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A MODEL OF MARRIAGE SERVICES IN RURAL AREAS OF DEVELOPING COUNTRIES

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ABSTRACT

The purpose of this paper is to develop a model of marriage services appropriate for rural areas of developing countries. In contrast to the marriage models available in the literature, the model assumes that marriage decisions are made at the level of the household, i.e., as if they were arrranged by the household head. It also postulates that marriage contracts are accompanied by dowry or bride price payments which equalize the values of the marriage services exchanged. The quantity demanded of marriage services is assumed to be represented by the desired age and educational attainment charateristics of the respective marriage partner and to be motivated by the receiving household's need for women and children, which depends on its portfolio of assets, on its degree of extension, and on the age and sex composition of the household and several other factors. Several hypotheses are proposed and subsequently, utilizing data from the Additional Rural Income Survey of rural India in the early 1970s, empirical support is provided for several of the most important hypotheses.

I. Introduction

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.

From a rather careful survey of the descriptive literature primarily of anthropology,[1/] we conclude that there are several basic shortcomings in the application of the conventional type of marriage models to rural areas of LDCs, in general, and to rural India, in particular.

A. The Identification of the Decision-Maker in Marriage Decisions

First, in contrast to what may be realistic in developed countries or even in urban areas of developing countries (LDCs), marriage deci-

sions are in general not made independently by the marriage partners themselves. Rather they are largely household decisions over which the household head and his wife exercise considerable control. Since in rural areas of LDCs extended or complex household structures, in which married sons and their wives and children remain within the household of the father and household head for a considerable number of years, are very common, and since household heads are generally unable to exercise much direct control over the fertility decisions of their daughters-in-law, it is by the exercise of their very substantial control over the timing and choice of partner-in-marriage that household heads can influence the fertility behavior of their sons' wives. The exercising of indirect influence over the fertility behavior of their children is not the only motive for the household head's interest in controlling age at marriage and the choice of the marriage partner. Because of the importance of household production activities of various sorts in the overall production and consumption activities of the household and the rather extreme degree of specialization by age and sex of the household members in the different activities,[2/] the determination of ages-at-marriage of sons and daughters (who "marry-out" of the household) is an important mechanism for affecting the age and sex composition of the household.

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 [Hitchcock and Minturn (1963), Jacobson (1977)] and for rules that require women to marry outside her native village [Sharma (1980), Goode (1963)].

Lang (1946), Goode (1963), Gore (1968), Jahan (1973) and Dixon (1976), among others, provide considerable evidence of the very considerable degree to which marriages are arranged or at least approved by household heads in rural areas of LDCs. The control of the head of the household over marriage decisions is a part of his control over all the property of the household including 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 marries-out is transferred from one household to another. [Freedman (1961-62, p. 328)]. 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 preference of their children.

In contemporary times, of course, the relative importance of "blind" marriages has diminished, and admittedly, 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,

goals and opportunities. 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)].[3/] 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 arranged, and which also, of course, are likely to have direct influences on age at marriage and hence on fertility.

B. The Process and Relevance of Search Activities

The second principal shortcoming of the application of traditional marriage models to rural areas of LDCs, and one which results from the fact that it is household heads who control age at marriage and even partners-in-marriage, is that the search process for marriage partners is not one which involves primarily the time of the potential marriage partners themselves. This is not to say that search activities are unimportant,[4/] but only to point out that the resources involved in search activities are either the time of other household members or ex-household members (such as daughters who have married into other villages and families and hence may have rather intimate knowledge of the characteristics of potential wives for the sons of household heads in those villages) or professional marriage brokers whose services can be procured in almost every village. If the resources involved in the search process are not those of the marriage partners themselves, it is obvious that it is unrealistic to depict the benefits and costs of search as being the primary or even only important determinants of age at marriage.

C. Side Payments: Bride Price and Dowry

The third aspect of traditional marriage models which is of dubious relevance to rural areas of LDCs is the assumption that the values of the services exchanged by way of the marriage contract between the marriage partners, or in this case between households, are equal and/or of no relevance in understanding marriage decisions. To the contrary, in rural areas of LDCs the consummation of the marriage contract is almost invariably accompanied by a side payment in one direction or another. In those cases where the side payment is from the husband's family to the wife's family, the payment is known as the bride price; in cases where the direction of payment is reversed, the payment is a dowry. Anthropologists working in rural areas of LDCs, especially in India, have long pointed out that both the direction and magnitude of the side payment tend to vary between different classes, different regions and according to the characteristics of both the individual marriage partners and the households from which they come.

The remainder of the paper is organized as follows. Because of the aforementioned shortcomings of applying the traditional marriage models to rural areas of LDCs, in Section II which follows we attempt to develop a model of marriage services that (1) takes account of the fact that marriage decisions are made at the level of the household and hence may be motivated by various household characteristics such as wealth, the age and sex composition of the household, and location, (2) recognizes the importance to the contracting parties of the respective values of the marriage services exchanged and hence incorporates a dowry function as an essential ingredient of the model, and (3) pays little attention to search since search activities are generally undertaken by

persons other than the potential partners in marriage and hence cannot influence age at marriage. For reasons only in part explained above, marriage decisions are regarded as being contingent on wealth and its composition, educational attainment, and household structure instead of being determined simultaneously with all their other decisions.[5/]

Then in Section III, we go on to describe the data utilized, and to set up empirical tests of the hypotheses derived from Sections I and II. Finally, in Section IV we present the empirical results and draw some conclusions.

II. The Model

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 designed to explain the ages at which sons are married, and the ages and quality characteristics of the daughters-in-law who "marry in." Although we model only a single representative household with 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 assume that all sons and their wives in the representative household are identical one to another. That is, we assume that all sons would have identical wage rates and be married off at the same age. Similarly, we assume that all 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, since marriage is almost universal and polygamy is extremely rare in rural India, the country to which the model is to be applied in subsequent sections of the paper, 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 1. 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 (1). The household's utility depends on the consumption of marriage services, MS_c, and the consumption of other marketable goods and services, X_c. Although for simplicity the utility function and all other equations of the model are stated in static terms, the time horizon of the model is that of a lifetime. Thus it is recognized that a certain amount of time discounting is implicit in the formulation of the model. In particular, because of their special relevance for old-age security, marriage services, and particularly children services which result from marriage services, may well be discounted relative to other goods and services, X_c, which are more important earlier in life. The nature of the utility function, and indeed of all other functions in the model, may be conditional on the existing degree of complexity of the household. 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 are considered given and hence are ignored in the following discussion.

In equation (2), the quantity of marriage services per wife, ms, is converted 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 ms is given in equation (3). Specifically, the production of ms depends on the human capital-weighted time allocation to such activities of husbands and wives, $T^h_{ms}\bar{H}^h$, and $T^W_{ms}H^W$, respectively, the quantity of market goods used in production of such services, X_{ms}, and finally on the lifetime supply of community services such as health and education specific to the production of marriage services, Z_1. 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 (4). It depends upon the aggregate time allocations of all household members, i.e., all husbands, all wives, all children (in the form of marriage services) and all others, allocated to production of X, upon the present values of both the non-human capital of the household and the community services such as roads, markets, etc. relevant to the production of X, Z_2. Equation (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, less the net exports of X, X_{NE}, and net of the use of X in the production of MS, i.e., $N^W X_{ms}$. Equation (6) is a similar balance equation for marriage services (children). The consumption of marriage services

MS_c is equal to the quantity produced MS less the quantity allocated to production of X, MS_x.

The time constraints of each husband and of each wife are given in equations (7) and (8), respectively. Since the time allocations of other household members is directly relevant only to the production of X, T_x^o is simply treated as exogenously given, thereby avoiding the need for a separate equation for T^o. The human capital of the wife H^w and the wife time, T^w, which translates into the age-at-marriage of the wife, are key variables to be determined in the model. The lifetime balance of payments constraint of the household is given in equation (9). The net imports of market goods over the lifetime must be equal to the net dowry receipts from the families whose daughters marry-in.

The model is completed with equation (10) that explains how the dowry or bride price of wives (daughters-in-law), D^w, is determined. In each case the dowry price is specified to depend on the relative stocks of non-human wealth of the households of destination and of origin, V and V_o, respectively, and the human capital- and wage rate-weighted time allocations to marriage services of both marriage partners, $T^wH^ww^w$ and $T_{ms}^h\bar{H}^h\bar{w}^h$, respectively. Specifically, increases in wife-time, the human capital of the wife or the female wage rate in the vicinity of the household should be expected to lower the dowry while increases in the wealth of the husband's household relative to that of the wife, the time allocation of the husband to marriage services, and the human capital and wage rate of the husband would be expected to increase the dowry, i.e., the value of the side payment required to balance the exchange of marriage services between households. In equation (11), the full income constraint of the household in terms of lifetime potential labor income

and non-human wealth is defined, thereby combining the budget and time constraints.

Before going to the solution of the model, an intuitive understanding of the marriage model is provided 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, would be a supply curve of human capital-weighted husband services, $T^h_{ms}\bar{H}^h$, which is designated S_{H_d} 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 D_{w_d} in Figure 1. One should 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 a similar model of another household, household m, would come a jointly determined human capital-weighted supply curve of daughters as wives, S_{w_m} in Figure 1, and a jointly determined demand curve for human capital-weighted husband services, D_{H_m} in the diagram. The dowry payment can hence be interpreted as the transfer payment from household of origin m 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 allocations of time and net export of goods X_{NE} 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 turn now to the solution to the formal version of the model given in Table 1.

Utilizing the Lagrangian formulation wherein the utility function (1) is maximized subject to the production functions for MS and X, (2)-(4) respectively, the fixed monetary budget constraint (9) and the full income constraint (11), we obtain the following Lagrangian equation:

$$= U[ms(T^h_{ms}\bar{H}^h, T^w_{ms}H^w, X_{ms}; \bar{Z}_1)\bar{N}^w - MS_x, X(\bar{N}^w T^h_x \bar{H}^h, N^w T^w_x H^w, MS_x, \bar{N}^o T^o_x \bar{H}^o, \bar{V}; \bar{Z}_2) - X_{NE} - \bar{N}^w X_{ms}]$$

$$+ \lambda_1[\bar{I} + q_x X_{NE} + D^w(\frac{\bar{V}}{V^o}, (T^w_{ms} + T^w_x)H^w\bar{w}^w, T^h_{ms}\bar{H}^h\bar{w}^h)\bar{N}^w] .$$

$$+ \lambda_2[\bar{R} - \bar{N}^o\bar{T}^o\bar{H}^o\bar{w}^o - V - \bar{N}^w\bar{H}^h\bar{w}^h(T^h_{ms} + T^h_x)] \qquad (12)$$

Differentiating (12) with respect to the following ten endogenous variables in the system, T^h_{ms}, T^w_{ms}, T^h_x, T^w_x, H^w, X_{ms}, X_{NE}, MS_x, λ_1 and λ_2, and after rearranging terms, we obtain in the same order the following first-order conditions:

$$\frac{\partial U}{\partial MS}\frac{\partial ms}{\partial T^h_{ms}} = -\lambda_1 \frac{\partial D^w}{\partial T^h_{ms}}\bar{w}^h + \lambda_2\bar{w}^h \qquad (13a)$$

$$\frac{\partial U}{\partial MS}\frac{\partial ms}{\partial T^w_{ms}} = -\lambda_1 \frac{\partial D^w}{\partial T^w_{ms}}\bar{w}^w \qquad (13b)$$

$$\frac{\partial U}{\partial X_c}\frac{\partial X}{\partial T^h_x} = \lambda_2\bar{w}^h \qquad (13c)$$

$$\frac{\partial U}{\partial X_c} = -\lambda_1 \frac{\partial D^w}{\partial T^w_x}\bar{w}^w \qquad (13d)$$

$$\frac{\partial U}{\partial MS}\frac{\partial ms}{\partial H^w}\frac{T^w_{ms}}{T^w_{ms}+T^w_x}+\frac{\partial U}{\partial X_c}\frac{\partial X}{\partial H^w}\frac{T^w_x}{T^w_{ms}+T^w_x} = -\lambda_1\frac{\partial D^w}{\partial H^w}w^{-w} \tag{13e}$$

$$\frac{\partial U}{\partial ms}\frac{\partial ms}{\partial X_{ms}} = \frac{\partial U}{\partial X_c} \tag{13f}$$

$$\frac{\partial U}{\partial X_c} = \lambda_1\bar{q}_x \tag{13g}$$

$$\frac{\partial U}{\partial X_c}\frac{\partial X}{\partial MS_x} = \frac{\partial U}{\partial MS_x} \tag{13h}$$

$$\bar{I} = -q_x X_{NE} - D^w[\frac{V}{V_o}, (T^w_{ms}+T^w_x)H^w\bar{w}^w, T^h_{ms}H^h\bar{w}^h]\bar{N}^w \tag{13i}$$

$$\bar{R} = N^o\bar{T}^o\bar{H}^o\bar{w}^o + \bar{V} + N^w\bar{H}^h\bar{w}^h(T^h_{ms}+T^h_x) = 0 \tag{13j}$$

Condition (13a) states that the marginal utility attributable to the marginal product of husband time or marriage services per wife should be equal to the difference between (a) the shadow price of time relative to the numeraire (the price of marriage services), and (b) the shadow price of money income multiplied by the marginal effect on the dowry of an extra infinitesimally small increment of husband-time, where both (a) and (b) are weighted by the male wage rate, $\bar{w}^h$.

Condition (13b) equates the marginal utility derived from the marginal allocation of wife-time to marriage services to the female wage rate-weighted marginal effect of that time on the dowry, weighted by the shadow price of money income (again relative to the value of marriage services). Because of the expectation that $\frac{\partial D^w}{\partial T^w} < 0$, both sides of (13b) are positive.

Condition (13c) equates the shadow price of time weighted by the male wage rate with the indirect marginal utility derived from the marginal product of husband-time to market goods production. Condition (13d) equates the marginal utility of the consumption of market goods with the marginal opportunity cost of wife-time allocated to market goods production, which is the marginal effect of that time on the dowry, weighted by the female wage rate and multiplied by the shadow price of money income. Once again, since $\partial D^W/\partial T_X^W < 0$, the right hand side of (13d) is positive. Condition (13e) equates the marginal utility derivable from the time share-weighted marginal productivities with respect to the marginal increment to her human capital with the female wage rate-weighted effect of that marginal increment on the dowry multiplied by the shadow price of money income.

Condition (13f) equates the marginal utility of consumption of market goods with the marginal utility of marriage services generated by the marginal product of market goods in the production of marriage services. Condition (13g) simply equates the marginal utility of direct consumption of market goods with their price, weighted by the shadow price of money income. Condition (13h) equates the marginal utility of marriage services with the indirect marginal utility of market goods attributable to the marginal product of marriage services in the production of market goods. Conditions (13i) and (13j) are, of course, simply equations (9) and (11) of the model as presented in Table 1.

Several of these conditions can be combined. For example, from equations (13b), (13d) and (13g) we find:

$$\frac{\dfrac{\partial U}{\partial MS}\dfrac{\partial ms}{\partial T_{ms}^W}}{\dfrac{\partial D^W}{\partial T_{ms}^W}\,\bar{w}^W} = \frac{\partial U/\partial X_c}{\dfrac{\partial D^W}{\partial T_X^W}\,\bar{w}^W} = \frac{\dfrac{\partial U}{\partial X_c}}{q_X} = \lambda_1$$

$$\frac{\frac{\partial U}{\partial MS}\frac{\partial ms}{\partial T^{w}_{ms}}}{\frac{\partial U}{\partial X_c}} = \frac{\partial D_w/\partial T^{w}_{ms}}{\partial D^{w}/\partial T^{w}_{x}} = \frac{\frac{\partial D^{w}}{\partial T^{w}_{ms}}\bar{w}^{w}}{q_x} = 1 = \frac{\frac{\partial D^{w}}{\partial T^{w}_{x}}\bar{w}^{w}}{q_x} = \lambda_1 \qquad (14)$$

In equation (14) we see the condition that the shadow price of money income is equal to unity, and is also equal to the ratios of the marginal utilities of marriage services and of market goods. We also note that the response of dowry to the time of the wife is independent of whether or not the wife is actively employed.

The procedure for deriving hypotheses is as follows:

Let x = vector of n endogenous variables

α = vector of k exogenous variables

Suppose there is an equilibrium at x^0, α^0. At this equilibrium we have a set of functions ψ such that $\psi(x^0,\alpha^0) = 0$. Under conditions 1, 2, and 3 below, there exists in a neighborhood of (x^0,α^0) a function $x(\alpha)$ such that $\psi(x,\alpha) = 0$ is maintained, that is $\psi(x(\alpha),\alpha) = 0$ in that neighborhood.

Let a function $\psi: B \to R^n$ be given where B is an open, connected subset of R^{n+k}. Suppose also that:

1) $\psi(x^0,\alpha^0) = 0$

for some x^0 in R^n and a^0 in R^k, with $(x^0,\alpha^0) \in B$

2) ψ is continuously differentiable in a neighbourhood N of (x^0,α^0)

3) $\rho(\frac{\delta\psi}{\delta x}(x^0,\alpha^0)) = n \Longleftrightarrow \det[\frac{\delta\psi}{\delta x}(x^0,\alpha^0)] \neq 0$

Then, there exists an ε neighborhood $N_\varepsilon(\alpha^0)$ of α^0 in R^k and a unique continuously differentiable function $x(\cdot)$ taking $N_\varepsilon(\alpha^0)$ into R^k such that:

$$x(\alpha^0) = x^0$$

$$(x(\alpha),\ \alpha) \in B,\ \alpha \in N_\varepsilon(\alpha^0)$$

$$\psi(x(\alpha),\ \alpha) = 0,\ \alpha \in N_\varepsilon(\alpha^0)$$

Knowing this, we can totally differentiate ψ in that neighborhood.

Since $\psi = 0$ a constant, its differential is also = 0 (the differental of any constant being 0). Therefore, we can write:

$$\frac{\delta\psi}{\delta x}\frac{dx}{d\alpha} + \frac{\delta\psi}{\delta\alpha} = 0$$

$$\frac{\delta\psi}{\delta x}\frac{dx}{d\alpha} = -\frac{\delta\psi}{\delta\alpha}$$

$$\frac{dx}{d\alpha} = -\left(\frac{\delta\psi}{\delta x}\right)^{-1}\frac{\delta\psi}{\delta\alpha}$$

If the number of $x = n$ and the number of $\alpha = k$, we need a set of n functions ψ such that:

$$\begin{pmatrix} \frac{dx_1}{d\alpha_1} & \frac{dx_1}{d\alpha_2} & \cdots & \frac{dx_1}{d\alpha_k} \\ \frac{dx_2}{d\alpha_1} & \frac{dx_2}{d\alpha_2} & & \vdots \\ \vdots & \vdots & & \vdots \\ \frac{dx_n}{d\alpha_1} & \frac{dx_n}{d\alpha_2} & & \frac{dx_n}{d\alpha_k} \end{pmatrix} = -\begin{pmatrix} \frac{\delta\psi^1}{\delta x_1} & \cdots & \frac{\delta\psi^1}{\delta x_n} \\ \vdots & & \\ \frac{\delta\psi^n}{\delta x_1} & \cdots & \frac{\delta\psi^n}{\delta x_2} \end{pmatrix}^{-1-1} \begin{pmatrix} \frac{\delta\psi^1}{\delta\alpha_1} & \cdots & \frac{\delta\psi^1}{\delta\alpha_k} \\ \vdots & & \vdots \\ \frac{\delta\psi^n}{\delta\alpha_1} & & \frac{\delta\psi^n}{\delta\alpha_k} \end{pmatrix}$$

where $\frac{dx}{d\alpha}$ is nxk , $\frac{\delta\psi}{\delta x}$ is nxn and $\frac{\delta\psi}{\delta\alpha}$ is nxk .

Because of the large numbers of terms, the large number of partial and cross-partial derivatives, and the fact that not all of the parameters in a particular relationship will have the same sign, it is quite likely that it will be difficult to derive hypotheses which require certain outcomes regardless of the magnitudes of the various parameters in the model. The size of the model, moreover, makes it rather cumbersome in practice to formally derive such comparative static results concerning the effects of changes in exogenous variables on all the endogenous variables in the system. Nevertheless, from Figure 1, from the specification of the model given in Table 1 directly as well as from the first-order conditions given in equations 13a-13j, the reader should be able to see the basis for the following hypotheses which we at this point simply assert:

(1) The greater the wealth $\bar{V}$, the larger will be the marginal products of given levels of MS_x and of the time allocations of husbands, wives and other household members in the production of market goods, and hence the larger will be the demand for wife-time, in general, and marriage services, in particular. Naturally, the composition of wealth would affect not only the magnitude but also the direction of these demand effects. For example, land, and especially irrigated land, and livestock might well increase the demand for marriage services, whereas agricultural machinery might tend to reduce the demand for such services. According to the model, wealth would also exert an influence through its role in the dowry function, equation (10). According to this function an increase in V would tend to increase the quantity and

quality of the wage rate-weighted wife services that can be purchased in return for a given amount of quality- and wage rate-weighted husband services and given dowry.

(2) The higher the male wage rate relative to the female wage rate, from the dowry function (for a given level of dowry) the greater is the volume of wife services that would have to be exchanged for any given value of husband services.

(3) Similarly, the higher the human capital index of the husband, the larger is the value of wife services (either younger age or more probably a higher human capital index) that would have to be offered (for given dowry) to settle the marriage contract.

(4) Since some of the benefits of marriage services, for example the old-age security benefits of children, are particularly important in the absence of capital markets, the demand for T^w and T^h_{ms} might be expected to be larger the less available or less developed the capital markets in the community. The effect of the presence or absence of such markets, however, might also be affected by the structure of the household and especially by the degree of its intergenerational extension.

(5) Given the aforementioned specialization by age and sex in the various different activities of the household, the demand for wife services, and also the supply of husband services, may well be affected by the age and sex composition of the other household members within the household, which for simplicity were all treated as simply "other" in the model. Specifically, we hypothesize that the larger the percentages of female and children members in the household, the lower would be that household's demand for marriage services.

(6) Finally, the relative supplies and the nature of the community supplied services, Z_1 and Z_2, and the price of market goods, q_x, could also exercise considerable influence over both the overall costs of production of marriage services relative to market goods and the marginal productivities of the different factors of production used in the production of each. For example, proximity to the market, or to employment opportunities, might be expected to increase the production of market goods relative to marriage services, whereas proximity to health and educational facilities might have the opposite effect. Assuming that the old-age security motive may be an important determinant of the demand for marriage services, one variable of this type which might exercise an especially depressing influence on the demand for marriage services would be a dummy variable indicating the household's participation in an old-age pension system.

Many of these hypotheses are couched in terms of conditions such as "given dowry" or "given human capital indexes." As the alert reader no doubt already realizes, in the formulation of the model these variables are indeed not given or constant. The derivation of specific hypotheses is, therefore, neither as easy nor as clear-cut as the above examples would indicate. In any case, further discussion of the hypotheses is postponed until after the data and empirical specifications are presented.

III. Data and Empirical Specification

The purposes of this section are to describe the data utilized and to provide the empirical specification of the marriage model which was formally presented in simplified form in Section II above.

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. As such surveys go, the sample is quite large (4,118 households and more than 27,000 individuals) and the structure of the questionnaire affords a number of consistency checks. Although far from ideal in some respects (as will be explained momentarily) for testing the relationships postulated in the model, it is indeed fortunate that retrospective data on marriage and fertility, and data on several of the other most important and most relevant variables in the model were collected, making it one of the most appropriate data sets for present purposes.

Specifically, the survey contains data on the size and structure of households, on income and expenditures, on wealth (V in the model) and the composition thereof in some detail, on age, education, marital 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 hence on the age and sex compostion of the household, and a fair amount of information on cropping patterns, technology, community-supplied services and locational characteristics, that may be deemed to measure or serve as proxies for the price of market goods, q_x, or the present value of the community services relevant to marriage services Z_1 or market goods Z_2. A major

limitation of the data for present purposes is that other relevant information is not available on a retrospective basis, thereby making it impossible to know anything about the household structure,[6/] labor force participation, income, wealth, cropping patterns and the like, prior to marriage. In short, nothing is known about the households of origin of the wives.

With respect to analyzing the effect of the introduction of a formal system of old-age pensions on marriage 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. 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 such a system, 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 characterisitics of such participants such as income and educational status, and also to a certain extent location.[7/]

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.

B. Empirical Specification and Descriptive Statistics

We turn now to the detailed empirical specification of the model. Although the model was presented in terms of a simultaneous equations framework in which some ten or more variables are determined simultaneously, unfortunately not all of these variables are observable. In particular, the amount of the dowry, D^W, and the allocations of market goods to marriage services and of the present value of marriage service inputs to market goods production, are not observed, and, indeed, the only observations on variables relevant to the inputs and outputs of market goods are for the two or three years of the survey which may bear little relation either to the life cycle of the household as a whole or to the period near the time of marriage. Also, the only available measures of the quality of husband and wife services are the educational attainment levels of the respective spouses. Therefore, in our empirical work we have to restrict our focus to the variables which are either observable directly or measurable by proxies.

It will be recalled that, from the perspective of the whole lifetime of the household, the time allocations of husbands and wives devoted to marriage services are inversely related to their ages-at-marriage. For measures of the quantity and quality of marriage services, therefore, we use the following variables: age-at-marriage of the male (AMM), age-at-marriage of the female (AMF) and their educational attainment indexes (EDCIM and EDCIF, respectively). The precise definitions of these variables as well as those of all exogenous variables in the model are given in Table 2.

Although the model, as presented in Table 1 above and as shown in Figure 1, portrays the decisions with respect to the quantity and qual-

ity of both husband and wife services, i.e., AMM, AMF, EDCIM and EDCIF, as being determined simultaneously, in the context in which the model is tested, however, and in particular since information is available only for the household in which the wife lives after her marriage, normally that of her husband's parents, several simplifications would seem appropriate.

First, for such a household, and especially because of the low level of educational attainment in rural India, the education of the son (husband of the wife studied) has normally been completed well in advance of marriage which, as will be seen in Table 3 below, normally takes place at about age 20. For this reason, it would seem reasonable to assume that, from the standpoint of the household of the son, his educational attainment level is a predetermined variable as far as the marriage decisions are concerned. Hence, although EDCIM may be presumed to affect the other measures of marriage services, namely, AMM, AMF and EDCIF, it can reasonably be assumed that it cannot be affected by these other variables.

Second, and again from the perspective of the household of the son (husband), which as explained above in rural India is generally in the position of importing a wife for the son, one might suppose the following chain of causation as a special case of the general interdependence provided for in the model. Given the son's educational attainment level inherited from the resource allocation decisions of the past, the demand for marriage services by the household determines AMM. Then, given AMM and EDCIM, and the appropriate household and community characteristics, the dowry function combines with the monetary budget and time constraints to determine EDCIF. Finally, given all of these, AMF is deter-

mined. Although plausible, since the causal chain hypothesis is simply that, i.e., a hypothesis, its validity will have to be examined.

In order to test the validity of the aforementioned causal chain, the alternative simultaneous equation system must be specified. Naturally in order to identify the parameters of such a system, certain restrictions on the parameters of the model have to be imposed. For convenience, we have identified the model by restricting the parameters of certain exogenous variables in each of the equations of the model to zero when such restrictions seemed plausible.

Because the information available, the variables considered relevant and the expected behavioral patterns, vary between cultivating and non-cultivating households, and also between nuclear and extended households, the specification of all three equations varies among the four types of households, cultivating extended, cultivating nuclear, non-cultivating extended and non-cultivating nuclear. The differences in specifications of the different equations for purposes of identification as well as relevance to and data availability for the different subsamples can be determined from the empirical results for AMM, EDCIF and AMF to be reported in Tables 4, 5, and 6, respectively, and discussed in Section IV.

Before commenting on the results, however, we need to add some comments concerning our choice of sample from which the four subsamples are taken. While there are some 4000 married women with spouse present, and therefore with information on the husband, in the ARIS sample, in general the data are believed to be less reliable and less relevant for older women. There are several reasons for this belief. First, for older women there is a greater possibility that the husband with whom

they are currently living may not be their first husband, and hence the reported age at marriage may not be the age at first marriage. Second, current living arrangements and characteristics of the household and community in which the older women may be living may well not be reflective of those relevant at the time or shortly after marriage. Finally, there is considerable evidence to suggest that the errors in measurement of variables such as age-at-marriage are considerably greater for older women than for younger women. For these reasons we limit ourselves in the choice of sample to that subset of married women with spouse present who have been married for no more that 16 years,[8/] and for whom the relevant data on the variables defined in Table 2 are available. Moreover, for extended households, where there may be more than one generation of married women with spouse present in the household, we restrict our attention to the wives of sons, specifically to those whose relation to the head of household is stated to be that of daughter-in-law. These restrictions reduce the overall size of our sample to 1109, of whom 728 are from cultivating households and 381 are from non-cultivating households.

The distinctions between what may be considered cultivating and non-cultivating, or between nuclear and extended, houseolds are not always very sharp, and in practice are often rather arbitrary, making for considerable differences from one study to another. We have tried to be as consistent as possible with the dominant traditions in the literature.[9/]

Let us turn now to the descriptive statistics for the different subsamples shown in Table 3, and in particular to the differences in means between the different subsamples. The first, and indeed a rather

striking, difference is in AMM between nuclear and extended households. The age at which males living in extended households marry is on the average about four years less than that at which males living in nuclear households marry. Although this might seem to support the view expressed by Davis (1955) that extended households tend to facilitate (subsidize) earlier marriage, the fact that virtually all married couples live in extended households immediately after marriage casts doubt on the validity of such an explanation. In any case, note that the age differential between nuclear and extended households with respect to AMF is considerably smaller, indeed, only a little over one year. Notably, therefore, the age differential between husbands and wives in nuclear households is much greater (slightly over seven years) than between that in extended households (between four and five years).[10/] In both cases the average age at marriage is slightly higher among those living in non-cultivating households than among those in cultivating households, perhaps reflecting the relatively greater demand for marriage services and children in agricultural households.[11/] The lower ages-at-marriage in extended households could also possibly be attributed to the greater demand for marriage services in such households.

Note also that the educational attainment levels of the two marriage partners, EDCIM and EDCIF, our proxies for the quality of marriage services, are higher for extended than for nuclear households although differences are minimal in the case of non-cultivating households. While EDCIM is on average higher in cultivating households than in non-cultivating households, EDCIF tends to be somewhat lower.

The rather dramatic differences between nuclear and extended households in the means of the asset variables given farther down in Table 3, such as LAND, HOUSE, AGRILCAP and IRRIGP which, at least in cultivating households, reveal extended households to be wealthier than nuclear households, provide another possible explanation (greater wealth as explained in the model) for the observed greater demand for marriage services in such households. Note also that the higher income cropping patterns, i.e., HYV wheat and cereals, and other crops with HYV, are also more common in extended households than in nuclear ones.

Although in general the community characteristics tend to vary somewhat less from one subsample to another, there are some interesting exceptions. For example, the villages in which non-cultivating households live are more likely than those in which cultivating households live to have a school, a factory, larger populations, more visits from agricultural extension agents, and lower transport costs to the market. Likewise, extended households live in villages that are more likely than those in which nuclear households live to have school, more visits from the extension agent, higher transport costs to the market and less favorable credit opportunities.

Our primary interests in the empirical analysis are to (1) determine whether or not the household and community type variables, including participation in an old-age insurance scheme, which would not normally be included in models of age-at-marriage since most such models have regarded marriages as decisions of the individual marriage partners themselves, play significant roles in determining the ages at marriage of both marriage partners, and (2) to determine the extent to which the individual characteristic variables interrelate in the way in which they would be expected to from the dowry function.

Bearing in mind these objectives, and also considering both the lack of information on characteristics of the households and communities of origin of the wives, on dowries, and on several other important endogenous variables in the model, and the fact that several variables are measured either as dummy variables or in terms of very crude indexes, we deliberately choose the simple linear form for all three equations in the system.

IV. Empirical Results

Our first task is to test the validity of the hypothesized special variant on the fully simultaneous determination of AMM, EDCIF and AMF, namely that of a causal chain going from AMM to EDCIF to AMF.

The test for recursiveness consists of two parts. The first part is to test, in the context of the following linear system $[I - A]Y + BX + u = 0$, namely,

	AMF	EDCIF	AMM	X	u
AMF	1	a_{12}	a_{13}	b_1	$u_1 = 0$
EDCIF	a_{21}	1	a_{23}	b_2	$u_2 = 0$
AMM	a_{31}	a_{32}	1	b_3	$u_3 = 0$

the validity of the joint restriction that $a_{21} = a_{31} = a_{32} = 0$. The second part of the test is to apply the Hausman (1978) test to determine whether or not the variance-covariance matrix formed by the errors u_1, u_2, u_3, is diagonal, diagonality being a necessary condition for recursivity.

The lack of information on the household of origin of the wife, and hence unavoidably the omission of potentially important variables from the equation for AMF, leads us to believe that the AMF, and possibly also the EDCIF, equations are subject to very considerable specification error, considerably more so than the AMM equation. If so, even if the first part of the recursivity test could not be passed decisively, the inclusion of AMF and EDCIF in the AMM equation might well introduce more specification error into the system as a whole, yielding parameter estimates with less desirable characteristics, than would be the case if the recursivity restrictions were imposed even when unwarranted. For this reason, in selecting a significance level for rejection of the aforementioned joint restrictions, we deliberately choose the .01 level, making it more difficult to reject the restrictions.

The results for the four subsamples under consideration are as follows:

	Cultivating Households		Non-Cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Degrees of Freedom	31,357	3,671	3,343	3,394
F Value	1.96	3.28	2.08	3.04
Significance Level	.1165	.0203	.1013	.0281

Since the joint restrictions on the coefficients of the endogenous variables cannot be rejected at the .01 level in any of the four subsamples, we move to the second step, the Hausman Test. The danger of introducing specification error by allowing the covariance structure of the error terms as in the third stage of the seemingly-related regres-

sion procedure would seem very slight. Indeed, because of common errors in measurement in the variables included in different equations of the model, one might suppose that more specification error might be introduced by imposing such restrictions even if they would be marginally rejected. For this reason, we choose the .05 level of significance in performing this chi-square test. In this case the restrictions turn out to be rejected at well below the .05 level in all cases. Therefore, for the results reported for the AMM, EDCIF and AMF equations in Tables 4, 5 and 6, respectively, we utilize the estimates of the third stage of the seemingly unrelated regression procedure allowing for non-zero elements in the covariance matrix formed by the interactions of the error terms in the different equations.

With respect to the AMM results given in Table 4, it can be seen that, as expected, the larger the size of landholdings, the lower is AMM, although from the τ values it can be seen that the coefficients are not significant at the .05 level. Also, as expected, different components of wealth have rather different effects on AMM. On the one hand, assets with considerable complementarity to labor, and especially child labor, and hence marriage services, such as LAND, LIVESTOCK and to a lesser extent YNONLPER, and IRRIGP, all reduce AMM, i.e., increase the demand for marriage services. AGRILCAP, on the other hand, which may well be more of a substitute for labor, has a positive effect on AMM in both extended and nuclear cultivating households.

The pattern of observed responses to differences in cropping patterns also fits expectations. Relatively high-valued crops, such as CV3A and CV3C, have significantly negative coefficients on AMM, whereas low-valued crops, such as other cereals without HYV, have significantly positive coefficients.

In virtually all cases in which there is enough information available to estimate the relevant coefficients, the coefficients of the household composition variables have the expected signs and are highly significant, thereby supporting both the underlying assumption of the model that marriage decisions are determined by household (as opposed to individual) considerations and the more specific hypothesis that the timing of marriage of the son would be positively related to the proportions of females and children in the total population of the household, WOMENP and CHILDP, respectively.

Of particular interest is the result that, at least among cultivating households, participation in the Provident Fund, PROVIDF, significantly raises the age-at-marriage of the male, AMM, not surprisingly by considerably more in nuclear households where it is more clear that the male whose marriage age is to be explained is the person who is the participant in the Provident Fund. The effect is not significant among non-cultivating households but this negative result may well be attributed to an insufficient number of persons participating in that program in these particular subsamples.

From the results for SCHOOL, CREDD21, CREDD22, and MINDIST, it can be seen that, although by no means generally statistically significant, the existence of a school in the village, the absence of credit or banking facilities and the minimum distance to transport depots have different directions of effects in nuclear than in extended households.

A possible explanation for the fact that SCHOOL tends to raise AMM in extended households and especially in extended cultivating households but tends to lower it in nuclear households is that in the latter context, where female or wife-time is rather scarce and therefore commands

a high opportunity cost, schools may tend to lower the cost of marriage services by providing, in effect, child care services, whereas in extended cultivating households the child care services of a school may be less useful and the presence of a school may tend to make school attendance for children more a cultural or legal norm, thereby lowering both the amount of child labor that can be extracted from children and perhaps their reliability as a source of old-age support (due to the effect of education in making children more independent and mobile).

In the case of the dummy variables representing the absence of credit institutions in the village, the effect of CREDD21 on AMM tends to be negative in nuclear households though positive but insignificant in extended households. The explanation for this interesting difference may be attributable to the fact that the institution of the extended household in part serves the function of credit in the form of intra-familiar intergenerational transfers. Hence, extended households would be expected to be less affected by the lack of credit and other financial institutions than nuclear households. On the other hand, nuclear households living in villages lacking adequate financial institutions may have a greater tendency to invest in marriage services (children) than in physical (purchased) assets because investments of the former kind are less dependent on credit and finance than those of the latter kind.

Finally, it can be seen that the regional dummy variables are frequently significant, once again with some sizable differences between nuclear and extended households. Such differences could, of course, be attributable to interregional differences in any number of factors not included in the empirical specification of the model. One such factor

might well be interregional variations in relative wage rates, in this case of males. Since (from the role of the dowry function in the model) high male wage rates might be expected to be associated with later age-at-marriage, the fact that male wage rates were in 1956-57 (a year quite close to that in which most women and men in the present sample got married) highest in the SOUTH and EAST regions (outside of the North) - regions with the largest positive coefficients - and lowest in the WEST and CENTRAL regions - the regions with the lowest or most negative coefficients,[12/] is indeed not inconsistent with this explanation for such differences.

Next, we turn to the results for educational attainment of the wife, EDCIF, given in Table 5. Note, first, that EDCIM has a positive and significant influence on EDCIF in every subsample, that influence being somewhat stronger in noncultivating households than in cultivating households. As expected, in cultivating households the asset variables LAND and HOUSE tend to raise EDCIF. Participation in the Provident Fund raises EDCIF, more so in nuclear than in extended households. Favorable community characteristics such as SCHOOL, FACT and VILPOP all tend to raise EDCIF more in nuclear households than in extended households. Once again, there are some significant, though not as striking, differences in the influences of the regional dummy variables across regions.

Finally, and perhaps most importantly because of its relevance for completed fertility, let us turn to the results for age-at-marriage of the female, AMF, given in Table 6. The reader should be reminded that because of the lack of information on the household and community characteristics concerning the household of origin of the wife, this equation is undoubtedly subject to some specification error.

Note, first, that in this case where all three of the other marriage services-related variables are included, the effects of such variables are frequently significant and, if significant, are of the correct signs. For example, AMM exerts a strong positive influence on AMF in all subsamples. As would be predicted from the dowry function, EDCIM is shown to have a negative influence on AMF in three of the four subsamples, and significantly so in the case of nuclear cultivating households. EDCIF, on the other hand, and again as expected, has a positive influence on AMF (i.e., delaying marriage) in three of the four subsamples, and again significantly so in nuclear cultivating households.

The pattern in the effects of the wealth variables on AMF is somewhat similar to that observed above for AMM. LAND, HOUSE and LIVESTOCK, forms of wealth which are generally rather complementary to labor in general and child labor in particular, tend to reduce AMF while AGRILCAP, which generally tends to substitute for labor, raises AMF. The less precise and more general measure of wealth, YNONLPER (the only measure of wealth available for non-cultivating households) has a weak negative influence on AMF. All of these variables have stronger effects in nuclear households where the sex and age composition of the household, which may be regarded as an intervening and complicating factor is not relevant. In this regard, once again, the reader will note the very significant positive effect of WOMENP and CHILDP on age-at-marriage, in this case on that of the female.

Once again also, there is a significant positive influence of participation in the Provident Fund on age-at-marriage in nuclear cultivating households. With respect to the effects of the community characteristics, presumably for the same reasons given above, the absence of

credit tends to raise the demand for marriage services only in nuclear cultivating households. Finally, variations in the magnitude and sign of the coefficients of the regional dummy variables suggest that in this case there may be somewhat less systematic variation from region to region, but again substantial differences between nuclear and extended households, the effects always being more negative or less positive in extended cultivating households than in nuclear cultivating households.

While because of the omission of information on several of the important variables in the model, both endogenous, such as the magnitude of the dowry, and exogenous, such as household and community characteristics pertaining to the wife's household of origin, and the simple functional form utilized in the present study, the results can only be considered tentative and preliminary. Nevertheless, they provide considerable support for the following hypotheses put forward in the study.

1. Household structure plays an important role in marriage decisions. Marriages tend to occur at younger ages in extended households than in nuclear households. More importantly perhaps, the influence of exogenous variables, such as participation in the Provident Fund, the absence of credit institutions, and the level and composition of wealth, are all likely to be rather different in different household types.

2. We find consistent evidence suggesting that not only the level of wealth but also the composition of wealth have considerable influence over marriage decisions. Those forms of wealth which are most complementary to labor, and especially child labor, are generally negatively related to age-at-marriage, whereas those which serve more like substitutes for labor are positively related to AMM and AMF.

3. The age and sex composition of the household tend to be very significant determinants of marriage decisions in extended households. Indeed, the more women and children in the household relative to the total population of the household, the more marriage will tend to be delayed. These results provide strong support for the household as opposed to the individual being the appropriate decision-maker with respect to marriage age.

4. The fact that participation in the Provident Fund has a significant positive influence of both AMM and AMF in nuclear households underscores the potential importance of the old-age security motive in marriage and hence indirectly in fertility behavior of rural households.

5. The signs of the coefficients of AMM, EDCIM, EDCIF and various other variables in the AMF equation are largely consistent with the existence of the dowry function which is an important component of our model of marriage services.

6. From the perspective of the household of destination of the wife, i.e., that of married sons, the hypothesis that causality goes from AMM to EDCIF and finally to AMF is supported.

If as suggested above the age-at-marriage and the educational attainment of one's spouse are to a large extent under the control of the household as a whole and the household head in particular, one important implication for research on fertility behavior might be that the explanation for variations in overall fertility should be broken down into two very different components, one in which differences in potential fertility arising from differences in age-at-marriage, and the education of one's spouse, are analyzed, and then another in which, the

individual motivation of the individual partners are considered. The latter might well be better studied in a model that tries to explain actual fertility relative to potential fertility as determined by age-at-marriage[13/] which may be considered given as far as the individual marriage partners are concerned.

The descriptive literature reviewed in the study, the descriptive statistics on the variables included in the study and the empirical results with respect to age-at-marriage all serve to underscore the potential importance of feedbacks to and from age-at-marriage, household structure, fertility, wealth, and hence in the long run other resource allocation decisions. Since some of these factors would seem to be household decisions and others are largely those of individuals within the household, the study calls attention to the need for a complex modelling structure and to the potential benefits, at least for analytic purposes of a modular theoretical structure.

Table 1

A Simplified Model of Marriage Services
for Rural Areas of Developing Countries

$$U = U(MS_c, X_c) \tag{1}$$

$$MS = ms\ \bar{N}^w \tag{2}$$

$$ms = ms(T^h_{ms}\bar{H}^h,\ T^w_{ms}H^w,\ X_{ms};\ \bar{Z}_1) \tag{3}$$

$$X = X(\bar{N}^w T^h_x \bar{H}^h,\ \bar{N}^w T^w_x H^w,\ MS_x,\ \bar{N}^o \bar{T}^o_x \bar{H}^o,\ \bar{V};\ \bar{Z}_2) \tag{4}$$

$$X_c = X - X_{ne} - \bar{N}^w X_{ms} \tag{5}$$

$$MS_c = MS - MS_x \tag{6}$$

$$\bar{T}^h = T^h_{ms} + T^h_x \tag{7}$$

$$T^w = T^w_{ms} + T^w_x \tag{8}$$

$$\bar{I} = -\ \bar{q}_x X_{NE} - D^w \bar{N}^w \tag{9}$$

$$D^w = D^w\left(\frac{\bar{V}}{\bar{V}_m},\ T^w H^w \bar{w}^w,\ T^h_{ms}\bar{H}^h \bar{w}^h\right);\ \frac{\partial D^w}{\partial T^w},\ \frac{\partial D^w}{\partial H^w},\ \frac{\partial D^w}{\partial w^w} < 0 \tag{10}$$

$$\bar{R}_1 = \bar{N}^w \bar{T}^h \bar{H}^h \bar{w}^h + \bar{N}^o \bar{T}^o \bar{H}^o \bar{w}^o + \bar{V} \tag{11}$$

Note: Unless otherwise specified, all first derivatives in the functional relationships (indicated by parentheses) are positive while the second derivatives are negative. For the exceptions where, as indicated in equation (10), the first derivatives are assumed to be negative, the second derivatives are assumed to be positive.

Endogenous Variables (in order of appearance)

MS_c = quantity of marriage services consumed per household.

ms = quantity of marriage services per wife.

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

T^h_{ms} = time allocation of husband (son) to marriage services.

T^w_{ms} = time allocation of wife (daughter-in-law) to marriage services.

H^w = human capital index of the wife.

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.

MS_x = quantity of marriage services used in production of market goods.

T^h_x = time allocation of husband (son) to the production of market goods and services.

T^w_x = time allocation of wife (daughter-in-law) to the production of market goods and services.

X_{NE} = quantity of net exports of market goods of the household.

T^w = time allocations of the wife.

D^w = dowry received for excess of value of husband services of sons over that of wife services of their wives.

Exogenous Variables

N^w, N^o = number of wives or daughters-in-law for sons as husbands and of other household members respectively.

T^h = time endowment of sons.

T^o_x = time endowment of other household members for use in market goods production including the supply of wage labor to the market.

V = stock of non-human wealth available for use in production of X.

Exogenous Variables (cont.)

V_m = stock of non-human wealth of household of origin.

I = the overall life time balance of payments constraint with respect to other households and institutions.

H^h, H^o - human capital stocks of husbands and others, respectively.

w^h, w^w, w^o = wage rates of husbands, wives, and others, respectively.

q_x = market price of x.

Z_1, Z_2 = the present value of community services specific to household production of marriage services and market goods, respectively.

Table 2

Definition of Variables

A. Endogenous Variables

AMM = age-at-marriage of the male (husband who is the son of the household head in extended households)(in years).

AMF = age-at-marriage of the female (wife who is the daughter-in-law of the household head in extended households)(in years).

EDCIM = educational attainment index of the male.

EDCIF = educational attainment index of the female.

= 1 if illiterate, = 2 if literate or primary, = 3 if some secondary, and = 4 if completed secondary or above.

B. Exogenous Variables

1. Personal Characteristics

AGEIM = age index of male.

AGEIF = age index of female.

= 1 if < 20;	= 5 if 35-44
= 2 if 20-24;	= 6 if 45-54
= 3 if 25-29;	= 7 if 55-64
= 4 if 30-34;	= 8 if 65-74
	= 9 if ≥ 75

2. Household Characteristics

RELIGM = Moslem religion

RELIGO = other non Hindu religions

LAND Size Class of landholding

1 = no land;
2 = ≤ 1 hectare;
3 = 1.1-2.5 hectares;
4 = 2.6-4.5 hectares;
5 = 4.6-6.5 hectares;
6 = 6.6-8.5 hectares;
7 = 8.6-10.5 hectares;
8 = 10.6-14.5 hectares;
9 = > 14.5 hectares.

HOUSE = value of the house (in thousands of rupees).

AGRILCAP = value of agricultrual machinery (in thousands of rupees).

LIVESTOCK = value of livestock (in thousands of rupees).

YNONLPER = value of permanent non-labor income per capita (in thousands of rupees).

IRRIGP = proportion of irrigated land to total land.

CVIA = rice with high-yielding varieties of seed (HYV); 1 if yes; 0 otherwise.

CVIB = rice without HYV; 1 if yes; 0 otherwise.

CVIC = wheat and other cerals with HYV; 1 if yes; 0 otherwise.

CVID = wheat and other cereals without HYV; 1 if yes; 0 otherwise.

CVIE = other crops with HYV; 1 if yes; 0 otherwise.

WOMENP = proportion of females 15 years and over in the total population of the household.

CHILDP = proportion of children (male and female ≤ 15 in the total population of the household.

PROVIDF = participation in the Provident Fund over all three years of the survey; 1 if yes; 0 otherwise.

3. Community Characteristics

SCHOOL = existence of a school in the village; 1 if yes; 0 otherwise.

FACT = existence of a factory in or near the village; 1 if yes; 0 otherwise.

VILPOP = size of the village population (in thousands).

MINDIST = minimum distance to a bus or railway station (in kilometers).

TRANSCOST = index of transport costs to the market. (measured by distance to market)

CREDD21 = absence of credit facilities except for money lender in the village; = 1 if yes; 0 otherwise.

CREDD22 = absence of credit facilities except for cooperative or money-lender in village; = 1 if yes; 0 otherwise.

Regional Dummy Variables:

SOUTH = 1 if Kerala or Tamil Nadu; 0 otherwise.

SOUTHCENTRAL = 1 if Andhra Pradesh or Mysore; 0 otherwise.

WEST = 1 if Maharashtra; 0 otherwise.

CENTRAL = 1 if Madya Pradesh or Uttar Pradesh; 0 otherwise.

EAST = 1 if Assam, Bihar, Orissa or West Bengal; 0 otherwise.

NORTHWEST = 1 if Gujarat, Himachel Pradesh, Kashmir or Rajasthan; 0 otherwise.

Table 3

Descriptive Statistics for Variables in

Model of Marriage Services for Different Subsamples

(Means and Standard Deviations)

Variable	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Sample Size	479	249	132	249
AMM	20.040	24.273	20.758	24.671
	(4.254)	(6.086)	(5.286)	(5.639)
AMF	15.964	17.197	16.114	17.651
	(2.671)	(3.754)	(2.808)	(3.727)
EDCIM	2.169	1.948	1.934	1.932
	(1.125)	(.955)	(1.081)	(1.023)
EDCIF	1.309	1.277	1.318	1.313
	(.666)	(.706)	(.702)	(.694)
AGEIM	3.113	4.667	3.076	4.602
	(1.162)	(.878)	(1.282)	(.805)
AGEIF	2.269	3.442	2.204	3.478
	(.983)	(.897)	(1.044)	(1.012)
RELIGM	.052	.092		
	(.223)	(.290)		
RELIGO	.008	.008		
	(.091)	(.089)		
LAND	4.944	3.438		
	(2.118)	(1.580)		
HOUSE	6.679	2.860		
	(7.635)	(4.806)		
AGRILCAP	3.020	1.307		
	(5.494)	(2.546)		
LIVESTOCK	2.595	1.301		
	(2.240)	(1.589)		
YNONLPER			.285	.313
			(.283)	(.667)
IRRIGD	.461	.425		
	(.427)	(.451)		
CV3A	.094	.108		
	(.292)	(.311)		
CV3B	.244	.361		
	(.430)	(.481)		
CV3C	.188	.076		
	(.391)	(.266)		
CV3D	.236	.249		
	(.425)	(.433)		
CV3E	.046	.040		
	(.210)	(.196)		
WOMENP	.283		.297	
	(.076)		(.073)	

Table 3 (cont.)

Variable	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
CHILDP	.232		.169	
	(.158)		(.198)	
PROVIDF	.027	.024	---	.036
	(.163)	(.154)	---	(.187)
SCHOOL	.248	.157	.394	.261
	(.433)	(.364)	(.490)	(.440)
FACT	.098	.144	.126	.157
	(.298)	(.352)	(.344)	(.364)
VILPOP	1.830	2.075	3.146	2.346
	(1.821)	(3.402)	(3.299)	(3.233)
EXTVIS	136.570	112.418	201.970	161.008
	(153.252)	(135.17)	(159.436)	(148.172)
MINDIST	6.457	6.281	5.977	5.859
	(6.420)	(6.438)	(7.446)	(8.029)
TRANSCOST	27.752	19.494	20.985	20.056
	(31.031)	(20.270)	(26.182)	(26.497)
CREDD21	.111	.096	.114	.120
	(.314)	(.296)	(.319)	(.326)
CREDD22	.430	.253	.364	.309
	(.496)	(.436)	(.483)	(.463)
SOUTH	.040	.116	.114	.245
	(.195)	(.321)	(.319)	(.431)
SOUTHCENTRAL	.073	.189	.114	.141
	(.260)	(.392)	(.319)	(.348)
WEST	.048	.068	.008	.044
	(.214)	(.252)	(.087)	(.206)
CENTRAL	.322	.157	.311	.104
	(.468)	(.364)	(.464)	(.306)
EAST	.123	.273	.182	.217
	(.329)	(.446)	(.387)	(.413)
NORTHWEST	.297	.149	.182	.128
	(.457)	(.356)	(.387)	(.335)

Note: Figures in parentheses are standard deviations.

Table 4

Empirical Estimates: Age at Marriage of the Male (AMM)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Constant Term	11.4225	-1.3921	8.3271	4.4486
	(8.93)	(.60)	(3.10)	(2.61)
Personal Characteristics				
EDCIM	.0603	-.1211	.1237	.2072
	(.41)	(.35)	(.37)	(.67)
AGF'M	2.2562	5.0630	2.8603	3.8077
	(16.64)	(16.32)	(.59)	(12.02)
RELIGM	-1.4322	.2550		
	(2.23)	(.26)		
RELIGO	-.3660	-.9196		
	(.24)	(.31)		
LAND	-.1001	-.2254		
	(1.24)	(1.07)		
HOUSE	.0337	-.0509		
	(1.57)	(.78)		
AGRILCAP	.0434	.2498		
	(1.52)	(1.88)		
LIVESTOCK	-.2721	-.1772		
	(3.71)	(.78)		
YNONLPER			-2.0763	.2302
			(1.53)	(.54)
IRRIGP	-.7102	.9166		
	(1.78)	(1.30)		
CV3A Rice with HYV	-.9786	-.8772		
	(1.61)	(.79)		
CV3B Rice without HYV	-.5206	.0575		
	(1.06)	(.07)		
CV3C Other Cereals with HYV	-.3949	-1.0273		
	(.74)	(.86)		
CV3D Cereals without HYV	.9272	.9379		
	(2.18)	(1.15)		
CV3E Other Crops without HYV	-.1815	1.6855		
	(.24)	(1.09)		
WOMENP	8.2461		7.0920	
	(4.18)		(1.41)	
CHILDP	6.7387		3.8536	
	(7.00)		(2.98)	
PROVIDF	1.8089	3.9432		.2673
	(2.00)	(2.07)		(.18)
Community Characteristics				
SCHOOL	.6570	-.0023	.8822	-.8904
	(1.77)	(.00)	(.98)	(1.39)
MINDIST	-.0271	.0710	-.0815	-.0381
	(1.08)	(1.63)	(1.27)	(1.01)

Table 4 (cont.)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
TRANSCOST	-.0023	-.0101	.0099	.0396
	(.44)	(.73)	(.58)	(3.71)
FACT	.0873	.0700	.6859	-.8687
	(.17)	(.09)	(.71)	(1.11)
CREDD21	.2908	-1.2778	1.2701	-2.6212
	(.55)	(1.23)	(.95)	(2.78)
CREDD22	-.5667	-.1604	.6550	-.4013
	(1.65)	(.23)	(.73)	(.62)
SOUTH	.9768	3.1965	3.1187	3.7061
	(1.03)	(2.17)	(2.01)	(3.77)
SOUTHERN	1.2318	2.1305	3.3722	3.1980
	(1.67)	(1.52)	(1.94)	(2.92)
WEST	-.5055	1.4016	.3679	1.4969
	(.60)	(.85)	(.10)	(.98)
CENTRAL	-1.6403	1.8112	-.2809	1.8727
	(2.91)	(1.31)	(.20)	(1.61)
EAST	1.2015	4.2648	.1195	3.2320
	(1.75)	(3.01)	(.09)	(3.28)
NORTHWEST	-1.9673	.2492	.0712	.7180
	(3.39)	(.16)	(.05)	(.64)
Degrees of Freedom	449	221	114	232
R^2	.578	.632	.623	.506

Note: Figures in parentheses are t values.

Table 5

Empirical Estimates: Educational Attainment of the Female (EDCIF)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Constant Term	.3415	.2386	.7937	.8616
	(1.89)	(1.01)	(2.35)	(4.31)
Personal Characteristics				
AMM	.0118	.0149	-.0021	.0061
	(1.63)	(2.64)	(.16)	(.90)
EDCIM	.2205	.1988	.2581	.3026
	(8.50)	(4.98)	(4.33)	(7.64)
AGEIF	-.0574	-.0500	-.0419	-.0854
	(2.09)	(1.32)	(.71)	(2.42)
Household Characteristics				
LAND	.0176	.0195		
	(1.36)	(.87)		
HOUSE	.0085	.0118		
	(2.25)	(1.55)		
YNONLPER			-.0365	-.0139
			(.23)	(.25)
PROVIDF	.3391	1.4239	---	.5916
	(1.95)	(6.42)	---	(2.90)
Community Characteristics				
SCHOOL	-.0307	.1835	.0712	.0106
	(.39)	(1.73)	(.35)	(.11)
FACT	.1058	-.0190	-.0236	.3156
	(1.12)	(.20)	(.13)	(3.13)
VILPOP	.0224	.0600	-.0358	.0413
	(1.33)	(4.41)	(1.43)	(3.09)
EXTVIS	-.0000	.0001	.0010	-.0005
	(.14)	(.37)	(1.88)	(1.71)
SOUTH	.9007	.1962	.5087	.0171
	(5.53)	(1.05)	(1.73)	(.13)
SOUTHERN	-.0043	.0851	.4440	-.1860
	(.03)	(.52)	(1.57)	(1.33)
WEST	.0805	.3481	-.1870	-.0372
	(.53)	(1.85)	(.27)	(.20)
CENTRAL	.1580	.0973	.0640	-.2918
	(1.57)	(.59)	(.25)	(2.01)
EAST	.2910	.2091	-.0862	-.0165
	(2.55)	(1.30)	(.35)	(.13)
NORTHWEST	.2176	.1732	-.2799	-.0547
	(2.20)	(1.05)	(1.16)	(.40)

Table 5 (cont.)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Degrees of Freedom	462	231	117	233
R^2	.355	593	301	.457

Note: Figures in parentheses are t values.

Table 6

Empirical Estimates: Age at Marriage of the Female (AMF)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
Constant Term	7.1637	7.4889	7.6685	5.7257
	(7.43)	(5.25)	(4.57)	(5.39)
Personal Characteristics				
AMM	.3099	.0936	.1873	.2926
	(11.51)	(3.02)	(4.38)	(8.61)
EDCIM	-.0690	-.7023	.1064	-.2172
	(.66)	(3.06)	(.51)	(1.01)
EDCIF	.0649	.7431	-.2666	.4588
	(.39)	(2.31)	(.91)	(1.51)
AGEIF	.7717	2.3097	1.3130	1.4326
	(6.72)	(11.37)	(6.25)	(8.31)
Household Characteristics				
RELIGM	-.8652	.1396		
	(1.98)	(.22)		
RELIGO	-.6878	1.2772		
	(.67)	(.67)		
LAND	.0937	-.2071		
	(1.70)	(1.56)		
HOUSE	-.0092	-.0353		
	(.64)	(1.46)		
AGRILCAP	.0075	.2187		
	(.39)	(2.54)		
LIVESTOCK	.0146	-.1695		
	(.29)	(1.20)		
YNONLPER			-.1838	-.2671
			(.33)	(.98)
IRRIGD	-.0936	.5325		
	(.34)	(1.20)		
CV3A	-.8525	-.5295		
	(2.07)	(.74)		
CV3B	-.5498	-.0716		
	(1.64)	(.13)		
CV3C	-.1666	.2692		
	(.46)	(.35)		
CV3D	-.1484	.8777		
	(.52)	(1.67)		
CV3E	-.4383	1.6452		
	(.86)	(1.66)		
WOMENP	5.5993		8.7191	
	(4.21)		(3.06)	
CHILDP	2.3477		2.8171	
	(3.50)		(2.48)	

Table 6 (cont.)

	Cultivating Households		Non-cultivating Households	
	Extended	Nuclear	Extended	Nuclear
PROVIDF	-.4470	3.1052		-.4488
	(.73)	(2.34)		(.46)
Community Characteristics				
MINDIST	-.402	.0684	-.0020	-.0308
	(2.36)	(2.44)	(.05)	(1.30)
TRANSCOST	-.0039	-.0107	-.0034	-.0020
	(1.12)	(1.18)	(.43)	(.29)
CREDD21	.4282	-1.6011	.7228	-.3616
	(1.18)	(2.38)	(1.03)	(.60)
CREDD22	-.1623	-.3186	-.1525	-.3852
	(.70)	(.73)	(.31)	(.93)
SOUTH	.0761	.2555	-.9546	-.0401
	(.12)	(.26)	(1.04)	(.06)
SOUTHCENTRAL	-2.2526	-.9547	-.8927	-1.2686
	(4.45)	(1.04)	(.87)	(1.78)
WEST	-1.4144	-.2635	-.5431	-.8018
	(2.57)	(.25)	(.25)	(.83)
CENTRAL	-.7740	-.4331	-1.2819	.8014
	(2.10)	(.49)	(1.65)	(1.07)
EAST	-.4692	1.2457	-2.2523	.4493
	(1.00)	(1.35)	(2.77)	(.71)
NORTHWEST	-1.2023	-.5738	-.7430	.5433
	(3.05)	(.58)	(.97)	(.76)
Degrees of Freedom	449	222	115	232
R^2	.506	.594	.535	.5400

Note: Figures in parentheses are t values.

Footnotes

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1/ See Nugent and Walther (1981a).

2/ 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 (1974), Mueller (1979), DaVanzo 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.

3/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. Even when urbanization and modernization influences are pervasive, however, the household head is not without instruments for delaying or mitigating the household-disintegrating, and old-age insecurity-increasing effects of such influences. For example, in the Caribbean and West Africa it is not uncommon to send one's children to one's parents or other relatives who may be either better disciplinarians or more likely happen to live in environments where children are likely to have fewer optons and less freedom to maneuver [Smith (1962), Goode (1963), Oppong (1973), Sanchez (1976)].

4/Indeed, household heads may invest very considerably in search activities to assure that the wives they obtain for their sons not only be reliable marriage partners for their sons and daughters, but also 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, 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 trustworthy and cooperative so as to facilitate good teamwork among all members of the household.

5/ For a more complete explanation see Nugent and Walther (1981b).

6/ As far as the household structure of the husband's household, this may not be a serious shortcoming by virtue of the demonstration effect that living with one's parents has on one's children. [See Nugent and Walther (1981) for some references]. Since the intergenerational character of household structure does not oscillate or change frequently, the probability of living in a nuclear household for any couple married less than 16 years is indicative of that of having split off from the household of the husband's parents exactly once.

7/ 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 our measure 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)].

8/ Another reason for choosing sixteen or less years of marriage as the maximum is that at this point in their life cycles a sufficiently large number of the married couples have split off into nuclear households so as to afford the opportunity to make comparisons in their marriage behavior relative to that of those in extended households. Still another reason for limiting the sample to younger women was to further justify our aforementioned approach of the developing separate theoretical models for marriage and fertility and especially for estimating them separately. Since the fertility histories are more complete only for older women, whereas the data on the households of younger married women are more relevant to the marriage model, the practice of estimating the marriage model with data from the sample of younger women and the separately developed though, of course, related fertility model with data from the sample of older women [Nugent and Walther (1982)] allows us to mitigate the simultaneous equation bias that otherwise might be present.

9/ We define cultivating households as those classifying themselves as cultivating households in each of the three years of the survey. All other households are classified as non-cultivating households. In making the distinction between nuclear and extended or complex households we follow the classification system suggested by Laslett (1973)

which is based on the reported relationships of all members of the household to the household head. For details of this application of this procedure see Walther and Nugent (1982).

10/ Indeed, the greater age differential between husbands and wives in nuclear households than in extended households may contribute to the explanation for the differences in the propensity to partition. For example, it could well be that women who are much younger than their husbands would tend to be more concerned with widowhood and hence attach greater importance to children for old-age security purposes. As a result, such women would be expected to have more children than women closer in age to their husbands. The greater number of children would of course constitute a greater cost to the grandparents of retaining their married sons within the extended household. At the same time, the greater age differential between husband and wife would tend to reduce the importance of transfers from children to the husband and hence reduce the usefulness of living with one's own parents for its demonstration effect on the willingness of one's sons to remain living with their father. Both of these factors would, of course, make it less likely for sons with younger wives to remain with the household of their fathers.

11/ Note also that the proportion of children to total population of the household (CHILDP) is considerably higher in cultivating than in non-cultivating households.

12/ See India, Directorate of National Sample Survey (1960), Tables 8 and 9.

13/ See, for example, Trussell (1977), Boulier and Rosenzweig (1978), and Nugent and Walther (1982).

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