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 his framework further to deal with the utility of different generations. He continues to assume that a single altruistic decision-maker 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 decision-maker 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 among 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 parents' financial cost of borrowing. At that point, further transfers to children from parent would all take the form of 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 *compensate* 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 *reinforce* 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 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 parents 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 non-human 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:

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

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 Beegle (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 a correlation between the education of women and household agricultural productivity or income. For example, an empirical analysis of data 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 education was insignificantly partially related to both 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 (1993)]. 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 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.

[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 a farm manager or farmer, who makes allocative decisions that may be better informed if he or she is better educated [Welch (1970)]. 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)].

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 decision-making 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:

$$\begin{aligned} &\max \mu U^A\left(X^A, X^B\right) + (1-\mu)U^B\left(X^A, X^B\right), \\ &\quad \text{subject to } p\left(X^A + X^B\right) = Y, \end{aligned} \tag{13}$$

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 – that is, the utility she might expect in some alternative family living arrangement.

Demand functions can be expressed conditional on the sharing rule:

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

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 $g(\cdot)$ 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:

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

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 $Y - \phi$ income to B, then each person maximizes their utility function subject to their income constraint, and conditional demand functions can be written as follows:

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

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 functions 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 (1994b); Lundberg et al. (1997)], extended family 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

[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)].

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 the 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 the husband's and wife's 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 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) employing Becker's (1974) theory, and has subsequently been analyzed by Grossbard and 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:

$$\begin{aligned} &\max\left[U^A\left(p, Y^A, Y^B, V^A, V^B\right) - U^{RA}\left(p, Y^A, V^A, EPP^A\right)\right] \\ &\quad \times\left[U^B\left(p, Y^A, Y^B, V^A, V^B\right) - U^{RB}\left(p, Y^B, V^B, EPP^B\right)\right] \\ &\quad \text{subject to } Y^A + Y^B + V^A + V^B = Y, \end{aligned} \tag{19}$$

where V^i refers to the nonearned income of individual i, $i = 1, 2$, and 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 setup [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 depend upon 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 this measure 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]

[3] Critics of this empirical approach tend to reject *a priori* the exogeneity of nonearned income, because it could reflect savings which might in turn be related to preferences for labor supply, leading to the expectation that nonearned income would exhibit a positive partial correlation with labor supply, whereas most studies find a negative correlation as expected for an exogenous "income effect". 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 household's 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 children's apparel or women's apparel, relative to the expenditures on men's apparel, increased [Lundberg et al. (1997)]. However, relabeling a transfer program may in itself change how it affects consumption patterns. Kooreman (1998) found in the Netherlands when "family assistance" was relabeled a "child payment", it also was associated with an increase in expenditures on children's apparel. But these differential effects of the child payment relative to the effect of other sources of income on children's apparel were the same in 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 U.K.

There remains relatively little strong direct evidence that preferences of mothers and fathers differ with regard to child consumption, holding technology and endowments constant, 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 in a unified family 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 that are less restrictive have therefore been developed, as discussed above [Manser and Brown (1980); Haddad et al. (1997)]. First, there is the cooperative Nash-bargained solution (Equation (19)), and then more general cooperative sharing rule models (Equation (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 decision-making, 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 only during that period of the life cycle when they have young children at home [Schultz (1981); Lundberg (1988)], or parents may pool resources but other coresidential relatives in the household 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 work in the market labor force. This time outside of the market labor force may include time in home production, such as household chores and child care. 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 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 forms of consumption other than leisure – such as expenditures on tobacco, alcohol, toys or gender-specific apparel – may be even more ambiguous as a private good, 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

[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.

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 would 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 sub-Saharan 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 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 intended to capture exogenous differences across persons in their budget constraints that do 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)].

[5] Evidence compiled by Svenberg (1990) indicates that female nutritional status and survival prospects in sub-Saharan 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 bride prices for their daughters and have a stronger incentive to invest in their health. The one region of sub-Saharan Africa where Svedberg's anthropometric indicators of nutrition and mortality do not indicate as strong a bias in favor of females is in Nigeria 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)].

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 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 is 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 "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 (1995) 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 that in closely knit ethnic groups in many parts of the world, 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 sub-Saharan 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

[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. Some but not all West African studies have replicated these empirical patterns [e.g., Udry (1996); Doss (1996b, 1997); Smith and Chavas (1997); Akresh (1999)].

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, which 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-owned plots receive a disproportionate share of the other variable inputs: manure and child labor. This would suggest that male "power" might contribute to male-owned plots obtaining these additional scarce, but not widely marketed, inputs, and these inputs could complement labor on male-owned 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-owned plots and account for the greater female productivity on male plots than on their own 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 is 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 he assumes they are substitutes, and on-the-job training in market work leads to human capital accumulation from work experience. This framework leads to the prediction that gender specialization between market and nonmarket work within the family is likely to occur. Alternatively, if nonmarket time of husband and wife were complements in nonmarket work, it might be expected that some couples would both work in the market and some might even team up to work together in nonmarket production, leading to market and nonmarket specialization across families, rather than within families. Yet 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 is intuitively plausible. 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 life cycle – before childbearing starts and after children leave the parental home – there may be less opportunity for substitution of the 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 life cycle and not restricted to be constant across all ages, and perhaps be allowed to vary between 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 that, 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 with U.S. data and rejected it, although in a subsequent paper this theoretically implied restriction was imposed [Ashenfelter and

Heckman (1974)].[7] But the test is conditional on many other aspects of the demand model, including functional-form approximations [Killingsworth (1983)].

This symmetry property of the family demand model unfortunately is 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 earnings from off-farm work or because 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 of 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 health.[8] This approach to estimation

[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.

[8] Alternatively, measures of the deviation in weather from their long-run average can be constructed in a particular agricultural region 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)].

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 (Equation (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 monetize comprehensively, for that requires imputing a value to the time of each child and parent 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 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 in 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) ex-

penditures [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 [U.S., 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 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 sub-Saharan Africa and Southeast 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) appears 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 in the United States devolves predominantly on male family workers, 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-earning 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); 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 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 pos-

sible explanation for the recently noted trend in India of the value of dowries (i.e., price of marrying a daughter) to increase [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 composition in terms of age and sex [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 life cycle 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 directly 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 decision-making would be motivated by a 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 strategy is to estimate a reduced-form relationship for the behavior under study, including in the sample all women, which implicitly solves out for intermediate relationships such as the family formation process, the marriage match of spousal characteristics, and the number and 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 exerts its total effect, but it is possible to assess the

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

unconditional effect of the woman's education, say, on the likelihood of, for example, her being currently married, or the number of children she has out of wedlock, 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 be excluded from entering certain household behavioral equations. 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 do not give us confidence about 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 life cycle pattern of personal savings [Schultz (1999)].

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 for parents has some of the attributes 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

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

differences within families 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 disproportionate level of child mortality among girls compared to boys emerges most strongly after the first month of life, because earlier infant deaths are mainly due to congenital problems at birth which appear to be less responsive to differential application of 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 and confirmed that there 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 does 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 in the northwest, such as the Punjab and Haryana, as well as the Himalayas and western regions, report low female to male child survival compared with the poorer southern 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 the female to male survival rate 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 nineteenth century Germany [Sen (1976); Chen et al. (1980,

1981); Miller (1981, 1997); Martorell et al. (1984); Bardhan (1984); Das Gupta (1987); Klasen (1998)].

Other cultures and 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 today exceeds the conventional range of between 1.03 to 1.06, and increases with higher parities. When the Chinese government in the 1970s adopted a strict population program that sought to enforce a one-child policy, infant and child mortality of females increased markedly, and the growing shortfall in women attracted the attention of demographers [Aird (1983); Zeng (1989)]. Perhaps in response to this development, the Chinese population policy was relaxed somewhat in the rural areas in the 1980s to permit a couple to have 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 in Nicaragua, Brazil, Philippines, Sri Lanka, and Ivory Coast [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 sub-Saharan 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 on the family from adverse health shocks.

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. Fertility is commonly observed 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 could also exert a reinforcing 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 in Ghana is strongly related to their wage productivity [Higgin 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 exceed that in girl's. As real income per adult increases, public expenditures per child on schools 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 the secondary school level [Schultz (1987, 1996)]. A catching up for girls is evident in both comparisons of different countries with increasing income [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 for men and women to differ, at least in the short run, 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 life span. In the Philippines, farm families are observed to invest more in the education of their daughters than of their sons, but to transfer more land to their sons, arriving at a rough economic balance [Quisumbing (1994, 1997)]. Differences in the composition of transfers by parents 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 in the Bicol Province is that the major irrigation projects 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 are 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 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 Latin American studies 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 has 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 transferred to children through the schools. He found little intrahousehold reallocation of calories in response to the selective feeding program administered through the schools.

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 some 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 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 it could 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 provide 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 many countries in the proportion of households headed by women has been observed recently. 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 rate of divorce in many developing and developed countries can be documented over time. 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 arranged early marriages, which are being slowly modified to allow individuals to exercise greater control over the timing of their marriage and to select 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 [Youssef and Hefler (1983); Knodel 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 Aid for Families with Dependent Children (AFDC) benefits for mothers without husbands, marriages were less common for 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" [Chiappori et al. (1997)].

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, and East and parts of Southeast Asia [Montgomery and Sulak (1989); Anderson and Hill (1987); King et al. (1986)]. The growing tendency of young, educated women to take paying jobs, 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 traditionally has also been accepted 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 were living in the same household with their spouse. To explain who is currently married, the specialization hypothesis 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

[11] Aggregate data were analyzed, for example, for 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)].

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 her predicted market wage opportunities. 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 with a greater proportion of Thai men residing with their wife.[12] But the estimated effect of property income on marriage is nine times larger (and of opposite sign) for women than for men 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.

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 would also shift the individual to the "single" category. About half of the female-headed households in Latin America are widows [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 in different societies, as does the family.

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

[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.

[13] For example, Rosenhouse (1988) illustrates from the 1985 Living Standards Measurement Survey for Peru that 90 percent of the male-headed households currently include wives, while only 5 percent of the female-headed households include husbands. 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

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" will be influenced by custom, their resources, and other opportunities, as in Thailand. Several studies have found an 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 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 [Gregory (1986); Mohan (1986)]. As a result, many urban women did not marry, but they were not necessarily economically disadvantaged compared to those who stayed behind in the countryside. The prospects in Latin America for women to advance from urban jobs as domestic servants – holding constant their education – to ones in industry, commerce, and other services, may even be favorable compared with men. The overall productive status of women relative to men, as well as their survival prospects, is 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

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 if 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).

traditional food crops largely without the aid of modern agricultural inputs or technologies [Boserup (1970); Ember (1983)]. African women initially suffered from lower levels of education than men [Schultz (1987, 1995a); Goldin (1995)], explaining perhaps 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 appears 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)]. It remains difficult, however, to infer how these various developments and the increase in the proportion of female-headed households are causally related [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 households headed by younger women than in those headed by men [Youssef 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 to 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 their children have worried social observers, from Malthus (1798) to Murray (1984), for they could encourage women to separate from their husbands or to have births out of wedlock to become eligible for public support. The conditions of work for husbands in the poorhouses of nineteenth 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 are 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, than a more typical couple who has two daughters and two sons (assuming the typical couple does not share in the dowries their sons receive in marriage). Elaina Rose (1995) and Deolalikar and Rose (1995) have shown that in India the revelation at birth of the sex of a child 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

[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 a particular sex of a child, these technologies are linked to growing imbalances of the sex ratio at birth. The ratio of male to female births tends 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)].

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)]; 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 in 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 of the more common gender difference in child mortality in parts of South and West Asia is attributed to different access between boys and girls in otherwise similar families to food, home care, and to medical interventions [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 local economy's derived demand for labor favors female labor relative to male labor, wages for women relative to men should increase, and labor force participation of women is also likely to rise. In such districts where women are 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, 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 by the increased investment of families in the health and survival of females.

Sub-Saharan 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 sub-Saharan Africa women engage in many forms of production, jointly with their husbands and separately on their

[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 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.

own plots and in their own businesses. This greater parity of women and men in production outside of the home in sub-Saharan Africa is a possible explanation for why sex differences in childhood survival in Africa are more similar to the rest of world than to South and West Asia [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 a deflator for income, to obtain a needs-based welfare measure of household income per "consumer unit", which implies that demands are conditioned on composition and statistically that household composition is uncorrelated with the disturbance in the estimated demand relationship [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, as weighted by their equivalent consumption scale, to obtain the average welfare level of household members [Gronau (1988)]. With no 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) the log of household size, and (3) a series of variables representing the share of household members in each relevant age and 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 household's 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 was 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 intra-household 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. Al-

though the precise causes of 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 relative to that of men is lowest, there is further evidence of differential survival favoring men, just as it is 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 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 hnman capital: Measnring retnrns

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

work 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 (2000, 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 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 *disabling illness* (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 (*ADL*) [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 that 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 percent 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 increase 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 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)].

Also mounting is evidence 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

[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)].

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.

[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, and nutrition returns [Schultz (1988)]. Comparisons of the efficiency of female and male farm operators also found few cases where schooling increased the profit of the farm operator more or less for men or women [Moock (1976); 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 [Mundlak 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 (U.S.) 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 as seen by the Europeans did little work in traditional agricultural systems in Africa. 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 emphasis on cash crops could most readily be explained by the same motives as occupied the colonial regimes – obtaining a reliable source of government revenue, whether the export crop was coffee, cocoa, or cotton.

The traditional shift from hoe to plow 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 have increased 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 that women, who obtained a small fraction of the schooling that men received, often lost control of the new, more profitable crops to men [Murdock and Provost (1973); Ember (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 by Boserup (1970) to the colonial administrators. 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 significant anomaly that needs to be explained, for it does not prevail in southern Africa. This unequal investment in education placed women in most of sub-Saharan 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 initially tended to be 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 than male farm managers in millets and maize, whereas male managers are higher than female managers 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 decision-makers. 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 [Ember (1983)]. 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 role in India reducing forest cover and increasing degradation of the land [Foster et al. (1998)]. Reducing environmental degradation is yet another possible beneficial social externality attributable to 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 combine observed productive returns and the unobserved consumption returns.

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 substantiate empirically 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 (1994b, 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 allocate public resources to public health programs, and in particular preventative child health interventions. Similarly, publicly subsidized schooling occurs due to a consensus that increasing school enrollments yields social benefits that outweigh the public outlays. And a mother's education generally has a larger impact on children's schooling than the 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 as preferences of the parents, it is more complicated to describe. Suppose men who prefer to have fewer 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 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 has been linked since the 1960s to the adoption of new agricultural technologies 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 of rural Indian and Bangladeshi families for sending girls to school in increasing numbers 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 woman 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 after 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 seem 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 to family income [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 our 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 the 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 in the alternative or "reservation arrangement" she might choose, e.g., divorce or separation

[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 as 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); 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); Engel (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)].

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 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, is expected to modify consumption and investment patterns, because the time of family members enters into the shadow prices of many consumption commodities and investment activities, and thereby modifies family demands, independently of bargaining power or differences in preferences among family members. 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 years of schooling, tends to start school earlier, attends 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 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, reduce 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 tracks in the school system, for this might "over supply" the labor market with these skills 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 sub-Saharan 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

[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 found that it may have increased compared to pre-program fertility levels. It is possible that credit subsidies for women's enterprises increase the value of children's labor in their enterprises and even weaken their incentives to invest in the schooling of their girls, who are most likely to work alongside their mothers [Pitt and Khandker (1998)].

rather than 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 the 20th 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 education increasing 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 from which she can reallocate her time to work in the market labor force.

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 women are educated than when men are educated, increasing the social returns to women's schooling relative to men's.

6. Conclnslons 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 [Barnum 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); De-Silva (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 involves 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 a traditional analysis based on farm production functions [Barnum 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. 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 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? 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. However, the nonunified or bargaining models of the household provide a more focused framework to assess indicators of individual welfare, such as height, BMI, and schooling, and for indicators of the consequences 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 positively 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 used for testing them is improving. It is somewhat early to highlight the empirical regularities that this literature has found or that give them any policy interpretation, but selections have been cited in this chap-

ter. 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 that of the father might deteriorate. Economists may not yet be able to provide firm answers in this complex area of how society can effectively support 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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Chapter 9

HUMAN CAPITAL: MIGRATION AND RURAL POPULATION CHANGE

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Contents

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Abstract

The movement of labor out of agriculture is a universal concomitant of economic modernization and growth. Traditional migration models overlook many potential interactions between migration and development. Given imperfect markets characterizing most migrant-sending areas, migration and remittances can have far-reaching impacts, both positive and negative, on incomes and production in agricultural households. Linkages through product and factor markets transmit impacts of migration from migrant-sending households to others inside and outside the rural economy. Recent theoretical and empirical studies reveal the complexity of migration determinants and impacts in rural economies, and they point to new arenas for policy intervention.

JEL classification: Q12

The migration of labor – geographically out of rural areas and occupationally out of farm jobs – is one of the most pervasive features of agricultural transformations and economic growth. This is true both historically in developed countries (DCs) and currently in less developed countries (LDCs). Among nations, the share of rural population declines sharply as per capita incomes increase (Figure 1), from 70 to 80 percent in countries with the lowest per capita GNPs to less than 15 percent in the highest-income countries. The share of the national workforce in agriculture plunges even more sharply (Figure 2), from 90 percent or higher in low-income countries to less than 10 percent in high-income countries. Developing countries from Mexico to India have experienced dramatic declines in their rural population shares over the past three decades, despite significantly higher rates of natural population growth in rural than in urban areas.

As internal migration redistributes populations and workforces from rural to urban areas, many countries – including those with the world's most dynamic fruit, vegetable, and horticultural crop production – turn to foreign-born migrants, frequently of rural origin, for labor. In the United States, for example, an estimated 69 percent of the 1996 seasonal agricultural service (SAS) workforce was foreign-born [Mines et al. (1997)], and in California, the nation's largest agricultural producer, more than 90 percent of the SAS workforce was foreign-born. The majority (65 percent) of these migrant farmworkers originated from households in rural Mexico.

The world's great migrations out of rural areas are accelerating, making internal and international migration potentially one of the most important development and policy issues of the twenty-first century. The most populous countries also are among the most rural (Figure 1). The greatest migration potential is in China, where 71 percent of the population is rural and an estimated one-third of the rural labor force of 450 million is either unemployed or underemployed. Despite barriers to labor mobility imposed by China's household registration (hukou bu) system, China currently has more migration than anywhere else, with between 50 and 100 million rural-to-urban migrants [Roberts (1997)]. Meanwhile, in high-income countries, farmers, with their reliance on foreign-born migrant workforces, find themselves at odds with an increasingly restrictionist public and policy stance towards immigration.

The determinants of migration and migrants' impacts, both on migrant-sending areas and on the rural communities that receive them, have been the subject of a prolific and growing literature in agricultural and development economics, a centerpiece of public policy debates, and a source of sharpening controversy and anxiety in migrant "host" countries and communities. The determinants of out-migration from rural areas and the impacts of this migration on rural areas are the focus of this chapter.

Section 1 presents a critical synthesis of theories of the determinants of migration out of rural areas, with a focus throughout on the implications of these theories for empirical analysis of migrant labor supply. It starts out with the (mostly implicit) role of migration in classical, two-sector models, in which the rural sector is characterized as having redundant or surplus labor, then presents neoclassical and expected-income models, human-capital models, and the "new economics of labor migration" (NELM). For the most part, economic theories of migration were developed in the context of

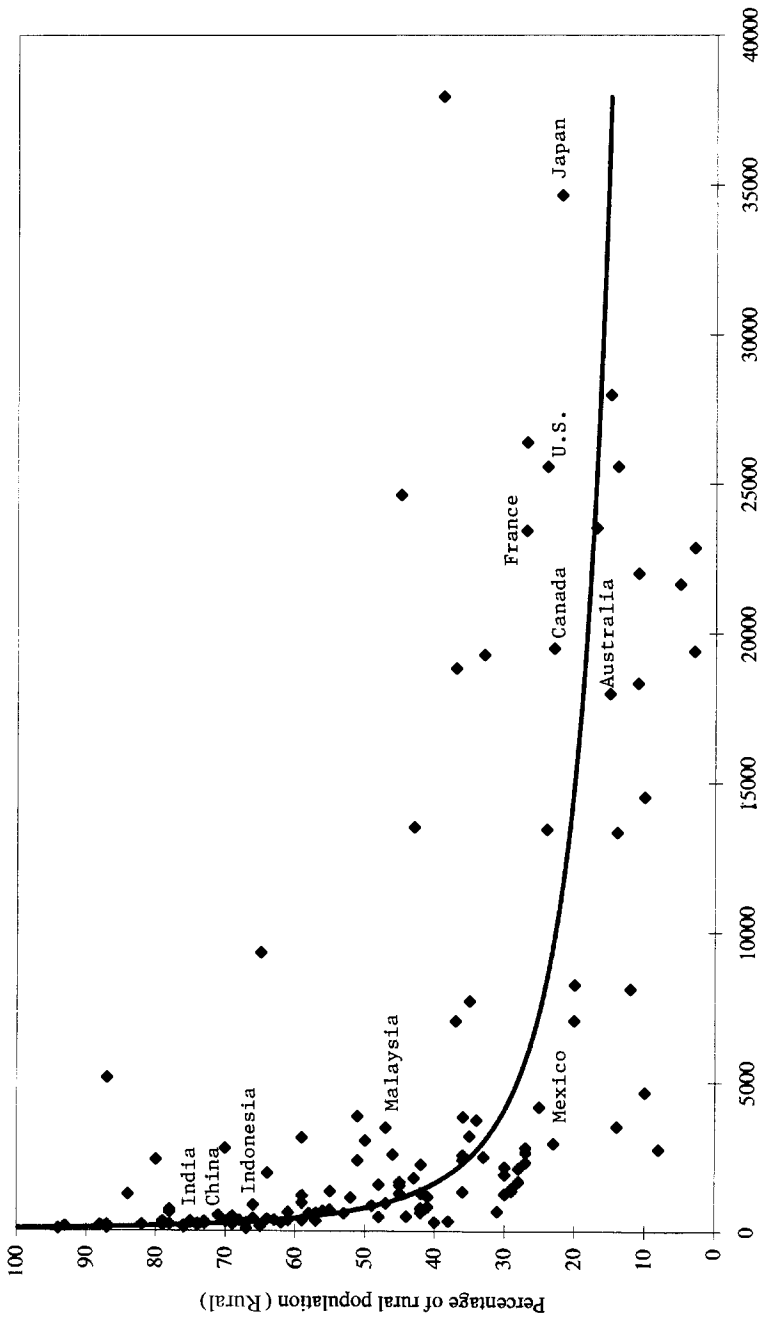

Figure 1. Rural population shares and GNP per capita, 1994. Regression line: Rural $= 395.12y^{-0.31}$ ($R^2 = 0.535$, $N = 127$).

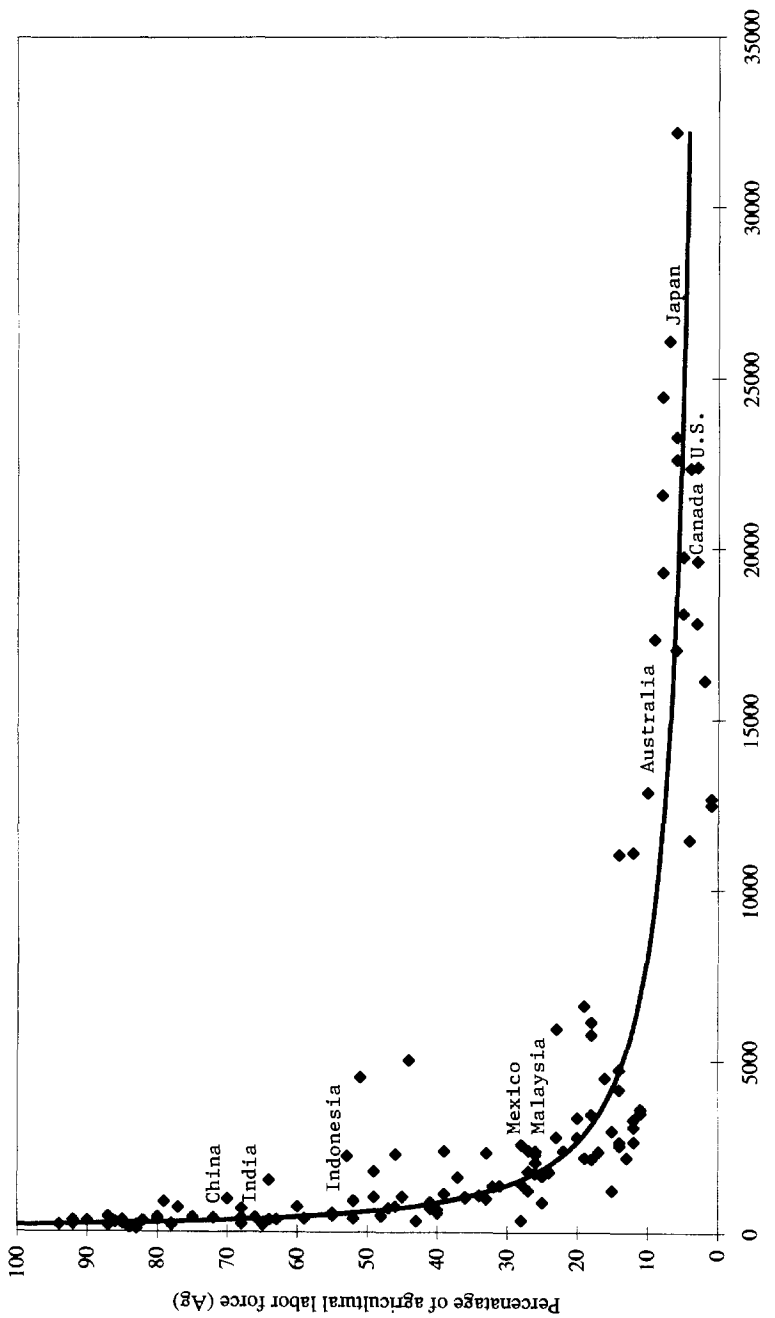

Figure 2. Agricultural labor shares and GNP per capita, 1990. Regression line: $Ag = 2672.9y^{-0.6211}$ ($R^2 = 0.783, N = 122$).

developing countries. However, virtually all economic models of rural out-migration and farm labor migration in developed countries are rooted in the migration theories presented here.

Section 2 presents modeling techniques that have been used to test the theories presented above. Section 3 reviews key findings of empirical farm labor migration research and reassesses migration theories based on these findings.

A significant theoretical and empirical literature addresses welfare effects of migration on migrant-sending economies. A nascent literature deals with impacts of migration on rural, migrant-receiving areas, e.g., the many small rural communities throughout the United States that are being transformed by migrants working in agriculture or agricultural processing industries. There is also fledgling research on impacts of rural-to-rural migration within LDCs, with a focus on the environment. Section 4 assesses this rural migration-impacts research, linking it to the migration models and findings presented in Sections 1 through 3. The impacts of migration are intimately tied to migration determinants, including the incentives to migrate and the selectivity of migration.

Most countries do not explicitly attempt to control rural out-migration (China is the significant exception). However, they do hold immigration policy levers, and there are some policy efforts to influence internal migration indirectly, e.g., via interventions in labor markets or by altering the availability of public services for migrants. High-income countries, especially the United States, have a long history of implementing policies aimed at restricting the inflow of foreign-born (mostly unauthorized) farmworkers without creating labor shortages on farms. These policies include fines for employers who knowingly hire unauthorized immigrants, farmworker legalization, restriction of public services to immigrants and their families, and guest worker programs. In many cases, these immigration policy changes have had unintended consequences for farmers and rural communities. Section 5 concludes with a discussion of policy implications of migration research. In particular, what economic justifications, if any, are there for designing policies to influence the supply or demand of migrant labor?

1. Theories of rural out-migration

1.1. The classical two-sector model

Social scientists have studied the movement of labor out of rural areas for a long time. Migration is addressed by Adam Smith in *The Wealth of Nations* (1776). In industrial revolution England, Ravenstein (1885) and Redford (1926) argued that a combination of Malthusian forces, land scarcity, and enclosure – that is, "supply push" variables – drove rural-to-urban migration. Others pointed to "demand-pull" variables, including the rapid development of manufacturing that fed population growth and urban poverty in Manchester during the early nineteenth century [e.g., Engels (1845)]. Johnson (1948) recognized rural out-migration as a solution to surplus labor and low incomes in agriculture.

The modern economics literature on migration often is traced to Lewis' (1954) seminal work on economic development with unlimited supplies of labor. Lewis does not propose an explicit migration model. His contribution is to explain the mechanisms by which an unlimited supply of labor in traditional sectors of less developed countries (LDCs) might be absorbed through capital accumulation and savings in an expanding modern sector. Nevertheless, migration plays an important role in the Lewis model. Ranis and Fei's (1961) formalization and extension of the Lewis model was the precursor to a generation of neoclassical and "neo-neoclassical" two-sector models which dominated the migration literature through the 1980s. Although originally designed to examine the reallocation of labor between rural and urban areas, it is potentially applicable to international migration. A Lewis-type model may offer some insights into rural out-migrations associated with very high wage elasticities, as appears to be the case for internal migration in some less developed countries (LDCs) and possibly also for foreign migrant-labor supply to some developed countries (e.g., Mexican migration to fill US agricultural jobs) – that is, migration that is largely demand-driven.[1]

The Lewis dual economy consists of a "capitalist" sector and a "noncapitalist" sector. Although Lewis did not intend this, in practice the capitalist sector has generally become identified with the urban economy and the noncapitalist sector with agriculture or the rural economy. The capitalist sector hires labor and sells output for a profit, while the noncapitalist (or subsistence) sector does not use reproducible capital and does not hire labor for a profit. Initially, labor is concentrated in the noncapitalist sector. As the capitalist sector expands, it draws labor from the noncapitalist sector. If the capitalist economy is concentrated in the urban economy, labor transfer implies geographic movement, i.e., rural-to-urban migration.

In theory, migration implies an opportunity cost for the rural economy, which loses the product of the individuals who migrate. However, the centerpiece of the Lewis model (and essence of the classical approach) is the assumption that labor is available to the industrial sector in unlimited quantities at a fixed real wage, measured in agricultural goods. In the limiting case, this implies that there is surplus or redundant labor in rural areas, such that the marginal product of rural labor is zero, and labor thus may be withdrawn from rural areas and employed in the urban sector without sacrificing any loss in agricultural output. That is, the opportunity cost or "shadow price" of rural labor to fill urban jobs is zero. (Various institutional arrangements ensure that consumption by members of the farm workforce is roughly equal to the average product of farm output, even if their marginal product is below this average.) Lewis argued that at least a quarter of the agricultural population in India was "surplus to requirements."

More generally, the supply of labor from the subsistence sector is unlimited if the supply of labor is infinitely elastic at the ruling capitalist-sector wage. A zero marginal

[1] In the classical model, migration is demand-driven in the sense that the supply of farm labor to nonfarm jobs is perfectly elastic (i.e., the supply curve is horizontal). Therefore, the movement of workers from farm to nonfarm jobs results solely from outward shifts in the nonfarm labor-demand curve.

product of labor in the noncapitalist sector is not a precondition for this. However, in the Lewis model, earnings at the prevailing capitalist-sector wage must exceed the noncapitalist-sector earnings of individuals willing to migrate, i.e., the average product of labor in the traditional sector. Moreover, any tendency for earnings per head to rise in the noncapitalist sector must be offset by increases in the labor force there (e.g., through population growth, female labor-force participation, or immigration).

A key testable hypothesis of the Lewis model is that rural out-migration is not accompanied by a decrease in agricultural production nor by a rise in either rural or urban wages. The Lewis assumption of general surplus labor in LDCs has been questioned, especially by Schultz (1964). [Also see Jorgenson (1967), and the exchange between Robinson (1969), and Gardner (1970)].

1.2. Neoclassical two-sector models

In Ranis and Fei's (1961) interpretation of the Lewis model, the perfectly elastic labor supply to the capitalist sector ends once the redundant labor in the rural sector disappears and a relative shortage of agricultural goods emerges, turning the terms of trade against the modern or capitalist sector. Through migration, the marginal value products of labor are equated between the two sectors; the Lewis classical world ends and the analysis becomes neoclassical. The dual economies merge into a single economy in which wages are equalized across space. Rural-to-urban migration exerts upward pressure on wages and on the marginal value product of labor in rural areas, while putting downward pressure on urban wages, assuming that wages adjust to ensure that both rural and urban labor markets clear. Empirically, in addition to the convergence of wages across sectors, one should observe an inverse relationship between rural out-migration and farm wages, on one hand, and agricultural production, on the other (other things (including technology) being equal). In addition, assuming full employment of labor in both rural and urban sectors and minimal transactions costs, inter-sectoral wage differentials should be the primary factors driving rural out-migration [Jorgenson (1967), Ranis and Fei (1961)].

Internal and international migration are modeled according to this perfect-markets neoclassical specification in virtually all computable general equilibrium models, both national [e.g., Adelman and Taylor (1991), Levy and Wijnberger (1992)] and international [e.g., the NAFTA models of Robinson et al. (1991)]. In contrast, most microeconomic models of rural out-migration are grounded on Todaro's seminal work, which incorporates labor-market imperfections, including urban unemployment, into a migration model (see the following section).

Despite its popularity for some modeling purposes, wage-driven neoclassical analysis of rural out-migration has largely been discredited for a number of reasons. These reasons include the empirical observation that urban formal-sector wages are "sticky", and migration tends to persist and even accelerate in the face of high and rising urban unemployment in LDCs [Todaro (1969, 1980)]; documented persistent differences in wage rates for comparable agricultural tasks across geographical areas [e.g., Rosenzweig (1978)]; and unskilled urban manufacturing wage rates that have remained 1.5 to

2 times agricultural wages over long periods of time [Squire (1981)], despite significant rural-to-urban migration. Such differences in the returns to homogeneous labor across sectors are not consistent with the predictions of neoclassical migration models. They are evidence of market imperfections – although, significantly (see the new economics of labor migration, below), not necessarily of imperfections in labor markets.

The continuation of migration despite high and increasing urban unemployment is the primary motivation for Todaro's (1969) expected income model of migration in the presence of labor-market imperfections, and imperfections in other markets – including markets for capital and risk – are a focus of the new economics of labor migration.

1.3. The Todaro model

Todaro (1969) proposed a modification of the neoclassical migration model in which each potential rural-to-urban migrant decides whether or not to move to the city based on an expected-income maximization objective. Expected urban income at a given locale is the product of the wage (the sole determinant of migration in the neoclassical models described above), and the probability that a prospective migrant will succeed in obtaining an urban job. Expected rural income is calculated analogously. Individuals are assumed to migrate if their discounted future stream of urban-rural expected income differentials exceeds migration costs; i.e., if

$$\Delta = \int_0^T \mathrm{e}^{\delta t}\left[p_u(t)y_u - y_r(t)\right]\mathrm{d}t - c \tag{1}$$

is positive, where $p_u(t)$ is the probability of urban employment at time t, y_u denotes urban earnings given employment, $y_r(t)$ represents expected rural earnings at time t, c is migration costs, and δ is the discount rate. Otherwise, they remain in the rural labor market. Note that this is not a model of risk and uncertainty; in the Todaro specification, individuals are assumed to be risk-neutral. For example, a mean-preserving increase in the variability of urban income leaves the migration propensity unchanged. As a result, utility maximization is tantamount to expected income maximization. The perfect-markets or wage-driven neoclassical model may be viewed as a special case of the Todaro model, in which the probability of employment at migrant destination (and origin) equals one.

The power of the Todaro model is its ability to explain the continuation and, frequently, acceleration of rural-to-urban migration in the face of high and rising urban unemployment. Its salient departure from perfect-markets neoclassical models is that it does not assume the existence of full employment; hence, a higher wage or income in the urban sector than in the rural sector is not a sufficient, or even necessary, condition for migration. In an environment of high unemployment, this wage or income is conditional upon the migrant's success at securing a job. A high (e.g., institutionally set) urban wage coupled with a low probability of obtaining a job at that wage may result in an expected wage that is lower in urban than in rural areas where the conditional wage is low but the likelihood of employment is high. Conversely, high rural

unemployment will make a given expected urban wage more conducive to promoting migration. Increases in urban employment (e.g., resulting from government-sponsored jobs programs) may increase urban unemployment rates through migration, and a rise in the urban minimum wage may reduce output in both the urban and rural sectors while increasing urban unemployment [Harris and Todaro (1970)].

Because this is characterized as a dynamic problem, migrants may perceive a low probability of urban employment initially [and queue for urban jobs; see Fields (1975)] but anticipate an increase in this probability over time, e.g., as they broaden their urban contacts. Contacts with family or friends in urban areas prior to migration (i.e., migration networks) may stimulate migration by shortening – or perhaps eliminating – the initial queuing period.

Although originally cast in the context of rural-to-urban migration, the Todaro model is also applicable to international migration [e.g., see Todaro and Maruszko (1987)].

Despite what has proven to be a seminal contribution to understanding determinants and impacts of rural out-migration, the Todaro model makes a number of restrictive assumptions. Some of these have been a focus of considerable subsequent research. They include:

(1) the assumption that urban job allocation follows a simple lottery mechanism;
(2) neglect of the competitive informal sector, which acts as a sponge for surplus labor;
(3) the assumption of a rigid urban-sector wage;
(4) the (perhaps unreasonable) time horizons and discount rates required to equate the present values of expected urban and rural incomes [e.g., see Cole and Sanders (1985, p. 485)]; and
(5) the omission of influences, besides expected income, that shape potential migrants' decisions and also their potential impacts on rural economies [Williamson (1988)].

It has been observed that, in LDCs, while nominal urban wages are typically 50 to 100 percent higher than nominal rural agricultural wages, urban unemployment rates typically are less than 10 percent. Thus, the rate of urban unemployment does not appear to reconcile the urban-rural wage differential; i.e., migration does not appear to equilibrate expected incomes across sectors [Rosenzweig (1988)]. In addition to overstating urban unemployment rates, the Todaro model almost certainly overstates the costs of migration for rural, migrant-sending areas. Neither this nor more traditional neoclassical migration models can explain temporary migration or the substantial flow of income remittances from migrants to their places of origin.

Assumption (5) is arguably the most restrictive and far-reaching of the assumptions and the one upon which much of the most recent research on migration and rural population has focused. It is the focus of the most recent wave of literature on migration determinants and impacts, which has become known as the new economics of labor migration (see below).

1.4. Human capital theory and migration

The essentially macro perspective embodied in both the classical and neoclassical migration models presented earlier leaves unanswered a fundamental question: Why do

some individuals migrate while others do not? More critical from a rural welfare point of view, what distinguishes the labor "lost" to migration from that which remains in the rural sector? Differences in wage rates and in the returns to migration may be explained largely by differences in skill-related attributes across workers, including experience and schooling.

As presented above, the classical and neoclassical migration models offer few insights into the question of migrant selectivity. In a Lewis world, when capital accumulation in the modern sector shifts the marginal value product curve outward, increasing the quantity of labor demanded at the prevailing urban wage, some reserve labor from rural areas is assumed to migrate to the modern sector and fill this excess demand. However, we do not know who these migrants are, or what distinguishes them from those who do not migrate. In the demand-driven, classical world of infinite labor supply, urban jobs must be rationed among redundant members of the rural population according to some rule that is left unclear in the Lewis model. Migrants presumably are individuals possessing specific characteristics on the basis of which modern-sector jobs are rationed out. For example, if urban construction jobs in Mexico City or farm jobs in California hire only agile, strong young men, only this demographic group will respond to new labor demands by migrating. Nevertheless, the supply of labor, even for this specific group, is assumed to be infinite at the prevailing wage in a Lewis-type model. In this way, a Lewis demand-driven migration model almost invariably begs the question of migrant selectivity.

The same problem potentially arises in an aggregate, wage-driven neoclassical model and in the Todaro expected-income model. Presumably, the individuals who migrate are those for whom the urban-rural wage (or expected earnings) differential is largest and/or for whom migration costs are lowest.

A well-developed literature addresses the question of migrant selectivity in the neoclassical and Todaro worlds by merging migration theories with human capital theory, arising from the early work of Mincer (1974), Becker (1975), and others. Human capital models of migration represent an effort to provide the migration theories presented above with a micro grounding, permitting tests of a far richer set of migration determinants and impacts.

In the perfect-markets neoclassical version of the human-capital migration model [e.g., Sjaastad (1962)], wages at prospective migrant origins and destinations are assumed to be a function of individuals' skills affecting their productivity in the two sectors. In a Todaro model, human capital characteristics of individuals may influence both their wages and their likelihood of obtaining a job once they migrate. In both types of model, characteristics of individuals may also affect migration costs (and the rate at which future urban-rural earnings differentials are discounted).

The human capital view of migration has the key implication that the types of individuals selected into migration are those for whom, over time, the discounted income (or expected-income) differential between migration and nonmigration is greatest and/or migration costs are lowest. As Todaro (1980) pointed out:

> "Migrants typically do not represent a random sample of the overall population. On the contrary, they tend to be disproportionately young, better educated, less risk-averse, and more achievement oriented and to have better personal contacts in destination areas than the general population in the region of out-migration."

Human capital migration theory produces a number of testable hypotheses. First, because this is a dynamic model, the young should be more mobile than the old, inasmuch as they stand to reap returns from migration over a longer period of time. Second, migration between locales should be negatively related to migration costs. This has been interpreted by many researchers as implying a negative association between migration flows and distance. However, considerations besides distance (especially access to information) may make distance less of a deterrent for some individuals (e.g., better-educated individuals or those with "migration networks", contacts with family or friends at prospective migrant destinations). Third, as Rosenzweig (1988) points out, neutral productivity growth in an economy – e.g., equal rates of growth in the rural and urban sectors – will increase migration from low-income (e.g., rural) to high-income (e.g., urban) sectors or areas. Fourth, specific human capital variables that yield a higher return in region A than in region B should be positively associated with migration from B to A. In addition to these predictions, human capital theory implies that income (or, in the Todaro case, expected income) differentials between rural and urban areas are eliminated by migration over time.

1.5. The new economics of migration

Continuing interactions between migrants and rural households suggest that a joint-household model would be more appropriate than an individual-level model of migration decisions. However, a joint-household model has difficulty explaining why the entire family does not move if expected incomes are higher in the urban sector, why higher-income migrants would remit income to lower-income relatives at the place of origin, or why – as has been found in some national studies – migrant remittances, while positively related to migrant earnings in urban areas, are not negatively related to the pre-transfer income of the rural household of origin. One is also left with the puzzle of why geographically extended families are prevalent in LDCs but less so in high-income countries [Rosenzweig (1988)], and the troubling assumption that households can be characterized by a single utility function and budget constraint.

The fundamental view of the new economics of labor migration is presented in Stark (1991) and Stark and Bloom (1985). Rather than being entirely the domain of individuals, migration decisions are viewed as taking place within a larger context – typically the household, which potentially consists of individuals with diverse preferences and differential access to income and is influenced by its social milieu. The perspective that migration decisions are not taken by isolated actors but by larger units of related people, typically households or families, is a trademark of the NELM. So is the contention that people act collectively not only to maximize income, but also to minimize risks and loosen constraints created by a variety of market imperfections, including missing or

incomplete capital, insurance, and labor markets. Finally, the effect of income on utility may not be the same for a given actor across socioeconomic settings, which motivates the relative deprivation theory of migration discussed below.

Stark (1982, 1978) argues that an implicit contractual arrangement exists between migrant and household. An LDC farm household wishing to invest in a new technology or make the transition from familial to commercial production lacks access to both credit and income insurance. By placing a family member in a migrant labor market, such a household can create a new financial intermediary in the form of the migrant. Rural households incur the costs of supporting migrants initially. In turn, once migrants become established in their destination labor market, they provide their households with liquidity (in the form of remittances) and with insurance (because of a low correlation between incomes in migrant labor markets and farm production; indeed, the correlation between remittances and farm production may be negative, as when migrants respond to crop failure by increasing the share of earnings they remit). Mutual altruism reinforces this implicit contract, as do inheritance motives (i.e., nonremitting migrants stand to lose their rural inheritance) and migrants' own aversion to risk, which encourages them to uphold their end of the contract in order to be supported by the rural household should they experience an income shock (e.g., unemployment) or other misfortune in the future. Anthropological research [e.g., Fletcher (1997), Rouse (1991)] points to the importance of rural households-of-origin as refuges for migrants who fall ill or suffer other sorts of misfortune (e.g., trouble with the law, substance dependence, etc.) that prevent them from working or residing at the migrant destination for extended periods of time.

Migration, while enabling families to spread their labor across sectors, may promote rural population growth by creating fertility incentives, as well. The role of grown children as migrants adds a new benefit to having children in rural areas; i.e., the future role of migrant children in facilitating production transformation, reducing family income risk, etc. No empirical research has attempted to test this migration-fertility link. However, Rosenzweig and Evenson's (1977) finding that children's wages significantly increased fertility in rural India suggests that a positive effect of migration on children's future earnings would have a similar effect.

NELM motives for migration, together with the post-migration resource transfers they imply, are likely to be of greater importance in less developed countries than in developed economies. The lack of a modern communications infrastructure in LDC rural areas makes information sparse and its acquisition costly. Asset markets that function relatively well in modern economies may be completely lacking in LDCs (futures markets and crop insurance are striking examples, but rural credit markets often are missing or incomplete, as well). Because of this, NELM research on rural out-migration has focused almost exclusively on LDCs.

Stark (1982) expounds migration's role as an intermediate investment that facilitates the transition from familial to commercial production. It performs this role by providing rural households with capital and a means to reduce risk by diversifying income sources. Lacking access to credit and income insurance outside the household, households self-

finance new production methods and self-insure against perceived risks to household income by investing in the migration of one or more family members. That is, market imperfections in rural areas – not the distortions in labor markets emphasized by Todaro (1969) – are hypothesized to be a primary motivation for migration.

Stark and Levhari (1982) use a graphical presentation to argue that migration is a means to spread risk, rather than being a manifestation of risk-taking behavior on the part of migrants. Stark and Katz (1986) formalize the argument that rural–urban migration, a labor-market phenomenon, is caused by imperfections in capital markets.

The spectrum of factors influencing migration decisions extends beyond the household. A household's income position vis-à-vis its reference group (e.g., the village) also influences its behavior, including migration. Stark (1984) and Stark and Yitzhaki (1988) present a relative deprivation model of migration, in which the household's objective is to maximize utility which, in turn, is a negative function of relative deprivation, or the bundles of goods of which the household is deprived within its reference group. In this model, a given expected income gain from migration does not have the same effect on the probability of migration for households situated at different points in the rural income distribution, or in communities with different income distributions. From a broader perspective, mean-preserving increases in rural income inequalities, to which migration would be completely immune in a Todaro model, may stimulate migration by increasing relative deprivation. By operationalizing the relative deprivation concept, Stark and Taylor (1989, 1991) test the importance of relative versus absolute income considerations in internal and international migration decisions by rural Mexican households (see Section 3).

Because skill-related attributes of individual family members influence the costs and benefits of migration for households, as well as for individuals, human capital theory has been incorporated into NELM models. However, the household perspective implies critical interactions between individual and household variables, including assets and the human capital of household members other than the migrants. These variables influence the marginal cost of migration for households (including the marginal effect of migration on farm production), as well as the impacts of remittances and the income insurance provided by migrants on the expected utility of the household as a whole.

The NELM perspective leads to significantly broader arenas for potential impacts of migration upon rural economies, for policy interventions to influence migration, and for the potential list of variables influencing migration decisions. A number of key implications of NELM models differ sharply from those of neoclassical migration models. First, contrary to both classical and neoclassical theories, the loss of labor to migration may increase (rather than decrease or, in the case of Lewis, leave unchanged) production in rural economies, by enabling households to overcome credit and risk constraints on production. Second, a positive income (or expected income) differential between urban and rural areas is not a necessary condition for migration. Migration in the presence of a negative urban-rural income differential is consistent with the NELM (provided that the variance of urban incomes and/or income covariance between the two sectors is sufficiently low). Third, the individuals who migrate are not necessarily those whom

a traditional human capital model would predict; the impact of an individual's outmigration on the productivity of other family members also matters. Moreover, while constituting a motivation for migration, imperfections in capital and insurance markets also may constrain migration, resulting in the seeming paradox that increases in rural incomes (which enable households to self-finance migration costs and self-insure against migration risks) may promote, rather than impede, migration [e.g., see Schiff (1996)]. Fourth, equal expected income gains from migration across individuals or households does not imply equal propensities to migrate, as predicted by a Todaro model, when risk and/or relative income considerations also influence migration decisions. From a migration policy point of view, the NELM shifts the focus of migration policy from intervention in rural or urban labor markets to intervention in other (most notably, rural capital and risk) markets, in which an underlying motivation for migration is found.

The progression of migration theory from the relatively simple, perfect-markets neoclassical model to NELM models involves both increasing complexity and more generality in how we think about migration determinants and impacts. Just as the wage-driven neoclassical model is a special case of the Todaro model, both may be viewed as special cases of NELM models, in which some or all market constraints that influence migration are nonbinding (e.g., households are risk-neutral or have access to efficient insurance markets), relative income considerations do not affect utility, and the effect of household variables on migration are negligible.

2. The analysis of migration determinants

Each of the migration theories outlined above implies a different objective function underlying migration decisions, a different set of potential variables shaping these decisions, and a distinct set of possible outcomes of migration for the rural economy. The most fundamental distinction concerns the unit of analysis. The classical and neoclassical (including Todaro) models treat migration as the result of an individual decision-making process. The objective function varies, but in all cases the individual is both decision maker and actor. On a micro level, this genre of migration research treats migration as a discrete choice (although potentially it could be represented as a continuous but limited variable, ranging from zero – no migration – to T – the maximum amount of time the individual has available for migration and nonmigration activities). In aggregate-level analyses, which represent the majority of empirical applications, the decisions of individuals are summed up into migration flows across space, and the migration (dependent) variable then becomes continuous.

In contrast to classical and perfect-markets neoclassical models, NELM models consider the family or household as the unit of analysis; family members are assumed to act collectively to maximize expected income and also to loosen constraints associated with missing credit, insurance, and other markets. Because of this, the NELM perspective fits neatly with the literature on agricultural household models, both neoclassical [e.g., Barnum and Squire (1979), Singh et al. (1986)] and in the context of missing

or incomplete markets [Strauss (1986), De Janvry et al. (1991)]. Methodologically, the NELM approach, with its focus on risk and market imperfections, requires the use of simultaneous, rather than recursive, farm household models to analyze both the determinants and impacts of rural out-migration. Nash-bargained household models [e.g., McElroy and Horney (1981)] also are potentially useful to analyze the implicit contractual relationship between migrants and family members who do not migrate. The NELM posits a role for variables hitherto ignored in the migration literature – especially relative-income considerations – as influencing household utility and thus migration decisions.

Migration decisions are inherently dynamic, shaped by a future stream of expected costs and benefits (appropriately discounted). Individuals or households may rationally choose to participate in migration even if the short-run expected utility gain from doing so is negative, provided that the discounted future gains are positive and sufficiently large. Few studies explicitly model migration as a dynamic phenomenon [for an exception, using aggregate country data, see Larson and Mundlak (1997)]; usually, the problem is treated as static. The theoretical complexity of introducing dynamics without oversimplifying the objective function or constraint set confronting migration decision makers, together with the paucity of longitudinal data, has discouraged the development of truly dynamic migration models.

At either the individual or household level of analysis, the most general objective considered in the migration-decision literature is to maximize a Von Neuman-type expected utility function of the form

$$EU = E\big[U(W, Z)\big], \tag{2}$$

where W denotes a vector of end-of-period consumption goods, Z is a vector of other variables posited to influence family utility, and E is the expectation operator. The utility function $U(\cdot)$ is defined for an individual in the case of the Todaro or straight neoclassical migration models. In a NELM model, it represents family utility, involving some kind of weighting of utilities of individual family members, including migrants and nonmigrants. In every NELM application to date, it has been assumed that family preferences can be represented by a single utility function, and income is pooled within households to define a single family or household budget constraint, as in a standard agricultural household model.

Expected utility is maximized subject to a set of constraints. In all models these include a budget constraint; in most, the primary or sole influence of migration on individuals or households operates through this constraint. Other constraints include an individual or family time constraint, and, in NELM models, production technologies and market (e.g., subsistence) constraints. In models where end-of-period income is not known but consumption decisions may be altered ex post, the vector of consumption goods in the utility function is often replaced by income or wealth, as in most of the risk and uncertainty literature. Such a simplification is usually not appropriate, however, when one or more markets are missing – for example, when perfect hired-labor substitutes are not available to compensate for family leisure demand, or when the household

faces a subsistence constraint resulting from a missing staple market, so that consumption decisions cannot be altered contingent upon income outcomes.

Each of the broad theoretical approaches presented earlier may be considered as a special case of this general expected-utility maximization model. David (1974) takes the individual as the unit of observation, represents utility as a function of wealth alone, and then approximates Equation (1) by its second-order Taylor series expansion around mean wealth. This yields the following expression for (approximate) expected utility of income associated with migration:

$$EU_m \approx U(\overline{W}_m) + 0.5U''E(W_m - \overline{W}_m)^2, \tag{2'}$$

where U'' is the second derivative of utility with respect to wealth (significantly, the numerator in the Arrow–Pratt index of absolute risk aversion). Assuming that the non-income component of end-of-period wealth is known with certainty, the squared term in parentheses can be replaced by the income variance, s^2. Letting EU_r (similarly approximated) denote expected utility of wealth if the individual does not migrate (i.e., remains in the rural sector), migration is observed if $EU_m > EU_r$.

Both the Todaro model and the standard neoclassical migration model can be viewed as special cases of the expected utility-maximization problem just presented. If one assumes that individuals are risk neutral (or, equivalently, that income variance is zero), the decision rule implied by Equation (2) collapses to the familiar Todaro migration rule, in which migration is observed if

$$p_m w_m > E[Y_r], \tag{3}$$

where w_m denotes the urban-sector wage and p_m is the probability that a prospective migrant will obtain a job at this wage.

At full employment, $p_m = 1$, and the migration rule in (3) reduces further to the simple neoclassical rule: Migrate if

$$w_m > w_r, \tag{4}$$

where w_r denotes the rural wage. Both Todaro and neoclassical migration rules usually recognize that there are migration costs and include a term to reflect this.

Expression (4) represents the migration probability equation underlying much of the econometric research on rural out-migration and farm labor migration in both LDCs and high income countries. For example, it is the foundation for Perloff, Lynch and Gabbard's (1998) and Emerson's (1984) studies of seasonal agricultural worker migration in the United States. It is also the starting point for all 12 studies of internal migration in LDCs examined in Yap's (1977) review and a large number of subsequent tests of the Todaro expected-income hypothesis [e.g., Knowles and Anker (1975), House and Rempel (1976), Hay (1974), Schultz (1975), Carvajal and Geithman (1974)].

2.1. NELM models

NELM variants of the general migration model take many forms, depending on the focus of the analysis. In most studies, the underlying objective function is implied rather than explicitly spelled out. A household variant of David's model, in which families allocate individual members' time to migration and nonmigration work in a series of discrete choices, appears in Taylor (1986). Household portfolio models of migration also appear, explicitly or implicitly, in Rosenzweig and Stark (1989), Stark and Katz (1986), and Stark and Levhari (1982).

A fundamental difference between individual and household migration models is that, in the household approach, individual family members' labor time is allocated between migration and nonmigration work so as to maximize household expected utility, which may be a function of both the expected value and variance of end-of-period household wealth (and, in the relative deprivation approach, a function of the incomes of other households, as well). Thus, household variables shaping both the first and higher moments of income – including the human capital characteristics of all family members and family assets – figure prominently in the migration decision, together with the human capital of the prospective migrants themselves. In this approach, as in any portfolio-allocation model, maximizing expected income does not necessarily imply allocating each family member's labor time to the market or activity in which her expected earnings or contributions to household income are highest. Risk also matters.

In an agricultural household model, the opportunity cost of migration is the loss of net income from production resulting from the allocation of a marginal unit of family time to migration. Here, migrant selectivity clearly matters to household welfare: the human capital embodied in migrants is likely to complement other family resources in production. Assuming decreasing returns to labor in farm production, the opportunity cost of migration increases with the amount of family time allocated to migration. However, the loss of highly productive family labor to migration may shift the marginal labor product curve leftward, lowering the opportunity cost of migration for the remaining family members. If, on the other hand, migrants act as financial intermediaries for the household, over time they may promote investments that shift the marginal labor product curve back to the right, discouraging future migration. The interplay of lost labor and investment effects of migration is the focus of some of the empirical NELM research presented in Section 3.

Because maximizing utility of expected income is analogous to maximizing expected income itself (given monotonicity of the utility function), household migration models that do not explicitly address risk are treated as expected income-maximization models. Such is the case in Taylor (1987). A model of household expected-income maximization subject to both labor and liquidity constraints is implied by Lucas' (1987) study of migration to South African mines and Taylor's (1992) and Taylor and Wyatt's (1996) studies of marginal income and distributional effects of migration and remittances in rural Mexico. In these models, migration [or, in Lucas (1987), wage work including migration] appears as a continuous variable – family labor time allocated to migration

work. Migration and remittances in turn produce feedback on the rural economy, both negative (through lost labor effects) and positive (through loosening of liquidity constraints on farm investments). These models highlight the importance of rural market imperfections in shaping both the motivations for migration and the impacts of migration on rural economies.

As indicated earlier, treating migration as a (limited) continuous variable is not necessarily outside the domain of individual-choice migration models; even for an individual, migration may be like the incomplete adoption of a new technology (in this case, a labor-market technology), with an individual spending part of the year as a labor migrant and the rest of the year on the farm. Nor must one necessarily take a household-level approach to examine feedback of migration on farm production. An individual farmer may find it optimal to engage in migration for part of the year (or, in a dynamic model, for one or more time periods) in order to obtain liquidity needed to invest in farm production (creating a new future stream of farm income). Such models would represent a new twist on NELM.

In practice, the association of NELM effects with household models of migration is motivated by the observation that families in LDC rural areas typically engage in migration by sending one or more members off as migrants (frequently, sons and daughters of the household head), who then share part of their earnings with the rural household, through remittances. While some family members migrate, others stay on the farm.

This observation raises the question of why migrants remit. Classical or neoclassical models of migration behavior do not explain the remitting of a (frequently large) share of migrant earnings back to the rural place of origin. However, remittances are a cornerstone of the NELM, representing one of the most important mechanisms through which determinants and consequences of migration are linked.

The NELM view that migration entails an implicit contract between migrant and household suggests a venue for collective models of household behavior [e.g., Bourguignon and Chiappori (1992)], including game theoretic approaches, and the role of altruism in shaping both migration and remittance behavior. In a Nash-bargained rural household [e.g., McElroy and Horney (1981)] containing migrants, household utility might be represented by the product of net utility gains deriving from household membership for migrants and other household members. Migrants' utility as nonmembers of the household – that is, the utility they would enjoy by severing their ties with the household – represents the threat point in this game. The more insecure that migrants perceive their future prospects outside the household, the smaller this threat point, the less likely migrants will sever ties with the household, and the more income migrants will remit, other things (including migrant earnings) being equal. While a model of pure altruism would predict a negative association between migrant earnings and rural-household wealth, a game-theoretic model would predict just the opposite, particularly if the migrant stands to inherit all or part of this wealth. In short, the greater the migrants' threat point, the greater the likelihood that migrants sever their ties with their rural households, and the lower remittances are likely to be. The lower the migrants' threat point (i.e., the stronger the relative bargaining position of the nonmigrant family members), the lower

the probability of migrants severing ties with their rural households, and the higher remittances are likely to be. This type of game theoretic perspective underlies Lucas and Stark's (1985) analyses of remittance behavior in Botswana (see Section 3), and a Nash-bargained household model appears explicitly in Hoddinott's (1994) study of rural out-migration in western Kenya. Contrast these with the overlapping utility function used by Funkhouser (1995) and the more conventional, homogeneous household-farm models underlying Taylor (1992, 1986), which do not imply a game-theoretic dynamic between migrant and household. A model of reciprocal altruism between generations underlies Tcha's (1996) novel and provocative work on rural-to-urban migration in Korea and the United States.

2.2. *Estimation of migration models*

Techniques used to estimate models of migration have evolved considerably over the last two decades, due as much to the development of new econometric methods as to advances in migration theory. All of the studies covered by Yap's (1977) then-exhaustive review of the migration literature and all but two of the studies referenced in Todaro (1980) used a basic, aggregate migration function of the following form:

$$M_{ij} = f(Y_i, Y_j, U_i, U_j, Z_i, Z_j, d_{ij}, C_{ij}) \tag{5}$$

the variables in which are defined as follows:

M_{ij}	Total migration flow from place i to place j (sometimes expressed as a net flow or a share of population at place i)
$Y_i(Y_j)$	Average wage or income level at place i (at place j)
$U_i(U_j)$	Unemployment rate at place i (at place j)
$Z_i(Z_j)$	Degree of urbanization of the population at place i (at place j)
d_{ij}	Distance between place i and place j
C_{ij}	Friends and relatives of residents of i at destination j (a migration network variable)

Populations at places i and j were often included as explanatory variables, as well.

Studies based on Equation (5) take either of two general forms: symmetrical and asymmetrical. In symmetrical models, explanatory variables appear as differences or ratios between regions; e.g., the income variable is Y_i/Y_j, or $Y_i - Y_j$. This constrains the effect on migration to be the same for changes in origin-region variables as for changes in destination-region variables. Implicitly, this approach appears to make some rather valiant assumptions, including perfect information in labor markets such that migrants are just as responsive to changes in labor markets at distant destinations as in the origin labor markets they presumably know well. In a less restrictive approach, explanatory variables for the two regions are included separately; e.g., both Y_i and Y_j appear as right-hand side variables in the migration regression equation. This permits explanatory variables' effects on migration to be asymmetric between regions. Fields

(1979) tests the sensitivity of findings on interregional migration in Colombia to the use of a symmetric versus an asymmetric model specification.

The aggregate specification above has the advantage of being easily estimated using ordinary least squares and aggregate census data available in many countries. However, it has a number of limitations that seriously limit its usefulness for prediction and for policy analysis [some of these are spelled out in Stark (1982)]. In general, the estimated coefficients of aggregate migration regressions do not represent estimates of the structural relationships implied by micro, human capital models. The exception is when a population is homogeneous, in which case average income measures the income an individual would receive in each region. This assumption usually is untenable; indeed, much of the richness of both the findings and policy implications of recent microeconometric migration research (Section 3) results from the heterogeneity among individuals – both migrants and nonmigrants – within regions. Another complication, which follows directly from Todaro's theoretical model, is that employment rates, while posited to influence migration, are, in turn, affected by migration. Endogeneity bias in the unemployment variables raises serious questions about the validity of most aggregate studies' findings. Very few researchers either consider or attempt to correct for this problem. Notable exceptions include Fields (1979), who resorts to a reduced-form migration equation, and Hunt and Greenwood (1984), who explicitly control for feedback of U.S. interstate migration to local labor markets.

The availability of new, micro data on individuals and households containing information on migration, together with advances in econometric techniques to analyze these data, opened up vastly improved avenues for empirical migration studies. As Stark and Bloom (1985) point out, the econometric techniques that have most profoundly influenced migration research include methods to estimate limited dependent variable models, methods to correct for sample selection bias, and techniques to analyze longitudinal and pseudo-longitudinal data.

At the level of the individual, migration usually entails a discrete, dichotomous or polychotomous choice. At the household level, time allocated to migration is a continuous variable; however, it is censored at zero (and also upward, at the family's total time endowment). Analysis based on the estimation rules presented earlier requires either a reduced-form approach, in which income or expected-income terms are replaced by a vector of exogenous (i.e., human-capital) variables, or else direct estimation of structural income variables. The reduced-form approach has been used in a number of studies utilizing probit or logit estimation techniques [e.g., see Taylor (1986), and Emerson (1984)]. These studies test important hypotheses concerning rural migration behavior. However, they have the drawback that structural income variables do not appear in the estimated migration equation, seriously limiting the usefulness of the model for policy analysis.

Estimation of structural income terms is complicated by the fact that individuals and households select themselves into and out of migration, presumably according to their comparative advantage in these activities. Data on migrant earnings or remittances are censored because they are observed only for those who migrate. Similarly, nonmigrant

earnings are generally not available for those who are selected into migration. Because the migration selection process is endogenous, shaped by many of the same characteristics that determine earnings in each regime, average migrant earnings may not reflect what nonmigrants would earn if they migrated, and nonmigrant earnings may be a poor indicator of what migrants would earn if they did not migrate. This sample selectivity problem is identical to selectivity problems frequently encountered in the labor literature [e.g., Lee (1978), Heckman (1974), Willis and Rosen (1979), Dickens and Lang (1985), a useful review of estimation techniques for models involving selectivity is available in Maddala (1983)].

Multinomial logit, probit, tobit, two-stage (Heckman), and various maximum-likelihood techniques for estimating discrete-continuous models, not available or accessible two decades ago, today are widely used to estimate migration-decision models at a micro (individual or household) level. Recent examples include Perloff et al. (1998), Emerson (1989), Taylor (1987, 1992), Stark and Taylor (1989, 1991), Lucas and Stark (1985), and Barham and Boucher (1998).

2.3. *Human capital variables in migration models*

Human capital variables are incorporated into the analysis of individual migration decisions by expressing earnings and expected earnings in (2) through (5) as functions of individuals' socio-demographic characteristics. The models may then be estimated either in reduced form, by expressing migration probabilities as a function of exogenous individual (and household) characteristics, or else in their structural form, by obtaining estimates of relevant income and risk variables and subsequently including these in the migration equation. The second approach is considerably more complicated from a modeling point of view. However, it has the advantage that structural variables shaping migration decisions often are of greater analytical and policy interest than are the exogenous variables appearing in the reduced-form equation. The exogenous variables may also appear in the structural equation, making it possible to isolate direct from indirect (through the income and risk variables) of these variables on migration using the structural approach.

2.4. *Data limitations and rural wages*

Largely because of data limitations, explicit analysis of the role of uncertainty in shaping migration decisions (as in expression (3)) is not found in the literature. At the level of the individual, longitudinal data on migrants' wages and employment at their destination for estimating variances of migrant earnings are generally unavailable. Data on employment and wages in rural areas for individuals across time are also rare. Contemporaneous income variances may be estimated using cross-sectional data, e.g., by employing the approaches for estimating production risk proposed by Just and Pope (1977), Antle (1983), and others, provided that income outcomes are available for both migrants and nonmigrants and measures are taken to correct for potential sample-selection bias.

The migration decision may then be treated as analogous to the choice of production technique in which returns under alternative technologies are modeled following a Just–Pope specification [Taylor (1986)].

Conceptual difficulties with modeling rural wages further complicate the analysis. Much of the rural workforce, including many prospective migrants, do not receive a wage income, but rather, are involved in some sort of agricultural-household production. In these cases, the rural wage in the models above must be replaced by a "shadow" wage, as in farm-household models with missing labor markets [e.g., De Janvry et al. (1991), Singh et al. (1986)], or by expected earnings imputed from this shadow wage. For an individual, earnings imputed at the shadow wage represent the net income from rural production foregone by migrating out of the rural sector. For a household, it is the net loss in income from rural production suffered as a result of the out-migration of a family member. The observed wage of rural wage earners may not accurately reflect this income loss unless hired and family labor are perfect substitutes. [For a discussion of the substitutability of family and hired labor see Bardhan (1988).] Despite this limitation, the rural wage, multiplied by days worked on the family farm, is generally used as a proxy for the opportunity cost of migration in studies where individuals are the unit of observation. In household models, an approach involving estimation of income functions with and without migration is used, correcting for selectivity of migration [Barham and Boucher (1998), Taylor (1992),Taylor and Wyatt (1996)].

The use of rural wages is not likely to pose a problem in studies of rural labor migration in developed countries, where few labor migrants are engaged in household-farm production prior to migration. For example, in studies of US farm labor migration, observed earnings of migrants and nonmigrants are used [e.g., Perloff et al. (1998), and Emerson (1989)]. Nevertheless, because individuals are not randomly selected into these two groups, these, like studies of rural out-migration in LDCs, must test and correct for potential sample selection bias.

3. Rural out-migration: Empirical evidence aud evaluatiou of migration theories

The empirical literature on determinants of rural out-migration is vast and spans a broad range of disciplines. Few studies, however, offer a basis to reliably test central hypotheses derived from the migration theories presented in Sections 1 and 2, above. Empirical research is hampered by high levels of aggregation, the absence of appropriate controls, a lack of micro data sets containing information on the array of variables required to estimate neoclassical and especially NELM migration models, and unreliable survey designs. Remarkably, information on migration and remittances is absent from nearly all household-farm surveys, making it impossible to estimate even the simplest migration decision model. Given advances in migration theory and in econometric estimation techniques over the past two decades, data limitations currently are the major constraint on empirical migration research. Only in relatively few cases have advances in migration theory informed the collection of new household-farm data. As a result, tests of

some of the most important and far-reaching propositions concerning migration and rural economies rest on a rather thin body of empirical literature.

Despite the potential richness of micro-level econometric analysis based on the migration decision rules presented earlier, most applied research has involved the estimation of aggregate migration functions of the general form of Equation (6). Wages and employment rates are included as regressors, but rarely is the Todaro expected-income term (the product of these two variables) included, and in even fewer cases is both a Todaro expected income term and a wage term included as a basis for testing the central hypothesis of a Todaro, versus a traditional neoclassical, model.

Results of econometric analyses of aggregate migration flows from LDC rural areas generally support both neoclassical and Todaro expected-income migration theories. [E.g., see reviews by Yap (1977), and Todaro (1980), Fields (1979), Schultz (1982).] That is, in most cases, differentials in average wages or incomes between regions are significant in explaining migration flows in the expected direction. When differences in unemployment rates, the Todaro proxy for job probability, are also included, they typically have independent explanatory power. In the few studies reporting direct tests of the Todaro expected income hypothesis, i.e., including both an expected wage variable and wages as regressors, the expected wage term comes out to be significant [e.g., see Barnum and Sabot (1975) for Tanzania, Levy and Wadycki (1974) for Venezuela, House and Rempel (1976) for Kenya, and Fields (1979) for Colombia].

During the 1960s, there was an average of one million rural–urban migrants in the United States each year, and migrants and their children were involved in disturbances associated with civil rights protests in major U.S. cities. Many leading agricultural economists set out to examine the determinants and effects of rural–urban migration. The 1960s witnessed an explosion of aggregate-level research on farm labor migration and rural–urban labor market linkages, perhaps best exemplified by the studies in Bishop (1967, p. 6) and in the report to the President's National Advisory Commission on Rural Poverty (1967). The sharp divergence in incomes between the farm and nonfarm sectors was attributed to "the failure of the labor market to transfer sufficient quantities of manpower from farms" [Bishop (1967), p. 6]. This view motivated research aimed at estimating, and designing policies to increase, the elasticity of labor supply from farms to the nonfarm sector, while recognizing social costs associated with rural out-migration, particularly for rural areas.

Schuh (1962), in a pioneering study that anticipated Todaro (1969), found econometric evidence that increases in expected nonfarm income, either through a reduction in unemployment or an increase in wages, resulted in large shifts in farm labor supply to the left. He also found that farm incomes could be raised, although not greatly, by price support programs and that education positively affected farm incomes, both by accelerating migration and by raising the productivity of the labor force remaining in agriculture.

Echoing Lewis while also suggesting impediments to mobility out of agriculture, Jones and Christian (1965, p. 524) argued that "the redundant supply of labor in agriculture ... is perpetuated by a lack of opportunity in alternative occupations. Agricultural

labor is 'trapped' in the 'other America' ". Others [e.g., President's National Advisory Commission (1967), also see papers in Heady (1961)] suggested that the rate of rural out-migration may have been excessive. The movement of people out of agriculture potentially creates social costs. Maddox (1960) classifies the costs of rural out-migration into three categories: those falling on the migrants themselves; those borne by the communities from which migrants move; and those affecting the communities to which migrants relocate. Maddox concluded that public action was warranted to offset negative externalities associated with out-migration from rural communities, particularly those related to human capital losses. Johnson (1960) cautions that one cannot say with certainty whether a reduction in farm labor will reduce total farm output; if it is associated with a move toward equilibrium, output may increase, while average earnings per farmworker may rise.

The President's National Advisory Commission on Rural Poverty (1967, p. 524) concluded that "the mass exodus from low income rural areas ... has meant that those left behind are often worse off than before". This conclusion reflects a partial-equilibrium view, i.e., that population decline creates a factor-market disequilibrium, reducing the incomes and welfare of those left behind. It ignores the equally plausible role of migration as an ameliorator of disequilibria (e.g., correcting a state of "too many farmers"). Gardner (1974), based on a two-stage least squares analysis of US census data, found that, during the 1960s, the rate of states' farm population loss was positively associated with the rate of growth of average rural-farm family income, and it had no adverse effect on rural nonfarm incomes. If off-farm migration created disequilibria and transitory income losses, it would appear that "the people left behind" were sufficiently mobile to adjust over the ten-year period covered by Gardner's study.

Carrying Schuh's analysis forward, Barkley (1990) found that economic growth resulting in rising returns to nonfarm relative to farm labor significantly explained the occupational migration of labor out of agriculture between 1940 and 1985. The elasticity of out-migration with respect to the ratio of nonfarm/farm average labor products (a proxy for wages) was estimated at 4.5. In contrast to Schuh (1962), however, controlling for this labor returns variable, Barkley found that urban unemployment did not deter labor migration, and the effect of agricultural policies (government payments to agriculture as a share of farm income) on labor migration from agriculture was insignificant. The decreasing effect of these unemployment and agricultural policy variables that were a focus of U.S. migration research in the 1960s probably reflects both that rural-to-urban migration had largely run its course by the end of the period considered by Barkley (1990), and that the principal source of labor for US agriculture had shifted from domestic to foreign.

Migration elasticities were also key inputs into some research on measuring the economic returns to labor-displacing agricultural research. Because many labor-saving agricultural innovations are developed with public funds at public institutions, the rural–urban migration induced by publicly funded research became an issue in the United States several times during the twentieth century. By releasing labor from agriculture, publicly supported research "saved" inputs. Schultz (1953) pioneered studies of the

value of inputs saved as a result of agricultural research, generating very high estimates of the rate of return to public research investments. Input savings of $10 billion in 1950 exceeded the cumulative $7 billion expenditures on agricultural research between 1910 and 1950 (in 1950 dollars).

However, if those displaced from agriculture are not re-employed in the higher wage nonfarm sector, and if the costs of these individuals' persisting unemployment are taken into account, estimated returns to agricultural research can fall sharply. Schmitz and Seckler in 1970 used the value-of-inputs-saved approach to measure the return to research on processed tomato mechanization. Based on the value of the hours of labor saved, they estimated in 1983 that the "gross" return to research expenditures was 929 percent to 1282 percent when the opportunity cost of funds was 6 percent. However, if it is assumed that displaced workers receive compensation equivalent to 50 percent of their previous wages, the return to tomato harvester research falls to between 460 and 814 percent. Richard Day (1967) noted that, if those displaced from agriculture wind up in concentrated poverty in cities, then efforts to speed up the diffusion of labor-saving innovations and to hasten migration may simply transfer rural poverty to urban poverty.

Schmitz and Seckler noted that compensation could be paid to displaced workers who migrated from rural to urban areas, making public investment in labor-saving agricultural research highly desirable nonetheless. However, there was no displacement compensation available for most farmworkers, who were excluded from many of the programs developed in the 1930s to cushion the effects of labor market adjustments, including unemployment insurance. In the late 1970s, when the United Farmworkers Union was at its peak strength, it sued the University of California over publicly funded mechanization research that displaced workers. The suit was settled out of court, but one result was that public funds spent on labor-saving research declined sharply [Martin and Olmstead (1985)].

In LDCs, the preponderance of aggregate studies found that the effects of employment-related variables generally equaled or exceeded those of wage-related variables [Massey et al. (1993, 1994, 1998); Schultz (1982) is one of the few exceptions]. For example, Maldonado (1976) found that differentials in both unemployment and wages significantly explained the volume of migration from Puerto Rico to the mainland United States, but the effect of the unemployment variable dominated that of the wage variable. Massey et al. (1994) re-estimated the Maldonado model, replacing the wage ratio with the ratio of expected wages (wages times employment probabilities). They found that unemployment rates still dominated the expected wage ratio in predicting out-migration to the mainland. Ramos (1992) and Castillo–Freeman and Freeman (1992) argue that displacement resulting from structural changes drives migration more than fluctuations in wages. An alternative explanation for the importance of the employment variable is suggested by Hatton and Williamson's (1992) excellent historical analysis of migration to the United States. They conclude that wage differentials shape the underlying propensity to migrate and drive long-term trends, but unemployment rates determine the timing of migration and thus are more important than wages in explaining year-to-year fluctuations in migration rates. Evidence that employment effects dominate wage-rate effects

is also provided by Straubhaar (1986) for migration from southern to northern Europe, and by Walsh (1974) for migration between Ireland and Britain.

The impacts of wage and employment-rate differentials on migration are not invariant across migration type. A body of econometric research on Mexico-to-U.S. migration flows lends support to the expected income migration model in explaining illegal and contracted-labor migration across borders. However, expected-income variables appear less effective at explaining legal migration. Most illegal-migrant and contracted (bracero) flows originate in rural Mexico. Jenkins (1977) modeled bracero and illegal migration (proxied by apprehensions) between Mexico and the United States between 1948 and 1972, finding that the Mexico–U.S. wage differential had a positive effect on both, as predicted by a neoclassical model. The wage effect was particularly strong when total (bracero plus illegal) migration was modeled. Blejer, Johnson, and Prozecanski (1978) extended this research by including legal migrants as well. The explanatory variables included the ratios of Mexico/U.S. unemployment, industrial wages, and agricultural wages. They found that the unemployment ratio was significant and of the expected sign, and most of the explanatory power of this variable came from variation in the Mexican unemployment rate. Controlling for this unemployment effect, relative wages did not significantly affect migration. The model performed considerably better for illegal than for legal immigrants, however. White, Bean and Espenshade (1990) found strong econometric evidence that both unemployment and wage ratios explain illegal Mexico-to-U.S. migration (measured by the log of monthly apprehensions) from 1977 through 1988. In an imaginative econometric analysis of Mexico-to-U.S. migration and trade in winter vegetables, Torok and Huffman (1986) found that both U.S. wages and unemployment rates significantly affected the U.S. demand for illegal immigrant workers (proxied by border apprehensions), while wages in Mexico significantly affected Mexico's supply of such workers.

Only two of the 18 studies reviewed by Todaro (1980) and Yap (1977) use micro-level, rather than aggregate, data. As indicated earlier in this chapter, the major difficulties in estimating micro-econometric models of rural out-migration stem not only from data deficiencies but also from potential problems arising from sample selectivity. The selection of individuals into and out of migration is endogenous, reflecting the comparative advantages of individuals and households in migration and nonmigration work [Taylor (1987), Emerson (1989)]. Econometric techniques are well developed and accessible to correct for such selectivity bias [e.g., see Maddala (1983), and Lee (1978)]. To correct for selectivity bias, typically an inverse-Mills ratio, obtained from a first-stage, reduced-form probit regression, is included in income or earnings equations for migrants and nonmigrants, following Heckman's (1974) two-step estimator. This selectivity-correction procedure, in addition to resolving selectivity bias, also yields insights into the relationship between expected returns from migration and individual or family migration decisions [e.g., see Emerson (1989), and Taylor (1987)] and differences in remittance behavior between migrant populations [Funkhouser (1995)].

Unfortunately, few surveys provide the data on earnings (or household-income contributions) of both migrants and nonmigrants required to implement selectivity-correction

techniques, and as a result, selectivity-corrected, structural models of migration decisions by individuals or households are rare. Notable exceptions are Emerson (1989), Robinson and Tomes (1982), Falaris (1987), Nakosteen and Zimmer (1980), Perloff et al. (1998), and Taylor (1987). All of these studies employ a "mover-stayer" human-capital migration model that controls for sample selection bias when estimating the economic returns from migrating. In contrast to aggregate migration models, which generally follow a Todaro specification, micro-econometric studies fall either into the "neoclassical" or "Todaro" category. For example, the agricultural labor migration studies of Emerson (1989) and Perloff et al. (1998) utilize expected earnings, which are shaped by both wages and employment, as their income variable, while Robinson and Tomes (1982) and Falaris (1987) use only wages.

Emerson (1989) provides an excellent example, in the context of U.S. agricultural labor migration, of how human capital theory, combined with micro data and appropriate econometric techniques for limited dependent variables and selectivity correction, yields insights not available from aggregate migration models. Employing a mover-stayer model, he offers micro-level support for the expected income model in a study of migratory labor and agriculture in the United States (Florida). Emerson first estimates separate earnings equations for migratory and nonmigratory work, correcting for sample selection bias. The estimated earnings in the two regimes are then used in a structural probit regression for migration. The results indicate that workers migrate for seasonal work in response to an expected wage differential favoring migratory work. Expected earnings for nonmigrant workers exceed those for migrant workers, and migrants are found not to have an absolute advantage in migratory work. Nevertheless, Emerson shows that individuals specialize in the type of work in which they have a comparative advantage. Because farmworkers' expected earnings are a function of both wages and employment, Emerson's model falls squarely into the Todaro theoretical framework.

Perloff et al. (1998) follow a similar approach in their econometric study of seasonal agricultural worker migration in the United States, using data from the National Agricultural Workers Study (NAWS) for 1989 through 1991. A novelty of this study is that it decomposes expected earnings into wages and employment, making it possible to examine the factors influencing each. Their findings support Emerson's (1989) conclusion that migration responds to expected earnings differentials across locales; however, the expected-earnings effect is small: employers must offer large earnings premia to induce workers to move. Earnings increases from migration are found to be due primarily to wage differentials, not to hours worked. Forty-eight percent of all seasonal farmworkers were found to migrate at least 75 miles in a given year.

Robinson and Tomes (1982), like the remaining studies in the above list, do not focus on rural migration; however, their study of interprovince migration in Canada is one of the earliest applications of a mover-stayer model to interregional migration, and it is instructive in illustrating the importance of selectivity effects when estimating returns from migration. They found that returns to migration were overstated when selectivity was not taken into account. Individuals who moved from place A to place B earned more at place B than people who stayed at A would have earned at B. Taking into account

selectivity, individual migration was found to depend significantly on potential wage gains. When selectivity was ignored, however, the wage effect became insignificant. Like most studies, Robinson and Tomes also found that, consistent with information theory, both language and education increased mobility of most groups. However, education reduced the mobility of Quebec francophones. The exclusion of employment variables limits this study's relevance for cases in which unemployment is a consideration at migration origins and/or destinations.

3.1. NELM models

A large and growing body of research offers both circumstantial and direct evidence supporting the NELM view that migration decisions take place within a family or household context and are influenced by families' efforts to overcome poorly functioning or missing risk and credit markets. Most of the NELM literature has been cast in the context of rural-to-urban migration. However, in light of relatively high wages available in developed countries (especially compared with LDC rural areas) and a low correlation between these wages and incomes in migrant-sending areas, international migration potentially represents a particularly effective strategy for minimizing family income risks and overcoming liquidity constraints. The importance of migrant, and especially foreign-migrant, income in the "income portfolios" of migrant-sending households is documented in a diversity of settings [e.g., Massey et al. (1994, 1998), Stark et al. (1986), Oberai and Singh (1980), Knowles and Anker (1981)].

Taylor (1987) tests for the significance of expected household income variables in shaping international (Mexico-to-U.S.) migration from rural Mexico. Using data on contributions to household income by migrants and nonmigrants, a selectivity-corrected structural probit migration model is estimated for a sample of households in Michoacán, traditionally the largest source-region for Mexico-to-U.S. migration. Consistent with both a Todaro expected-income and NELM model, increases in expected income contributions from migration by individual family members are found to significantly and positively explain the allocation of these individuals to migration. However, controlling for this expected-income gain, several other individual and household variables also significantly explained migration, through their effect on migration costs or other NELM considerations. Anticipating Emerson's finding that comparative advantage considerations influence migration, this study found that individuals who migrated to the United States were not above average contributors to rural Mexican household incomes, either as workers in Mexico or as migrants in the United States. However, family members with the highest expected contributions to rural Mexican households as nonmigrants were significantly less likely to migrate to the United States.

Family migration networks, or the presence of contacts at prospective migrant destinations, are consistently found to be among the most important variables driving migration [Greenwood (1971), Nelson (1976), Massey et al. (1987)], particularly to destinations that are associated with high migration costs and risks and a scarcity of information [Taylor (1986)]. In the case of rural Mexico-to-U.S. migration, assistance from family

members already in the United States is often instrumental in financing new migration. These family contacts also lowered the psychic costs of living and working abroad and played an important role in providing information.

The NELM also hypothesizes that extra-household variables influence migration decisions. Building upon Taylor (1987), Stark and Taylor (1989) test the hypothesis that, controlling for expected absolute income gains from migration, a household's relative income position within its reference group (village) influences migration incentives. They include a measure of households' initial relative deprivation in a structural probit equation for migration. This variable has a positive and significant impact of the probability that rural Mexican households send migrants to the United States. The relative deprivation hypothesis turns on the stability of reference groups in the face of migration; both the migrant and the rest of the household must continue to view the village as the relevant reference group after migration occurs. This is more likely in the case of international migration, into a distinct cultural, social, and economic milieu, than for internal migration. In a subsequent study, Stark and Taylor (1991) find that relative deprivation significantly raises the probability of international (Mexico-to-U.S.) but not internal migration.

Tests of impacts of risk on migration decisions (and vice-versa) hypothesized by the NELM are scarce, largely because of data availability. Rosenzweig and Stark (1989), using unique longitudinal data from India, test the hypothesis that the "exchange" of individuals between households through marriage reflects efforts by households to mitigate risk and smooth consumption in a context of information costs and spatially covariant risks. They find that (a) marriage cum migration reduces variability in consumption, given the variability of income from crop production; and (b) households exposed to higher income risk are more likely to invest in long-distance migration-marriage arrangements. A unique feature of NELM risk models is the possibility of a positive relationship between distance and migration probabilities. In a Todaro model, distance represents a cost of migration and therefore discourages it.

A less direct test of NELM risk-and-migration hypothesis appears in Lucas and Stark (1985), the first attempt to test NELM predictions of migration and remittances. Using cross-sectional farm household data from Botswana for a drought year, a key implication of the NELM – that migrants function as insurance intermediaries – is explored. Families at greater risk of temporary income loss as a result of the drought are found to receive significantly greater remittances in the drought year. The study rejects a "pure altruism" model of remittance behavior, while finding evidence of an inheritance motive to remit.

Echoing Lucas and Stark, Hoddinott (1994) found evidence from west Kenya that wealthier parents, who can offer a greater (inheritance) reward for remittances, extracted a larger share of migrant earnings through remittances. He also found evidence that the credibility of the parental threat to reduce future bequests had a positive effect on remittances, controlling for migrants' earnings.

The roles of family ties are central to Mincer's (1978) and Borjas' (1990) migration-probability models. Borjas (1990) models migration in the context of "dynastic house-

holds", positing the welfare of children as an important variable explaining migration decisions. Building upon these and the dynastic fertility model of Barro and Becker (1986), Tcha (1996) finds compelling evidence that reciprocal altruism between generations significantly affects rural-to-urban migration in Korea and in the United States. If migration decision makers' altruism toward their children is high, the weight attached to their own expected income gains from migration (the Todaro variable) may be low relative to the weight attached to the descendants' incomes. If the descendants' permanent incomes are sufficiently large in urban areas (and with urban schooling), migration may be optimal in the absence of a positive urban-rural expected income differential for the parents, provided that parents' altruism toward their children is high. These studies reflect the NELM's emphasis on intra-familial ties when modeling migration decisions; however, they depart from most NELM research by restricting migration to moves by entire households rather than treating migration as a mechanism to diversify family labor allocations across space.

Lucas (1987), Taylor (1992), Taylor and Wyatt (1996), and Rozelle, Taylor and de-Brauw (see Section 4) offer findings consistent with the NELM hypothesis that families participate in migration in an effort to overcome liquidity constraints on local production.

Rosenzweig (1980) tested the hypothesis that capital market and information constraints restrict labor mobility within rural areas. He found that laborers with land are less mobile than the landless. Balan, Browning and Jelin (1973) and Nabi (1984) find that rural-to-urban migrants from households owning land in rural areas are more likely to be temporary migrants. In these studies, the negative effect of land ownership on mobility (or duration of migration) is attributed to the difficulty of selling land holdings without suffering a capital loss. That is, mobility is reduced because of a capital-market imperfection: part of the capital accumulated by rural residents is not transportable.

3.2. More on the selectivity effects of migration

The findings from studies presented earlier indicate that migrants are selected on key characteristics, including their expected earnings potential as migrants and nonmigrants. Individual human capital and household variables, in turn, affect individuals' and households' incomes with and without migration. Because of this, there is a "derived" selectivity of migration on specific individual and household characteristics, through the differential effects of these characteristics in migrant and nonmigrant labor markets. As human capital theory [Sjaastad (1962)] would predict, migrants tend to be younger than their counterparts who do not migrate. Household variables that influence individuals' income creation as migrants and/or nonmigrants (e.g., family migration networks or landholdings) often are found to significantly affect migration as well. The effects of some human capital variables differ sharply across migrant destinations. For example, education typically promotes rural out-migration, but not to all potential migrant destinations. Individuals significantly take their education to labor markets where they will reap the highest economic return to their schooling. In addition to a derived selectivity,

through income, there also appear to be direct effects of schooling, age, and other individual and household variables on migration that are independent of expected income [e.g., Massey et al. (1994, 1998), Taylor (1987)].

There is evidence that migration is selective on extra-household variables, as well. Schultz (1988) and Rosenzweig and Wolpin (1985) found that migration in Colombia is selective of characteristics of regions (i.e., relative prices): households sorted themselves across localities with different relative prices. Selectivity of migration based on extra-household variables (e.g., local income disparities) is also documented by Stark and Taylor's (1989, 1991) studies of relative deprivation and migration, described above.

The selectivity of rural out-migration may differ not only across migrant destinations but over time as well. For example, the Binational Study of Mexico-to-U.S. Migration [United States Commission on Immigration Reform (1997)] found that this migration is not only highly selective, reflecting differences in information and the costs and benefits of migration across individuals and households in Mexico, but also that this selectivity process has changed substantially in response to changing characteristics of migrant labor demand in the United States, migrant labor supply in Mexico, and the networks of contacts with family and friends that link prospective migrants with U.S. labor markets. Labor migrants from rural Mexico, once almost entirely solo men with limited schooling, are increasingly female, married, and better educated than those who stay behind. Key human capital variables like schooling may yield low returns in rural areas compared with urban areas, but there may be little reward for education in some migrant labor markets, e.g., low-skill labor markets abroad in which unauthorized immigrants frequently are concentrated.

Taylor (1986) found that schooling had a positive effect on rural out-migration but a significant negative effect on migration to the United States from a sample of rural-Mexican households in 1983. Taylor (1987) found that, controlling for migration selectivity, the income returns to schooling for rural Mexican households were positive for internal migration but insignificant for Mexico-to-U.S. migration, which usually entailed work as illegal immigrants in low-skill activities. Because of this, schooling was negatively related to household income from international migration. However, using data from a more recent survey that included these same households, Taylor and Yúnez-Naude (2000) find that the schooling effect on Mexico-to-U.S. migration was significant and positive. This change may be attributable to Mexico's economic crisis of the mid-1980s and early 1990s, which dramatically reduced expected earnings for urban workers in Mexico.

Using aggregate data on migration between Puerto Rico and the U.S. mainland, Castillo-Freeman and Freeman (1992) and Ramos (1992) also find evidence of shifting migrant selectivity over time. There, however, migration selection increasingly favored the unemployed and individuals with little schooling, apparently because of an increase in the island's minimum wage that reduced employment in low-wage industries [Castillo-Freeman and Freeman (1992)].

4. Impacts of migration on rnral economies

In both classical and neoclassical (including Todaro) migration models, the only avenue through which rural out-migration can impact the rural economy is through labor markets. Migration represents a loss of human resources for rural migrant-sending areas. If there is surplus rural labor, however, this labor loss has zero opportunity cost. In the theoretical world developed by Lewis (1954), where the rural migrant-sending areas are characterized by a surplus of workers and a perfectly elastic labor supply, the loss of human resources through migration does not provoke a production decline, nor does it exert upward pressure on rural wages. The only potential welfare effect of out-migration on the rural economy is an increase in the average product of labor for the non-migrating rural population, assuming that rural households cease to support out-migrants once they leave, and vice-versa.

Graphically, this condition is depicted by a marginal product curve for labor in the rural sector that is no longer positive once the entire work force is employed. In Figure 3, any labor force size in excess of L_1 is "redundant" in the sense that it does not contribute positively to agricultural production. This condition means that an amount of labor equal to $L_T - L_1$ may be withdrawn from the rural workforce without inflicting a production loss. As this labor is withdrawn, the average product of labor – total production divided by the remaining rural workforce – increases [Ranis and Fei (1961)]. Beyond this point, the opportunity cost of emigration for the sending economy becomes positive. Once the

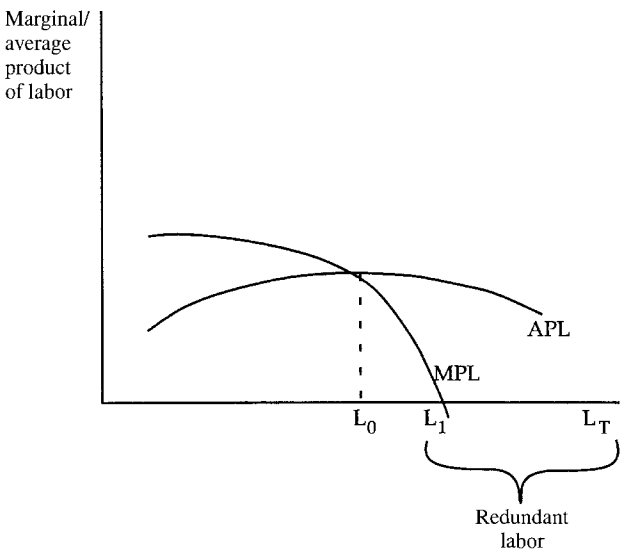

Figure 3. Labor-market impacts of emigration in a Lewis world. An amount of labor equal to $L_T - L_1$ can emigrate without inflicting any production loss on the sending area.

marginal product of rural labor exceeds the urban wage, we leave the classical Lewis world and enter the neoclassical world.

The validity of the Lewis surplus labor hypothesis has been challenged empirically by research showing that, even where surplus-labor conditions prevail most of the year, seasonal bottlenecks may produce a marginal product of labor that is positive [see Gregory (1986), for example]. In this circumstance, the opportunity cost of rural out-migration is not zero, since the loss of workers results in production declines in seasonal activities.

Lewis (1954) actually pays considerable attention to the interaction between rural development and migration. However, the Lewis model (especially its interpretations) has been criticized for implicitly treating the rural sector as a black box from which surplus labor is drawn for use in an expanding modern sector. As such, most treatments of this model offer limited insights into the interactions between migration and rural development.

The Todaro model produces a richer set of rural welfare and policy implications than either its classical or neoclassical predecessors, implicitly shifting migration and unemployment policy focus from the urban to the rural (i.e., labor-supply) sector in two ways. First, a high migration elasticity with respect to urban jobs means that an urban employment-generation project may result in more, not less, urban unemployment. (Considerations of urban or rural unemployment lie outside the realm of the traditional neoclassical migration model.) Because higher urban employment increases the urban expected wage and triggers more migration, policies operating solely on the labor-demand (i.e., urban) side are not likely to significantly reduce urban unemployment. Second, estimates of the shadow price of rural labor to the urban sector are likely to be biased downward if the migration elasticity is ignored. The lost agricultural product of the migrant who secures an urban job does not represent the full opportunity cost of rural out-migration if more than one rural worker is induced to migrate. The opportunity cost for the rural sector also includes the loss of agricultural production of others who migrate but are less fortunate in finding urban employment.

Theoretical economic research on the welfare costs of labor and capital lost to migration focuses principally on international migration. However, the findings of this research are equally relevant to rural out-migration, either to destinations domestic or abroad.

In a perfectly competitive, neoclassical world (without surplus labor or other market imperfections), a worker is paid the marginal value of what he or she produces prior to emigrating. Based on this assumption, early theoreticians argued that emigration should have a neutral effect on the economic welfare of nonmigrants: any decrease in local production attributable to the loss of labor through emigration should equal the wages that workers received prior to emigrating [Grubel and Scott (1966)]. Although local production may decline by an amount equal to the marginal product of the migrant who has departed, the size of the economic pie available to those who do not migrate is exactly the same as before.

Consider an economy characterized by a production function that is homogeneous of degree one, i.e., $y = f(k)$, where y and k are the output-labor and capital-labor ratios,

respectively, and $f'(k) > 0$. In this case, outmigration increases k and thus the income per head of those left behind. This basic conclusion does not change when migrants own capital but leave it behind, even if they continue to receive the income generated by their capital. [MacDougal (1960) and Kemp (1964) present a formally identical argument for the case of foreign investment.] The only case in which those left behind may be worse off is when the migrants own a lot of capital and take it with them.

In a Lewis (1954) world of surplus labor, emigration leaves total production unchanged, and the average product of labor for nonmigrants unambiguously increases. However, if migrants take capital with them, the marginal product of labor curve may shift downward, increasing the size of the "redundant" work force and setting the stage for new rounds of rural out-migration. In this scenario, migration may reduce the average product available for nonmigrants.

The migration of migrant-owned capital out of the rural economy is not considered by either Lewis or Todaro. However, both Johnson (1967) and Berry and Soligo (1969) argue that the effect of out-migration on economic welfare in sending areas depends critically on how emigration affects the local capital stock – that is, on how much capital migrants take with them. A loss of capital through migration has two implications. First, the capital supply curve shifts inward, driving up the local rental rate on capital and raising marginal profits. Second, the loss of capital through emigration reduces the productivity of complementary labor inputs. This effect could be illustrated by an inward shift of the labor demand curve, which would reduce the wages of those who stay behind. Berry and Soligo (1969) show that, under general neoclassical assumptions, the out-migration of labor lowers the total income of non-migrants unless (a) emigrants own a disproportionately *large* share of capital and (b) they leave this capital behind when they emigrate. If these conditions hold, emigration increases the capital/labor ratio for those who do not emigrate, thereby raising labor productivity and wages.

The most obvious instance in which conditions (a) and (b) above do not hold is the emigration of human capital, i.e., people with education, skills, entrepreneurial spirit, and a willingness to take risks. By definition, human capital is attached to the migrant and necessarily leaves the rural sector when he or she does. If migrants are positively selected with respect to human capital characteristics, therefore, it will cause a "brain drain" from the rural economy, the effects of which are similar to those of capital flight, lowering the productivity, and hence the wages, of complementary labor in migrant-sending areas.

Thus, two clear lessons relevant to understanding welfare effects of migration on rural areas emerge from early theoretical research on welfare effects of out-migration. First, the effects of labor emigration depend critically on how this migration affects the capital-labor ratio among non-migrants. Second, the distributional effects of emigration are likely to be unequal across socioeconomic groups. Rivera-Batiz (1982), in a seminal piece, explored the theoretical implications of emigration for capital-rich and labor-rich individuals. He showed that if migrants take capital with them, then the real income of capital-rich individuals unambiguously increases, but the effect on labor-rich individuals is unclear. Other studies [Wong (1983), Quibria (1988), Davies and Wooton

(1992)] offer theoretical support to the argument that emigration both is globally beneficial to those who do not migrate and reduces income inequality in migrant-sending areas, provided that it results in an overall increase in the capital-labor ratio within the migrant-sending economy.

4.1. Remittances and welfare

Migration not only produces lost-labor, and possibly also lost-capital, effects on rural economies. It also represents a potentially important source of income and savings, through migrant remittances. Djajic (1986), in an extension of the neoclassical research cited earlier, concludes that nonmigrants benefit from emigration, even if they do not receive any of the remittances themselves, provided that the magnitude of migrants' remittances exceeds a critical threshold roughly equal to the value of the production they would have produced had they stayed behind.

Measuring remittances is difficult because migrants often enter developed countries outside of official channels and repatriate their earnings through informal means. Money may be returned in the form of goods purchased abroad or in the form of cash savings brought back by migrants or visiting family members, what Lozano Ascencio (1993) calls "pocket transfers".

Despite these difficulties, research indicates that migrant remittances, like other types of income transfers, contribute to rural migrant-sending economies in at least three ways: first, they increase income directly, by raising incomes of migrant-sending households; second, they may also raise local incomes indirectly by enabling families to overcome liquidity and risk constraints on local production (the NELM effects described above); and third, they create general-equilibrium effects inside and outside the rural economy.

A number of studies present econometric estimates of remittances in LDCs [e.g., Banerjee (1984), Johnson and Whitelaw (1974), Lucas and Stark (1985), Rempel and Lobdell (1978)]. Unfortunately, few take into consideration the self-selectivity of migration when estimating remittance functions. Exceptions include Hoddinott (1994) and Taylor (1987), which are discussed below.

4.2. NELM impacts

Few researchers have attempted to test the implications of migration for rural incomes and welfare in a NELM framework. The few that do find evidence that migration unleashes an array of indirect effects on rural economies that are largely outside the realm of neoclassical migration models.

Lucas (1987) uses aggregate time-series data on migration to the Union of South Africa from five African sending nations. His econometric analysis finds that the opportunity cost of wage labor, which includes migration, is large: output in migrant-sending households falls as labor is withdrawn from farm production. However, he also finds a positive feedback of migrant remittances on production. Two possible explanations

for the second finding are, first, that migrant remittances are invested in production at home, which loosens financial constraints on productivity-enhancing ventures and yields a higher output, and second, that migration diversifies income sources and encourages risk-averse households to undertake unproven, but potentially productive, investments.

Consistent with these predictions, Adams (1991b) finds that rural Egyptian households containing foreign migrants have a higher marginal propensity to invest than do their non-migrant counterparts. Migration thus has a positive effect on investment that is independent of its contribution to total household income. Policy biases against agriculture, however, discourage agricultural investments in favor of land purchases, yielding the remittance-use pattern frequently observed in community studies.

Taylor (1992) estimated the marginal effect of migrant remittances on farm income and asset accumulation using data from households interviewed at two points in time in rural Mexico. Initially (in 1982), the marginal effect of remittances on household income was less than unity – that is, a $1 increase in remittances produced less than a $1 increase in total income within remittance-receiving households – an effect that is consistent with the hypothesis that the marginal product of migrant labor is positive prior to migration.

In a later period (1988), however, the marginal impact of remittances on total income was greater than unity: a $1 increase in remittances brought a $1.85 increase in total household income. This finding is consistent with the view that remittances loosen constraints on local production, once migrants become established abroad. In the Mexican case, Taylor (1992) also found that remittances promoted the accumulation of livestock over time and increased the rate of return to livestock assets (through complementary investments). Moreover, subsequent research using these data showed that, consistent with NELM theory, the marginal income effect of remittances was greatest in the most liquidity-constrained households [Taylor and Wyatt (1996)].

The micro impacts of migration and remittances on agricultural productivity are complex and have been little explored. Rozelle, Taylor and deBrauw (1999), using simultaneous-equation methods and a unique data set from China, found that the loss of labor to migration significantly reduced grain yields, reflecting an absence of on-farm labor markets. However, migrant remittances significantly increased yields, partially offsetting the negative lost-labor effect. Overall, Rozelle et al.'s findings suggest that constraints in the operation of on-farm labor and capital or insurance markets both provide households with a motivation to migrate and distort on-farm operations when labor leaves. Policies alleviating these market constraints could increase production efficiency while reducing the need to send migrants out into the labor force to finance on-farm activities and/or insure against income shocks.

These studies, while offering econometric evidence in support of the new economics of labor migration, also suggest that the relationship between migration and development is not invariant over time or across settings. Over time there appears to be a pattern first of negative and then of positive effects of migration on non-migration income in sending households. Across settings, the extent of the positive effect depends on the

profitability of investments in new production activities, which in turn depend on other local conditions.

In Taylor's rural Mexican communities, livestock production proved to be a viable income-generating activity because pastureland was available, transportation links were relatively well developed, and marketing facilities were accessible. Once households were able to overcome the constraint of having limited resources to invest in livestock herds, the potential for economic growth and development was quite large. In other communities, however, profitable investment opportunities in cattle-raising were limited by environmental conditions, market constraints, and government policies that structured the terms of trade against agricultural production.

Thus, government policies represent a vital link between migration and development. Compared with the neoclassical model posited by Todaro and others, the new economics of labor migration developed by Stark and his successors leads to a radically different set of policy prescriptions to reduce emigration. Rather than intervening directly in labor markets, governments that wish to reduce out-migration should attempt to correct failures in local capital and risk markets, thereby offering households credit and insurance alternatives to migration. In the new economic model, imperfect credit and risk markets, not a low equilibrium wage in the labor market, are the fundamental causes of international migration (although credit and risk market imperfections, by restricting growth, may result in a low equilibrium wage).

4.3. General-equilibrium effects

Both rural out-migration and migrant remittances may generate important general-equilibrium effects as well, including feedback on the rural economy. For example, Mexico-to-U.S. migrant remittances in excess of $4 billion annually [United States Commission on Immigration Reform (1987)], most of which flow into Mexico's rural economy, increase rural households' demand for both food and manufactured goods. In this way, they generate demand linkages that may stimulate rural production activities and also incomes and employment in urban areas. Increases in urban incomes, in turn, increase the demand for food and other goods produced in rural areas.

General equilibrium effects of migration and remittances on rural economies can be estimated using economy-wide modeling techniques, which trace how both remittances and the labor lost to migration influence income and production as they work their way through the migrant-sending economy. Unfortunately, with a few exceptions, economy-wide techniques have not been utilized to examine the impacts of out-migration on rural economies. The few that have are from Mexico. They offer evidence at both the national [Taylor et al. (1996)] and village [Taylor and Adelman (1996), Taylor (1996), Adelman et al. (1988)] levels that migrant remittances produce significant multiplier effects on migrant-sending economies; that in the case of international migration, these effects are particularly important for rural areas; and that remittances also tend to have an equalizing effect on the distribution of income among socioeconomic groups.

Kim (1983, 1986) found that between 3 percent and 7 percent of 1976–81 GNP growth in South Korea was attributable, directly or indirectly, to migrant remittances. Ro and Seo (1988) set the figure at a remarkable 33 percent in 1982. Likewise, Hyun (1984) reported that a 10 percent increase in remittances brought a 0.32 percent increase in private consumption, a 0.53 percent increase in fixed investment, a 0.22 percent increased in GDP, and a 0.13 percent increase in prices. Based on his computable general equilibrium (CGE) analysis of Bangladesh, Habib (1985) estimated that the money remitted by Bangladeshi overseas workers in 1983 gave rise to an additional final demand of $351 million, which, in turn, generated 567,000 jobs. Ali (1981) and Mahmud (1989) found that while remittances to Bangladesh were targeted primarily to current consumption, a significant share went to nontraded goods such as land, housing, and education. After estimating employment multipliers, Stahl and Habib (1991) found that each migrant created an average of three jobs through remittances. Taylor et al. (1996) concluded that, in Mexico, remittances flow disproportionately into poor rural and urban households, and they create second-round income linkages that also favor the poor. In other words, many of the benefits of remittances accrue to households other than the ones that receive them, both inside and outside the rural economy; income linkages between migrant and non-migrant households transfer the benefits away from the remittance-receiving household.

Village research by Adelman, Taylor and Vogel (1988) estimated a "remittance multipliere" from international migration equal to 1.78; that is, $1 of international migrant remittances generated $1.78 in additional village income, or 78 cents' worth of second-round effects. The additional income was created by expenditures from remittance-receiving households, which generated demand for locally produced goods and services, bolstering the incomes of others in the village. They also found that remittances created new rural–urban growth linkages by increasing the demand for manufactured goods produced in Mexican cities. Finally, remittances stimulated investments in physical capital and schooling (by $.25 and $.13 per dollar of remittances, respectively) among both migrant and nonmigrant households in the village.

Village CGE studies from Mexico, Java, Kenya, and El Salvador find that migration tends to compete with local production for scarce family resources, raising rural incomes but in some cases producing, in the short run, a "Dutch disease" effect on migrant-sending economies. In the long run, however, remittance-induced investments increase community income. Both the household and regional effects of migration depend, however, on how remittances, and the losses and gains of human resources through out-migration, are distributed across households, on the existence of nontradable consumer and investment goods in the migrant-sending economy, and on production constraints in different households [Taylor and Adelman (1996)].

In general, migration is likely to have the largest positive effect on rural economies when the losses of human and other capital from out-migration are small; when the benefits of migration accrue disproportionately to households that face the greatest initial constraints to local production; and when households that receive remittances have expenditure patterns that produce the largest rural income multipliers.

4.4. Migration, inequality, and rural welfare

A number of researchers have examined the distributional effects of migrant remittances by comparing income distributions with and without remittances [Barham and Boucher (1998), Oberai and Singh (1980), Knowles and Anker (1981)] or by using income-source decompositions of inequality measures [Stark et al. (1986, 1988), Adams (1989, 1991a), Adams and Alderman (1992)]. These studies offer conflicting findings about the effect of remittances on income inequality.

Stark, Taylor and Yitzhaki (1986) provide a theoretical explanation for these conflicting findings. They argue that rural out-migration, like the adoption of a new production technology, initially entails high costs and risks. The costs and risks are likely to be especially high in the case of international migration. Given this fact, pioneer migrants tend to come from households at the upper-middle or top of the sending-area's income distribution [e.g., Portes and Rumbaut (1990), Lipton (1980)], and the income sent home in the form of remittances is therefore likely to widen income inequalities.

This initial unequalizing effect of remittances is dampened or reversed over time as access to migrant labor markets becomes diffused across sending-area households through the growth and elaboration of migrant networks [see Massey et al. (1994)]. Thus, Stark, Taylor and Yitzhaki (1988) found that migrant remittances had an unequalizing effect on the income distribution in a Mexican village that recently had begun to send migrants to the United States, but an equalizing effect on another village that had a long history of participating in Mexico-to-U.S. migration. They then conducted a welfare analysis of remittances using a social welfare function sensitive to both per capita income and inequality. Remittances were shown to increase rural welfare in the case of both villages, although the positive effect of remittances on inequality dampened the welfare effect in the first village.

Taylor (1992) extended this analysis by taking into account the indirect effects of international migration on income and asset accumulation over time. He provides longitudinal evidence in support of the Stark–Taylor–Yitzhaki hypothesis. Lost labor effects tend to dampen the unequalizing effects of remittances in the short run, but the positive indirect effects of migration on household income in poorer families (achieved by loosening capital and risk constraints on local production) make migration more of an income equalizer in the long run.

Over time, the indirect effects of migration on both income and inequality become increasingly important. If the Stark–Taylor–Yitzhaki hypothesis is correct, then we would expect poorer households to have the largest capital and risk constraints on investments in local income-generating activities, and therefore, the largest incentives to place migrants abroad as "financial intermediaries" to facilitate the tasks of risk management and capital acquisition, other things being equal. Initially, however, barriers to international migration in the form of high costs, poor information, and uncertainty discourage poor households from sending their family members to labor abroad.

Stark, Taylor and Yitzhaki (1988) find evidence of such barriers in the Mexican case. As barriers to international migration fall with the expansion of migrant networks, how-

ever, the benefits of international migration flow increasingly to the households that are most capital- and risk-constrained (i.e., lower income households). If these households invest in local income-generating activities, then indirect income effects should reinforce the increasingly favorable direct impacts of remittances on sending-area income distributions. This expectation is consistent with Taylor's (1992) and Taylor and Wyatt's (1996) findings from Mexico.

Findings from the relative deprivation migration studies of Stark and Taylor (1989, 1991) indicate that rural income inequality may be a determinant of, as well as influenced by, migration. In a Todaro model, a mean-preserving spread in the rural income distribution does not affect migration, because it leaves the expected income gains from migration unchanged. However, in a relative deprivation model, an increase in rural income inequality that makes some households more relatively deprived creates new incentives for migration by those households. The feedback of migration on relative deprivation may make rural out-migration a self-perpetuating process. As migration creates income gains for some rural households, it makes others (i.e., those not receiving remittance income) more relatively deprived. This, in turn, increases the latter's likelihood of participating in migration in an effort to overcome this relative deprivation in the future.

4.5. Migration's impacts on rural migrant-receiving areas

A large and burgeoning literature addresses the impacts of immigration in developed countries, particularly the United States [for an excellent review, see Borjas (1994)]. However, with very few exceptions, the focus of these studies has been on urban, rather than rural, labor markets. A nascent body of research examines the reshaping of rural economies in the United States through immigration. Interestingly, it echoes many of the themes and findings of research in the 1960s and 1970s on the impacts of rural population change in the United States (see above), but in a context of growing, rather than declining, rural populations. In LDCs, there has been growing interest in rural-to-rural migration and its implications for the environment.

4.6. Impacts of immigration on rural economies in developed countries

Several conceptual models attempt to describe how immigrants affect local populations and economies [Taylor et al. (1997)]. Two models mark the extremes. One argues that the presence of immigrant workers creates economies of scale and multiplier effects. In other words, the arrival of immigrants increases local economic activity and creates or preserves good jobs for local residents. This view characterizes much of the urban-focused research on immigration in the 1980s; for example, see Borjas (1984), DeFritas (1988), Altonji and Card (1991), Bean, Lowell and Taylor, (1988), LaLonde and Topel (1991), Borjas (1990), Grossman (1982), Muller and Espenshade (1985), Winegarden and Khor (1991), Simon, Moore and Sullivan (1993), Card (1990), Butcher and Card (1991), Vroman and Worden (1992), and Fix and Passel (1994). Their findings generally

support Piore's (1979) argument that most recent immigrants are concentrated in distinct labor-market segments. According to Piore,

> The jobs (immigrants take) tend to be low-skilled, generally but not always low paying, and to carry or connote inferior social status; they often involve hard or unpleasant working conditions and considerable insecurity; they seldom offer chances of advancement toward better-paying, more attractive job opportunities (p. 17).

Because of this, migrants and native workers tend to be complements, not substitutes, in production. The econometric model these studies employ involves regressing wages and employment (weeks worked) for different native-worker groups on the number of immigrants in local labor markets (SMSAs). Implicitly, this corresponds to a statistical experiment in which immigrants are randomly injected into closed labor markets.

The other extreme view, inspired by neoclassical trade theory, argues that immigrants take over local jobs and freeze low wages into place, competing with at least some groups of workers. It is based on a fundamental critique of the research methods utilized by earlier studies, recognizing that native workers are likely to respond to the arrival of immigrants by moving to less immigrant-impacted labor markets, shifting the labor-supply curve inward and dissipating the impacts of immigration through internal migration. Studies that focus on immigration impacts on local economies, including local rural economies, therefore may mask the macro effect of immigration on wages and employment [Borjas (1994)].

There are reasons to expect a priori that both of these models help characterize the impacts of immigration in rural communities. Taylor, Martin and Fix (1997) found that, in California, the preponderance of new immigrants are low-skilled, capital-poor workers who compete with other low-skilled immigrants for seasonal farm jobs. Most have poverty earnings. They coexist in rural towns with established, usually older immigrant groups who have some access to capital and often specialize in providing farmworkers with services like housing, transportation, food, and job placement. New immigrants create new sources of income (income linkages) for these established residents of farmworker towns, while constituting an inexpensive and flexible source of labor for agricultural employers who typically live outside the towns that house their workforce. The resulting mixture of positive income linkages for some groups and competition for low-wage, seasonal farm jobs among low-skilled immigrants creates a socioeconomic geography of contrast. While California's 12 major agricultural counties had farm sales of over $12 billion in 1993, more than any U.S. state except California itself, an average of 26 percent of all residents of farm towns in these twelve counties lived below the poverty line in 1990. Data from the NAWS indicate that, nationwide, more than 50 percent of all farmworker households had incomes below the poverty line in 1996 [Mines et al. (1997)].

Econometric findings reported in Taylor and Martin (1997) and Taylor, Martin and Fix (1997) point to a circular relationship between farm employment and immigration in 65 rural towns and cities of California. Taylor and Martin (1997); [also see Martin and

Taylor (1999)] estimated a five-equation simultaneous-equation model for immigration, farm employment, migration, poverty, and welfare use. They found evidence of a circular relationship between immigration and farm employment between 1980 and 1990: an additional 100 farm jobs were associated with 143 more immigrants, and an additional 100 immigrants, in turn, were associated with the creation of 36 more farm jobs. Because most farm jobs are seasonal and offer workers below-poverty-level earnings, each additional farm job was associated with $987 in welfare payments in 1990. There was no evidence that poor immigrants were more likely to receive welfare income than poor nonimmigrants in rural California. However, immigration constituted an important link in the farm employment–immigration–poverty–welfare chain. Based on a three-stage least-squares analysis of census tract data, Taylor and Martin (1998) found evidence of a similar "vicious circle" of immigration, poverty, and farm employment in the western United States between 1980 and 1990. It stood in contrast with negative effects of farm employment on poverty and welfare use, both in the West and in the United States as a whole, one decade earlier.

Taylor, Martin and Fix (1997) examine the re-creation of rural poverty through immigration, drawing from an econometric analysis of census data and case studies of rural California communities. They reach three broad conclusions: First, immigration, principally from rural Mexico, is fueling an unprecedented growth in population, poverty, and public service demands in rural California communities. Second, upward mobility of immigrant farmworkers in rural California is the exception rather than the rule. Third, public resources available to integrate newcomers are declining even though the number of immigrants is increasing. In rural areas, federal assistance programs originally created for other purposes have become de facto immigrant assistance programs. This study found no evidence that the poverty impacts of immigration spill over into adjacent communities.

These findings are consistent with those of Gardner (1974) and others who documented a positive relationship between out-migration and rural incomes in earlier periods. Just as rural out-migration appears to have resolved the poverty associated with "too many farmers" between 1940 and 1970, immigration, stimulated by the expansion of low-skill farm jobs, appears to be creating a poverty associated with "too many workers" in the 1980s and 1990s. If history repeats itself, this new rural poverty will stimulate rural-to-urban migration. However, given an elastic supply of low-skilled workers from abroad, it is not clear whether future rural out-migration will alleviate poverty in rural communities.

More research is needed to understand immigration–employment–poverty links in rural areas and design policies to reduce poverty in an era of immigration-driven rural population growth.

4.7. Rural-to-rural migration in LDCs

Nearly all research on internal migration in LDCs addresses rural-to-urban migration, to such an extent that "internal" and "rural-to-urban" are often treated as interchangeable

in migration research. Recently, there has been some interest in understanding the magnitude of, and the forces driving, rural-to-rural migration – that is, the redistribution of populations within rural areas. This research is motivated primarily by the environmental ramifications of migration to remote rural areas of those in search of land to continue agricultural livelihoods. The World Bank's 1992 World Development Report notes that migration into new rural environments is an important mechanism by which rural population growth and poverty result in environmental degradation, including deforestation:

> Because they lack resources and technology, land-hungry farmers resort to ... moving into tropical forest areas where crop yields on cleared fields usually drop sharply after just a few years [The World Bank (1992), p. 7].

Bilsborrow (1992) compares magnitudes of different types of internal migration flows in 14 countries and finds that rural-to-rural migration is the largest in three and exceeds rural-to-urban migration in eleven, despite being almost universally ignored in the literature on internal migration. His research highlights statistical challenges to studying rural-to-rural migration, including questions surrounding the criteria used to classify populations as "rural" versus "urban" in different country settings. Nevertheless, it underlines the potential importance of rural-to-rural migration for some countries, particularly those containing an extensive forest margin or rural frontier, on the one hand, and high rural population densities or inegalitarian land distributions, on the other. Typically, migration to the rural margins is facilitated by public investments in roads to open up new agricultural frontiers [Bilsborrow and Carr (1998)]. Salient examples include migration into the Brazilian and Ecuadorian Amazon, the emergence of new rural plantations in Malaysia and Thailand, agricultural labor migration from southern to northwestern Mexico, and the forced relocation of Javanese in Indonesia.

The same tools used to model rural-to-urban and international migrations and their impacts potentially are useful for studying rural-to-rural migration; however, to date, little formal modeling of rural-to-rural migration has appeared in the economics literature. Understanding the origins of rural-to-rural migration is crucial for determining the causes of, and formulating appropriate policy responses to, migration-induced deforestation in LDCs.

5. Conclnsions and policy considerations

The movement of labor out of agriculture is both a quintessential feature of agricultural transformations and a prerequisite for efficient and balanced economic growth. Yet one of the motivations for migration research, particularly for Todaro (1969) and his followers, has been to identify appropriate policy measures to reduce the rate of rural out-migration. The case for government interventions turns on the argument that some market distortions exist and that these distortions result in "too much" rural out-migration as well as in various migration-induced externalities at migrant origins and destinations. Concern over such externalities underlies much of the research on rural out-migration in the United States between 1940 and 1970.

As Romans (1974) [also see discussion in Greenwood (1975)] pointed out, social burdens or benefits from migration can arise from pecuniary externalities (e.g., income redistributive effects of the type discussed by Berry and Soligo (1969) (see Section 4 of this Chapter); impacts of migration on prices and, through them, on the derived demand for labor at migrant origins and destinations; technological externalities (e.g., increasing returns to scale or various external economies associated with migration); and/or market distortions (e.g., effects of migration on the demand for, and revenues to support, public goods and services).

In a neoclassical world of complete and well-functioning markets, there is little or no economic rationale for policies to reduce migration. In Todaro (1969), migration in excess of urban job creation results in high rates of urban unemployment, with obvious welfare costs for urban areas. In addition, because each new urban job stimulates the migration of more than one rural worker, the opportunity cost of urban job creation for the rural economy is larger than would be the case in a context of urban full employment. Todaro's policy prescriptions all focus on interventions in labor markets; i.e., combining urban wage subsidies with physical restrictions on migration, he argues, is necessary to achieve economywide production efficiency (a second-best solution). (Bhagwati and Srinivasan (1974) show that this is actually not correct because a first-best solution is possible using a variety of tax and subsidy schemes, without relying on physical restrictions on migration. They, too, focus on labor-market interventions to reduce unwanted rural-to-urban migration.) The market distortion that results in too much migration in this view is a formal-sector urban wage that is institutionally set above the market-clearing level. This results in urban unemployment and creates the rationale for using an expected-income migration model.

The NELM shifts the focus of migration policy from interventions in labor markets to interventions in other markets, especially those for capital, risk, and information. In this view, market imperfections are the distortions that stimulate migration at levels that would not be optimal in a strictly neoclassical world. There is no reason to assume that disequilibrium in the labor market, reflected in migration, should be addressed by policy interventions in that market. As the Russian proverb cited by Stark (1982) so aptly puts it, "It is not the horse that draws the cart, but the oats".

Unlike in the Todaro approach, however, it is not clear whether there is too much or too little migration in a NELM world. For example, if rural households engage in migration in an effort to reduce their income risk or overcome credit constraints, the result is more migration than would be observed in the presence of perfect rural insurance or capital markets. On the other hand, migration risks, liquidity constraints on financing costly migration, and imperfect information about labor markets at migrant destinations would result in less migration than would be optimal in a world of perfect information and markets. While migration in excess of urban job creation pushes up the shadow wage associated with urban jobs, a positive feedback of migration on rural production reduces this shadow wage [Stark (1982)].

Nevertheless, who migrates matters. Rural market distortions create inefficiencies by discouraging migration by individuals who lack access to information (e.g., because

they do not have migration networks, or contacts at migrant destinations) or who are less credit- or risk-constrained. In a first-best world, the individuals who migrate are those whose movement out of the rural sector results in the largest productivity and income gain for the economy as a whole. This is not necessarily the case when rural market imperfections drive migration decisions.

In the light of distortions in rural credit, risk, and information markets, it is clear that migration decisions do not take place in a first-best world in the NELM, as in the Todaro, view. However, adding a new constraint to the general-equilibrium system by physically restricting migration, as Todaro proposes, obviously does not transport us to a second-best world if market distortions outside the labor market drive rural out-migration. Rather than attempt to directly influence rural out-migration, policies should focus on alleviating imperfections in rural markets that encourage "too many" people to leave the rural sector – keeping in mind that leaving does not always mean economically abandoning – and perhaps also on making migration and remittances more conducive to rural development.

In immigrant-receiving rural areas in the United States, the limited evidence available suggests that a continuing influx of foreign workers to fill seasonal jobs may be a double-edged sword. Employers benefit from the presence of low-wage workers, but rural communities bear the costs of providing services and public assistance to impoverished seasonal workers and their families. Immigration policies tend to produce unintended consequences, increasing rather than reducing agriculture's use of immigrant farmworkers and changing the structure of farm labor markets in ways that make immigration and labor laws more difficult to enforce and rural poverty more difficult to extirpate [Thilmany (1996), Martin et al. (1995), Taylor and Thilmany (1993)].

In LDCs, the redistribution of population within rural areas towards extensive forest margins or rural frontiers carries with it potentially far-reaching environmental consequences, including the irreversible loss of biodiversity. Researchers are only beginning to address the negative environmental externalities associated with migration to the rural margins of LDCs. In the meantime, government policies frequently encourage this migration through infrastructure investments and other measures. It is likely that a complex interaction of government policies and market imperfections in migrant-sending areas shapes rural-to-rural migration and that environmental, like economic, outcomes are influenced by the selectivity of this migration.

Because the stakes are high and the potential for policy failures along with market failures considerable, much more research is needed to determine whether, indeed, there is excessive rural migration in LDCs and excessive rural in-migration in high-income countries, and, if so, what the true determinants of this migration and the appropriate roles for government policy are. Disagreements over whether there is too much or too little migration partly reflect a scarcity of solid empirical research documenting alleged market distortions and their influence on migration and its welfare impacts. Until the hypotheses and welfare implications of competing migration models are more thoroughly tested (and appropriate data generated to support such tests), these ambiguities will persist. One thing is certain: regardless of what directions our migration policies

and research take, the exodus of population out of the world's rural areas will continue and most likely accelerate in the twenty-first century.

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Chapter 10

AGRICULTURAL FINANCE: CREDIT, CREDIT CONSTRAINTS, AND CONSEQUENCES

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Contents

Handbook of Agricultural Economics, Volume 1, Edited by B. Gardner and G. Rausser

Abstract

The theory and methods used to analyze the market, management, and policy elements of agricultural finance draw substantially on modern finance concepts, but with significant tailoring to the unique characteristics of agricultural sectors throughout the world. Both developed and developing economies are considered in this chapter. Discussed in detail are lender-borrower relationships, financial growth and intertemporal analysis, portfolio theory and financial risk, investment analysis, the financial structure of agriculture, and private and public sector suppliers of financial capital. Other key issues involve the linkages between investment and finance, and the extent of credit rationing in agriculture.

JEL classification: Q14

1. Introduction

Agricultural finance focuses on the acquisition and use of financial capital by the agricultural sectors of both developed and developing economies. Financial capital includes debt, equity, and leased capital, although each of these sources may include numerous forms. Much of the analytical work in agricultural finance has centered on the concept of credit as a firm's borrowing capacity and its utilization in acquiring and managing debt capital. Also receiving considerable attention are the leasing and related payment obligations for farmland and other types of assets, and the management of equity capital. Channels for bringing outside equity capital into agriculture, however, are not well developed. Outside equity has been discouraged from agricultural investment financing in the past by risk and information problems, small farm size, and public policies and preferences.

Agricultural finance includes elements of markets, management, and policy. The market element considers the organization and performance of institutions functioning as financial intermediaries for the agriculture sector, the trading of financial instruments in the financial markets, and potential rationing of credit and other market imperfections. The management element for agricultural firms includes investment analysis, capital structure, performance measurement, financial planning, risk and liquidity management, and establishment of "relationships" with financial intermediaries. These components may be evaluated at the firm level or at the aggregate, sector level. The policy element considers the role of governments in filling gaps and resolving imperfections in the agricultural finance markets and in providing targeted assistance to designated recipients consistent with social goals that are unmet by private sources of financial capital.

Agricultural finance utilizes key concepts of modern finance theory, adapted for application to the unique characteristics of agriculture. For example, the relatively small-scale, non-corporate structure of most farm businesses precludes the issuances, trading, and risk pricing of equity capital shares in public markets. These structural characteristics also result in greater emphasis on reputation and informal information exchanges in the formation of lender-borrower relationships. Consequently, approaches to investment analysis, optimal capital structure, and credit evaluation procedures must accommodate these and other empirical characteristics of agriculture. The unique structural and information characteristics of agricultural sectors have also led to the creation of specialized financial institutions, often publicly authorized, operated, and subsidized.

This chapter identifies and develops key concepts of agricultural finance, by focusing on the market, managerial, and policy elements cited above. The scope of the chapter's analysis includes both developed and developing economies, although most of the applications are drawn from the developed economy setting. Section 2 of this chapter delineates the key financial characteristics of agricultural firms in greater detail. Sections 3 and 4 identify key concepts from modern finance theory and assess their applicability to agricultural finance. Included is insight provided by principal-agent theory, financial contracting, and other elements of organizational economics. Section 5 addresses lender-borrower relationships in agriculture, including the role of social capital

as a complement to the traditional relationship concepts. Sections 6 and 7 consider, respectively, firm growth and intertemporal analysis, and the role of risk management in agricultural finance. Section 8 focuses on aggregate investment analysis of the agricultural sector, including farmers' investment behavior, tax policies, and capital structure. Section 9 addresses the relationship among finance, economic growth, and the structure of agriculture. Section 10 focuses on suppliers of financial capital to agriculture, and Section 11 provides a concluding perspective on credit, credit constraints, and their consequences.

2. Financial characteristics of agriculture

Managers of agricultural firms rely heavily on debt capital in combination with their own equity capital to finance their capital base, mechanize and modernize their farming operations, conduct marketing and production plans, and to serve as a valuable source of liquidity in responding to risks. In developing economies, debt capital is also important in smoothing consumption patterns over time. Readily available credit has facilitated many of the significant, long-term changes in the farm sector–increasing commercialization, larger farm sizes, fewer farms, greater specialization, greater capital intensity, adoption of new technology, stronger market coordination, and others [Barry (1995)].

Most farms throughout the world are small in size, not organized as corporations, and have ownership, management, and risk bearing concentrated in the hands of individual farmers and farm families [Barry et al. (1995); Barry (1995)]. Farms in developed economies generally are much larger than their developing economy counterparts. A few farms, especially in developed countries, are large in size, industrialized in operations, and have complex contractual arrangements for ownership, management, labor, and financing. Examples include large-scale cattle feedlots, hog production units, poultry and egg production plants, orchards, and other specialty crop farms.

Despite the small business orientation, agriculture typically is a capital-intensive industry with investments in farmland, buildings, machinery, equipment, and breeding livestock dominating the asset structure of most types of farms. Farm real estate comprises about 70 percent to 80 percent of total assets from year to year for the U.S. farm sector (U.S. Department of Agriculture). Inventories of livestock, machinery, crops, and other non-real-estate farm assets generally make up 10 percent to 15 percent of total assets. The dominance of farm real estate together with the relatively small holdings of financial assets indicates the high capital intensity and low asset liquidity of the sector. High capital intensity and low asset liquidity, in turn, create the demand for longer-term financing and careful matching of repayment obligations with projected cash flows.

The farm sector debt-to-asset ratio typically falls in a relatively low range compared to debt-to-asset ratios in many other economic sectors. The farm sector debt-to-asset ratio in the U.S. increased steadily to reach the 15 percent to 18 percent range in the 1970s and then rose above 20 percent in the mid-1980s, reflecting the decline in farm real estate values that characterized this period. Subsequent reductions in farm debt

and recoveries in farmland values in the late 1980s returned the debt-to-asset ratio to the 15 percent to 18 percent range, a range exhibited by other countries with similar characteristics. The farm sector balance sheet for Canada is consistent with the U.S. experience, although debt levels per farm and the aggregate debt-to-asset ratio remained higher than in the U.S. through the end of the 1980s [Freshwater (1989); Barnard and Grimard (1995)]. Similarly, the balance sheet for U.K. agriculture indicates debt-to-asset ratios below 10 percent in the 1970s and in the 10 percent to 18 percent range for the 1980s [Johnson (1990)]. In Australia, the farm sector ratio of long-term debt to total assets was less than 10 percent for 1990–1993 [Buffier and Metternick-Jones (1995)].

These farm sector debt-to-asset ratios are low relative to those in many other economic sectors. For the Australian case, Buffier and Metternick-Jones (1995) report that the long-term debt-to-asset ratio is the lowest for agriculture (10 percent), compared to ten other economic sectors (the three highest ratios are 66 percent for transport, 52 percent for construction, and 50 percent for recreation). Petersen and Rajan (1994) report average institutional debt-to-asset ratios for over 3,400 small non-farm U.S. businesses of 27 percent for corporations and 24 percent for sole proprietorships and partnerships. For large global corporations, selected year-end 1997 ratios of total liabilities to total assets are 87 percent for General Electric Company, 76 percent for IBM, 65 percent for Pepsico, and 50 percent for Amoco Oil Company.[1]

Low debt-to-asset ratios in agriculture, relative to other sectors of the economy, reflect the use of current market values of farm real estate compared with original cost-adjusted book values for depreciable assets in other sectors [Irwin (1968b)]. The lower range for the debt-to-asset ratio, however, is also consistent with the heavy reliance in agriculture on a non-depreciable asset such as farmland in which much of its economic return occurs as capital gains or losses on real estate assets [Melichar (1979); Barry et al. (1995)]. Several studies [Barry and Robison (1986); Ellinger and Barry (1987); Lee and Rask (1976)] have shown that the debt-carrying capacity of non-depreciable assets (for example, land) is considerably lower than that of depreciable assets, under traditional loan repayment arrangements. Lower aggregate debt-to-asset ratios for the farm sector are, therefore, logical to expect.

The dominance of real estate among the farm sector's assets, along with a long-term growth in returns to farm assets (interrupted in the early 1980s) has meant that much of the farm sector's total economic returns has been unrealized capital gains or, on occasion, capital losses.

When subject to financial analysis, the farm sector's financial statements indicate a reasonably solvent industry, but one that experiences chronic liquidity problems and cash flow pressures resulting from relatively low, but volatile, current rates-of-return to farm assets. These characteristics make the farm sector's debt-servicing capacity and creditworthiness vulnerable to downward swings in farm income and land values.

[1] The total liabilities for large corporations include contingent and deferred obligations in addition to outstanding debt. They are not, thus, directly comparable to the farm sector ratios, based on farm debt alone.

Non-farm income is also important to the liquidity position and financial well-being of the farm sector. The total annual non-farm income earned by farm operators in the U.S. has exceeded total net farm income since the early 1980s. Most of the non-farm income, however, is earned by large numbers of very small, part-time farms.

The dominance of real estate in the agricultural sector's total assets and farmland's low debt-carrying capacity have fostered an extensive farmland leasing market. The leasing of farmland by farm operators has become a widespread and commonly accepted method of gaining control of land in many countries, one that is especially effective for expanding farm size. In 1992, 43 percent of total farmland in the U.S. was operated by farmers under a rental arrangement with landlords [Economic Research Service (1994)]. The remaining acreage was farmed by an owner-operator. The dominant form of rental arrangement in 1992 was a cash lease (65 percent) in which farmers paid a fixed or flexible amount of cash per acre to the landowner. Share leases and other arrangements constitute the remaining 35 percent of the total acreage under lease. The extent of leasing and share rents differs substantially among regions and states–share leasing is highest, for example, in the high soil productivity areas of the Midwest region of the United States, especially in Illinois (62 percent in 1992).

In general, farmers who lease most of the land they operate can have higher debt-to-asset ratios and experience greater current rates of return to farm assets and equity than those who rely more on ownership. These measurement differences reflect different accounting benchmarks in the profitability and solvency measures for different tenure positions. These financial ratios may also differ substantially among farmers with differences in farm size, age of operator, and major type of enterprise. Reliance on leasing and the resulting higher leverage ratios may also reflect the life cycle of the farm operator. Younger age classes of farmers lease more and tend to have higher leverage ratios.

Agricultural firms face a complex risk environment. Included are risks resulting from lengthy biologically based production, marketing activities, contractual relationships with other parties, changes in asset values, and other related income-generating activities. Farmers also face risks associated with financial leverage and unanticipated changes in interest rates, debt-servicing requirements, and credit availability. Conditions in the general economy, financial markets, government policy, and international markets may all influence the risks faced by farmers. In general, the combined effects of business, financial, and contractual risks are high for most types of farms, thus placing a high value on risk management.

In response to these risks, farmers can employ a broad range of risk management practices [Patrick et al. (1985)]. Besides production and marketing responses to risk, financial responses include holding liquid assets, establishing and maintaining credit reserves, adjusting leverage positions, utilizing insurance, and maintaining flexibility in the frequency of making new capital investments or replacing depreciable assets. Some of the financial responses to risk are directly influenced by public policies, including crop insurance and public credit programs. Finally, a number of studies have shown that rates of return to agricultural assets have low, and in some cases negative, correlations with rates of return on various types of financial and non- farm assets [e.g., Barry (1980);

Arthur et al. (1988); Young and Barry (1987); Gu (1996)]. Thus, the high risks of stand-alone investments in agriculture may be substantially reduced when these investments are added to well-diversified portfolios.

The characteristics of the agricultural sector just described combine to yield a significant and unique setting for the study of agricultural finance. The focus is on a capital-intensive industry in which the dominance of farm real estate has brought liquidity and debt-carrying challenges as well as significant reliance on the leasing of farmland by many farmers. Production units are mostly of smaller scale, although the gap is widening between numerous small, part-time, limited-resource farms and the relatively few but much more economically significant, commercial-scale operations. Business, financial, and contractual risks in agriculture are high, but numerous risk management options are available, especially for larger operations.

These features of the agricultural sectors have been the objects of considerable research in agricultural finance. Numerous farm-level, regional, and sector studies have provided explanations of, or strategies for improving, farm financial structure, firm growth, investment behavior, liquidity and credit management, land valuation and control, leasing arrangements, and risk management. Public policy alternatives for responding to these issues have also been identified and evaluated. Other studies have considered the appropriate structure, regulations, and management of financial institutions providing credit and other financial services to the agricultural sector under the financial characteristics and conditions cited above. Especially important have been evaluations of public credit programs. Subsequent sections of this chapter will consider the approaches and findings of many of these studies in greater detail.

3. Modern finance concepts

Modern finance theory provides a rich perspective on the provision of financial capital by the financial markets and its effects on lender-borrower relationships in agriculture. This perspective is based strongly on the relative information and incentive positions of the parties to a financial contract. It contains elements of agency theory, transactions cost economics, incomplete contracting, property and control rights, and the resulting boundaries of a firm. In this perspective, the firm is viewed, alternatively, as a nexus of contracts [Jensen and Meckling (1976)], a governance structure [Williamson (1996)], or a locus of asset ownership and control [Hart (1988, 1995)], in contrast to the traditional characterization of the firm as a production function [Hart (1988)]. The modern perspective has important implications for evaluating the financial performance of agricultural firms and the financial markets and institutions serving the agricultural sector.

3.1. Agency relationships, adverse selection, and moral hazards

The principal-agent problem is a general one that applies to any contractual, interdependent relationship. Examples in finance are the relationships between a lender (the