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FERTILITY AND SAVINGS IN A TWO-PERIOD HOUSEHOLD MODEL:

A THEORETICAL AND EMPIRICAL ANALYSIS

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ABSTRACT

"Fertility and Savings in a Two-Period Household Model: A Theoretical and Empirical Analysis"

An attempt is made in this paper to develop a two-period model of a rural household in a less-developed country in which the savings and fertility decisions are treated as jointly-determined parental decisions influenced by a common set of prices, wages, and fixed factors. The implications from the theoretical model are then tested with 1970-71 household survey data from India. The results generally lend support to a model of joint fertility-savings determination. In particular, the effect of the interest rate on fertility is observed to be significant and positive, implying a wealth effect of an increase in the interest rate that dominates the substitution effect. The effect of wages earned by children on savings is, however, observed to be negative, indicating that parents substitute children for physical savings as child wages increase. The model generally indicates the importance of prices and wages in the fertility and savings decisions of Indian rural households.

INTRODUCTION

The relationship between savings and fertility has long been a subject of interest and empirical investigation. However, most empirical studies have either been macro-modelling simulation exercises that have typically assumed (rather than estimated) certain effects of fertility on savings and capital formation (Coale and Hoover, 1958; Enke, 1960; Simon, 1976) or household-level studies that have treated fertility and income as exogenous variables affecting the household's rate of capital accumulation (Peek, 1974; Mueller, 1976). An exception is a study by Kelley (1980) which uses household data from Kenya to investigate the relationship between fertility and savings by explicitly recognizing both variables and household income to be endogenous to the household's decisions.

Although the study by Kelley is an improvement over the other studies in this area, it has several shortcomings that limit its usefulness to policy. Kelley does not present a theoretical model of the Kenyan household, so it is difficult to interpret his empirical results. Furthermore, he estimates a structural savings equation in which number of children and income -- both endogenous variables -- appear as regressors. Although the equation is estimated by two-stage least squares, which provides consistent estimates of the effect of fertility on savings, holding children's contribution to household income constant, it is not in the spirit of joint fertility-savings determination. Knowing that the number of children in a household does or does not affect household savings is of little policy significance if fertility is a household decision variable. What is important is to estimate the joint effect of exogenous policy variables on both fertility and savings. In Kelley's model, parents' age and education are about the only exogenous variables which enter the fertility and income equations and thus indirectly the savings equation.

In this paper, a theoretical two-period model of a rural household in a less-developed country (LDC) is developed in which fertility and savings are treated as jointly-determined parental decision variables. The phenomena of young children contributing to household income and of the old age security motive for having children -- factors unique to LDCs -- are explicitly considered in the model. The reduced-form demand equations for children and savings, which have as their arguments parents' wage rates and education, children's wage rates, market prices of consumption goods, rates of return on savings, and ownership of land, are then estimated using 1970-71 survey data on over 1,000 households from all over India. The empirical results lend support to a model of joint fertility-savings determination. The two effects that are unique to such a model -- viz., the interest rate effect on fertility and the child wage effect on savings -- are both highly significant. The results also show that, while savings and fertility move in the same direction in response to changes in the father's wage rate and education, the interest rate, and ownership of land, they move in opposite directions in response to changes in other exogenous variables such as the mother's wage rate, child wage rates, and the price of consumption goods. There is thus no clear (gross) substitutability/complementarity relationship between the two decision variables.

THEORETICAL ANALYSIS

Any exercise to model the joint fertility-savings decisions of rural households in LDCs must satisfy two requirements. First, it must be a multi-period model which explicitly incorporates the parental motive to save. Second, it must recognize the fact that, besides providing parents with utility, children in traditional agriculture begin contributing to household income at a fairly young age (Rosenzweig and Evenson, 1977). The responsibility of children does not diminish as they grow older. In fact, parents depend almost entirely on their (grown-up) children for their consumption needs in old age. In this sense, children are substitutes for parental savings, since both provide parents with security in old age.

The model developed below satisfies both of the above requirements. It considers two time periods in household decision-making.[1] Parents derive utility from the children they have in the first period and their own standards of living in both periods. In the first period, both parents and children work, and the resulting family income is spent in child-related consumption, non-child related parental consumption, and savings. Since parents do not work in the second period, their consumption is financed by the returns from their first-period savings and the income contribution of their children.

Formally, it is assumed that parents maximize a utility function

$$U = U(N_1, C_1, C_2), \qquad U' > 0, \qquad U'' < 0, \tag{1}$$

composed of three commodities: number of children in the first period (N_1), parental consumption in the first period (C_1), and parental consumption in the second period (C_2).

Children are 'produced' according to a linear homogenous production function

$$N_1 = N_1(X_N, T_{FN}), \tag{2}$$

where X_N are goods inputs used in the production of children and T_{FN} is the time contribution of the mother in producing children. It is assumed that the father's time does not play a role in child production.

Parents maximize the utility function in (1) subject to an income constraint in both the periods. The first-period income constraint is

$$p_N x_N N_1 + p_1 C_1 + w_F t_{FN} N_1 + S_1 = w_M T_{MW} + w_F \Omega_F + w_1^N t_{NW} N_1 + Y_1, \tag{3}$$

where p_N is the market price of goods used in producing children; p_1 is the price of parental consumption goods in period 1; w_M, w_F, and w_1^N are the first-period wage rates of the husband, wife, and children, respectively; x_N and t_{FN} are the marginal (or average) input coefficients of goods and female time used in the household production of children; T_{MW} is the time worked by the husband (assumed to be predetermined); Ω is the total non-leisure time available to the wife for work and child production activities; t_{NW}^1 is the marginal work contribution of a child (assumed to be fixed); Y_1 is unearned income in period 1; and S_1 is household savings in period 1.

The second-period budget constraint can be written as

$$(4) \qquad p_2C_2 = \delta w_2^N t_{NW}^2 N_1 + (1+r) S_1 + Y_2,$$

where p_2 is the price of consumption goods in period 2, w_2^N is the wage rate of children in the second period, t_{NW}^2 is the marginal work contribution of each child in the second period (assumed to be fixed), r is the rate of return on savings, Y_2 is exogenous income in period 2, and δ is the proportion of children's second-period income remitted to parents (also assumed to be fixed).

To keep the model tractable, several simplifying assumptions have been maintained. For instance, the wife's leisure decisions, as well as the husband's labor supply decisions, are assumed to have been made prior to the savings-fertility decisions. The wife is thus faced with a choice of spending her non-leisure hours in child production or market work. Similarly, it is assumed that the marginal work contribution of each child is given and fixed in both periods. Finally, one could imagine that the proportion of children's second-period income remitted to parents is also fixed institutionally. All of these variables could have been endogenized without changing the basic structure of the model or its predictions, but this would have made the model far less tractable. Since the focus of this paper is on the fertility and savings decisions of parents, and not on the family labor supply decisions, the above assumptions are not unreasonable.

Maximization of (1) subject to (3) and (4) leads to the following Lagrangean expression:

$$(5) \qquad L = U(N_1,C_1,C_2) + \lambda\{w_M T_{MW} + w_F \Omega_F + w_1^N t_{NW}^1 N_1 + Y_1 + \delta w_2^N t_{NW}^2 N_1 (1+r)^{-1} + Y_2 (1+r)^{-1} - p_N x_N N_1 - w_F t_{FN} N_1 - p_1 C_1 - p_2 C_2 (1-r)^{-1}\} ;$$

in which the income constraints of both periods have been collapsed into one present-value-of-income constraint. The necessary conditions for an interior maximum of (5) are:

$$(6) \qquad \partial L/\partial N_1 = \partial U/\partial N_1 - \lambda\{p_N x_N + w_F t_{FN} - w_1^N t_{NW}^1 - w_2^N t_{NW}^2 (1+r)^{-1}\} = 0,$$

$$(7) \qquad \partial L/\partial C_1 = \partial U/\partial C_1 - \lambda p_1 = 0,$$

$$(8) \qquad \partial L/\partial C_2 = \partial U/\partial C_2 - \lambda p_2 (1+r) = 0, \text{ and}$$

$$(9) \qquad \partial L/\partial \lambda = 0 \Rightarrow \text{present-value-of-income constraint.}$$

Equation (6) implies that the shadow price of children $(\frac{\partial U}{\partial N_1}/\lambda)$ is positively related to the price of goods used in child production and the mother's wage rate, but is negatively related to the present value of the income contribution of each child in the first and second periods. Equations (7) and (8) imply that the shadow price of consumption in each period is equal to the price or discounted price of consumption goods in that period.

We have totally differentiated the first-order conditions in equations (6)-(9) to solve for the effects of infinitesimal changes in the exogenous variables on the three endogenous variables: N_1, C_1, and C_2.[2] The signs of these effects provide some empirically testable hypotheses. However, additional structure has had to be imposed on the model to derive any testable hypotheses. In particular, strong contemporaneous and intertemporal separability -- implying zero cross-partial derivatives -- has been imposed on the utility function.[3] Defining D as the determinant of the bordered Hessian matrix and D_{ij} as the minor of the i,jth element of the matrix, and using the results of the comparative static analysis,[4] the following expressions can be written for the uncompensated derivatives in the system:[5]

(10) $$dN_1/dY_1 = \underset{(-)}{-D_{42}/D} > 0,$$

(11) $$dN_1/dY_2 = -(1+r)^{-1}\underset{(-)}{(D_{42}/D)} > 0,$$

(12) $$dN_1/dw_1^N = -\lambda t_{NW}^1 \underset{(-)}{(D_{22}/D)} - N_1 t_{NW}^1 \underset{(-)}{(D_{42}/D)} > 0,$$

(13) $$dN_1/dw_M = -T_{MW} \underset{(-)}{(D_{42}/D)} > 0,$$

(14) $$dN_1/dw_F = \lambda t_{FN} (D_{22}/D) + (t_{FN}N_1 - \Omega_F)(D_{42}/D)$$

$$= \lambda t_{FN} \underset{(-)}{(D_{22}/D)} - T_{FW} \underset{(-)}{(D_{42}/D)} \gtrless 0,$$

(15) $$dN_1/dr = \lambda\delta w_2 t^2_{NW} (1+r)^{-2} (D_{22}/D) + \lambda(D_{32}/D)(1+r)^{-2} - S_1 (D_{42}/D)(1+r)^{-2}$$

$$= \lambda\delta w_2 t_{NW} (1+r)^{-2} \underset{(-)}{(D_{22}/D)} + \lambda\underset{(-)}{(D_{32}/D)}(1+r)^{-2} + S_1 \underset{(+)}{(dN_1/dY_2)} < 0, \text{ if } S_1<0,$$

(16) $$dN_1/dp_1 = - \lambda\underset{(-)}{(D_{12}/D)} + C_1 \underset{(-)}{(D_{42}/D)} \gtrless 0,$$

(17) $$dC_1/dY_1 = \underset{(+)}{D_{41}/D} > 0,$$

(18) $$dC_1/dY_2 = \underset{(+)}{D_{41}/D} (1+r)^{-1} > 0,$$

(19) $$dC_1/dw^N_1 = \lambda t^1_{NW} \underset{(-)}{(D_{21}/D)} + t^1_{NW} N_1 \underset{(+)}{(D_{41}/D)} \gtrless 0,$$

(20) $$dC_1/dw_M = T_{MW} \underset{(+)}{(D_{41}/D)} > 0,$$

(21) $$dC_1/dw_F = -\lambda t_{FN} (D_{21}/D) + (t_{FN}N_1 - \Omega_F)(D_{41}/D)$$

$$= -\lambda t_{FN} \underset{(-)}{(D_{21}/D)} + T_{FW} \underset{(+)}{(D_{41}/D)} > 0,$$

(22) $$dC_1/dr = -\lambda\delta w_2 t^2_{NW} (1+r)^{-2}\underset{(-)}{(D_{21}/D)} - \lambda(1+r)^{-2}\underset{(+)}{(D_{31}/D)} + S_1(1+r)^{-1}\underset{(+)}{(D_{41}/D)} \gtrless 0,$$

(23) $$dC_1/dp_1 = \lambda\underset{(-)}{(D_{11}/D)} - C_1 \underset{(+)}{(D_{41}/D)} \gtrless 0,$$

Most of the derivatives in equations (10)-(23) cannot be signed unambiguously because of the usual problem of opposite substitution and income effects. The derivative dN_1/dw_1^N is an exception, since an increase in the first-period child wage has positive own substitution as well as income effects. Since there is no substitution effect of the father's wage (because of our assumption that father's time does not contribute to child production), its effect on fertility is a pure income effect and hence positive. The effect of the mother's wage on first-period consumption is also unambiguously positive, because both the income and the substitution effects are positive. The positive substitution effect arises from the fact that an increase in the mother's wage increases the shadow price of children and thereby increases first-period consumption.[6]

Of special interest are the two derivatives, dN_1/dr and dC_1/dw_1^N, which are unique to this study. The derivative dN_1/dr cannot be signed unambiguously, again because of a positive (future) income effect. The first right-hand side term in equation (15) reflects the fact that an increase in the interest rate increases the shadow price of children (thereby reducing desired fertility) by lowering the present discounted value of children's earnings. (Recall that the shadow price of children is negatively related to the present discounted value of children's earnings.) The second term in equation (15) is also negative because an increase in the interest rate lowers the shadow price of second-period parental consumption ($\pi_{C_2} = p_2(1+r)^{-1}$) and thereby desired fertility (since fertility and second-period parental consumption are net substitutes by assumption). The third term in equation (15) reflects the positive (second-period) income effect of an increase in the interest rate on fertility among net savers. An increase in the rate of return on savings increases the future income of net saver households (i.e., households with $S_1>0$), which in turn increases desired fertility (ruling out inferiority of children). However, for net borrower households (i.e., those with $S_1<0$), an increase in the interest rate reduces future income (i.e., income in the second period) and thereby desired fertility. Hence, for these households, the effect of the interest rate on fertility can be signed as unambiguously negative.

The effect of first-period child wages on first-period parental consumption, dC_1/dw_1^N, is also ambiguous, because an increase in the former has a positive income effect and a negative substitution effect on first-period parental consumption (a compensated increase in child wages reduces the shadow price of children and thereby desired first-period parental consumption). Thus, neither of the effects that are unique to a joint fertility-savings model can be signed a priori.

So far we have been concerned only with first-period parental consumption and not with savings. Since a savings equation will be estimated empirically, we need to make comparative static predictions about the effect of changes in the exogenous variables on S_1. The derivative dS_1/dZ (where Z is any exogenous variable) can be signed on the basis of the signs of dN_1/dZ and dC_1/dZ, using the first-period income constraint in equation (3). Differentiating equation (3) with respect to Z and rearranging terms, we have

$$(24) \qquad dS_1/dZ = (w_1^N t_{NW}^1 - p_N x_N - w_F t_{FN})\, dN_1/dZ - p_1 dC_1/dZ.$$

Thus, dS_1/dZ can be signed unambiguously only if both dN_1/dZ and dC_1/dZ can be signed. From equations (10)-(23), we know that only the effects of Y_1, Y_2, and w_M (all positive) can be signed for both N_1 and C_1. It is, however, obvious from equation (24) that dS_1/dY_1, dS_1/dY_2, and dS_1/dw_M cannot be signed unless $w_1^N t_{NW}^1 - p_N x_N - w_F t_{FN}$ (i.e., each child's marginal income contribution in the first period less marginal cost in the first period) is negative. If the latter is negative, then dS_1/dY_1, dS_1/dY_2, and dS_1/dw_M are all negative.

The comparative static analysis thus suggests estimation of the following reduced-form household demand equations:

$$(28) \qquad N_1 = N_1(\underset{+}{w_M}, w_F, \underset{+}{w_1^N}, p_1, r, \underset{+}{Y_1}),$$

$$(29) \qquad S_1 = S_1(w_M, w_F, w_1^N, p_1, r, Y_1).$$

Comparative static predictions of the signs of various effects are indicated below each coefficient in equations (28) and (29). Note that all the exogenous variables in the model have not been included in the equations, since data on future child wages, future exogenous income, future price of consumption goods, and the price of goods used in child production can rarely, if ever, be obtained from cross-sectional household surveys.

THE EMPIRICAL MODEL

Equations (28) and (29) have been estimated using data collected from an all-India sample survey of 4,118 rural households.[7] The survey, called the Additional Rural Incomes Survey (ARIS), was undertaken by the National Council of Applied Economic Research, New Delhi, in three rounds: 1968-69, 1969-70, and 1970-71.[8] With the exception of data on savings, the information used in this paper comes entirely from the third, more extensive round.

Translation of the theoretical model into an empirically estimable model is rendered somewhat difficult by the facts that (i) the cross-sectional survey data include households at varying stages of their life-cycle, and (ii) both fertility and savings have strong life-cycle patterns. Before using these variables in the analysis, they need to be purged of their life-cycle components. For instance, in the case of fertility or children ever born to the wife of the household head (N_1), an adjustment is required for the wife's age, since the sample includes several households in which the head's wife had not completed her child-bearing period.[9] We have used the index proposed by Boulier and Rosenzweig (1978), which is a ratio of the actual to the potential number of live births. The latter is taken from Coale and Trussell (1974), who construct an age-specific natural fertility schedule from birth rate data for ten non-contracepting populations.

Since no standard or natural age profile of household savings exists, the age adjustment for savings (S_1) is more difficult.[10] The procedure followed here is to estimate a cohort-specific age (of the head) profile of household savings (somewhat akin to the age-cohort profile of individual earnings estimated by Haley (1976)), and use this to construct a measure of life cycle-adjusted savings. (See Appendix Table A-1 for the estimates of the age-cohort profile of savings.) The latter expresses actual savings as a proportion of 'normal' savings (as defined by the estimated age profile) for a household with a head of a given age and cohort. The availability of panel data (for three years) on savings has allowed us to separate the cohort of head effect from the age of head effect on savings. As is observed from Appendix Figure A-1, the separation of the cohort effect is important because younger cohorts tend to have age profiles of savings that are higher and flatter than those of older cohorts.

Several of the explanatory variables in the model also need correction before being used in the savings and fertility regressions. Daily wage rates for the head, his wife, and their children (w_M, w_F, w_1^N) are not available directly from the ARIS survey, but have to be calculated by dividing annual earnings by annual days worked -- a procedure that is known to introduce a potential source of measurement error. Further, since wages can be calculated only for persons working one or more days in a year, the use of actual wages would result in the exclusion of all non-working persons from the sample. This would not only reduce the sample size drastically (relatively few households have working fathers, mothers, and children), but also introduce truncation bias in the estimates of the fertility and savings equations. It is, therefore, desirable to use predicted wages in the analysis. We have estimated separate wage equations for the household head and his spouse, using the sample of households reporting wages for the husband or wife. These equations have been used to construct predicted wages. Since almost one-half of the wives in the sample reported no work during the year, the wage regression for the wife includes a linear correction term -- due to Olsen (1980) -- for the potential selectivity bias that arises when using a non-random sample such as workers. The male and female wage regression results, as well as the regression results for the probability of observing the wife's wage (which is used to construct the Olsen correction term in the female wage equation), are shown in Appendix Tables A-2, A-3, and A-4. Interestingly, the female wage equation results confirm the presence of significant selectivity bias. They suggest that, holding all their characteristics constant, the imputed wage rate for a non-working woman may be more than twice as large as that for a working woman.

The wage equation for children has been estimated over the entire sample of working children, and includes child-, family-, and community-specific characteristics as regressors. (See Appendix Table A-6.) Since the correction term for selectivity was not significant in the children's wage equation, the wage rate equation without the selectivity correction term has been used to obtain predicted child wages. To arrive at a household- (instead of child-) specific measure of children's wage rate, predicted child wages have been averaged over all the children in a household.

The average interest rate paid by a household on all operational (farm and business) borrowings has been used as a proxy for the rate of return on savings (r). Since a large number of sample households did not report interest rates, an interest rate function, regressed over a set of household-, village-, and district-level characteristics, has been estimated for households reporting interest rates, and fitted values of this function have been used in the savings and fertility regressions. (See Appendix Table A-8.) The same technique used to correct for selectivity bias in the wife's wage equation has been used here. The correction term is significant, and suggests that, holding other factors and the interest rate constant, the imputed interest rate may be as much as 50 per cent higher for households who do not borrow in the market than for households who do borrow and report interest rates.

The price of parental consumption goods in the first period (p_1) is proxied by the state-level Consumer Price Index for Agricultural Laborers (ALCPI), published by the Government of India (1975). Although the basket of commodities used to derive this index includeds several goods used in child production, the ratio of parental consumption to child-related consumption goods in the basket is likely to be so large that one can safely treat the ALCPI as a proxy for p_1 rather than for p_N.

As the quality of the unearned income variable in the ARIS file is poor, we use the amount of land owned by a household as a proxy for non-wage income in the first period (Y_1).[11] The remaining variables appearing as regressors in the savings and fertility equations are control variables that could reflect differences in tastes across households. These are the education of the household head and his age and age squared. Since education of the household head already enters as a regressor in the head's wage rate equation, it will reflect a pure taste or technology (in child production) effect in the savings and fertility equations, and be purged of its wage effect. Similarly, the age of the head and age squared variables will reflect taste/technology differences across households and not any life-cycle effects, since the fertility and savings measures used in the empirical model have already been purged of their life-cycle components.

ESTIMATION AND RESULTS

The means and standard deviations of the variables used in the analysis are reported in Table 1. Since Equations (28) and (29) form a system of reduced-form equations having an identical set of exogenous variables as regressors, they can be estimated consistently and efficiently by OLS-IV estimation. The OLS-IV regression results are reported in Table 2. The comparative static predictions of the signs of the uncompensated price effects are all borne out by the empirical results. In particular, the first-period husband's and children's wage rates and land ownership are observed to have positive and statistically significant effects on fertility.

The mother's wage rate is observed to have a negative and significant effect on fertility, indicating a large and dominant substitution effect of female wages on fertility. This is a standard result obtained by De Tray (1972), Schultz (1972), Gardner (1973), and Turchi (1975), among others, using U.S. data, and by Rosenzweig and Evenson (1977) using Indian district-level data.[12] Education of the head has a puzzling positive and significant sign in the fertility equation, implying that educated men either have a preference for larger families or are more 'efficient' at producing children with given levels of goods and time inputs.

With the exception of the age of the head and age squared variables, all the explanatory variables in the savings equation are

Table 1

Mean and Standard Deviations, Rural Indian Households, 1970-71
(Sample Size = 1018)

Variable	Definition	Mean	Std. Dev.
RELFERTL	Children ever born to wife of household head relative to natural fertility at her age	0.47	0.19
RELSAVNG	Average annual saving (income less consumption expenditure) over period 1968-69 to 1970-71 divided by predicted annual saving given age and cohort of household head	1.25	2.57
HDWAGE+	Predicted daily wage rate of the head	3.07	1.27
SPWAGE+	Predicted daily wage rate of the spouse of the head	1.72	1.31
AVCWAGE+	Average of predicted daily wage rate for all children (below 15) in the household	1.64	3.03
INTEREST+	Predicted interest rate paid by household on all operational borrowings taken during 1970-71	10.52	2.25
ALCPINDX	Agricultural Laborers' Consumer Price Index (varies by state only)	205.31	18.39
YRSEDUHD	Years of education completed by the head	5.72	4.43
AGEHD	Age (in completed years) of the head	47.86	11.55
AGEHDSQ	Age of head squared	2423.87	1181.30
LANDOWN	Hectares of land owned by the household	1.30	3.54

+Instrumental variables. See Appendix B for details of the wage and interest rate regressions as well as the estimated cohort-age profile of saving.

Table 2

OLS-IV Regressions of Savings and Fertility, Rural India Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Relative Fertility (RELFERTL)		Relative Saving (RELSAVNG)	
INTERCEPT	0.518		-4.220	
HDWAGE+	0.011 (1.8)	[0.074]	0.574 (7.5)	[1.408]
SPWAGE+	-0.019 (-3.7)	[-0.07]	0.133 (2.1)	[0.183]
AVCWAGE+	0.005 (2.2)	[0.016]	-0.105 (-4.1)	[-0.138]
INTEREST+	0.010 (3.6)	[0.228]	0.055 (1.6)	[0.462]
ALCPINDX	-0.000 (-0.6)		0.016 (4.0)	[2.616]
YRSEDUHD	0.007 (3.7)	[0.082]	0.072 (3.2)	[0.329]
AGEHD	-0.003 (-1.0)		-0.030 (-0.7)	
AGEHDSQ (X1000)	-0.004 (-0.1)		0.277 (0.7)	
LANDOWN	0.005 (3.2)	[0.015]	0.109 (5.2)	[0.113]
F-Ratio	11.50		30.39	
R-Square	0.093		0.213	
df	1008		1008	

+Instrumental variable.

Figures in brackets are elasticities evaluated at the sample mean. Elasticiies have been computed only for coefficients significantly different from zero at the 0.10 level of significance.

significant. Savings are observed to be highly (positively) elastic with respect to the head's wage rate and with respect to the price of parental consumption goods. The elasticity of savings with respect to the interest rate is also positive, although less than unity. While the theoretical model does not actually predict the signs for any of these elasticities, conventional wisdom suggests positive income, interest rate, and consumer price level effects on savings. It is reassuring to find the empirical results supporting this wisdom.

In a sense, the two most important price elasticities in the model are the elasticity of savings with respect to the (first-period) child wage and the elasticity of fertility with respect to the interest rate. These are the elasticities that are unique to a model of joint fertility-savings determination. The theoretical model does not suggest any particular signs for these effects (except for net borrower households). Neither is there much of a literature in this area which could suggest signs for these effects. However, if both or either of the coefficients are observed to be not significantly different from zero, there would little support for a model of joint fertility-savings determination.

The results in Table 2 are reassuring in this regard. Both coefficients are observed to be highly significant. The effect of the interest rate on fertility is positive, implying that the (future) income effect of an increase in the interest rate dominates the (negative) substitution effect (Equation 15). The derivative of savings with respect to the first-period child wage is, however, negative. As is obvious from Equation (30) below,

$$(30) \qquad dS_1/dw_1^N = (w_1^N t_{NW}^1 - p_N x_N - w_F t_{FN})\ dN_1/dw_1^N - p_1 dC_1/dw_1^N,$$

an observed negative dS_1/dw_1^N could imply almost any sign for the net marginal contribution of a child to household income $(w_1^N t_{NW}^1 - p_N x_N - w_F t_{FN})$ and the effect of child wages on first-period parental consumption (dC_1/dw_1^N).

CONCLUDING NOTES

In this paper, an attempt has been made to model the fertility and savings decisions of rural households in less-developed countries as jointly-determined decisions influenced by a common set of prices and other exogenous factors. It is argued that previous studies have misspecified the relationship between savings and fertility by treating the latter as an exogenous variable.

The empirical results strongly support the few predictions derived from the theoretical model. Fertility is observed to be positively related to the father's wage and the wage rates of children but negatively related to the mother's wage rate. Savings are observed to be positively related to the interest rate and to the father's wage rate. Both the coefficients that are unique to this study -- viz, the interest rate effect on fertility and the child wage effect on household savings -- are significantly different from zero, lending support to a model of joint fertility-savings determination. The results suggest that, while an increase in the rate of return on savings will increase household savings in less-developed countries, it may also result in an increase in fertility due to a strong (and positive) income effect. On the other hand, an increase in wage rates earned by children may result in the substitution of children for financial savings by rural parents. The results also indicate that, ceteris paribus, large farm households have both larger families and more savings than small farm or agricultural labor households. The paper suggests the general importance of price effects in household fertility and savings decisions.

FOOTNOTES

1) All of the issues of interest in this paper can be studied as readily in a simple two-period framework as in a full (and far less tractable) life-cycle model of the household.

2) The comparative static derivatives have been computed with respect to only those exogenous variables for which data are available.

3) The separability assumption is not unrealistic given the level of aggregation of the three commodities. Also, note that, although the separability assumption implies that fertility, parental consumption in the first period, and parental consumption in the second period are net substitutes for each other, there is no implication for the net substitutability/complementarity relationship between fertility and savings. The latter will depend upon a number of other factors, including the net contribution of children to household income.

4) The detailed comparative static calculations can be obtained from the author.

5) Since the effects actually estimated in the empirical model are uncompensated effects, the comparative static analysis is focused on the uncompensated effects of the exogenous variables on fertility and savings.

6) Note that, because of strong separability of the utility function, all three commodities -- number of children, first-period parental consumption, and second-period parental consumption -- are net substitutes for each other. Hence, a compensated increase in the shadow price of children increases parental consumption in the first period.

7) Due to missing values, the sample used in this paper is much smaller, viz., 1018 households.

8) See Sarma (1975) for a full description of the data.

9) In extended households having two or more families living together, only the primary family (i.e., the household head, his wife, and their children) has been retained in our sample. Thus, only children born to the head's wife are enumerated in the fertility variable.

10) Two measures of savings are available from the ARIS file. Savings, as defined by the change in the value of assets owned by a

household over a one-year period, has not been used here, since it includes only changes in physical (and not financial) assets. The other measure of savings, viz., the difference between income and expenditure, is more comprehensive and has been used in this paper.

11) It should, however, be realized that even this proxy is likely to be crude, and that estimation of fully (income) compensated price effects may be almost impossible (Kniesner, 1976).

12) It is interesting to note that, even though Rosenzweig and Evenson (1977) have used very different (district-level) data for a different time-period (1960-61), their estimated fertility equation is very similar to the one estimated in this paper. They, too, have obtained positive male wage, child wage, and land ownership effects and negative female wage effects on fertility.

Appendix Table A-1

OLS Estimates of the Age-Cohort Profile of Household Saving, Rural Indian Households, 1968-69 to 1970-71[a]

(t-statistics in parentheses

Independent Variable	Equation[b]
Intercept (b_o)	-387342
Age of head (b_1)	6494.563 (1.4)
Age of head squared (b_2)	-33.219 (-3.3)
Year of birth of head (d_o)	198.053 (1.8)
Year of birth of head X Age of head (d_1)	-3.264 (-1.4)
Year of birth of head X Age of head squared (d_2)	0.017 (3.3)
F-Ratio	13.68
R-Square	0.0054
df	12499

[a]Data have been pooled across over 4,000 households and three years-1968-69, 1969-70, and 1970-71.

[b]The equation estimated is of the following form:

$$S = a_o + a_1 A + a_2 A^2, \text{ where}$$

$$a_o = b_o + d_o C,$$

$$a_1 = b_1 + d_1 C, \text{ and}$$

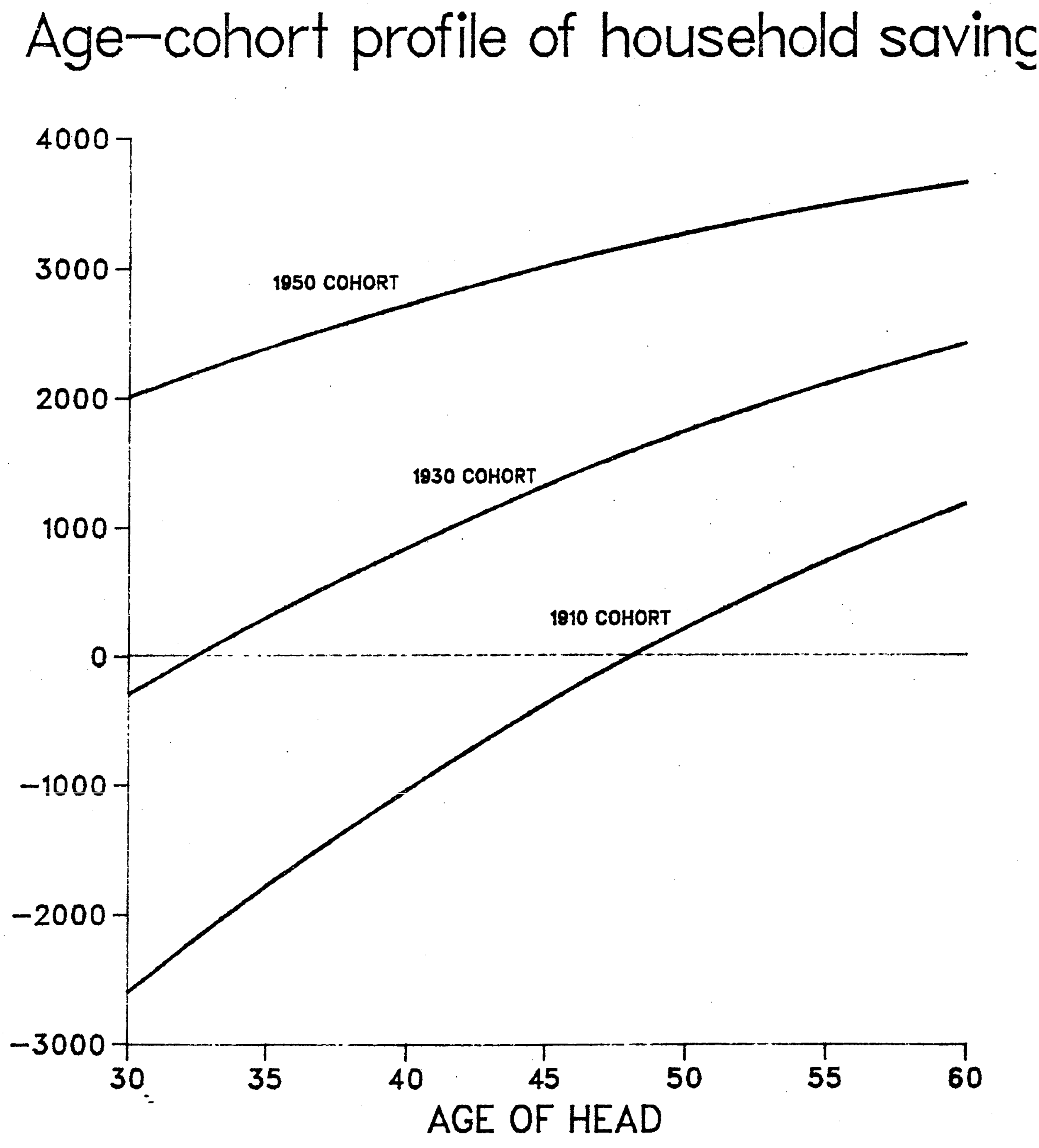
$$a_2 = b_2 + d_2 C.$$

All of these collapse into a linear equation estimable by OLS:

$$S = b_0 + d_o C + b_1 A + d_1 CA + b_2 A^2 + d_2 C \cdot A^2.$$

S = saving, C = birthcohort, and A = age of head.

Appendix Figure A-1



Appendix Table A-2

OLS Regressions of the Log of the Daily Wage Rate earned by the Household Head, Rural Indian Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Equation
Intercept	0.143
Age of head	-0.006 (-3.4)
Years of education of head	0.042 (9.7)
Reported daily wage rate for male agricultural labor in the district of residence	0.152 (9.3)
Percentage of male adults literate in the district	0.005 (3.1)
Percentage of district population that is Muslim	0.009 (3.5)
Cropping intensity (gross cropped area as a percentage of net cultivated area) in the district	0.003 (2.2)
F-Ratio	77.59
R-Square	0.382
df	753

Appendix Table A-3

OLS Regression of the Probability of the Head's Wife Reporting a Wage Rate, Rural Indian Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Equation
Intercept	0.452
Age of wife	-0.005 (-7.4)
Years of education of wife	-0.007 (-1.8)
Whether head of household is a Muslim	-0.113 (-3.4)
Land owned by the household	-0.013 (-4.7)
Percentage of net cultivated area irrigated (= 0 for landless households)	-0.001 (-7.7)
Whether any registered factory in the village	-0.030 (-0.8)
Whether any small-scale industry in the village	0.073 (2.5)
Population of the village (x100000)	-0.666 (-1.7)
F-Ratio	21.13
R-Square	0.084
df	1836

Appendix Table A-4

OLS Regressions of the Log of the Daily Wage Rate earned by the Wife, Rural Indian Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Equation 1	Equation 2
Intercept	-0.517	0.107
Age of wife (x1000)	-0.464 (-0.1)	5.713 (1.8)
Years of education of wife	0.112 (8.3)	0.121 (9.2)
Land owned by the household	-0.075 (-1.5)	-0.079 (-1.6)
Whether any registered factory in the village of residence	0.393 (2.9)	0.480 (3.6)
Whether any small-scale industry in the village	0.128 (1.4)	0.071 (0.8)
Population of the village (x 1000000)	3.566 (2.7)	4.568 (3.6)
Selectivity Correction $(1-\hat{p})^a$	1.099 (2.3)	
F-Ratio	25.20	28.09
R-Square	0.411	0.399
df	253	254

[a] $\hat{p}$ is the predicted probablility of the wife reporting a wage rate, obtained from Appendix Table A-3.

Appendix Table A-5

OLS Regression of the Probability of a Child Reporting a Wage Rate, Rural Indian Households, 1970-71[a,b]

(t-statistics in parentheses)

Independent Variable	Equation
Intercept	-0.023
Sex of child	0.009 (2.8)
Age of child	0.005 (8.1)
Whether eldest child in the household	0.008 (2.0)
Whether head of household is a Muslim	-0.014 (-2.0)
Years of education of the household head	-0.003 (-8.3)
Land owned by the household	-0.001 (-2.0)
Whether any small-scale industry in the village	-0.007 (-1.3)
F-Ratio	30.19
R-Square	0.034
df	6038

[a]The sample used for this regression includes all the children in all households surveyed.

[b]Education of the child was not included as a regressor since it is likely to be an endogenous variable that is jointly determined with the labor force participation of the child.

Appendix Table A-6

OLS Regressions of the Log of the Daily Wage Rate Earned by Children, Rural Indian Households, 1970-71[a]

(t-statistics in parentheses)

Independent Variable	Equation 1	Equation 2
Intercept	-0.419 (-0.5)	-7.796 (-0.7)
Sex of child	0.686 (2.9)	0.751 (2.9)
Age of child	0.057 (0.9)	0.108 (1.1)
Land owned by the household	-0.796 (-2.5)	-0.852 (-2.6)
Whether any registered factory in the village	2.202 (4.6)	2.184 (4.5)
Whether any small-scale factory in the village	-1.102 (-1.6)	-1.161 (-1.6)
Population of the village (X 100000)	9.284 (2.1)	8.765 (1.9)
Selectivity Correction $(1 - \hat{p})$[b]		7.073 (0.7)
F-Ratio	7.62	6.56
R-Square	0.281	0.284
df	117	116

[a]Education of the child was not included as a regressor because of the possibility that it is endogenous and may, in fact, depend on the opportunity cost of time (or the wage rate) of the child.

[b]$\hat{p}$ is the predicted probability of the child reporting a wage rate, obtained from Appendix Table A-5.

Appendix Table A-7

OLS Regression of the Probability of a Household Reporting an Interest Rate on Current Operational Borrowings, Rural Indian Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Equation
Intercept	0.156
Years of education of the head	0.013 (7.5)
Age of head (X 1000)	0.010 (0.2)
Land owned by household	0.009 (2.9)
Presence of a loan cooperative in the village	0.011 (0.4)
Percentage of male adults literature in the district	-0.002 (-2.4)
Percentage of district population belonging to scheduled (backward) castes and tribes	-0.001 (-0.7)
Percentage of district population that is Muslim	-0.003 (-3.3)
F-Ratio	12.43
R-Square	0.040
df	2092

Appendix Table A-8

OLS Regressions of the Log of the Interest Rate Paid

On Current Operational Holdings, Rural Indian Households, 1970-71

(t-statistics in parentheses)

Independent Variable	Equation 1	Equation 2
Intercept	5.019	5.469
Whether head is a Muslim	0.166 (1.1)	0.176 (1.2)
Presence of a loan cooperative in the village[a]	-0.523 (-6.3)	-0.543 (-6.5)
Presence of a bank in the village[a]	0.045 (1.0)	0.044 (1.0)
Whether district of residence is an IADP (Intensive Agricultural Development Program) participant district	-0.083 (-2.0)	-0.086 (-2.0)
Percentage of male adults literate in the district	-0.009 (-4.0)	-0.009 (-4.1)
Percentage of district population that is Muslim	0.003 (0.9)	0.004 (1.6)
Selectivity correction $(1 - \hat{p})$[b]	0.526 (1.6)	
F-Ratio	11.09	12.44
R- Square	0.203	0.196
df	305	306

[a]Excluded category is informal money-lenders.

[b]$\hat{p}$ is the predicted probability of reporting an interest rate, obtained from Appendix Table A-7.

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