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A Simultaneous Equation Model of Fertility : The Case of Muslims of Indian Sub-continent

Introduction

SERIOUS concerns have been expressed regarding the global population growth and its impact on human welfare. It is estimated that, unless reduced, the current growth rate will push the world population over the seven billion mark by the year 2020. Fears have started haunting the minds of social thinkers and policy makers that the world resources, unless miraculously increased, might not be able to sustain population of this magnitude. Already, some minds are busy harvesting the idea that recurrent regional arms conflicts, scarcity of food and large-scale population migrations, particularly among the developing nations, are manifestations of this imbalance. Consequently, countries are busily devising and implementing policies to control population growth by depressing human fertility.

Though declining, high fertility is deep rooted in the Indian Sub-continent¹ which inhabits approximately 20 percent of the world population. Nearly 35 percent of the Sub-continent's total population practices Islamic faith. The measurement of the impact of certain factors on fertility behaviour of this group is the main object of this study.

In demographic literature, numerous researches have focused their attention on the analysis of fertility behaviour of members of various faiths.² These studies may be classified in several ways: (i) economic based with utilitarian approach; (ii) micro or regional in scope, including case studies; (iii) identifying ethnic or religious differential in fertility, and (iv) analyzing fertility patterns of specific groups, religious or otherwise.³ This study falls into the fourth category and investigates the pattern of Muslim fertility in the Indian Subcontinent.

Evidence claims that fertility in India, and by implication in the entire Indian Sub-continent, is higher among Muslims than among their counterparts belonging to other

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1. From the standpoint of the scope of this paper, the Indian Sub-continent comprises three countries: Bangladesh, India and Pakistan.

2. The list of such studies is long and exhaustive and cannot be reproduced in toto here for want of space. Some of the recent ones are: Blakie (1975); Khan (1979); Chamie (1981); Gulati (1988); Mandelbaum (1988); Axelrod (1990); Gutmann (1990); Gutmann and Riess (1993); Omran and Roudi (1993) and Balk (1994).

Balk (p. 42), using a dummy variable for Bangladeshi Muslims, concludes that this variable (religion) has a strong direct effect on fertility.

3. For further discussion on this point, see Khan (1979) and Easlerlin and Crimmins (1985).

religious groups. In a study, involving a village in Andhra Pradesh, India, Mahadevan (1986: 104) finds Muslims having the highest fertility among all religious groups studied. In another study of Travancore region in Kerala, India, Jayasree (1989: 54-60) concludes that both Muslims and Christians have higher fertility than that of Hindus.⁴ There are numerous other studies which confirm these findings.⁵ On the other hand, Hussain (1970), in his study of the city of Lucknow, U.P., India, finds higher fertility among Hindus than that among Muslims. Still there are other studies which find an insignificant difference in fertility among various religious groups (Driver 1963). The same inconclusive situation is depicted in a number of studies involving members of various faiths in North America, Europe and elsewhere.

The rather inconclusive nature of these studies leads one to conclude that although fertility differentials do exist, perhaps the factors causing such differentials are not religions. Rather, they may be cultural and historical (Axelrod 1990; Basu 1993), political contexts (Obermeyer 1992) or even the very limited nature and scope of some of the studies themselves (Mosher *et al.* 1992). Indeed, differences in socio-economic progress and personal and psychological motivations are known to be the significant causes of fertility differentials (Mahmood 1992; Gertler and Molyneux 1994).

The present study focuses its attention on the pattern and trends in Muslim fertility in the Indian Sub-continent. It explains, and measures, the impact of certain socio-economic and cultural factors on reproductive behaviour. It uses a model based on the time series data for the period 1971-1990. Due to the paucity of consistent and reliable data and the macro nature of the investigation, the causal effects of selected variables on fertility are measured and analyzed. Chosen for this study, some of the predictors are: accessibility to, and attitudes towards, family planning programmes, education, labour market opportunities (particularly for women), family income and religious values and norms as expressed indirectly in terms of women's status, gender preference and female literacy.

Furthermore, the study uses Pakistani Muslims' fertility behaviour as a proxy for the behaviours of all Muslims living in the Sub-continent mainly because of their common norms and values. It is recognized that socio-cultural (and linguistic) differences do exist among the Muslims of the Sub-continent just as such differences are found to exist in any group belonging to even a village, region or nation.

Methodology

Nature of the Study and Sources of Data

This is a macro study which quantifies and analyzes fertility behaviour of Muslims of the Indian Sub-continent. It focuses its attention on certain selected factors which are characteristic of the Muslim social structure and have direct and indirect bearing on Muslim fertility. Its scope is continental though it uses patterns of the Pakistani Muslim fertility as a proxy for that of the entire Muslim population of the Sub-continent. The reasons

4. These are strictly (micro) case studies and, hence, are subject to the same criticism as any other study with only a regional scope.

5. See for example, Krishnakumar (1971) and Desai (1975).

are: (1) Paucity and lack of consistency in macro data involving several variables. (2) Despite regional, economic and social differences, most Muslims, like members of any other community or faith, are bound together by the same values and norms. (3) Muslim population of one country of the Sub-continent is not mutually exclusive of the others and, hence, may be used as a proxy for all.⁶ (4) Micro study alone of a region or part of one country (e.g., Pakistan) is likely to yield much less useful results applicable to regions or parts of, say, Bangladesh or India.

The time series for the study are drawn mostly from the official documents of the Government of Pakistan. Statistical information published by some other national and international sources, unfortunately, is incomplete and inconsistent.

The Model

Due to the interdependencies existing among the explanatory variables themselves and the two-way causality between dependent and independent variables, we make use of a simultaneous-equation (multi-equations) model. It consists of four equations: (i) Birth rate equation; (ii) Income equation; (iii) Female labour force participation rate equation, and (iv) Female education equation.

Two variants of the total model are used. The first one is based on the two stage least square method introduced by Theil (1971) and the second one, on the three stage least square (Zellner and Theil 1962). As a guide to policy decision-making, elasticity multipliers have also been computed. Total impact of any variable on fertility should include, as we have done, both direct and indirect effects.

The Four Equations and Data Description

Fertility equation. We assume that the birth rate among Muslims in the Indian Sub-continent is a function of (a) per capita income, (b) female labour force participation rate, (c) infant mortality rate, (d) health expenditure as a percentage of GNP, (e) female education, (f) unemployment, and (g) the number of maternity and child care centers. The fertility equation thus becomes:

$$Y_{1t} = \alpha_{10} + \beta_{12}Y_{2t} + \beta_{13}Y_{3t} + \beta_{14}Y_{4t} + \gamma_{11}X_{1t} + \gamma_{12}X_{2t} + \gamma_{13}X_{3t} + \gamma_{14}X_{4t} + U_{1t} \quad (1)$$

Y_1 = Crude birth rate which may be defined as number of live births per 100 population.

Y_2 = Per capita annual income in constant rupees.

Y_3 = Female labour force participation rate (%).

Y_4 = Infant mortality rate (per 100).

6. It should be noted that a sizable Pakistani population had migrated from parts of India soon after the partition of the Sub-continent in 1947. Many such migrants also moved to areas now constitute Bangladesh. Literally, hundreds of thousands of Bengalis reside in Pakistan. Hence the assumption that all Muslims have basically the same religious values and norms and that Pakistani Muslims represent all Muslims of the Sub-continent is a realistic one. Socio-economic differences exist among Muslims themselves even if they live only in one country, say, Bangladesh, India or Pakistan.

X_1 = Number of maternity clinic and health centers.

X_2 = Health expenditure as a percentage of GNP.

X_3 = Female literacy rate (%).

X_4 = Unemployment (%) as a proxy for economic uncertainty.

The household income measures the economic status and well-being of a family. It also determines the desire and ability of a family vis-a-vis the number of children it wants to have.⁷ The economic and demographic literatures have paid due attention to the relationship between income and fertility (Simon 1969; Chang 1976; United Nations 1987; Joshi 1990 and Mahmood 1992). While there exists some difference of opinion concerning the net effect (positive or negative) of income on fertility,⁸ it is not the intention of the present study to reconcile it. Rather, it includes per capita income variable Y_2 in the birth rate equation (1) because any change in income changes the family's budget constraint and, hence, is likely to change its fertility behaviour.

Related with the family's fertility decision is the paid employment of women. While female employment affects the family income, it is affected, in turn, by the fertility itself. A significant increase in fertility forces a mother to a periodic or total withdrawal from the active labour force. This has a detrimental impact on the family income and its social standing and, thus, a lower demand for children. (Gulati 1988; Hoem and Hoem 1989 and Joshi 1990).

The economic value of children is the result of (a) the cheap labour which they contribute towards household production, and (b) old-age security for the parents, or as an insurance for future risk (Mukherji 1977; Mannan 1989; Vlassoff 1990; Clay and Haar 1993 and Rahman and Da Vanzo 1993). This concept of the economic value of children may, in fact, contribute to high fertility. Due to the two-way causal relationship between fertility and a woman's labour market activities, therefore, the female labour force participation variable W is included in the birth rate equation.

The high fertility among developing nations is motivated by (a) the idea that the larger the number of working age children (mostly sons), the higher will be the probability for the parents to achieve upward social mobility (Clay and Haar 1993),⁹ (b) the replacement effect of high infant mortality (Bhuiya and Streatfield 1991), (c) low cost of child rearing (Mannan 1989), (d) psychological, political and social needs (Chamie 1981; Mannan 1989 and Vlassoff 1990), and (e) the unequivocal preference for male offspring (Vlassoff 1990).¹⁰

7. Apart from those studies which analyze the impact of socio-economic and cultural factors on fertility, there exists a long list of others which explain who, in the family, actually decides the number of children a couple should have. The decision may be made by the wife (seldom alone), husband, by both or even by other member/s of the family. See for further discussion on this aspect, Poffenberger (1975) and Mannan (1989).

8. There is a body of economic literature which explains the positive relationship in terms of income effect when children are treated as 'normal goods.' The other view is that of negative correlation based on the substitution effect, or on the high opportunity cost (women's earning) of bearing and rearing a child.

9. Of course, the validity of this idea is dependent upon the assumption that the sum total of the net economic returns generated by the larger number of children will be positive and greater than that generated by a smaller number of children. It should be pointed out that the premise of a positive correlation between mortality and fertility is not universally accepted. See, for instance, Khan, 1979, pp. 4-6 for further discussion.

10. The preference for sons is especially true in most developing societies and in agrarian activities.

The effect of infant mortality rate variable Y^* has a very significant impact on fertility, specially in agrarian societies, such as Bangladesh, India and Pakistan, because of the motivating factors outlined above. The situation in urban settings is slightly different. We, therefore, include the variable Y^* in our birth rate equation.

For any developing nation, a significant reduction in fertility is a key element in improving economic and social life of its citizens. This can be achieved by providing, among other amenities, proper family planning education and facilities for maternal and child care. We have used number of maternity clinics and child health centers as a substitute for them. The variable X_1 represents this in the birth rate equation.

Proper nutrition and general health care are also important during and after pregnancies if the object is to reduce fertility (Bhuiya and Streatfield 1991). We use variable X_2 which denotes health expenditure and is directly related to X_1 . Both of them have a very powerful influence on fertility.

There seems to emerge a general consensus about the role of education and its influence on fertility behaviour. It is associated with significantly lowering fertility (Gertier and Molyneux 1994). It gives women the potential to improve their health and lives as well as those of their children and other family members (Boume and Walker 1991). Vlassoff (1991) finds education even more important than income or occupation in inducing fertility reduction. Education also helps women realize the advantages of having small families and various family planning practices to realize them (Pritchett 1994). Because of its importance, education variable X_3 is included in the equation.

Finally, the unemployment rate variable X^* is included as an indicator of uncertainty in the economy. If the unemployment is very high, people tend to give up plans for having more children. Conversely, high unemployment with little or no earning potential (opportunity cost of women's time) may actually increase demand for children (Shapiro 1993). It also explains the extent to which market offers opportunities for female employment.

Per capita income equation. To Specify per capita income, we follow the standard permanent income hypothesis of Friedman (1957). It states that the family's permanent income depends on the current income and its expectation concerning its future earning capacity. The female labour force participation variable K_a can be regarded as an indicator of current income. Expected future earning capacity depends on the female literacy rate X_3 and on the certainty of the future employment opportunities, expressed inversely by X^* . Thus the per capita income equation becomes:

$$Y_{2t} = \alpha_{20} + \beta_{23}Y_{3t} + \gamma_{23}X_{3t} + \gamma_{24}X_{4t} + U_{2t} \quad (2)$$

Female labour force participation rate equation. In developing nations, mothers generally take care of rearing their children. Usually, this forces working mothers to withdraw, temporarily or permanently, from the active participation in the labour market. We postulate a negative relation between birth rate Y_1 and females' market activities Y_3 . Without doubt, more literate and better educated women X_3 , other things being equal, have greater probability of being actively involved in the labour market. Similar relationship

exists between availability of health care facilities X_i and female labour market participation Y_3 .

Also, a high unemployment rate impacts a greater reduction in participation of females into the labour force as a result of substitution of male for female workers. Therefore, female unemployment rate variable X_4 is part of the female labour force participation rate equation which becomes:

$$Y_{3t} = \alpha_{30} + \beta_{31}Y_{1t} + \gamma_{32}X_{2t} + \gamma_{33}X_{3t} + \gamma_{34}X_{4t} + U_{3t} \quad (3)$$

The infant mortality equation. The infant mortality affects, and is affected, by the birth rate Y_1 . It is influenced by the availability of health care X_2 female education and a knowledge of hygiene techniques X_3 . Female education also plays an important role in reducing infant mortality rate. A further factor in explaining infant mortality is unemployment X_4 . If unemployment is too high, families will be adversely affected and parents will be less able to provide nutritious food, proper housing and adequate medical treatment for their children. Our equation for infant mortality takes the form:

$$Y_{4t} = \alpha_{40} + \beta_{42}Y_{2t} + \gamma_{43}X_{3t} + \gamma_{44}X_{4t} + U_{4t} \quad (4)$$

Modification of the Model

In order to estimate the system of equations (1) to (4), we use the time series data of Pakistan, covering a period of twenty years (1971-1990), which are given in Table 1. The separate data for Muslim females are not available for India. Likewise, consistent data for Bangladesh were also not available to the authors.

Two stage least squares (2SLS) is the most important and widely used procedure for estimating the regression coefficients. It is obtained by entering the predicted values of the endogenous variables as independent variables in the second stage (Johnston 1984 and Theil 1971). Three stage least square (3SLS) techniques are used to catch the cross-equation correlation. They are more efficient than 2SLS techniques, subject to proper specification of the equations as well as the variables used in the model.

The 3SLS procedure was introduced by Zellner and Theil (1962) which takes into account all equations in a model. This procedure may also be found in Liew and Kahng (1971). Our results are based on both of them. They also show that the coefficient of family planning variables X_1 and X_2 are more significant under three stage than under two stage estimation. This provides justification for using these variables as indicators of family planning.

In most cases the differences between the 2SLS and the 3SLS estimates are not very significant. But there is a catch. These procedures are applicable to equations which are exactly identified or are over identified (Johnston 1984:472). Since our system of equations is under identified, it had to be modified. We did that by adding lagged endogenous variables

TABLE 1 : TIME SERIES DATA FOR FERTILITY VARIABLES*

Year	Y_1	Y_2	Y_3	Y_4	X_1	X_2	X_3	X_4
1971	4.59	2,785	9.30	14.12	668	0.25	21.68	1.76
72	4.54	2,789	9.40	14.00	631	0.28	21.89	2.05
73	4.51	3,031	9.48	13.82	675	0.39	22.37	1.88
74	4.48	2,956	9.69	13.65	772	0.43	21.88	1.78
75	4.46	2,864	9.79	13.47	690	0.57	23.72	1.64
76	4.43	2,955	9.89	13.30	696	0.74	21.35	2.13
77	4.40	2,985	10.10	13.12	715	0.63	24.37	2.62
78	4.39	3,263	10.19	12.90	726	0.57	25.67	3.11
79	4.38	3,300	10.29	12.67	748	0.58	26.45	3.55
1980	4.37	3,485	10.41	12.45	772	0.55	26.06	3.66
81	4.36	3,589	10.68	12.23	812	0.58	26.12	3.70
82	4.35	3,639	10.89	12.01	823	0.58	26.08	3.80
83	4.37	3,896	11.11	11.78	817	0.59	25.89	3.93
84	4.38	4,008	11.29	11.56	794	0.67	25.17	3.82
85	4.40	4,088	11.39	11.50	787	0.66	25.51	3.71
86	4.30	4,138	11.69	10.90	778	0.77	26.68	3.63
87	4.40	4,242	11.89	10.70	773	0.97	27.76	3.04
88	4.30	4,480	12.09	10.56	798	1.00	28.05	3.14
89	4.30	4,457	12.31	10.43	998	0.90	29.11	3.14
1990	4.40	4,566	12.51	10.29	1,027	0.81	29.98	3.14

*For variable definitions, see Section, The Four Equations and Data Description in the section on Methodology.

$Y_{1,(t-1)}$ and $Y_{4,(t-1)}$ on the right hand side of the equation (1) and treating them as predetermined variables. We lag on Y_1 and Y_4 because these are very important endogenous variables. The modified form of our model is as follows:

$$Y_{1t} = \alpha_{10} + \beta_{12}Y_{2t} + \beta_{13}Y_{3t} + \beta_{14}Y_{4t} + \delta_{11}Y_{1,t-1} + \delta_{14}Y_{4,t-1} + \gamma_{11}X_{1t} + \gamma_{12}X_{2t} + \gamma_{13}X_{3t} + \gamma_{14}X_{4t} + U_{1t} \quad (5)$$

$$Y_{2t} = \alpha_{20} + \beta_{23}Y_{3t} + \gamma_{23}X_{3t} + \gamma_{24}X_{4t} + U_{2t} \quad (6)$$

$$Y_{3t} = \alpha_{30} + \beta_{31}Y_{1t} + \gamma_{32}X_{2t} + \gamma_{33}X_{3t} + \gamma_{34}X_{4t} + U_{3t} \quad (7)$$

$$Y_{4t} = \alpha_{40} + \beta_{42}Y_{2t} + \gamma_{42}X_{2t} + \gamma_{43}X_{3t} + \gamma_{44}X_{4t} + U_{4t} \quad (8)$$

As outlined in the system of equations (1)-(4), the exogenous variables are total number of maternity centers, X_1 , health care expenditure, X_2 , female literacy rate, X_3 , and unemployment rate, X_4 .

The endogenous variables are birth rate (Y_1), per capita income (Y_2), female labour force participation rate (Y_3) and infant mortality rate (Y_4)

The Results

The Regression Coefficients

The two-stage and three-stage regression results are given in Tables 2 and 3 with the corresponding t-ratios under each coefficient in parentheses. The estimated values of the coefficient of determination and \bar{R}^2 are given at the end. The elasticity multipliers values are presented in Tables 4 and 5. Except for a few aberrations, most estimated coefficients are significant and according to our *a priori* expectations. As mentioned earlier, there is little difference between the 2SLS and 3SLS estimated coefficients. The values of the coefficient of determination for the four equations are significantly high and lend credence to our variable selection.

The Indian Sub-continent is a developing region. Within this context, an average Muslim fertility of 4.39¹¹ per 100 Muslim population, though falling, is considerably high. Taking into account a low (and still declining) average infant mortality rate of 12.07 percent, the average net fertility rate, unless depressed further, poses a serious demographic problem for the region, the type of relationships among fertility and its determinants, as indicated in this study, however, are most encouraging. They all point out to a continuous fertility decline.

As is almost universally recognized, our estimated model 4.1 also confirms that availability of expanded medical and hospital facilities (X_2) and establishment of, and accessibility to, more child and maternity care centers together with family planning programmes (X_1) seem to be the key factors in motivating reduced fertility.

We note that, at five percent significance level, raising the levels of female education and per capita income tends to suppress fertility rate much the same way as our *a priori* expectations though their importance is less significant than those of improved health facilities and family planning programmes. It confirms the theoretical arguments made earlier¹² that as family's economic condition improves and as the status of Muslim women enhances beyond the one conferred by the patriarchal convention, their fertility is expected to further decline. It should not be surprising to note a positive correlation between infant mortality and fertility because of the 'replacement effect'. Though declining, infant mortality rate of about 12 percent is still alarmingly high. This study confirms the theoretical underpinning that as long as the replacement demand for children continues to be high,¹³ the fertility rate will remain high even though child mortality may further decline.

11. Our results indicate the means of birth rate, per capita income, female labour force participation rate and infant mortality rate to be, respectively, 4.3878 children per 100 population, rupees 3,672 annually, 10.872 percent and 12.074 per cent.

12. See also Shapiro, pp. 7-8.

13. As explained earlier, the high demand for children may be due to economic reasons (family income, parents' old-age security), social norms (parents' or couple's own decision about the size of family, gender preference) and/or psychologically based (power, prestige, male virility or replacement).

TABLE 2 : TWO STAGE ESTIMATED REGRESSION RESULTS

<i>Variables :</i> Endogenous > Exogenous	<i>Equations</i>			
	(4.1) Y ₁	(4.2) Y ₂	(4.3) Y ₃	(4.4) Y ₄
Constant	9.1755 (2.241)	-2101.1000 (-7.233)	-18.5260 (-0.915)	19.6540 (41.958)
Y ₁	—	—	4.5104 (1.046)	—
Y ₂	-0.00007 (-0.290)	—	—	-0.0014 (-11.112)
Y ₃	0.0306 (0.210)	512.5700 (11.689)	—	—
Y ₄	0.0579 (0.424)	—	—	—
Y ₁₁	-0.6233 (-1.380)	—	—	—
Y ₄₁	-0.1332 (-0.738)	—	—	—
X ₁	-0.0004 (-1.819)	—	—	—
X ₂	-0.4749 (-2.088)	—	3.7828 (3.177)	-1.3933 (-4.335)
X ₃	-0.0117 (-1.234)	-26.6810 (-1.073)	0.2744 (2.913)	-0.0441 (-1.448)
X ₄	-0.0894 (-3.495)	65.1220 (1.641)	0.4438 (1.597)	-0.1233 (-2.089)
R ²	0.8886	0.9778	0.8848	0.9908
df	8	14	13	13

The negative and significant relationship between unemployment rate and fertility poses an interesting dilemma. One would expect that as more and more women work (lower female unemployment rate), demand for children would decline due to higher opportunity cost of their time. Our observations show otherwise, both in 2SLS and 3SLS models. One possible explanation of this phenomenon may be the reduced financial ability of the family to support large number of children. The other may be the socio-psychological norms rather than economic (see fn. 3).

Considerable attention has been paid in economic and demographic literature explaining the very favourable impact of enhancing women's status on the family structure and its social and economic well-being. Unexpectedly, results in Tables 2 and 3 do not agree with this contention. Female status, as expressed by their educational attainments, has an inverse relationship with the family's economic status shown in terms of average annual income. The lack of labour market opportunities (unemployment) too has a strange (direct)

TABLE 3 : THREE STAGE ESTIMATED REGRESSION RESULTS

<i>Variables :</i> <i>Endogenous ></i> <i>Exogenous</i>	<i>Equations</i>			
	<i>(4.1) Y₁</i>	<i>(4.2) Y₂</i>	<i>(4.3) Y₃</i>	<i>(4.4) Y₄*</i>
Constant	7.9388 (2.763)	-2104.9000 (-6.712)	-16.0560 (-0.935)	19.8140 (41.364)
Y ₁	—	—	4.0271 (1.101)	—
Y ₂	0.000047 (0.373)	—	—	-0.0014 (-12.612)
Y ₃	0.0408 (0.387)	487.000 (10.661)	—	—
Y ₄	0.0944 (1.017)	—	—	—
Y ₁₁	-0.7287 (-2.405)	—	—	—
Y ₄₁	-0.0823 (-0.681)	—	—	—
X ₁	-0.0004 (-2.387)	—	—	—
X ₂	-0.3878 (-2.952)	—	3.9540 (3.394)	-1.2282 (-4.788)
X ₃	-0.0119 (-1.749)	-14.4950 (-0.554)	0.2570 (2.654)	-0.0570 (-1.843)
X ₄	-0.0864 (-4.600)	65.935 (1.539)	0.4386 (1.657)	-0.1128 (-1.945)
R ²	0.9037	0.9776	0.8848	0.9905
<i>df</i>	8	14	13	13

association with the family's economic and social standing. Unless this relationship is treated as an aberration, the authors fail to offer a convincing explanation for it. Females' active role in economic activities (labour force participation) is greatly impacted by the availability of the health, medical and educational opportunities as indicated in Tables 2 and 3.

Finally, small wonder that infant mortality and variables such as per capita income, availability of health facilities and mother's (female) education are inversely related. These relationships have been discussed, at length, in the present and other studies. Higher income provides better nutrition and other amenities for children; a better educated mother, obviously, knows more about various aspects of child's health and safety, and thereby, increased chances of child survival. Coupled with proper and adequate health facilities, education also reduces gender biases or gender preference and, hence, results in a lower demand for children. Perhaps the only puzzling finding is the negative correlation between infant mortality and female unemployment rate. A possible explanation for this unexpected

association may be the women's role in child-rearing. Since in a male dominated society (like the Sub-continent) women play proportionately a much more important role, than their male counterparts, in taking care of their children, their involvement with market activities leaves them with less time to pay adequate attention to the well-being of their offspring.

Elasticity Multiplier

An elasticity multiplier measures the percentage change in an endogenous variable caused by a given percentage change in an exogenous variable when both the direct and indirect effects of the latter are considered. For example, the elasticity multiplier of the female labour force participation rate, Y_1 , with respect to the female literacy variable X_3 is computed as:

$$(\delta Y_1 / Y_1^*) / (\delta X_3 / X_3^*)$$

where (δY_1) denotes a change in the value of Y_1 when there is a change (δX_3) in the value of X_3 and Y_1^* and X_3^* denote the sample mean values.

The values of the elasticity multipliers are derived for the four endogenous variables (Y_1 , Y_2 , Y_3 and Y_4) with respect to the exogenous variable (X_1 , X_2 , X_3 and X_4) and are presented in Tables 4 (two stage) and 5 (three stage).

The elasticity multipliers provide real insight into the fertility behaviour and, from the policy standpoint, constitute important tools in decision-making. For instance (reading sideways in Table 4), one finds that a one percent increase in the number of maternity clinics and child health centers is likely to decline the birth rate by about 0.08 percent. Likewise, a marginal increase of one percent in health expenditure will, most likely, depress fertility by about 0.07 percent. The impacts of changes in female educational achievements and economic activities are also very noticeable.

Next, one finds the likelihood of female labour force participation rate to increase by about 0.21 percent consequent upon an increase in health expenditure by one percent. The positive and significant relationship between female education and female labour market activities is also evident. Increase in women's education by one percent, in all probability, will increase their employment opportunities by about 0.6 percent.

The importance of female literacy rate assumes even greater importance when one realizes the highly desirable impact of female literacy on birth rate. As is evident in Table 4, one percent increase in literacy rate will induce reduction in fertility by about 0.07 percent.

Thus, it may be concluded that the principal determinants of fertility behaviour are increased health care facilities for all citizens, particularly for mothers (during and after pregnancies) and children, educational improvement, enhancing women's status in the society and effective fertility control methods. In light of the cumulative impact of various socio-economic and psychological factors on fertility, we believe that religion, *per se*, has little direct impact on the Muslim's fertility behaviour in the Sub-continent. Its effect may be indirect one through the values and norms that Muslims adhere to.

TABLE 4 : ELASTICITY MULTIPLIER COEFFICIENTS (Two Stage)

Endogenous Variables	Exogenous Variables			
	X ₁	X ₂	X ₃	X ₄
Y ₁	-0.0750	-0.0721	-0.0684	-0.0628
Y ₂	—	—	-0.1870	0.0546
Y ₃	—	0.2064	0.5782	0.1119
Y ₄	—	-0.0769	-0.0941	-0.0315

Note : For variable definitions, see Section, The Four Equations and Data Descriptions.

TABLE 5 : ELASTICITY MULTIPLIER COEFFICIENTS (Three Stage)

Endogenous Variables	Exogenous Variables			
	X ₁	X ₂	X ₃	X ₄
Y ₁	-0.0728	-0.0589	-0.0697	-0.0606
Y ₂	—	—	-0.1016	0.0553
Y ₃	—	0.2157	0.5416	0.1106
Y ₄	—	-0.0678	-0.1215	-0.0288

Note : For variable definitions, see Section, The Four Equations and Data Descriptions.

Our analysis of the elasticity multiplier effects provides valuable testing for underlying hypotheses on fertility behaviour. As well, it provides important information for family planning programmes and for the policy makers.

5. Conclusions

In this study, we have presented the magnitudes of the impact of various socio-economic and demographic factors on the Muslim fertility behaviour in the Indian Sub-continent.

Religious affiliation, in particular Catholicism and Islam, has been cited, in several studies,⁴ as a factor which motivates high, though declining, natality. The evidence of it is inconclusive. It is suggested (West off 1959) that religion affects fertility in two ways: First it directly imposes sanctions against birth control and, secondly, it indirectly affects natality "by indoctrinating its followers with a moral and social philosophy of marriage and family that emphasizes the virtues of reproduction."¹⁵

Gulati, at one point (1988 : 53) suggested that Muslims in India have a higher fertility than their counterparts, Hindus. However, Gulati.Chamie (1981) and several others do agree that the operative forces seem to be more social, economic, cultural and educational rather than directly religions.¹⁶ Chamie (1981: 79), for this reason, warns of any generalization of

14. For further discussion and excellent biographical references, see Chamie, 1981, and Gulati, 1988.

15. Westoff, 1959, p. 117.

16. Quebec, a province in Canada, is predominantly catholic. Only a few decades ago, it was not uncommon for an average family to have half a dozen children or more. Today, in the same province, the actual fertility index stands at 1.4 while it requires 2.1 just to sustain the existing population.

the relationship between religious doctrine and fertility behaviour. Islamic doctrine does not directly explain the high fertility observed in the region (Obermeyer 1992). Nor does it indirectly restrict family planning efforts (Khan 1979: Appendix, Part A).

The present study assumes that *Islam, per se*, is not an exogenous variable which affects fertility in the region. Therefore, we assume that fertility is determined in terms of a number of socio-economic and psychological factors. It also sets the guidelines for policy-making in inducing lower fertility.

Apart from the biology, our study agrees, fertility involves individual (and/or family) choice which, in turn, is determined by economic and social conditions. Therefore, the first, and perhaps the foremost requirement is improvement in the socio-economic conditions of the people. This involves providing the population with better health, educational and employment opportunities. Education, in particular, enhances the status of women in society, equips them with better knowledge of market opportunities and social environments. Evidently, higher social status of women also improves child care and consequently child survival.

There is evidence to suggest¹⁷ that Muslim women of the Sub-continent are reluctant to adopt fertility control behaviour. It may be due to personal or social, and not religious, disapproval of the idea of family planning. Traditional orientation may also reject planned parenthood without any rational thinking, an outcome of ignorance or one's own convictions (right or wrong). In the Indian Sub-continent, reported gender (son) preference is highly pronounced (Rahman and Da Vanzo 1993). Obviously, it becomes a contributing factor to high fertility.

Personal traits and motivation shape individual's behaviour vis-a-vis fertility control. Considerable evidence exists which claims that, historically, the family planning programmes have failed to reach a large proportion of the population potentially susceptible to adopting birth control methods. It has also been suggested that the idea of family control, too, has failed to motivate quite a few of those who have been contacted. Greater efforts, therefore, are needed, first, to reach a section of population as large as possible and, secondly, to adopt and use proper methods to motivate individuals to use measures of planned parenthood. Traditions and old values fade but very slowly. Care, therefore, should be taken in introducing ways to improve family structure and control behaviour.

Political economy is yet another factor deterring the desired decline in fertility. It is axiomatic that family planning policy should be carefully formulated. Its implementation should be perceived as an effective force for the social uplift of the population. Under no circumstances, such a policy should be perceived to be a compulsion on ordinary citizens to comply with a reproductive behaviour for which they are not ready.

Our simultaneous equation model has been designed to account for both direct and indirect effects which selected variables have upon fertility rates among Muslims in the Indian Sub-continent. The four-equation model can be considered as another step forward in the area of population research and can be improved upon, in several ways, to a more sophisticated model. One way of doing this is to introduce distributed lags to pinpoint the

17. Mahmood, 1992.

timings of the impact upon birth rates or to include more endogenous variables. Due to the importance of education on fertility, it might be a better idea to deal with breakdowns by the type and category of education, for example, a breakdown in terms of primary, secondary and university educational attainments, or in terms of educational achievements of husbands, wives and children.

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