

A MODEL OF HOUSEHOLD STRUCTURE, MARRIAGE, AND  
FERTILITY IN RURAL AREAS OF DEVELOPING COUNTRIES  
WITH SPECIAL EMPHASIS ON THE EFFECTS OF OLD AGE PENSIONS

by

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May, 1981

The authors express their appreciation to Samar Datta, Lee Lillard, Jane Jaquette, Wendy Gramm, Bill Partridge, Steve Lansing, Eisaly Krause, Amyra Grossbard Schechtman, Kingsley Davis, Nick Dirks, Tom Gillaspay, Pat Fleuret, Jim Hanson, Maureen Lewis, Jess Benhabib, Leigh Tesfatsion, Jerry Nickelsburg, Sylvia Vatuk, and Anthony Carter for suggestions, comments, and to the United States Agency for International Development for financial support, to Indra Makhija, Ken Wolpin, RAND and the National Council of Applied Economic Research for help in obtaining the data, and especially to Malik Younas and Chuck Williams for their research assistance. An earlier version of the paper was presented to the Southern Economic Association meetings in Washington D.C.

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## Abstract

This paper reviews the existing anthropological evidence concerning the old-age pension motive for fertility behavior in rural areas of developing countries. From this review several important implications for economic modelling of the relationships involved are derived. A framework capable of analyzing the indirect as well as direct effects of the introduction of a formal old-age pension system is developed. The framework is modular in the sense that household structure, marriage, fertility and resource allocation decisions are analyzed in separate but interrelated modules is developed and then tested utilizing panel and cross-section data from rural India. Policy implications and suggestions for future research are also derived.

The paper develops a modeling framework for analyzing the direct and indirect effects in fertility of <sup>Social Security</sup>????? and applies that framework to panel data from rural India.

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The purposes of this paper are (1) to review the cultural, social, and economic institutions and other circumstances which condition the actions of individuals and families, including childbearing, in rural areas of developing countries (LDCs), (2) to present an analytical framework consistent with the findings of that review that can be used both for investigating the role of the "old age security" motive in fertility and related decisions (such as marriage and household formation) and for assessing the potential influences, both direct and indirect, of introducing a social security system on fertility in such countries, and (3) to provide some preliminary empirical estimates based on panel household survey data from rural India for testing several important components of the analytical framework.

Our presentation begins in Section I with our review of the relevant literature on household structure, marriage, old-age security, and fertility. While this review reveals considerable generality in the conditions prevailing in rural areas of LDCs, it gives special attention to the conditions of rural India from which the data used in the study are taken.

Section II presents our modeling framework. In contrast to much of the recent economic modeling of such relationships which tends to emphasize the simultaneity of the static and dynamic decisions involving fertility, marriage, labor supply and education, our approach is modular. The modular approach allows for interdependencies among these various household decisions, but more realistically recognizes both that the timing of the individual decisions is far from simultaneous and that the influences exerted on such decisions by different individuals or groups thereof within the household unit vary quite significantly from one decision to the other. Specifically, the

modeling framework is divided into four distinct modules, each dealing with a different decision or set of decisions. Module I develops an overlapping generation model for analyzing how living arrangements or household structures are determined. Given the structure of the household, Module II determines the age of marriage of both marriage partners, and finally, conditional on household structure and the age of marriage of both marriage partners, fertility behavior is determined in Module III. The fourth module which determines the allocation of household resources is in the process of development.

Section III presents some preliminary empirical estimates from rural Indian data of some of the theoretical relationships specified in Modules I, II and III, derives some tentative conclusions and contains some suggestions for future research.

#### I. DECISION MAKING WITH REGARD TO OLD-AGE SECURITY, HOUSEHOLD STRUCTURE, MARRIAGE AND FERTILITY: THE ANTHROPOLOGICAL EVIDENCE

The purpose of this section is to provide anthropological and other evidence in support of the following hypotheses, some of which are at odds with the conventional formulations of economists:

1. that the old-age security motive is of potential importance in fertility behavior in rural areas of LDCs;
2. that age of marriage and household structure are important intermediary steps between the old-age security motive and fertility;
3. that not all of the relevant decisions in these steps between old-age security and fertility are made by the same individuals or groups thereof;

4. that household formation/partition decisions are strategic economic decisions resulting from the interaction of household heads and their male offspring;
5. that marriage decisions are investment decisions which in many developing societies are made primarily by household heads on behalf of the household as a whole; and
6. that fertility behavior, although influenced by age of marriage, household structure, and the resource allocations of household heads, is also strongly influenced by wives who have a special interest in old-age security.

Our presentation is divided into the following sections:

Section A which deals with the importance of the old-age security motive for fertility, Section B which concerns the choice of the appropriate decision-making unit, namely the residential household, Section C which treats the variations in household types over time and space, Section D which deals with the determinants of household affiliation and partition decisions, Section E which concerns the allocation of the household's resources including marriage decisions, and finally Section F which focuses on fertility decisions and infant mortality and the interrelationships between them.

A. The Importance of the Old-Age Security Motive in Fertility Behavior

Although until relatively recently only a few economists, notably, Leibenstein (1957, 1978), Boserup (1965), Clark (1967), Neher (1971), Mauldin et al (1974), and Willis (1979), have given much attention either in their theoretical models or empirical studies to the old-age security motive for fertility, it has certainly not gone unnoticed among rural sociologists, anthropologists, and family historians and particularly among those who have done much interviewing in LDCs and especially in the rural areas thereof.

The potential importance of the old-age security motive for fertility arises primarily in rural areas of LDCs because of the absence of alternative vehicles for obtaining old-age security in such settings. Capital markets are often so limited or nonexistent in rural areas of LDCs that there may be virtually no physical assets that can be accumulated and then sold for sustenance during old age.

Several reasons may be cited for the incompleteness of capital and land markets in LDCs. First, the property rights of private individuals or households over appropriately accumulable assets like land and capital are frequently restricted, making it illegal for such assets to be bought or sold. Second, since the value of land tends to be considerably greater to those with long experience with and intimate knowledge of specific land parcels, land is likely to be much less valuable in the market than it is to the households who have used it, thereby discouraging its sale. Third, while in principle indebtedness should be expected to force indebted owners to put land and capital on the market to pay off their debts, in practice the labor, and commodity markets are so closely interlinked with those of land and capital that it becomes uneconomic for creditors to

do so.<sup>1</sup> Fourth, other available assets, such as foodstuffs, livestock and financial assets, are unfortunately subject to rapid rates of depreciation, either real as in the case of livestock and food, or financial as in the case in which inflation eats away at the value of financial assets. Finally, the unequal distribution of assets plus the usual problems of the scarcity and the high cost of knowledge make for high transactions costs which, once again, discriminate against transactions in markets dependent on pervasive information.

Even if there were physical assets that could be accumulated and then decumulated during old-age, there would likely be excessive risk in so doing. For example, the value of private accumulation may be rendered highly insecure as a result of law and order break downs, threats of invasion by landless squatters, uncertainties with respect to government policy related to land tenure and reform, uncertainties with respect to natural catastrophes such as floods, droughts, volcano eruptions, and the unforeseen consequences of various sudden man-made catastrophes, such as radioactive or toxic chemical contamination, and other forms of water and air pollution, and/or the more systematic and pervasive effects of unwanted ecological consequences.

Still another reason why other assets are not likely to be as efficient as children in providing for old-age security is uncertainty with respect to the timing of old-age disability and death. If one knew these with certainty, one would know how much of such assets would have to be accumulated. Not knowing them, however, and in the absence of sophisticated financial instruments for purchasing old-age annuities, transfers from children are the most efficient and perhaps ever the only sources of such annuities [Parsons (1977)]. On occasion, as for example in the medieval English manor document by Homans (1941, p. 149), these intra-

familiar intergenerational transfers take explicit written contractual form. [For more contemporary examples, see also Sussman, Cates and Smith (1970)]

Finally, even if there were viable and dependable means of accumulating and then decumulating assets, dependent old persons would not be able to purchase the goods and services they need in local markets, and hence all the thrift in the world would do them little good (Ben-Porath, 1976). On the other hand, children and grandchildren can produce the required goods and services and, particularly if one trains them to be loyal, can be extremely efficient and reliable sources of such services. This is not to say that asset accumulation is irrelevant; indeed the promise of inheritance of such accumulated assets can be an important instrument for inducing the loyalty of one's children (Parry, 1979; Smith, 1978; Parsons, 1977). As Kingsley Davis (1955) in reviewing the experience in a number of countries put it: "Young adults can thus provide (through children) security for their old age even when few other means are available, and they are encouraged to do so by their elders."

Naturally, such conditions are not universal. Some societies may have well-established communal mechanisms for caring for their old and disabled citizens. Extra-familial private philanthropy or official government programs could also be highly developed in certain societies. Indeed, social security and old-age pension systems have now been adopted throughout much of the developed world; although significant declines in fertility have accompanied the spread of social security in developed countries and in the urban areas of LDCs, the direction of causation has not yet been established.<sup>2</sup> Old-age pension systems are, however, still a rarity in rural areas of developing countries.<sup>3</sup> Hence, we hypothesize

that the old-age security motive can be an important motive for fertility behavior in rural areas of LDCs.

In the following paragraphs, we demonstrate the apparent pervasiveness of the importance of the old-age security motive in rural areas of developing countries with some examples chosen primarily to illustrate that the motive is not limited to narrow geographic areas or special institutional circumstances.

Among societies where interviews have turned up the importance of children as sources of old-age security are:

1. Java (Nag, White, and Peet, 1978)

It seems that, to a very great extent, parents rely on their own (including adopted) offspring, etc., at least for their immediate, day-to-day support. A couple with few or no living children is often eager to adopt one or more, preferably from among the children of a sibling or other close relative, precisely to ensure this kind of support. (p. 299)

2. Nepal (Nag, White, and Peet, 1978)

. . . this indicates that here, too, most elderly persons depend on their children, children's spouses, or grandchildren. (p. 299)

3. Solomon Islands (Keesing, 1970)

4. Japan (Smith, 1977; Arnold et al, 1975)

5. Mexico (Ryder, 1976; Van Keep and Rice-Wray, 1975; Nugent and Gillaspay, 1979)

Note for example in the Van Keep and Rice-Wray KAP study that almost 40 percent of the urban women interviewed agreed that "having many children is a guarantee of being well-looked after when one is old."

6. Botswana (Mueller, 1979)

The desire for large numbers of children on the part of poor rural women probably is motivated by this striving for security rather

than by the value of child labor (p. 30).

7. Kgatla, South Africa (Nag, 1962)

Among the principle factors behind the high level of fertility was the fact that "parents rely upon their children for support in their old age" (p. 29).

8. Ceylon (Nag, 1962)

Old people depend on their sons for economic security. Often aged parents, especially when widowed, live with the eldest son. (p. 45)

9. China (Lang, 1946)

10. The Chagga of the foothills of Mt. Kilimanjaro in East Africa

Moore (1978) summarizes the plight of the old women in the village without married sons by saying...."The flaw is that, lacking sons with families nearby, they find themselves surrounded by kin whose interest in them is secondary rather than primary in the Chagga hierarchy of intensity of relationships and obligation."

11. Yugoslavia (Simić, 1978)

"However, most Yugoslavs would undoubtedly consider that in the normal course of events children will care for their elderly parents as a moral imperative and that parents in turn will view this relationship not as one of demeaning dependence but rather as an opportunity to further engage in the exchanges which have typified their entire life cycle." (p. 103)

12. Korea

According to Arnold et al. 1975, 71 percent of rural respondents to questions about the value of children indicated that they expected to rely on children for financial support in old age.

13. Philippines [Arnold et al. 1975]

14. Thailand [Arnold et al. 1975]

15. India (Nag, 1962; Babu, 1979; Vatuk, 1980a,b, Mandelbaum, 1974)

"In India it is expected that when a person grows old he will be provided a home by his married sons." [Vatuk (1980b, p. 4)]

".....sons are the only reliable form of social security for the aged in the traditional system"....."It is generally agreed that providing for old age is one of the major motives for a high rate of reproduction, particularly among rural Indians"[Vatuk (1980b, p. 5)]. Although stressing the sensitivity of rate-of-return-to-children calculations to rather arbitrary assumptions about cost, age, and value of first productive work, etc., Cassen (1978) points out that the rationality of investments in children in India hinges principally on the fact that (1) these investments are a form of forced savings, which is important when incomes are as low as they are throughout India, and (2) these investments provide a reliable source for old age support relative to other forms of investments or insurance. From the interviews with household heads drawn from the Additional Rural Income Survey data that will be utilized below, it can be seen that more household heads gave the old-age security benefits of children as their rationale for having children than for any other reason.

This brief list of societies in which the old-age security motive has been alleged to be of considerable importance in fertility behavior is certainly incomplete. Undoubtedly, it can easily be supplemented.<sup>4</sup> Of course, this is not to say that it is the dominant motive or that people who mention the old-age security motive in interviews may not be attributing to this motive what are closely related but nevertheless distinct kinds of motives. By the same token, however, other motives

mentioned in such interviews, such as "survival," "viability," the desire for survival of the family line, prestige, etc. may well be proxies or disguises for the old-age security motive. Hence, there is very considerable prima facie evidence for the relevance and importance of the old-age security motive for fertility in rural areas of LDCs.

One of the barriers to theoretical and empirical analysis of the security motive has been the difficulty of separating out the interdependent determinants of fertility and other closely related forms of behavior, and to distinguish causes from effects given the interdependencies between the various motives, circumstances, and responses. For this reason any adequate analysis must take into account both the relevant institutional circumstances and the context within which fertility and other decisions are made (Carter and Merrill, 1979; Birdsall et al., 1979).

#### B. The Choice of the Appropriate Decision-Making Unit for Household Decisions

Economic studies have often taken the decision-making unit for granted, merely adopting that unit, be it the individual, the household head, or the firm, which happens to be analytically or statistically convenient. Once the decision is made, the tendency in the literature toward more sophisticated general equilibrium models (as opposed to the earlier partial equilibrium models) has brought with it the implicit assumption that the unit of analysis, i.e., the decision-making unit, is common to all the decisions made simultaneously. This assumption of a single utility function, when applied to household demographic behavior, implies that the welfare of children and other family members enters the utility function of the single decision-maker even in cases where the,

objective is to explain the determinants of family composition (Nerlove, 1974). In our opinion, in the context of demographic behavior and household decisions, this assumption is not sufficiently realistic, quite possibly invalidating the conclusions derived from such studies.

Specifically, on the basis of our reading of the anthropological literature, we consider it more plausible to argue that different decisions, though interdependent, may be made by different individuals or groups within the household.

The first issue to be faced is that of the appropriate unit of analysis for studying household behavior. Indeed, there is some controversy on the issue, some (e.g., Kessinger, 1978) arguing that the common property holding group is the more appropriate unit of analysis, others arguing that a higher level, e.g., the clan, tribe, or set of persons with common kinship relations, is the appropriate unit of analysis. Although there are merits to these perspectives, we find compelling the following arguments in favor of the residential household as the basic unit of analysis.

First, although broader kinship relations can be important in various circumstances, as Shah (1974) has pointed out, interhousehold relationships cannot be properly understood unless one starts with a satisfactory analysis of intrahousehold relationships and of the way in which the household functions. Second, as Ben-Porath (1977, 1980) has emphasized, the importance of transaction costs in poor rural areas of developing countries mitigates against transactions outside of the household. Although there may be important rituals and other exchanges that transcend the household, there are certainly many more transactions that take place within the residential household. Third, the distinction between the residential unit and the property-holding

unit may not be very important. Numerous studies have shown that the correspondence is in fact quite close in rural LDCs, and in those relatively few instances where groups have separate residences but common property such arrangements may be only temporary ones representing a traditional phase on the way to complete partition of both property and residence [Simić (1978), Parry (1979)]. In any case, because the frequency of contact and the scope of interrelations and coordination among members of a common residence are greater than among those in a common property group, the choice of the residential household would seem especially appropriate in the analysis of fertility behavior.

As Carter and Merrill (1979), Nag (1962), Shah (1974), and others point out, however, it would seem important to allow for different individuals or subunits of the household (especially in the case of "extended" family households) to play different roles in different decisions. Clearly, different subgroups are relevant in deciding whether or not to live in a joint family or to separate; the head of the household may be the relevant decision maker for many decisions, especially those involving the allocation of resources; wives are of special importance as far as fertility decisions are concerned; individuals and nuclear husband-wife units may be the relevant decision makers in determining living arrangements and migration patterns. The relative importance of different individuals in some forms of behavior may vary from society to society, but within any society certain norms can generally be detected (Nag, 1962).

### C. Variations in Household Type Over Time and Space

Once one adopts the household as the basic unit of analysis in the rural LDC context, one has to come to grips with and take account

of the considerably greater diversity of household types that exist compared to LDCs. Households vary widely in size and structure in most rural areas and may be subject to systematic changes over time. These changes, moreover, may be intimately related to the fertility and other decisions made within the household (Carter and Merrill, 1979; Birdsall et al., 1979).

Of particular interest and importance for fertility behavior are two complementary hypotheses: first, the hypothesis of a secular trend in household type toward the nuclear type that dominates in "western" developed countries (Bailey, 1957; Epstein, 1960); and second, the hypothesis that the institution of the extended family contributes to the high fertility rates prevailing in most rural areas of developing countries. For example, Davis (1955) argues that extended families would favor high fertility rates by lowering the costs of bearing and raising children, by reducing the age at marriage as a result of removing the need to accumulate savings for household formations, and by increasing the incentive for a wife to have children early in marriage so as to induce her husband to split off from the parental household, thereby protecting her from her in-laws. (See also Lorimer, 1954; Davis and Blake, 1956.) The transition from "traditional" extended family households to nuclear ones would then be expected to lower fertility rates gradually over time. Despite their seeming plausibility, however, both component hypotheses are open to challenge.

First, there does not seem to be any compelling evidence that there has been a general trend toward nuclear households. Indeed, if anything, the evidence seems to suggest that no discernible trends are in evidence, despite substantial economic and social change. This evidence consists of both historical studies for developed countries

(e.g., by Laslett, 1972; Goody, 1972; Smith, 1978; Goody, Thirsk, and Thompson, 1976) showing little or no evidence that developed countries had ever been dominated by anything but nuclear households, and historical studies for LDCs, e.g., by Kessinger (1974), Orenstein (1961), Gore (1968), Rae (1968), Karvé (1963), Avalaskar (1966), Shah (1974, and Kolenda (1967, 1968) for India, by Cohen (1976) for China, Little and Price (1974) for Africa, and Fukutaki (1967) and Smith (1977) for Japan, finding little or no evidence, other than legend, myth, and social and religious norms which may not necessarily have been based on historical experience (Shah, 1974) that extended households had been more common in earlier times.

The second hypothesis, that of higher fertility in extended family households than in nuclear households is also open to challenge on several grounds (Stykos, 1958; Burch and Gendell, 1972; Carter and Merrill, 1979). While the possibility of living in the extended family may make it easier as far as the couple is concerned to marry and raise children, the joint household as a whole has to face up to the costs of financing marriages (which include both bride price or dowry payments and the costs of often elaborate wedding feasts and can thus be major investments as far as the household is concerned) and of feeding and raising the children in those households.

Historical studies in Europe and elsewhere, moreover, have revealed cyclical movements in household size, thereby demonstrating that both nuclear and joint households can be consistent with either high or low fertility (Laslett, 1972; Tilly, 1978). The historical cycling evidence has been supplemented by the cross-sectional observations by Nag (1962) and Goode (1963) suggesting that fertility behavior of both nuclear and joint households can vary considerably as conditions change.

This evidence greatly weakens the case that there must necessarily be systematic differences between nuclear and joint families with regard to their fertility behavior.

Empirical studies of India by Nag (1967), Pakrasi and Malaker (1967), Bebarta (1977) and Shah (1974) and of other countries by Freedman, Takeshita, and Sun (1964), and Liu (1967) have yielded ambiguous results. Much of the ambiguity of the results may be attributable to the rather arbitrary distinctions that have frequently been drawn in such studies between those households that have been classified as "nuclear" and those that are "joint" or "extended" (Shah, 1974) and from other shortcomings in data and research design (Bebarta, 1977; Shah, 1974; Burch and Gendell, 1972). Since the household structure tends to vary with the life cycle of the family, it would seem important to distinguish the character of the household of current residence of the woman from that of residency in childhood, upon marriage and all during her fertile years (Burch and Gendell, 1972). Most importantly, as Shah (1974), Burch and Gendell (1972), Parry (1979), and Carter and Merrill (1979) have all persuasively argued, there may be a self-selectivity bias problem and also interdependencies between fertility and household structure suggesting the need for a more complex analytical model and testing procedure in order to separate out other differences such as wealth, occupation, education, and religion, between nuclear and extended households and to determine the extent to which household structure causes fertility rather than vice-versa. Parry (1979), in particular, has stressed the possibility that differences in fertility behavior among the wives of male siblings living within a joint household may

be a determinant of household partition. Shah (1974), Vatuk (1980a,b), Keesing (1970), Bebarta (1974), and Smith (1977) stress both the relevance of the joint household as far as old-age security is concerned, and the relevance of old-age security to fertility.

The lesson to be drawn from this literature is unmistakable. For any satisfactory treatment of the relation between old-age security and fertility, one must not only take household structure and changes therein into consideration, but also account for the interdependencies among wealth, income, inheritance rules, the shares of household subunits in full income and expenditures, marriage costs, mortality, and of course, both household structure and fertility.

#### D. Determination of Household Affiliation and Formation/Partition Decisions

The fact that households go through a life cycle with respect to size and structure has been acknowledged in the previous section. Indeed, Fortes (1949), Goody (1958, 1972), and others have suggested that this natural life cycle of the household is its most important feature, and suggesting that the position in the life cycle may be the most important and perhaps even sole determinant of household size and structure.

More detailed investigations, e.g., by Kolenda (1968), Shah (1974), and others, however, tend to illuminate the rather wide variations that exist in household structure even after taking position in the life cycle into consideration. Although most households may follow the life cycle, in general, there are certainly non-random variations in degree and timing (Parry, 1979). Thus, allowing for differences in institutional conditions, region, status or caste, etc.,

still leaves a great deal of variation in household structure to be explained, and furthermore, begs the question of why such differences should exist.

Much of the anthropological literature quite naturally focuses on the personalities involved, and in the Indian context pays considerable attention to the rivalries and personal conflicts that arise between the adult female members in joint families, thereby attributing partition decisions within joint households to conflicts which would seem to be both random in occurrence and in the long run almost inevitable. Recently, however, an important minority of anthropologists, e.g., Shah (1974), Kolenda (1968), Parry (1979), Carter and Merrill (1979), have become increasingly skeptical of this view, finding variables that seem systematically related to the probability that these conflicts result in partition.

Although personalities undoubtedly come into it, such decisions are not, I suggest, a purely random outcome of individual whims or of a man's sudden realization that he can no longer face the prospect of living at such close quarters with his brothers. The crux of the case I shall argue below is that these individual decisions conform to a pattern which can only be understood in the light of a set of material constraints imposed by the employment and inheritance prospects of men, and by marriage strategies of fathers vis-a-vis their children. (Parry, 1979, p. 179)

Household affiliation and composition are in this light the outcomes of individual or group strategies of how to maximize one's situation given the relevant resource and other constraints. They are the net result of various competing centrifugal and centripetal forces. What forces of each kind can be identified? Most observers have found that the factors involved and their relative importance tend to vary with the type of relation--the father-son or intergenerational relations generally

being stronger and subject to somewhat different pulls and pushes than those between siblings.

Perhaps in order to reduce transaction costs (Cheung, 1972), such relations are generally subject to societal norms which can be deviated from only when one is willing to pay a price in terms of moral and other sanctions. Both the norms themselves and the sanctions against their violation vary from society to society. In India, for example, the norms and the moral sanctions on those who sever familial relationships prematurely (as for example the partition of a household by a son prior to the death of his father) are considerably stronger in the case of father-son relations than in other cases. As Parry (1979) points out, it is the combination of these societal norms and environmental constraints which conditions household affiliation and hence formation and partition decisions.

In any single instance partition takes place because individuals decide that it should and this decision is made within the context of certain demographic, economic, and moral constraints. It is these constraints on choice which generate regularity or frequency in empirical form. (Parry, 1979, p. 155)

. . . individual and group self-interest (i.e., what was economically rational) varied widely. As a result, the economic value to an individual living within a joint family or of making use of the authority structure and role relationships of a joint family . . . also varied widely. (Owens, 1971, p. 223)

Chief among the forces of attraction is almost certainly the security motive. Large, complex families provide a mechanism for pooling risks. The advantages of joint or extended households need not be confined to the security motive and the risk-sharing advantages of cohesion. Nevertheless, the relevance and importance of the old-age security motive is a major consideration in favor of cohesion with respect to fathers and sons and their respective wives and children

(Shah, 1974, p. 50). Even those observers, (e.g., Cassen, 1978), who have failed to see household affiliation as a rational decision, and those who have failed to appreciate the other advantages of the joint household, such as economies of scale and specialization, have not failed to appreciate the risk-sharing advantages of the large extended household. For example as Cassen (1978, p. 76), a strong critic of the system, expressed it:

In a society lacking in communal supportiveness, where the powerful use and perpetuate their advantages in every conceivable way, the family becomes for most people the only source of security. It is an inefficient and in some ways a cruel one; it will continue so until an alternative appears.

The old-age security benefit to the old of living in joint family arrangements accrues, of course, only if one's children are loyal and provide intrafamilial transfers. Loyalty, however, is something that parents can at least partially inculcate in their children, and numerous field studies have noted the many sometimes subtle ways in which children are trained to be loyal. Normally, the mother plays an important role in such training, and this may not be entirely accidental considering that in many societies wives are younger than their husbands, making it likely that they will become widows, and hence a high proportion of old-age dependents are, in fact, widowed mothers [Vatuk, 1980a,b].

The reasons why joint family living arrangements have advantages as far as old-age security is concerned are several. Certainly the aforementioned higher transactions costs of extra-household activities relative to intra-household ones and the absence of markets for the goods and services that old-age dependents need in rural areas of developing countries have a great deal to do with it. Also, there

are the advantages of scale and division of labor given the specific factor proportions of supplying those goods and services. A rather neglected advantage is the fact that living in an extended family with one's parents may help inculcate loyalty, providing an important example to or having a demonstration effect on one's children, suggesting that they, too, should take care of their parents in their old age.

There are, of course, ways in which such goods and services can be provided to old-age dependents without joint living arrangements, such as when the old-age dependents live next door to their providers making it easy for food, clothing, and the like to be brought in. This goes back to the choice of the decision-making and statistical unit, discussed in Section B above, where the balance of pros and cons seemed to favor the household as the most appropriate unit in most but not all circumstances. Although the living-next-door arrangement may be a close substitute for joint living arrangements, it is certainly not a perfect substitute, and separate living arrangements may considerably reduce the costs of coordinating decision making and resource allocation between the households, even though they are within the same family, and in close proximity to one another.

The recent studies of Beberta (1977), Shah (1974), and especially Parry (1979) are the source of many additional hypotheses about factors affecting the decision to live together or apart.

#### (1) Inheritance and Wealth

The prospect of inheritance is certainly an important instrument that older persons have with which to induce flows of desired goods and services from their potential heirs. In most societies inheritance generally goes from fathers to sons (or mothers to daughters

in matriarchal societies). In some societies, such as those in parts of Africa, inheritance goes from brother to brother. Not surprisingly joint households among siblings are more common in the latter societies whereas joint households among parents and their children are more common in countries where the former types of inheritance rules dominate (Goody, 1972). In most societies where inheritance goes from father to son, land and other accumulated endowments are not transferred until death of at least the male parent, and sometimes also not until the death of the female parent. The threat of non-bequeathal is certainly an important tool in the hands and minds of parents to instill loyalty on the part of their children, especially in societies in which accumulations of land and capital are difficult to accomplish.

Its effectiveness can be constrained by certain institutional rules and constraints such as those of primogeniture or equal division rules (which may have been established to control fratricidal murders and disruptive fighting). Its effectiveness can also be reduced by the absence of competition, as when there is only one potential heir. Parents can make this tool more effective by having several children or indeed several male children in patriarchal societies. Notably, however, the rules tend to be defined to fit the circumstances and there is often considerable deviation of actual practice from official rules. (Parry, 1979 points out, e.g., that the Indian government's efforts to guarantee equal inheritance shares to female children as to male children is disregarded in rural areas.) The effectiveness of the inheritance instrument is strengthened if the parents can wait until the last possible moment in naming their heir. When forced to make such a decision in advance of death, other things being equal,

there may be advantages to naming the youngest son as the heir since the youngest son offers the greatest security by his higher probability of longevity; and by holding off the decision until the youngest son comes of age and is fully productive, the parent maximizes the contributions that he (she) is in the meantime able to extract from the older sons as earners and providers to the joint family by holding onto them as long as possible during their prime working years.

Inheritance, of course, is ineffective if there is nothing to inherit. Hence, the extent to which parents are likely to be able to hold on to their children and indeed their loyalty by the bequeathal promise should be positively related to their wealth.

## (2) Other Advantages of Wealth and Land

Aside from its relation to inheritance and hence its ability to induce loyalty in the form of intra-household intergenerational transfers, the quantity and quality of land and other forms of wealth can also have other cohesive influences. Children and siblings of working age may have outside employment opportunities. Their willingness to remain in the joint household under the direction of the household head will be affected by the differential benefits relative to costs of remaining in the household relative to those of moving out in order to take advantage of those outside employment opportunities. While there may be circumstances wherein one can work elsewhere than on the family farm and yet remain in the household, there are certainly limits to such possibilities and hence often a decision to work elsewhere is accompanied by a decision to move out. In such circumstances, given the available opportunities for off-farm employment, the more land available within the household the higher will be the marginal and average productivity of on-farm labor and hence the more likely the

extra worker can be induced to stay on the farm and in the joint household (or if there are no male children the more likely it is that husbands can be induced to marry-in with their daughters or that sons can be adopted) (Fuller, 1976; Shah, 1974; and Parry, 1979). Shah (1974) goes on to suggest two additional reasons for the cohesive influence of wealth: (1) that wealth or income is a cure for the intrafilial feuds that develop, especially among wives in the joint household, and (2) that wealth and income increase survival rates, thereby making old-age dependency more relevant and important for wealthier households.

### (3) Fertility Differentials Among Couples Living Within Joint Households

If all male members of the household provide an equal share of the budget of the joint household, the propensity to partition will be greater, the greater is the differential in fertility between the wives of the married males. To avoid friction, fertility differentials would have to be compensated for by differential contributions to the household budget. Note, however, that children and wives can provide at least part of these differential contributions.

The timing of marriages can also be a factor in partition. In India, for example, where marriage costs are of major importance in the overall household budget, and a brother has no responsibility for financing the marriage of his brother's daughter after partition, partition is likely to take place prior to the marriage of the children of siblings.

Given the interest of wives in providing for their old-age security via offspring and also for wanting to get out from under the domination of her in-laws with whom she lives with initially

(which is an especially understandable motive in the Indian context), wives may feel that having children early in marriage would be beneficial for them in part because it is likely to induce partition of the joint household. On the other hand, once a wife becomes the mother-in-law in the joint family household, and assuming that she already has had male children, it is in her interest to stop having children in order to induce her sons to remain in the joint household. This economic explanation would seem to explain the otherwise paradoxical findings of Bebarta (1977) that women in joint households have children earlier than other women but also stop having them earlier, making it possible for their completed fertility to be lower than that of women living in nuclear households.

While anthropologists have put forward these and other interesting hypotheses that have implications of potential importance for both theory and policy with regard to fertility, their reliance on essentially inductive techniques wherein their data generates their hypotheses implies that these hypotheses have not yet been tested in any meaningful sense.

#### E. The Allocation of Household Resources and Marriage

Since for the most part there is coincidence between the property-holding group and the residential group, the household's resources are generally utilized collectively and allocated by the household head whose responsibility it is to resolve disputes about the fairness of resource allocation within the household. Generally, household heads allocate resources in what would seem a "rational" or "efficient" manner (Parry, 1979; Carter and Merrill, 1979).

Given the variety of tasks that have to be performed within a

rural household, only a small proportion of which are typically marketed, it is not surprising that there is substantial room for variation in comparative advantage among the different members of the household and that a division of labor and degree of specialization among tasks is arrived at. Almost all anthropological studies provide at least qualitative evidence of the marked extent to which there is division of labor especially between sexes.

Even allowing for a considerable margin for error in measurement, virtually all time allocation studies (e.g., Dasgupta, 1977; Nag, White, and Peet, 1978; Shah, 1974; Cain, 1977; Bond, 1971; Mueller, 1979; Da Vanzo and Lee, 1978), although drawn from a wide variety of countries, demonstrate a high degree of specialization by age and sex. In particular, young girls spend large portions of their time on those activities, such as fetching water, cooking, food preparation, care for the sick and disabled, sewing and repair work, that are in demand by old-age dependents. Young boys spend substantial portions of their time on animal husbandry, gathering firewood, and hunting and fishing; middle-aged men concentrate on the heavy agricultural tasks and on civic responsibilities such as meetings; finally women spend their time on housework, child care, food preparation, and in some cases on marketing and agricultural activities. Old people tend to remain active in primary agricultural activities until later in life than they do in DCs (Adams, 1972; Cardy, 1976; Harlan, 1976; Vatuk, 1975, 1980; Raj and Prasad, 1971; Mueller, 1976).

If as a result of changes in technology, in market prices, in transport costs, or in institutions (such as the introduction of a social security system of old-age pensions), the household's mix of

activities changes, this change in the activity mix can bring about a substantial reallocation of time to activities among members of the common household, and can affect the relative value of having different types of people in the household. In technical terms, the shadow prices of the time of different sex and age groups can be affected, thereby also affecting the economic value of children and hence desired fertility.

Such changes can also affect savings and investment allocation decisions including marital fertility and adoption decisions. Many of these influences can affect the level of wealth of the household, and hence can affect the household's preference for the present over the future, and hence its savings and investment rate. For example, increased commercialization may induce farmers to go into debt lowering their wealth and thereby forcing themselves to save more (partly to pay off their debts). Decreased infant and child mortality may leave the household with more surviving children of any sex than they had expected, making them feel wealthier, thereby possibly lowering their savings and investment rate. Similarly, the introduction of an old-age pension system may make people feel wealthier and hence lower their savings. In the rural developing country context, however, lower or greater savings may translate into a wide variety of reallocations of the time and other resources of all members of the household.

In all of these reallocation decisions the household head's role is vital. The parallel in these allocation functions between the role of the household head and that of the entrepreneur or manager of the firm is striking indeed. The household head's role is to coordinate and supervise the work of the household, to allocate

people and their time to tasks, to either decide or exert leadership in reaching dynamic decisions such as the level of savings and the allocation of investments including marriage. The household head's most essential function is to guarantee the basic viability of the household. The work of the household head and of the household as a whole is likely to be most effective when his headship is unchallenged, and because of close family relations in a common residence, there is both good teamwork among household members and a considerable amount of mutual trust, thereby avoiding the need to set up elaborate and costly monitoring activities to detect shirking and self-indulgence by individual household members.<sup>5</sup> With more distant relations or unrelated persons, the trust and intimate knowledge of the members of the household team are likely to be weaker and hence the greater is the potential for partition of the household.

The fact that headship is likely to be less open to challenge in father-son relations than in relations among brothers or between uncles and nephews, at least in many societies, makes it likely that father-son joint households will be more successful and be more durable than intragenerational ones or those between uncles and sons (Parry, 1979; Carter and Merrill, 1979).

Part of the household head's function is also to train a successor, which cannot easily be accomplished if the head refuses to turn over some of his responsibilities to his successor. Learning-by-doing would seem to contribute greatly to successful headship.

Household heads play important roles in the management of household assets and in determining the rate of accumulation and the allocation of resources. Although the available data are often only

anecdotal and qualitative, there is every indication that household heads participate in a major way in education, migration, agricultural investment, and marriage decisions. Since the household head normally has considerable discretion over the allocation of resources, he can exert considerable influence over the composition and structure of the household inasmuch as he can offer inducements to stay or to leave. Indeed, the household head is also likely to possess the power of expulsion over household members, although (according to Parry, 1979 and Carter and Merrill, 1979) this power is usually thought to be so strong that it is in fact seldom utilized.

The household head's (and also the non-head husband's) control over fertility and infant mortality of his wife and of his brothers and sons' wives is weaker and more ambiguous, and certainly more indirect. Undoubtedly also its effectiveness varies considerably from one society to another, and perhaps even from one head to another. The head is certainly not without instruments. He can usually divorce his wife; he can usually remarry after being either widowed or divorced and, in some cases, he can take several wives at once. As for the allocation of resources, the household head may be able to encourage or discourage fertility, but he is usually reluctant to interfere very directly in the fertility decisions of other couples within the household.

Indeed, because (1) expenditures on marriage and adoption frequently constitute a very significant part of overall household expenditures, (2) the presence of male and female members in several generations is of such importance to the short-run as well as long-run viability of the household and (3) the timing of marriage and the choice of marriage partners are major sources of influence over fertility decisions, household

heads in many if not most rural societies play a very important role in arranging marriages of daughters and sons. This power includes considerable and sometimes even unlimited discretion over the choice of time, place, and partner-in-marriage.

As has already been pointed out, the bulk of the anthropological evidence on rural areas of developing countries suggests that marriages are more likely to be "arranged" or at least approved than are marriages in more developed countries (Lang, 1946; Gore, 1968; Jahan, 1973; Goode, 1963; Dixon, 1976). Marriage also tends to be more essential in such countries, inasmuch as the long-run viability of households requires that the individual household have both male and female members, and preferably those of more than one generation, so as to ensure complementarity in production and consumption both in a given time period and over time.

Household heads may invest very considerably in search activities to assure that the wives they obtain for their sons be not only reliable marriage partners for their sons and daughters, but also to possess characteristics of value to the household as well as to their sons. The head can be expected to search for women who are capable of producing healthy sons and daughters, and who are likely to be productive, hardworking members of the household, to be loyal to the household head and his wife so as not to be likely to want to induce partition of their sons from the joint household (thereby lowering the expected value of transfers from children in old age) and also to be trustworthy and cooperative so as to facilitate good teamwork among all members of the household.

The control of the head of the household over marriage decisions is a part of his control over all the property of the household in-

cluding its human capital. Referring to conditions that used to prevail in rural China, Lang (1948, pp. 26-28) notes:

The head of the family was the oldest male member . . . he held the title to all family property and he alone could dispose of it, as well as of the earnings and savings of all the family members. He settled the marriage of his children and signed the marriage contracts.

As a result of marriage, the daughter who married-out is transferred from one household to another. As Freedman (1961-62, p. 328) expresses it:

Her marriage cut her off economically and as a legal person from her own family and transferred the rights in and over her to the family receiving her . . . to a large extent physically, and in all degrees legally, she was locked within her husband's gates.

Again, referring to China, Cheung (1972) calls attention to various devices such as the binding of feet that were traditionally used to prevent daughters from running away from their new households, thereby raising their value in terms of bride price. In many religious rituals, couples are not to see each other prior to marriage, thereby allowing household heads to arrange marriages free from the interference and expressed preferences of their children. In contemporary times, of course, the relative importance of "blind" marriages has diminished, but the household head still maintains considerable control over both the timing and choice of partners in marriage, at least in rural areas. The influence of the household head on the marriage decision contrasts somewhat dramatically with the formulations specified in many economic models of marriage where it has become conventional to have the marriage partners themselves engaging in the search activities, the length of search thereby determining in large part the timing of marriage. In rural LDCs, search would seem to be much more of an activity of

the household head or of his agents including quite frequently former members of the extended household who have married into candidate households in other villages as well as professional marriage brokers.

Still another reason for the head of household's control over marriage decisions of their children is to protect headship and the authority of the head from emotional attachments that may arise when marriage decisions result from the voluntary choice of the marriage partners themselves. This can also be an explanation for marriage early in life.

"If the young girl or boy can be kept from members of the opposite sex so that no emotional attachments can be formed and marriages are arranged early, the bride and groom have neither independent emotional nor independent socioeconomic resources with which to oppose such decisions. Thus it was to the interest of elders who wished to maintain the traditional family system to arrange the marriage at as early an age as possible." [Goode (1963), p. 105]

Admittedly, however, there are other influences which may tend to reduce the influence of parents and the household head in arranging or even approving marriages of their children or other relatives in their households. Education, for example, may tend to make children more independent, both by keeping the children away from the household and perhaps by changing their tastes, aspirations, and goals. Also, better communications, commercialization, and other factors that are certainly of growing importance may tend to reduce the role of parents in educating their children about the world, and in making marriage decisions for them (Hull, 1978). It would seem important, therefore, to account for the education of children, non-agricultural employment, and other factors that might tend to reduce the extent to which marriages are ar-

ranged, and which also, of course, are likely to have direct influences on age at marriage and hence on fertility.

Notably, several of these factors tending to reduce the role of parents and household heads in particular in marriage decisions (and also to raise the age at marriage) are associated with urbanization. In Hong Kong (which is almost entirely urbanized now) Mitchell (1971) notes that 53% of women over 60 years of age said that they were introduced to their husbands by a match-maker whereas only 1% of those 24 and under said the same thing. Likewise, 66% of spouses 60+ years of age but only 18% of those 24 years of age and less said that their marriage was either "ordered by parents or arranged by a match-maker". Similarly, 47% of those aged 60 and over said that they had no courtship before marriage whereas only 1% of those 24 and less gave the same response.

#### F. Fertility and Infant and Child Mortality

Traditional demographic transition theory has depicted the relation between mortality and fertility to be a simple one: namely, that population growth is attributable to the rather long realization and adjustment lag between decreases in mortality and subsequent decreases in fertility, thereby ascribing to mortality the role of an exogenous variable. This theory and this role, however, are increasingly open to challenge.

First, recent historical studies have increasingly challenged the view that fertility rate declines lagged substantially behind mortality rate declines in Europe, Japan, and elsewhere, and anthropological studies have tended to reject the notion of a long adjustment lag in contemporary developing countries (Carter and Merrill, 1979). This is not to say that declining mortality rates are not responsible for popu-

lation growth in the recent history of LDCs, but only to point out that the sharpness of the decline in mortality rates that developing countries have experienced during these years has been without historical precedent and that fertility rates have indeed been falling quite significantly, especially during the last decade (Birdsall et al., 1979).

Second, as mathematical modelers of demographic conditions have pointed out, stability or equilibrium in the relation between mortality and fertility does not necessarily imply a fertility rate consistent with zero population growth (Heer and Smith, 1969; Burch, 1970).

Third, the relation between mortality and marital fertility need not be a very direct one for the overall relationship between mortality and fertility to hold. This is because much of the adjustment to variations in mortality may well take the form of variations in age at marriage, rather than in marital fertility rates (Wrigley, 1978).

Fourth, changes in mortality can affect several other variables with possible indirect effects on fertility. For example, as Ram and Schultz (1979) have argued, the decline in mortality rates can affect the rate of return to investments in human capital, especially education. This, in turn, can influence household savings, income growth, sex-specific labor force participation rates, the entire allocation of resources within the household, and in the long run even the structure of the household. Any such changes can influence fertility, and can also have consequences for the direction of the intergenerational transfers within the household (Goode, 1963; Caldwell, 1976; Aries, 1965; Doubert, 1970; Laslett, 1965; Laslett and Wall, 1972; Stone, 1977; Thadani, 1978). As Birdsall et al. (1979), emphasize, the overall effect of mortality on fertility can be captured only if one considers

both the biological effects (such as the shock and disruption to household activities that sickness and death of one's child may bring about) and the economic effects including both the wealth and relative price effects and both the static and dynamic effects of each. Notably both the relative price and the income or wealth effects of mortality declines may vary significantly from one household to another depending on the size and structure of the household.

Fifth, the direction of causation in the relationship may not be as unidirectional as it had been assumed to be. Much recent work on nutrition and infant mortality has revealed that fertility and birth spacing can have important effects on infant nutrition and hence on the probability of survival. As evidence for the hypothesis that infant mortality is at least partially endogenous in rural areas of poor, overpopulated developing countries, Scrimshaw (1978) cites examples of extreme child neglect and even infanticide, the relation of the female work load to infant mortality, the rather marked sex differentials in infant mortality, and the positive relation of infant mortality to the time elapsed from the immediately preceding birth. Again as the above-mentioned new historians of the family point out, expectations with respect to infant mortality can be self-fulfilling and reinforcing. If one expects there to be a good chance that one's child will not survive, one invests little in the child in terms of time and emotional attention; as a result, the probability of survival is reduced. Smith (1977) rather convincingly documents, with birth registration and census statistics, the importance of systematic infanticide over long periods of time historically in rural Japan. Cassen (1978), Parry (1979) and Mitra

(1979) suggest that infanticide is not unheard of and enjoys the collaboration of the wife-mother in it in contemporary India, especially with respect to female children.

Some of these effects on infant mortality may thus be intended. Others may well be inadvertent. For example, the relationship between close spacing of births and infant mortality, especially of the earlier birth, is attributable to premature weaning of the infant from the mother's breast to make room for the newborn. In the absence of sanitary and nutritionally sound alternatives, there is a relatively high probability that the weaned child will not survive into adulthood (Khan, Hammer, and Lynch, 1977; Wray, 1971). For additional evidence of this and other economic and social effects on infant mortality see Heller and Drake (1979). Interdependence between fertility and infant mortality can also be attributed to the practice of breastfeeding and its effect on postponing ovulation (post partum amenorrhoea). The strength of this effect is also affected by health and the nutritional status of the mother (Butz and Habicht, 1976).

Additional evidence of the endogeneity of infant mortality comes from (1) demonstrations that public health improvements, such as malaria and other disease eradication programs, and programs to supply potable water and to provide sewage systems explain only a fraction of the mortality decline in specific countries and (2) studies showing that infant mortality has tended to decline more rapidly in those societies that have achieved reductions in the degree of income inequality, such as Sri Lanka (Birdsall et al., 1979).

With respect to the important issue of the appropriate decision-makers(s) within the household with respect to fertility and infant

mortality decisions, as has been mentioned above, the role of the household head especially in extended or joint households would seem to be much smaller and more indirect than that in the other decisions which have been reviewed. Most studies (e.g., Dixon, 1976; Salaff, 1972) concede to the wife an important, if not dominant, role in fertility behavior, especially in relation to how constrained she is in virtually all other respects. Also in infant mortality, the wife-mother plays a dominant role, although, of course, circumstances can be much affected by the household structure and the static and dynamic allocation of resources. Within the household not only are fertility and mortality variables over which married women are likely to have more control, but, in view of the likelihood of long widowhood, women also are likely to have the incentive to exercise that control.

The importance of widowhood and hence of dependence on one's sons can be seen in the fact noted by Vatuk, (1980b) that only 25% of all Indian males over 60 years of age are without wives whereas over 70% of all Indian women over 60 are widows. This large discrepancy is due in part to higher remarriage rates for husbands than wives after divorce or widowhood and also to the rather sizeable age differentials that generally prevail between husbands and wives at first marriage [Vatuk 1975, 1980a,b]. Given that widowhood is such an important fact of life for most women, that sons are a relatively reliable form of old-age security and the various surveys [Vatuk, 1981] show that more than two-thirds of elderly women in rural India live with their sons, it should hardly be surprising that Indian women "...generally begin to be concerned at a fairly early stage of life with the need to provide themselves with a male heir." [Vatuk, 1980b, p. 5]. As Ridker put it, "children, espe-

cially sons, may appear to be all that will save them from destitution after their husbands are dead ...." (Ridker, 1976, pp. 9-10).

Another source of evidence in the anthropological literature for the widowhood, old-age security motivation for fertility being especially strong in females is the tendency for the wife-mother to be the center and most effective promoter of the affectual links, the peacemaker between generations, and the fulcrum of stability of the household. [Velez 1978, p. 159, Simić 1978, p. 102]

Many anthropologists, especially those working in Africa and in the more primitive regions of other geographic areas, e.g. Fortes (1978), explain the special interest in, and hence independence of the wife-mother over fertility in terms of the substantial rights that she attains from motherhood as opposed to the rather few rights that accrue to her on marriage. Likewise, the prestige associated with the demonstration of fertility (but also the shame or blame for failure to conceive) is focused almost exclusively on the wife rather than on the husband.

Still another explanation for the wife-mother exerting an independent (though perhaps rather constrained) influence on fertility and child-survival in rural areas of LDCs comes from the literature of social psychology. In this literature it is argued that degree of agreement over action i.e., lack of independence of the wife-mother in family matters, is positively related to the degree of communication between spouses. The literature also provides strong evidence that communication between spouses is much less frequent, complete and satisfying in rural areas of LDCs, and perhaps paradoxically especially so in societies in which male domination of women is strongest, than it is in developed countries. [See, for example Stycos (1955), Bott (1957),

Blood and Wolfe (1960), Hill et al (1959), Yaukey et al (1965), Navran (1967), Poffenberger (1969), Carlaw et al (1971), Mitchell (1972), Knodel and Prachuabmoh (1976), Coombs and Fernandez (1978)]. Where lack of communication and hence lack of agreement between spouses about fertility are prevalent, it is implied that wife-mothers will exercise independent influences over fertility and child-survival.

Finally, some psychologists have argued that there is experimental evidence that women in different cultures are generally more risk-averse than men. [ ]. If so, this could provide an additional explanation as to why women are more concerned with old-age security than are men.

Whatever the cause or source of the independent role of the wife-mother, the point is that there are very considerable grounds for believing that she may be able to play such a role when it comes to fertility behavior even in societies in which males dominate females in virtually all aspects. Indeed, in some societies as Fortes (1978) points out, after marriage and the birth of the first child some of the property rights over the wife's sexuality and her children accrue to her as opposed to her husband or to the household in which she lives.

#### G. Implications Derived from this Evidence

From Section A above, there would seem to be very considerable prima facie evidence in support of the hypothesis that old-age security is an important concern in rural LDCs. This is because in such areas there is a dearth of both (a) reliable assets that can be accumulated and subsequently decumulated during old age and (b) markets for at least some of the goods and services that elderly people require for survival. Section

A also provides rather convincing evidence that rural residents of LDCs tend to look to their children and especially to their male children as sources of old-age support. As noted in Section F, this tendency is most noted in women because of their greater expectations of a fairly lengthy period of widowhood.

Sections A, C and especially D provide evidence for the fact that joint living arrangements are a common and efficient means of providing for old-age support in the form of intergenerational transfers. The anthropological evidence in Section D, moreover, indicates that the practice of joint living arrangements with one's parents may also be useful for its demonstration effect on one's own children of what they should do for their parents in their old-age. Ample evidence in a variety of institutional conditions is also provided for the fact that property rights and inheritance rules are generally rigged in such a way that household heads, especially wealthy ones, have at their disposal rather powerful instruments of control for holding onto their children, i.e., inducing them to remain in the parental household until their demise.

Household affiliation and structure, therefore, are important links in the causal chain between old-age security and fertility, especially considering that the degree of extension of the household can exert a variety of influences, both positive and negative, on fertility. Notably, however, there is also evidence of potentially important feedbacks from fertility behavior to household structure.

Although already well established in the literature, additional anthropological evidence was provided in Sections E and F for the proposition that completed fertility is likely to be rather closely related

to age-at-marriage. Indeed, since household heads have relatively limited direct control over fertility behavior of their daughters, daughters-in-law, nieces, etc., age-at-marriage and the choice of partners in marriage are the major instruments of household heads over fertility and thus constitute another important link in the relationship between old-age security and fertility. Once again, however, the relationship is not free of feedback effects from age-at-marriage and hence marital status to household structure and old-age security.

What is important for the provision of old-age security in a society such as India, however, is not simply births or even male births but surviving male children. Considerable evidence is provided in Section F for the view that infant and child mortality, to a much greater extent than has generally been realized, are endogenously determined and affected very considerably by the allocation of breast milk, time and other resources by the wife-mother. Not surprisingly, therefore, there tend to be important sex differentials in infant and child mortality. Infant and child mortality are also apparently very closely related to fertility, child-spacing, and the sex ordering of live births. Fertility, on the other hand, seems closely related to experience with and expectations concerning infant and child mortality. Clearly, therefore, fertility and infant mortality or survival are rather intimately interrelated, and both must be considered in the satisfaction of the old-age security motive.

Although there is some remaining controversy on the issue, the evidence presented seems strong that the majority of "household" decisions in rural LDCs are made at the level of the residential household. The household head serves the residential household as its primary

decision maker, coordinator of activities, arbiter of disputes, and allocator of its resources both statically and dynamically. Loyalty to and respect for the household head are important characteristics for the smooth and efficient operation of the household and essential ingredients to its preservation. Not surprisingly, therefore, there is evidence not only of the tendency for household heads to reward the display of such characteristics but also for the fact that the household head's ability to hold the household together, especially his married sons, tends to increase with the value of the resources at his disposal i.e. the wealth of the household, and decrease with the quality and quantity of external opportunities which are not only affected by location but also by the age, sex and educational attainment level of the individual. Household affiliation decisions and the resulting household structure are thus not simply subject to the direct dictates of the household head. Indeed, household affiliation decisions or outcomes would more realistically seem to be individual decisions, essentially the outcomes of the interactions of different individuals or subgroups with the household head and/or with other individuals and subgroups within the overall household.

As already mentioned, the evidence is also strong that the influence of household heads over fertility and infant mortality behavior is both weaker and more indirect, the wife-mother having, in most cultures at least, a somewhat larger and more independent role in such behavior.

Three important implications for how economic models of household behavior should be constructed can be derived from this survey of anthropological findings.

First, because not all household decisions are made by the same decision-maker, it underscores the importance of correctly identifying the appropriate decision-maker and the appropriate unit of analysis for specific cultural environments if gross errors in specification are to be avoided.

Notably, the identification of the appropriate unit of analysis for some decisions in certain rural areas of some LDCs would appear to be different than that in other LDCs, in DCs and as conventionally modelled. For example, marriage decisions seem to be largely household decisions in rural LDCs such as India whereas they are usually considered to be individual decisions in DCs and hence have typically been modelled as such. The same may also be true for educational decisions. On the other hand, because of the importance of the distinction between the couple and the household and of the possible presence of several married couples and of those of different generations within the same (joint) household, it would seem especially important to allow the wife-mother a role in fertility and infant mortality outcomes in rural LDCs even if no such distinction between the household and the wife is important and therefore conventional in DCs. The choice of the appropriate unit of analysis, an issue which has been ignored by most social scientists in their quest for convenience and expedience in research design, cannot be ignored in the LDC context.

Second, even though many different kinds of "household" type behavior are closely interrelated, because they are made by different individuals or subgroups within the household, it is most obviously incorrect to specify them as being determined within a single simultaneous equation system, as has become increasingly common among social scientists and especially among economists.

Last, but certainly not least, since all household decisions are in fact made by or within households, and yet since there is much greater variation in household size and structure among households in rural areas of LDCs, the structure of the household can be of potential importance in explaining virtually all forms of household behavior. In the long run, the structure of the household, itself can be affected by a number of influences both endogenous and exogenous to the household. In order for the long run effects of various influences, especially those concerning long run goals like the satisfaction of old-age security, to be fully sorted out and measured, the indirect effects by way of changes in household structure must be included within the analysis. Since the determination of household structure has not been given much attention by economists, and since the anthropological evidence concerning their effects seems to belie the stereotyped assumptions that are usually made about them by economists, the explicit treatment of both the determinants and effect of household structure would seem to be an extremely important addition to economic models of household behavior.

Any satisfactory analysis of the effects on fertility of any fundamental exogenous changes such as those in market prices, technology, and institutions such as inheritance rules or old-age pension systems, must recognize all of these interdependencies in what goes on within the household and the feedbacks back-and-forth from within the household to the household as a whole, which in the long run affect its size and its composition.

## II. A FORMAL MODEL LINKING OLD-AGE SECURITY WITH HOUSEHOLD STRUCTURE, MARRIAGE AND FERTILITY.

The purpose of this section is to specify a formal model of household behavior which makes explicit the manner in which the old-age security motive affects household formation and partition, marriage, and fertility in less developed countries. The model is designed so as to be suitable for analyzing both the direct and indirect effects of introducing a formal social security system on these various forms of behavior and to be sufficiently flexible so as to allow for various cultural differences that may well exist between different countries or even regions within a single country. In specifying the model, a concerted effort is made to be as faithful as possible, without adding unnecessary complexity, to the findings of the survey presented above, and especially to the conclusions stated in Section G of Part I.

The model is one of household decision making and postulates that all household decisions are made rationally, in the sense that they are motivated by a desire to achieve given objectives, subject to environmental, economic, and institutional constraints and a set of initial conditions. Within the context of the model, decisions are assumed to be made by either the household as a whole or by individual members of the household, implying both that many of the decisions may be closely interrelated and that any or all such decisions may well be affected by the size and structure of the household. In order to allow for differentiation in the identity of the decision makers and for variations in the timing of the various household decisions from one such decision to another, the interdependence of household decisions is represented by a

series of interdependent models which we refer to as modules. This approach contrasts with the approach frequently taken in which interdependencies are represented by a system of simultaneous equations which can be traced back to one decision maker and one set of constraints.

At present, the model consists of three distinct modules. The first module focuses on the structure of the household; the second module deals with the marriage decision for both males and females; the third module concerns the fertility decision. In the not too distant future we plan to add a fourth module wherein the static and dynamic allocation of household resources would be determined. In any case, the decision-making unit varies from one module to another. The household structure module adopts the individual as the decision-making unit; the marriage module adopts the wife as the decision-making unit. Finally, the resource allocation module to be added later on will adopt the household as the unit of analysis. The time frames also vary by module. The household structure module incorporates an infinite horizon in an intergenerational model; the marriage module adopts the lifetime of the "household" or the parents of the potential marriage partners as the time frame; the fertility module adopts the lifetime of the wife as the time frame, and finally, the yet-to-be completely formulated resource allocation module uses the finite lifetime of the household with a constraint on end year capital stocks as the appropriate time frame. The modular framework, while placing restrictions on the decision-making unit for specific decisions, allows for some variation in the choice of the decision-making unit from one decision to the next, a feature generally not available in economic models of demographic decision-making.

## A. The Household Structure Module

The model of household structure presented in this section focuses on the relationship between living arrangements and intergenerational transfer mechanisms. The family transfer mechanism wherein older adults are dependent on their children for support, the private market mechanism wherein older adults are dependent on the purchasing power of assets, and the government-based social insurance mechanism, wherein older adults are dependent on "earned" transfers made possible by a tax system, are viewed as imperfect substitutes (Ben-Porath, 1980; Leibenstein, 1978; Parson, 1977). The probability of receiving transfers and the level of transfers are related to household structure by virtue of the hypothesis that joint living arrangements both facilitate the transfer of resources across generations and provide the individual with a means of influencing the expected level of benefits. As a result, joint living arrangements are expected to be more common in situations where older persons rely on children for their support. The development of private capital markets and government-sponsored social insurance systems are expected to decrease the extent to which older persons rely on children for support and, as a consequence, to decrease the chances that individuals are found in complex living units.

In order to consider these relationships in more detail, a two generation, general equilibrium model is formulated. By explicitly allowing household structure to influence the level of family transfers and by introducing other transfer mechanisms, the potential relationship between household structure and the introduction of a social insurance system may be derived. The model also attempts to distinguish the

production-based benefits of joint living from the transfer-based benefits of such arrangements.

In relation to previous models of household structure, the model makes no assumptions regarding preferences either for privacy or for "noise" and companionship (Beresford and Rivlin, 1968; Carliner, 1975; Michael, Fuchs, and Scott, 1980). The model also takes as given previous fertility and marital decisions and, as a result, the expected availability of kin (Kobrin, 1976). The focus of the model is thus on variations in household structure attributable to variations in the availability of substitutes for the family system of transfers.

The historical antecedent for the formal model of household structure to be presented is the two-period life cycle growth model considered by Samuelson (1975a, 1975b). The innovations include the introduction of intrafamily transfers in addition to the government transfers previously introduced by Samuelson, the provision for different population growth rates for the family than for the society, and the explicit recognition of the potential role played by household structure in determining output, family transfers, and utility. By focusing attention on the form of the intergenerational transfers, the interdependencies among household structure, fertility, private savings, and social insurance schemes are emphasized.

The two-period, or equivalently two-generation, model is a far cry from the complexity of human populations, and the simplicity of the model admittedly limits its usefulness. As noted by Arthur and McNicoll (1978), the restriction to two periods effectively means that the costs of children both to private individuals and to society at large are ignored. In addition, the exclusion of sex differences means that sex

differences in survival rates as well as the complex process of marriage which in turn can affect household structure are not dealt with explicitly. If attention were to be focused on the first problem, the solution would appear to be the adoption of either an  $n+1$  period or a continuous time model (Gale, 1973; Arthur and McNicoll, 1978). When as in the present context attention is focused on household structure and the accompanying importance of distinguishing nuclear families from extended families, the adoption of an  $n+1$  period or a continuous time framework is not particularly useful.

The intergenerational framework has been used on a number of previous occasions to study population-related issues. Following Samuelson's contribution (1975a) in which the relationship between the market interest rate and the population growth rate was recognized, Willis (1979) developed an intergenerational model in which the number of births was allowed to adjust, providing a mechanism for altering the level of transfers received in old age. Arthur and McNicoll (1978) have considered models in which the number of generations is expanded to  $n+1$  and the consumption and production schedules are specified for  $n+1$  periods. Both these models and the model to be presented in this section focus attention on the individual as the decision-maker. A recent paper by Lee (1980), in contrast, advocates that the household be specified as the decision-maker, but largely overlooks the process by which households are formed. Thus, various kinds of intergenerational models have been used to study population issues, with some of the differences pertaining to the number of generations (or time periods) and the choice of the decision-making unit. As a general rule, these have not been concerned with the mechanisms employed in transferring the resources across generations (Samuelson,

1975b; Arthur and McNicoll, 1978). The objective of the model presented in this section is to focus attention on the interdependencies among the three systems of providing for old-age support and to derive implications concerning the effect on household behavior, including household formation and partition, and of institutional changes, such as the introduction of a government sponsored old age pension system.

At this point, a formal specification of the model is provided. The algebraic representation of the model is provided in Table 1.

The starting point for the model is a two-generation asexual society.<sup>6</sup> Each individual (distinguished only by year of birth) is assumed to live for two periods, the first as an adult who both consumes and produces output, and the second as a dependent elderly person who only consumes output.

The well-being of a representative individual is given by an ordinal utility function, quasi-concave in  $c^1$  and  $c^2$ ,

$$U(c^1, c^2, \bar{E}) \tag{A.1}$$

where  $c^1$  and  $c^2$  are the levels of consumption for the representative individual in the two periods, i.e. as a productive adult and as a non-productive elder, and  $E$  is the complexity of the household structure. The introduction of  $E$  directly into the utility function allows for the direct impact of household complexity on utility. In the case of rural India where the complex household is generally recognized as an ideal household form and individuals are assumed to place positive value on the degree of complexity or extension of the household, the marginal utility of household complexity,  $\frac{\partial U}{\partial E}$ , would be assumed to be positive

(see Section I). This assumption is, of course, not necessary; indeed, in the longer run, preferences may change and the marginal utility of additional complexity may approach zero or even become negative, as it is assumed to be in studies where trends toward separate living arrangements in developed countries have been related to the demand for privacy. In summary, for the case of rural India, we assume

$$\frac{\partial U}{\partial c^1} > 0, \quad \frac{\partial U}{\partial c^2} > 0, \quad \text{and} \quad \frac{\partial U}{\partial E} > 0.$$

In the absence of a capital market in which to borrow or lend, the individual's consumption in each period is subject to a period-specific constraint. In the first period, i.e., period 1; it is constrained by his level of output during the period 1, i.e. while a productive adult, less what he is required by the household head to contribute to investment to maintain the household's capital-labor ratio  $k$  in the face of the growth rate of population (which is known to it), and less that which he provides in the form of both taxes and family contributions. Consumption in the second period,  $c^2$ , is constrained by the transfers which he receives in the form of both social security benefits and family contributions.

$$c^1 = f(k; E) - gk - \tau_1^1 - \tau_2^1(E, k) \quad \text{A.2}$$

$$c^2 = \beta_1^2 + \beta_2^2(E, k) \quad \text{A.3}$$

where  $f(\ )$  is the per capita production function characterized by constant returns to scale in capital and labor,  $k$  is the capital stock per worker,  $\tau_1^1$  is the social insurance tax per worker,  $\tau_2^1$  is the family obligation

per worker,  $\beta_2^2$  is the family benefit transferred to the dependent population by productive family members.

The expected signs of the partial derivatives in the various functional relationships are discussed below. In the production function expressed on a per worker basis,  $f(k; E)$ ,  $\frac{\partial f}{\partial k}$  is positive and decreasing, consistent with the constant returns to scale assumption and diminishing returns to the capital and labor inputs. For a given capital-labor ratio,  $k$ ,  $\frac{\partial f}{\partial E}$  is expected to be positive when  $E$  is small (less complex) and to be negative when  $E$  is large (more complex), an assumption based on the observation that, under a given set of conditions, there is an optimal household size for production purposes. In the family transfer functions,  $\tau_2^1$  and  $\beta_2^2$ , the partial derivatives with respect to  $E$  and  $k$ ; i.e.,  $\frac{\partial \tau_2^1}{\partial k}$ ,  $\frac{\partial \tau_2^1}{\partial E}$ ,  $\frac{\partial \beta_2^2}{\partial E}$ , and  $\frac{\partial \beta_2^2}{\partial k}$ , are expected to be positive.<sup>7</sup> These assumptions regarding the influence of maintaining extended households and benefits are consistent with the findings of the anthropological literature surveyed in the previous section which suggested that the support that one can expect in old age is related to living arrangements and to the non-human wealth that can potentially be inherited. In other words, both extension and capital for potential inheritance may be thought of as instruments for increasing transfers in old age.

For this system of transfers and benefits to be feasible, the sum of the benefits transferred to the dependent population both through the social insurance and family transfer systems is necessarily equal to the transfer payments from taxes and family transfers plus any change in the

"social" capital stock. Defining the number of persons in the  $t^{\text{th}}$  generation as  $L_t$ ,  $L_t$  being the productive generation in period  $t$ ,  $L_{t-1}$  being the dependent generation in period  $t$ , i.e., the generation that was productive in period  $t-1$ ,  $k^S$  being the social capital per worker, and  $r$  being the rate of return on that capital that the government but not the individual household can obtain, the feasible condition or budget identity for the system of intergenerational transfers as a whole can be written:

$$[\beta_1^2 + \beta_2^2(E,k)]L_{t-1} \equiv [\tau_1^1 - \tau_2^1(E,k)]L_t + rk_t^S L_t - (k_{t+1}^S L_{t+1} - k_t^S L_t) \quad \text{A.4}$$

If the growth rate of the labor force equals  $g$ , or equivalently, if

$$L_t = (1 + g)L_{t-1} \quad \text{A.5}$$

and a steady-state equilibrium is assumed, implying that  $k^S$  is constant, then by substitution of A.5 into A.4,

$$[\beta_1 + \beta_2(E,k)] \frac{1}{1+g} \tau_1 + \tau_2(E,k) + r \cdot k^S - [k^S(1+g) - k^S] = 0 \quad \text{A.6}$$

Note that in obtaining this steady-state equilibrium condition, the task of proving the existence of the steady-state equilibrium has been bypassed. We simply assume that such an equilibrium exists.

To emphasize the relationship between the interest rate and the population growth rate in this identity, as well as in order to prepare for the substitution for the right hand side of A.6 for  $\beta_1$  and  $\beta_2(E,k)$  in the optimization problem, A.6 may be rewritten as

$$\beta_1 + \beta_2(E,k) \equiv [\tau_1 + \tau_2(E,k) + (r-g)k^S](1+g) \quad \text{A.7}$$

This is the steady-state equilibrium condition for the society as a whole. (Once again, the reader is reminded that this relevant society may be as small as a certain portion of a village.) All three systems of providing for old age dependents are incorporated; the formal social security system is represented by  $\tau_1$  and  $\beta_1$ , the family transfer system is represented by  $\tau_2$  and  $\beta_2$ , and the capital accumulation and rate of return process (in this case of the government) is represented by  $r$  and  $k^S$ . As such, the capital accumulation and earning process is treated as simply a part of the government's old-age pension system. In principle, it could be separated out and introduced as a genuinely different (private) alternative. This, however, could only be done at the cost of adding greater complexity to the model by allowing for heterogeneity among the agents with respect to endowments and hence providing the rationale for borrowing and lending operations among private individuals. The imposition of the steady-state equilibrium condition leaves the budget constraint of the first period essentially unchanged. The only difference is that in A.8 we drop the time subscripts because of the steady-state assumption. Substituting the right hand side of A.7 into the budget constraint of period 2, A.3 gives us the simplified steady-state resource constraint of the individual for period 2 (old age), given by A.9. The term  $gk$  appears in both A.2 and A.8, in recognition that the household head would require a certain saving and investment rate. Since the investment decision is a household decision, it is determined along with the other allocation of resource decisions in another module (Module IV)

of our system. Here we assume that the rule is that investment takes place at the rate of growth of the labor force so as to maintain the capital-labor ratio.

The Lagrangian formulation for the problem of optimizing utility, A.1, subject to the steady-state resource constraints for the two periods A.8 and A.9 is presented in equation A.10. In Part II of Table 1, specifically in equations A.11a-A.11e, we give the first-order conditions. These conditions are reexpressed in equations A.12a-A.12e and can be used to solve for the five unknowns -  $c^1$ ,  $c^2$ ,  $E$ ,  $\lambda_1$ , and  $\lambda_2$ . The exogenous variables are  $r$ ,  $\tau_1$ ,  $g$ ,  $k$ , the subjective rate of time preference  $i$ , and  $k^S$ .

Condition A.12a equates the marginal utility of consumption in the first period with  $\lambda_1$ . Similarly, condition A.12b equates the marginal utility of consumption in the second period with  $\lambda_2$ . Setting  $\lambda_1 = 1$ ,  $\lambda_2 = \partial U / \partial c^2 = 1/1+i$ , where  $i$  is the subjective discount rate or rate of time preference. Conditions A.12d and A.12e are the budget constraints for the two periods. From the latter it can be seen that tax-transfers of the government system of old-age pensions  $\tau_1$  would substitute on a one-to-one basis for those of the intrahousehold intergenerational type  $\tau_2$ . Hence any increases in  $\tau_1$  would bring about decreases in  $\tau_2$  and hence  $E$ . The same would be true for any system of capital formation yielding a return  $r$  that can be used in order to satisfy the consumption needs of the second period. Note, however, that in the latter case it is only the excess of  $r$  over that savings rate which is needed to maintain the steady-state capital labor ratio with growing population,  $(r-g)(1+g)k^S$  that would substitute for intrahousehold transfers  $\tau_2$ .

The most important condition for present purposes is, of course,

A.12c which equates the marginal utility of household complexity or extension  $\frac{\partial U}{\partial E}$  with the sum of several terms involving  $\lambda_1$ ,  $\lambda_2$  (or alternatives  $i$ ),  $g$ , the negative of the marginal product of the degree of extension, i.e.  $-\partial f/\partial E$ , and the partial derivative of intrafamilial intergenerational transfers with respect to  $E$ ,  $\partial \tau_2/\partial E$ . Since, by assumption,  $\partial \tau_2^1/\partial E$  and also  $\partial U/\partial E > 0$  for rural India at least, the sign of  $\partial f/\partial E$  depends heavily on the relative sizes of  $g$  and  $i$ , i.e., the growth rate of the labor force and the subjective discount rate. If  $g > i$  as might be the case for settings in which the subjective discount is relatively low and the survival-weighted fertility rate is relatively high, the negative second term would outweigh the positive  $\frac{\partial \tau_2}{\partial E}$  component of the first term, thereby requiring  $\partial f/\partial E < 0$  order to satisfy the equality. A negative  $\partial f/\partial E$  is, of course, consistent only with a high level of extension. On the other hand, if  $i > g$ , the negative second term would not outweigh the positive  $\lambda_1 \frac{\partial \tau_2}{\partial E}$  component of the first term and hence  $\partial f/\partial E$  need not be negative. A more positive  $\frac{\partial f}{\partial E}$  implies a reduction in family complexity. Finally, if  $i = g$ , the two terms involving  $\partial \tau_2/\partial E$  cancel each other out and the marginal utility of extension is equal to the product of the marginal utility of consumption in period 1,  $\lambda_1$ , and the negative of the marginal product of extension. As expected, increases in utility gained from additional household complexity would lead to decreases in  $\frac{\partial f}{\partial E}$  and corresponding increases in household complexity.

As suggested previously, the demand for household extension, one of the endogenous variables in the model, could be derived from the set of first order conditions. The demand for  $E$  will depend on the exogenous variable -  $r$ ,  $i$  or  $\frac{\lambda_1}{\lambda_2} \tau_1$ ,  $k$ ,  $k_s$  and  $g$  - and the parameters of the

utility, production, and transfer functions. The importance of the transfer function depends on the relationship between  $g$  and  $i$ . Although there is always the possibility of increasing transfers by altering  $E$ ,  $\frac{\partial \tau_2^1}{\partial E}$  being assumed to be always positive, the term would have no impact when  $i = g$ .

Although the derivation of more specific testable implications would require the specification of specific functional forms for the utility function and other functions in the model, and as suggested in footnote 7 the introduction of greater complexity into the model, without going further in this regard, the model predicts that the degree of household extension should be negatively related to the quality and dependability of investment alternatives, and the availability of old-age pension programs. From the production function relationship, the larger the wealth or capital stock, the higher would be the marginal product of extension and hence the larger the degree of extension that would be predicted. Likewise, and perhaps even more importantly, recalling the presence of  $k$  in the  $\tau_2$  function of equation A.10, a rise in  $k$  would also raise the ability of the dependent generation to extract transfers from the productive generation, and hence once again would raise the demand for  $E$ . As we have already shown, other things being equal, the higher the weight that is attached to old-age dependence, i.e., the higher is  $\lambda_2$  relative to  $\lambda_1$  (or the lower is  $i$ ), the higher is the desired degree of extension.<sup>8</sup> Likewise, as long as education could be interpreted as extension-augmenting, the higher the level of education, the lower would be the desired degree of extension. These predictions of the model are consistent with the historical and anthropological evidence referred to in Section I above suggesting that extended house-

Table 1

## The Household Structure Module

## I. Structure of Model

$$U(c^1, c^2, E) \quad \text{A.1}$$

$$c^1 = f(k^1; E) - gk^1 - \tau_1^1 - \tau_2^1(E, k) \quad \text{A.2}$$

$$c^2 = \beta_1^2 + \beta_2^2(E, k) \quad \text{A.3}$$

$$[\beta_1^2 + \beta_2^2(E, k)]L_{t-1} \equiv [\tau_1^1 + \tau_2^1(E, k)]L_t + rk_t^S L_t - (k_{t+1}^S L_{t+1} - k_t^S L_t) \quad \text{A.4}$$

$$L_t = (1+g)L_{t+1} \quad \text{A.5}$$

$$[\beta_1 + \beta_2(E, k)](1+g)^{-1} \equiv \tau_1 + \tau_2(E, k) + rk^S - [k^S(1+g) - k^S] \quad \text{A.6}$$

$$\beta_1 + \beta_2(E, k) \equiv [\tau_1 + \tau_2(E, k) + (r-g)k^S](1+g) \quad \text{A.7}$$

$$c^1 = f(k, E) - gk - \tau_1 - \tau_2(E, k) \quad \text{A.8}$$

$$c^2 = [\tau_1 + \tau_2^1(E, k) + (r-g)k^S](1+g) \quad \text{A.9}$$

## II. Optimization Problem

The problem is to choose  $c^1$ ,  $c^2$ , and  $E$  so as to maximize utility, A.1, subject to A.8 and A.9

$$\begin{aligned} \mathcal{L} = & U(c^1, c^2, E) - \lambda_1 [c^1 - f(k; E) + gk + \tau_1 + \tau_2(E, k)] \\ & - \lambda_2 \{c^2 - [\tau_1 + \tau_2(E, k) + (r-g)k^S](1+g)\} \end{aligned} \quad \text{A.10}$$

$$\frac{\partial \mathcal{L}}{\partial c^1} = \frac{\partial U}{\partial c^1} - \lambda_1 \quad \text{A.11a}$$

$$\frac{\partial \mathcal{L}}{\partial c^2} = \frac{\partial U}{\partial c^2} - \lambda_2 \quad \text{A.11b}$$

$$\frac{\partial \mathcal{L}}{\partial E} = \frac{\partial U}{\partial E} - \lambda_1 \left[ -\frac{\partial f}{\partial E} + \frac{\partial \tau_2}{\partial E} \right] - \lambda_2 \left[ -\frac{\partial \tau_2}{\partial E} (1+g) \right] \quad \text{A.11c}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_1} = -c^1 + f(k; E) - gk - \tau_1 - \tau_2(E, k) \quad \text{A.11d}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_2} = -c^2 + [\tau_1 + \tau_2(E, k) + (r+g)k^S] (1+g) \quad \text{A.11e}$$

$$\frac{\partial U}{\partial c^1} = \lambda_1 \quad \text{A.12a}$$

$$\frac{\partial U}{\partial c^2} = \lambda_2 = \lambda_1 \left( \frac{1}{1+i} \right) \quad \text{A.12b}$$

$$\begin{aligned} \frac{\partial U}{\partial E} &= \lambda_1 \left[ -\frac{\partial f}{\partial E} + \frac{\partial \tau_2}{\partial E} \right] + \lambda_2 \left[ -(1+g) \frac{\partial \tau_2}{\partial E} \right] \quad \text{A.12c} \\ &= \lambda_1 \left[ \frac{\partial \tau_2}{\partial E} - \frac{\partial f}{\partial E} \right] - \frac{(1+g)}{(1+i)} \lambda_1 \frac{\partial \tau_2}{\partial E} \end{aligned}$$

$$c^1 = f(k, E) - gk - \tau_1 - \tau_2(E, k) \quad \text{A.12d}$$

$$c^2 = [\tau_1 + \tau_2(E, k) + (r-g)k^S] (1+g) \quad \text{A.12e}$$

### III. Definitions of Variables

$c^i$	consumption in period $i$ , $i = 1, 2$
$E$	level of extension
$i$	subjective rate of time preference
$k$	capital-labor ratio of the individual
$\tau_1$	social insurance tax
$\tau_2$	family contribution
$\beta_1$	social insurance benefits
$\beta_2$	family benefit
$L_t$	labor force in $t^{\text{th}}$ period
$k_t^S$	social (government) capital per worker
$r$	rate of return
$g$	rate of growth of labor force

holds are more common in relatively wealthy households and especially in those in which land and other non-human capital related assets are important relative to human capital [Nimkoff and Middleton (1960), Goode (1963), Laslett (1972), Anderson (1972), van der Woude (1972) and Goody (1972)].

Since the periods of the model are long (entire generations) and it is solved from the perspective of steady-state equilibrium, it should be abundantly clear that these predictions should hold only in the very long run. It does not predict how long it would take for household structure to respond to its determinants such as the establishment of viable investment opportunities, competitive capital markets, and government-sponsored old-age pensions. Since these actions may take time, since there may be substantial lags in the recognition of such changes on the part of the economic agents, and perhaps also since there may be substantial costs of adjusting to such changes, the adjustments may well be slow. The reader should also be reminded of the fact that household structure is also responsive to marriage and fertility decisions. In any case all these determinants of household structure will be spelled out in more detail in the empirical formulation of the model.

#### B. The Marriage Module

In much of the literature on marriage and especially of that emerging from the new home economics, marriage decisions are assumed to be made by rational individuals who trade off the advantages of accepting specific marriage offers from partners of the opposite sex with those of remaining single while engaging in further marriage search activities (Becker, 1973, 1974; Freiden, 1974; Preston and Richards, 1975; Becker, Landes and Michael, 1977; Keeley, 1977, 1979; Grossbard, 1978a, 1978b,

1979; Hogan, 1978; Anderson, 1981). The benefits relative to costs of marriage are based in large part on complementarities in the production of children and other household commodities. Almost invariably, these models specify that all such commodities are produced with constant returns to scale production functions, having the effect of placing most of the burden of adjustment in equilibration on the demand side of the markets (models). Since marriage decisions are often conceived of as being made simultaneously with those regarding education, labor force participation, household formation and fertility, a simultaneous equation system is often utilized as the analytical framework.

Taking into consideration the institutional perspective of Section I above, there would seem to be several basic shortcomings in applying the conventional type of marriage models to rural areas of LDCs, in general, and to rural India, in particular.<sup>9</sup>

First, the various decisions treated as being made simultaneously in economic models, in particular, marriage, fertility, labor force participation and education, are, in fact, made neither simultaneously in time nor even by the same individuals or other decision making units. Second, although search for appropriate marriage partners is at least as important as, and probably even more important in LDCs than in DCs, because of intermarriages of present and former household members in neighboring villages and owing to the existence of professional marriage brokers, the search for partners in marriage is generally not the responsibility of the potential marriage partners themselves. As a result, there is no reason to suppose that the need to conduct search would delay marriage, at least not very directly. Third, in both DCs and LDCs, alike, there is no empirical justification for assuming that

either marriage services or other household activities would be characterized by constant returns to scale. For example, the number of children and other marriage services cannot be doubled simply by doubling the inputs of time on the part of husbands and wives and any other relevant inputs. Fourth, and perhaps most importantly, in rural areas of LDCs marriage decisions are still, to a much larger extent than in DCs, made primarily by household heads.

We propose to overcome these deficiencies in the following ways: (1) as already mentioned, we avoid simultaneity without sacrificing interdependence by treating marriage decisions in a module which, although separate, feeds back to fertility decisions and to household structure/ affiliation decisions and is, in turn, influenced by household size and structure decisions. (2) Search activities are formulated explicitly and depend on the time of other household members and the services of professional marriage brokers. (3) The decision maker is depicted to be the household head acting on behalf of the household as a whole. (This is in contrast to the fertility decision which is seen as being that of the wife and to the household affiliation decision which is that of the individual or at least all adult males.) (4) Unlike marriages in DCs, marriages are represented as involving a side payment from one household to another to compensate the seller of the one party (the wife or the husband) for the excess of the value of the services of that party relative to the other. This side payment can be regarded either as fixed by custom or constrained to a specific amount by what the household can afford, given its other objectives and constraints, and after considering the number of daughters to be married out, sons for whom wives are to be obtained, etc. Given the modular character of

our approach and considering the multiplicity of considerations that enter into the budgetary decisions of the household, it is the latter assumption that is made here. The other budgetary decisions (both short-run and long-run) may be considered as determined in the fourth module (yet to be developed).

Since in many rural areas of LDCs and especially in India it is usually daughters who change residence upon marriage, sons, even married ones, tending to remain in their household of origin, our model is developed to explain the ages at which a household will "marry out" its daughters, at which time its sons will marry and at which time the daughters-in-law will "marry in." Although we model only a single representative household which has both daughters to marry out and sons for whom to obtain wives, full equilibrium depends on agreement in marriage contracts among the households supplying wives to and the households demanding daughters as wives from the model's representative household.

In order to simplify the analysis, we shall assume that all sons, daughters and wives in a single household are identical one to another. That is, we assume that all daughters would have identical wage rates and be married off at the same age. Similarly, we assume that all sons would have identical wage rates and marry at the same ages, and that the wives obtained for these sons would be brought into the family at the same ages and have the same wage rates. (These assumptions are not necessary and are invoked only to facilitate the exposition of the model. They could easily be relaxed by distinguishing between different husbands, wives and daughters.) Likewise, and again strictly for convenience in exposition, we assume that the time allocations of all

members of any such set would be identical. Further, it is assumed that everyone marries at some point in their lifetimes. Because polygamy is relatively rare in India, and especially because the data to be utilized do not clearly identify cases of multiple wives, we assume monogamy and hence that the number of sons (husbands) is equal to the number of daughters-in-law (wives).

In order to facilitate the reader's comprehension of the model, the complete set of equations making up the marriage module is given in Table 2. Exogenous variables are distinguished from endogenous ones with the use of bars over the variables. The model begins with the utility function of the representative household in Equation B.1. The household's utility depends on the quantity of marriage services  $MS$ , the consumption of other marketable goods and services  $X_c$ , and the prestige associated with the wealth of the other households  $V_p$  into which the representative household's daughters marry. This factor is weighted by the number of daughters  $N^d$  since, if there were no daughters in the household, this factor would be irrelevant.<sup>10</sup> Although for simplicity the utility function and all other equations of the model are stated in static terms, it is recognized that a certain amount of time discounting is implicit in the formulation of the model. Also, as has already been mentioned in the household structure model, the relative importance of children for old age security depends on the interest rate and perhaps on other community and household characteristics. It also may be conditional on the existing degree of complexity of the household  $E$ . However, since we are considering at present only the situation for the representative household, both the degree of household complexity and other household and community characteristics may be considered given and hence can be ignored for the time being.

Table 2

A Model of Marriage Services

$$U = U(MS, X_C, \bar{N}^d V_p) \quad B.1$$

$$MS = ms \bar{N}^W \quad B.2$$

$$ms = ms(T_{ms}^h \cdot \bar{H}^h, T_{ms}^W H^W, X_{ms}) \quad B.3$$

$$X = X(\bar{N}^W T_X^h \bar{H}^h, \bar{N}^W T_X^W H^W, \bar{N}^d T_X^d \bar{H}^d, \bar{N}^0 T_X^0 \bar{H}^0, X_X) \quad B.4$$

$$X_C = X - \bar{X}_{NE} - X_X - X_S - N^W X_{ms} \quad B.5$$

$$S = S(\bar{N}^0 T_S \bar{H}^0, X_S) \quad B.6$$

$$S = S_W \bar{N}^W + S_d \bar{N}^d \quad B.7$$

$$\bar{T}^h = T_{ms}^h + T_{::}^h \quad B.8$$

$$T^W = T_{ms}^W + T_{::}^W \quad B.9$$

$$\bar{T}^d = T_X^d + T_W^d \quad B.10$$

$$\bar{T}^0 = T_X^0 + T_S^0 \quad B.11$$

$$I = \bar{q}_X \bar{X}_{NE} + D^W \cdot \bar{N}^W = D^d \bar{N}^d \quad B.12$$

$$D^W = D^W \left( \frac{\bar{V}}{\bar{V}}, T^W \cdot H^W W^W, T_{ms}^h \bar{H}^h W^h, S_W \right) \quad B.13$$

$$D^d = D^d \left( \frac{\bar{V}^0}{\bar{V}}, T_W^d \bar{H}^d W^d, T_{ms_p}^h H_p^h W_p^h, S_d \right) \quad B.14$$

Table 2 (Continued)

$$R_1 = \bar{N}^w \bar{T}_H^h \bar{H}^h \bar{W}^w + \bar{N}^w \bar{T}_H^w \bar{H}^w \bar{W}^w + \bar{N}^d \bar{T}_H^d \bar{H}^d \bar{W}^d + \bar{N}^o \bar{T}_H^o \bar{H}^o \bar{W}^o + V + D^w \bar{N}^w \\ - D^d \bar{N}^d + \bar{q}_x \chi_{NE}$$

$$R_2 = \bar{N}^w \bar{T}_{ms}^h \bar{H}^h \bar{W}^w + \bar{N}^w \bar{T}_{ms}^w \bar{H}^w \bar{W}^w + \bar{N}^w \chi_{ms} \quad (MS)$$

$$\bar{N}^w \bar{T}_x^h \bar{H}^h \bar{W}^w + \bar{N}^w \bar{T}_x^w \bar{H}^w \bar{W}^w + \bar{N}^d \bar{T}_x^d \bar{H}^d \bar{W}^d + \bar{N}^o \bar{T}_x^o \bar{H}^o \bar{W}^o \quad (X)$$

$$+ \bar{N}^o \bar{T}_s^o \bar{H}^o \bar{W}^o + \chi_s \quad (S)$$

$$+ \bar{N}^d \bar{T}_w^d \bar{H}^d \bar{W}^d + \bar{N}^d \bar{T}_{ms_p}^h \bar{H}_p^h \bar{W}_p^w \quad (D) \quad B.15$$

$$\mathcal{L} = U(MS, \chi_c, \bar{N}^d V_p) + \lambda_1 \bar{N}^w [ms(T_{ms}^h \bar{H}^h, T_{ms}^w \bar{H}^w, \chi_{ms}) - ms] \quad B.16$$

$$+ \lambda_2 [X(\bar{N}^w \bar{T}_x^h \bar{H}^h, \bar{N}^w \bar{T}_x^w \bar{H}^w, \bar{N}^d \bar{T}_x^d \bar{H}^d, \bar{N}^o \bar{T}_x^o \bar{H}^o, \chi_x) - X]$$

$$+ \lambda_3 [S(\bar{N}^o \bar{T}_s^o \bar{H}^o, \chi_s) - S] + \lambda_4 [\bar{N}^w \bar{T}_H^h \bar{H}^h \bar{W}^w + \bar{N}^w \bar{T}_H^w \bar{H}^w \bar{W}^w$$

$$+ \bar{N}^d \bar{T}_H^d \bar{H}^d \bar{W}^d + \bar{N}^o \bar{T}_H^o \bar{H}^o \bar{W}^o + \chi_{NE} \bar{q}_x + \bar{N}^w D^w \left( \frac{\bar{V}}{\bar{V}_0}, T_{H^w W^w}^w, T_{ms}^h \bar{H}^h \bar{W}^w, S_w \right)$$

$$- \bar{N}^d D^d \left( \frac{\bar{V}_p}{\bar{V}}, T_w^d \bar{H}^d \bar{W}^d, T_{ms_p}^h \bar{H}_p^h \bar{W}_p^w S_d \right)]$$

$$- \lambda_4 [\bar{N}^w \bar{T}_{ms}^h \bar{H}^h \bar{W}^w + \bar{N}^w \bar{T}_{ms}^w \bar{H}^w \bar{W}^w + \bar{N}^w \chi_{ms} + \bar{N}^w \bar{T}_x^h \bar{H}^h \bar{W}^w$$

$$+ \bar{N}^w \bar{T}_x^w \bar{H}^w \bar{W}^w + \bar{N}^d \bar{T}_x^d \bar{H}^d \bar{W}^d + \bar{N}^o \bar{T}_x^o \bar{H}^o \bar{W}^o + \chi_x$$

$$+ \bar{N}^o \bar{T}_s^o \bar{H}^o \bar{W}^o + \chi_s + \bar{N}^d \bar{T}_w^d \bar{H}^d \bar{W}^d + \bar{N}^d \bar{T}_{ms_p}^h \bar{H}_p^h \bar{W}_p^w]$$

$$\partial \mathcal{L} / \partial MS = (\partial U / \partial MS) - \lambda_1 \bar{N}^w = 0 \quad B.17a$$

$$\partial \mathcal{L} / \partial \chi_c = \partial U / \partial \chi_c + \lambda_4 (-q_x) = 0 \quad B.17b$$

$$\partial \mathcal{L} / \partial V_p = \partial U / \partial \bar{N}^d V_p \cdot \bar{N}^d + \lambda_4 \bar{N}^d (-\partial D^d / \partial V_p) = 0 \quad B.17c$$

$$\partial \mathcal{L} / \partial \chi = -\lambda_2 + \lambda_4 \bar{q}_x = 0 \quad B.17d$$

$$\partial \mathcal{L} / \partial S_d = -\lambda_3 \bar{N}^d + \lambda_4 (-\bar{N}^d (\partial D^d / \partial S)) = 0 \quad B.17e$$

Table 2 (Continued)

$$\partial \mathcal{L} / \partial S_w = -\lambda_3 \bar{N}^w - \lambda_4 (\bar{N}^w (\partial D_w / \partial S_w)) = 0 \quad \text{B.17f}$$

$$\partial \mathcal{L} / \partial T_{ms}^h \bar{H}^h = \lambda_1 \bar{N}^w (\partial ms / \partial T_{ms}^h \bar{H}^h) - \lambda_4 \bar{N}^w \bar{w}^h = 0 \quad \text{B.17g}$$

$$\partial \mathcal{L} / \partial T_x^h \bar{H}^h = \lambda_2 \bar{N}^w (\partial X / \partial T_x^h \bar{H}^h) - \lambda_4 \bar{N}^w \bar{w}^h = 0 \quad \text{B.17h}$$

$$\partial \mathcal{L} / \partial T_{ms}^w H^w = \lambda_1 \bar{N}^w (\partial ms / \partial T_{ms}^w H^w) - \lambda_4 \bar{N}^w \bar{w}^w = 0 \quad \text{B.17i}$$

$$\partial \mathcal{L} / \partial T_x^w H^w = \lambda_2 \bar{N}^w (\partial X / \partial T_x^w H^w) - \lambda_4 \bar{N}^w \bar{w}^w = 0 \quad \text{B.17j}$$

$$\partial \mathcal{L} / \partial T_w^w H^w = \lambda_4 \bar{N}^w \bar{w}^w + \lambda_4 \bar{N}^w (\partial D_w / \partial T_w^w H^w) = 0 \quad \text{B.17k}$$

$$\partial \mathcal{L} / \partial T_x^d \bar{H}^d = \lambda_2 \bar{N}^d (\partial X / \partial T_x^d \bar{H}^d) - \lambda_4 \bar{N}^d \bar{w}^d = 0 \quad \text{B.17l}$$

$$\partial \mathcal{L} / \partial T_w^d H^d = \lambda_4 (-\bar{N}^d \bar{w}^d) (\partial D^d / \partial T_w^d H^d) - \lambda_4 \bar{N}^d \bar{w}^d = 0 \quad \text{B.17m}$$

$$\partial \mathcal{L} / \partial T_x^0 \bar{H}^0 = \lambda_2 \bar{N}^0 (\partial X / \partial T_x^0 \bar{H}^0) - \lambda_4 \bar{N}^0 \bar{w}^0 = 0 \quad \text{B.17n}$$

$$\partial \mathcal{L} / \partial T_s^0 \bar{H}^0 = \lambda_3 \bar{N}^0 (\partial S / \partial T_s^0 \bar{H}^0) - \lambda_4 \bar{N}^0 \bar{w}^0 = 0 \quad \text{B.17o}$$

$$\partial \mathcal{L} / \partial X_{ms} = \lambda_1 \bar{N}^w (\partial ms / \partial X_{ms}) + \lambda_4 (-\bar{N}^w) \bar{q}_x = 0 \quad \text{B.17p}$$

$$\partial \mathcal{L} / \partial X_x = \lambda_2 (\partial X / \partial X_x) + \lambda_4 (-q_x) = 0 \quad \text{B.17q}$$

$$\partial \mathcal{L} / \partial X_s = \lambda_3 (\partial S / \partial X_s) + \lambda_4 (-q_x) = 0 \quad \text{B.17r}$$

$$\partial \mathcal{L} / \partial T_{ms_p}^h H_p^h = \lambda_4 (-\bar{N}^d \bar{w}_p^h) (\partial D^d / \partial T_{ms_p}^h H_p^h) - \lambda_4 \bar{N}^d \bar{w}_p^h = 0 \quad \text{B.17s}$$

Endogenous Variables (in order of appearance)

MS = quantity of marriage services per household

ms = quantity of marriage services per wife

$X_c$  = quantity of market goods and services consumed directly by the household

Table 2 (Continued)

- $V_p$  = prestige obtained from having daughter marry into household p and which is associated with the non-human wealth of household p.
- $T_{ms}^h$  = time allocation of husband (son) to marriage services.
- $T_{ms}^w H^w$  = human capital weighted time allocation of wife (daughter-in-law) to marriage services.
- $X_{ms}$  = quantity of market goods and services used in production of marriage services by each wife (daughter-in-law).
- $X$  = quantity of market goods and services produced by the household.
- $T_x^h$  = time allocation of husband (son) to the production of market goods and services.
- $T_x^w$  = time allocation of wife (daughter-in-law) to the production of market goods and services.
- $T_x^d$  = time allocation of daughters to the production of market goods and services.
- $T_x^o$  = time allocation of other household members to the production of market goods and services.
- $X_x$  = quantity of market goods used in the production of market goods and services.
- $X_s$  = quantity of market goods and services used in search activities.
- $S$  = quantity of search activities.
- $T_s^o$  = time allocation of other household members to search activities.
- $S_w$  = quantity of search activities for wives of sons (daughters-in-law).
- $S_d$  = quantity of search activities for husbands of daughters
- $T_w^d$  = time allocations of daughters as wives
- $D^w$  = dowry received for excess of value of husband services of sons over that of wife services of their wives.

Table 2 (Continued)

$D^d$  = dowry payment for excess of value of husband services supplied by sons in household p over that of wife services of daughters by household d.

$T^{WH^W}$  = human capital-weighted time of wives (daughters-in-law) in household d.

$T_{ms_p}^h H_p^h$  = human capital-weighted time allocation to marriage services of husbands in household p of daughters from household d.

### Exogenous Variables

$N^d$  = number of daughters

$N^W$  = number of wives or daughters-in-law (sons as husbands)

$N^h$  = number of husbands

$N^O$  = number of other household members

$T^d$  = time endowment of daughters

$T^h$  = time endowment of sons

$T^O$  = time endowment of other household members

$V$  = stock of non-human wealth (prestige)

$V_o$  = stock of household d of non-human wealth of household o.

$X_{ne}$  = net exports of goods and services (expenditures available for dowry payments).

$H^h, H^d, H^O$  = human capital stocks of husbands, daughters and others, respectively.

$w^h, w^W, w^d, w^O, w_p^h$  = wage rates of husbands, wives, daughters and others in household d, and of husbands in household p, respectively.

$q_x$  = market price of x.

Equation B.2 converts the quantity of marriage services per wife,  $ms$ , into the aggregate quantity per household  $MS$  that enters into the utility function by multiplying by the number of wives  $N^W$ . The production function for the quantity of marriage services per wife,  $ms$ , is given in equation B.3. Specifically the production of  $ms$  depends on the human capital-weighted time allocation to such activities of husbands and wives,  $T_{ms}^h \bar{H}^h$ , and  $T_{ms}^w H^w$ , respectively and the quantity of market goods used in production of such services  $X_{ms}$ . The quantity of marriage services can be thought of in terms of both numbers of children and their health and education.

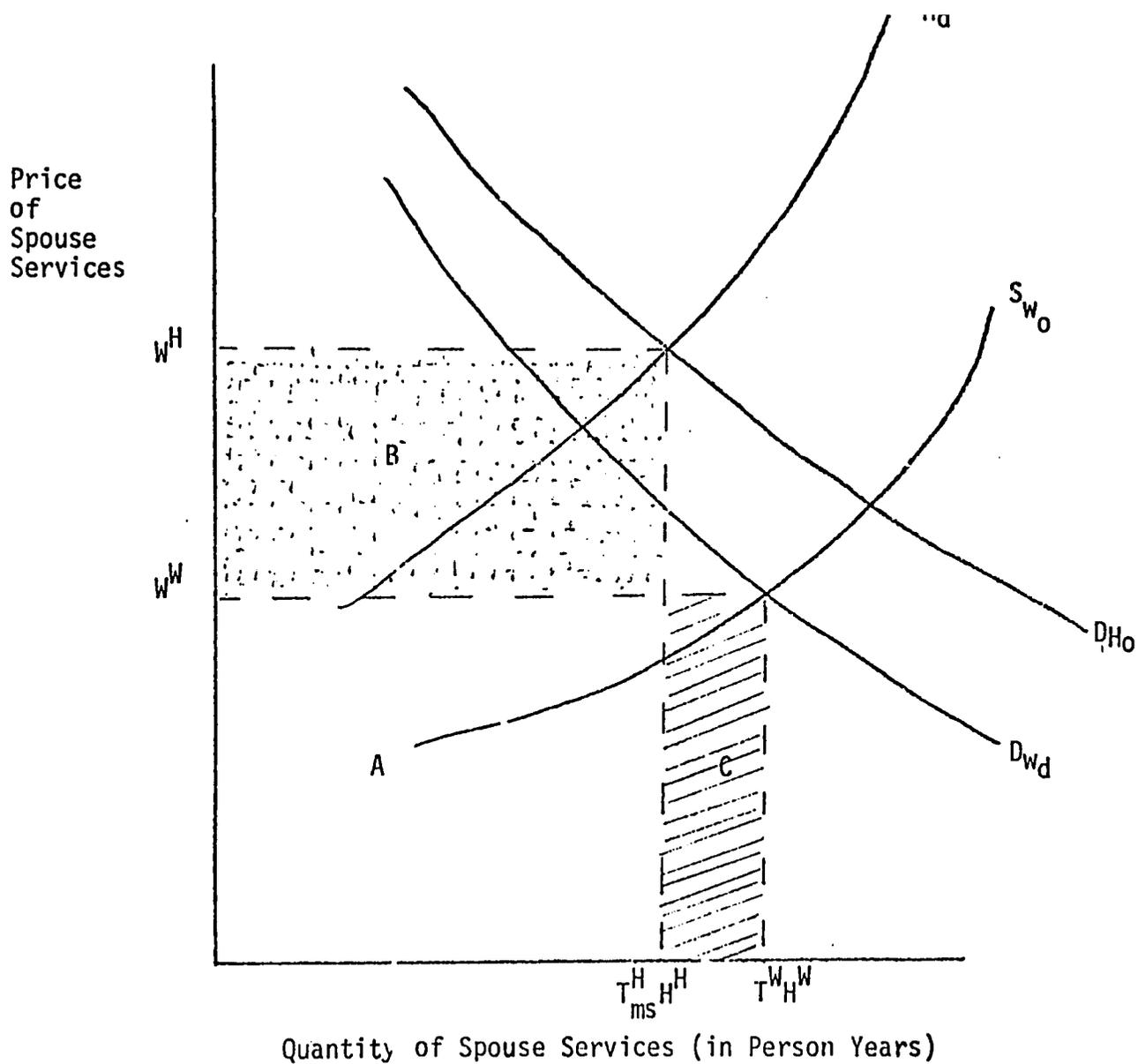
The production function for market goods and services  $X$  is given in equation B.4. It depends upon the aggregate time allocations of all household members, i.e., all husbands, all wives, all daughters and all others, and upon the quantities of market goods used as intermediate inputs  $X_x$ . Equation B.5 is the balance equation for  $X$ . It states that the quantity of market goods available for direct consumption by the household  $X_c$  is the quantity of such goods produced,  $X$ , net of the net exports of  $X$ ,  $X_{NE}$ , and the use of  $X$  in production of  $X$ ,  $S$  and  $MS$ , i.e.,  $X_x$ ,  $X_s$  and  $N^W X_{ms}$ , respectively. The production function for marriage search  $S$  is given in equation B.6. The quantity of  $S$  depends upon the human capital-weighted time allocations to search for all other household members,  $\bar{N}^0 T_S^0 \bar{H}^0$ , and the purchases of market services (such as those of marriage brokers)  $X_s$ . Equation B.7 is a balance equation for search, equating the supply of search with the demand for search on behalf of sons (for wives) and daughters for husbands,  $S_w$  and  $S_d$ , respectively.

The time constraints are given in equations B.8-B.11. Those for husbands are given in B.8, those for wives in B.9, those for daughters in B.10 and those of each of the other household members in B.11. Note that the aggregate time endowments are given for all individuals except wives  $T^W$ . The human capital-weighted wife time,  $T^{WH^W}$ , which translates into the age-at-marriage and health and educational status of the wife, is one of the key variables to be determined in the module. The income or budget constraint of the household is given in equation B.12. As stated above, the net amount of expenditures on dowry payments on daughters over those received for wives who marry-in is assumed to be given for the household on the basis of what the household can afford after taking care of all other income and budget decisions.

The model is completed with equations B.13 and B.14 that explain how the dowry prices of wives (daughters-in-law)  $D^W$  and of daughters  $D^d$ , are determined. In each case the dowry price is specified to depend on the relative stocks of non-human wealth  $V$ , of the household of origin and destination, and the human-capital weighted time allocated to marriage services of both marriage partners, their wage rates  $w$ , and the relevant quantities of search activity,  $S_w$  and  $S_d$ .

Before going to the solution of the model, we attempt to provide the reader with an intuitive understanding of the marriage model by means of the graphical representation of the model given in Figure 1. Emerging from the formal model of the representative household of destination for wives, household  $d$ , is a supply curve of human capital-weighted husband services  $T_{ms}^h \bar{H}^h$  which is designated in the diagram. Also emerging from the model would be a demand curve for wife services,  $T^{WH^W}$  in the model. This curve is designated in Figure 1. One should

Figure 1  
Spouse Service Equilibrium between Households o and d



bear in mind that these curves of the representative household of destination  $d$  are not independent of each other but rather are jointly determined in the model. Likewise, from an identical model of another household, household of origin of wives  $o$ , would come a jointly determined human capital-weighted supply curve of daughters as wives,  $T_{WH}^{d,d}$  in the model, and a jointly determined demand curve for human capital-weighted husband services,  $T_{MS}^{h,h}$  in the model. These curves are labeled  $S_{W_o}$  and  $D_{H_o}$ , respectively, in the diagram. The dowry payment can hence be interpreted as the transfer payment from household of origin  $o$  to household of destination  $d$  that settles the net surplus of household  $d$  in the values of the two streams of services exchanged in kind after the optimal search and allocations of time have been arrived at.

Most of the variables included in the formal model are variables which would determine the position and slope of the respective supply and demand curves in the diagram.

We return now to the solution to the formal version of the model. The income or budget constraint B.12 can be combined with the time constraints (B.8-B.11) and the accounting identity for  $X_c$  (equation B.5), in order to obtain the full income constraint  $R$  given in equation B.15.

The first of the two versions of this constraint, which we shall designate  $R_1$ , is nothing more than the sum of (a) the values of time of all household members, (b) the non-human wealth of the household  $V$ , (c) the net dowry receipts and (d) the value of net exports of market goods and services  $\bar{q}_X X_{NE}$ . The second version, which we designate  $R_2$ , is the value of the expenditures on the inputs (including the intermediate or capital goods inputs) of all commodities and services in the household economy, i.e.,  $MS, X, S$  and  $D_d$ .

Utilizing the Lagrangian formulation of the maximization of the utility function, equation B.1, subject to the full income constraint, B.15, one arrives at equation B.16 in Table 2.

From equation B.16 the first-order conditions for maximization given in B.17a-B.17b can be derived. This is a system of 19 equations in 19 endogenous variables:  $MS$ ,  $X_c$ ,  $V_p$ ,  $X$ ,  $S_d$ ,  $S_w$ ,  $T_{ms}^h$ ,  $T_x^h$ ,  $T_{H^W}^W$ ,  $T_{X^W}^W$ ,  $T_{ms}^W$ ,  $T_x^d$ ,  $T_w^d$ ,  $T_x^o$ ,  $T_s^o$ ,  $X_{ms}$ ,  $X_x$ ,  $X_s$  and  $T_{ms_p}^h H_p^h$ . Once these variables are determined, the four remaining endogenous variables in the system can be determined as follows:  $ms$  from equation B.2,  $S$  from equation B.7 and  $D^W$  from equations B.13 and B.14. The system is, therefore, fully determinate. We proceed now to the interpretation of the first-order conditions given by equations B.17a-B.17s.

Condition a of B.17 equates the marginal utility of marriage services to the shadow cost of those services, which is calculated as the number of wives multiplied by the shadow cost of such services per wife  $\lambda_1$ . Condition b requires that the marginal utility of direct consumption of market goods be equal to the shadow price of money (relative to marriage services) multiplied by the market price of market goods  $q_x$ . Condition c requires that the marginal utility of prestige associated with the marriage of daughters into wealthy households  $p$  (proxied by  $V_p$ ) be equal to the product of the shadow price of money and the negative of the marginal effect of  $V_p$  on the dowry payment. Condition d equates the shadow cost of production of  $X$  with its market price weighted by the shadow price (or marginal utility) of money (relative to marriage service).

Conditions e and f are the efficiency conditions for the use of search activities for husbands of daughters and wives of sons, respect-

ively. In each case the shadow cost of search is equated with the marginal effect of search on the dowry weighted by the shadow price of money. Conditions g and h are the efficiency conditions in the allocation of husband time (i.e., of sons) between production of marriage services and of market goods. In both cases the marginal product of their human capital-weighted time allocations weighted by the shadow prices of the respective goods are equated with the wage rate of husbands weighted by the shadow price of money. Likewise, the corresponding efficiency conditions in the allocation of wife time between MS and X are given in conditions i and j of B.17, of daughter time to X in conditions l, and of other household members time to x and S in conditions n and o. The efficiency conditions in the use of market goods in the production of MS, X and S are given in equations B.17p-B.17.

The remaining conditions k, m and s relate more specifically to the dowry functions and the model as depicted in Figure 1. Specifically, B.17k equates the wife wage with the negative of the marginal effect of the human capital weighted time of the wife on the dowry payment,  $\partial D^w / \partial T^w H^w$  (which itself is negative). Condition m is the corresponding one for the daughter and condition s is the corresponding one for the husband of the daughter. (A similar condition on marriage service time of husbands could be specified but, in view of B.17g, the imposition of such a condition would be redundant.)

The most direct implications of the model are the interdependencies between age-at-marriage and the human capital endowments of both marriage partners in a son-daughter-in-law pairing, and secondarily with the age at marriage of one's daughters and their husbands. Also of relevance in the determination of age-at-marriage of the various marriage partners

are the non-human wealth endowments of the respective households, the numbers of sons, daughters and others, the human capital endowments of each and the wage rates appropriate to each. As mentioned in the presentation of the model, implicit in the model are also the interest rate, investment opportunities, household structures, etc., all of which would affect the household's preference for marriage services relative to market goods and the prestige associated with the wealth of the households into which one's daughters marry. Therefore, the model of marriage services presented above is capable of generating numerous testable implications, several of which are quite different from those derived from conventional marriage models. This will be demonstrated and carried out in Section IIIB below.

### C. The Fertility and Infant Mortality Module

This section presents the theoretical structure of the module to be used in examining the relationship between fertility decisions and the availability of other forms of old age support. Inasmuch as fertility decisions are conditional on the age at marriage and characteristics of the spouse, and since marriage decisions are determined, in large part, by the desire for children, the fertility module interacts with the marriage module. The fertility module also interacts with the household structure module both because household partition decisions are associated with the number of dependents one has, a point supported by the background material presented in Section I, and because fertility decisions are likely to be influenced by the structure of the household.

The module, as developed below, focuses on the demand for surviving children and assumes that the mother, the woman who bears and rears the

children, is the primary decision maker. Other members of the household, including her husband, influence her decisions through their control over the flow of resources to her. Thus, the time she is required to contribute to productive activities for the household is assumed to decrease as the number of children she bears and cares for increases, the amount of the decrease depending on the value placed on children by the household. In a similar fashion, the household also controls the share of the household's food and other goods that the mother receives. The mother, however, is assumed to be in a position to determine how to allocate the resources and time available to her among child bearing and rearing activities and other activities that are "hers", i.e., are above and beyond the time and resources she is required to devote to fulfillment of her responsibilities to the household.

All of these child-related decisions are dependent on the marriage and household structure decisions. The mother's ability to bear children is dependent on the age at which she marries and the value placed on children by the mother is dependent on the age differential between herself and her spouse. The first relationship is based largely on biological considerations while the second relationship comes from the observation that the age differential between spouses contributes directly to the number of years she can expect to survive following the death of her spouse and to the value she places on child services over and above the value placed on child services by the household. The decisions on the part of the mother to bear and rear children are dependent on the resources allocated by the household for her child bearing and rearing activities, i.e., on allocation decisions which are dependent on the structure of the household and particularly on the number of women of

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child-bearing age and on the number of dependents in the household. Thus, the fertility decisions of the mother are directly related to household structure decisions and to the marriage decisions.

As noted previously, the focus of the module is on the number of surviving children. Issues related to sex preference, to the timing and spacing of children, and to the joint relationships between fertility and infant mortality, while acknowledged to be of importance, are for simplicity not dealt with explicitly in the theoretical presentation of the model. The issue of sex preference could be incorporated quite readily into the theoretical framework presented here by directly incorporating the sex ratio of children in the wife-mother's preference function and by distinguishing between male and female child services. However, in order to fully incorporate sex preference into the decision-making process, a dynamic or sequential analysis wherein fertility decisions would be viewed as conditional on the sex composition of surviving children, would be required. A similar type of model would also be required to deal adequately with the spacing and timing issues and with the joint relationships between fertility and infant mortality.

The structure of the model has a number of features found in the one-period fertility models based on the household production models which have been developed over the last two decades (Becker, 1960; Willis, 1974; Becker and Michael, 1976; Rosenzweig and Evenson, 1977). Specifically, the model employs a static one-period framework, envisions the decision-maker as having preferences both for child services and for other commodities, and considers the production of these commodities to be the result of combining time and goods. However, in contrast to the models described above, the model presented here treats the mother (as

opposed to the household or other individuals in the household) as the decision-maker and restricts her resources to "her" time, i.e., that which is net of the time she is required to allocate to productive activities for the household, and to the resources she receives both for herself and for her child-bearing and rearing activities. These features allow the mother's preferences for children to differ from those of the household and give her some independence in fertility behavior but at the same time recognize that the mother's decisions to bear children are very much constrained by the household's decisions.

At this point, we turn to a formal specification of the model. In order to facilitate the presentation, the equations specifying the structure of the model, as well as the first-order conditions for optimization, are presented in Table 3.

The structure of the model consists of three parts: (1) the utility function for the decision-maker, in this case the wife-mother, (2) the production functions for the commodities providing utility, namely, the number of children, the quality of children (per child) and other commodities which provide satisfaction, and (3) the constraints on the inputs, time and goods, in the production functions.

As specified in equation C.1, the utility of the mother is a function of child services,  $C$ , and other commodities,  $Z$ , where child services are defined as the product of number of children,  $N$ , and quality per child,  $Q$ . The preferences for  $C$  and  $Z$  are determined by the social and cultural environment and depend specifically on the value placed on child services relative to that on other activities which provide satisfaction.

Table 3  
The Fertility Module

I. Structure of the Model

Utility function

$$C.1 \quad U(C, Z) = U(NQ, Z)$$

Production functions:

$$C.2 \quad N = N (T_{1N}, T_{2N}, X_N; E)$$

$$C.3 \quad Q = Q (T_{1Q}, T_{2Q}, X_Q; E)$$

$$C.4 \quad Z = Z (T_{1Z}, X_Z; E)$$

Time and Goods Constraints

$$C.5 \quad T_1 - T_{1L}(C) = T_{1N} + T_{1Q} + T_{1Z}$$

$$C.6 \quad T_{2N} = T_{2N}(N)$$

$$C.7 \quad T_{2Q} = T_{2Q}(Q)$$

$$C.8 \quad V_1(C) + V_2(C) + V_3 = q_x (X_N + X_Q + X_Z)$$

Table 3 (Cont'd.)

II. Optimization of the wife-mother's utility utilizing the Lagrangian formulation of constrained optimization.

$$\begin{aligned}
 \text{C.9 } L = & U(N, Q, Z) - \lambda_1 (N - N(T_{1N}, T_{2N}, X_N)) \\
 & - \lambda_2 (Q - Q(T_{1Q}, T_{2Q}, X_Q)) \\
 & - \lambda_3 (Z - Z(T_{1Z}, X_Z)) \\
 & - \lambda_4 (T_1 - T_{1L}(C) - T_{1N} - T_{1Q} - T_{1Z}) \\
 & - \lambda_5 (T_{2N} - T_{2N}(N)) \\
 & - \lambda_6 (T_{2Q} - T_{2Q}(Q)) \\
 & \lambda_7 (V_1(C) + V_2(C) - V_3 - q_x (X_N + X_Q + X_Z))
 \end{aligned}$$

First order conditions (18)

$$\text{C.10 } \frac{\partial L}{\partial N} = \frac{\partial U}{\partial C} \cdot Q - \lambda_1 + \lambda_4 \frac{\partial T_{1L}}{\partial C} \cdot Q - \lambda_5 \frac{\partial T_{2N}}{\partial N} - \lambda_7 \frac{\partial V}{\partial C} \cdot Q = 0$$

$$\text{C.11 } \frac{\partial L}{\partial Q} = \frac{\partial U}{\partial C} \cdot N - \lambda_2 + \lambda_4 \frac{\partial T_{1L}}{\partial C} \cdot N - \lambda_6 \frac{\partial T_{2Q}}{\partial Q} - \lambda_7 \frac{\partial V}{\partial C} \cdot N = 0$$

$$\text{C.12 } \frac{\partial L}{\partial Z} = \frac{\partial U}{\partial Z} - \lambda_3 = 0$$

$$\begin{aligned}
 \text{C.13 } \frac{\partial L}{\partial T_{1N}} = & -\lambda_1 \frac{\partial N}{\partial T_{1N}} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot Q \frac{\partial N}{\partial T_{1N}} + 1 \right) - \lambda_5 \frac{\partial T_{2N}}{\partial N} \cdot \frac{\partial N}{\partial T_{1N}} \\
 & - \lambda_7 \frac{\partial V}{\partial C} \cdot Q \cdot \frac{\partial N}{\partial T_{1N}} = 0
 \end{aligned}$$

Table 3 (Cont'd.)

$$\begin{aligned} \text{C.14 } \frac{\partial L}{\partial T_{1Q}} &= \lambda_2 \frac{\partial Q}{\partial T_{1Q}} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot N \frac{\partial Q}{\partial T_{1Q}} + 1 \right) - \lambda_6 \frac{\partial T_{2Q}}{\partial Q} \cdot \frac{\partial Q}{\partial T_{1Q}} \\ &- \lambda_7 \frac{\partial V}{\partial C} \cdot N \frac{\partial Q}{\partial T_{1Q}} = 0 \end{aligned}$$

$$\text{C.15 } \frac{\partial L}{\partial T_{1Z}} = \lambda_3 \frac{\partial Q}{\partial T_{1Z}} - \lambda_4 = 0$$

$$\text{C.16 } \frac{\partial L}{\partial T_{2N}} = \lambda_1 \frac{\partial N}{\partial T_{2N}} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot Q \cdot \frac{\partial N}{\partial T_{2N}} \right) + \lambda_5 - \lambda_7 \frac{\partial V}{\partial C} \cdot Q \frac{\partial N}{\partial T_{1N}} = 0$$

$$\begin{aligned} \text{C.17 } \frac{\partial L}{\partial T_{2Q}} &= \lambda_2 \frac{\partial Q}{\partial T_{2Q}} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot N \cdot \frac{\partial Q}{\partial T_{2Q}} \right) - \lambda_6 \\ &- \lambda_7 \left( \frac{\partial V}{\partial C} \cdot N \frac{\partial Q}{\partial T_{2Q}} \right) = 0 \end{aligned}$$

$$\begin{aligned} \text{C.18 } \frac{\partial L}{\partial X_N} &= \lambda_1 \frac{\partial N}{\partial X_N} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot Q \frac{\partial N}{\partial X_N} \right) + \lambda_5 \left( \frac{\partial T_{2N}}{\partial N} \frac{\partial N}{\partial X_N} \right) \\ &- \lambda_7 \left( \frac{\partial V}{\partial C} \cdot Q \cdot \frac{\partial N}{\partial X_N} - q_x \right) = 0 \end{aligned}$$

$$\begin{aligned} \text{C.19 } \frac{\partial L}{\partial X_Q} &= \lambda_2 \frac{\partial Q}{\partial X_Q} + \lambda_4 \left( \frac{\partial T_{1L}}{\partial C} \cdot N \frac{\partial Q}{\partial X_Q} \right) + \lambda_6 \left( \frac{\partial T_{2Q}}{\partial N} \cdot \frac{\partial N}{\partial X_Q} \right) \\ &- \lambda_7 \left( \frac{\partial V}{\partial C} \cdot N \frac{\partial Q}{\partial X_Q} - q_x \right) = 0 \end{aligned}$$

$$\text{C.20 } \frac{\partial L}{\partial X_Z} = \lambda_3 \frac{\partial Z}{\partial X_Z} + \lambda_7 q_x = 0$$

Table 3 (Cont'd.)

$$C.21 \quad \frac{\partial L}{\lambda_1} = N - N(T_{1N}, T_{2N}, X_N) = 0$$

$$C.22 \quad \frac{\partial L}{\lambda_2} = Q - Q(T_{1Q}, T_{2Q}, X_Q) = 0$$

$$C.23 \quad \frac{\partial L}{\lambda_3} = Z - Z(T_{1Z}, X_Z) = 0$$

$$C.24 \quad \frac{\partial L}{\lambda_4} = T_1 - T_{1L}(C) - T_{1N} - T_{1Q} - T_{1Z} = 0$$

$$C.25 \quad \frac{\partial L}{\lambda_5} = T_{2N} - T_{2N}(N) = 0$$

$$C.26 \quad \frac{\partial L}{\lambda_6} = T_{2Q} - T_{2Q}(Q) = 0$$

$$C.27 \quad \frac{\partial L}{\lambda_7} = V_1(C) + V_2(C) - V_X(X_N + X_Q + X_Z) = 0$$

Unknowns include: $\lambda_1 - \lambda_7$ ,	7
$T_{1N}, T_{1Q}, T_{1Z}$	3
$T_{2N}, T_{2Q}$	2
$X_N, X_Q, X_Z$	3
$N, Q, Z$	3 = 18

Table 3 (Cont'd.)

## III. Definition of Terms

- C Child Services
- N Numbers of children
- Q Quality of services per child
- Z Other commodities
- E The degree of household extension and other variables determining efficiency in household production
- $\tau_{ij}$  Time inputs for  $i^{\text{th}}$  person (1 = mother, 2 = others) in  $j^{\text{th}}$  activity ( $j = N, Q, Z, X, L$ )
- $X_j$  Marketable goods inputs into  $j^{\text{th}}$  activity
- L Productive work either in wage market or required by household.
- $V_1$  Resources dependent on transfers from household
- $V_2$  Resources dependent on direct transfers from children to mother
- $V_3$  Resources such as social insurance benefits not contingent on child services
- V Sum of  $V_1$  and  $V_2$ , both of which are functions of C.
- $\lambda_k$  Shadow prices for commodities and inputs to production of commodities ( $k = 1, 2, \dots, 7$ )

The benefits of children to the wife-mother associated both with their direct contributions to her when she is older and dependent on others for support and with the contributions that the household provides her that are dependent on her fertility behavior are not included in the preference function directly. Instead, these reasons for valuing children are incorporated in the resource constraints. Naturally, aside from the benefits of children in general, there may well be a preference for those of one sex over the other, generally for male over female children due to the facts that it is the male children (in India at least) who traditionally support the mother in widowhood and that male children are more productive in agricultural production and hence have higher wage rates than female children. As has already been stated, the differential preferences for male and female children could, in principle, be handled in a number of different ways. The most complete and satisfactory way would be to fully distinguish between male and female children through the model. For simplicity, however, we shall simply add the sex ratio to child services when it comes to the empirical application of the model in Section III.

The production functions for the three commodities in the mother's utility function are specified in equations C.2-C.4. The production functions for numbers of children and for quality of children are specified as functions of the time inputs by the mother,  $T_{1n}$  and  $T_{1q}$ , of the time inputs of other family members,  $T_{2n}$  and  $T_{2q}$ , of the marketable goods inputs,  $X_n$  and  $X_q$ , and of the efficiency of the household in producing these commodities,  $E$ . The production function for  $A$  is similar, but the time of other household members is excluded. The concept underlying these production functions is that there are a number of

alternative means for producing child services and other commodities. The mother's time is distinguished from the time of others in that the two inputs are not considered to be perfect substitutes. A usual assumption regarding these production functions is that they are linear homogeneous which implies that doubling the inputs -  $T_{1n}$ ,  $T_{2n}$ , and  $X_n$  - would lead to a doubling in the number of children. As has been pointed out in the presentation of the marriage module, this assumption is excessively restrictive and is not required at this point.

Finally, the goods and time constraints, are presented in equations C.5-C.8. Both the goods and time constraints are specified assuming no joint production. The total time of the mother,  $T_1$ , net of the time she is required to contribute to the household,  $T_{1L}(C)$ , is specified as the sum of the inputs into the three production functions. The time provided by other members for producing numbers of children,  $T_{2n}$ , and child quality,  $T_{2q}$ , are given by the household. We assume that both the time the mother is required to contribute to the household and the time the other members contribute to the bearing and rearing of children are dependent on the child services produced, and thus can be influenced at least indirectly by the wife-mother to a limited extent.

The goods constraint is possibly the most crucial aspect of the model in that we herein distinguish the contributions of children which result from their participation in the household from those which result from their direct responsibility for the care of the mother when she is old. In addition, a third form of resources are those not contingent on one's children which could include social insurance and returns on assets. Equation C.8 provides the specification of the goods constraint, where  $V_1(C)$  represents the present value of resources provided to the

mother in return for her contribution of children,  $V_2(C)$  represents the present value of the direct contributions of children to their mothers,  $V_3$  represents resources that she can expect which are not dependent on child services, and  $q_n(X_N + X_Q + X_E)$  represents the market value of the marketable goods. The extent to which the household rewards the mother for bearing children depends on the value it places on children which, in turn, is likely to depend on the structure of the household, particularly on the sex and age distribution of dependents, and on the agricultural practices and land ownership of the household. The present value of the benefits the wife-mother receives directly from children,  $V_2(C)$ , depends on the length of time she expects to be widowed and on the level of benefits she expects to receive on an annual basis. The level of benefits is tied directly to the numbers and quality of children and to the extent she has been able to develop in them a sense of responsibility for her support.

The mother is assumed to choose how to allocate her time net of the time she is required to contribute to the household and her resources in the production of the three commodities (numbers and quality of children and other commodities) so as to maximize her satisfaction. The Lagrangian for the optimization problem along with the first-order conditions, the necessary conditions for optimization, are presented in Part II of Table 3. There are a total of 18 first-order conditions and 18 unknowns so that conceptually one may solve for the demand for children and for the demand for child quality. The unknowns include the shadow prices for the inputs to the production and utility function ( $\lambda_1$ - $\lambda_7$ ), the time inputs of the mother and other family members ( $T_{1n}$ ,  $T_{1q}$ ,  $T_{1z}$ ,  $T_{2n}$ ,  $T_{2z}$ ), the marketable goods inputs ( $X_N$ ,  $X_Q$ ,  $X_Z$ ), and the commodities ( $N$ ,  $Q$ ,  $Z$ ) which enter the utility function.

The first-order condition, C.10, indicates that the shadow price of children,  $\lambda_1$ , depends on the direct utility,  $\partial U/\partial C$ , and the old-age benefits she derives from her children,  $\partial V_1/\partial C$ , as well as on the response of the household to additional children,  $\partial T_{1L}/\partial C$ ,  $\partial T_{2N}/\partial N$ , and  $\partial V_2/\partial C$ . These relationships are expressed as:

$$\begin{aligned}\lambda_1 &= \frac{\partial U}{\partial C} \cdot Q + \lambda_4 \frac{\partial T_{1L}}{\partial C} \cdot Q - \lambda_5 \frac{\partial T_{2N}}{\partial N} - \lambda_7 \frac{\partial V}{\partial C} \cdot Q \\ &= Q \left( \frac{\partial U}{\partial C} + \lambda_4 \frac{\partial T_{1L}}{\partial C} - \frac{\lambda_5}{Q} \frac{\partial T_{2N}}{\partial N} - \lambda_7 \frac{\partial V}{\partial C} \right)\end{aligned}$$

The expectations are that  $\frac{\partial T_{1L}}{\partial C} < 0$ ,  $\frac{\partial T_{2N}}{\partial N} > 0$ ,  $\frac{\partial V}{\partial C} > 0$  and thus that, from the standpoint of the woman, the shadow price of number of children would be lower than the direct utility of children given by the first term. A similar relationship for the quality of child services is obtainable from C.11 and may be written as:

$$\lambda_2 = N \left( \frac{\partial U}{\partial C} + \lambda_4 \frac{\partial T_{1L}}{\partial C} - \frac{\lambda_6}{N} \cdot \frac{\partial T_{2Q}}{\partial Q} - \lambda_7 \frac{\partial V}{\partial C} \right)$$

Thus, the shadow prices of quality and quantity of children, as viewed by the mother, are dependent on her expectations regarding the response of the household to her child-bearing and rearing activities and on her expectations regarding the direct benefits she expects from her children when she is older. To obtain more specific hypotheses on the determinants of the mothers's demand for the quality and quantity of children, restrictions on the nature of the production functions would be required.

In any case, even as presented it should be clear that the model allows for a certain degree of independence of the wife-mother in child-

bearing and rearing activities. Nevertheless, it also includes the constraints imposed on her decisions by the household which may, of course, be rather stringent in certain circumstances. By focusing on the behavior of the individual wife-mother in the context of a household which is both changing over time and reacting to her behavior suggests that it could be fruitful to pose the model as a multi-period one instead of as at present a single period one. The virtual absence of retrospective information, other than on fertility itself as is the case with the data from rural India employed here, however, implies that there would be no way of testing such a model. Hence, for present purposes we deem the single period model sufficient.

### III. EMPIRICAL ANALYSIS

The purposes of this section are to describe the data utilized, to provide detailed empirical specifications of the three modules that were presented in Section II above, and finally to present the results.

#### A. The Data

The data utilized are from the survey of rural households in India conducted by the National Council of Applied Economic Research pertaining to the agricultural years 1968-69 through 1970-71 and known as the Additional Rural Income Survey (ARIS). Some of the data, especially that on income and expenditures, were collected for each of the three years covered by the survey. The other data were collected for only one or two of the years. Although far from ideal in some respects for testing the relationships postulated in the three different modules, some data on several of the most important and most relevant variables in each of the modules were collected. As such surveys go, the sample is quite large (4,118 households and more than 27,000 individuals) and the structure of the questionnaires affords a number of consistency checks. The fact that this data has also been used in a number of other studies, moreover, provides some useful opportunities for comparison.<sup>11</sup>

Specifically, the survey contains data on the size and structure of households, on income and expenditures both broken down into sources and types in some detail, on age, education, marital status, headship status, labor force participation and occupational status, relationship to the household head of all individuals in the household, on the timing of children, surviving and otherwise, for all married women in the sample households, and a fair amount of information on cropping patterns,

technology, and land ownership and agricultural capital for cultivating households. A major limitation of the data for present purposes is that, aside from the fertility and marriage records, little of the other information is available on a retrospective basis, thereby making it impossible to know anything about the household structure, labor force participation, income, wealth, etc., prior to marriage, or at the time of the various births, for older women and their husbands in the sample.

With respect to analyzing the effect of the introduction of a formal system of old-age pensions on household structure and behavior, notably, the data contains information that identifies whether or not there are household members participating in the "provident fund", the major formal old-age pension system in India. It also identifies and quantifies the amount of pensionary income received by each household, but unfortunately it does not distinguish these transfers from other sources of transfers. Although there are welfare programs at the state and local government levels and several old-age homes run by religious and other groups that may also substitute for either the private system of intergenerational intrafamilial transfers or the Provident Fund (formal) system of transfers, the amounts of support available from such programs are so small, and the indigence requirements so difficult to satisfy that lack of information about them is not an important qualification, especially considering that most such programs and facilities are restricted to urban areas. [See, for example, Vatuk (1980b)]. Unfortunately, however, the number of rural householders participating in the formal Provident Fund program is relatively small, making it difficult in practice to distinguish the effects of participation in that scheme from those of other and closely associated characteristics

of such participants such as income and educational status, and also to a certain extent location.<sup>12</sup>

Other limitations of the data are (1) that it contains little information about tenure status or of the nature and duration of contracts, and (2) that there is relatively little information about prices. The latter shortcoming makes it difficult to utilize some of the more operational approaches such as the linear expenditure system or "translog" system for estimating systems of demand and/or supply equations with explicit (and general) functional forms of the underlying utility functions. Fortunately, however, there is for one year household-specific information on the prices relevant to agricultural production for cultivating households, for use in the determination of cropping patterns, the degree of market participation, etc.

#### B. Empirical Specification of Key Relationships in the Three Modules

We turn now to the detailed specifications of the modules of household affiliation, marriage and fertility. Although each of the modules uses a simultaneous equations framework in which a number of variables is determined simultaneously, not all of these variables are observable. Our emphasis is on that subset of the potentially observable that are of greatest relevance in linking the old-age security motive with fertility behavior, the primary purpose of this paper.

Therefore, in our empirical work we focus on only the most important variables. Although, as we have already pointed out, there are certainly significant shortcomings in the data available relative to what would be ideal for complete testing of even these key relationships, our specifi-

cations are nevertheless capable of testing a considerable number of the postulated relationships with respect to the key variables. We also include in our empirical specification certain other more conventional determinants of the forms of behavior under consideration even though, for simplicity, these determinants were not included in some of the theoretical models.

Although, consistent with the modular character of the overall theoretical framework, each of the specifications is presented separately, it should be recalled that the decision-making framework of each of the modules is conditional on decisions already having been taken in the other modules. The starting point is, of course, arbitrary; for consistency purposes we start with the household affiliation module, follow with the marriage module and conclude with the fertility or child services module. Nevertheless, since household affiliation is conditional on marital status which is determined in the second module, the household affiliation model is estimated separately for individuals of different marital status. Likewise, the marriage and fertility models are estimated separately for different types of households, in particular for nuclear and for extended households.

#### 1. The Household Structure Module

The review of anthropological studies on household structures in Section I supported the notion that household affiliation can be regarded as determined within a rational decision-making framework. In Section II we presented a model of such a process. It was an intergenerational model in which the "demand" for household complexity was found to be dependent on the extent to which the production process was characterized by economies and diseconomies of scale, on the difference between the

effective return on investment and the growth rate of population on wealth, educational attainment, and a variety of individual, household and community characteristics and on the availability of substitutes for family support in one's old age. In this section, we attempt to operationalize the model and utilize the aforementioned data from rural India to provide evidence concerning the validity of the various relationships postulated in the operationalized version of the theoretical model.

Footnotes

<sup>1</sup>For recent discussions of the importance of interlinking between labor, land, credit and product markets and for explanations of how these can be important see Bhaduri (1973), Bharadwaj (1974), Bi.alla (1976), Bardhan and Rudra (1978), Bardhan (1979, 1980), Braverman and Srinivasan (1980), and Braverman and Stiglitz (1981).

<sup>2</sup>For recent examinations of this issue see Goode (1963), Kelly et al (1976), Entwisle (1980) and Entwisle and Winegarden (1981). At least four different reasons may be given for reversed causation in this respect: (1) Reduced fertility might increase the need and hence the demand by older persons for old-age support from extrafamilial sources. (2) If parents have fewer children this means that the transfer requirements per child for old-age support rises, inducing children to seek other sources of such support for their parents. (3) Declining fertility may imply weakened bargaining power of parents and their inheritable assets relative to their children, hence decreasing their ability to extract transfers from children and once again increasing their demand for such support from outside the family and household. (4) Decreased fertility implies a change in the age distribution of the population, increasing the political power of older generations relative to that of the younger generation.

<sup>3</sup>For a review of such programs see Savy (1972).

<sup>4</sup>As reported in Mathew (1975, p. 103) a study of 1973 Knowledge, Attitude and Practice Surveys between 1950 and 1970 revealed parents' "evaluation of children as the source of family strength, as the economic anchor of the family and sons as the security against old age" to be the major motive for desiring children. See also Bulatao (1979).

<sup>5</sup>For an interesting elaboration of these aspects as well as a more detailed explanation of the importance of authority, see Sanchez (1976).

<sup>6</sup>The society need not be thought of as a regional or national one. It could be only a village or even a certain social stratum of a single village.

<sup>7</sup>The intrafamilial transfer function could easily be extended to include other considerations derived from the anthropological evidence. To include the number of dependent children  $D$  would be one such extension. One might expect that the ability to transfer to one's dependent parents could be reduced by the need to transfer to one's dependent children. Likewise, from the standpoint of the dependent parents or those approaching the period of dependence, they would be less likely to want to live with sons with many children as long as there are other sons with fewer children. Therefore, one would expect  $\partial\tau_2/\partial D < 0$ . Since such an extension would amount to the addition of a third generation to the model, rather considerably complicating it, we deliberately avoid the inclusion of this consideration at least until the empirical

analysis in Section III. Another such extension would involve the effect of education on  $\tau_2$  and  $\beta_2$ . If education has the effect of improving the off-farm employment opportunities and/or of countering or at least reducing the within-the-family loyalty training, it might have the effect of reducing  $\tau_2$  and  $\beta_2$ . On the other hand, to the extent it raises the income of the  $L_T$  generation it might be expected to increase  $\beta_2$ . Such an extension would be less difficult to bring about, but, since one could think of education as embodied in  $E$ , these effects can be considered dealt with even within the present model as long as it is properly interpreted. Another possible extension would be the inclusion of the numbers of unmarried females in the household (other than one's own daughters) since it was suggested in the anthropological evidence that in those areas of India in which dowry payments are substantial, and all members of the household share equally in the responsibility to finance the dowries of household members, the presence of females approaching marriage age would tend to lower the expected transfers and hence lower the desired degree of extension. This and other extensions of a similar sort could be handled by simply making both the transfer function and the resulting demand for  $E$  function depend on the specific characteristics of the household. Once again, this can be accomplished rather easily in the empirical application of the model and hence is postponed until Section III.

<sup>8</sup>On the other hand, the higher educational attainment level should raise income for any given level of  $k$ , and  $E$  and hence increase the individual's ability to demand more  $E$  through relaxation of the budget constraint. Ambiguity in the effect on  $E$  of this variable is also

demonstrated in the model of Parsons (1977). Nevertheless, a negative effect of education on E would seem likely.

<sup>9</sup>This criticism is directed primarily toward the economic theories of marriage. Explanations by sociologists, being primarily inductive in origin, are less subject to these criticisms but on the other hand are largely devoid of analytic content. While many of these theories acknowledge that marriage decisions are household as opposed to individual decisions, and identify some usually macroeconomic-demographic correlates of marriage age, such as sex ratios, household structure, and educational patterns, they provide little explanation for how and why these determinants are important and why marriage age should vary systematically across households in any given society. For examples, see Dixon (1971), Mitchell (1971), Coale (1971), Fernando (1975), Hajnal (1953, 1965), Palmore and Marzuk (1969), Lesthaeghe (1974), von Elm and Hirschman (1979), Salaff (1976). A significant portion of this literature is primarily methodological, devising methods to measure accuracy, measurement biases, and for drawing inference from limited information. Few of these studies have satisfactory predictive power. von Elm and Hirschman (1979), for example, explain 7-15 percent of the variation in marriage age across households.

<sup>10</sup>An economic motive lying behind the prestige factor is that the household may be able to derive subsequent economic benefits from marital connections with rich families, e.g., in the form of low interest rate loans in time of need; technical assistance, equipment, etc. Note, for example, the references to the interlinking literature given in footnote 1 above.

<sup>11</sup>Other studies employing ARIS include National Council of Applied Economic Research (1974a, 1974b) Bhalla (1979), Rosenzweig and Wolpin (1979), Rosenzweig and Evenson (1977), Makhija (1978), Nugent and Walther (1980), Walther and Nugent (1981).

<sup>12</sup>Participation in the provident fund may be presumed to become relevant and important only for those participants whose actual or expected participation covers a relatively long period of time. In view of the fact that few rural workers could be expected to have long and stable employment histories in jobs that qualify them for provident fund participation, and in the absence of retrospective information on employment histories, the possibility that current participation in the provident fund scheme would have significant effects on fertility (especially past) and other forms of behavior would seem rather limited. Another shortcoming of provident fund participation in this respect is that participants are given the right and apparently frequently do withdraw their funds before retirement, hence, in reality not really constituting an old-age pension system even for those who are long term participants [Far East Economic Review (1978)].

## REFERENCES

- Adams, F. McA. 1972. "The Role of Old People in Santo Tomas Mazaltepec" in D.O. Cowgill and L.D. Holmes, eds. Aging and Modernization. New York: Appleton - Century - Crofts.
- Afzal, M., A. Khan and N.A. Chandhry. 1976. "Age at Marriage, Fertility and Infant Child Mortality in a Lahore Suburb" (Part I). Pakistan Development Review 15, no. 1 (Spring): 90-109.
- \_\_\_\_\_ (Part II).  
Pakistan Development Review 15, no. 2, 195-210.
- Aghajanian, A. 1978. "Family Type, Family Resources and Fertility among Iranian Peasant Women", Social Biology 25, 205-209.
- Anderson, K. 1981. "Age at Marriage in Malaysia" Paper presented to the Population Association of America meetings in Washington, D.C., mimeo.
- Anderson, M. 1972. "Household Structure and the Industrial Revolution; Mid-nineteenth Century Preston in Comparative Perspective" in P. Laslett and R. Wall, eds. Household and Family in Past Time. Cambridge: Cambridge University Press, 215-236.
- Aries, P. 1962. Centuries of Childhood. N.Y.: Random House.
- Arnold, F. et al. 1975. The Value of Children - A Cross National Study, Vol. 1 Hawaii: East-West Population Institute.
- Arthur, W.B. and G. McNicoll. 1978. "Samuelson, Population, and Intergenerational Transfers", International Economic Review 19, 241-246.
- Arthur, W.B. and G. McNicoll. 1977. "Optimal Time Paths with Age Dependence", Review of Economic Studies 44, 111-124.
- Avalaskar, S.V. 1966. "Some Notes on the Social Life in Nagson in the Early 19th Century", Indian Economic and Social History Review 19, 241-246.
- Babu, S. 1979. "Economic Analysis of Fertility Rates in Less Developed Countries with Special Reference to India", paper presented to the American Economic Association annual meeting December 28, 1979, in Atlanta, Georgia.
- Bailey, F.G. 1957. Caste and the Economic Frontier, Manchester: Manchester University Press.
- Bebarta, P.C. 1977. Family Type and Fertility in India. North Quincy, Massachusetts: Christopher Publishing House.

- Becker, G.S. 1965. "A Theory of the Allocation of Time", Economic Journal 75, 493-517.
- Becker, G.S. 1973. "A Theory of Marriage: Part I." Journal of Political Economy, 81, no. 4 (July/August).
- \_\_\_\_\_. 1974. "A Theory of Marriage: Part II." Journal of Political Economy 82, no. 2 (March/April).
- Becker, G.S., E.M. Landes and R.T. Michael. 1977. "An Economic Analysis of Marital Instability." Journal of Political Economy 85, no. 6 (December): 1141-1188.
- Becker, G.S. and N. Tomes. 1979. "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility", Journal of Political Economy 87, 1153-1189.
- Ben-Porath. Y. 1977. "The Economic Value and Costs of Children in Different Economic and Social Settings" in International Population Conference, Mexico 1977, Vol. 2, pp. 77-96. Liege: International Union for the Scientific Study of Population.
- Ben-Porath Y. 1980. "The F-Connection Families, Friends and Firms and the Organization of Exchange." Population and Development Review 6, no. 1 (March): 1-30.
- Beresford, J.C. and A.M. Rivlin. 1966. "Privacy, Poverty and Old Age" Demography 3: 247-258.
- Birdsall, N., J. Fei, S. Kuznets, G. Ranis and T.P. Schultz. 1979. "Demography and Development in the 1980s" in P. Hauser, ed. World Population and Development: Challenges and Prospects. Syracuse: Syracuse University Press.
- Blood, R.O. and D.M. Wolfe. 1960. Husbands and Wives. New York: Free Press: 227-228.
- Bond, C.A. 1974. "Women's Involvement in Agriculture in Botswana", mimeo.
- Boskin, M. 1977. "Social Security and Retirement Decisions", Economic Inquiry.
- Bott, E. 1957. Family and Social Network. London: Tavistock.
- Boulier, B. 1976. "Children and Household Economic Activity in Laguna, Philippines", Manila: University of Philippines Discussion Paper.
- Boulier, B. and M.R. Rosenzweig. 1979. "Age, Biological Factors and Socioeconomic Determinants of Fertility: A New Measure of Cumulative Fertility for Use in the Empirical Analysis of Family Size." Demography 15, no. 4 (November): 487-497.
- Burch, T.K. 1970. "Some Demographic Determinants of Average Household Size: An Analytical Approach", Demography 7, 61-69.

- Burch, T.K. and M. Gendell. 1972. "Extended Family Structure and Fertility: Some Conceptual and Methodological Issues" in S. Polgar, ed. Culture and Population. Cambridge: Schenkman.
- Butz, W.P. and J. DaVanzo. 1975. Economic and Demographic Family Behavior in Malaysia: A Conceptual Framework for Analysis, R-1834-AID.
- Butz, W.P. and J. DaVanzo. 1978. The Malaysian Family Life Survey: Summary Report, R-2351-AID.
- Butz, W.P., J. DaVanzo, D.Z. Fernandez, R. Jones and N. Spoelstra. 1978. The Malaysian Family Life Survey: Appendix A, Questionnaires and Interviewer Instructions, R-231/1-AID.
- Butz, W.P. and J.-P. Habicht. 1976. "The Effects of Nutrition and Health on Fertility: Hypotheses, Evidence and Interventions" in R.G. Ridker, ed. Population and Development: The Search for Selective Interventions. Baltimore: John Hopkins University Press.
- Cain, M.T. 1977. "The Economic Activities of Children in a Village in Bangladesh", Population and Development Review 3, 201-227.
- Cain, M.T. 1978. "The Household Life Cycle and Economic Mobility in Rural Bangladesh", Population and Development Review 4, 421-438.
- Cain, G.G. and M.D. Dooley. 1976. "Estimation of a Model of Labor Supply, Fertility and Wages of Married Women." Journal of Political Economy 84, no. 4, part 2 (August): 5179-5199.
- Caldwell, J.C. 1976. "Toward a Restatement of Demographic Transition Theory", Population and Development Review 2, 321-366.
- Carlaw, R.W., R. Reynolds, L.W. Green and N.I. Khan. 1971. "Underlying Sources of Agreement and Communication between Husbands and Wives in Dacca, East Pakistan". Journal of Marriage and the Family 33: 571-583.
- Carlner, G. 1975. "Determinants of Household Headship", Journal of Marriage and the Family, 37: 28-38.
- Carter, A.T. and R.S. Merrill. 1979. "Household Institutions and Population Dynamics", Rochester: University of Rochester, mimeo.
- Cassen, R. 1978. India: Population, Economy Society. New York: Holmes and Meier Pub., Inc.
- Cheung, S.N.S. 1972. "Property Rights in Children." Economic Journal 82 (June): 641-657.
- Cleave, J.M. 1974. African Farmers: Labor Use in the Development of Smallholder Agriculture. New York: Praeger Publishers.

- Coale, Ansley J. 1965. "Appendix: Estimates of Average Size of Household," in A.H. Coale et al., eds., Aspects of the Analysis of Family Structure pp. 64-69. New Jersey: Princeton University Press.
- \_\_\_\_\_. 1971. "Age Patterns of Marriage." Population Studies 25 (July): 193-214.
- Cohen, M. 1976. House United, House Divided: The Chinese Family in Taiwan. New York: Princeton University Press.
- Cohn, B.S. 1961. "Chamar Family in a North Indian Village: A Structural Contingent", The Economic Weekly 13, 1051-1055.
- Coombs, L.C. and D. Fernandez. 1978. "Husband-wife Agreement about Reproductive Goals" 15 (February): 57-71.
- Dasgupta, B. 1977. Village Society and Labour Use. Delhi: Oxford University Press.
- DaVanzo, J. and D.L.P. Lee. 1978. "The Compatability of Child Care with Labor Force Participation and Non-Market Activities: Preliminary Evidence from Malaysian Budget Data", mimeo.
- Davis, K. 1942. "Changing Models of Marriage: Contemporary Family Types" in H. Becker and R. Hill, eds. Marriage and the Family. New York: D.C. Heath.
- \_\_\_\_\_. 1955. "Institutional Patterns Favoring High Fertility in Underdeveloped Areas", Eugenics Quarterly 2, 33-39.
- \_\_\_\_\_. and J. Blake. 1956. "Social Structure and Fertility: An Analytical Framework", Economic Development and Cultural Change 4, 211-235.
- Deardoff, A.V. 1976. "The Optimum Growth Rate for Population: Comment", International Economic Review 17, 510-515.
- Desai, I.P. 1956. "The Joint Family in India: An Analysis", Sociological Bulletin V, 146-156.
- Desai, N.C. 1936. Report on the Hindu Joint Family" in Economic and Social Aspects. Baruda: Baruda State Press.
- DeTray, D.N. 1977. "Age of Marriage and Fertility: A Policy Review". The Pakistan Development Review 16 (1, Spring): 89-100.
- DeTray, D. and Z. Khan. 1977. "On the Care and Handling of Regression Specifications in Fertility Research", Pakistan Development Review 16 (Autumn): 309-324.
- DeVany, A., and N. Sanchez. 1977. "Property Rights, Uncertainty and Fertility: An Analysis of the Effect of Land Reform on Fertility in Rural Mexico." Weltwirtschaftliches Archiv.

- \_\_\_\_\_. 1979. "Land Tenure Structures and Fertility in Mexico". Review of Economics and Statistics 61 (February): 67-72.
- Dixon, R.B. 1971. "Explaining Cross-Cultural Variations in Age at Marriage and Proportions Never Marrying." Population Studies 25 (July): 215-233.
- Dixon, R.B. 1976. "The Roles of Rural Women: Female Seclusion, Economic Production and Reproductive Choice:", in R.G. Ridker, ed., Population and Development, The Search for Selective Interventions, Baltimore: Johnston.
- Dube, S.C. 1955. Indian Village. London: Routledge and Kegan Paul.
- Entwisle, B. 1980. "On the Relationship Between Pension Programs and Fertility Levels," paper presented at the Annual Meetings of the American Sociological Association, New York City, August 1980.
- Entwisle, B. and C.R. Winegarden 1981. "Fertility as a Determinant and Consequence of Government-Sponsored Pension Programs in LDCs", Washington D.C.: Paper presented to the Annual Meetings of the Population Association of America.
- Epstein, T.S. 1962. Economic Development and Social Change in South India. Manchester: University Press.
- Far East Economic Review, 1978. "Own Your Own Home and Have Money for Old Age, Far East Economic Review 101 (April 11) 55-62.
- Feldstein, M. 1974. "Social Security, Induced Retirement, and Aggregate Capital Accumulation", Journal of Political Economy 82, 905-926.
- Fernando, D.F.S. 1975. "Changing Nuptiality Patterns in Sri Lanka 1901-1971", Population Studies Vol. 29 (July) 179-190.
- Fortes, M. 1949. "Time and Social Structure: An Ashanti Case Study" in M. Fortes, ed. Social Structure: Studies Presented to A.R. Radcliffe-Brown. Oxford: Clarendon Press.
- Fortes, M. 1978. "Parenthood, Marriage and Fertility in West Africa" Journal of Development Studies 14 (July): 121-149.
- Freedman, M. 1961-62. "The Family in China: Past and Present." Pacific Affairs (Winter).
- Freedman, R., J.Y. Takeshita and T. Sun. 1974. "Fertility and Family Planning in Taiwan: A Case Study of Demographic Transition", American Journal of Sociology 20, 16-27.
- Freiden, A. 1974. "The United States Marriage Market." Journal of Political Economy 82, 2 Part II (March/April): 534-553.
- Fukutake, T. 1967. Japanese Rural Society, translated by R.P. Dore. Ithaca: Cornell University Press.

- Fuller, J. 1976. The Nayars Today. Cambridge: Cambridge University Press.
- Gale, D. 1973. "Pure Exchange Equilibrium of Dynamic Economic Models", Journal of Economic Theory 6, 12-36.
- Goldscheider, C. 1971. Population, Modernization and Social Structure. Boston: Little, Brown and Company.
- Goode, W.J. 1963. World Population and Family Patterns. New York: Free Press.
- Goody, J. 1972. "The Evolution of the Family" in P. Laslett, ed. Household and Family in Past Time. Cambridge: Cambridge University Press.
- \_\_\_\_\_. 1976. "Aging in Nonindustrial Societies" in R.H. Binstock and F. Shanas, eds. Handbook of Aging and the Social Sciences. New York: Van Nostrand - Reinhold Co.
- Gore, M.S. 1968. Urbanization and Family Change. Bombay: Popular Prakashan.
- Goubert, P. 1970. "Historical Demography and the Reinterpretation of Early Modern French History: A Research Review", Journal of Interdisciplinary History, 37-48.
- Green, L.W. 1965. "Preliminary Notes on Problem, Scope, Relevant Literature, Hypotheses, Design, Sample and Schedule for the User/Sometime User/Non-User (USN) Study in Dacca, East Pakistan," East Pakistan Research and Evaluation Study.
- Hajnal, J. 1953. "Age at Marriage and Proportions Marrying." Population Studies 7 (November): 111-136.
- \_\_\_\_\_. 1953. "The Marriage Boom." Population Index (April): 80-101.
- \_\_\_\_\_. 1954. "Analysis of Changes in the Marriage Pattern by Economic Groups." American Sociological Review 19 June, 295-302.
- Hajnal, J. 1965. "European Marriage Patterns in Perspective" in D. Glass and D.F. Eversley, eds. Population in History. Chicago: Aldine Publishing Co.
- Harlan, W.H. 1964. "Social Status of the Aged in Three Indian Villages", Vita Humana 7, 239-252.
- Heckman, J.J. 1976. "A Life Cycle Model of Earnings, Learning and Consumption", Journal of Political Economy 84, 511-545.
- Heer, D.N. and D.O. Smith. 1969. "Mortality Level, Desired Family Size and Population Increase: Further Variations on a Basic Model", Demography 6, 141-149.

- Heller, P.S. and W.D. Drake. 1979. "Malnutrition, Child Morbidity and the Family Decision Process", Journal of Development Economics 6, 203-236.
- Hill, R. et al. 1959. The Family and Population Control. Chapel Hill, N.C.: University of North Carolina Press.
- Hogan, D. 1978. "The Effects of Demographic Factors, Family Background and Job Achievement on Age of Marriage" Demography 15 (May) 161-175.
- Homans, G.C. 1941. English Villagers of the Thirteenth Century. Cambridge, Mass.: Harvard University Press.
- Hull, T.H. 1978. "Economic Value of Children: Comment", Current Anthropology 19, 301-302.
- International Labour Office. 1971. Labour Force Projections. Geneva: International Labour Office.
- Jahan, R. 1973. "Women in Bangladesh", Dacca: Ford Foundation, mimeo.
- Jones, R. and N. Spoelstra. 1978. The Malaysian Family Life Survey: Appendix C, Field and Technical Report. R-2341/3-AID.
- Karve, J. 1953. Kinship Organization in India. Poona: Daccan College.
- Keeley, M.C. 1977. "The Economics of Family Formation." Economic Inquiry 15, 2 (April): 238-249.
- Keeley, M.C. 1979. "Economics of Family Formation", International Economic Review 20 (June) 527-544.
- Keesing, R.M. 1970. "Kwano Fosterage", American Anthropologist 72, 919-1019.
- Kelly, W.R. et al. 1976. "Comment on Charles F. Hohm's Social Security and Fertility: An International Perspective", Demography 13, 4: 581-586.
- Kessinger, T.G. 1974. Vilyatpur 1848-1968. Berkeley, Los Angeles: University of California Press.
- Khan, M.A., J.S. Hammer, and L.E. Lynch. 1977. "Pakistani Standard for Pre-school Child Feeding and Growth", Islamabad, Pakistan: Planning and Development Division, Nutrition Cell.
- King, F.M. 1976. "Time Allocation in Philippine Rural Households", University of Philippines: Institute of Economic Development and Research Discussion Paper, 16-20.
- Kolenda, P. 1967. "Regional Differences in Indian Family Structure" in R.J. Coane, ed. Regions and Regionalism in South Asian Studies: An Exploratory Study, Durham: Duke University Program in Comparative Studies of Southern Asia.

- Kolenda, P. 1968. "Region, Caste and Family Structure: A Comparative Study of the Indian Joint Family" in M. Singer and B.S. Cohn, eds. Structure and Change in Indian Society. New York: Werner-Gren Foundation, 339-396.
- Knodel, J. and V. Prachuabmoh. 1976. "Preferences for Sex of Children in Thailand: A Comparison of Husbands' and Wives' Attitudes". Studies in Family Planning 7: 137-143.
- Kobrin, F.E. 1976. "The Fall in Household Size and the Rise of the Primary Individual in the United States". Demography 13: 127-138.
- Lang, O. 1946. Chinese Family and Society. New Haven: Yale University Press.
- Laslett, P. 1965. The World We Have Lost. New York: Scribner's.
- Laslett, P. and R. Wall, eds. 1972. Household and Family in Past Time. Cambridge: Cambridge University Press.
- Laslett, P. 1972. "Introduction: The History of the Family" in P. Laslett and R. Wall, eds. Household and Family in Past Time. Cambridge: Cambridge University Press.
- \_\_\_\_\_. "Mean Household Size in England since the Sixteenth Century", in P. Laslett and R. Wall, eds., Household and Family in Past Time. Cambridge: Cambridge, University Press: 125-158.
- Lazear, E.P. and R.T. Michael. 1980. "Family Size and the Distribution of Peal Per Capita Income", American Economic Review 70, 91-107.
- Leibenstein, H. 1957. Economic Backwardness and Economic Growth. New York: John Wiley.
- \_\_\_\_\_. 1978. General X-Efficiency Theory and Economic Development. London: Oxford University Press.
- Lesthaeghe, R. 1974. "The Feasibility of Controlling Population Growth through Nuptuality and Nuptuality Policies". International Population Conference, Liege: International Union for the Scientific Study of Population, Vol. 3, 1973.
- Levine, D. 1977. Family Formation in an Age of Nascent Capitalism. New York: Academic Press.
- Little, K. and A. Price. 1974. Urbanization, Migration and the African Family. Reading, Massachusetts: Addison-Wesley Module no. 51.
- Liu, P.K.C. 1967. "Differential Fertility in Taiwan" in Contributed Papers, Sydney Conference on Population. Liege: International Union for the Scientific Study of Population, 363-370.
- Lorimer, F. ed. 1958. Culture and Human Fertility. New York: Greenwood Press.

- Makhija, I. no date. "Adult and Child Labor Within the Household and the Quantity and Quality of Children: Rural India", Illinois: University of Chicago, mimeo.
- Makhija, I. 1978. "The Work Done by Children in Rural Developing Societies: Effects on Fertility and Schooling." Mimeo.
- Mamdani, N. 1972. The Myth of Population Control: Family Caste and Class in an Indian Village. New York: Monthly Review Press.
- Mandelbaum, D. 1974. Human Fertility in India. Delhi: Oxford University Press.
- Mathew, T.I. 1975. "Parental Attitudes of Dependence on Children from Old-age Security - Some Evidence from Selected Asian Countries", in Aging Regional Symposium of National Specialists on Population Aspects of Rural Social Security. Kuala Lumpur 17-26 November 1975. Bangkok: International Labour Office for Asia.
- Mauldin, W.P., N. Choucri, F.W. Noteslein and M. Teitelbaum. 1974. "A Report on Bucharest," Studies in Family Planning 5: 357-395.
- McNicoll, G. 1978. "Population and Development: Outlines for a Structuralist Approach", Journal of Development Studies 14, 79-99.
- Merchant, K.T. 1935. Changing Views on Marriage and the Family: Hindu Youth. Madras: B.G. Paul and Co.
- Michael, R.T. and G.S. Becker. 1973. "On the New Theory of Consumer Behavior", The Swedish Journal of Economics 75, 378-395.
- Michael, R.T., V.R. Fuchs and S.R. Scott. 1980. "Changes in the Propensity to Live Alone: 1950-1976", Demography 17 (February): 39-56.
- Mitchell, R.E. 1971. "Changes in Fertility Rates and Family Size in Response to Changes in Age at Marriage, the Trend Away from Arranged Marriages, and Increasing Urbanization", Population Studies 25 (November) 481-489.
- Mitchell, R.E. 1972. "Husband-wife Relations and Family Planning Practices in Urban Hong Kong", Journal of Marriage and the Family 34: 139-146.
- Mitra, A. 1979. India's Population: Aspects of Quality and Control. New Delhi: Abhinav Publications.
- Moore, S.F. 1978. "Old Age in a Life Term Social Arena: Some Chagga of Kilimanjaro in 1974" in B.G. Myerhoff and A. Simic, eds. Life's Career-Aging: Cultural Variations on Growing Old. Beverly Hills: Sage 23-76.
- Mueller, E. 1976. "The Economic Value of Children in Peasant Agriculture" in R. Ridker, ed. Population and Development: The Search for Selective Interventions. Baltimore and London: John Hopkins University Press.

- \_\_\_\_\_. 1979. "Household Structure, Time Use, and Income Distribution", paper presented to the Population Association of America annual meeting April, 1979.
- Munnell, A. 1974. The Effect of Social Security on Personal Saving. Cambridge, Massachusetts: Ballinger Publishing Co.
- Nag, M. 1962. Factors Affecting Human Fertility in Nonindustrial Societies: A Cross Cultural Study. New Haven: Yale University, Department of Anthropology, Publication 66.
- \_\_\_\_\_. 1967. "Family Type and Fertility" in Proceedings, World Population Conference 1965, Vol. II. New York: United Nations.
- Nag, M., B. White and R.C. Peet. 1978. "An Anthropological Approach to the Study of the Economic Value of Children in Java and Nepal", Current Anthropology 19, 293-306.
- Navran, L. 1967. "Communication and Adjustment in Marriage". Family Process 6 (September) 173-184.
- Neher, P.A. 1971. "Peasants, Procreation, and Pensions", American Economic Review 61, 380-389.
- Nerlove, M. 1974. "Household and Economy: Toward a New Theory of Population and Economic Growth", Journal of Political Economy 82, S200-S218.
- Nimkoff, H.F. and R. Middleton. 1960. "Types of Family and Types of Economy". American Journal of Sociology 66 (November), 215-225.
- Nugent, J.R., and T. Gillaspay. 1981. "Old-Age Pensions and Fertility in Rural Areas of Less Developed Countries: Some Evidence from Mex'co." Economic Development and Cultural Change, forthcoming.
- O'Hara, D.J. 1972c. Changes in Mortality Levels and Family Decisions Regarding Children. Santa Monica: RAND Corp., R-914-RF.
- \_\_\_\_\_. 1972b. "Mortality Risks, Sequential Decisions on Births and Population Growth." Demography 9 no. 3 (August): 285-298.
- \_\_\_\_\_. 1975. "Microeconomic Aspects of the Demographic Transition." Journal of Political Economy, 83, no. 6 (December): 1203-1216.
- Orenstein, H. 1961. "The Recent History of the Extended Family in India", Social Problems 8, 341-350.
- Owens, R. 1971. "Industrialization and the Joint Family", Ethnology 10, 223-250.
- Pakrasi, K. and C. Malaker. 1967. "The Relationship between Family Type and Fertility", Milbank Memorial Fund Quarterly 45, 451-460.

- Palmore, J.A. and A.B. Marzuki. 1969. "Marriage Patterns and Cumulative Fertility in West Malaysia: 1966-1967", Demography 6 (4 November): 383-401.
- Parry, J.P. 1979. Caste and Kinship in Kangra. London: Routledge and Kegan Paul.
- Parsons, D.O. 1977. "On the Economics of Intergenerational Relations", mimeo.
- Pellechio, A.J. 1979. "Social Security Financing and Retirement Behavior", American Economic Review 69, 284-287.
- Poffenberger, T. 1969. "Husband-wife Communication and Motivational Aspects of Population Control in an Indian Village". New Delhi: Central Family Planning Institute Monograph Series No. 10.
- Potter, R.G., Jr., J.B. Wyon, M. Parker, and J.E. Gordon. 1965. "Case Study of Birth Interval Dynamics." Population Studies 19 (July): 81-96.
- Preston, S.H. and A.T. Richards. 1975. "The Influence of Women's Work Opportunities on Marriage Rates." Demography 12 (May): 209-222.
- Pryor, E.T. 1972. "Rhode Island Family Structure: 1875 and 1960" in P. Laslett and R. Wall, ed. Household and Family in Past Time. Cambridge: Cambridge University Press 1972.
- Raj, B. and B.G. Prasad. 1971. "A Study of Rural Aged Persons in Social Profile", The Indian Journal of Social Work 32, 155-162.
- Rao, M.S.A. 1968. "Occupational Diversification and Joint Household Organization", Contributions to Indian Sociology, New Series II, 98-111.
- Repetto, R., A. Deolalikar and V. Shah. 1980. "The Dynamics of Demographic and Economic Change in Rural India, A Study of Matar Taluka in Gujarat State from 1965 up to 1975". Paper presented to the Population Association of America.
- Ridker, R.G. ed. 1976. Population and Development: The Search for Selective Interventions. Baltimore: Johns Hopkins University Press.
- Ridker, R.G. 1976. "Perspectives in Population Policy and Research" in R.G. Ridker, ed. Population and Development: The Search for Selective Interventions. Baltimore: Johns Hopkins University Press.
- Rosenzweig, M.R. and R. Evenson. 1977. "Fertility, Schooling and the Economic Contribution of Children in Rural India: An Econometric Analysis.", Econometrica 45, 1065-1079.
- Rosenzweig, M.R. and T.I. Wolpin. 1980. "Life-Cycle Labor Supply and Fertility: Causal Inferences from Household Models." Journal of Political Economy 88, no. 2, 328-348.

- \_\_\_\_\_. 1980. "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment." Econometrica 48, no. 1 (January): 227-240.
- Ross, H. and I. Sawhill. 1975. Time of Transition. Washington, D.C.: The Urban Institute.
- Ryder, J.W. 1976. "Interrelations between Family Structure and Fertility in Yucatan" in B.A. Kaplan, ed. Anthropological Studies of Human Fertility. Detroit: Wayne State University Press.
- Salaff, J.W. 1972. "Institutionalized Motivation for Fertility Limitation in China", Population Studies 26, 233-262.
- Salaff, J. 1976. "The Status of Unmarried Hong Kong Women and the Social Factors Contributing to their Delayed Status". Population Studies 30 (November) 391-412.
- Samuelson, P.A. 1958. "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money", Journal of Political Economy 66, 467-482.
- Samuelson, P.A. 1975a. "The Optimum Growth Rate for Population", International Economic Review 16, 531-538.
- Samuelson, P.A. 1975b. "Optimum Social Security in a Life-Cycle Growth Model", International Economic Review 16, 539-544.
- Samuelson, P.A. 1976. "The Optimum Growth Rate for Population: Agreement and Evaluation", International Economic Review 17, 516-525.
- Sanchez, N. 1976. "The Rural Family and Capital Accumulation: A Theoretical Analysis", mimeo.
- Sarma, J. 1964. "The Nuclearization of Joint Family Households in West Bengal", Man in India 44, 193-206.
- Savy, R. 1972. Social Security in Agriculture. Geneva: International Labour Office.
- Schultz, T.P. 1976. "Interrelationships between Mortality and Fertility" in R.G. Ridker, ed. Population and Development: The Search for Selective Interventions. Baltimore: John Hopkins University Press.
- Scrimshaw, S.C.M. 1978. "Infant Mortality and Behavior in the Regulation of Family Size", Population and Development Review 4, 383-404.
- Shah, A.M. 1974. The Household Dimension of the Family in India. Berkeley and Los Angeles: University of California Press.
- Simic, A. 1978. "Winners and Losers: Aging Yugoslavs in a Changing World", in B.G. Myerhoff and A. Simic, eds., Life's Career-Aging: Cultural Variations on Growing Old. Beverly Hills: Sage, 77-106.

- Singer, M. 1968. "The Indian Joint Family in Modern Industry" in M. Singer and B.S. Cohn, eds. Structure and Change in Indian Society. Chicago: Aldine.
- Smith, T.C. 1977. Nakahara: Family Farming and Population in a Japanese Village, 1717-1830. Stanford: Stanford University Press.
- Southey, C. 1973. "Peasants, Procreation, and Pensions: Note", American Economic Review 63, 983-985.
- Srinivas, M.N. 1952. "A Joint Family Dispute in a Mysore Village", Journal of MPS University of Baroda 1, 731.
- Stycos, J.M. 1955. Family and Fertility in Puerto Rico. New York: Columbia University Press.
- Stycos, J.M. 1958. "Some Directions for Research on Fertility Control", Milbank Memorial Fund Quarterly 36, 126-148.
- Sussman, M.B., J.N. Cates and D.T. Smith. 1970. The Family and Inheritance. New York: Russell Sage Foundation.
- Teitelbaum, M.S. 1974. "Population and Development: Is a Concensus Possible?", Foreign Affairs 52, 742-.
- Tilly, C. 1978. "The Historical Study of Vital Processes" in C. Tilly, ed. The Historical Studies of Changing Fertility. Princeton: Princeton University Press.
- United Nations. 1975. Report of the United Nations World Population Conference, 1974. New York: United Nations.
- van der Woude, A.M. 1972. "Variations in the Size and Structure of the Household in the United Provinces of the Netherlands in the Seventeenth and Eighteenth Centuries" in P. Laslett and R. Wall, eds. Household and Family in Past Time. Cambridge: Cambridge University Press: 299-318.
- Vatuk, S. 1975. "The Aging Women in India: Self-Perceptions and Changing Roles" in A. deSouza, ed. Women in Contemporary India. Delhi: Manohar.
- Vatuk, S. 1980a. "Withdrawal and Disengagement as a Cultural Response to Aging in India" in C.L. Fry, ed. Aging in Culture and Society. Brooklyn, New York: Bergin.
- Vatuk, S. 1980b. "Cultural Perspectives on Social Services for the Aged in India", Paper presented at Gerontological Society, San Diego, California.
- Vatuk, S. 1981. "Aging in Industrializing Societies: The Case of India", in P. Stearns, ed. Pre-Industrial Old Age. New York: Holmes and Meier.

- Velez, G.G. 1978. "Youth and Aging in Central Mexico: One Day in the Life of Four Families of Migrants", in B.G. Myerhoff and A. Simic, eds., Life's Career-Aging: Cultural Variations on Growing Old. Beverly Hills: Sage, 107-162.
- von Elm, B. and C. Hirschman. 1979. "Age at First Marriage in Peninsular Malaysia", Journal of Marriage and the Family 41 (4, November), 877-891.
- Willis, R.J. 1979. "The Old Age Security Hypothesis and Population Growth", working paper no. 372, NEER Working Paper Series. Cambridge, Massachusetts: National Bureau of Economic Research.
- Wray, J.D. 1971. "The Malnutrition-Morbidity-Mortality (Triple M) Complex in Pre-school Children". New York: Rockefeller Foundation.
- Wrigley, E.A. 1978. "Fertility Strategy for the Individual and the Group" in C. Tilly, ed. Historical Studies of Changing Fertility. Princeton: Princeton University Press.
- Yaukey, D., B.J. Roberts and W. Griffiths. 1965. "Husbands' vs. Wives' Responses to a Fertility Survey", Population Studies 19: 29-43.
- Yaukey, D., W. Griffiths and B.J. Roberts. 1967. "Couple Concurrence and Empathy on Birth Control Motivation in Dacca, East Pakistan." American Sociological Review 32: 716-726.