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Economic Determinants of Fertility-- Analysis Based upon Census Data for West Bengal

I

IT seems somewhat curious that India, where family planning has attracted so much official attention, has remained relatively unaffected by the recent upsurge of the theory of household behaviour in economic research. The main focus of this theory is on the complex character of the forces behind observed demographic variables like fertility and migration. The theory postulates a joint decision mechanism on the part of the family that determines these variables. The success of this research in several countries and the increasing reliance of population policy on economic measures suggest a promising potential for such analysis in India. An important contribution in this direction is made in a recent paper by Rosenweig and Evenson, 1977 [4] demonstrating the strength of the theory by using the 1961 census data to show how family decisions in rural India on fertility, schooling and labour force participation of children are jointly determined by economic factors. This rigorous econometric analysis uses a complicated estimation procedure. However, many questions remain unanswered. It should be possible to consider these on the basis of the limited information available from the Indian Censuses. The present paper examines some of the more simple questions concerning economic factors affecting fertility in India. Its basic objective is to test how far such economic models are statistically applicable to assess the role of economic factors in explaining varia-

tions in fertility. It seeks to examine the possible effects on fertility of three sets of factors : *(o)* Social/Demographic, *(b)* Educational, and (c)Female Employment patterns.

In Section-II an economic interpretation of the three sets of variables is presented; in Section-Ill the methodology, data and variables are discussed. Section-IV discusses the results, and these are compared with the results of some other studies, and Section-V summarises the conclusions.

II

It is hypothesized here that parents' desired number of children is determined, among other economic and non-economic factors, by the following :

(i) *Social-Demographic :* Nature of family-joint or unitary; Female Migration; (ii) *Educational Level*: Literacy and educational standard of males and females; and (iii) *Female Employment :* Agricultural labour and cultivator, mining and manufacturing, household industry.

Nature of Family. The costs associated with children—both direct and opportunity costs—as perceived by parents are likely to differ according to whether the family is extended joint or unitary. The direct costs of raising children in an extended joint family are shared by different earners in the sense that they are generally met from a common pool. This implies an element of externality for the parents. Moreover, the children being taken care of generally in the family, the opportunity costs of parents, especially for the mother, are reduced in a joint family. This is likely to act as an incentive for parents to have children. A positive association between joint family and fertility is therefore postulated.

On the other hand, the expected benefits from children especially as old age insurance, may be lower in a joint family. Besides, beyond a point a joint family might face problems of accommodation with in the house, particularly in urban areas; this might lead to increases in family costs. This would mean a negative association between joint family and fertility. The observed association would thus be indeterminate, either positive or negative, depending upon the relative strength of the two sets of factors.

Female Migration. It is often suggested that the behaviour of the migrant may be different from that of the resident population. It is not unlikely that a

migrant female would have a pattern of decision-making about the number of children that is different from that of a non-migrant mother. Such differences may be the result of factors that are specific to regions and are rather stable over time. The specific nature of the association between migrant characteristics of the female population and fertility would depend upon the relative perceptions of costs and returns on the part of the parents. It may be expected, however, that an additional child would cost more to a migrant than to a resident female, while the perceived returns, accruing in the same final place of residence, would be the same for both.

Education. Education has been used in economic models of fertility as a proxy for a number of things [Mukhopadhyay (2)]. By and large, economists view education as a measure of the value of time in market and non-market activities. Since children normally use more of mother's time, it has been hypothesised that the perceived cost of time forgone for children would be much higher for the mother than for the father. And so, the effect of education on the demand for Children may be postulated to be higher for the female than for the male. Past studies have supported the hypothesis that female education is often strongly and negatively associated with fertility, while this association is rather weak and often positive for male [Schultz (5)]. It may also be hypothesised that the relationship between education and fertility is non-linear positive at low levels of education but negative at higher levels because of the changing magnitudes of income and substitution effects at different levels.

Female Employment Pattern. Participation in the labour force makes it possible to convert the potential value of time into actual income received. However, not all occupations are the same with regard to the mother's time away from child rearing activities. It may be suggested that occupations like manufacturing should cost the mother more time than activities like household industry. Association between fertility and household industry employment for the female would thus be either negligible or positive, whereas that between fertility and factory employment should be negative.

The economic interpretation of the model of fertility given in this paper, if proven acceptable, should provide a valuable element in the formulation of economic-cum-population policy for the country. Conventionally, economic development policy is formulated assuming the population factor as exogenous, while population policy is often formulated in partial isolation of economic

policies. Answers to questions of both economic development and population planning may be sought simultaneously in a jointly determined framework.

III

The following linear model is used here :

$$Y_{i,t} = A_{i,t} + \sum_{j} \alpha_{j,i,t} \cdot X_{j,i,t}$$

where $Y_{i,t}$: Dependent variable : Fertility, for i-th region, t-th year;

A : Constant;

$X_{j,i,t}$: Independent variable j, for i-th region, t-th year;

$\alpha_{j,i,t}$: Coefficient for j-th explanatory variable.

The coefficients have been estimated by using Ordinary Least Squares method.

Two points are in order here. First, the postulated *linear* relationship has been used in most economic models of fertility. Non-linear variants of the model have, however, been tried without any notable improvement in the specification of the relationship [Schultz (5)]. Second, it has been suggested throughout this paper as well as elsewhere, that the joint decision making process in the theory of household behaviour lends itself to estimation in simultaneous equations, preferably dynamic, framework. However, subject to certain assumptions made in several other studies*, a reduced form of single equation demand model has been attempted here as an initial exploration into the area.

The model has been applied to district level data for the districts of the State of West Bengal for 1961 and 1971 available in the Census Reports. Separate equations have been estimated for the two Census years covering the 15 Rural and 19 Urban districts of West Bengal. The variables have been defined in the following way :

(*Y*) ***Fertility.*** An approximate measure of fertility has been attempted here

*See *Journal of Political Economy*, March/April, 1977.

by using the formula :

$$Y = \frac{\frac{1}{2}(P_5 + P_{10}) + P_{6-9}}{F_{20-54}} \text{ for 1961}$$

and

$$Y = \frac{P_{5\ 9}}{F_{20-54}} \text{ for 1971,}$$

where P stands for total population and F for female population for group in the subscript.

The reason we have chosen this formula is that errors are likely to be more frequent at the two limiting points of the age interval. Children aged 0-4 and female population aged 14-19 are excluded in the hope that this will minimize the effect of infant deaths and also the effects of reporting errors. In an economic model of household behaviour, this measure of fertility based upon the number of children per mother, rather than completed family size, entails the additional assumption of symmetry between the variation in the two [Mukhopadhyay (2)].

(X_1) : *Joint Family*. The census definition of joint family has been used here depending on the data available in the respective censuses.

$$\text{For 1961 : } X_1 = \frac{\text{Married relations + never married, widowed, divorced persons + unrelated persons}}{\text{Total household population}}$$

$$\text{For 1971 : } X_1 = \frac{\text{Spouses in households + single member households}}{\text{Total household population}}$$

(X_2) : *Female Migration*. $X_2 = \dfrac{\text{Migrated female population}}{\text{Total female population}}$

(X_3) : *Literate Male*. Proportion of literate males in total males aged 20-54 for 1961, and 20 and above for 1971.

(X_4) : *Literate Female*. Proportion of literate females in total females in age group 20-54 in 1961, and 20 and above for 1971.

(X_5) : *Primary Educated Male*. Proportion of primary educated males in total males aged 20-54 for 1961, and 20 and above for 1971.

(X_6) : *Primary Educated Female.* Proportion of primary educated females in total females aged 20-54 for 1961 and 20 and above for 1971.

(X_7) : *Matriculate and above Male.* Proportion of matriculate and higher educated male in total males in age group 20-54 for 1961 and 20 and above for 1971.

(X_8) : *Matriculate and above Female.* Proportion of matriculate and higher educated female in total females in age group 20-54 for 1961 and 20 and above for 1971.

(X_9) : *Female Employment as Agricultural Labour and Cultivator.*

$$(X_9) = \frac{\text{Female workers in agriculture + female cultivators}}{\text{Total female population}}$$

(X_{10}) : *Female Employment in Mining and Manufacturing*

$$(X_{10}) = \frac{\text{Total of female workers in mining, manufacturing, construction etc.}}{\text{Total female population}}$$

(X_{11}) : *Female Employment in Household Industry*

$$X_{11} = \frac{\text{Female workers in household industry}}{\text{Total female population}}$$

A disclaimer on using Census data for analysis of fertility variations across regions and time is that the level of aggregation (district) being high, there is the underlying assumption of variations between districts reflecting variations among households. This assumption admittedly is restrictive. However, as a first approximation this might be acceptable.

IV

Ordinary least squares estimates of the model are presented in Table-I. Eight equations have been fitted for 1961 and 1971 Census years for Rural and Urban districts of West Bengal. Some of the implications of these results are briefly discussed here. It would appear that the social-demographic, educational and employment-related variables selected in this study explain 55 to 89 percent of the variations in fertility, which is quite favourable compared to most studies

TABLE 1—CROSS-SECTIONAL REGRESSIONS ON FERTILITY : WEST BENGAL DISTRICTS 1961, 1971
COEFFICIENTS FOR INDEPENDENT VARIABLES

Equation No.	Reference	*Sociological-Demographic*		*Educational*					
		Joint Family (X_1)	*Female Migration* (X_2)	*Literacy (Male)* (X_3)	*Literacy (Female)* (X_4)	*Primary (Male)* (X_5)	*Primary (Female)* (X_6)	*Matric (Male)* (X_7)	*Matric (Female)* (X_8)
1	1961 (Rural)	0.271	—0.014	—0.011	—0.055				
		(0.180)	(0.026)	(0.018)	(0.046)				
2	1961 (Urban)	0.150	0.017	0.045	—0.025				
		(0.086)	(0.026)	(0.045)	(0.032)				
3	1971 (Rural)	0.092	0.038	—0.045	0.130				
		(0.802)	(0.132)	(0.067)	(0.161)				
4	1971 (Urban)	0.452	0.021	—0.046	0.038				
		(0.253)	(0.031)	(0.071)	(0.049)				
5	1961 (Rural)	0.244	—0.012	—	—	—0.031	0.066	—0.167	—0.544
		(0.248)	(0.034)	—	—	(0.069)	(0.255)	(0.322)	(0.029)
6	1961 (Urban)	0.187	0.015	—	—	0.051	—0.074	—0.043	—0.006
		(0.150)	(0.027)	—	—	(0.046)	(0.094)	(0.082)	(0.132)
7	1971 (Rural)	—1.153	0.159	—	—	—0.172	—0.066	0.903	—0.341
		(0.751)	(0.149)	—	—	(0.127)	(0.251)	(0.555)	(0.018)
8	1971 (Urban)	0.454	0.066	—	—	0.152	—0.223	—0.002	—0.219
		(0.245)	(0.030)	—	—	(0.097)	(0.109)	(0.078)	(0.079)

(Figures in brackets indicate standard errors of estimate).

Table 1 (*contd.*)

Equation No.	Reference	Female Employment/Occupation			Constant	R^2
		Agricultural labourer and cultivator (X_9)	Minning and Manufacturing (X_{10})	Household Industries (X_{11})		
1	1961 (Rural)	−0.073 (0.013)	0.031 (0.026)	0.047 (0.166)	−0.816	0.89
2	1961 (Urban)	−0.366 (0.862)	−0.090 (0.189)	0.039 (0.155)	−0.493	0.55
3	1971 (Rural)	−0.180 (0.129)	−0.023 (0.104)	1.467 (2.170)	8.645	0.61
4	1971 (Urban)	0.011 (0.946)	−0.493 (0.189)	0.313 (0.505)	−2.911	0.61
5	1961 (Rural)	−0.068 (0.016)	0.033 (0.042)	0.718 (0.208)	−0.659	0.88
6	1961 (Urban)	−0.248 (0.785)	−0.084 (0.044)	0.013 (0.173)	−0.466	0.60
7	1971 (Rural)	−0.144 (0.113)	−0.064 (0.127)	1.971 (0.020)	10.103	0.75
8	1971 (Urban)	−0.037 (0.804)	−0.544 (0.158)	0.793 (0.430)	−0.789	0.82

in this area. The single most powerful explanatory variable in the model seems to be family characteristics—whether joint or nuclear. All the coefficients for this variable have positive sign—an indication that the incentive mechanism induced by the sharing of costs in having children in joint family is dominant in both rural and urban areas. This is also consistent with the finding of Rosenweig and Evenson who found a similar positive association between family size and fertility for rural Indian districts in 1961 (See Table 2). It is notable that, except for the last equation (No. 8), the coefficient for joint family is larger for rural areas than for urban areas—indicating relative strength of this variable's impact in the rural families.

TABLE 2—ESTIMATED RELATIONSHIP BETWEEN FERTILITY AND ECONOMIC VARIABLES : A COMPARATIVE VIEW

Reference	*Sign of coefficients for*			R^2
	Agricultural composition of Population	*Male Education*	*Female Education*	
Taiwan				
Schultz [5] :				
(OLS 1965 . .	+	−	+	.53
estimates) 1969 . .	+	−	+	.59
Pooled				
(Transferred : . .				
variables)	+	−	−	.55

	Percent of Rural Population	*Primary Education (M)*	*Matric (M)*	*Primary Education (F)*	*Matric (F)*	*Family Size*	R^2
India : 1961							
Rosenweig and Evenson [4]	−	−	+	+	−	+	.43
2-Stage least squares							

Female migration is also positively associated with fertility except for 1961 Rural. These coefficients are, however, mostly statistically insignificant and it

is hard to identify the consequences on fertility of the migrant characteristics of the female population without examining the specific nature of their migration.

Education variables are here treated in two ways, first, only the percentage of literate male and female without level of education (Equations 1-4) and then primary and matriculate and above for both sexes (Equations 5-8), with a view to testing the possible non-linearity in the effect of levels of education. The replacement of overall literacy by levels of education does introduce some improvement in the specification of the equation. The explanatory power of most of the equations shows an increase, and the statistical significance of more coefficients records improvement. The results are consistent with the view that there is a non-linearity in the effect of educational levels. More coefficients arc significant for female than for male education and, what is perhaps most interesting, the sign of the coefficient for female matriculate and above is negative throughout. This suggests the possibility of a good pay off for educational investment for women beyond the primary level.

With regard to female employment pattern, female employment is by and large, strongly related with fertility. There is, however, an asymmetry in the relationship when different occupations are considered separately. Both agricultural labour-cultivator and mining-manufacturing occupations show negative relationship with fertility, whereas household industry seems to be positively associated with it. Household industry—mostly an extension of household activity carried out commonly under the same roof, is hardly conflicting with child bearing and rearing.

It is instructive broadly to compare the results of the present study with those of some other studies. Table 2 shows the sign of the coefficients of similar explanatory variables used in two other relevant studies of Taiwan and India. Although the methods of estimation vary, this table shows that the explanatory power of these models is not higher than that of the present study. Whereas the sign of the cofficient for percentage of agricultural populating for Taiwan is by and large positive, the Indian study shows a negative sign for this coefficient—consistent with our coefficient for female employment in agriculture. With regard to education also these two studies generally reveal a negative sign for female education, which is consistent with the findings of the present exercise.

TABLE 3—REGRESSION ON DIFFERENCES IN VARIABLES (1961-1971)

Equation	Coefficients for Differences in								Constant	R^2
	Joint Family	Female Migrant	Literacy (Male)	Literacy (Female)	Female Employment in Agriculture	Female Employment in Minning and Manufacturing	Female Employment in Household Industries	Female Employment in Child labour		
Rural	0.7396	—0.1914	—0.0974	0.4062	0.0449	0.3244	—0.1302	—0.3107	—1.6097	0.66
	(0.2448)	(0.18191)	(0.0551)	(0.2495)	(0.0876)	(0.1605)	(0.1556)	(0.3765)		
Urban	—0.0439	—0.0078	—0.0231	0.0122	0.2278	1.0215	0.0086	—0.0952	0.0771	0.99
	(0.0078)	(0.0027)	(0.0092)	(0.0075)	(0.0448)	(0.0145)	(0.0163)	(0.0275)		

TABLE 4—REGRESSION ON CROSS-SECTION-TIME-SERIES POOLED DATA

Rural	5.4035	0.2948	—0.1874	—0.5057	—0.3399	0.1308	—3.7079	—0.1169	26.6854	0.99
	(0.0958)	(0.5721)	(0.1667)	(0.2534)	(0.3260)	(0.1959)	(0.8214)	(1.4550)		
Urban	5.5283	—43.0958	—0.6762	0.0034	14.5906	1.0762	—3.5098	0.7587	27.9241	0.98
	(0.2421)	(24.5547)	(0.4402)	(0.3292)	(9.2086)	(1.5466)	(2.0438)	(3.7977)		

V

To summarise, the study seems to underline the relevance of a micro-economic approach to the analysis of fertility in India. The results support the hypotheses that economic considerations play a role in the determination of the desired number of children. The policy significance of such analysis cannot be easily dismissed for the economic-demographic development of the country. The economic mechanism of the joint family system which seems to be in favour of a larger number of children per family, is gradually losing force with urbanization and the problem of housing. Education, not unexpectedly the key variable in the determination of fertility, turns out to be much more powerful for mothers at higher levels of education. Simple literacy movement for the nation should not perhaps overlook this point. Similarly, pure overall growth of employment of female labour without respect for the nature of employment may not bring about reduction in fertility as often expected in simplistic aggregative analysis. It may be noted that there may be perhaps an element of trade off between the twin objectives of increased employment and reduced fertility, if too much reliance is placed upon household industries without bringing about any technological change in them.

However, we would emphasize that ours is only a preliminary exploration and is subject to several limitations, including the following :

(1) The model should include more variables than have been considered here. Examples are : child labour, some measure of income/wealth, family planning facilities, etc,

(2) The model used here is a single equation, static model.

(3) The study is limited to West Bengal; it should be extended to all over India —with appropriate stratifications.

(4) The analysis relates to district level population; it should be conducted at micro levels —like the household or family. In this regard, the NSS household schedules should provide a valuable source of such data.

References

1. Mukhopadhyay, Sudhin K., 1976, *Sources of Variation in Agricultural Productivity*, Macmillan Co., New Delhi.
2. , 1978, Population Control and Micro-Economics of Fertility ; A Brief Survey,

Kalyani University Economics Seminar Paper : Presented at the Annual Conference *of* the Indian Association for the Study of Population, Hyderabad.

3. Ncrlove Mark and Schultz, T. Paul, 1970, *Love and Life between the Censuses : A Model of Family Decision Making in Puerto Rico, 1950-1960,* Rand Corporation.
4. Rosenweig, Mark and Evenson Robert, 1977, Fertility, schooling and the economic contribution of children in rural India ; An economic analysis, *Econometrica.*
5. Schultz, T. Paul, 1973, Explanation of birth rate changes over space and time : A study of Taiwan, *Journal of Political Economy.*