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YALE UNIVERSITY

P.O. Box 208269
New Haven, Connecticut 06520-8269

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WOMEN'S ROLE IN THE AGRICULTURAL HOUSEHOLD:
BARGAINING AND HUMAN CAPITAL

T. Paul Schultz
Yale University

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Abstract

This paper reviews the methods and empirical findings from economic analyses of women's contribution to social welfare and the determinants of their human capital. To understand better women's roles in agricultural households, three themes have gained prominence in the economics literature. First is the conceptualization of the unified family as coordinator of production and consumption over the lifecycle. Second is the role of separability of production and consumption decisions in the agricultural household that depends on the equivalence of hired and of family labor and the existence of competitive factor markets. Third, is the exploration of individualistic Nash-bargaining or Pareto efficient collective coordination within the family that preserves the distinct preferences of individuals to be expressed in behavioral variation across families. The changing bargaining power of men and women is traced primarily to the increasing investment in women's human capital, in the forms of nutrition, health, schooling, mobility and family planning. This reduction in the gender gap in human capital is shown to be closely related to declines in mortality, fertility, and population growth in most studied populations and may importantly affect the intrahousehold distribution of resources.

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1. INTRODUCTION

This chapter takes stock of the methods and empirical findings from economic analyses of women's contribution to social welfare and the determinants of their well-being. To account for women's roles in the agricultural household, economic research has been greatly affected by three steps in the general analysis of the family in the last thirty years. First is the conceptualization of the unified family as a coordinator of the production and consumption of a group of persons over an extended period of the lifecycle, with the household production of consumption commodities for family use constrained by the pool of household endowments including time, market prices, and knowledge of home production possibilities (Becker, 1965, 1981). Second is the role of separability of production and consumption decisions in the agricultural household, which depends on the perfect substitutability of hired and family labor and the adequacy of factor markets (Barnham and Squire, 1979; Singh et al., 1986). Third is the introduction of individualistic bargaining or collective coordination of the family, that preserves the distinct endowments of the individual and the expression of possible differences in personal preferences (McElroy and Horney, 1981; Chiappori, 1988; Lundberg and Pollak, 1993). This third innovation has relaxed the unified family model in different ways, and is still being extended and adapted to new problems or forms of game theory and econometrics. It has already been used to guide more penetrating empirical studies of the intrahousehold allocation of resources, and much further work is currently underway.

The chapter also explores how gender differentials in various forms of human capital arise, are sustained, and affect social welfare in different cultural regions of the world. Although much of this literature has focused on agricultural households in low-income countries, many features of the field are not unique to agriculture, though occasionally issues emerge that are based in the agricultural sciences: effects of crop mix and management for the derived demand for male or female labor, the adoption of new technologies in agriculture, the degradation of the environment due to overused common resources, seasonality, weather as an observable source of risk, etc. One problem area in interpreting existing evidence in this field is the variation in the composition of families, by which I mean both fertility and the extension of nuclear families to absorb other generations and relatives. The consumption, savings, and poverty literatures often mechanically

normalize away the variation in household composition, or condition on this composition as though it were an exogenous constraint, when it is widely believed that marriage, fertility, and family extension are choices that respond to the conventional economic variables of prices, sources of income, and personal endowments. The growing numerical importance of female-headed households in many parts of the world, and even the differential survival of existing members of the household are shown to be responsive to the relative costs and benefits of different family arrangements and compositions.

Changes in women's earning power compared to men's and children's affect what the family specializes in and what other institutions in society do, such as firms and government. Functions where the family retains a comparative advantage may also be performed with a changing mix of labor and capital in response to the evolution of the wage structure. The secular convergence in productive capacity of men and women is a notable development of this century. This narrowing of the gender gap in labor productivity is closely associated with the narrowing of the difference between male and female adult schooling, and is modified by the improved health and longevity of females compared to males (Schultz, 1995a). Fertility, mortality, and rural-urban migration determine population growth in the agricultural and nonagricultural sectors, and all of these demographic process have been shown to respond to the economic productivity of adult males and females, at the household and aggregate levels. Thus, the evolving gender differences in human capital provide the best available explanation for world patterns of demographic transition, interregional migration, and changes in women's participation in the labor force outside of the family (Schultz, 1981). Yet we have only a poor understanding of what has propelled the advance of women's human capital in different settings throughout the world. Why have women been left at a substantial disadvantage to their male folk in broad parts of South and West Asia and SubSaharan Africa, and what will be the economic consequences on womens roles, population growth, and economic development?

This chapter is structured as follows. Sections 2 reviews the alternative theoretical approaches to modeling the determinants of individual and family resource allocations and their relevance to the welfare and productivity of women. Section 3 summarizes the empirical evidence on how family allocations respond to changes in the endowments of husband and wife and other features of the family environment. Section 4 examines two attributes of family composition that

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have received considerable attention: the increased frequency of female headed households and the gender differentials in child survival that may be related to women's productive roles in society. Section 5 examines the problems of estimating the productivity of women compared with men using either wage functions or production functions, and the general policy implications of the social externalities associated with increasing the schooling of females. Section 10 concludes by reviewing progress made and the challenges that lie ahead in this field.

2. Models of Individual and Family Economic Behavior

2.1 Individual Consumer Demands or Expenditure Systems

Simple models of consumer demand in a single period generally assume that the consumer receives (exogenously) a disposable income (I) for a reference period such as a year, knows the prices of market goods (P_1, P_2), and then selects a combination of goods (X_1, X_2) to maximize individual utility:

$$U = U (X_1, X_2),$$ (1)

subject to the income constraint:

$$I = P_1X_1 + P_2X_2.$$ (2)

The decision how much time to work at a market determined wage (w) is then incorporated into the consumer's optimization problem by adding leisure (L) to the individual's utility function:

$$U = U (X_1, X_2, L),$$ (3)

and a single period time constraint:

$$T = L + H,$$

where T is assumed to be the total time available for all persons in the reference period and H is the hours worked in the wage market. Market income then becomes the sum of (exogenous) nonearned income (V) and market wage income where the wage is assumed independent of hours worked:

$$I = V + Hw = P_1X_1 + P_2X_2.$$ (4)

The concept of full income (F) introduced by Becker (1965) is the potential income the individual could obtain by allocating all of his or her time to wage work:

$$F = V + Tw = P_1X_1 + P_2X_2 + Lw.$$ (5)

The equilibrium conditions from maximizing the utility function (3) with respect to the full income constraint (5) include:

$$MU_L/MU_{X_i} = w/P_i, \quad i=1,2. \tag{6}$$

The ratio of the marginal utility of time as leisure to the marginal utility of either good is equal to the ratio of the market wage to the good's price. If, however, the individual spends all of her time in nonmarket activities, called here simply leisure, then the shadow price of leisure (MU_L) presumably exceeds the market wage offer.

If the commodity or service that enters the utility function of the individual is purchased in the market in the form that it is consumed, such as a bread, the above model may be satisfactory. But if, alternatively, the commodity or service providing the welfare to the individual is produced in the home with market inputs (i_h) and own time (t_h), such as might be expected with health, human capital, or children, home production functions (H) might be assumed to describe these technological and biological possibilities:

$$H = H(i_h, t_h, e), \tag{7}$$

where e is an individual-specific endowment that increases the home output but is not controlled by the individual, and this form of heterogeneity is generally unobserved by the researcher and may affect the productivity of the other inputs and time used in this and other home production processes.

This intermediate layer of home production functions, introduced between market goods and the commodities from which utility is derived, allows the economist to consider substitution possibilities that the home producer may consider in optimizing home production (Becker, 1965, 1981). The individual or family can now adjust consumer/producer behavior to exogenous changes in market prices, wages, and nonearned income along two dimensions; they can adjust the composition of what they ultimately consume, including leisure, and they can also modify how these home-produced commodities are produced at least cost, through changes in their input factor proportions as would a market-oriented firm.

Home production functions are more difficult to estimate than production functions that describe technical relationships determining how goods are produced for exchange in the market. This is partly because the output of home production is generally not sold or quantified, and thus the shadow value of such a nontraded commodity may differ across households. For example, the

shadow value of a child to one mother may not be the same as to another, because there is no relevant market and individual preferences (and fecundity) will vary.

In many types of home production, such as the formation of human capital in children, productive endowments of the individual influence input productivity and therefore possibly influence parent allocation of inputs across family members. If these innate endowments are not observed by the researcher, as denoted by e in (7), direct estimation of the marginal productivity of home inputs by regressing H on I and t are likely to yield biased indications of their technological contribution or productivity because the input e is omitted from the estimated home production function. For example, Becker hypothesizes that "ability" of a child increases the private rate of return to schooling a child (Becker, 1967, 1981; Becker and Tomes, 1979). If parents then allocate more schooling to their more able children, the direct association between schooling and productivity of the children would overstate the returns to schooling, other things being equal (Griliches, 1977). In attempting to estimate the home production function (7), the relationship among observable inputs and outputs will tend to be biased by any correlation between the individual endowment and the observed market and time inputs, which violates the standard estimation assumption that the inputs are independent of the disturbance in the output equation. In household production of children and health human capital, variation in the biological endowments of the couple and children can be of substantial importance. The technical marginal product of inputs can then be seriously misunderstood (Rosenzweig and Schultz, 1983; Schultz, 1984). A parallel problem arises in attempting to estimate the effectiveness of contraception on controlling fertility, when the choice of birth control is informed by the couple's partial knowledge of their fecundity or likelihood of conception given their observed input behavior (Rosenzweig and Schultz, 1985, 1989).

2.2 Multiperson Agricultural Family and Household Demands

Issues of allocation and decision making become more complicated when more than one individual is involved. In reality individuals will differ in their preferences for goods and services and what they can contribute to the welfare of the group. Most of the research on households and the family has been based on the convenient working assumption that families or coresidential groups have identical preferences or one individual dominates the allocation process and consults

his, or her, preferences in determining an optimal solution. As a consequence, a stable scheme for the ordering of alternatives is arrived at for the group. In other words, the group is treated as if it were an individual. Because the members of families and households tend to differ in their productive capacities and personalities, as they do in sex and age, households are not likely to be made up of identical individuals. That leaves us with the "dominant dictator" model as the remaining, least implausible, conceptual foundation for the unified family/household decision making unit. In the next two sections of this paper some alternative approaches for treating the conflicting interests of family members are reviewed and their distinct and testable empirical predictions explored.

These non-unified approaches to household decision making build on an explicit or implicit bargaining process taking place within the family; they assume either that information is shared symmetrically between cooperative individuals, which then tends to lead to allocations which are Pareto efficient, or that private information is not shared and is hence asymmetrical, with this failure of coordination leading to inefficient allocations across the household members. This is an area of recent methodological progress and an active focus for the new empirical research on family behavior (e.g. Haddad et al., 1997). It is accordingly emphasized in this chapter, but two things should be recalled. First the unified household model of Becker (1965, 1981) provided a fruitful general framework to guide research for several decades into the division of labor within the family, and the conclusions drawn in that literature have not yet been called into question by the newer alternative approaches for interpreting family behavior. The exception may prove to be West Africa, where individuals privately manage their own agricultural plots with limited coordination or pooling of resources at the household or family levels (Jones, 1983, 1986; Udry, 1996). Second, growing documentation of differences in consumption among persons in the household or family can be interpreted as suboptimal only after researchers specify criteria for optimality (Haddad and Kanbur, 1990), such as calorie distribution between persons within the household. But in this case of calories, for example, the "needs" of individuals may actually be endogenous, to the extent that they vary by the choice of type and amount of work engaged in by individual family members (e.g. Pitt et al., 1990; Higgins and Alderman, 1997) or due to sources of unobserved heterogeneity, such as morbidity and weight. Evidence is only beginning to amass that the error introduced by neglecting intra household bargaining changes

important policy conclusions or alters preferred agricultural development strategies, although the reach of these new approaches to family decisionmaking is only beginning to be explored (Strauss and Beegle, 1996)

A second significant important feature of the agricultural family is the combined functions its performs of producing agricultural output and coordinating consumption and labor supply of its members (Barnham and Squire, 1979; Singh et al., 1986). It is commonly assumed in such an agricultural model of the family that hired and family labor are identical in production, and that the labor market is perfect in providing the family with both a source of jobs for any excess supply of family workers it may have beyond the profit maximizing labor demand on its own farm, and a source of hired labor for any shortage of family labor to meet its farm's production requirements. This assumption of separability allows the optimization problem facing the agricultural family to be solved in a two-step process. First, farm outputs and inputs are determined to maximize farm profit. Second, the family maximizes its unified utility to determine how much family labor supply is allocated to farm and off-farm activities, and how much labor is residually hired to satisfy farm labor input requirements (Barnham and Squire, 1979; Singh et al., 1986; Pitt and Rosenzweig, 1986; Benjamin, 1992; Maluccio, 1997; DeSilva, 1997). Without this form of complete and competitive factor market for family and hired labor, the production and consumption decisions would have to be made jointly and they could yield different results from those arrived at by the simpler two-step process. Testing explicitly for this form of separability has not yet produced strong empirical evidence rejecting the simplifying restriction. Risk and uncertainty as well as dynamics in the sequencing of labor and other inputs can complicate greatly separability (Roe and Graham-Tomasi, 1986; Skoufias, 1993a, 1993b, 1996), as can other interlinked factor markets, such as those for credit. Specific parameterizations for the profit and family utility functions can be postulated and simulated to trace out the consequences of market failures, but these are not, in my view, empirical tests of separability (de Janvry et al., 1991).

Yet it seems likely that there are activities where hired and family labor are not good substitutes, perhaps because of differences in relevant skills and farm-specific management experience, or because incentive and monitoring costs differ in these tasks for family and hired labor. For some special tasks hired labor can be paid according piece rates, as may occur in the case of harvesting, to reduce the cost of monitoring labor. In performing other tasks, family

altruism and sharing in final output might provide family labor with better work incentives than can be readily offered hired labor, and then in these tasks family labor would have an efficiency advantage. Even when disaggregated tasks are studied separately by calendar period of the crop cycle, Maluccio finds only a few instances in the Bicol Province of the Philippines where separability is rejected. Pitt and Rosenzweig (1986) and Benjamin (1992) also cannot reject separability among the Indonesian rural families they analyze. One could imagine that in societies in South Asia where it is less common (or socially acceptable) for adult women to work outside of their own family farm, that separation would not hold. But in rural India in 1969-1971, families that were relatively short of land and surplus on female labor did not appear to employ more than the profit maximizing level of female labor on their own farm. In other words, when both the land and labor markets were modeled jointly, family farms appear to be efficiently allocating their own and hired labor (and land) in a manner that could not be statistically shown to be inefficient due to labor market or family imperfections (Seavy, 1987). Agricultural production functions estimated at the district level for India suggest that family and hired labor may exhibit different productivity and may deserve to be treated as separate inputs, although this has proven difficult given the extent of gender segregation of agricultural tasks (Deolalikar and Vijverberg, 1983; Laufer, 1985). Where factor markets appear to be least well developed, as in SubSaharan Africa or parts of South and West Asia, nonseparability in hired-family labor markets is still anticipated by some development economists and these problems are probably more severe for female labor than for male (de Janvry et al., 1991).

2.3 Intra Household Allocations and Bargaining

The unitary model of household resource allocation is based on the maximization of a single household welfare function subject to a time and resource budget constraint and home production technology, taking as given market prices and wage opportunities. Samuelson (1947, 1956) elaborated on the implausible assumptions required for aggregation of individual preferences to deal with family or household choice in a form that would satisfy the axioms of individual consumer choice. Arrow (1951) went so far to as prove the impossibility of consistently aggregating the preferences of agents for the purposes of systematizing choices made by social units such as the family. Nonetheless, with the palpable importance of the family in coordinating

consumption and labor supply behavior, the unitary model of the family (Becker, 1965) has been often used to combine in a single model the process determining household consumer demands and labor supply, allowing for cross effects of the shadow wage rates of all family members to affect all of their labor supply choices (Mincer, 1963; Kosters, 1966; Heckman, 1971; Ashenfelter and Heckman, 1974).

Because the unified model of family behavior does not explicitly deal conceptually with how families aggregate the welfare of individual members to guide its decisionmaking and to determine the distribution of consumption and welfare among members within the family, the unified model of the family has not shed much light on how individual and family resources affect the welfare of persons <u>within</u> the family. This failure to study the intrafamily distribution of welfare cannot be entirely attributed to the lack of a theoretical framework, for reduced-form models can be readily estimated for this purpose. Although it is easy to conceive of "private consumption goods" in the family, it is more difficult to measure empirically forms of "assignable consumption," such that one person's consumption of a good can be readily monitored and would not raise (or lower) the utility of other family members. Human capital, assuming it can be valued and quantified, may be such a private or assignable good, if it has no externalities beyond the economic agent in whom it is invested. With the family ascribed a central role in financing (savings and transfers between possibly altruistic generations) and coordinating human capital investments in children, the allocation of human capital investments among children may provide an empirical window through which to take stock of an important aspect of the personal distribution of welfare within the family (e.g. Thomas, 1990, 1994; Strauss and Thomas, 1995).

Schooling and education were the first forms of human capital to be studied across children within a family, and more recently height and weight for age have been analyzed as indicators of long run nutritional and health status, expected longevity, and productive capacity (Fogel, 1994; Strauss and Thomas, 1995). Becker's (1965, 1981) approach to the gains from marriage emphasizes cumulative returns to individual specialization in time allocation in the household, and imperfect substitution of the labor of one for another family member in either or both market and nonmarket production. The market earnings or income of the individual is not synonymous with the individual's welfare or endowment brought into the family, because earnings

reflect the endogenous choice of labor supply that depends on technology and preferences, as well as the endowments and wages of all family members and market determined exchange prices.

Becker (1981) extends further his framework to deal with the utility of different generations. He continues to assume that a single altruistic decisionmaker takes account of the separable welfare of each of his offspring, in the form of subutility functions. Two additional strong assumptions are introduced: that the parent decisionmaker maximizes the present discounted value of the family's consumption, and that the parent prefers to equalize the lifetime consumption opportunities across his or her children, despite differences in innate ability and market productivity of children. It is further assumed that this innate source of heterogeneity among children interacts positively with the internal rate of return these children earn from a given human capital investment, and that initial human capital investments yield economic return in excess of market borrowing costs, so all parents want to invest in some human capital for each of their children. Becker and Tomes (1979) elaborate why parents in this framework, guided by efficiency, would invest differentially in the human capital of their children until the returns on these marginal investments fell to the parent financial cost of borrowing. At that point, further transfers to children from parent would all take the form on nonhuman capital, and thus earn the same market return. These additional nonhuman capital transfers would be allocated to equalize lifetime consumption opportunities across all children, and thus advance the parent's equity goal. This wealth maximization model implies parents <u>compensate</u> in their allocation of nonhuman capital transfers (both during their lifetime and in the form of bequest at death) for innate child endowments, whereas they <u>reinforce</u> these innate child endowments in their allocation of human capital investments.

If the borrowing costs for parents to invest in their children's human capital vary substantially due to differences in the parents' collateral, only the relatively rich may make the optimal human capital investments in all of their children and still have enough resources left to equalize the consumption opportunities of their offspring through further transfers of nonhuman capital. The rich parents will be able to achieve both efficiency (i.e. wealth maximization) and equity (i.e. equal lifetime consumption for all their children), whereas some poorer parents will presumably have to sacrifice one goal for the other due to their constrained access to credit. Behrman (1997) reviews these and other aspects of Becker's wealth maximizing parent's solution

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for intergenerational transfers. The empirical evidence has been mixed on whether parents do actually reinforce innate endowments of their children through their human capital investments. There is also little evidence in the United States, and few studies elsewhere, to suggest that bequests of parents to their children are disproportionately larger for children whose earnings or education are less than the average of siblings. Indeed, the most common pattern is for equal bequests, but this does not address the possibility that parent may make transfers before their death which partially or wholly compensate the child whose lifetime earnings are relatively lower than her siblings.

An alternative specification of the intergenerational family utility function proposed by Behrman, Pollak, and Taubman (BPT) (1982) assumes that human capital and nonhuman capital transfers to children from the parent are separable in the parent's utility function, and therefore the parents may not treat the two mechanisms for increasing a child's consumption as necessarily equivalent. It is also a goal of the BPT framework to permit parent preferences toward wealth maximization and inequality aversion in children's consumption to vary and these basic preference parameters of parents to be estimated from intergenerational bequest and transfer data.

To make their framework empirically tractable, BPT assume a constant elasticity of substitution functional form for the utility function and a Cobb Douglas household production function to create the child's human capital. The utility function that aggregates the lifetime earnings capacity (E) of the children is assumed to exhibit a constant elasticity of substitution between children, or in the case of two children:

$$U(E_1, E_2) = (\alpha_1 E_1^\rho + \alpha_2 E_2^\rho)^{1/\rho} \quad . \tag{8}$$

Equal concern with child 1 and 2's earnings implies $\alpha_1 = \alpha_2$, and $-\infty < \rho < 1$ represents aversion to inequality, where $\rho = -\infty$ implies Rawlesian preference for always increasing the earnings of the less productive child, and $\rho = 1$ implies no inequality aversion or a purely investment strategy in maximizing aggregate family net worth.

The child's lifetime earnings (E) is produced by a Cobb Douglas production function with the arguments being μ, the child's innate endowment, Y the years of schooling received, and X the resource intensity per year of schooling (or school quality):

$$E_i = \mu_i^\lambda Y_i^\beta X_i^\gamma , \quad i=1,2. \tag{9}$$

First order conditions from maximizing utility subject to the production function and budget constraint implies that the relative years of schooling provided two children will be the following function of their relative earnings:

$$Y_1/Y_2 = (\alpha_1/\alpha_2)(E_1/E_2)^\rho . \tag{10}$$

Solving for reduced forms for the relative earnings or schooling of the children, one obtains:

$$Y_1/Y_2 = (\alpha_1/\alpha_2)^{1/(1-\delta\rho)}(\mu_1/\mu_2)^{\lambda\rho/(1-\delta\rho)} , \tag{11}$$

$$E_1/E_2 = (\alpha_1/\alpha_2)^{\delta/(1-\delta\rho)}(\mu_1/\mu_2)^{\lambda/(1-\delta\rho)} , \tag{12}$$

where $\delta = \beta + \gamma$. But the reduced forms are in terms of the endowments of the children which are generally not observed, so data are used to fit the first order condition, where earnings and years of education are observed for the children (Strauss and Beegle, 1996).

This framework is also applied by Behrman (1988) to analyze health investments in nutrition of boys and girls in Indian agriculture (E. Rose, 1995), and extended to consider how the parameters differ between the lean and surplus seasons in agriculture in low income countries (Harriss, 1990; Strauss and Beegel, 1996). One could imagine that parents would demand more equality in the surplus season after the harvest. Other intertemporal variations might be investigated in periods of famine or crisis (Agarwal, 1991, 1994). Some have found in periods of extreme food scarcity that female child mortality increases more than male mortality, as documented in the famine in China from 1959-61 following the "great leap forward" (Aird, 1983). Consumption smoothing that shelters human capital accumulation in the form of child health and schooling behavior should also be less constrained by credit for rich parents than poor, if the rich have more collateral (Jacoby, 1994). Foster (1995) found that during serious floods in Bangladesh in 1988 the landowners were better able to protect their children's nutritional status from the severe shocks of food shortages than were the landless laborers. But differentials by the sex of the child in this form of consumption smoothing behavior did not appear significant (Foster, 1996).

It may not always be the case, however, that increasing wealth leads to a reduction in inequality among children, or more specifically between boys and girls. Studies have suggested that in parts of rural India, green revolution gains in agricultural productivity have in some regions led to a reallocation of women's time toward home production in landowning households, as women's participation in off-farm work has diminished, and fertility has remained high (Mukhopadhyay, 1994). If women realize smaller productive gains from education in home

production than in the market, this change in family time allocation could even reduce the incentives for women to receive more education. Although female education has not declined in India, progress in increasing female average levels of schooling has been slower than in most other regions of the low-income world (Schultz, 1987, 1995a, 1996).

Some studies do not find the education of women is partially correlated with household agricultural productivity or income. For example, an analysis of about a thousand rural households in Pakistan collected from 1986 to 1989 included several dozen input and family background variables to estimate crop production functions and household income functions. Household averages for six male and six female human capital variables were included, and female years of education was insignificantly partially related to outputs and income. Average female education in the sample is, however, 0.6 years compared with the male mean of 3.7 years. Having already controlled for female health status, test scores, and parent background, it is not surprising that female education is not partially related to crop outputs, livestock income, or nonfarm income (Fafchamps and Quisumbing, 1998a). More wealthy rural families may withdraw women from agricultural tasks, and employ them in household production for which the outputs are generally not counted in income.[1] Studies of India have also found more educated rural women are not necessarily more likely to work in agriculture, and improvements in household income related to the green revolution can even lead landowning households to reduce the labor force participation of their wives (Mukhopadhyay, 1994; Unni, 1995). A national panel study of rural Indian households finds that women with more than a primary education do not work substantially more time in the labor market (Behrman et al., 1997).

In extensions of the unified household production function approach to estimating reduced-form demands for time allocation, demographic behavior, and demands for market goods, it is not typically possible to recover the basic parameters of the underlying utility function of

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[1] This common pattern in traditional agricultural populations where there are few nonmanual jobs for women in the rural sector can be formally interpreted in terms of the standard family labor supply model in which the husband's cross wage and wealth effects on the woman's market labor supply are negative and outweigh the positive impact of her own wage effect associated with her increased education (Schultz, 1981; Alderman and Chishli, 1991). It is also not uncommon to find that wage rates in casual day labor do not increase notably with the education of the worker, whether male or female. The returns to schooling for a worker in agriculture tend to be realized by farm managers or farmers, who makes allocative decisions that may be better informed if he or she is better educated (Welch, 1980). In Africa and Southeast Asia where women do farm on their own, they are noted to reap private income returns to schooling at much the same rate as do men (e.g. Moock, 1976).

parents or the technology parameters of the human capital production functions, as in the more restricted BPT framework. Nonetheless, one can assess which factors in the family endowments and constraints affect the gender gaps in human capital formation or intrahousehold inequality in the general neoclassical unified household production model (Rosenzweig and Schultz, 1982b; Pitt et al., 1990; E. Rose, 1995). If innate endowments of children can be measured, then it is also possible to assess whether parents reinforce or compensate for differences in the endowments of their children.

However, the unitary approach maintains the idea that one member dictates and enforces allocations within the family, and that he is a benevolent altruist with sufficient resources to coordinate the behavior of other family members (Becker, 1981; Bergstrom, 1997). While this unified regime may be a reasonable approximation for describing some aspects of family behavior, it would seem more realistic to relax the model, if that modification is not too costly. Conflicting personal preferences for outcomes could affect both the intrahousehold allocation of productive resources and the distribution of consumption that determines personal well being, as well as affect who finds it in their interest to be in a family versus alone, and the composition of that family.

2.4 Collective Pareto-Efficient and Sharing Rules Households

The collective household models (Chiappori, 1988, 1992, 1997) are in one sense a return to building on individual decisionmaking models, but they preserve Pareto efficiency for the group which is generally associated with cooperative solutions of a market or bargaining process in which information is shared between the agents, or with situations involving repeated games, where there are private opportunities for learning and hence opportunities to avoid inefficient outcomes.

Browning et al. (1994) show that when the household is Pareto efficient then its objective function can be written as a weighted sum of its member's utilities, or for a two-adult household that would take the following form:

$$\max \quad \mu U^A(X^A, X^B) + (1-\mu)U^B(X^A, X^B) , \tag{13}$$

$$\text{subject to} \quad p(X^A + X^B) = Y ,$$

where U^i is the utility of family member i, i=A,B, X^i is the private consumption of individual i, and μ is the welfare weight of the member A in the household, such that the weights sum to one across member A and B. The sharing rule summarized by μ is itself affected by prices (p) and total household income (Y), and possibly other variables such as the individual's earnings opportunities which could influence the person's reservation utility she might expect in some alternative family living arrangement.

Demand functions can be expressed conditional on the sharing rule:

$$X^i = f\,(p,\, Y,\, \mu(p,\, Y))\,, \tag{14}$$

and reduced-form demand functions are obtained by substituting out the sharing parameter:

$$X^i = g\,(p,\, Y)\,. \tag{15}$$

Browning et al. (1994) show that empirically testable restrictions on g(.) can be obtained that are similar to the matrix of income-compensated responses to prices and wages obtained in the unitary demand model, i.e. Slutsky equations (Strauss and Beegle, 1996). A two-stage decision process is proposed that restricts the value function to be weakly separable:

$$W^A(U^A(U^A), U^B(X^B))\,. \tag{16}$$

Egoistic (selfish individual) behavior that assigns no weight to a partner's utility is nested in this formulation. If a specific amount of income, φ, is allocated to member A, and Y-φ income to B, then each person maximizes their utility function subject to their income constraint, and conditional demand functions can be written as follows:

$$X^i = X\,(p,\, \varphi)\,. \tag{17}$$

The ratio of the marginal propensity to consume a good with respect to changes in the incomes of the two individual incomes should be the same across all pairs of goods, for example k and j:

$$\frac{\partial X^{\,k}/\partial Y^{\,A}}{\partial X^{\,k}/\partial Y^{\,B}} \;=\; \frac{\partial X^{\,j}/\partial Y^{\,A}}{\partial X^{\,j}/\partial Y^{\,B}}\;. \tag{18}$$

In the unitary household model this ratio is unity. In the collective model the ratio represents sharing weights that correspond to the individual's relative command over resources or potential income. μ and φ are a function of p, Y, tastes and individual income opportunities and assets, as well as what McElroy and Horney (1981) call extra environmental parameters (EEPs) that affect an individual's welfare outside of this family, such as applicable divorce laws, (Peters, 1986), welfare policies for single mothers (Schultz, 1994; Lundberg et al., 1997), extended family

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support networks (Cox and Jimenez, 1990), and the local ratio of marriageable males to females (Chiappori et al., 1997) which might alter the reservation utility of being a member of the family. In the unitary model only p, Y, and tastes influence household demands, but in the collective model individual endowments and alternatives (EEPs) can influence demands or explain outcomes dependent on the family bargaining process.

If goods are assignable to either the husband or wife (and are observable), and separate exogenous incomes are attributable to these individuals, then the sharing rule may be derived across estimated household demands. Moreover, the restriction that the sharing rule is constant across pairs of commodities is then testable in estimating the system of demand equations as shown in (18).[2]

The test of the sharing rule's constancy across pairs of commodities reported in the paper by Browning et al. (1994) relies on women's and men's apparel expenditures for a sample of Canadian couples who are purposively selected to both work for wages and have no children. The test relies on earned income of the woman and man to influence the income sharing parameter φ. A wife's clothes are assumed not to influence a husband's utility, and thus satisfy the separability requirements of the utility function, and vice versa. The earnings of the wife must be exogenous and not reflect her labor supply decision, and more specifically, working more time in the labor market may not affect her requirements for more and more expensive clothes. These are strong assumptions and they lack realism, and the specially selected sample weakens further how one is to interpret their empirical evidence. But the paper illustrates how the collective model can be used to motivate more compelling empirical tests in the future of the cooperative structure of the family.

The framework has been extended to include labor supply by Chiappori (1992), although that requires the observation of husband and wife nonearned income to influence the sharing rule (Fortin and Lacroix, 1997). If home production is added (Chiappori, 1997; Apps and Rees, 1996, 1997), other restrictions are required, such as constant returns to scale of household production and no joint production, just as Becker (1965) assumed originally in his unitary household

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[2] Errors in the measurement of the nonearned income of the individuals, Y^A and Y^B, may differ. But due to the ratio form of equation (18) used for testing of the constancy of the sharing rule, the attenuation bias introduced by such measurement errors would cancel out across different commodities, k and j, and not affect the estimated ratio or the test of the ratio's constancy across different pairs of commodities. See Thomas and Chen (1994).

production model. Marriage matching (Chiappori et al., 1997) can also be incorporated into the framework, where the sex ratio of marriageable males to females is specified to affect the sharing rule between married couples. The use of the sex ratio to affect marriage gains was first empirically explored by Frieden (1974) following Becker (1974) and subsequently analyzed by Grossbard–Shechtman (1993). The ratio of marriageable males to females in a suitably defined marriage market (i.e. homogeneous in demographic characteristics and region of residence) should have opposite signed effects on marriage rates of men and women, and presumably displace their reservation utility, and hence affects their bargaining power within marriage (Chiappori et al., 1997). If the distributional sharing rule is contracted on entry into marriage, and is thereafter binding, then the sex ratio at the time of the marriage should be the relevant constraint to a household's current sharing rule and resulting demand behavior.

Another way to approach the intra-family allocation process is to prescribe how the surplus in benefits produced by a marriage is distributed between spouses. One specific framework is the symmetric Nash (1953) bargained solution. The two members are assumed to maximize the product of the individual gains from the marriage in excess of their reservation utilities outside of the union:

$$\max \ [U^A(p, Y^A, Y^B, V^A, V^B) - U^{RA}(p, Y^A, V^A, EPP^A)]$$
$$* [U^B(p, Y^A, Y^B, V^A, V^B) - U^{RB}(p, Y^B, V^B, EPP^B)] \tag{19}$$
$$\text{subject to } Y^A + Y^B + V^A + V^B = Y$$

where V^i refers to the nonearned income of individual i, i=1, 2, EEP^i are parameters that affect the ith individual's reservation utility U^{Ri}. The Nash solution has many attractive features and some disadvantages. The main limitation to the Nash solution is that it focuses on only one, relatively arbitrary, Pareto efficient allocative solution. This solution is also motivated by the concept of a threat point, linked in most discussions to divorce or leaving the union. That extreme irrevocable threat may seem unreasonable for many stable marriages that are not currently near the margin where dissolution would be preferred by either partner. On the other hand, the simplicity of the Nash bargained set up (Manser and Brown, 1980; McElroy and Horney, 1981; McElroy, 1990) opens the door to consideration of conflict within families as an intermediate process affecting observed household behavior. The notion that marriages might operate as a cooperative game with extensive sharing of information is not an unrealistic starting point for analyses of intrahousehold

allocations. Many more complex setups which involve repeated games may also lead, in the long run, to solutions which closely resemble Nash-bargained solutions.

The unitary model implies that the distribution of nonearned income between spouses should not affect consumption behavior. Rejecting empirically this implication of resource pooling within the family does not immediately support one over another model of nonunitary family behavior, but it reinforces the search for alternatives to the unitary model, including possibly the Nash-bargained model (Schultz, 1990b; Haddad et al., 1997). However, it is not satisfactory to examine spousal-specific earnings as a proxy for partner "bargaining power," because earnings embodies labor supply which is typically viewed as endogenous to the household's demand system. The shadow wage of the husband and wife might appear preferable, but these measures of the opportunity value of spousal time may also influence home production in the unified family model and reflects the impact of life cycle specialization in market and home production by spouses, and thus is contingent on their endogenous expectations regarding the permanence of the union. Moreover, to exclude, as Browning et al. (1994) have, "couples who were not both working for a wage in the labor force" may in all likelihood introduce sample selection bias. To correct for such a bias and be able to impute the shadow value of time to those who are not currently working for a wage would require the imposition of additional structure in the model, as will be discussed later. Of course, even nonearned income may be related to past savings and accumulation behavior that could differ by market and home production specialization, and thus be endogenous in this setting. However, I know of no systematic empirical evidence of a simultaneity bias between nonearned income and household demand behavior. Indeed, the empirical evidence preponderantly shows that wage labor supply is negatively associated with nonearned income, as would be expected if nonearned income were exogenous in the simple labor supply model.[3]

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[3] Critics of this empirical literature who reject *a priori* the exogeneity of nonearned income do not explain why, if nonearned income is expected to be saved from persistently above average prior wages, there are few studies showing a positive partial correlation between labor supply and nonearned income. Of course, identification of these models of family bargaining would be more satisfactory if a variable were observed that accounted for a substantial share of the individual variation in nonearned income within and across households, and this variable were theoretically independent of all other individual and family constraints and tastes that might otherwise influence household demand behavior. What is needed are random social experiments that affect the resources of husband and wife independently, but they appear, unfortunately, to be rare. Yet with these refined models in hand, empirical research should proceed to design and measure more satisfactory variables determining the "threat points" of family members, such as inheritances or dowries in certain systems of family property rights.

There is an implicit sense in this literature that the "threat point" in the family bargaining model is the reservation utility the individual could expect to receive outside of the marital union, if the union ends or, in other words, if divorce occurs. But Woolley (1988) and Lundberg and Pollak (1993) propose a different interpretation to the marital bargaining process. They introduce an intermediate noncooperative state before divorce is reached which is maintained on the basis of socially sanctioned gender roles and a customary division of labor within the household. For example, women may remain responsible for child care while men maintain responsibility for providing income for the purchase of certain market goods. This noncooperative equilibrium might be adopted before the costs of union dissolution or divorce are incurred. One empirical implication of this "separate spheres" model of marriage bargaining is that changing the recipient of a government's child support payment between the parents is likely to affect the couple's relative bargaining power and thereby influence the households allocation of consumption, if the parents have different preferences over alternative observed forms of consumption. In the United Kingdom, child payments were redirected in 1990 from fathers to mothers, and expenditures on child apparel or women's apparel, relative to the expenditures on man's apparel, increased (Lundberg et al., 1997). However, relabeling a transfer program may in itself change how it affects consumption patterns. Koremann (1998) found in the Netherlands when "family assistance" was relabeled a"child payment", it also was associated with an increase in expenditures on child apparel. But these differential effects of the child payment relative to the effect of other sources of income on child apparel were the same in both female headed households as in two-parent households, raising doubts about the importance of differences in preferences between mothers and fathers to explain the change in consumption in the UK.

There remains relatively little incontrovertible evidence that preferences of mothers and fathers differ with regard to child consumption, but many suggestive empirical studies find increments to women's resources are associated with increased child health and well-being (Fuchs, 1988; Thomas, 1994). One straightforward test of the unified family model remains, however, that nonlabor income is pooled. Additional restrictive assumptions are required to construct tests to evaluate the Pareto efficiency of intrahousehold allocations. Portraying the family as a noncooperative bargaining unit may be plausible when coresidence ends in divorce and the public good character of children is modified by rules of child custody. Before that stage, the challenge

remains to show inefficiency due to the "separate spheres" equilibrium. Evidence of family inefficiency emerges from analyses of the allocation of farm production inputs, but not yet clearly from the study of intrahousehold consumption patterns, which depend critically on the observability of private goods (Cf. Udry, 1996).

3. Empirical Regularities

3.1 How Families Allocate Resources

Evidence has gradually accumulated in the last decade that challenges the strict formulation of the neoclassical unified family demand model (e.g. Becker, 1981). Models of bargaining have therefore been developed, as discussed above, that are less restrictive (Manser and Brown, 1979, 1980; Haddad et al., 1997). First, there is the cooperative Nash-bargained solution (Eq. 19), and then more general cooperative sharing rule models (Eq. 13) that allow partners to choose intrahousehold allocations from among a wider range of Pareto efficient possibilities (Chiappori, 1988). Noncooperative bargaining models generally presume the existence of asymmetric information, which is reasonable in some cases, such as child support and divorce settlements. They represent a less well-defined framework within which to analyze family decisionmaking, and provide an explanation for outcomes that are not Pareto efficient (Lundberg and Pollak, 1993; Jones, 1983, 1986; Udry, 1996). However, few widely accepted empirically testable predictions distinguish between noncooperative schemes, though many extensions of game theory have not yet been adapted to the study of household behavior. The goal here is to describe the initial modeling efforts that have added flexibility to the neoclassical family demand model by dealing with the possibly distinct interests and separate resources of family members. The model may also allow for a partial pooling of resources, rather than the complete pooling as assumed in the unified family demand model. For example, husbands and wives may appear to pool resources and consistently coordinate their use of time during that period of the life cycle when they have young children at home and not otherwise (Schultz, 1981; Lundberg, 1988), or parents may pool resources, but other coresidential relatives in the household may maintain their own separate finances.

Consider, for example, how the individual supplies labor. It is generally assumed that increases in nonearned income increase the demand for leisure and nonmarket time and reduce

time supplied to the labor market. As this framework is adapted to analyze the labor supply behavior of wives and then other family members (Mincer, 1963; Kosters, 1966; Heckman, 1971), the leisure of each additional family member is added as an argument to the family utility function, but the family's nonearned income is simply pooled. This unified approach to family demands and labor supply consequently assumes that the demand effects of nonearned income would be identical regardless of the individual's status in the family, or that the distribution of the nonearned income by personal source would not affect family coordinated demand and labor supply behavior. Situations may arise where this pooling assumption appears realistic and others where it does not conform to what we think we know about resource pooling of family members or the coordination of family decision-making.

The cooperative Nash-bargained model assumes the couple cooperatively maximizes a product of the individuals' marital gains in their utility compared to their utility available outside of the union as in equation (19). Unless the utility in the marriage for both partners exceeds their alternatives (i.e. reservation "wages" or U^{Ri}) the union would not be economically viable. This reservation "utility" establishes a "threat point" or lower limit for consumption allocations to each adult within the family. Nonearned income controlled by the husband or the wife is thus expected to raise the "threat point" of that spouse: it leaves the spouse less dependent on marital gains. The bargaining power of the wealthier spouse is thus strengthened, and this potentially changes the distribution of consumption within the family.[4]

Even when there is an observable consensus on who controls physical assets or nonearned income within the family, there remains the problem of specifying "private goods." Leisure is a natural candidate for a normal good whose beneficiary is the specific individual. But in reality the variable observed is often not consumption of leisure but time not counted as at work in the market labor force. Since this time outside of the market labor force may include time in home production, such as household chores and childcare. Consequently, it is unclear whether nonmarket time is universally a normal good whose demand increases with income. In other words, does spending more time at home constitute unambiguous evidence of women's increased

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[4] Of course, the bargaining could occur at the outset, when the family is formed, which suggests that members use their initial resource endowments to agree on the weights for individual goals in the "family's utility function." If these resources change unexpectedly, because of a bequest or inheritance or alternative marriage proposition, the "threat points" would shift and a new bargain and agreed-upon family utility function would be adopted as a guide to subsequent intrafamily allocations.

utility? Counting who is in the market labor force is also subject to some ambiguity, particularly for women where cultural standards of acceptable activities may introduce forms of enumeration bias (Folbre and Abel, 1989). The margin of uncertainty in the enumeration of women in the labor force is exaggerated in agriculture, for virtually all women on farms do much unpaid work in the production of market as well as nonmarket goods, but surveys and censuses may or may not count such activities as qualifying them as engaged in productive activity or in the "economic" labor force. Durand (1975) discounts much of the reported variation across countries in rates of female participation as unpaid family workers in agriculture as a statistical artifact due to variation in cultural interpretations of women's accepted roles. The definition of workers who are counted in the labor force working in an unpaid capacity in the family can also change within a country over time, creating anomalous shifts in female labor force participation rates, as noted in India between the censuses of 1960 and 1970.

The effect of private nonearned income on other forms of consumption than leisure may be even more ambiguous as a private good, such as expenditures on tobacco, alcohol, toys or gender-specific apparel, for there is nothing to prevent wealthier women or men from deriving (selfish) satisfaction from varied consumption activities of other members of their household, even if the good appears to be individual specific and targeted to another individual or demographic group in the household.

Nonearned income (or its sources) might be divided into those elements brought to the marriage or accumulated during the marriage through distinct individual kinship relationships and independent personal activities, the receipt of bequests or inter vivos transfers, or other personal connections. A wife's nonearned income, such as she might have inherited or brought to the marriage as a dowry, might be expected to reduce her market labor supply by a greater amount than the same amount of nonearned wealth brought to the marriage by her husband (Malathy, 1993). Conversely, the payment of a bride-price in many areas of subSaharan Africa by the groom to the bride's parents may be associated with the bride increasing her supply of time to the family's labor force (Jacoby, 1992).[5] This prediction of the individualistic bargaining model received only

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[5] Evidence compiled by Svenberg (1990) indicates that female nutritional status and survival prospects in subSaharan Africa are superior overall to male, possibly because women are economically more productive in converting calories into work than men. As a consequence, perhaps, parents are paid brideprices for their daughters and have a stronger incentive to invest in their health. The one region of subSaharan Africa where Svedberg's anthropometric indicators of nutrition and mortality do not indicate as strong a bias in favor of females is in Nigeria

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modest support from its first empirical test against U.S. household data, probably because most enumerated wealth was in the form of residential housing, for which the ownership was generally reported to be joint or shared equally (Horney and McElroy, 1988). Subsequent study of the allocation of time of U.S. husbands and wives to housework provided more support for the bargaining or collective approach to household allocation, perhaps because spouse specific nonearned income was better measured (Carlin, 1991). Additional studies based on data from Thailand, India and Brazil unequivocally reject the pooling of nonearned income as it affects family labor supplies, thereby challenging the unified household model (Schultz, 1990b; Duraisamy, 1992; Thomas, 1990).

In principle, the measurement of nonearned income is to capture an exogenous difference across persons in their budget constraint that does not also induce a change in money or time prices of various types of consumption or behavior. In practice, nonearned income (rents, dividends, interest, and capital gains) could arise from inheritances that are similar to schooling, in that they are largely financed by parents and extended family and can be viewed as exogenous at the start of adult life. But nonearned income also represents returns on a person's life cycle accumulation of savings, and hence captures in part the person's past behavior. It then becomes, for some purposes, an endogenous choice variable. Hence, it is desirable for survey questionnaires to pursue the source of each individual's current nonearned income, current assets, and the date of receipt of bequests that led to these current assets, and whether they came from the husband's or wife's side of the family. The Rand Malaysian family life survey comes closest to asking these questions, but I know of no analysis of these data from the perspective outlined here (Butz and DaVanzo, 1978). The Rand Indonesian family life surveys have extended further this line of questioning that should advance research on family bargaining and demand behavior (Rand, 1996).

In Thailand women have traditionally participated in the agricultural labor force almost as frequently as men, and agricultural land is often inherited and managed by women. Although marriage among women was nearly universal in the past, divorce and remarriage were not uncommon. In 1981 the nationally representative Socioeconomic Survey collected by the National

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and perhaps Senegal. Both of these countries contain a significant Islamic element and women's productive roles are more circumscribed in these segments of the population (Caldwell and Caldwell, 1987).

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Statistical Office distinguished between the individual's ownership of nonearned income within families. This large survey thus provides an opportunity to test the resource pooling implications of the unified family demand model. The estimated negative effect of a specified amount of nonearned (from rentals, interest or dividends) income on labor force participation by women aged 25 to 54 was three times larger if this income is owned by the woman compared to the effect of nonearned income owned by her husband. Conversely, a husband aged 25 to 54 reduces his labor force participation three times as much when the family's nonearned income is owned by him rather than by his wife (Schultz, 1990b). In other societies it may be more difficult to collect meaningful data on the ownership of nonearned income for each individual in a family. For example, in a survey of rural Northeast Brazil, few women report nonearned income, though the proportion increases in urban areas, and there it is statistically associated with improvements in indicators of child health and nutritional development, holding constant for the weaker effect of men's nonearned income (Thomas, 1990). These empirical patterns challenge the validity of the unified family demand model, but they do not tell us which particular bargaining solution or household behavioral model is preferred.

Transfers may also be a useful basis on which to modify the unified family model, and perhaps even distinguish the limits to the layers of the extended (altruistic) family. It may be assumed that transfers, as with nonearned income, serve primarily the interests of the individual who receives them. Transfers may also be reciprocally provided by members of the extended family with the expectation that they are to be used to support particular forms of consumption. For example, a sick child may elicit transfers from kin that are intended to help meet the costs of the child's medical attention or help the family reallocate its time to care for the sick child, though it involves a loss of market income. Whether the distinctive effect of the transfer on consumption patterns or labor supply behavior in the family can be attributed to the individual through whom the transfer is received, has not been tested, to my knowledge.

Related issues of altruistic limits to sharing in the extended family are reported in the literature, but few generalizations have emerged. Ainsworth (1996) found in Cote d'Ivoire that foster children are treated equally to biological children in the families into which they were fostered, at least in terms of their time allocation and school attendance. Kochar (1998) examines how the wealth and consumption of a child's household affects the labor supply of their

coresidential elderly parents. She finds family ceremonies may function as a "public good" that encourages the elderly in the family to work less, compared with consumption of private goods which do not have this disincentive effect on the labor supply behavior of the elderly living with their children. Hayashi (1997) analyzes how the relative income status of the older and younger generation in a Japanese household affects the composition of foods consumed, when the preferences for specific foods are demonstrably different between the younger and older generations. There is much need for further analyses of how the sources of family income affect its allocation, as the family unit is extended from the nuclear unit to the extended kinship system. It is a natural extension to note in closely knit ethnic groups, in many parts of the world, that the solidarity of the family and the village provides a consumption smoothing insurance system against readily monitored individual idiosyncratic risks (Rosenzweig, 1988; Townsend, 1994; Udry, 1994).

There is some evidence that as women obtain more education and marketable skills, they consume more of their family's resources and are "treated" better. But these patterns do not help to distinguish between the competing intra-family resource allocation models. The unified family demand model emphasizes that the human capital embodied in women affects their value of time and influences the allocation of time and investments within the family (Mincer, 1963; Becker, 1965). Consequently, empirical evidence that time allocations, consumption, and investment patterns within the family respond to differences in male, female and child wages does not help to discriminate between the unified family demand and bargaining models. But the cooperative Nash-bargained model of household behavior also predicts differential consumption effects of nonearned income depending on who controls it. The bargaining framework offers a reasonable way to explain why women may engage in separate jobs from their husbands to enhance their control over the resources they produce. Indeed, this pattern is particularly notable in subSaharan Africa and South-East Asia, although women may still work some of their time as an unpaid worker in their family or on their husband's plot of land (Schultz, 1990a).

In parts of Africa husband and wife cooperate in the joint production of some crops, while other crops or parts of the production process -- e.g. marketing -- are entirely the responsibility of one sex. The unified model of the family leads to the prediction that the wife allocates her time between the joint crops and her own crops to equalize the value of her marginal product across all

activities. The bargaining model, however, allows that she might work more on her own fields, because the value of her marginal product there is more under her control and hence of greater value to her. Jones (1983, 1986) confirmed these predictions of the bargaining model with survey data collected from Yagoua in North Cameroon. Allocative incentives within these Massa families, therefore, may not achieve a strictly efficient use of labor but may advance other individual interests of family members.[6] Udry (1996) has documented a similar pattern in the allocation of family labor between husband and wife controlled agricultural plots in Burkina. The loss in output due to the less than Pareto efficient intrahousehold allocation of the couple's time is estimated by Udry to be about 6 percent, compared with the intra-village level inefficiency of twice this magnitude due to the apparent misallocation of labor across plots of the same crop of different families in the same village. Thus, the bargaining process may interject a modicum of inefficiency in within-family allocation of labor, but it is only about half as large as the within-village inefficiency across households in the allocation of the factors of production (Udry, 1996, p. 1040).

It should also be noted that most production function estimates of the marginal product of women's and men's labor assume that all inputs into the production process are observed and are exogenous. This requires that any omitted inputs are uncorrelated with labor allocations, and the inputs are not allocated on the basis of unobserved factors or shocks, such as management bias or weather that could affect the productivity of the labor input. If the allocation of these omitted inputs is, however, affected by the assets and empowerment of women and men, then these production inputs must be treated as endogenous and their allocation explained in terms of exogenous factors. Well defined exogenous market prices for inputs that vary across the sample households might provide one basis for identifying the production function parameters on observed inputs, including those that determine the marginal productivity of male and female labor. For example, in Udry's (1996) analysis of Burkina labor productivity by plot, he notes that male plots receive a disproportionate share of the other variable inputs: manure and child labor.

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[6] In principle there might be a superior Pareto efficient allocation of husband and wife labor that would yield a larger output for both members of the family. But in practice, there are costs in monitoring labor inputs over scattered plots and transaction costs in exchange of inputs and outputs that might be required to provide both persons with the incentives needed to achieve Pareto efficiency. These transaction costs might absorb most of the output gains. Other West African studies have replicated these empirical patterns (e.g. Udry, 1996; Doss, 1996b, 1997; Smith and Chavas, 1997).

This would suggest that male "power" might contribute to male plots obtaining these additional scarce, but not widely marketed, inputs, and these inputs could complement labor on male plots, explaining the lower productivity of female labor when women work their own plots. Udry is also worried that unmeasured qualities in the plots could favor male plots and account for the greater female productivity on male plots than on their own female plots. As noted in many studies comparing the agricultural productivity of women and men, it is extremely difficult to estimate confidently the separate marginal productivity of male and female labor in joint agricultural production without maintaining very strong untested working assumptions (Quisumbing, 1996b).

3.2 Intrahousehold Allocation of Time

The time allocation of unrelated individuals or groups of individuals combined in a family enterprise may be analyzed by estimating production functions or cost functions, from which the marginal product of different types of labor are inferred. Then when profit and utility are sequentially maximized, the allocation of labor can be attributed to exogenous or quasi-fixed endowments of such factors as land, market prices of inputs and outputs, or the state of nature, e.g. weather. The more common approach to studying time allocation is to start with the demand for leisure within the consumption framework as outlined in section 2, and then the time worked (or not demanded as leisure) is a function of the wage offered for working, other sources of nonearned income, and relative market prices.

When this consumer demand model is generalized to a unified family of several adults and time allocated to nonmarket production is treated as distinct from leisure, the issue arises whether the time of the husband and the time of the wife in household (nonmarket) production are substitutes or complements. In Becker's unified model of the family they are assumed to be substitutes, and with on-the-job training leads to human capital accumulation from work experience, this framework leads to the expectation of gender specialization between market and nonmarket work within the family. But if nonmarket time of husband and wife were complements in nonmarket work, it might be expected that some couples would both work together in the market and a few might even work together in nonmarket production, leading to market and nonmarket specialization across families, rather than within families. But to the extent that child care, food preparation, and household chores for the family's own consumption constitute the

major nonmarket production activities of the household, Becker's model of specialization within families has some intuitive appeal. In the agricultural household model in which the family coordinates its farm production at home, there may be more range for complementarity between spouses. Also during the early and late stages of the nuclear family's lifecycle before childbearing starts and after children leave the parental home there may be less opportunity for substitution of spouses time in nonmarket production, and indeed if nonmarket time of spouses includes leisure they might be complements among the very young and old (Schultz, 1981). These cross substitution possibilities between the time of adults in nonmarket activities should be estimated at different periods in the lifecycle and not restricted to be constant across all ages, and perhaps be allowed to vary across agricultural and nonagricultural households (e.g. Lundberg, 1988).

An empirically testable implication of the unified demand model is that the income-compensated cross-substitution effects should be symmetric or equal, or specifically those associated with spousal cross-wage effects. This restriction of the unified family demand model implies in allocating their labor supplies, husband and wife are in complete agreement as to the value of each other's nonmarket time. It could be imagined, as an alternative hypothesis, that a husband would assign a higher value to his own nonmarket time than does his wife to his nonmarket time. In the case of their valuations of the wife's nonmarket time, the wife might correspondingly value her own time more highly than does her husband. An individualistic bargaining model allows for the possibility that the wife and husband might value some "goods" differently, most naturally their own "leisures." Thus, the strong restriction of the unified family demand model that the income-compensated cross-wage effect of the husband's wage on the demand for the wife's nonmarket time must be equal to the income-compensated effect of the wife's wage on the husband's nonmarket time can be empirically tested. Heckman (1971) tested this statistically and rejected it with U.S. data, although in a subsequent paper this theoretically implied restriction was imposed (Ashenfelter and Heckman, 1974).[7] But the test is conditional on

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[7] The overall determinant-condition of maximization theory in the family demand model is also rejected by Heckman in the static case (1971: Chapter 2, pp. 32-33). Both the static and "life cycle" estimation approaches pursued by Heckman lead to rejection of the symmetry condition. Ultimately, however, he imposed the restriction to obtain his preferred estimates (Chapter 2, pp. 37-38). One possible explanation for the rejection of the demand system parameter restrictions is the difference in spouse-specific nonearned income effects that may be used to infer individual compensated cross-wage effects.

many other aspects of the demand model, including functional-form approximations (Killingsworth, 1983).

This symmetry property of the family demand model is unfortunately not tested, to my knowledge, in agricultural settings where off-farm wage labor is more common (Huffman, 1974, 1976, 1980; Skoufias, 1993a; Kimhi and Lee, 1996). Such analyses might confirm whether women assign a greater value to their off-farm market time than do their husbands, perhaps because women exercise more control of their earning from off-farm work or it conveys status (or stigma) depending on the cultural context. To proceed in this direction, information on the nonearned income or individually controlled assets of the farm couple would be required. To evaluate the partial effect of the husband's or wife's nonearned income on family expenditures, the wage rates of both partners and market prices must be held constant. The wage rates and nonearned income determine the full income constraint of the couple, where full income is defined in order to be independent of the family's allocation of time to market work (Becker, 1965).

Shares on income expended on specific items are expected to be more systematically related to the family's permanent or lifetime income than to the family's transitory income. Total expenditures of the family are often viewed as a better measure of permanent or lifetime income than the total of reported current income sources. Total expenditures should, of course, include imputed values for home produced and consumed goods and services, such as the rental value of owner-occupied housing or home produced food and apparel. Shares of this family expenditure total spent on specific items, such as food, are then often explained in terms of total expenditures per adult, and relative prices, including the wage rates available to family members or the shadow value of their time if not working for pay in the labor force (Deaton and Muellbauer, 1980). Methods for dealing with differences in household composition are discussed later in section 3.3.

To estimate the effect of permanent income on consumption patterns or savings requires a method to distinguish between transitory and permanent income components. One approach is to specify an instrumental variable that is thought to be strongly correlated with the permanent income component, such as education and initial assets or inheritances, but uncorrelated with the transitory income component, due to such factors as weather variation or idiosyncratic shocks to

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health.[8] This approach to estimation of expenditure-share or savings functions by instrumental variable methods provides a starting point for evaluating whether nonearned income of the husband and wife exert roughly comparable effects on intrahousehold consumption/savings allocations. If the effect of husband nonearned income and wife nonearned income differ to a statistically significant degree (Eq. 18), this finding further weakens the argument for adopting the unified family demand model and strengthens the argument for adopting one of the more individualistic bargaining frameworks (Thomas and Chen, 1994). Alternatively, total nonearned income may be included as a conditioning variable in the expenditure share or savings functions, and the ratio of wife's to husband's nonearned income is included to test whether nonearned income is pooled within the family. The ratio variable should exert no effect on the expenditure/savings patterns, if the unified family demand model is a valid description of the underlying behavioral process. As in Thailand, this gender relative nonearned income variable may be expected to increase the allocation of the wife's time to her leisure activities and other female private goods, if a bargaining model is valid and preferences of husband and wife differ in the expected direction for the specific goods being studied.

Investments in children's education and health are expenditures that society may want to encourage. But these expenditure categories are difficult to comprehensively monetize, for that requires imputing a value to the time of each child and parents involved in schoolwork in the home or in health maintenance activities, respectively. Some forms of human capital stocks, however, can be roughly quantified in surveys and assigned as a private good to the individual. In the case of health or nutritional status, "height-for-age" and "weight-for-height" are two anthropometric indicators that are positively correlated with survival and reduced incidence of acute and chronic morbidity, and with wage rates and labor productivity among working adults (Floud et al., 1990; Fogel, 1986, 1994; Strauss and Thomas, 1995, 1998; Schultz, 1995b). In the case of education, years of schooling completed is a standard measure of educational investments, although this can be refined by including additional qualitative dimensions of the resource intensity of the years of schooling, such as the hours attending school per year, the training of the

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[8] Alternatively, measures of the deviation in weather from their long run average can be constructed in a particular agricultural region to instrument for unexpected weather shocks and used as an instrumental variable to approximate transitory income in an agricultural household. In this case, the residual household income can approximate the permanent income component. (Wolpin, 1982; Rosenzweig, 1988; Paxson, 1992).

teacher, the teacher-student ratio (i.e. inverse of class size), quality of facilities, and books and school supplies (Schultz, 1988).

It has been noted in a number of studies that increments to women's nonearned income and increments in men's nonearned income have a tendency to augment health and educational investments in children, but the effect of women's nonearned income tends to be larger than that of men's. Expenditure shares on food are also often closely related to proxies of women's economic bargaining power in the family, holding permanent income constant (e.g. Thomas, 1990, 1994; Hoddinott and Haddad, 1995; Doss, 1996a, 1997). These findings that enhanced female nonhuman capital increases allocations of family resources on children are consistent with Fuchs' (1988) psychological hypothesis that mothers exhibit stronger preferences for investments in child welfare than do fathers, or as recently restated that females are less selfish (Eckel and Grossman, 1998). It is also consistent with the previously noted study that found child support payments paid to mothers rather than to fathers increased child (and female adult) expenditures (Lundberg et al., 1997). But assessing longer term consequences for child well-being of redistributing nonearned income from men to women is complicated by the likely changes such a redistribution scheme might induce in family composition (Schultz, 1994b). If the comparison group of husband-wife-child units decreases because of an increase in separation, as previously noted in the Seattle Negative Income Experiment in the United States (US, DHHS, 1983), attrition bias might arise.

The unified family demand model, nonetheless, has the appeal of simplicity and widespread applicability, and some useful empirical applications. How much realism should be sacrificed by a theoretical paradigm to gain tractability to a wide range of phenomena is debatable (Becker, 1981). As the testable restrictions built into the unified family demand model become clearer, and sample surveys elicit more precisely the personal distribution of resource ownership in the family, it is to be expected that future studies will be able to reject this simplified abstraction (Alderman et al., 1995). But how much our answers to important policy questions change when we relax the family model and replace it by a bargaining model remains unclear (Strauss and Beegle, 1996). If one of our goals is to understand the determinants of child welfare, child human capital investments in nutrition and schooling, or women's well being -- then the

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alternative bargaining or sharing rule models seem to be a useful first step, but it remains to be seen whether these new models will change our interpretation of available data substantially.

For example, in societies where nearly all women marry by age 30 and there is little dissolution of marriage, as was true until the last few decades in Korea, China or Taiwan, the unified model of the family might prove satisfactory. But in much of subSaharan Africa and South East Asia where men and women often have different sources of income and distinct responsibilities for the support of family consumption, individual economic interests may be much less submerged in a "unified" family. In the latter regions, the cooperative Nash-bargained model of McElroy and Horney (1981) or the Pareto Cooperative model of Chiappori (1992) appear to be a more attractive framework within which to structure research on family and individual behavior, because it generalizes the unified family demand model and permits the restrictions implied by the unified model to be tested and potentially rejected empirically. These bargaining approaches to the family direct particular attention to who controls what assets and streams of income in the family, and may lead to new insights about how women's status influences the development process, including the timing of the decline in child mortality and fertility that governs the pace of the demographic transition and thereby impacts on the age composition of the population, and potentially on the rates of household savings and investment (Ram and Schultz, 1979; Higgins and Williamson, 1997).

3.3 Risk and Labor Allocation of Agricultural Households

If farm families are risk averse, greater farm income variability should increase off-farm labor supply. This pattern is observed for a sample of Kansas farm families in 1992 analyzed by Mishra and Goodwin (1997). One might also think that where specialization in managing farm production devolves predominantly on male family workers in the United States, the off-farm labor supply of female adult family members would respond more elastically to farm risk than that of the corresponding male. But the study by Mishra and Goodwin (1997) found the opposite, with the off-farm labor supply of the male farmer increasing more than that of his spouse to the risk

associated with farm income, proxied by the coefficient of variation in on-farm earnings for the last ten years.

This approach to intrahousehold coordination of the family members time allocation across risk-specific occupations tends to assume that the risk associated with the off-farm earnings is not perfectly correlated with the risk associated with the on-farm earnings. There is thus an insurance value to the pooling of the on- and off-farm income risks and a clear justification for following a mixed strategy for the family that combines in this case more than one type of job. It may also be reasonable to assume that the uncertainty of farm earnings is greater than that of off-farm earnings, though I know of few comparisons to document this conjecture (Friedman, 1957).

More generally the family is expected to diversify its mix of crops, its portfolio of income earnings opportunities, so as to trade off a reduction in its aggregate risk against a reduction in the expected value of its total income (Rosenzweig, 1988; Jacoby and Skoufias, 1992; Kochar, 1995; Lilja et al., 1996; Valdivia et al., 1996; Quisumbing, 1996a). One way that this may occur is when the family coordinates the migration of family members to other occupations or labor markets, and the most common example is by encouraging family members to work outside of the agricultural sector in the urban economy, for which it is plausible to imagine that income risks are not strongly positively correlated with those experienced within the farm. There is also a possibility that the family is not unified and altruistic (Becker, 1981), and that the migrants might engage in strategic behavior with the family at origin (Lucas and Stark, 1985).

Marriages may build dynasties that cement powerful relationships and reduce the risks of its members. Marriage of daughters may be a means to mitigate risk across the extended family. In such an environment the family might encourage daughters to marry husbands who are located in different agri-climatic zones and who would thereby reduce the family aggregate exposure to agricultural production risk, assuming that the daughter's new family and her origin family accept a social obligation to insure each other against some shocks to their earnings. Rosenzweig and Stark (1989) report evidence of this marriage pattern in South Indian ICRISAT villages, where the consumption of farm families is better smoothed from local weather shocks if they have male migrants living outside of the household or daughters married and living in more distant villages. They hypothesize further that as the Green Revolution changes the prevailing agricultural technology, it becomes more costly to monitor whether income variability is due to insured

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exogenous sources, such as weather, or to endogenous behavior of the family such as effort or choice of more risky new technologies. Then, these traditional risk-reducing insurance strategies of the extended family could become less valuable with more rapid technical change. This might erode the "insurance value" of daughters to farm families in technologically more progressive regions (Rosenzweig, 1995). Here is another possible explanation for the recently noted trend of the value of dowries (i.e. price of marrying a daughter) to increase in India (Cf. Rao, 1993).

3.4 Variation in Household Composition

Studies of price and income effects on expenditures and savings justify a variety of procedures for standardizing household behavior for differences in the household size and its age and sex composition of (Deaton and Muellbauer, 1980; Deaton et al., 1989; Deaton, 1997). However, these procedures may introduce their own problems as they try to normalize for "consumption needs" implied by household composition. This is because household composition embodies a variety of lifecycle choices, including marital status, fertility, and coresidential extension of the family to accommodate other generations and isolated kin, which may also be affected by market prices, income, and preferences. If the form of behavior being modeled, such as savings or time allocation, responds as do fertility and family extension in some manner to price and income conditioning variables, the partial relationship between household composition and economic behavior will not estimate a causal effect or suitable normalization, and controlling for this endogenous household composition variable will bias all other estimates of conventional price and income effects.

From this perspective, the researcher could proceed in at least two directions. It is possible to evaluate the effects of prices, etc. within a sample restricted to similar family units, to avoid variation in family composition. Thus, Heckman's (1971) unified model of family labor supply is fit to husband-wife couples who are both wage earners, eliminating the need to deal with (1) nonworking women, for whom the first-order conditions would be different and for whom no wages are observed, or (2) women without husbands, whose labor supply decisionmaking would be motivated by somewhat different optimizing framework. For analogous reasons, Browning et al., (1994) restrict their estimation sample to working husbands and wives without children to avoid the effects of variation in household composition on expenditure patterns. However, if the

goal is to assess the effect of price and income variables on all women, these selectively drawn samples will tend to yield biased estimates, if as seems likely, the probability of being selected into the sample is correlated with the disturbance in the behavioral equation estimated from the selected sample (Heckman, 1979).[9]

Another direction to proceed is to estimate a reduced-form relationship for the behavior under study, including all women, and implicitly solving out for the family formation process, the marriage match of spousal characteristics, and the characteristics of other "discretionary" members of the household (Lam, 1988). In this case, we are not able to identify the pathways through which an exogenous variable operates, say whether a woman's education affects the likelihood of being currently married, or whether her husband has relatively low earnings, or her having more children, other things being equal (Schultz, 1994b). But the reduced-form relationship approximates the sum of the direct and indirect effects of exogenous variables on each of her choice or outcome variables evaluated separately, including time allocation, consumption and savings behavior, as well as marital status, fertility, and the average human capital characteristics of her children, if she has any. Neither solution to the household composition problem is entirely satisfactory, for rarely is the sample selection correction model theoretically well specified, with a clear rationale for why the instrument identifying the sample selection rule should also be excluded from entering the household behavioral equation. Correspondingly, the reduced-form estimates may provide the aggregated effects of some policy variables, such as prices, subsidies, and taxes on behavioral outcomes of interest, but does not give us confidence on how these relationships operate. But there is growing evidence that ignoring the problem, and conditioning on family composition variables for household heads can itself be misleading; for example, it can mask the characteristic lifecycle pattern of personal savings (Schultz, 1999).

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[9] Newman and Gertler (1994) reformulate the rural family's labor supply decisionmaking problem in order to accommodate together in the same estimation framework families with different adult compositions.

3.5. Who Consumes What Assignable or Private Goods

It is hard to evaluate systematically and comprehensively what individual family members consume. Some household goods benefit all members: consumption of such a "public good" by one family member does not reduce that which is available to others in the family. This property of public goods can be used to explain family formation (Lam, 1988). Children are often referred to as a marriage-specific investment and a public consumption good, though the analogy has its limitations (Becker et al., 1977; Schultz, 1981). Economies of scale in home production and public consumption are also difficult to disentangle empirically from the implications of public goods within the family. Both phenomena contribute to the gains from marriage.

Nonmarket production is particularly elusive without prices and often lacking quantitative dimensions to the commodity. Child rearing is a nonmarket good that has some of the attributes for parents of a public good. For this reason most empirical analyses of intrafamily distribution of resources have focused on human capital investments in children, because such investments are largely produced by the family, are embodied in the children, and hence are subject to the child's future control, and they are quantifiable at least in terms of some of the inputs used, such as years of education. A family's investments in children account for a substantial part of a family's savings and intergenerational transfers. As noted above, three indicators of human capital investment in children are most frequently studied: survival (or mortality), anthropometric measures of child nutrition and health, and schooling. However, studies examining gender differences in child mortality, health, and education in low income countries are still sparse.[10] Reviews of a few such economic studies must suffice to illustrate how gender differences can be interpreted within families to measure regularities in behavior that should inform economists about intrahousehold resource allocation.

One of the notable features of India is the shorter life expectancy of women than men, and more specifically the lower child survival rates for females than males. The relatively low female survival emerges most clearly after the first month of life, because earlier infant deaths are mainly due to congenital problems at birth that appear to be less responsive to differentials in household inputs of child care, nutrients, and medical attention. Visaria (1971) analyzed the ratio of female-to-male children of specific ages as enumerated in the Indian 1961 Census to confirm that there

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[10] See later 19 for references to this literature.

was no other explanation for the shortfall of girls than a higher female than male child mortality rate. Miller (1981) illustrated that this pattern of excess female child mortality compared to most other populations was documented in earlier Indian Censuses (e.g. 1931) and that large variations across the districts of India were also noted in ethnographic studies in various parts of India. Miller finds that if cultural practices in a locality encourage women to restrict their participation in work outside of the family, a bride's family is more likely to give the groom's family a dowry upon marriage, and girls become less valued than boys. These cultural practices vary across regions and across castes or tribal groups in India in much the same manner as do the child sex ratio, with the higher dowries being associated with relatively lower female to male child survival. The regional variation in the child sex ratio does not follow closely income levels. Some of the richest agricultural areas, such as Punjab and Haryana, in the Northwest, as well as the Himalayas, and Western regions report low female to male child survival compared with the poorer South and Eastern areas of India. Also, the propertied castes often report lower female to male child survival ratios than the unscheduled or tribal castes, who are relatively poorer, at least in the Northwest. Miller (1997) raises the possibility that economic development and rising incomes would not necessarily curb this relative neglect of female children.

An econometric study of the Indian 1971 Census rural district data matched by a parallel analysis of households from a rural household survey from 1969-71 offers an economic account for these differentials in female to male child survival (Rosenzweig and Schultz, 1982b). It shows that in those districts and villages where economic conditions were more favorable for women to work in the labor force outside of their family, the survival of girls relative to boys was higher and closer to the international norm. A later study of a household survey from the Punjab, India suggested that public policies that increase access to public health, without affecting the relative productivity of men and women, reduced the average mortality level, but increased the mortality rate of girls relative to boys after the first month of life (Amin and Pebley, 1978). Subsequent studies have shown that in rural regions of India where female to male survival appears to be particularly low, family allocations of food and health care tend to favor boys, and the sex differential in survival is responsive to this sex discriminatory pattern of intrahousehold resource allocation. Analogous studies have found similar patterns in Bangladesh, Nepal, and in 19th

Century Germany (Sen, 1976; Chen et al., 1980, 1981; Miller, 1981, 1997; Martorell et al., 1984; Bardhan, 1984; Das Gupta, 1987; Klasen, 1998).

Other regions of the world also exhibit gender differences in child survival that appear to reflect differential investments (neglect) by parents, though they are less well documented, persistent, and perhaps smaller in scale than in India, including the ancient Greeks, Romans, Carthaginians, and Japanese, to name only a few. Historically fewer females than males survived famines, and this was still evident in China during the great leap forward of 1959-61. The Chinese ratio of male to female registered births exceeds the conventional range of between 1.03 to 1.06, and increases with parity. When the Chinese government in the 1970s adopted a strict population program that sought to enforce a one-child policy, infant and child mortality increased disproportionately among females, and the growing shortfall in women attracted demographic attention (Aird, 1983; Zeng, 1989). Perhaps in response to this development, the Chinese population policy was relaxed in the 1980s to permit in rural areas a second child, when the first was a girl. With the spread of ultrasound diagnostic equipment that could determine the sex of the fetus, female selective abortion increased the ratio of male to female births, especially at higher parities (Schultz, 1997).

In many equally poor societies gender differences in child nutrition, health status, and survival are smaller or nonexistent, such as Nicaragua, Brazil, Philippines, Sri Lanka, and Ivory Coast, for example (Blau, 1984; Popkin, 1980; Senauer et al.,1986, 1988; Thomas et al., 1990; Thomas, 1990; Thomas and Strauss, 1997; Strauss and Beegle, 1996). In some regions of SubSaharan Africa where women take a more active role in the labor force outside of the home than in much of South and West Asia, survival rates for females appear to often exceed those for males, despite low levels of income, high levels of malnutrition, and poor public health services (Sen, 1976; Svenberg, 1990). One interpretation of the available evidence on international patterns of gender differences in child health and survival is that there are marked cultural variations, often related to the relative economic productivity of adult women relative to men. But with increases in wealth, families in most cultural and economic settings appear to exhibit a preference for greater gender equality in nutritional and health investments within the family (Schultz, 1995a).

Periods of acute illness have also been analyzed as economic shocks to the family to assess how consumption smoothing is achieved in periods when there is a marked shortfall in income. Pitt and Rosenzweig (1990) find that when young children are ill, teenage daughters in Indonesian families are particularly likely to retract time from school or the labor market to care for the sick child, rather than teenage sons. Dercon and Krishnan (1997) explore the effects of health shocks on intrahousehold consumption smoothing. They postulate that idiosyncratic shocks to individual health should have no effect on relative interpersonal allocations except for their effect on the household's total budget constraint, if risk is shared in the collective Pareto-efficient or unified models of the family. But instead they find that in poorer households in Southern Ethiopia, women bear most of the adjustment burden from adverse health shocks to the family. Some of their other findings can be reconciled with the bargaining model: they show that the relative position of wives improves when local customary law dictating divorce settlements is more favorable to wives, the household's wealth is greater, and the age-gap (proxying productivity or power) between partners is smaller.

The demographic transition is also related in many ways to the improving health and productivity of women. It is commonly observed for fertility to be a decreasing function of the productivity of the woman, or opportunity cost of children, often proxied by the education of women (Schultz, 1997). But declining fertility can also exert a feedback effect on a woman's subsequent health and productivity. When the nutritional status of women in Ghana is measured by their body mass index (i.e. weight divided by height squared), and this health status is explained by endogenous inputs of calories, current burden of morbidity, work effort, and parity, it is found that endogenous declines in fertility (parity) are associated with improvement in the nutritional status of women, which is strongly related in Ghana to their wage productivity (Higgins and Alderman, 1997; Schultz, 1995b).

There is an analogous pattern across countries in the investments families make in the schooling of girls compared to boys. At low income levels, investments in boy's schooling often exceeds that in girl's. As real income per adult increases, public expenditures on schools per child tend to increase as do enrollment rates. But the income related increase in enrollment rates among girls is significantly larger than it is among boys, particularly at secondary school level (Schultz, 1987, 1996). A catching up for girls is evident in both cross country comparisons at different

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stages of development (King and Hill, 1993) and within countries as income increases (e.g. Chernichovsky, 1985; NaRanong, 1998; Schultz, 1996). Equal educational treatment of boys and girls may be a "normal good" within the family, and as income per capita increases, and reproductive goals are freely chosen, a variety of indicators of consumption and investment become more equally distributed between male and female family members.

Investments in the schooling of boys and girls are also influenced by the productive returns schooling imparts, and given gender specialization of work routines (Boserup, 1970, 1990), it would not be surprising for the productive returns to schooling to differ, at least in the short run, for men and women, although in the long run one would expect gender specialization in the labor force to diminish as fertility declines and child rearing occupies a diminishing share of a woman's adult lifespan. In the Philippines, farm families are observed to invest more in the education of their daughters than sons, but transfer more land to their sons, arriving at a rough economic balance (Quisumbing, 1994, 1997). Differences in the composition of parent transfers to their children by gender may help to explain their different propensities to migrate out of agriculture or to adopt new technological innovations. Lanzona (1996) notes that the greater the importance of irrigated land for the family, the greater is the investment in schooling of sons, holding constant for the parent's education and community school infrastructure. One hypothesis for this pattern is that the major irrigation projects in the Bicol Province facilitated the adoption of profitable high yielding varieties. Where these new agricultural inputs held the most immediate promise, families sacrificed more to educate their sons, preparing them to evaluate and profitably adopt these promising new production possibilities. The education received by daughters prepared them for employment in nonagricultural activities.

The Bicol region of the Philippines has experienced heavy outmigration to regions where per capita incomes are higher. The likelihood of outmigration increases with the earnings of individuals, holding constant for observed determinants of wages, such as education and age. Earnings for both men and women who remain in their parents' home is thus negatively impacted by selection bias, supporting the view that those who stay at home in a backward region are likely to be the less productive workers, controlling for observables (Lanzona, 1998). Among those males who remain at home, uncorrected wage returns to schooling are about a fifth lower than the returns to schooling that are corrected for sample selection bias of sons who stay at home. Returns

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to schooling among the selected sample of those men who remain in this poor agricultural region of the Philippines tend to be downward biased by the rapid pace of outmigration, as noted in earlier studies in Latin America during the 1970s (Schultz, 1988).

Public policies are limited in their ability to influence the family's final distribution of consumption. The family can usually, if it wants, have the last word on intrahousehold resource allocations. For example, a free school lunch program in Brazil or India may lead to a decrease in the family's supply of food to those children who benefit from the school feeding program. Part of the family's food that would have been supplied to the children in the absence of the program is reallocated within the family to advance the family's own objectives. Evaluation of nutritional intervention programs have tried to assess this redistributional power of the family (Chernichovsky and Zangwill, 1988). Jacoby (1997) in a study in the Philippines finds that the family may be less effective (or less inclined) than expected in using its redistributional capacity to compensate in home food allocation for food targeted through schools. He found little intrahousehold reallocation of calories in response to the selective feeding program.

To assess what might be the optimal targeting strategy for transferring public resources to particular individuals in the family and to particular uses by that individual requires much information, some of which can be inferred from analyses of household surveys and other from studies of public administration records and variations in pilot programs. First, what is the "leakage" of the transfer to other persons in the household (society) or to other uses. Second, what is the relative social benefit from increasing the consumption of those other beneficiaries (are they also poor relatives or rich middlemen?) and other consumption uses, compared to the primary targets? Third, what administration costs would be incurred to reduce these leakages, and by how much? The state could simply contribute to the general pool of family resources, where the location, occupation and education of household head could be used to target the poor group. Alternatively, the transfer could be invested in the vocational training of specific individuals, or it could provide income-in-kind (i.e. food or health services) to the family, or transfer selected consumption goods to specific individuals, such as through a program of school lunches, or even restrict those school food supplements to "inferior" foods that only the poor and malnourished are likely to want to consume. The reduction in leakages and resulting increased "fairness" of the

program must be an adequate justification for the mounting costs of administering the targeting (Kanbur et al., 1995).

Public programs can provided vocational training or access to credit for women, where women are thought to have less than equal access to education and collateral required for borrowing. The expectation is that the resulting gains in women's productivity will provide the private returns for the program, and the gain in women's productivity may have an added impact on intrahousehold consumption patterns favoring women's priorities, such as investments in their children. As noted above, there is an extensive literature suggesting that consumption patterns within families change as the productivity of women increases. Interventions designed to increase women's credit, entrepreneurial capacity, and training for the off-farm labor force are receiving increasing attention by policymakers, but the task of program evaluation is daunting as the simple comparisons are gradually replaced by quasi-experimental manipulations of large databases (e.g. Kennedy and Cogill, 1986; Blumberg, 1988; Pitt and Khandker, 1998).

4. Marital Status, Mortality, and Health Investments

One way that people express their demands for consumption patterns is in the form of the families they create. An increase in the proportion of households headed by women has been observed recently in many countries. This increase in female-headed households can be related to the decline in marriage, the increase in divorce, and a third, somewhat distinct factor, the increase in widowhood affecting primarily the elderly. The decrease in the prevalence of marriage and the increase in the risk of divorce can be documented over time in many developing and developed countries. There are exceptions, such as Indonesia, where the incidence of divorce appears to have decreased in recent decades; this opposite trend is attributed to the universality of young arranged marriages in the past being slowly modified to allow individuals to exercise greater control over the timing of their marriage and their growing involvement in selecting their partner. The interpretation of trends in marriage arrangements may also be complicated by increased cohabitation between unmarried couples, which has presumably provided an increasingly accepted substitute for marriage in some settings. In certain regions of Latin America where the average age at civil marriage was relatively late at the start of the twentieth century, consensual marriages were common and may have provided a close substitute for legal marriage for groups with little

property to transfer to their children (Nerlove and Schultz, 1970). The share of women reporting themselves as in consensual unions is again increasing today in some countries of Latin America (Ribero, 1999).

Most empirical evidence of the prevalence of marriage is consistent with the simple economic model of family demands and labor supply (Becker, 1974). Increased productive opportunities for women in the labor market are associated with delayed age at first marriage and decreased prevalence of currently being married and living with a spouse. The frequency of marriage is linked to changes in the jobs that women take, at least in the industrially developed countries and urban Latin America (Youseff and Hefler, 1983; Kniesner et al., 1987). One explanation for changing marriage patterns is then the increasing productivity of women compared to men in the labor market. According to cross sectional patterns in family labor supply in industrial or urban economies, increasing the level of male and female wages by the same proportion is generally associated with an increase in women's participation in the labor market, a delay in age at first marriage, and diminished lifetime fertility (Schultz, 1981; Layard and Mincer, 1985). These developments are hypothesized to have reduced the net gains from specialization of husband and wife in market and nonmarket production, respectively, within lifetime marriages (Becker, 1981). In those societies where women earn nearly as much as men, there are fewer marriages and a larger proportion of households are headed by women.[11] In states within the United States that provided more generous AFDC benefits for mothers without husbands, marriages are less common for both white and black women in 1980 and 1990 (Schultz, 1994b, 1998). Much work remains to elaborate on these regularities and document the other factors that are implicated, such as the ratio of marriageable men to women in the relevant "marriage market.".

Individual data have also been analyzed to estimate the determinants of age-at-first-marriage among women. More educated women marry later, even in cases where marriage is sufficiently delayed in the overall society to reduce overlapping with school, as in much of Latin America, East and parts of South East Asia (Montgomery and Sulak, 1989; Anderson and Hill, 1987; King et al., 1986). The growing tendency of young educated women to take paying jobs

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[11] Aggregate data were analyzed, for example, in Chile (DaVanzo, 1972), the U.S. (Frieden, 1974; Becker et al., 1977), and in Puerto Rico (Nerlove and Schultz, 1970). More recent work on marital status has analyzed individual data (e.g. Boulier and Rosenzweig, 1984; Jacoby, 1995).

before marriage, financially encourages both them and their parents to delay entry into marriage. Few studies have yet examined how local market demands for female workers affect migration and the timing and duration of marriage for women, but it may be an important part of the story.

Evidence from Thailand suggests that the family bargaining model may help to account for variation in the prevalence of marriage. Demographic and anthropological studies of Thai society document that marriage was until recently nearly universal. About 95 percent of men and women reported themselves as having been married (once) by age 35 (in the 1960 Census cited by Knodel et al., 1987; Table 5.1). An informal process of divorce has also been traditionally common with frequent remarriage (Smith, 1981). In the 1981 Socioeconomic Survey of Thailand 75 and 85 percent of the women and men, respectively, between the ages of 25 and 54 are living in the same household with their spouse. To explain who is currently married, the specialization argument as well as the bargaining model would suggest that marital gains would decrease with an increase in women's predicted wages and increase with an increase in men's predicted wages, other things equal. This is partly confirmed in Thailand, where the likelihood that a woman age 25 to 54 is currently married and residing with her spouse is lower the greater is her predicted market wage opportunity. But Thai men are also less likely to be married if their wages are expected to be higher. The test of the bargaining model is clearer in the case of property income, where these sources of income are not tied to labor supply or the duration of schooling, the shadow price of time or other market prices which could affect the gains from marriage. If the woman has more property income she is less likely to be living with a husband. On the other hand, the ownership of more property income is associated among Thai men with a greater proportion residing with a wife.[12] But the estimated effect of property income on marriage is nine times larger for women than for men (and of opposite sign) at similar levels of nonearned income (Schultz, 1990b). Marriage, it would appear, is not a "normal good" for Thai women, although it is for men. According to the bargaining model, property income for women increases their "reservation utility," thereby reducing the proportion of women who find a sufficiently productive (attractive) male to marry.

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[12] These probit estimates of marriage also include controls for wage rates for the individual, transfer nonearned income (which has a similar sign pattern to property income by sex), age, and urbanization zone in Thailand.

Other hypotheses could also account for these patterns of marriage and residence in Thailand, and the available survey data do not distinguish perfectly among them. The death of a spouse could increase an individual's wealth through inheritance, and also shift the individual to the "single" category. About half of the female-headed households in Latin America are widows (e.g. Mohan, 1986; Rosenhouse, 1988). Alternatively, women might be more inclined than men, upon divorce, to move back into the household of their parents, other relatives, or children. Marital and residential histories that include the timing of inheritance and transfers are needed to discriminate more adequately among these competing explanations for family formation patterns. Undoubtedly they will differ greatly as does the family in different societies.

4.1 Households Headed by Women: Multiple Types

Simple comparisons of income of female and male headed households are not very informative. Most male headed households tend to include wives, while customarily few female headed households include husbands.[13] In some surveys the husband is treated as the de jure household head even when he is not recently resident in the household.[14] Which women find themselves in families that are called "male headed" or in "female headed" households will be influenced by custom, their resources, and other opportunities, as in Thailand. Several studies have found an

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[13] For example, Rosenhouse (1988) illustrates from the 1985 LSMS from Peru that 90 percent of the male headed households are currently married, while only 5 percent of the female headed households are in such unions. Her data also show that in Peru half of the female household heads are widowed, and they are older than the male heads. These groups are really quite incomparable and not particularly well structured to analyze particular sources of poverty in society. As discussed in the text, there are many possible causes for the increase in female headed households. The greater longevity of women than men is one possible source. Another source would be the lower frequency of remarriage by women than men. Female household heads also work fewer hours than do male heads, even ignoring the contribution of wives to their households, and the higher average wages received by men than women. Multiple earner households are also the rule, not the exception, in Peru. To advance our understanding of the determinants of poverty will require a modeling of the behavioral and biological selection of individuals into households of very different compositions. It is simply difficult to infer anything from the widely reported characteristics of households with male and female heads.

[14] It is easy to fault definitions of "head of household," when there is no consensus on the concept being measured or its use. There is a need to distinguish one individual around which to relate other household members, for the purposes of establishing kinship. There is also the idea of dominant economic provider or family elder whose authority is respected. But in the LSMS in Côte d'Ivoire the customary approach is to count females in the rural sector as belonging to a male headed household even though the "head" resided in a distant city, more or less permanently. The increasing documentation of short-term seasonal or circulating migration in many low income countries underscores the need to measure household membership according to a variety of rules depending on how the data are to be used. For a list of some of the problems with the current data collection practices see Rosenhouse (1988).

association between wealth of individuals and decreased frequency of divorce, separation, and death of spouse (Becker et al., 1977; Peters, 1986; Grey, 1998). But the tendency noted in several parts of the world for the share of households headed by women to increase may be traced to a variety of sources, not all of which imply the same consequences. Improvement in health is associated with a disproportionate fraction of the elderly being female, and older widows have few marriageable males to choose from. This group may not have children to support, and though their consumption, housing, and health needs can represent important issues, these groups also may benefit from accumulating inheritances and private and public old-age support schemes.

Another source of the increase in female headed households in low income countries is migration, which affects women differently from one region to another depending on their skills and the changes in employment opportunities in the country. In Latin America, migration out of agriculture to the cities was led by women, as it was in Europe and North America. Urban job prospects for women were better than for men, and the ratio of women to men in some metropolitan areas of Latin America was as high as 1.2 in the 1960s (e.g. Gregory, 1986; Mohan, 1986). As a result, many urban women did not marry, but they are not necessarily economically disadvantaged compared to the conditions they left behind in the countryside. The prospects for women advancing in Latin America from urban jobs as domestic servants -- given their education -- to ones in industry, commerce, and other services, may be even favorable compared with comparably educated men. The overall productive status of women relative to men, as well as their survival prospects, are traditionally higher in the cities than in the countryside (Preston and Weed, 1976).

Unlike Latin America, migration flows in Africa were dominated by men, drawn (or driven) to the mines and plantations, domestic services, commerce, state enterprises, and government bureaucracies. Women remained on the land, often continuing to produce traditional food crops largely without the aid of modern agricultural inputs or technologies (Boserup, 1970; Ember, 1983). African women suffered from lower levels of education than men (Schultz, 1987, 1995a; Goldin, 1995), offering one explanation for why men were the first to migrate freely from the rural sector and were more successful in setting themselves up in urban livelihoods (e.g. Caldwell, 1968). In Africa, therefore, the high proportion of female headed households (de facto) is not associated with offsetting economic benefits for women. In both Africa and Latin America,

however, the divergence of male and female migration streams appear to have contributed to the relative decline in the two parent household, and to the growth of other social problems.

Women have increased their educational attainment compared to men in most low income countries in recent decades (Schultz, 1986, 1995a, 1996). Associated with these educational gains some data also confirm that wage rates and productivity of women have increased relative to that of men. Gains in the market productivity of women compared to men reduces the traditional spheres of specialization by women and men, and erodes the economic advantages of lifetime marriage (Becker, 1981). This development along with the increasing participation of women in the market labor force is another factor contributing to the increase in the proportion of female headed households (Schultz, 1981, 1990a).

Households headed by women generally report lower per capita income than those headed by men. Market income differences between male and female headed households may overstate the gap in welfare unless consideration is given to a broader concept of "full" income which also includes nonmarket production and time allocated to home production and even leisure. Even so, differences in "full" income between male and female headed households warrant more study. There may be more children to support per adult in younger households headed by women than those headed by men (Youseff and Hefler, 1983; Barros et al., 1995). Changes in family structure can be viewed as the choices of consenting adults, but society may be involved in the impact on third parties -- in this case, children dependent primarily on their mothers. If the physical and mental development of children is adversely affected by this shift in family structure, then society may wish to intervene to reverse the trend or compensate for its adverse consequences on children.

Governments in more developed countries have for a century or longer sought to design a "safety net" to help support female headed households with dependent children (Palmer et al., 1988). The incentives built into most such assistance programs designed for lone mothers and children have worried social observers, from Malthus (1798) to Murray (1984), for they could encourage women to separate from their husband or to have births out of wedlock to become eligible for public support. The conditions of work for husbands in the poorhouses of 19th Century England may have been designed to be onerous in order to reduce the attractiveness of relying on the Poor Laws for support (Besley et al., 1993). The United States has also tried to

increase the likelihood that a father pays for the support of his children, even if he does not reside with his child's mother, but child support payments in the U.S. elevate relatively few poor children out of poverty (Beller and Graham, 1993; Currie, 1995). Most high income countries today, with the notable exception of the United States, do not condition their child support programs on the marital status of the mother, perhaps so as not to discourage marriage (Palmer et al. 1988). In the United States there is little evidence that existing welfare programs are responsible for higher fertility levels, but there are indications across states that welfare programs reduce the prevalence of marriage, at least for white women (Schultz, 1994b, 1998). Data from other countries suggest that widespread increases in the fraction of female headed households are not primarily due to transfer programs, but rather is partly a response to the decreasing difference between the labor productivity or wages of men and women.

4.2 Sex Differences in Survival: Costs and Household Choice

The composition of the household is primarily a choice of adults responding to their endowments, possibilities for production and exchange, and preferences. In addition the intrahousehold allocations of resources can affect differentially the very survival of family members by sex and age, and thereby modify further household composition[15]. Analysis of these survival patterns sheds light on how the economic productivity and status of adult men and women may affect the costs to parents of rearing boys and girls, and potentially influence the availability of food and medical care for different family members. These survival patterns may also clarify how individual and community resources as well as the production environment of agricultural households can change sex-specific survival rates.

Dowries and brideprices arrived at in the marriage market provide information on differences in adult lifetime productivity of men and women. A dowry makes a daughter more marriageable. Thus, a couple with four girls is required to save more from the same lifetime income to accumulate the two extra dowries they will need to assure their daughters suitable husbands, compared with a more typical couple who has two children of either sex (and they will

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[15] Based on ultrasound examination of the fetus or amniocentesis, sex-selective abortion can also permit parents to alter the sex composition of their births. Where there are strong preferences in a society for the sex of a child, these technologies are linked to growing imbalances of the sex ratio at birth. The ratio of male to female births tend to increase notably (e.g. from 1.05 to 2 or more) for higher order births today in China and Korea (Zeng et al., 1993; Schultz, 1997) and possibly in other Asian areas (Miller, 1998).

not share in the two dowries their sons would receive in marriage). Elaina Rose (1995) and Deolalikar and Rose (1995) have shown that the revelation of the sex of a child at birth in India has an immediate impact on the family's subsequent consumption (and savings) level, just as we would expect from such a lifetime windfall capital loss (or gain). The birth of a girl leads the family to increase its savings, and correspondingly to reduce its consumption, while increasing the husband's market labor supply and reducing his leisure.

In most parts of the world females live longer than males, presumably because given roughly comparable living environments and consumption possibilities, females are less frail than males (Preston and Weed, 1976; Verbrugge, 1985; Waldron, 1986; United Nations, 1982). Apparently this survival advantage enjoyed by females has grown wider in many countries in this century (Preston and Weed, 1976; Trovato and Lulu, 1996), and in earlier centuries age-specific mortality estimates do not suggest a similar widespread sex imbalance, although there have been suggestive time series variations (Klasen, 1998). Yet there are well-documented contemporary exceptions, such as North India where early child mortality still occurs more frequently for girls than boys (Visaria, 1971; Miller, 1981; Das Gupta, 1987). This previously noted reversal in the more common gender difference in child mortality in parts of South and West Asia is attributed to different access to food and home care and to different access to medical interventions between boys and girls in otherwise similarly poor families (Sen, 1976; Chen et al., 1981).

The level of dowries for brides in India is one quantifiable facet of the higher net costs incurred by parents to rear a girl to maturity than a boy, and might explain part of the relative neglect of daughters by parents where dowries are on average relatively large (Miller, 1981, 1997). Where the derived demand of the local economy for female labor compared to male labor is stronger, wages for women relative to men should increase, and labor force participation of women is also likely to rise. In such districts where women were relatively more productive in the market labor force, the net costs of rearing girls compared to boys are lower because the parents might expect to capture some of these productive advantages realized by their daughters working before they marry, and because local dowries required by a groom's family would be lower due to the higher present discounted value of a bride's future wage opportunities.[16] As noted earlier,

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[16] Other factors have also been linked to the marriage comparative advantage due to specialization and market determination of dowries. When population growth accelerated in many low income countries after the Second World War, due primarily to a decline in child mortality, a predictable shortage of grooms emerged two

district- and household-level data for rural India in the 1960s indicate that as conditions favor more women to work outside of their family (i.e. instrumental variable estimates) there are improvements in female relative to male child survival rates (Rosenzweig and Schultz, 1982b). The greater productivity of females is thus one explanation for the increased investment of families in the health and survival of females relative to males.

SubSaharan Africa is often contrasted with South Asia, for in both regions women have received a small fraction of the education that men have, and thus women's productivity is substantially lower than men's, on average. But in subSaharan Africa women engage in many forms of production, jointly with their husbands and separately on their own plots and in their own businesses. This greater parity of women and men in production outside of the home in subSaharan Africa is seen as a possible explanation for why sex differences in childhood survival in Africa are similar to the rest of world where they favor females (United Nations, 1982).

Systems of household demand equations are generally specified as depending on total income and market prices. Household's composition is employed as an exogenous deflator for income, to obtain a suitable welfare measure of household income per "consumer unit" and demands are conditioned on composition (Deaton et al., 1989). As emphasized in section 3.4, this approach has serious limitations. If there were a valid consumer equivalence scale, and household composition were not affected by its members choices, e.g. fertility and extension, household income or total expenditures could then be divided by the sum of household members, weighted by their equivalent consumption scale to obtain the welfare level of household members (Gronau, 1988). Without a consensus on an equivalence scale, methods for estimating this scale have been invented. The most common practice is to regress the share of total expenditures for a specific group of goods across survey households on (1) the log of total income, (2) log of household size, and (3) a series of variables representing the share of household members in each relevant age and

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decades later. Slowly the supply of marriageable-aged women increased relative to the supply of marriageable-aged (older) men. The evolution in the age composition of the population has been attributed a role in the secular increase in dowries in India (Rao, 1993). The widespread trend of female educational attainments to catch up to that of males (Schultz, 1995a) has also contributed to delaying the age when women are inclined to marry, presumably because marriage and continuation of schooling for the woman are relatively incompatible. These pressures have led not only to a decline in the years of educational attainment gap between men and women in the same age cohort, but also a decline in the age gap between husbands and wives. Both the closure of the education and age gaps between spouses is likely to decrease the gap between the economic productivity of husbands and wives that is an important source of the gains from marriage (Becker, 1981).

sex group (Deaton and Muellbauer, 1980; Deaton, 1986). The coefficients on these age and sex group variables represent the proportionate difference between the income "requirements" of that group and the excluded group, say prime-age males. By considering an expenditure group that does not exhibit unitary income elasticity, such as food, compensating variations in income (expenditure) can be derived as would leave the households welfare constant while changing its age/sex composition. A "discriminatory bias" within the family in expenditures according to sex can thus be estimated from the difference between the coefficients on male and female age groups (Deaton, 1989).

In rural Kenya, for example, Evenson and Mwabu (1996) found that household educational expenditures were of a similar magnitude regardless of whether children age 7 to 14 in the household were boys or girls, but girls between the ages of 15 and 19 were associated with only half the household educational expenditures as boys in these ages. They conclude that the high cost of continuing into secondary schools were more frequently accommodated by families for boys than for girls, a reality that is confirmed from Kenyan sex-specific school enrollment rates. Their evidence suggested that these poor rural Kenyan families were allocating nearly a fifth of their expenditures to the education of their many children. Because expenditure surveys rarely report who in the family benefits directly from specific expenditures, such as those on education, the analysis of intrahousehold allocation of resources among members is difficult. Without direct information on which child benefits from educational expenditures, the estimation approach of Evenson and Mwabu provides at least an indirect estimate.

I have considered in this section some of the complex factors behind the growing share of female headed households evident in many parts of the modern world. Although the precise causes for this trend and its consequences are poorly understood, it is closely associated with societies investing more equally in the human capital of men and women. Where women's human capital is lowest relative to that of men, there is further evidence of differential survival favoring men, just as it does for schooling and training in the labor market. Section 5 surveys the evidence on the private and social returns to investments in women's and men's human capital, to assess whether these regional patterns in gender distribution of human capital could be an efficient response to distinctive conditions in these regions, or whether these patterns appear to be

inefficient social and private allocations of investment resources that might help to account for secular economic growth trends in these various regions.

5. Investment in Women's Human Capital: Measuring Returns

It is widely believed that investments in human capital account for much of the secular growth in economic output per individual worker, per adult in a household, and per capita in an aggregate economy. To summarize the many forms that human capital can take, economists have in recent years considered a growing array of processes, some relatively well understood, for which the production process has been repeatedly represented, quantitatively and statistically. In the case of schooling, the internal rate of return can be derived from streams of direct and opportunity costs set against the later increased market productivity of the person, if he or she survives (Becker, 1964). But in many other forms of human capital, the biological and behavioral mechanisms determining accumulation are less well understood and the consequences of these forms of human capital for individual lifetime labor productivity per unit time worked are more uncertain. The internal rates of return to these forms of human capital accumulation other than schooling are therefore not well established, because the investment cost components of the human capital accumulation process are less precisely defined (e.g. what share of the cost of nutrition is attributed to investment and what share to consumption?), and the private and social returns are also more uncertain when the investors in human capital allocate more of their time to nonmarket production activities for which the value of output is difficult to price (e.g. reduced child mortality). Two directions have been followed, estimating wage functions and production functions.

5.1 Estimating Wage Functions Without Bias

The literature on human capital returns was first built on evidence of schooling returns to males (Becker, 1964), where the conceptual ambiguities were least serious and the data most satisfactory. For women, and for the many important forms of human capital other than schooling, such as health and migration, more research is needed to deal with the major sources of statistical bias (Schultz, 1995a). In poor agricultural households, women tend not to work for a wage. Thus, the first and foremost problem is constructing a satisfactory model to explain which women in the

agricultural household works off-farm for a wage rate, and this off-farm labor supply decision (selection into the wage earner sample) must be assumed to depend on observed variables that do not theoretically enter into the market wage offer or modify the person's labor productivity as a wage worker (Heckman, 1979; Huffman, in this volume). The natural identifying exclusion restriction to motivate the sample selection correction model of the woman's wage equation is an exogenous source of variation in the woman's nonmarket productivity that would not be relevant to her market productivity or wage rate. One possible source of such variations might be nonlabor income, such as inherited wealth or other nonearned income sources (Schultz, 1990b, 1995a). These identifiers of the wage participation equation might include attributes of the agricultural household that would either raise the woman's labor productivity in agricultural work within the family enterprise or increase the value of the woman's product in home production and leisure activities, but have no theoretical reason to affect off-farm wages. For modeling the behavior of the agricultural household, land and fixed capital of the farm are often treated as a quasi-fixed factors and assumed predetermined for the time allocation decisions of family members. But it is important to stress that it is not appropriate to rely on the number and age of children in the household to determine time allocation, particularly for the wife, for these variables merely reflect fertility decisions of the couple that are likely to be jointly determined with the lifetime plan for the woman's allocation of her time among home, farm and off-farm production activities. Another factor that could be particularly important in the off-farm labor force participation decision would be the transportation costs associated with the distance between the farm household and nonfarm employment opportunities, and the analogous effect of the household's remoteness on the diffusion of information about job opportunities in neighboring areas.

Correcting for possible sample-selection bias in estimating the wage function from wage earners, a number of studies have assessed separately for men and women the wage returns to schooling. A variety of other human capital stocks have also been included in some studies: (1) anthropometric indicators of nutritional status such as adult height as a lifetime proxy for the balance of nutrients and the burden of disease experienced in childhood (Fogel, 1994; Strauss and Thomas, 1995, 1998), (2) weight divided by height squared, or the Body Mass Index (BMI) as a nonmonotonic proxy for current malnutrition or health status (Fogel, 1986), (3) current intakes of calories, proteins and other micro-nutrients as short-run inputs required for physical and possibly

mental labor (Thomas and Strauss, 1997), (4) duration of acute spells of <u>disabling illness</u> (or injury) reported during a retrospective reference period of a month or two weeks (Schultz and Tansel, 1997), (5) functional limitations in performing Activities of Daily Living (<u>ADL</u>) (Strauss, et al., 1995), (6) subjective categorical assessments of personal health, and finally, (7) migration and the mobility of labor that is associated with workers finding locations where they can be more productive, which tend to increase with development and specialization (Sjaastad, 1962; Gisser, 1965; Kuznets, 1971; Schultz, 1982, 1995a). Migration and formal education of the worker may also weaken the capacity of the family at origin to determine the lifetime employment opportunities of its children, and consequently migration and education may themselves reduce the importance of apprenticeship vocational training that traditionally occurs within the family.

There has been a long debate on how to get behind the direct correlation between these stocks of human capital and wage productivity to disentangle the causal effect of human capital on wages for a representative member of the population (Griliches, 1977). The most common concern has been that other factors affecting labor productivity are omitted from the analysis when estimating the effect of human capital on wage rates, and these omitted factors may be correlated with the observed stocks of human capital, and these factors can sometimes be plausibly implicated as a factor determining who receives the observed human capital investments. For example, the "ability" of the individual is expected to raise their productivity, and might reasonably increase also their receipt of schooling (or other human capital inputs). The analogous argument is made that family wealth may permit parents to borrow at lower interest rates to invest in their children's schooling (Becker, 1967; Jacoby, 1994; NaRanong, 1998), or family wealth increases the demand for children's education because the child's education is viewed by the parent as a normal consumption good. Family wealth and connections may be used to obtain for children better paying jobs, or wealthy parents could invest in other unobserved forms of human capital for which the wage returns are misattributed to observed human capital, i.e. education (Lam and Schoeni, 1993).

This omitted-variable bias is compounded by errors-in-measurement bias that arises if the human capital stock variable is itself not reported accurately or measured precisely. Griliches (1977) among others illustrates how efforts to "control for" omitted variable bias that might be expected to otherwise overstate the wage returns to human capital will also augment the errors-in-

measurement bias that would understate the wage returns to the poorly measured human capital inputs. The net effect of these often offsetting sources of bias is not obvious, and a proposed solution used increasingly in economics is to specify a suitable instrumental variable that is correlated with the human capital stock. For example, a locality-specific variation in the price of an input to produce that form of capital can serve as an instrumental variable, such as the local school tuition or distance to a school, or in the case of health the price of nutrients or the distance to health care. Of course this local price or program variation must explain a sufficient amount of the variation across a sample of persons in their human capital investments, and it must not be correlated with the unexplained variation in wage rates.

The studies by Angrist and Krueger (1991a, 1991b) of U.S. data illustrate that instrumental variable estimates of the wage return to schooling can be as large or larger than the direct ordinary least squares (OLS) estimates. In many contexts the returns to schooling are not overestimated by OLS methods, and therefore the errors-in-measurement bias might appear to be larger (in a negative direction) than the omitted-variable bias (in the positive direction) (Card, 1998). The same conclusion can be drawn from studies of wage functions in the West African countries of Ghana and Côte d'Ivoire that simultaneously control for schooling, height, BMI, and migration (Schultz, 1995b). Although these four proxies for human capital are positively intercorrelated, suggesting that the inclusion of all is likely to reduce the returns estimated individually, each retains much of its own contribution to explaining wage variation. Moreover, the significant effects of schooling on wages are reduced by at most 15% by the inclusion of the other nutrition, health and migration variables. Instrumental variable estimation methods designed to correct for sources of bias in the wage function do not, in this West African case, change statistically the returns to education and migration, but increases markedly those to nutrition and health, as proxied by adult height and BMI.[17] The returns to all four forms of human capital are similar for men and women, even though women have received substantially fewer years of schooling than men in these two countries. There is a growing body of evidence in a variety of countries that rates of return to schooling of men and women in wage employment, when they are corrected for sample selection bias, are of a similar magnitude for both sexes. In countries where women have

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[17] The Hausman specification tests suggest that education should be treated as exogenous, whereas height and BMI appear to be endogenous or measured with error. Schultz (1995b).

received substantially less education than men, the returns tend to be higher for women than for men at the secondary and higher educational levels (King and Hill, 1993; Schultz, 1995a; Mwabu and Schultz, 1996).

Evidence is also mounting, collected by economic historians (Floud et al., 1990; Fogel, 1994; Steckel and Floud, 1997), epidemiologists (Waterlow et al., 1977; Spurr, 1983; Falkner and Tanner, 1986; Waterlow, 1988), and development economists (Strauss, 1986; Strauss and Thomas, 1995, 1998; Knaul, 1998; Ribero and Nunez, 1998) that improved nutrition and health are important determinants of stature, labor productivity, and time allocation (Khandker, 1987, 1988; Binswanger et al., 1980; Kimhi, 1994; Sahn and Alderman, 1996). Persuasive as these conceptual and empirical studies are, they have not been assembled into the form that one needs to infer the internal wage rate of return to private or social investments in child and adult nutritional status, as they impact on the present value of the individual's lifetime productive capacity. Most investigations find nonlinear relationships between increases in nutritional status and productivity, where economic returns to constant physical increments of nutritional inputs diminish with increasing scale. These nonlinearities imply different groups will benefit by different amounts given comparable increments to their nutrition or anthropometric status, and therefore, if the nutritional and health improvements can be effectively targeted to the poor, they are likely to have larger proportionate effects on lifetime productivity. Simple measures of nutritional status can also be excessive (i.e. BMI above 28 implies obesity) and hence counterproductive in terms of labor productivity, mortality, and morbidity. Nonetheless, the limitations of existing analytical methods and small samples do not provide precise estimates of the counterproductive effects of excessive BMI (or height) in poor countries (Schultz, 1995b). Public health and disease abatement programs and nutritional intervention schemes must be costed-out and implemented in a random experimental program in order to assess how much they increase nutritional outcomes and adult wage productivity for different target groups (Newman et al., 1994). This process should define the circumstances under which the productive payoff to such public investment programs will justify the commitment of public resources. Then it will be possible to compare confidently the private monetary returns to nutrition and health programs using the same metric as with the private wage returns to schooling (Becker, 1964; Mincer 1974).

The impact of human capital on wage productivity does not exhaust the issues involving human capital returns when it comes to comparisons of women and men. First, women tend to allocate more of their time than men to nonmarket production activities, and our assessment of the returns to human capital is primarily based on market wage differentials. The correction for sample selection bias may deal with the unobserved differences between those individuals who work in the market sector and those who do not. But for nonwage workers, labor productivity returns to human capital will remain more difficult to gauge, aggregate and value (Michael, 1982; Haveman and Wolfe, 1984). Studies that have separated self employed from wage earners have not generally found salient differences in the percentage increase in hourly earnings associated with an additional year of schooling (Chiswick, 1976, 1979; Fields and Schultz, 1982; Ben-Porath, 1986; Strauss and Thomas, 1995). It would be preferable, however, to analyze the range of employment opportunities faced by a more educated worker, including whether to migrate to the urban sector, and whether to work as self employed or in wage employment. Vijverberg (1995) has been able to do this with a sample from Côte d'Ivoire, and decompose the market returns to education for women and men into that portion that accrues due to each of these reallocations of the time of better educated workers to the sectors where their labor is more highly rewarded.[18] However, for those workers entirely in nonmarket production or working in an unpaid capacity in a family enterprise, the attribution of human capital returns may still be obscured. Yet at this time there is little evidence on the magnitude of this bias, or even its sign.

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[18] Another intersectoral allocation of labor occurs between the private and public sectors. Glick and Sahn (1997) evaluate the returns to men and women in Guinea from education, and how it differs between self employment, private wage sector, and public wage sector, and they find public sector jobs provide a larger wage premia for educated workers, particularly for women. Van der Gaag and Vijverberg (1987) also report substantial wage differentials between public and private sector wages in Côte d'Ivoire, but after they control for education and other worker characteristics in a switching regression framework that corrects for the self selection of workers into the sector where they are most productive, the public-private wage gap is eliminated. If the goal is to decompose the total gain from education or another form of human capital into that which arises from migration and from gaining access to particular sectors of employment, a more complicated structural model of the sector allocation of labor is required. But estimates of this structural decomposition will depend critically on additional controversial identifying restrictions, which if they are incorrect could distort any interpretation of the data. Reduced form wage equations based on the entire population within a relatively closed labor market is therefore the best starting point for an analysis of schooling, health, nutrition returns (Schultz, 1988). Comparisons of the efficiency of females and males farm operators also found few cases where schooling increased the profit of the farm operator by more or less depending on gender (Moock, 1967; Guyer, 1980; Dey, 1981; Buvinic et al., 1983; P. Rose, 1995; Lilja et al., 1996; Alesina and Djata, 1997; Smith and Chavas, 1997; Yang, 1997).

5.2 Gender Productivity Differences from Production Functions

Production functions are used to summarize the production possibilities confronted in agriculture, and to estimate the marginal products of inputs used in a specific combination (Heady and Dillon, 1961). But when men and women work jointly in producing agricultural outputs, estimates of the marginal productivity of men relative to women are generally not estimated with much precision (Quisumbing, 1996a, 1996b; Jacoby, 1992, 1995; Fafchamps and Quisumbing, 1998a, 1998b). This problem may arise because the allocation of family labor to production is endogenously determined, and therefore affected by productive factors omitted from the production analysis, such as management skills (e in equation 7), or affected by the preferences of family members toward work and leisure (Mudlak and Hoch, 1965; Singh et al., 1986). This problem may be exacerbated because men and women often perform distinctive functions in the natural sequence of agricultural production activities, and thus they are not generally good substitutes for each other within some functions, e.g. men do not often plant rice or women plow. Moreover, the success of one stage in the production process can then augment the relative demand for male and female labor in a later stage. For example, if the plowing and planting labor is approximately predetermined by the plot size and quality, the labor required for harvesting will depend also on how good the weather was up to the harvest, or the extent of pest infestation, etc. (Laufer, 1985). For example, assume the share of women's labor in the total labor input over the entire season is an increasing function of the size of the harvest, because women are called upon to assist in harvesting only when the crop is plentiful. Under these assumptions, unobserved weather productive effects would be attributed in estimating a normal (OLS) single-stage production function to women's labor productivity, biasing upward production function estimates of women's marginal product. Only when labor and other agricultural inputs are properly endogenized, and the stages of the production process suitably modeled, is it likely that estimates of the production function will become a satisfactory basis for inferring the marginal product of male and female labor. These difficulties are reviewed in Quisumbing (1996b), and reinforce our initial reliance on comparisons of male and female wage rates, even when the proportion of women in the wage labor force is relatively small.

Another dilemma arises in using family farm production data to infer the productivity of labor. How should the education of the men and women in the family labor force or hired labor

force be appropriately aggregated. Much of the early evidence of productive returns to schooling in small-scale agriculture in poor countries was based on the schooling of the male head of household (Jamison and Lau, 1982). It was reasoned that the farm management decisions for which education was decisive fell on the male head of the farming family, and thus his education would be important and his spouse's education would not. Others have debated whether to include the average education of the family labor force, or the highest education of any family worker under the presumption that a younger family member who was not head could, if well educated, solve the production problem and guide the others to follow his or her plan (Yang, 1997). Jolliffe (1997) finds evidence in the Ghana Livings Standard Survey of 1988-89 that the highest education or average education of the family labor force performed better than the head's education in empirically accounting for farm profits, total income or nonfarm income. But this conclusion does not resolve our need to jointly assess the economic return to schooling for both the husband and wife.

Finally, agricultural production functions have been used to clarify the adoption of agricultural innovations, the diffusion of new technologies, and the distribution of benefits from this process that accounts for much of the growth in agricultural productivity. The first insight was that the rate of technical change or increase in farm yields was positively related to the amount of extension activity per farmer within a (US) state, and by the educational attainment of farmers in that state. But extension activity and farmer education were found to be substitutes for each other, suggesting that the benefits of extension were concentrated among the least educated farmers who could not otherwise decipher quickly the new technological options that would be most profitable (Welch, 1970; Huffman, 1974, 1976, 1980; T.W. Schultz, 1975). Extension activity was therefore a leveling force that promoted greater income equality in the context of a technologically dynamic agricultural sector such as was observed in the United States. These patterns were then replicated in many low income countries (e.g. Moock, 1976; Jamison and Moock, 1984; Birkhaeuser et al., 1991). The conclusion was that there must be a pool of new technology worth extending to farmers and an efficient extension service. Again it was found that the extension activity, in this context, had greater benefits for less educated farmers.

5.3 Agricultural Crops, Extension, and The Environment

It has been argued that the Colonial administrators did not look with favor on female farming systems in Africa, and Boserup (1970) has documented the results of this pattern of governance. She argues that agricultural extension systems promoted cash crops to engage the idleness of men who did little work in traditional agricultural systems in Africa, as seen by the Europeans. Land rights of ownership and use that were enjoyed traditionally by women were gradually assigned to men. New technologies that were developed and introduced to enhance the productivity of agriculture had the effect of then increasing the productivity of labor in cash crops relative to subsistence food crops. As a consequence, the economic productivity of men relative to women in African agriculture tended to increase. These colonial efforts to promote agriculture tended to be perpetuated by the subsequent independent nations with a continued focus on raising the yields and profitability of cash crops for export. This emphasize on cash crops could most readily be explained by the same motives as occupied the Colonial regimes-- obtaining a reliable source of government revenues, whether the export crop was coffee, cocoa, or cotton.

The traditional shift from hoe to plough agriculture with economic development often led to a reduction in the burden on women as the mainstay of the workforce in agriculture, although it might eventually increase the demand for female labor again after irrigation permitted multiple cropping of the land in each year, raising the share of labor required for weeding and transplanting, tasks for which female labor may be more productive than men's (Boserup, 1970). But in Africa where draft animals were rare, due partly to the endemic tsetse fly, this displacement of women from the burdens of subsistence agriculture did not proceed as rapidly or as widely as in Asia or Latin America. Nonetheless, the shift in the mix of crops grown in agriculture toward cash crops was often associated with male domination of the new, often more profitable, crops. But there were exceptions as well. Many of the successful cocoa farmers of Ghana were women (Hill, 1963; Guyer, 1980). With their enormous disadvantage in educational attainment compared to men, and their challenged rights to use the land and offer it as collateral for credit, African women have continued nonetheless to dominate the agricultural sector (Evenson and Siegel, 1998).

This process of the introduction of cash crops is well documented in West Africa where irrigation made rice a commercial crop, shifting it from a traditionally female crop to one dominated by males (Dey, 1981; Jones, 1983; von Braun and Webb, 1989). In East Africa coffee

also became a cash crop, and one more often produced by males than females. Whatever the causes for this evolution of commercial crops in Africa, the result was one in which women, who obtained a small fraction of the schooling that men received, often lost control to men of the new more profitable crops (Murdock and Provost, 1973; Embers, 1983; Kennedy and Cogill, 1986; Smith and Chavas, 1997). The crops that benefited most from agricultural research and development efforts in Africa, and the gender bias in the extension effort toward male farmers, is attributed to the Colonial administrators by Boserup (1970). I have not encountered alternative explanations for the resulting gender bias in the redistribution of resources. But the differential educational attainment of men and women in Central, East and West Africa is a curious phenomena that needs to be explained, for it does not prevail in Southern Africa. This unequal investment to education placed women in most of SubSaharan Africa at a great disadvantage in deciphering what was most profitable in the new spectrum of agricultural crops, modern varieties, and inputs.

Birkhaeuser et al. (1991) find the extension systems of Africa are far from uniformly successful, but they have been on average cost effective. As Boserup (1970) argued, they tended to be initially dominated by male extension agents and were relatively ineffective in transmitting their technologies to female farmers. But these agricultural extension institutions have in some countries changed their practices, and female agents have been hired and trained to reach more effectively female farmers. When the gender bias in contacts or visits between the extension agents and farmers is allowed for, it has been shown that female farmers are as effective as males in increasing their yields in response to new technological inputs. The effects of female extension staff are particularly positive for female farm managers. In Burkina Faso the yields of female farm managers appear to be higher in millets and maize, whereas male managers are higher in cotton and groundnuts (Evenson and Siegel, 1998). Modeling the gender of the farmer and the agent appears to be an essential aspect of the process of technology transfer, learning by doing, and diffusion.

Environmental degradation is often seen as an example of market failure in the management of a resource for which social externalities are not taken into account by private decisionmakers. Women's specific production tasks in the rural sector are often linked to the negative social externalities of removing forest coverage, depleting the neighborhood's supply of

fuelwood, reducing the fertility of commonly held land, and accelerating erosion due to overgrazing of the commons. Because of the gender division of labor in many settings, the costs of environmental degradation may be borne disproportionately by women. For example, women must spend more of their time fetching fuel from greater distances, or they must reduce their livestock herds that depend on the degrading common resources (Meinzen-Dick et al., 1997). It is also argued that the intensification of agriculture is related to a decline in women's productive contribution to agriculture (Embers, 1985). Fertility and population growth depends sensitively on women's educational attainment relative to men's (Schultz, 1997). Population growth has also been attributed a significant negative effect on forest cover and exploitation in India (Foster et al., 1998). It might, therefore, be concluded that reducing environmental degradation is yet another beneficial social externality of increasing society's investments in women's education and productivity which is likely to reduce fertility and dampen the pressure of population on the environment.

5.4 Externalities of Women's Human Capital

Human capital is complex because it functions as both a consumption and investment good, being valued for itself and for the increased productivity it imparts to the worker. But these consumption benefits of human capital do not alter the rationale for estimating productive returns in the labor market as a lower bound on the full private returns received by the individual or family that would be augmented by the unobserved consumption return.

It has also been argued that human capital is the source of social externalities, or benefits, that are not captured by the nuclear or even extended private family who is called on to sacrifice current consumption to invest in human capital. If this were true, then there is a case to allocate public resources to subsidize the socially optimal level of human capital investments, or at least treat these externalities as defraying the current public costs of human capital formation programs in schools, public health programs, family planning, etc. With the exception of investments in public health to reduce social exposure to communicable diseases, there are few well-documented examples of social externalities of human capital. There is little empirical evidence that an economy or labor market functions better in the aggregate because its population is better educated, over and above the private returns to education that are captured by better educated

workers and form the basis of estimates of wage returns. There are no widely accepted estimates of the externalities for economic growth arising from subsidies for the adoption and use of birth control in family planning programs. Although these notions have remained plausible to program advocates, they have been difficult to empirically substantiate in the form of scientifically defended estimates of production functions that quantify social spillovers from private investments in human capital. The exception, however, may be women's education, as alluded to earlier.

It is widely believed that there are social externalities beyond the private family that arise from female schooling, largely because female education impacts a variety of household production processes that synergistically foster the accumulation of human capital in the next generation of children. Women's schooling is associated with a reduction in child mortality among her children, whereas the impact of men's schooling is less substantial (Heller and Drake, 1979; Schultz, 1980; Cochrane et al., 1980; Mensch et al., 1985; Schultz, 1994, 1995a). There need be no market failure here, because a woman's family privately internalizes these gains. But societies also value child health, and thus allocates public resources to public health programs, and in particular preventative child health interventions. Similarly, publicly subsidized schooling occurs due to a consensus assessment that increasing school enrollments yields social benefits that outweigh the public outlays. And mother's education generally has a larger impact on children's schooling than father's education (Cf. King et al., 1986).

There is one challenge to this interpretation of the empirical record that needs more study, but because it relies on the roles of unobservable variables, such a preferences of the parents, it is more complicated to describe. Suppose men who prefer to have fewer children and better educated children seek wives who are better educated and thus more productive in producing human capital in children. These (unobserved) preferences of men for lower fertility and higher "quality" children would lead them to make the necessary sacrifices in other areas (i.e. reduce their other consumption) to marry better educated women, or more specifically, better educated women than they would be expected to marry, on average, in the normal functioning of the marriage market. In this case, it becomes ambiguous whether the lower fertility and increased child schooling associated with a mother's schooling is a causal effect of the home productivity of

a woman's schooling, the preferences of women for higher quality children, or an incidental outcome of the marriage matching process and men's and women's preferences.

In rural Bangladesh and India empirical evidence has been assembled, conditional on a structural model, that suggests part of the correlation between women's schooling and their children's schooling is due to the marriage matching process and consequently can be more appropriately attributed to men's preferences rather than to women's differential productivity in schooling their children (Foster, 1996; Behrman et al., 1997). The Indian study first notes that women's schooling does not contribute to increased agriculture productivity, whereas men's schooling is strongly linked to the adoption of new agricultural technologies since the 1960s and consequently to increases in rural incomes (Foster and Rosenzweig, 1995). Women's and men's schooling may also not earn much of a private return in the labor market for casual routine rural wage labor in India. A remaining possible economic reason for sending girls to school in increasing numbers by rural Indian and Bangladesh families is that the better educated women are able to increase the schooling (and health) of their children. Men who want better educated (healthier) children are thus motivated to marry a better educated women with increased productivity in producing child human capital. An improved understanding of the joint determination of the marriage market and these home child human capital production processes could affect the magnitude of estimates of the technological productivity of female education on child human capital, and plausibly reduce them in circumstances where women's schooling is privately valued by men mainly for its productive effects on child rearing.

The final potential externality of schooling relates to fertility, which is widely found to be inversely related to women's schooling (Schultz, 1981, 1994a; Cochrane, 1979; Cochrane et al., 1980). If family planning programs are currently subsidized by the state because a reduction in fertility is thought to impart a social benefit, then increasing the schooling of girls should also be subsidized for it is associated in about a decade with diminished fertility. In this instance, not all societies base their support for family planning on the desirability of reducing fertility; some endorse these programs to improve women's lifetime welfare opportunities and strengthen their reproductive rights. There are also a handful of instances in Africa where the first few years of female education seems to have little effect on a woman's fertility, perhaps because of the low quality of available education, or the counterbalancing effect of schooling on improving

reproductive health and avoiding sexually transmitted diseases that induce subfecundity and prevent some women from having the number of births they want. On balance, the evidence suggests that increments to the schooling of men, holding constant the educational attainment of women, are associated in low-income countries with increases in fertility, although this pronatal effect of male education seems to diminish as the country develops and child labor becomes less important (Schultz, 1994a, 1997). The social costs of high fertility and rapid population growth are difficult to scientifically quantify (National Research Council, 1986), but many countries have concluded that their society stands to gain in the long run by slowing rapid population growth, and this conclusion would justify assigning a higher priority to women's education than to men's in these countries.

To conclude this section, if the private market wage returns are of comparable magnitudes for men and women, but the social externalities associated with reduced child mortality, increased child anthropometric capacities, increased child school enrollments, and decreased fertility are all linked more positively to women's schooling than they are to men's schooling, and these outcomes are also positively valued by society, it is efficient for society to invest more in the schooling of women than of men (McGuire and Popkin, 1990). A deeper understanding of the marriage market may sharpen out insights into these connections, but is unlikely to reverse these basic findings. The magnitude of the subsidy that would be socially optimal will depend on the value society assigns to slowing population growth and transferring resources in the form of human capital to the younger generation. It would also seem clear that where female school enrollments are markedly lower than male, there would be a prima facie case for greater subsidies for female education. The only reason to revise this mandate is if market wage returns for female schooling fall substantially below those of male schooling, presumably due to an overproduction of women's human capital given the social institutions prevailing in the labor market. I have not yet found a well-designed empirical study that reports such an overproduction of women's schooling.

5.5 Does Women's Economic Control over Household Resources Create Social Externalities?

The conclusion of many empirical studies of child development is that increased economic resources in the hands of their mother is generally associated with improvements in birth

outcome, survival, infant and child nutrition and health, child physical growth and maturation, earlier entry into school, increased school enrollment for age, and more years of school completed.[19] The first issue in assessing this empirical evidence for supporting the collective approach to the family is whether the increased economic resources of the mother are evaluated appropriately. Clearly, the early studies that relied on the labor market earnings or income of women as their measure of women's control over economic resources were not satisfactory. This initial measure depended directly on the woman's labor supply decision, and if women with more economic resources worked in the market less of their time, as might be accounted for by economic theory, the market earnings of women could be a misleading indicator of the theoretically desired variable.

Economic theory suggests the measure of lifetime "full income" is needed for the woman (and man), both within the existing family configuration and if possible the full income that the women might expect to command in the alternative or "reservation arrangement" she might choose e.g. divorce or separation from the union. The full income is composed of both her potential full-time earnings and her claims on nonearned income. The objective is to estimate from a suitable, sample selection corrected wage function her opportunity wage in the labor force or in the household, if the latter is larger, and that wage would then be weighted by a standard

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[19] The literature on these issues is enormous and full of complexities that cannot be examined in the scope of this paper. The evidence on female education on child mortality is widely accepted after the Latin American Census samples were cross tabulated and World Fertility Surveys become available for a widening sample of low-income countries (e.g. Behm, 1976, 1980; Caldwell, 1979; Schultz, 1980; Cochrane et al., 1980; Rosenzweig and Schultz, 1982a, 1982b; Farah and Preston, 1982; Mensch et al., 1985; Barrera, 1990; Thomas et al., 1990). The studies of anthropometric indicators of child health began somewhat later, but also clearly indicated that better education of the mother was correlated with better height and BMI indicators for her children (summarized in Behrman and Deolalikar, 1988, 1989; Behrman and Wolfe, 1984, 1989; Strauss and Thomas, 1995, 1998). Schooling of children as a function of maternal education is also a frequently found pattern, although a few exceptions can be found where father's education is equally strongly and positively related to child schooling, if household income is not controlled (e.g. Rosenzweig and Evenson, 1977; Chernichovsky, 1985; King et al., 1986; Duraisamy, 1988; Duraisamy and Malathy, 1991; Malathy, 1993; Jacoby, 1994; Rosenzweig and Wolpin, 1994; Glewwe and Jacoby, 1994, 1995; Lloyd and Blanc, 1995; Haveman and Wolfe, 1995; Lavy, 1996; Tansel, 1997; Holmes, 1997; Behrman et al., 1997; Behrman, 1997; NaRanong, 1998; Sipahimalani, 1998). Not only do these studies differ in how they measure women's control over resources, starting with education and then advancing toward labor market productivity (Kennedy and Cogill, 1986; Senauer et al., 1986; Engle, 1988; Blumberg, 1988; Kennedy and Peters, 1992; Haddad and Hoddinott, 1994; Thomas, 1990, 1994; Thomas and Chen, 1994; Hoddinott and Haddad, 1995). The studies also control in different ways for the endowments of the husband, family income, and family composition. As argued throughout this paper, there are serious analytical problems with most methods for dealing with family composition, and consequently there is continuing search for better methods to explicitly model marriage matching and marital status (e.g. Boulier and Rosenzweig, 1984; Schultz, 1994b; Foster, 1996; Behrman et al., 1995, 1997).

full-time labor supply (i.e. 2000 hours per year), to which returns to nonhuman capital and other nonearned income sources would be added. When the procedure or data for estimating and imputing wages is not satisfactory, the woman's nonearned income component may be examined separately as an exogenous factor conditioning household outcomes, just as the parallel nonearned income variable is included for the man in the household as another resource constraint on the family. Analogously, this nonearned income component of the husband and wife can serve as an instrumental variable for identifying the effect of a constructed full family income variable (Cf. Heckman, 1971). In both the unified family model and the bargaining family model the value of the husband's and wife's time, or shadow wage rates, are expected to modify consumption and investment patterns, because the time of family members enter into the shadow prices of many consumption commodities and investment activities, and thereby modify family demands. To reject the unified family model and to support alternatives, such as the family bargaining models, it has been shown that the personal distribution of nonearned income in the family affects the allocation of consumption and human capital investments. Perhaps the most readily interpreted evidence of this form is that an individual's own nonearned (exogenous) income causes a greater reduction in own time allocated to work than does the spouse's nonearned income, holding constant for the family's total nonearned income and the shadow value of the time of both spouses. This empirical regularity strongly suggests that the pooling of family resources is less than perfect.

The simplest comparisons of the effect of women's empowerment on family outcomes may not distinguish between the formal models of family behavior, but they highlight the main policy conclusion that emerges from this literature. How are family outcomes related to women's human capital as initially summarized by her education? To assess this conditional effect, one also wants to control for the value of her husband's education, for the self selected population of couples, and for the relative supply of potential husbands in the local community marriage market. In most investigations of this design, women's schooling has a greater beneficial effect on child human capital formation and survival than does the husband/male education. Fertility is lower, child mortality is lower, and the children's generation completes more year of schooling, they tend to start school earlier, and attend more often, etc. (Schultz, 1986, 1993, 1994a, 1995a).

The second problem for constructing comparisons is the family composition. How is one to deal with the self selection of those women who are living with a man, or living on their own, or living with other relatives? How is one to treat the potential earnings or nonearned income of a resident man, if he is not currently married to the woman? All these ambiguities in what constitutes the appropriate test of the bargaining model hypothesis that female nonearned income has a larger positive effect on child development (if she prefers child welfare compared to her mate) than male nonearned income, alerts us to the difficulty of drawing definitive conclusions from the empirical evidence that is currently at hand, and on validating a complete version of the bargaining model of the family.

To the extent that society views these outcomes of lower fertility and child mortality and increased schooling of youth as objectives it values investing in, the advancement of women's schooling creates a positive social externality. On the basis of this externality argument, societies may optionally expend public resources promoting the schooling of women. Although gender equity is one powerful reason for supporting such an allocation of resources, the argument here is based on economic efficiency -- maximizing total output. The externality argument relies on an efficiency gain in terms of women's schooling saving resources from other programs that seek to accomplish the same goals: reduce child mortality, fertility and increase the schooling of the next generation of youth. One policy intervention with this objective would be fellowships to promote the attendance at school of more girls. The evidence suggests that female enrollments are especially low for poor families in poor countries where credit constraints are a particular disadvantage for girls (e.g. NaRanong, 1998). Carefully graduated inducements for girls to continue in school might also take the form of subsidized school uniforms for girls, but not necessarily boys[20]. Tax and transfer schemes that encourage higher continuation rates in school for girls should be careful not to prepare women to enter traditionally female-dominated occupational

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[20] Programs that improve the economic welfare of women may be justified on many accounts, but it should not be assumed that they increase human capital investments in girls. For example, the Grameen Bank in Bangladesh is widely credited with successfully providing micro enterprise credit to groups of poor women. Although these programs were associated with increasing the income of the women in the villages that benefited from the placement of such programs, a study found no evidence that as the incomes of these women rose, their fertility declined, and may have increased compared to preprogram fertility levels. It is possible that credit subsidies for women's enterprises increase the value of children's labor in their enterprises and even weakened their incentives to invest in the schooling of their girls, who are most likely to work along side their mothers. Pitt and Khandker, 1998.

tracks in the school system, for this might "oversupply" the labor market with these skill and reduce the wage returns women receive for their years in school relative to men. It is likely that the externality argument for promoting female schooling would be strongest in those societies where the sex imbalance in schooling is currently greatest. Thus the externality argument for publicly subsidizing female schooling more than male schooling would be strongest in many of the countries of South and West Asia and subSaharan Africa where child mortality is high, average schooling levels are low, and fertility remains relatively high, sustaining moderate to rapid rates of population growth (Subbarao and Raney, 1995; Schultz, 1995a).

Public finance arguments can also justify redirecting human capital toward women in order to recover educational subsidies, broaden the tax base, and reduce tax distortions. If government revenue requirements are fixed and can be met only by taxing market transactions, as seems reasonable, reallocating school enrollments toward women rather than to men should expand the market earned income tax base and allow the tax rate to decline and distortions of consumption and production decisions to diminish. It is a well documented empirical regularity that the market labor supply response associated with an increase in own schooling is more positive for women than for men. This regularity may help explain the large increase in female market labor supply in this century, first in the industrially advanced countries, and more recently throughout most other parts of the world, at least in the nonagricultural sector of the economy (Schultz, 1981, 1990a). One interpretation of this empirical regularity is that this labor supply effect of schooling is due to the uncompensated wage effect caused by schooling raising worker productivity. It is widely concluded that the substitution effect of own wage on female labor supply exceeds the income effect of the wage, whereas in the case of male labor supply, the positive substitution effect is more or less offset by the negative income effect, weighted by hours worked in the market, leaving a small uncompensated own wage effect for males of either positive or negative sign (Schultz, 1981; Killingsworth, 1983). Increase a woman's schooling by one year and her market labor supply will tend to increase by more than for a man, perhaps because she has a wider range of home production activities she can substitute out of to make time for more rewarding market work.

In studies of farm families the parallel pattern emerges in high- and low-income countries. Increases in female schooling are associated with increased labor supply to off-farm labor market

activities and often also increased farm labor supply. In the case of men, the general tendency is for male labor supply to off-farm activities to increase but farm labor supply to decrease by approximately the same amount (Huffman, 1980; Huffman and Lange, 1989; Tokle and Huffman, 1991; Kimhi and Lee, 1996). Thus the tax base of male earnings does not substantially respond to increased male schooling, but the female market earnings will increase with her schooling. Moreover, estimates of family labor supply models suggest that the cross-wage effect of the male wage (schooling) on the female labor supply also tends to be substantial and negative, whereas the effect of female wage (schooling) on male labor supply is rarely estimated to be significant (Killingsworth, 1983). Consequently, the own female schooling effect on the market earnings tax base is positive, and the cross effect of male schooling is negative, reinforcing the conclusion that the tax base would expand with a redirection of human capital formation from men to women. In other words, a larger fraction of the increased public cost of education is recouped by the public sector through added tax payments, when the education is received by women than by men, increasing the social returns to women's schooling relative to men's.

6. Conclusions and Direction for Further Work

Three decades ago economists were challenged to treat the family as a unified coordinator of both consumption demands and the time allocation of its various members (Becker, 1965). Two decades ago models of the agricultural household combined the profit maximizing production problem of the farm with the utility maximizing problem of the family deciding on time allocation and consumption (Barnham and Squire, 1979; Singh et al., 1986). This second advance depended on the assumption of separability between the farm production and the family consumption decisions, and it implied that hired and family labor were equivalent and all families had access to well-functioning labor markets to bring their labor demands into balance with their family supplies. Econometric testing of this restrictive assumption has continued in a variety of contexts and it is somewhat surprising that it has not been resoundingly rejected, as yet, based on studies of Indonesia, India, and the Philippines (e.g. Singh et al., 1986; Pitt and Rosenzweig, 1986; Seavy, 1987; Benjamin, 1992; Maluccio, 1997; DeSilva, 1997). This literature has concluded that families with a relative shortage or excess of family labor for a farm's production needs, do not exhibit distinctively different own-farm input proportions. Even for family female labor in India,

where it might be expected that off-farm labor involve social stigma and monitoring costs, the tests of separability appear to be satisfied (Seavy, 1987). Although factor markets are undoubtedly imperfect in many settings, econometricians have not built a strong case for rejecting the premises underlying the simplified agricultural household model that treats the production and consumption decisions as approximately separable. Women's roles in the agricultural household have not been central to this separability literature, but from the outset the agricultural household model introduced the idea that women's family labor supply might diminish as farm profits increased due to technical change, increasing the demand for hired labor more than would otherwise be expected from an traditional analysis based on farm production functions (Barnam and Squire, 1979; Singh et al., 1986).

A third generation of research on women, family production and consumption behavior has developed in the last decade, drawing upon three issues. The first is the relaxation of the theory of the unified altruistic model of the family to deal with family members having different control over individual resources and potentially different preferences for consumption. An objective of this theoretical literature is to take the theory against data, and thus to be able to test the restrictions implied by the theory against household survey data across cultures. The second issue is the growing interest in what determines intrahousehold resource allocations, and the resulting distribution of well-being among members of the household, in particular men, women, children, and elderly. The third issue is the recognition that families and separate individuals observed in a survey are selected into these production-consumption units according to economic and social matching based on preferences and endowments. Thus, it is not appropriate to treat two parent families as a random sample of the population to test a family bargaining theory, any more than to assume that wage earners represent the productive potential of all individuals. Little empirical work has integrated these three strands of research, and that is one of the major challenges of the field.

Intergenerational perfect altruism can be rejected in the U.S., to the extent that parent and child living in separate households do not perfectly smooth each other's consumption (Altonji et al., 1992). Nonetheless this leaves some margin for "altruism" to express itself over time in the form of transfers and bequests (Cox, 1990; Cox et al., 1996; Quisumbing, 1994, 1995, 1996a, 1996b). The formation and composition of families is changing in ways that can be partly

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explained by economic models of individual and group cooperative or strategic behavior. Thus, the samples restricted to married or single persons, with or without coresidential children, headed by females or males, with or without elderly dependent parents, are not random with regard to the economic consumption and production choices economists want to understand. A more comprehensive theoretical framework is needed that accounts for how individuals are matched and marriages and separations are determined, and other mechanisms that modify fertility, child survival by sex, home leaving age for offspring by sex, and whether or not elderly parents enter the home of their child, etc (e.g. Foster, 1996). Without such a theory of household formation and composition, answers to many analytical questions cannot be obtained from our data.

A second reason for relaxing the unified family model is the growing interest in intrahousehold resource allocation -- who receives what within the household and why? Although the unified family model provides a framework for answering some questions about the distributional consequences of changing wages for men, women, and children, access to local programs, and market prices as they may modify reduced form outcomes in the family, the nonunified or bargaining models of the household provide a more focused framework to look for indicators of individual welfare, such as height, BMI and schooling, and for indicators of individually controlled nonearned resources in the household, such as dowry and inheritances. The bargaining models have justified collecting data on separate sources of nonearned income by husbands and wives, separate assets that they bring to their marriage, personal support networks they maintain in their extended families and communities, and individual access they have to credit based on collateral or personal connections. Although a few social scientists continue to debate how conceptually to measure women's "status" in society, most economists have accepted the idea that the labor productivity of women relative to men, outside of their family, is a critical factor governing changes in the form and functioning of today's families and a factor affecting women's status and welfare. Moreover, it is a measure of status and welfare that can be approximately measured in many diverse cultural settings.

Other work in this field seeks to understand the nonhuman capital that women control within a family and can take with them in the event that the family separates. Anthropologists have studied certain forms of social and network capital and may provide economists with guidance into this new murky terrain of modeling and help to measure empirically what is meant

by "gender empowerment" or "social capital." Feminists have also been outspoken in their pursuit of deeper social values than those reflected in economic-market-determined prices and wages (Folbre, 1994). Little progress has been made in response to this challenge, though it deserves more study.

The evolving variety of household allocation models based on cooperative or noncooperative bargaining is growing, and the data useful for testing them is improving. It is somewhat early to highlight the empirical regularities that this literature has found or give them any policy interpretation, but selections have been cited in this chapter. There is frequently a regular relationship between nonearned income or nonhuman capital controlled by women in the family and increased consumption shares of food (incidentally, a sign of poverty according to Engel's law), but there is also a tendency for children to be healthier and better nourished and attending school longer and more consistently, holding constant in one manner or another for the family's overall budget constraint. Even this glimmer of an empirical regularity, which might be interpreted as encouraging policymakers to target resources for child support to the custody of mothers rather than fathers, needs to be carefully examined in controlled experiments before policy lessons are drawn (Newman et al., 1994). The full ramifications of such policy interventions need to be studied longitudinally for a considerable period of time during which other behavioral adaptations can be expected to occur. One can imagine providing support to mothers (rather than fathers) would also increase the rate of marital dissolution, and the lifetime welfare of affected children would not necessarily improve, while those of the father might deteriorate. Economists may not yet be able to provide firm answers in this complex area of how society can effectively supports particular objectives within the family. The problem merits more study. The field is trying to fashion more relevant theory and collect data that promises to be more useful than what was available to researchers in the past. Applying these new methods and examining these new data to understand the role of women in agricultural (and nonagricultural) families is a basic challenge for economists, one that will keep the profession occupied for some time.

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