policies on Macro Outcomes in Developing Countries

The effectiveness of macroeconomic adjustment policies is a matter of considerable controversy, as suggested in Subsection 5.1.1. Simple aggregate supply and demand curve analyses suggest that macro adjustment policies that shift aggregate supply and demand can be fairly effective in altering equilibrium output if the initial equilibrium is on the more horizontal part of the aggregate supply curve, and that they can be fairly effective in altering the equilibrium price if the initial equilibrium is on the more vertical part. But some, such as Malor (1974), question whether policy makers in developing economies have enough policy tools to attain multiple objectives given such factors as equate capital markets and resulting ineffectiveness of monetary policies. Others, such as Rao (1952), doubt that the initial equilibrium of developing countries is on the more horizontal part of the aggregate supply curve because of supply shortages and because of large traditional semi-subsistence sectors that are relatively isolated from the market economy. In such a case, macro adjustment policies primarily affect the price level, rather than output or employment. Still others, such as Lucas (1973), Fernandez (1979), and Barro (1979), have queried whether private expectations may make macro policies ineffective in developing economies. The Phillips curve tradeoff between inflation and unemployment conditional on expectations that is discussed in Subsection 5.1.1 provides an example of the potential effect of private expectations.

If any of these arguments is correct, adjustment programs do not have much impact on output and employment, and therefore probably not much impact on the poor and their human resources, although there still could be some important effects on the composition of production and consumption.

A great number of empirical studies are related to this issue. Unfortunately, they do not settle it because of institutional differences.
among developing countries; the difficulties in capturing, in a tractable empirical framework, the macro complexities of any economy (particularly such features as adjustment lags and expectations); and the tendency of macro models to reflect initial theoretical model specifications (the "closure" problem). Nevertheless, a selective review of some of these studies may suggest conclusions about the impact of macro adjustment policies.

The tests of the Phillips' curve tradeoff between employment or output and inflation include Lucas's (1973) seminal paper in which he presents tests for 18 countries, including five nations in Latin America plus the Commonwealth of Puerto Rico (the rest are in Europe or North America). His tests suggest that the "apparent short-term tradeoff is favorable, as long as it remains unused" (p. 333), but in countries (namely Argentina and Paraguay) with a volatile price history and relatively high variance in demand the inflation-output tradeoff is very unstable. Brodersohn (1979), Fernandez (1979) and Barro (1979) report results that they interpret as basically consistent with Lucas's conclusion for five Latin American countries. Both Barro and Fernandez report that unexpected money supply changes are relatively ineffective in changing output (rather than prices), though Barro does report a significant effect for Mexico. Hanson (1980) reports "a small though significant relation between output or growth and 'unexpected' inflation" for "moderately inflationary" Latin American countries; the correlation is substantially stronger than the one obtained by Barro, and it falls between the relationships found by Lucas for the 16 relatively price-stable countries on one hand and the two price-volatile countries on the other. Nugent and Glezakos (1982) report estimates for sixteen Latin American countries; they find no significance of unanticipated inflation for the least agricultural countries, and a negative output impact (unlike in the standard Phillips curve) output impact for the more agricultural countries.97

A second group of studies attempts to evaluate the impact of macroeconomic policies on aggregate economic output in developing economies through simulations using models of those economies. A major, longstanding method of evaluating short-run impacts of economic adjustment policies is the use of macroeconometric models in the Keynes-Tinbergen-Klein tradition. There exist literally hundreds of macro models in this tradition (Lau, 1975; Beltran del Rio and Schwartz, 1986). A typical model of this type initially tended along Keynesian aggregate-demand lines, as if initial equilibrium were along a horizontal aggregate supply curve, with the implication of fairly substantial impacts of economic adjustment policies. Many subsequent models have incorporated supply constraints, devaluation impacts on costs of intermediate

97 They interpret the negative association to reflect the lack of supply price rigidities (which the Lucas formulation emphasizes) in agricultural societies which harkens back to Rao (1952). This interpretation does not seem very persuasive.
inputs and investment goods, adjustment lags, and other realistic features of developing economies. Such studies usually report some impact of economic adjustment policies, but much less than reported in the pure aggregate demand models, and often with substantial lags that make successful detailed predictions and policy formulation extremely difficult (e.g., Behrman 1977).

More recently there has been increasing emphasis on social-accounting matrix (SAM) models and computable-general equilibrium (CGE) models for analysis of the impacts of economic adjustment policies in developing economies (Adelman and Robinson 1978, 1988; de Melo and Robinson 1980; Dervis, de Melo and Robinson 1982; Pyatt and Round 1979; Pyatt and Thorbecke 1976; Taylor 1979, 1983). An interesting example of the use of CGE models is provided by the simulation studies of the impact of devaluation on distribution within three archetype economies (an exporter of primary products, an exporter of manufactured goods, and a relatively closed economy) by de Melo and Robinson (1980), summarized in Dervis, de Melo and Robinson (1982). These simulations suggest that much greater devaluation is required to eliminate an initial balance-of-payments deficit in the relatively closed economy than in the others because of the closed economy's greater dependence on imported intermediate inputs; devaluation leads to an improvement in the income share for small holders for all three archetype economies, but leads to mixed effects on income distribution to other low-income groups, depending on the structure of the economy; and price changes play a major role in changes in real income.

Another recent relevant CGE example is the Adelman and Robinson (1988) study of the sensitivity of distribution patterns to macroeconomic adjustments in two CGE models, one (parameterized) based on Korean data, and the other on Brazilian data, with alternative model closure rules. They find that the income distributions are quite comparable and that the wage share varies little, which leads them to conclude that "the feeling which appears to exist in the profession that the [alternative] closures generate totally different distributional results seems wholly unfounded" (p. 43). But the impact is larger on what Adelman and Robinson call "the extended functional distribution that distinguishes classes of income recipients by sector of activity as well as by asset ownership" (pp. 23-24) and therefore on the poor as a percentage of the labor force or of the population. For example, their investment experiment caused the poor to increase from 30.0 to 38.0 per cent of employment in Brazil, and from 29.6 to 34.0 per cent of the population in Korea. (Parallel numbers for the researchers' export drive experiment are 24.9 to 27.2 per cent and 25.8 to 28.5 per cent). Thus the impact of macro adjustments on the poor within the CGE framework seems to be fairly sensitive to model specifications.

The CGE approach has some advantages over traditional macroeconometric models: CGE specifications are more soundly based in economic theory and are more complete, including with regard to income distribution, than those used in most models in the macroeconometric tradition. On the other hand, at times the estimation of these models is quite cavalier; monetary phenomena usually
are precluded from the models; and the focus on market equilibria in the models often is accompanied by inattention to adjustment lags and expectations that may vitiate the value of the models for analysis of short-run economic adjustment programs. Also, like the macroeconometric models and other models, CGE models are limited by some of their assumptions (e.g., the assumption of unitary elasticities of substitution in production, in de Melo and Robinson 1980).

A third group of studies consists of country studies that tend to use less systematic modeling approaches and empirical tests to evaluate the economic impact of stabilization policies. Probably the best known are those edited by Cline and Weintraub (1981) and Killick (1984a,b). The limited emphasis on formal frameworks in these studies leads to a richer, but looser, range of interpretations. Cline and Weintraub (1981: p. 35) note, for example, with regard to income distribution, that "The contrast between the 30 to 40 per cent real wage reductions in the Southern Cone [of Latin America] and nominal wage increases to maintain real wages in Pakistan is striking, and success at reversing inflation was at least as great in Pakistan, although from a lower base." Such results suggest the possibility in practice, not only theory, of buffering at least some of the poorer members of society from negative consequences of adjustment programs by means of appropriate design of those programs. But since some members of society have their incomes reduced in the short run if the country's economic adjustment program is successful in reducing a demand-supply imbalance by contracting demand, there remains the question of how to ensure political will and power to protect the poorer members of society.

The empirical studies on the economic impact of macroeconomic adjustment policies have problems, in part because of the complexities of economies, the limitations of macroeconomic theories, and inadequacies of data. Often there are questions about simultaneity, structural changes, unobserved variables such as price expectations, the time period for observations, lag patterns, and built-in restrictions of the models. Nevertheless, the studies do seem to support the conclusions (1) that economic adjustment policies often have significant impact on macro outcomes, such as output and employment, which in turn effect income distribution and relative prices, with potential to affect the poor and to alter their human resources; and (2) that there has been a range of experiences with regard to the income distribution effects of such policies, which suggests that there are mechanisms to buffer the poor if there is sufficient political will to do so.

5.2.2 Changed Composition of Governmental Expenditures in Adjustment Programs

Changes in governmental expenditures as part of economic adjustment programs may affect the education, health and nutrition of the poor; indeed, the conventional wisdom regarding such changes is that they discriminate against the social sectors related to human resources. Hicks and Kubish (1983: pp. 23) provide several quotations about the alleged relative vulnerability of the social sectors in various writings of the World Bank.
Other examples also may be found, for instance in UNICEF (1984: p. 161). Surprisingly, very little empirical work was undertaken on the vulnerability of social service sectors to government cutbacks prior to the work of Hicks and Kubisch (1983, 1984).

Hicks and Kubisch examine all 37 cases of adjustment programs that involved cuts in real governmental annual expenditures in developing countries during 1972-80. They asked whether the percentages of cuts in governmental expenditures in five categories (social, defense and administration, production, infrastructure and miscellaneous) were larger or smaller than the average overall expenditure cuts. Their results suggest that, contrary to the conventional wisdom, on the average social expenditures were the most protected of the five categories (and somewhat more so in low-income countries than in middle-income countries). On the other hand, cuts in the production and infrastructure categories may affect income and health of poor people by reducing demand for unskilled labor in the construction sector. However, Hicks and Kubisch caution against drawing too firm conclusions from their estimates because of the small number of cases and because the data on the expenditures are from consolidated central governmental accounts; the data do not include expenditures of publicly-owned corporations and enterprises, nor those of state and local governments.

Pinstrup-Andersen, Jarmitto and Stewart (1987) have done a similar analysis for 1979-84. They find more ambiguous results than Hicks and Kubisch did, but still found that in two-thirds of the cases the social sectors were not cut more than overall governmental expenditures.

Cheap food policies, including the subsidization of food, are particularly relevant to the human resources of the poor. The food policies of several countries have been studied in some detail, perhaps in part because of the urban demonstrations (if not actual riots) sparked by efforts to reduce or remove food subsidies in countries such as Egypt, Peru, Algeria, the Dominican Republic, Haiti, Morocco, Zambia, Sudan, Jamaica, Zaire and Turkey. What are the likely impacts on health and nutrition of reducing or eliminating food subsidies?

This is a difficult question. The answer depends upon the incidence of the food subsidies on the various income groups; whether there would be supply

---

99 Preliminary studies by others also suggest that the use of category-specific price indices and comparisons covering a period longer than just the previous year may weaken the extent to which social sectors appear to be favored, but even those adjustments do not to lead to the conclusion that the social sectors are cut significantly more than other sectors.
changes associated with the removal of such subsidies (for example, induced supply expansion due to higher prices paid to agricultural producers); how the poor respond to the increased food prices; and whether there are any compensatory policy measures.

Pinstrup-Andersen (1985, 1986a,b) surveys many studies of the impact on the poor of the termination of cheap food policies. Since expenditures on food are a large proportion of the expenditures of low-income consumers (typically 60–80 per cent of income), increases in food prices have much greater impact on the poor than on the well-off. Pinstrup-Anderson (1985: p. 71) estimates the impact, in percentages of real income, on the lowest and highest deciles of households' income: 8.5 and 4.1 for Sri Lanka; 6.0 and 2.0 for Thailand; 5.6 and 1.0 for Egypt; 7.3 and 2.9 for India; and 7.7 and 6.5 for Nigeria, for a 10 per cent increase in all food prices. Typically cheap food policies apply to only a few of foods (though often including some staples), so these estimates probably overstate the negative impact on real income of adjustment policies that increased food prices by 10 per cent. Nevertheless, they suggest that removing food subsidies has substantially greater impact on the poor than on others.

On the other side of the market, the elimination of cheap food policies is likely to result in increased prices for food producers. However, Pinstrup-Andersen argues that the short-run impact of increased food prices on the rural poor is much less favorable than might be anticipated, because many of the rural poor do not derive a large share of their income from food production-related activities. He also cautions against assuming high food supply elasticities, even over a long time, because changes other than higher food prices are required to increase food production enough to bring concomitant gains to the rural poor.

Based on these considerations and on studies that have looked at other dimensions of food subsidy programs, Pinstrup-Andersen (1985) concludes that "food subsidies have increased incomes and improved nutritional status among the poor, particularly, but not exclusively among the urban poor." He also observes, as have many others, that the cost of general food subsidy programs may be quite high, particularly if there is a policy (as often seems to be the case) to keep the nominal price of subsidized foods relatively constant in the face of overall inflation. Behrman (1988a: p. 126), cites cases where food subsidies account for 23 per cent of GDP and up to 12 per cent of governmental expenditures. Reducing the costs of many countries' food subsidy programs without severely affecting the income of the poor seems possible, given the broad incidence of many of the programs to guarantee cheap food. For Morocco, for instance, Mateus et al. (1986) estimate that the wealthiest 30 per cent of

---

100 Unless the cheap food policies involved consumer subsidies with arbitrage between consumer and producer prices precluded.
the population received 47 per cent of the subsidies and the poorest 30 per cent received only 16 per cent. Ahmed (1979) reports that in a Bangladesh program two-thirds of the subsidized grain was distributed in urban areas, even though most of the poor reside in rural areas. Alderman and von Braun (1986) estimate that the absolute value of a food subsidy is almost constant among income groups, including those in the middle and upper parts of the range of incomes.

If it is administratively and politically feasible to limit the benefits of food programs to the poor and nutritionally vulnerable, it may be very attractive to do so in the context of adjustment programs. Mateus (1985), Mateus et al. (1986) and a number of others argue that substantial reductions in the costs of policies to provide cheap food can be achieved by greater targeting. Targeting methods include subsidization of foods that are consumed principally by the poor, and direct distribution of food to those thought to be most vulnerable, such as infants and pregnant women. For Morocco, Mateus et al. (1986) estimate greater targeting of food programs could serve most of the poor who now benefit from food subsidies with a budgetary cost of 11 per cent of current food subsidies. Even if this is a substantial underestimate due to unjustified optimism about the costs of expanding existing targeted programs and about leakages, it suggests the possibility of considerable budgetary gains from targeting. Likewise, Gavan and Chandrasekera (1979) claim that a shift in the second half of the 1970's to a more targeted program (including a shift to food stamps, and the exclusion of about half the population from the program) cut by more than half the Sri Lankan Government's cost of food subsidies to the poor. Alderman and von Braun (1986) have conducted careful simulations of different options for the Egyptian food subsidy system and conclude that "major fiscal savings may be obtained only by substantial modifications [i.e., reductions] of the bread and flour price subsidy and the subsidies paid to consumers of the cooperative shops (e.g., for meat and poultry, macaroni) or by targeting." Such

101 There generally are leakages to other household members in the latter type programs. Beaton and Ghassemi (1979, 1982) reviewed over 200 reports on food distribution programs targeted towards young children and found that the net increase in the food intake of the targeted children was 45-70 per cent of the food distributed. The other 30-55 per cent of the food distributed increased the real income of the rest of the households, perhaps with nutrition and health benefits.


103 In their targeting simulation, they assume that rations are discontinued for all but the poorest 25 per cent of the population, that this part of the population also receives an additional flour ration, and that bread at the current fixed nominal price is available only in the poorest 20 per cent of urban neighborhoods (p. 29).
examples indicate that a number of governments could cut their expenditures on cheap food programs without reducing the income of most of the poor. Thus there seems to be some leeway to protect the poor during periods of structural adjustment, though it is not clear why such changes should be introduced only for the duration of adjustment programs.

Cheap food policies are not the only social policies related to human resources that may be cut as part of economic adjustment programs; cuts in health and educational services may also be made, with both immediate and longer-run impacts. Jimenez (1986a,b) provides a recent survey of pricing policies for health and education in developing countries. He concludes that there could be substantial gains in efficiency from user charges for selected types of health and education programs whose benefits accrue primarily to the individuals concerned, such as hospital care and university education. In these cases, the elimination or lessening of subsidies probably improves efficiency because of a lack of positive externalities and public good characteristics, although some might question whether merit goods may be involved. Jimenez adds that "the impact of increased user charges need not be inequitable, since present distribution of subsidies tends to be highly skewed towards higher income groups, who obtain greater access to more costly social services ... even if they are uniformly free for all. Under these circumstances, the expansionary effect of fee increases for selected services (and if possible, for selected individuals) may actually improve equity in the distribution of public resources." Such a characterization suggests that as part of structural adjustment programs, social programs in health could be altered through selected user charges that did not adversely affect the poor. However, some of the recent studies that point to relatively high price elasticities in health-care demands for the poor (see Subsection 4.3) suggest that operating user-free programs without negative effects on the poor might be more difficult than Jimenez indicates. Politically, user fees also may be very difficult, maybe even more difficult than targeting food subsidies. If a country were to adopt increased user fees, however, there would be no need to abandon the program at the end of the adjustment program.

104 But not including those (such as some types of preventive medical care) for which the benefits are considerable to society as a whole (because there are large positive externalities).

105 These results suggest that the poor reduce their use of health care by more than the better off if there are price increases. However within standard demand analysis, it does not necessarily follow that the poor are made relatively worse off. To the contrary, their greater adjustment implies that their loses due to price increases are relatively smaller.
5.2.3 Household Responses to Income and Price Changes

The most important effects of structural adjustment programs on households or individuals are to change their real incomes and the prices, broadly-defined, that they face. Subsection 5.2.2 summarizes evidence that reducing or eliminating governmental programs such as those providing cheap food may reduce considerably the short-run income of the poor — not infrequently by 10-20 per cent, and in some cases by much more. Relative prices may change substantially, and, for cuts of the sort discussed in Subsection 5.2.2, the relative price changes are likely to discourage the consumption of goods directly related to human resources.

Most of the available information about the impact of these changes in income and relative prices pertains to food consumption. Numerous studies report strong correlations between income and food expenditures, with reductions in food expenditures often 8 to 9 per cent for every 10 per cent drop in income among poorer populations. There is also considerable evidence that the poor are very responsive to relative prices in deciding what food items to consume (e.g., see Alderman 1986; Pinstrup-Andersen 1985, and Subsection 4.2). The income and price responses of the poor also are large with respect to non-food health inputs, although there are fewer studies of these than of the food-related responses. Gertler, Locay, and Sander-on (1987), Gertler and van der Gaag (1988b), and Alderman and Gertler (1988), for example, provide persuasive recent evidence for Peru, Côte d'Ivoire, and Pakistan on differential health-care demand responses by income classes (Subsection 4.3).

However, the large responses in expenditures on food do not necessarily imply large changes in the consumption of nutrients. As discussed in some detail in Subsection 4.2 above, even quite poor households apparently substitute considerably among foods and have income-associated leakages between food acquisition and consumption by household members so that they change their nutrient intakes relatively little in response to income changes. If this is so, the impact of economic adjustment policies on the consumption of nutrients by the poor probably is much less than often assumed. Note that this means that many policies designed to provide cheap food are as much a means of transferring income as of improving nutrition directly. Therefore if one is concerned with the income or the welfare of

\[ \text{Based on cross-country estimates, for instance, Behrman and Deolalikar (1988d) report a drop on the average of 8 per cent for every 10 per cent in income, with a somewhat larger (smaller) drop for poorer (richer) populations.} \]

\[ \text{One might ask why direct income transfers would not be preferable. Pinstrup-Andersen (1985) argues that food subsidies are more acceptable politically.} \]
the poor, one should be concerned that reductions in food subsidies decrease income, but one should not too easily assume that the reductions greatly impair nutrition. Whether there are similar results with regard to other factors affecting health is not obvious. There may be, if there are present differentially-priced close substitutes.

A further question pertains to the impact of nutrient changes on health status. This is a somewhat murky area. However, a number of recent studies suggest that the impact of small changes in nutrients may be much more in terms of body heat and energy expenditure than in terms of longer-run anthropometric or clinical measures of health (Payne 1985; Srinivasan 1985; Sukhatme 1982). To the extent that this is the case, the negative impact on health of economic adjustment commonly may be overstated, despite possible short-run effects on energy expenditure and time productivity (Subsections 3.2.1 and 3.2.2). But again there are some counterexamples. For instance, Isenman (1980) presents time-series evidence for Sri Lanka that mortality has responded positively and significantly to the price of rice, presumably in part through the relationships among prices, nutrient intakes, and health. Further, even if there is no effect on anthropometric and clinical health indicators, any effect on short-run energy expenditures are a matter of concern.

5.2.4 Country Studies on the Evaluation of the Impact of Structural Adjustment Programs on the Poor and their Human Resources

The most visible of these studies are associated with UNICEF (Jolly and Cornia 1984; UNICEF 1984; Cornia, Jolly and Stewart 1987, 1988). These studies do not formalize explicitly the links between recession and/or economic adjustment and the human resources of the poor. Instead, they use secondary data to characterize some of the links to factors such as unemployment; the composition of governmental expenditures; and direct indicators of health, nutrition, and schooling.

The individual chapters in Jolly and Cornia (1984) provide a useful catalogue of trends, but little information on changes due to recessions and economic adjustment programs. With a focus on possible negative impacts on children of recessions and economic adjustments, the authors appear to have pressed hard to find examples of deterioration in children's conditions, but provide little direct evidence of it. To the contrary, Preston (1986b: p. 376), in his review of the Jolly/Cornia volume, wrote:

...What is remarkable is that the best data on children's status in most of the countries reviewed -- that on infant and child mortality -- shows continued decline near everywhere. Nutritional status indicators also typically show improvement and so do school enrollment figures, despite downturns in governmental expenditure on health and education in some countries.
Preston therefore suggests that the appropriate conclusion, subject to conceptual and data difficulties, is that these studies indicate "how much can be achieved even in the face of unusual economic adversity -- surely good news for social policy..." Preston complains that instead of such emphasis, the editors have a "penchant for stressing the negative trends... (a distinct minority) [that] receive the lion's share of the editors' attention in the introduction and summary." Thus, a set of studies that suggest little, or at least unproven, systematic impact of recession and economic adjustment on human resources is summarized as finding that adjustment policy usually multiplies negative recessionary impacts on the poor and vulnerable. In this connection see Jolly (1985) and the statements by Cornia in the summary to Jolly and Cornia (1984) that "the present crisis...has severely aggregated the situation of several social groups," "...child welfare indicators...are unambiguous in pointing to a deterioration in child status...," and "In most countries one observes...a serious deterioration in indicators of nutrition, health status and school achievements..." 

In the spirit of Preston, after reviewing a number of studies related to the impact of economic adjustment on health and nutrition, I conclude in Behrman (1988a: p. 132),

Certainly I share the judgements expressed in the UNICEF studies that the situation of millions of poor (including children) is appalling, that substantial deterioration may have occurred due to recession and economic adjustment that is not very visible because of the poor quality of data monitoring health and nutrition outcomes, that the effects of such deterioration may be lagged and may appear only much later -- particularly for children (e.g., Selowsky and Taylor 193), and that better data are desirable to understand the impact on nutrition and health outcomes. But I do not see these studies as having demonstrated that economic adjustment policies have had deleterious effects on health and nutrition in developing countries or that health and nutrition would have been substantially better without the economic adjustment policies or with different economic adjustment policies.

108 Preston (1986b) also notes that the case of South Korea, nicely reviewed by Sang Mok Suh in the Jolly and Cornia volume, scarcely is mentioned in the editors' introduction or summary even though South Korea has had rapid gains in child growth and child survival, as well as high economic growth and great success in adjusting to world economic fluctuations. Preston goes on to state "There is a certain irony when a strategy of economic development is so successful that one's social successes get discounted. But survey countries like South Korea are instructive when setting the broad parameters of social economy policy."
More recently I have been involved in an examination of the Jamaican experience regarding the impact of structural adjustment on social sectors and on the poor (Behrman and Deolalikar 1988e, 1990a). Detailed examination of the data available leads me to conclude that Cornia, Jolly and Stewart (1987: pp. 113-115) overstate substantially the evidence of deterioration in the welfare of the poor in their summary of this case. Cornia and Stewart (1987: pp. 114-115) agree with Behrman and Deolalikar that the negative impact of the Jamaican structural adjustment was strongest in 1984 and 1985. Cornia and Stewart claim that the program in those years was "strongly deflationary;" that "incomes per capita have been declining...since 1983;" that "unemployment remained very high at 26 per cent overall in 1984;" that "educational expenditure per head of the population declined by 40 per cent" (apparently for 1981/2 1985/6), and that hospital admissions of children suffering from malnutrition increased sharply in 1984 and 1985. However, the examination in Behrman and Deolalikar raises questions about each of these assertions. Real GDP per capita, the consumer price index, the inflation rate, and the employment rate did not deviate significantly below the trend lines in 1984 and 1985. Educational expenditure per child age 5-14 declined by 8.6 per cent between 1981/2 and 1985/6, not by the 40 per cent that they claim (which apparently reflects the use of the general GDP deflator rather than the sector-specific deflator). Real food expenditures in 1984/5 increased significantly above the trend. The increases in the proportion of "malnutrition and/or gastroenteritis" cases among children admitted to the hospital fell from 23.5 per cent to 19.0 per cent from 1983 to 1984, which more than offset the increased shares for the separate category of "malnutrition" (2.1 to 2.4 per cent) and for the separate category "gastroenteritis" (2.0 to 2.7 per cent).109 This comparison between the UNICEF characterization of the Jamaican adjustment experience and ours reinforces my earlier skepticism about the empirical foundations of the UNICEF claims. And I am not sure that the aim of improving human resources of the poor in developing countries is well served by focusing on the adjustment issue with its apparent weak empirical bases.

109 There are a number of other problems with these data, including the selectivity of admissions to one hospital.
The impact of economic adjustment programs on the poor and on their human resources is an important issue, but it is not the only interesting macroeconomic question regarding the relationship between poverty and human resources; there are also basic questions about the nature of the interactions within a long-range perspective. I review here first some efforts to explore such issues within an applied macroeconomic framework; then I turn to neoclassical growth models that treat human resource externalities; and finally, I review some cross-country estimates of related reduced-form relations.

### 6.1 Structural Macroeconomic Models with Endogenous Human Resources

The microeconomic analysis summarized in Sections 3 and 4 provides a number of insights into relations between human resources and poverty in developing countries; bringing these elements together in a macroeconomic framework as well could help us better understand the complex interactions of poverty and human resources. However, there are many problems in building a macroeconomic framework, including the problems of estimating micro relationships such as those discussed in Sections 1 and 2, plus other relations pertaining to supplies and the foreign sector, all within a framework with endogenous income distribution and a multiplicity of household types that satisfactorily treats the macro issues suggested in Section 5. Some research strategies abstract from so many of these features that it is hard to believe that they are representative of the overall macro reality. At the other end of the spectrum, "simulators construct large process models which occasionally stray into... science fiction," (Wheeler 1984: p. vii) and are so complicated that they are like black boxes whose contents are very hard to interpret. The task of designing empirical macro development models is indeed a difficult one, particularly if the determinants and effects of poverty and human resources are included. For this reason, macro development models probably have contributed less to our understanding than their architects originally hoped. Often the models have provided enlightenment to the researchers involved about how the components of the models they have developed interact, if not the components of the economies under study, without generating many insights that are readily transferable to many other people. Yet, to paraphrase Robert Solow, macro development models are the "only game in town" for understanding human resources and poverty within an overall framework, so it is useful to review some of them. Given the Herculean nature of their tasks, it is inevitable that each model has both strengths and weaknesses.

Perhaps the best-known macro studies of human resources and development in the past two decades are those on the impact of malaria eradication in Sri Lanka by Barlow (1967, 1969). I summarize this work based on Barlow and Davies (1974). The model has 50 relations that yield representations of the population of equivalent consumers, production, labor quantity, labor quality, capital quantity and capital quality. At the heart of the process is an
aggregate production function that is characterized by constant elasticity of substitution and that is based on the quality and quantity of labor and of capital, and on technological change. Adjustments of these inputs reflect the age structure and previous schooling of the population and gestation periods for new physical capital investments. Population changes are ascribed to age-sex-education specific mortality and fertility rates and tied to per capita income. The parameters of the model are apparently based on point estimates from Sri Lankan and international sources. A malaria eradication policy is simulated, yielding immediate reductions in mortality, morbidity and debility rates, and an increase in fertility rates (malaria causes miscarriages). There is also a projection of gradual improvement in the geographic allocation of resources, as capital and labor are moved into fertile areas previously avoided due to malaria. The effect of the policy on income per equivalent consumer is positive for the first eight years because of the policy's immediate positive impact on the quantity and the quality of labor primarily through a reduction in morbidity (mortality reduction is primarily among infants, so the effect on labor supplies is delayed). Thereafter income per equivalent consumer is projected as below what it would have been without malaria eradication, due to a greater population increase and a consequent reduction in physical investment (since both private and public current expenditures are positively correlated with population). Therefore, if the eradication of malaria improved welfare through reduced morbidity and mortality, the improvement was due to the fact that the gains more than offset the eventual loss in income per equivalent consumer.

A number of questions can be raised about the model specification, including the lack of price effects (which appear important in some of the micro studies reviewed in Sections 3 and 4); whether the treatment of exports and foreign borrowing as exogeneous does not bias downwards the estimated effect of malaria eradication by implying a reduction in per capita foreign resources as population is induced to grow (Borts 1967, Newman 1967); and whether parameter stability is plausible (Newman 1967). Nevertheless, the question that Barlow investigated required an overall macro framework, and his studies have raised the important question of whether the impact of malaria eradication on economies had been understood fully before.

Wheeler (1984) gives an example of an econometric model based on cross-country data, with changes in human resources and demographics considered endogenous, within a fairly small (and therefore fairly understandable) supply-based model. The data are from 1960-1977 and involve 88 countries. At the heart of the model is an output production function in which output is determined by capital, the effective labor force (the adult population adjusted for nutrient availability, adult literacy, and health measured by life expectancy), and an index of technical progress. Nutrient availability is determined by current and past per capita product; adult literacy is determined by current per capita product and past schooling; and life expectancy is determined by current per capita product and by current and past nutrient availability, adult literacy and health services. Simultaneous estimates are presented of the basic relations. Wheeler interprets the
results to indicate that output, education and perhaps nutrition are jointly determined, but that health (life expectancy) is not a determinant of output (a conclusion contrary to an earlier one by the same author; see Wheeler (1980) and Subsection 6.2 below). However, Wheeler does find that health is affected significantly by output per capita, and that change in the death rate is due primarily to factors exogenous to the model, such as "the generalized diffusion of basic medical technology such as mass vaccinations" (p. 139). A submodel in this study indicates that health and education could have had a significant impact on export growth in the 1970's, but not in the 1960's. Simulations of the model on the cost-effectiveness of investments in human resources (such as investments in schooling, medical training, and family planning) compared to equally costly investments in physical capital lead to the conclusions that "no general rule is possible in a complex dynamic system... Initial conditions matter... The discount rate matters as well...." (p. 141). To elaborate, for poor, prototypical African societies, physical investments rather than investments in human resources are preferable for very high discount rates, with education preferable for intermediate discount rates, and family planning preferable for very low discount rates. For middle-income, prototypical Latin American societies, education is preferable over a wide spectrum of discount rates. Note that direct health policies and direct nutrient policies are not considered, although health would be affected substantially by the choices made. Moreover, the objective function only includes per capita income; if it were expanded to include health, policies directly related to health and nutrition would fare better. Finally, it is important to emphasize that Wheeler is exceptionally careful to indicate the limitations of his approach and to reveal the details of his research strategies and of his unsuccessful experiments.

This study is not without flaws, as Wheeler himself notes. The determinations of what is exogenous and what is endogenous are questionable, as discussed with respect to estimates from Wheeler (1980) in Subsection 6.2. The specification ignores the effects of market prices, even though micro estimates of nutrient demand relations (Subsection 4.2), for example, suggest that price effects might be quite important, and other studies suggest that macro prices (particularly the exchange rate) may be critical. Endowments are not included explicitly, although they are to some extent implicit in the exploration of regional prototypes. The use of country averages obscures distributional questions. For the purpose of this review (though not necessarily for Wheeler's purposes), too little attention is paid to policies directly related to human resources, and the nutrient availability specification is confined to the representation of past growth history (since nutrient availability is posited to depend only on a distributed lag in per capita product).

These qualifications limit the positive implications of Wheeler's study for this review, although his thoughtful reflections are useful to anyone considering macro approaches to human resources and poverty in developing countries. Aside from general research strategy, what seems most relevant to the present review in Wheeler (1984) are the systematic associations of health
and nutrition with development; the indication that nutrition may have an important productivity impact; and the idea that initial conditions and discount rates may figure importantly in an evaluation of human resource policies.

Using an approach quite different from those of Barlow and Wheeler, Bishai and Simon (1987) present a "system dynamics model" of the impact on economic development of expenditures on health. The model, DEVNAT, consists of over 500 differential equations whose parameters have been set by a comparison of simulation results with intuition and available data. Bishai and Simon (p. 8) claim that "The use of system dynamics to study the effects of health expenditure on economic development is particularly appropriate because of this system's intricate structure. Multiple feedback loops involve health status and population, health status and economic output, and population and economic output... The model tolerates relatively great amounts of error in the data and still provides relevant and useful insights." Although Bishai and Simon's description of this model is quite spare, it appears that at the heart of the model there is a log-linear aggregate production function with health subsumed into effective labor, and with technological change treated as exogenous. Health quality is measured by the incidence of fatal or disabling disease, the fatality rate, the average degree of disability from disease, and the average duration of disability. Incidence varies with education and with expenditures that promote health; the other three health variables are determined by education and by measures to cure disease.

In the Bishai/Simon paper, a baseline simulation is established for a 70-year period. Then eight simulations are conducted, four with low (0.05 per cent per year) and four with higher (0.5 per cent per year) exogenous technological change. For each simulation a foreign aid agency is assumed to donate 2.5 per cent per year of the developing country's original GNP, which alternatively is assumed to be denoted to: (i) health expenditure, (ii) physical capital investment, (iii) primary education, and (iv) health, investment and education in equal shares.

In simulations with low technology, the first alternative causes only a short-term fall in the death rate, because the population growth caused by better health decreases per capita income to such an extent that the death rate begins to increase again within three decades. (Per capita income increases slightly in the first decade, but falls thereafter.) The other three alternatives all result in higher per capita income, with the largest increase associated with investment in physical capital investment, the second largest with the mixed strategy, and the third largest with education. Investment in education results in the largest (by far) decline in the death rate throughout the 70-year period, with the mixed strategy generally second and the health strategy usually third (although slightly better than the mixed strategy after 10 years and worse than the pure physical investment strategy after 60 years).
In simulations with higher technological growth, the differences among the four policy alternatives are much smaller. The relative impact on the death rate is the same as in the low-technology scenarios, except that death rates decline monotonically. In all four high-technology alternatives, per capita income also rises monotonically, but decidedly slower in the health expenditure scenario than the other three after a few decades; the investment strategy is the best for the first five decades, but the education strategy is best thereafter.

On the basis of such simulations, Bishai and Simon conclude that circumstances such as exogenous technological change have considerable influence on the results of policy; that health expenditure may be a short-run, but is not a long-run, means to greater economic prosperity; and that investments in health should be combined with investments in education, technology, and physical capital in order to improve both health and per capita income.

Such conclusions are provocative, but it is hard to know what to make of them in terms of the relations between health and nutrition and development and distribution. The analytical procedure seems mechanical and does not tie into the micro evidence discussed in Sections 3 and 4 above regarding, for example, price responsiveness. Though Bishai and Simon claim that their results are robust to specification changes, the results appear sensitive to a number of critical parameters (for example, that education has a strong and immediate impact on health, since in both sets of simulations death rates are reduced immediately more by education than by expenditures on health, which is surprising since the effect of primary education might reasonably be expected to occur with a substantial lag). It is very difficult to understand and evaluate a model that contains over 500 equations.

6.2 The New Neoclassical Growth Models and Cross-Country Evidence

Recently there has been a revival of theoretical literature on economic growth, with an effort to incorporate externalities in human resources into the analysis. The externalities take the form of increasing the private returns to human resources if there are more human resources available elsewhere in the economy. Leading studies in this area include the papers by Romer (1986), Lucas (1988) and Azariadis and Drazen (1990). The last of these develops a model with multiple equilibria so that slight enhancements of a country's human resources may lead to a substantial growth spurt as the country moves to a higher growth equilibrium.

To date these approaches have been subjected to very little empirical testing, though Azariadis and Drazen do present some graphs that indicate that countries rich in human resources (such as literacy) relative to their per capita income at the start of recent periods tended to have high per capita income growth rates thereafter. The fact that empirical testing of these models to date has been very limited reflects that it is always difficult to capture the effects of externalities. But such externalities, if important,
would seem to have an influence on aggregate developments greater than that that would be expected on the basis of micro relations. Therefore, a crude test of the models would be a comparison of highly aggregated relations with less aggregated ones. To my knowledge, no one has conducted such a test. But aggregated cross-country estimates of production functions might provide some insight, although at least the Azariadis-Drazen study leads to multiple equilibria which suggest that there are regions of sharply increasing returns to investments in human resources in an aggregated production function analysis.

While a number of cross-country studies show correlations between per capita income (or other measures of productivity) and human resources, almost all of them fail to take into account the possibility of simultaneity, and thus do not permit us to conclude that human resources affect per capita income, rather than only the other way around. The cross-country study by Wheeler (1980) is an exception, in that it is explicitly concerned with simultaneity. Wheeler models a GDP production function dependent upon calorie availability, adult literacy, and life expectancy -- all treated as endogenous variables -- and upon labor and capital stock. Wheeler finds a significant positive effect of life expectancy and calorie availability on output, with elasticities of output of 1.7 for life expectancy and 2.7 for calorie availability (compared to output elasticities of 0.2 for labor and capital) and thus concludes that better health and nutrition significantly increase income. These results suggest a major impact of health and nutrition on productivity, although the results should be qualified for several reasons: some of the instruments used (for example, the 1960 levels of literacy, life expectancy and calorie availability) may be serially correlated with subsequent endogenous values of these same variables; other instruments (such as primary schooling enrollments, medical personnel), do not seem to be exogenous; and the model lacks robustness for the life expectancy variable if the sample is extended to the mid-1970's (see Wheeler 1984).

---

110 Statistical identification of the endogenous variables is achieved with variables such as the initial (1960) levels of literacy, life expectancy, and calorie availability; primary schooling enrollment; population per nurse; and population per physician.
7. CONCLUSIONS

Recently, in my judgement, definite progress has been made in understanding the complex interrelationships among human resources and poverty. Some previous understandings have been found simplistic or wrong; others have been confirmed. Understanding of the role of simultaneous feedbacks has improved. Initial conditions are better appreciated and controlled in both micro and macro analysis. A few of the complex interactions within a macro framework have been explored. But while there has been progress, there remain considerable lacunae in our knowledge. In this section I try first to summarize what we have learned and then to point to areas where further research seems most promising.

7.1 Summary of Studies Reviewed

At the start of the 1990's, there is still considerable malnutrition, poor health and limited schooling in the developing world,\textsuperscript{111} despite very substantial gains in human resources there in recent decades.\textsuperscript{112} The ongoing inadequacies in human resources are widely thought to be caused in part by poverty, and in turn to contribute to its perpetuation. National averages hide a wide range of variances, and countries that appear similar according to per capita income averages may have quite different average human resources. For example, the life expectancy at birth in 1983 was 69 years in Sri Lanka, as compared to 38 years in Sierra Leone, though both had an average estimated per capita income of $330 for that year.

The use of health production functions or reduced-form demand equations to investigate the micro determinants of health or of health-care utilization has met with some, but only limited success. Some micro health production function studies suggest that direct nutritional supplements improve the health of children but not adults. This may not be surprising given the greater importance of nutrients in child development than in adult maintenance. For adults, nutrient increases seem to result in increased energy expenditures, sometimes with increased productivity. For children, some studies suggest increased schooling attainment, but the failure to control for simultaneity renders the results not very persuasive.

\textsuperscript{111}Consideration of differences among individuals, and of the adaptability of the human body to its environment, may lead to a more positive characterization of the current situation regarding malnutrition and perhaps health, and to a somewhat different identification of those at risk. Nevertheless, large numbers of individuals in the developing world have inadequate diets and health.

\textsuperscript{112}These gains have been larger in fact than the gains indicated by narrowly-defined economic indicators such as per capita income.
Reduced-form micro demand relations for both child and adult health find limited evidence of responses to relative market prices, income or wealth. Thomas's recent (1989) study suggests that whether it is men or women who receive income may make a considerable difference, with much more positive effects if women receive the income. The limited efforts to incorporate the dynamics of human resource investments with information acquired over time regarding endowments suggest that such a formulation may result in different understanding. The micro estimates, however, contrast with aggregate estimates that show fairly strong associations between indicators such as life expectancy and per capita real product or per capita income. This contrast raises the question of whether the micro results are misleading because of measurement errors for health and/or income and because of specification errors regarding lags and time use, or whether in the macro estimates per capita income or product is representing not the purchasing power of individuals so much as the general level of development (and associated public health) that are not well-represented in micro estimates. Therefore, while studies do suggest that poverty has some impact on health, the extent of the impact appears more ambiguous than many presume.

A number of both micro and macro studies indicate substantial importance of women's schooling, in some cases overshadowing other inputs. Mensch, Lentzner, and Preston (1985), for example, conclude that women's schooling is associated much more closely with child mortality rates than the composite impact of a number of other development indicators, including per capita income. Cochrane, Leslie, and O'Hara (1980, 1982) conclude that the inverse correlation between women's schooling and child mortality is quite strong, with about twice the impact as men's schooling. In one sample with extensive control for the women's unobserved childhood background-related characteristics, however, the estimate for the impact of women's schooling on child health almost vanishes, and the indicators of the impact of their schooling on the women's own health become much weaker with much greater imprecision of the estimates. In other studies in which parental anthropometric measures are used to control partially for parental characteristics, the estimated impact of parental schooling on child health and survival is reduced substantially, though not as much as with controls for characteristics of adult siblings. Thus, while there may be an important impact of schooling, it probably is not as large as standard estimates without control for other parental characteristics suggest. Although a number of studies consider only women's schooling, those that include both men's and women's do not suggest that women's schooling is so much more important than men's schooling as conventional wisdom suggests. Often the differences are not found to be significant, contrary to the Cochrane, Leslie, and O'Hara two-for-one characterization noted above.

As is discussed in Subsection 4.1, however, it is not clear that these results measure an income effect, or merely that more productive women have more positive impact on their children's health than less productive women.
Reduced-form demand estimates for nutrient intakes indicate some substantial responses to food prices. These responses mean that many policies and market developments may affect nutrition, whether or not that is their authors' intent. Policy makers need to be sensitive to such possibilities in their policy design and implementation. The food price responses, moreover, are not always negative. In some cases, and not only for rural households, the nutrient elasticities with respect to food prices may be positive and large, though the ones for the prices of basic staples generally are negative. For households that have some such positive elasticities, subsidies for foods other than the basic staples may worsen nutrition. Another interesting characteristic of the price elasticities is that they tend to be larger for poorer households. The existence of different price elasticities for different income groups allows for price policies that favor the poor without great windfalls to those who are better off, as long as the foods subsidized are the basic staples of the poor.

Studies of nutrient determinants indicate a wide range of income and expenditure elasticities. However most of the large expenditure elasticities seem to result from aggregations that ignore unit price changes associated with income, from measurement errors, and from the gap between household food acquisitions and food actually consumed by household members. Recent estimates of nutrient elasticities with respect to income suggest positive effects that are fairly small (e.g., elasticities on the order of 0.1, not 0.8) even for the poor (with perhaps somewhat larger effects for the very poor). Therefore increases in income probably will not improve the nutrient intakes of the poor as much as often has been assumed. Apparently other food characteristics -- taste, appearance, status value, degree of processing, composition, provision of food for guests and laborers -- are valued at the margin much more than nutrition, even by relatively poor people. Cross-country studies also suggest that in part the low income elasticities for nutrients (as compared with those for food expenditures) reflect an increasing desire for variety in food as income increases. If nonnutritive food characteristics that are not highly correlated with nutrients determine food purchases at the margin, then increases in income and the general development process will not alleviate malnutrition nearly so much as the World Bank (1981), Srinivasan (1985) and others have claimed. (Note, however, that recent estimates by Thomas (1990) suggest that women's income may have substantially larger effects than men's income.) On the other hand, the apparent limited importance to individuals of increasing nutrient consumption at the margin suggests the possibility that they do not give as high a priority to reducing their malnourishment as many outsiders believe they should, which is consistent with the Sukhatme-Srinivasan- Seckler-Payne hypothesis of individual adaptability to nutrient availabilities and "small but healthy" people. Of course this does not tell us why so many people in some populations are so small, nor does it allay the suspicion that the malnutrition experienced by many children in those populations seems to lead not only to small adults, but also to high infant and child mortality. An alternative possibility is that such people are not very well informed about
how their food choices affect their nutrient intakes, in which case there may be a high payoff to improved information.114

Beyond relative prices and perhaps income, some but far from all studies point to the possible importance of women's schooling, nutritional knowledge, and public health programs in improving nutrient consumption (particularly for children). The impact of women's schooling and nutrient knowledge simply may mean that better-educated consumers choose more nutritious food than others, other things being equal. The impact of women's schooling on nutrient consumption, in contrast to its impact on health, is illustrated in one sample which has control for unobserved childhood background characteristics. Variables representing public health services such as safe water may reflect an increased value of nutrients because of the complementarity of those services with nutrients in the health production function. Of course, the variable for women's schooling also may reflect complementarities instead of only representing better information about the nutritional value of different foods.

Most studies of the determinants of children's schooling highlight family income and parental schooling, a fact which suggests that schooling is an important intergenerational transmission mechanism for poverty. There are no very satisfactory representations of the expected returns to schooling as a determinant of child schooling.115 Recent studies, however, raise the question of what household income and parental schooling variables are actually representing. For example, household income seems in part to be a proxy for the quality of local schools, which indicates that policy makers may limit the intergenerational transmission of poverty by improving the quality of schooling that poor children receive. With regard to the impact of parental schooling, there is evidence that not only the length of parental schooling, but also its quality matters. Moreover, there is evidence of substitutability between paternal and maternal schooling in influencing

114This does not seem to be the whole story, however, since some of the changes in food composition that occur with income increases (e.g., shifts from broken grain to whole grain rice) would seem to have obvious limited nutritional impact to the individuals making decisions to so change the composition of their food.

115In private conversations, Hanan Jacoby has indicated that he intends to explore such representations based on the data and conclusions of his 1989 paper on shadow wages in rural Peru. He will do so by exploring the possibility that the expected rates of return to schooling for children in a household depend upon the impact of schooling on shadow wages in that household. Since shadow wages tend to vary substantially among households, he can make some headway on the problem of representing rates of return to schooling so that they vary from point to point in the sample.
children's schooling, rather than dominance of the latter, as often assumed. Finally, the one study of adult siblings presents the question of whether the variable for maternal schooling is not primarily representing unobserved characteristics related to ability, motivations, and so on, rather than the effect of schooling itself.

In studies of some groups of poor people, nutrition and health status both appear to have positive effects on agricultural productivity, labor market wages and possibly schooling productivity. Nutrient intakes might affect productivity without altering indicators of health status because changes in nutrient changes may lead principally to changes in energy expenditures (with some impact on productivity). Except in extreme cases, malnourishment does not seem to alter fertility biologically, but some studies are consistent with the notion of impacts on fertility through behavior. Declines in infant mortality seem to reduce fertility. Health and nutrition are thus not only important ends in themselves, but also important means to productivity and population goals.

Schooling is seen to affect productivity, or as a proxy for productivity, in many studies. Conventional wisdom is that the returns to schooling, particularly primary schooling, in economic productivity and therefore in reducing poverty are substantial. Average social rates of return to primary schooling of about 25 per cent per year have been cited by the World Bank (1980), Psacharopoulos (1985) and many others, and the implied private rates of return are even higher. However, recent studies cause considerable doubts about whether such rates of return are well-based empirically. There seem to be substantial upward biases due to the failure to control for unobserved aspects of family background, schooling quality, ability, household and community characteristics, schooling dropout and repetition experience, and credentialism. Studies that do attempt to control for such factors indicate that: (1) standard studies overstate substantially the true economic rate of return to investments in schooling, by 50 to 80 per cent or even more in many cases; (2) these biases tend to be largest for primary schooling; (3) the returns to improving the quality of schooling may be at least as high as those to extending schooling of a given quality; and (4) the last two points mean that, contrary to many previous claims, there are definite productivity/equity tradeoffs in policy decisions about schooling. Even though the economic returns to schooling probably have been overstated substantially and the time necessary to reap the returns from schooling is considerable, the returns to schooling are sufficient that more and better schooling is an important policy tool for the alleviation of poverty.

UNICEF and others have made strong allegations that macroeconomic adjustment policies have very negative effects on human resources of the poor. Careful examination of the relevant studies, however, suggests that the empirical basis for those allegations is quite weak. In fact, the studies demonstrate that societies and individuals have adapted well in order to minimize any negative effects on human resources, contrary to the interpretation of UNICEF. This is not to say that there are no major problems with the levels of human resources of the poor, but rather that focusing on
the problems as the consequences of economic adjustment programs well may be misleading and even counterproductive if the focus detracts from the basic developmental dimensions of the human resources of the poor.

Economy-wide analyses have been provocative on the topics of the effects of human resource improvements, the importance to economic studies of initial conditions in terms of resources and technology, and the possibility that in some instances increases in population induced by development programs eventually may overtake productivity gain, with consequent declines in per capita income. And yet the studies suffer from so many limitations in specification and estimation, such as inattention to simultaneity biases and price responses, that they must be viewed as at most suggestive rather than definitive.

7.2 Directions for Desirable Research

Despite the growing number of studies of relationships among human resources and poverty in developing countries, the lacunae in our knowledge remain substantial.

There are major questions pertaining to the measurement of nutrition and health, and thus to the extent, incidence and determinants of inadequacies in nutrition and health. The adaptability hypothesis discussed in Subsection 2.2.2, for instance, raises difficult questions about how policy makers or other analysts can identify at reasonable cost who is malnourished. The failure to establish clearly the determinants of health (particularly for adults), for another example, may be due to substantial measurement errors in representing the state of an individual's health. Frequently researchers use data on disease as reported by survey respondents, although such reports are likely to be influenced endogenously by characteristics such as education and wealth. The benefits of clinically-based health indicators, therefore, may be worth the added costs. It may be cost-effective to obtain such information on health, but by encouraging epidemiologists and other health professionals to expand their data collection efforts to include broader, more representative samples and to include more socioeconomic data, with sufficient variance in critical price and asset variables. In the meantime, conclusions about health must be qualified because they are built upon quite imperfect indicators of health and nutrition. Future studies fruitfully might explore how their results compare with alternatives such as the use of latent variable specifications of health and nutrition.

With respect to the determinants of health, major questions also remain. To what extent does the limited nature of our success in estimating micro health production functions and reduced-form demand relations reflect data inadequacies regarding health measures, inappropriate lag structures, energy expenditure adaptations, or the failure to specify the influence of individual, household and community endowments? Does selectivity in surveying poor households cause downward biases in the estimated importance of variables such as housing and water supply? Can economic theory provide more useful guidance for the specification of empirical studies, as in some recent
investigations (e.g., Behrman and Deolalikar 1989c, Bouis 1989, Gertler and van der Gaag 1988b, Gertler, Locay and Sanderson 1987, Rosenzweig and Wolpin 1988, Rosenzweig and Schultz 1987)? What are the biological processes involved, the extent of substitutabilities and complementarities in health production processes, the nature of lags, and the role of nutrition? How important is parental education in determining health? Does the often significant role ascribed to education, particularly women's education, reflect increased efficiency of educated people in using measures to enhance health, or better information? Or is it primarily a proxy for unobserved individual and household endowments, as suggested by the one set of studies available on adult sibling deviations, and, to a lesser extent, by the several recent studies that include parental anthropometric measures? If schooling is primarily a proxy for background, does that suggest any new policies? Are education and public health measures substitutes, as found in some studies, or complements as found in others? More generally, what are substitution and complements in health production functions? Is the relatively large impact of women's unearned income reported by Thomas (1990) really basically an income effect? Or does such income primarily reflect productivity, through association with past earnings and the assignment of household tasks on the basis of sex -- factors that would have much different implications? Are non-linearities or asymmetries in the impact of income and other variables particularly important? How important are seasonal variations, particularly in rural areas? How can the very limited nature of our success in estimating micro health relations be reconciled with the fairly strong associations between health and development across societies? What role does uncertainty play in the determination of health?

With respect to the determinants of nutrient intakes, progress has been greater, but questions remain. To what extent would more extensive specification of prices, assets and endowments change our current understanding? What is the nature of the intrahousehold allocation process? Is it better represented by a bargaining framework? If so, what difference does it make? Once again, how should results such as those of Thomas (1990), which show a strong association between women's unearned income and nutrition and health, be interpreted? How fungible are resources within a household? For instance, how much do school children benefit from food provided at school, and to what extent is receiving food at school offset by receiving less food at home? Likewise there are questions about the extent to which food subsidies, food stamps or food rationing improve the nutritious of recipients, or only result in the increased purchase of less nutritious foods or non-food goods and services? How fungible are sources across seasons? How much is nutrition likely to improve with the development process? Are there important non-linearities or asymmetries?

The impact of schooling on outcomes seems important, but it is probably overstated in conventional studies. If indeed these effects are overstated, are other relationships suggested by the household, individual or community endowments in the background? What are the effects of extra-classroom forms of training, such as training?
Recent systematic studies suggest that for some low-income groups, the impact of health and nutrition on farm and labor market productivity may be substantial. How can such conclusions be reconciled with the skepticism summarized in Rosenzweig (1988b)? Are such conclusion valid for other societies? Is the evidence of the impact of health and nutrition on schooling productivity valid in the presence of control for simultaneity and unobserved endowments? Is there more widespread evidence of the effects of health and nutrition on fertility? If so, what are the implications for productivity growth? population growth? understanding labor market structures? and population, schooling, health and nutrition policy?

Much of the micro analysis summarized in this review is for given households, but some of the important causal relationships could involve household formation and dissolution. What are the relationships between such changes in household structure and human resources and poverty? How will such relationships change with the development process and with concomittant improvements in capital and other markets? Do the possibilities of such changes affect intrahousehold bargaining relevant to human resources? Do bargaining approaches change our understanding of the determinants of human resources? Can such approaches be tested satisfactorily?

Some have argued that the determinants of health and nutrient intakes and their impact on economic growth and distribution only can be understood fully within an economy-wide framework. This may be true for programs such as malaria control or large-scale food subsidies, which have multiple effects and are big enough to change basic prices in an economy. But economy-wide modeling has had a number of limitations. Can these be overcome by better utilization of micro results, better specification (particularly regarding prices, endowments, income distribution and lags), and better estimation regarding simultaneity and unobserved variables? If so, can the models still be understandable to individuals not immersed in them? What insights do such models offer for policies affecting interactions among human resources and poverty and about the effects of other policies (such as exchange rate policies)?

Of course one motive for concern about interactions between human resources and poverty is the desire to improve policy. What are the policy implications of the growing corpus of empirical work on human resources? Can the apparent greater price and income responsiveness of poorer members of society be utilized in designing more effective policies? Is the optimism of Mateus (1983) and Pinstrup-Andersen (1985) about targeting food subsidies warranted? If increases in income have little effect on nutrition, might direct income transfers be preferable to food subsidies? What externalities, returns to scale, imperfect information or distributional concerns justify subsidies for human resources? Are the distinctions between therapeutic and preventive care useful to the making of decisions about health subsidies? What would be the impact on the health of various elements of a population of increasing user charges, or of new insurance schemes for various health measures? How is the dissemination of knowledge and new health practices affected by governmental pricing and subsidy policies, information problems
and industrial structure? How should governments handle the special problems associated with pharmaceuticals because of their large share in developing country health budgets, the information limitations regarding long-term effects, quality control, and the role of multinational companies? Can more appropriate health technologies be developed for the chronic diseases that are of increasing importance for developing countries, but for which current technologies are more appropriate for use in developed than developing countries? To what extent are policies justified by externalities, public-good characteristics, returns to scale, market failure, or distributional objectives? To what extent do governmental policies cause inefficiencies in the provision of human resource related inputs? Do other changes, such as changes in capital markets, substantially alter the determinants of human resources? Can developing countries design health insurance schemes to provide adequate coverage at lower cost and with fewer distortions than those of most developed economies? Do macro adjustment policies have multiplied or mitigated consequences for health and nutrition? Can better policy design and monitoring lessen the negative effects? Do vested interests preclude a significant shifting towards primary and away from secondary health care, and towards more appropriate (and less sophisticated) health care that the World Health Organization (1978) and others have advocated? What are the economy-wide consequences of major policies regarding human resources? How does their impact on human resources compare with the impact of other macro policies?
REFERENCES


Beaton, G.H. and H. Ghassemi, 1979, "Supplementary Feeding Programmes for Young Children in Developing Countries," Report prepared for UNICEF and the ACC Subcommittees on Nutrition.


______, 1987c, "Schooling in Developing Countries: Which Countries are the Under- and Overachievers and What is the Schooling Impact?" Economics of Education Review 6:2, 111-128.


"Communication on Returns to Education: A Further Update and Implications," Journal of Human Resources 22:4 (Fall), 603-606.

"Implicit Equity-Productivity Tradeoffs in the Distribution of Public School Resources in Brazil," European Economic Review 32.


"Interhousehold Transfers in Rural India: Altruism or Exchange?" Philadelphia: University of Pennsylvania, mimeo.

135


_______, 1987a, "How Does Mother's Schooling Affect the Family's Health, Nutrition, Medical Care Usage, and Household Sanitation?" Journal of Econometrics 36, 185-204.


Berstecher, Dieter, "The Educational Fallout of Adjustment," Unesco, mimeo.


Harriss, Barbara, 1987, "The Intrafamily Distribution of Hunger in South Asia," Helsinki: WIDER.


Jamison, Dean and Lawrence J. Lau, 1982, Farmer Education and Farm Efficiency, Baltimore, MD: Johns Hopkins University Press.


Pinstrup-Andersen, P., 1985, "Food Prices and the Poor in Developing Countries," European Review of Agricultural Economics 12:1/2.


Pinstrup-Andersen, P. and Harold Alderman, 1988, "The Effectiveness of Consumer-Oriented Food Subsidies in Reaching Rationing and Incomes Transfer Goals," in Per-Pinstrup Andersen, ed., Food Subsidies in Developing Countries: Costs, Benefits, and Policy Options, Baltimore: Johns Hopkins University Press.


Rodgers, Beatrice Lorge, 1988, "Design and Implementation Considerations for Consumer-Oriented Food Subsidies," in Per Pinstrup-Andersen, ed., Food Subsidies in Developing Countries: Costs, Benefits, and Policy Options, Baltimore: Johns Hopkins University Press.


, ed., 1982, Newer Concepts in Nutrition and Their Implications for Policy, India: Maharashtra Association for the Cultivation of Science Research Institute.


, 1988, "How Does Mother's Education Affect Child Height?" Coventry: University of Warwick, mimeo.


Winkler, Donald, 1975, "Educational Achievement and School Peer Group Composition," Journal of Human Resources 10:2 (Spring), 189-204.


_______, 1987, "Women's Schooling and Children's Health: Are the Effects Robust with Adult Sibling Control for the Women's Childhood Background?" Journal of Health Economics, 6:3, 239-254.


<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARGENTINA</td>
<td>Galerias del Norte, Saavedra 175, Bs.As.</td>
<td>Tel: 011-4391-1234, Fax: 011-4391-1234</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>PO Box 800, Sydney, NSW 2000</td>
<td>Tel: 02-9212-1212, Fax: 02-9212-1212</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>Av. Paulista 1500, Sao Paulo</td>
<td>Tel: 11-3131-1234, Fax: 11-3131-1234</td>
</tr>
<tr>
<td>CANADA</td>
<td>123 Main Street, Ottawa</td>
<td>Tel: 613-999-1234, Fax: 613-999-1234</td>
</tr>
<tr>
<td>CHINA</td>
<td>123 Beijing Road, Beijing</td>
<td>Tel: 10-1234-5678, Fax: 10-1234-5678</td>
</tr>
<tr>
<td>COLOMBIA</td>
<td>Calle 123, Bogota</td>
<td>Tel: 11-1234-5678, Fax: 11-1234-5678</td>
</tr>
<tr>
<td>DENMARK</td>
<td>Kongens Nytorv 1, Copenhagen</td>
<td>Tel: 31-234-5678, Fax: 31-234-5678</td>
</tr>
<tr>
<td>DOMINICAN REPUBLIC</td>
<td>Avenida 123, Santo Domingo</td>
<td>Tel: 809-123-4567, Fax: 809-123-4567</td>
</tr>
<tr>
<td>EGYPT</td>
<td>El Babylon Street, Cairo</td>
<td>Tel: 20-123-4567, Fax: 20-123-4567</td>
</tr>
<tr>
<td>FINLAND</td>
<td>P.O. Box 123, Helsinki</td>
<td>Tel: 358-123-4567, Fax: 358-123-4567</td>
</tr>
<tr>
<td>FRANCE</td>
<td>123 Avenue des Champs-Élysées, Paris</td>
<td>Tel: 33-123-4567, Fax: 33-123-4567</td>
</tr>
<tr>
<td>GERMANY</td>
<td>Siemensstrasse 1, Berlin</td>
<td>Tel: 49-123-4567, Fax: 49-123-4567</td>
</tr>
<tr>
<td>GREECE</td>
<td>123 Stadiou Street, Athens</td>
<td>Tel: 30-123-4567, Fax: 30-123-4567</td>
</tr>
<tr>
<td>INDIA</td>
<td>123 Shahid Bhagat Singh Road, New Delhi</td>
<td>Tel: 91-11-123-4567, Fax: 91-11-123-4567</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>Jalan Sudirman 123, Jakarta</td>
<td>Tel: 62-123-4567, Fax: 62-123-4567</td>
</tr>
<tr>
<td>ITALY</td>
<td>Piazza Duomo 123, Milan</td>
<td>Tel: 39-123-4567, Fax: 39-123-4567</td>
</tr>
<tr>
<td>JAPAN</td>
<td>Shinjuku Nishi 123, Tokyo</td>
<td>Tel: 81-3-1234-5678, Fax: 81-3-1234-5678</td>
</tr>
<tr>
<td>MOROCCO</td>
<td>Avenue Mohammed V, Casablanca</td>
<td>Tel: 212-321-4321, Fax: 212-321-4321</td>
</tr>
<tr>
<td>MEXICO</td>
<td>Av. Reforma 123, Mexico City</td>
<td>Tel: 52-55-1234-5678, Fax: 52-55-1234-5678</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>P.O. Box 123, Amsterdam</td>
<td>Tel: 31-20-123-4567, Fax: 31-20-123-4567</td>
</tr>
<tr>
<td>NEW ZEALAND</td>
<td>P.O. Box 123, Wellington</td>
<td>Tel: 64-4-123-4567, Fax: 64-4-123-4567</td>
</tr>
<tr>
<td>NIGERIA</td>
<td>P.O. Box 123, Lagos</td>
<td>Tel: 234-123-4567, Fax: 234-123-4567</td>
</tr>
<tr>
<td>NORWAY</td>
<td>Postbox 123, Oslo</td>
<td>Tel: 47-22-123-4567, Fax: 47-22-123-4567</td>
</tr>
</tbody>
</table>

For subscription orders: International Subscription Service, P.O. Box 1234, New York, NY 10012

For orders outside the USA: Please contact your local distributor.
No. 40  The Effects of Household and Community Characteristics on the Nutrition of Preschool Children: Evidence from Rural Côte d'Ivoire

No. 41  Public-Private Sector Wage Differentials in Peru, 1985–86

No. 42  The Distribution of Welfare in Peru in 1985–86

No. 43  Profits from Self-Employment: A Case Study of Côte d'Ivoire

No. 44  The Living Standards Survey and Price Policy Reform: A Study of Cocoa and Coffee Production in Côte d'Ivoire

No. 45  Measuring the Willingness to Pay for Social Services in Developing Countries

No. 46  Nonagricultural Family Enterprises in Côte d'Ivoire: A Descriptive Analysis

No. 47  The Poor during Adjustment: A Case Study of Côte d'Ivoire

No. 48  Confronting Poverty in Developing Countries: Definitions, Information, and Policies

No. 49  Sample Designs for the Living Standards Surveys in Ghana and Mauritania/Plans de sondage pour les enquêtes sur le niveau de vie au Ghana et en Mauritanie

No. 50  Food Subsidies: A Case Study of Price Reform in Morocco (also in French, 50F)

No. 51  Child Anthropometry in Côte d'Ivoire: Estimates from Two Surveys, 1985 and 1986

No. 52  Public-Private Sector Wage Comparisons and Moonlighting in Developing Countries: Evidence from Côte d'Ivoire and Peru

No. 53  Socioeconomic Determinants of Fertility in Côte d'Ivoire

No. 54  The Willingness to Pay for Education in Developing Countries: Evidence from Rural Peru

No. 55  Rigidité des salaires: Données microéconomiques et macroéconomiques sur l'ajustement du marché du travail dans le secteur moderne (in French only)

No. 56  The Poor in Latin America during Adjustment: A Case Study of Peru

No. 57  The Substitutability of Public and Private Health Care for the Treatment of Children in Pakistan

No. 58  Identifying the Poor: Is "Headship" a Useful Concept?

No. 59  Labor Market Performance as a Determinant of Migration

No. 60  The Relative Effectiveness of Private and Public Schools: Evidence from Two Developing Countries

No. 61  Large Sample Distribution of Several Inequality Measures: With Application to Côte d'Ivoire

No. 62  Testing for Significance of Poverty Differences: With Application to Côte d'Ivoire

No. 63  Poverty and Economic Growth: With Application to Côte d'Ivoire

No. 64  Education and Earnings in Peru’s Informal Nonfarm Family Enterprises

No. 65  Formal and Informal Sector Wage Determination in Urban Low-Income Neighborhoods in Pakistan

No. 66  Testing for Labor Market Duality: The Private Wage Sector in Côte d'Ivoire

No. 67  Does Education Pay in the Labor Market? The Labor Force Participation, Occupation, and Earnings of Peruvian Women

No. 68  The Composition and Distribution of Income in Côte d'Ivoire

No. 69  Price Elasticities from Survey Data: Extensions and Indonesian Results

No. 70  Efficient Allocation of Transfers to the Poor: The Problem of Unobserved Household Income

No. 71  Investigating the Determinants of Household Welfare in Côte d'Ivoire

No. 72  The Selectivity of Fertility and the Determinants of Human Capital Investments: Parametric and Semiparametric Estimates

No. 73  Shadow Wages and Peasant Family Labor Supply: An Econometric Application to the Peruvian Sierra