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A MULTIVARIATE AREAL ANALYSIS OF PROGRAMME AND NON-PROGRAMME EFFECT ON FERTILITY IN PAKISTAN

GHULAM YASIN SOOMRO
M. NASEEM IQBAL FAROOQUI
HUSSAIN BAKHSH SIYAL

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PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS, ISLAMABAD
POST BOX 1091, ISLAMABAD
(PAKISTAN)

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INTRODUCTION

The second stage of demographic transition in which many developing countries are caught has led to a rapid rise in the rate of population growth, despite concious efforts to break through the constancy of this stage. The third stage of demographic transition which the developed countries have already reached is characterized by a regulated rate of fertility level. Though the peculiar dynamics of this transition have not yet been specified, there is evidence that a significant role was played by late marriages and to some extent by the use of traditional contraceptive techniques /5/. The Industrial Revolution and the consequent socio-economic modernization process in developed countries reinforced the pace of this transition.

The postwar 'Baby Boom' in the U.S.A. stimulated the interest of both the demographers and the economists to analyze this phenomenon. The concomitant prevalence of overall economic prosperity, led many economists to come up with an economic explanation of the 'Baby Boom'. Within this context mention can be made of the survey conducted to study fertility behaviour of wealthier section of the New Jersey population in 1960 by Becker (an economist) /1/ The survey led to the conclusion that income is positively related to fertility with the obvious implication that family decisions were determined within income constraints.

However, Becker's fertility paradigm was contradicted by the experience of developing countries where higher fertility was prevalent mostly among the poor.

This phenomenon was explained by the proponents of Neo-Malthusian as the result of a "contraception failure", which obviously arose from the non-availability of contraceptive technology in the less developed countries. Consequently, the institution of a family planning programme was advocated to provide birth control services.

This rationale for the family planning programme was criticised as the ultimate means to an end and an alternative methodological conception was presented that gave greater weightage to socio-economic factors in influencing the fertility levels. It was postulated that fertility was influenced simultaneously by the family planning programme and through the process of socio-economic development which influence the overall social well being through changes including income, consumption, production, employment, opportunities for education, health, nutrition, age at marriage and fertility levels of the geographic areas receipient of such development. Thus it was extremely difficult to evaluate the corresponding influence of programme and non-programme factors in the decline of fertility levels. In a response to this problem, it was felt to look at the fertility on an aggregate level and measure the effects of program and non-program factors on an areal basis.

A consolidated population policy was adopted in Pakistan during the Third Five Years Plan (1965-1970) period /11/. As a result of this, an organized family planning program was established to provide contraceptive services to the couples. The program was started at the national level that included many districts of the Punjab and Sind.

few districts of NWFP, one district in Baluchistan, and in some areas of the Federally Administered Tribal Agencies. The technique of areal analysis of program and socio-economic data is being applied to study the socio-economic demographic and progam factors affecting fertility in Pakistan.

The major objective of this study is to identify both program and non-program determinants of fertility and to observe the contribution of socio-economic development within the districts of the country affecting adoption of program methods and their subsequent effect on fertility.

DATA AND ITS LIMITATIONS:

Data for this study has been obtained from the Population Censuses 1972 and 1981, Agricultural Census 1972, Family Planning Service Statistics 1973-74 /3, 20 4, 21/.

Information on socio-economic and demographic characteristics concerning income, education, enrollment, agricultural workers, proportion married, total fertility rate, age-sex adjusted birth rate, family planning personnel, expenditure and couple years of protection were gathered for 39 programme districts. The variable per capita income was an aggregate of crop cash value per capita and industrial value added per capita for the year 1975-76. /19/ The information on education was obtained from Population Census 1972 for the percent literate population aged 10 years and over defined as thsoe who could read and write with understanding regardless of any language. The enrollment statistics of students for both sexes in secondary schools was taken from the statistical bulletin of Ministry of Education /17/. The index of agricultural workers was obtained from the Agricultural Census 1972 involving both

household members and hired workers aged 10 years and above engaged in the agriculture sector. This index was an aggregate for both the sexes. The proportion married aged 20 to 29 years was calculated from the Population Census, 1972. Total fertility rate (TFR) and age-sex adjusted crude birth rate (CBR) were estimated indirectly from the age structure yielded by the relevant district populations in the Population Census, 1981.

The family planning service statistics was used to extract information on family planning personnel, expenditure and couple years of protection for the fiscal year 1973-74. The list of personnel included field motivators and other non-administrative staff who were directly involved in family planning operation at the interface level. The expenditure on communication included funds expended on mass media compaigns for dissimination of family planning information. The index of couple years of protection (CYPs), an administrative index that was used in Pakistan programme to compare performance among the districts by providing protection against the risk of pregnancy to the target population was weighted for all programme methods which vary in average length of protection.

The analysis involving the assessment of development impact on fertility becomes difficult due to the fact that development affects fertility indirectly depending upon the level of input of various development programmes operating simultaneously in a given area. In this situation assessment of relevant contribution of each programme becomes difficult to control for the study of fertility behaviour. In these circumstances, development of a paradigm which takes into account the nature and direction of association between variables adequately is a complex phenomenon. This complexity of interrelationships between development and fertility causes problems in specifying

the model. Stoeckel while describing these issues of macro level data categorized four types of data limitations namely simultaneity, incompletness, time lags and multicolinearity. / 22 /. Simultaneity creeps into the relationship between two variables which makes it difficult to draw causal inferences. Incompleteness of specification due to non-availability or measurement error in data could also lead to spurious results. Time lags allowed for measurement of development impact on fertility may be insufficient because of the fact that changes in fertility are hardly a short-run phenomenon. Multicolinearity among the independent variables influence the effect and confidence limits making it difficult to determine their individual effect on fertility.

The limitation with programme service statistics at the first place is that it was gathered under the doctorine of goal attainment model with mandatory targets assigned to the personnel. The measurement of couple years of protection is therefore a result of the targets achieved through the distribution of various program methods. In this situation, estimated figure of CYP's may be upwardly biased due to lack of any feedback on their ending up into an effective use.

The overestimation of programme performance in relation to observed fertility decline appeared to be 41 percent higher controlling for changes in demographic parameters such as age structure, marital status, marital fertility and proportion of women in reproductive ages in total population /10/. This figure was achieved on the assumption that all the observed decline in marital fertility was entirely due to programme effect and no allowance was given to non-programme contraception. However, from the robustness standpoint, the CYPs figures in this study were therefore discounted by 50 percent for all the districts taken into consideration.

METHODOLOGY

Areal analysis through the technique of Path Analysis has been applied in this study /13, 8, 16/. The unit of observation taken in this technique is any sub-set of geographical unit or any other administrative area. The unit selected in this study is a district which is an administrative unit after a province and division. In this type of analysis a plausible measure of aggregate fertility is regressed against the programme and non-programme variables. In this study two fertility measures namely total fertility rate (TFR) and age-sex adjusted crude birth rate (CBR) have been used as dependent variables. These two measure were estimated indirectly from the 1981 Population Census age structure by application of Rele's method based on the stable population model /22/. The underlying assumption in this method is that the mean length of generation of the population concerned lies between 28 and 29 years. The indirect estimates would be robust if the mean length of generation ranges in the assumed length of period. Rele derived measures of fertility for the European populations that tended to be too close to the actual levels of fertility of those populations although European populations had been experiencing substantial migration within and outside their borders. Henenberg also used this technique to arrive at the estimates of fertility for the provinces of Thailand /12/. His estimates however, did not seem to differ much from those obtained by other techniques. The mean length of generation in the case of Pakistan comes out to be 28.2 years which is a well assumed range. The derived estimates of fertility levels were for the calender year 1975. The average figures for TFR and CBR derived indirectly for Pakistan appeared to be 6.5 and 40.8 respectively. The robustness of

these measures could be observed from the close comparison of these with Pakistan Fertility Survey (PFS), 1975 which revealed these figures to be 6.3 (TFR) and 40.5 (CBR) respectively. (See technical note in appendix).

The application of CBR as dependent variable is not considered a satisfactory measure because of its heavy dependence on age structure unless it is standardized. Kitagawa /15/observed that age-sex standardized crude birth rate may not strictly control for age and sex ckmpositional differences. However, the use of CBR in this study as Y variable is to check its relative strength against TFR. As stated earlier path analysis has been used in this study to determine the total effects of family planning programme and development on fertility. This is an interpretational technique which helps to determine the appropriate set of dependent and independent variables which provide causal ordering between a set of variables. The choice of this multivariate technique was made due to its comparative advantage in isolating the unknown effects of exogenous variables on dependent variable. Heremalin described Path Analysis, "..... a multivarate technique useful in explicating linear causal models. It bears close affinities to multiple regression analysis but helps make explicit the underlying assumptions and interconnections ..... The correlation between two variables can be decomposed into a direct, indirect and the joint effects shared with other variables in the system" /13/. The underlying assumptions in Path Analysis are that there are no interaction or multicolinearity in effects of independent variables and the causal order of the variables is non-circular. However, to avoid the multicolinearity problem a composite socio-economic development variable ranked on Z-score and estimated by Principal Component Method was used as an exogenous variable.

Srinavasan in this respect pointed out that regression on Z's yields coefficients that are more meaningful and reliable compared to similar excercise made on X's. /24/. In this study a composite socio-economic development variable was used with programme variables to study and compare their effects on fertility against the set of development variables used separately.

To account for the issue of time lag, the variables of education, enrollment, and agricultural labour force were lagged to three years prior to fertility. However, the income variable was available concurrently to the dependent variable. Programme variables were lagged by one year to observe the desired effect on fertility.

Path coefficients were estimated by following equations:

$$Y_1 = P_{12}Y_2 + P_{13}Y_3 + P_{11}X_1 + P_{12}X_2 + P_{13}X_3 + P_{14}X_4 + P_{15}X_5 + P_{16}X_6 + P_{1u}R_u$$

$$Y_2 = P_{21}X_1 + P_{22}X_2 + P_{23}X_3 + P_{24}X_4 + P_{26}X_6 + P_{2u}R_w$$

$$Y_3 = P_{31}X_1 + P_{32}X_2 + P_{33}X_3 + P_{34}X_4 + P_{35}X_5 + P_{36}X_6 + P_{3u}R_v$$

where:

Y_1 = Total Fertility Rate (TFR) in year t and again substituted for Crude Birth Rate (CBR) in year t.

Y_2 = Proportion married aged (20-29) in year t-3

Y_3 = Couple years of protection in year t-1

X_1 = Per capita income in year t

X_2 = Level of education in year t-3

X_3 = Secondary Enrollment Ratio in year t-3

X_4 = Agricultural worker's in year t-3

X_5 = Family Planning Personnel in year t-1

X_6 = Family Planning Expenditure on Communication in year t-1

In the second set development variable was used as following:-

$$Y_1 = P_{12}Y_2 + P_{13}Y_3 + P_{11}X_1 + P_{12}X_2 + P_{13}X_3 + P_{1u}R_u$$

$$Y_2 = P_{21}X_1 + P_{22}X_2 + P_{23}X_3 + P_{2u}R_w$$

$$Y_3 = P_{31}X_1 + P_{32}X_2 + P_{33}X_3 + P_{3u}R_v$$

where:

X_1 = Composite Development Variable

X_2 = Family Planning Personnel

X_3 = Family Planning Expenditure.

Finally, a multivariate analysis of outliers was performed to detect the deviant cases and examine goodness of fit of the equations under the assumption that error terms are independent with zero mean, homogenous variance and normal distribution /7/. The residuals were plotted against the predicted Y and outliers were examined by looking at the data points laying three standard deviations plus or minus of zero mean of residuals at the scatter plot. All the residuals were found to be almost clustered around in the rnage of plus or minus 1.0 standard deviation.

THEORETICAL CONSIDERATIONS IN MODEL

The study utilizes three sets of explanatory variables to study their impact on fertility on areal basis. Those include developmental, demographic and programme variables. The variables indicative of level of development used in the model are income, education, enrollment and percentage of workers in agriculture sector. Marriage rate as nuptiality variable was selected in the model and two input variables personnel and expenditure and one output variable couple years of protection were used as programme variables. The choice of nuptiality and contraception as intermediate variable was made under historical perspective of demographic transition theory where delayed marriages and celibacy were the major determinants of fertility decline together with the use of traditional

contraceptive methods in the European populations. The upti- ality changes and limited use of traditional contraceptive methods in the European populations. The nuptiality changes and limited use of traditional methods was a byproduct of socio-economic development taking place during European Industrial Revolution.

The conceptualization of the variables is guided by Economic Theory of Fertility. Interrelationships of supply and demand concepts under dilution model are explained with relevant variables used in the model. It may further be pointed out that demand theory of fertility works on a priori level in a developing country like Pakistan. The empirical testing led DeTray to conclude that, "Although flawed by certain methodological problems, the empirical investigation carried out in this paper points quite clearly toward the conclusion that demand models of fertility are as effective in explaining variations in children ever born in 'nutural fertility' populations as they are in contracepting populations". /6/.

Per capita income has been conceptualized as an indicator of income distributions. When development takes place it increases income levels in a more un-skewed fashion. This provision of more resources influences demand to satisfy wants. If prices are held constant, the rise in income will create demand both for commodities as well as for children implicating positive relationship of income with fertility. DeTray while analyzing demand for children with a proxy variable of income argued that "if one accepts this interpretation then the demand theory hypothesis that wealthier families have more children is supported by virtually every wealth proxy" /6/. However, the development under human capital theory induce to invest more in children to improve upon their quality. The trade off between quantity

and quality of children, under pure income effect, will create demand both for more number and better quality children. Becker and Lewis argued that quality of children becomes cheaper than quantity resulting into substitution for fewer and expensive children /2/. Within this perspective, Williams explained that, "The usually observed negative association of fertility and income occurs because rise in income are usually associated with price changes" /26/. The composite effect of income on other environmental variables is explained in this fashion. The rise in income reduces infant and child mortality, affects birth interval in either way depending upon prevalent breast feeding practices, influences spacing directly in relation to desired family size to be achieved at preferred timing which is responsive to socio-economic development /26/. Thus, the quality and biological timing of births lead towards controlled fertility in which contraceptive technology aids regulate the fertility.

Education is an important social development variable which reflects the level of its distribution on areal basis. This affects the environments by creating awarness, vertical social mobility and receptiveness towards innovations. Education not only represents socio-economic level of the area but serves as a proxy of status and wealth. In this causal order, education influences the tastes of people by exposing them to alternative life styles and improving their level of information /9/. All of these effects lead towards rationale approach in decesion making including that of number and quality of children. The effect of education on fertility has been found negative not because of causality but because of perceived selection process guided mainly by tastes.

Enrollment of children at secondary stage of schooling is reflective of the availability of educational opportunities and quality concept of children. This is an outcome of prevailing spread

of adult education among parents at the household level who decide for quality over number bearing in mind the cost of children. In this way the negative association of enrollment has been observed with fertility and positive with controll of fertility. The quality aspirations affect enrollment positively which causes delay in marriage. In this causal order enrollment has negative association with marriage rate.

The index of percent agricultural workers characterises rural setting, poverty and illitracy in LDCs. Agriculture is labor intensive sector where the child labour contributes in agricultural output as an agent of production to augment the household income. This value of children leads to earlier marriages and higher family size levels which lead to conceptualizing its positive relationship with fertility.

The demographic supply variable of marriage rate affects fertility directly. Taken as intermediate variable, this reflects the impact of marital fertility of highly fertile age group of 20-29 year depending upon the onset of reproductive period on fertility. The process of economic development causes decline in marriage rate when decisions to seek more education guided by qualitative human capital are operative in the society.

Family Planning supply variable, expenditure on communication, is aimed at providing family planning information so as to cause an attitudinal change in reproductive behaviour together with providing information on services availability and personnel as well as to cater services and persons to person motivation. The prevelence of knowledge and availability of modern effective contraceptive methods at low cost

together with quality consideration of children cause a decline in fertility resulting into decline in fertility aspirations for family size desires. This would lead towards small family size norms achievable through regulated fertility behaviour.

ANALYSIS OF RESULTS

The interpretation of the results is based on areal unit of district in this study. While analyzing aggregate data, caution was taken to avoid the problem of ecological fallacy. This problem arises in making generalizations based on empirical evidence that the results which hold for area may not necessarily be true for the individual behaviour.

The results of Path Analysis are presented in Table 1 and 2 where as correlation matrix of all the variables involved in the analysis is given in Table 3. The diagrammatic representation of the methods are portrayed in figure 1,2,3, and 4. As is evident the decomposition of direct, indirect and total effects of path coefficients are presented in Table 2 whereas their causal ordering is given in path diagrams. It may be pointed out that in figure 1, the effects of programme and non-programme variables are depicted on total fertility rate (TFR) whereas in figure 2 similar effects are shown on age sex adjusted crude birth rate (CBR). Similarly in figure 3 and 4 the effects of composite development variable together with programme variables are shown on TFR and CBR respectively.

It may be observed from the four given models that variables are affecting fertility through three different paths namely nuptiality, contraception as well as directly as indicated by the pointing arrows. This causal ordering of the variables and their subsequent effect on fertility through different paths cannot be achieved by the simple application of multiple regression analysis. Furthermore, it may also

be pointed out that all the models in this study are best fit at the conventional levels of statistical significance.

The variable of adult education showed the problem of multicollinearity with urbanization and to some extent with the linearized density through natural logarithm. However, these two variables which embody the urban characteristic were run separately with education on the dependent variable, TFR. The variable of urbanization increased the coefficient of determination by 4.2 percent whereas density explained 0.6 percent of such an increase in R^2.[1] To strengthen the significance level of path coefficients, both of these variables were, therefore, discarded from the analysis against education which represented the contents of areal development adequately.

Taking into consideration the role of intermediate variables, it may be observed that nuptiality is determined as usual by developmental variables with school enrollment exerting the most significant effect. The probable explanation for this significance is that higher correlation of this variable with nuptiality as compared to income and education. The implication of this significance can be accounted by the fact that enrollment represents two distant effects of its own. Firstly it represents the areal effect of socio-economic development as well as the prevailing schooling opportunities. Secondly it reflects the level of parents education. Therefore, higher level of areal development would under human capital theory induce parents to invest more in children for a better quality over quantity of children. In Pakistan society where family decision are taken by parents, the educated parents prefer their children

1. The relative increase in R^2 explanation was measured by this general formula of multiple partial coefficient.

$$r_1^2(jk\ldots n).\ tu\ ..\ w = \frac{R_i^2.jk\ \ldots\ w - R_i^2.tu\ \ldots\ w}{1 - R_i^2.tu\ \ldots\ w}$$

For details see Blalock, H. "Social Statistics", 2nd Edn. McGraw Hill, N.Y. 1972.

to seek more education that causes delay in age at marriage. Similarly, the intermediate variable of contraception was affected both by developmental and programme input variables. Notable among these is the adult education which is highly significant in its effect on contraception. In order to achieve quality objectives of children, educated parents tended to adopt contraception for substituting quality over quantity of their children. The quality aspects of children incorporate the element of cost incurred on them making children an expensive commodity which resulted into contraceptive behaviour to limit the quantity guided by utility function. This finding therefore corroborates the earlier research that contraception in a natural fertility society like Pakistan was also guided by demand theory for children /6/. The other variables of importance were the expenditure on family planning communication and the agricultural workers which were appropriate in direction and significant at 10 percent confidence level.

The programme policy variable of expenditure derives its strength from the fact that the government has already invested huge sums of money in the national programme to create attitudinal changes for effective demand for contraception. It may be emphasized that choice of expenditure variable which incorporates the amount of expenses incurred on dissimination of family planning information through mass media proved to be more powerful in its effect on contraceptive use than the effect due to family planning personnel. The path coefficients of agricultural workers, however, represented the traditional resistence towards innovations especially in regard to regulated fertility behaviour.

The examination of the model as a whole shows that nuptiality and education exerted significant direct effects on fertility. Other

variables of importance were the family planning personnel and contraception. Although their effects was not significant yet were substantial in magnitude. The positive path coefficient from contraception to fertility signifies the work of multicolleniariety between exogenous variables although the correlation between these two wasnegative. The other explanation could be that programme was highly successful in enrolling the high age and parity women. Because of this reason, the analysis from micro level survey data also showed positive effect of contraception on fertility. Moreover, the relatively insignificant impact of contraception on fertility was probably due to the lower rates of prevalence as indicated by periodic demographic sample surveys. The programme personnel's direct effect on fertility appears to be spurious in causal ordering of the framework. However, the direct effect of programme personnel could be an outcome of person to person communication. This variable did not seem to transform its effect through programme contraception, the likely explanation for this phenomenon could be the work of catalytic effect of contraception.

It is apparent from Table-2 and Figure-1 that socio-economic and programme variables were affecting fertility directly as well as through intermediate variables nuptiality and contraception. The variables affecting fertility substantially through their indirect effects were adult education and enrollment ratios. About 41 percent effect of adult education on fertility was through contraception only whereas enrollment showed 73 percent of such effect on fertility through nuptiality. These findings could also be corroborated with the findings from micro level data of Pakistan Fertility Survey, 1975. Nizamuddin found the most significant effect of wife's education on contraceptive use where as Mehtab found strong influence of school attendance on delayed marriages /18,14/. The effect of income appeared to be insignificant but appropriate in direction. However, it mostly influenced fertility directly and only

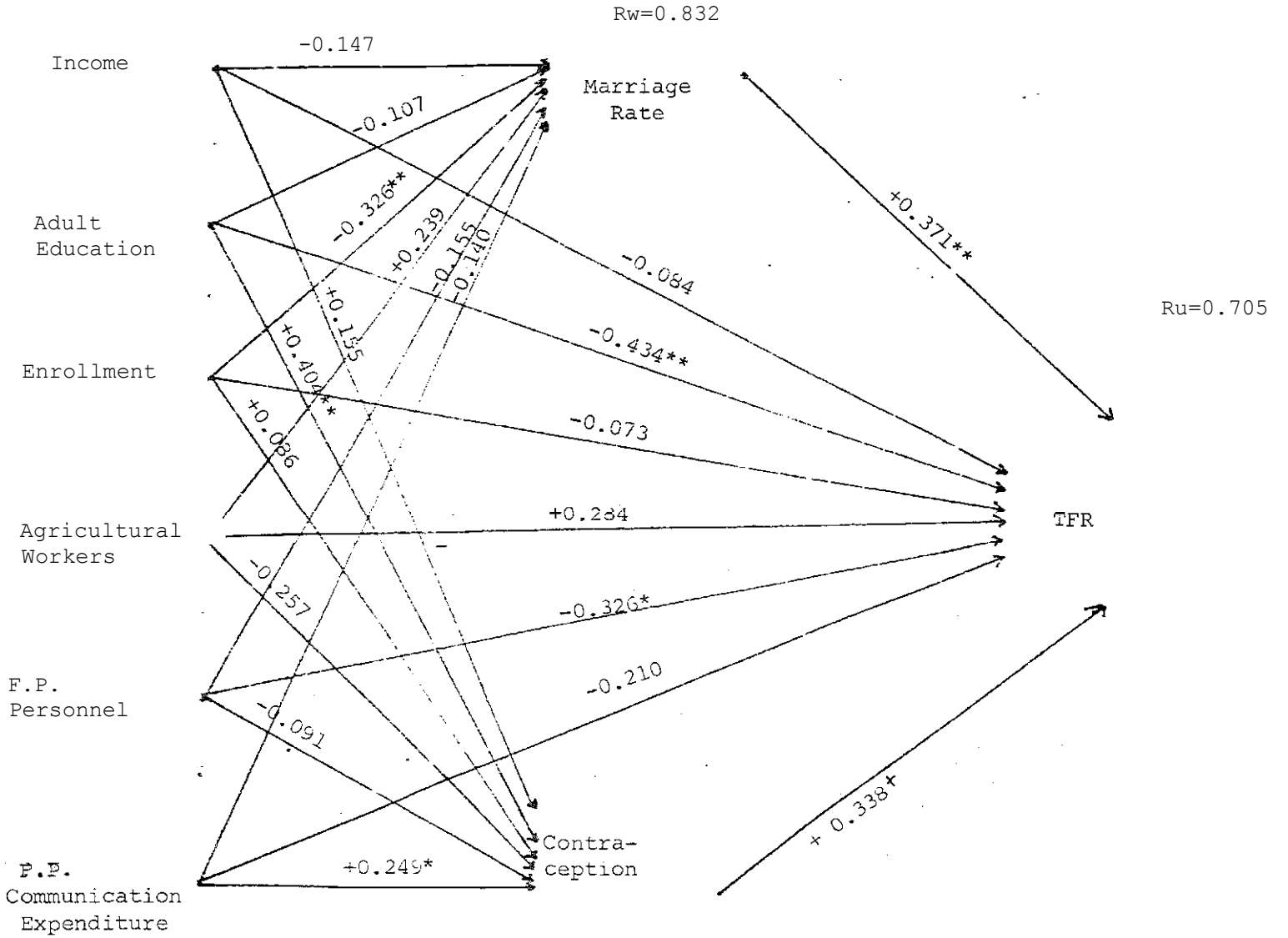
Table 1: Path Coefficients of Exogenous Variables in Model
(t-ratios in parenthesis)

Dependent variable	Composite variable	Income	Education	Proportion married	Enrollment	Agriculture Labor Force	Family Planning Personnel	Family Planning Communication Expenditure	Couple year protection	R^2
TFR	-	-0.08428 (0.590)	-0.43445^{++} (2.729)	0.37074^{++} (2.390)	-0.07340 (0.507)	0.28368^{+} (1.690)	-0.32458^{+} (2.024)	-0.20971 (1.350)	0.33834^{+} (1.700)	0.50264
CBR	-	0.02136 (0.152)	-0.35120^{+} (1.965)	0.42307^{++} (2.510)	-0.11101 (0.700)	0.31898^{+} (1.771)	-0.23297 (1.340)	-0.12124 (0.074)	0.44869^{++} (2.090)	0.41903
TFR	-0.15043 (0.744)	-	-	0.45735^{++} (2.820)	-	-	-0.21456 (1.300)	-0.16263 (0.970)	0.05009 (0230)	
CBR	-0.08110 (0.387)	-	-	0.51742^{++} (3.083)	-	-	-0.12487 (0.723)	-0.09961 (0.754)	0.19070 (0.840)	0.29117
Marriage Rate	-	-0.14736 (0.925)	-0.10734 (0.686)	-	-0.32567^{++} (2.113)	0.23899 (1.338)	-0.15479 (0.851)	-0.14018 (0.840)	-	0.30760
Contraception	-	0.11456 (0.921)	0.40374^{++} (3.302)	-	0.08591 (0.714)	-0.25665^{+} (1.840)	-0.09062 (0.646)	0.24879^{+} (1.909)	-	0.57796
Marriage Rate	-0.43782^{++} (2.867)	-	-	-	-	-	-0.02848 (0.176)	-0.14076 (0.847)	-	0.23654
Contraception	0.56285^{++} (4.949)	-	-	-	-	-	-0.25160^{+} (2.081)	0.22102^{+} (1.786)	-	0.57640

++ Path Coefficients significant at 1 to 5 percent level.
+ Path coefficients **significant** at 10 percent level.

FIGURE-1

PATH DIAGRAM OF EFFECTS OF SOCIO-ECONOMIC, DEMOGRAPHIC AND PROGRAMME VARIABLES ON TOTAL FERTILITY RATE (TFR)

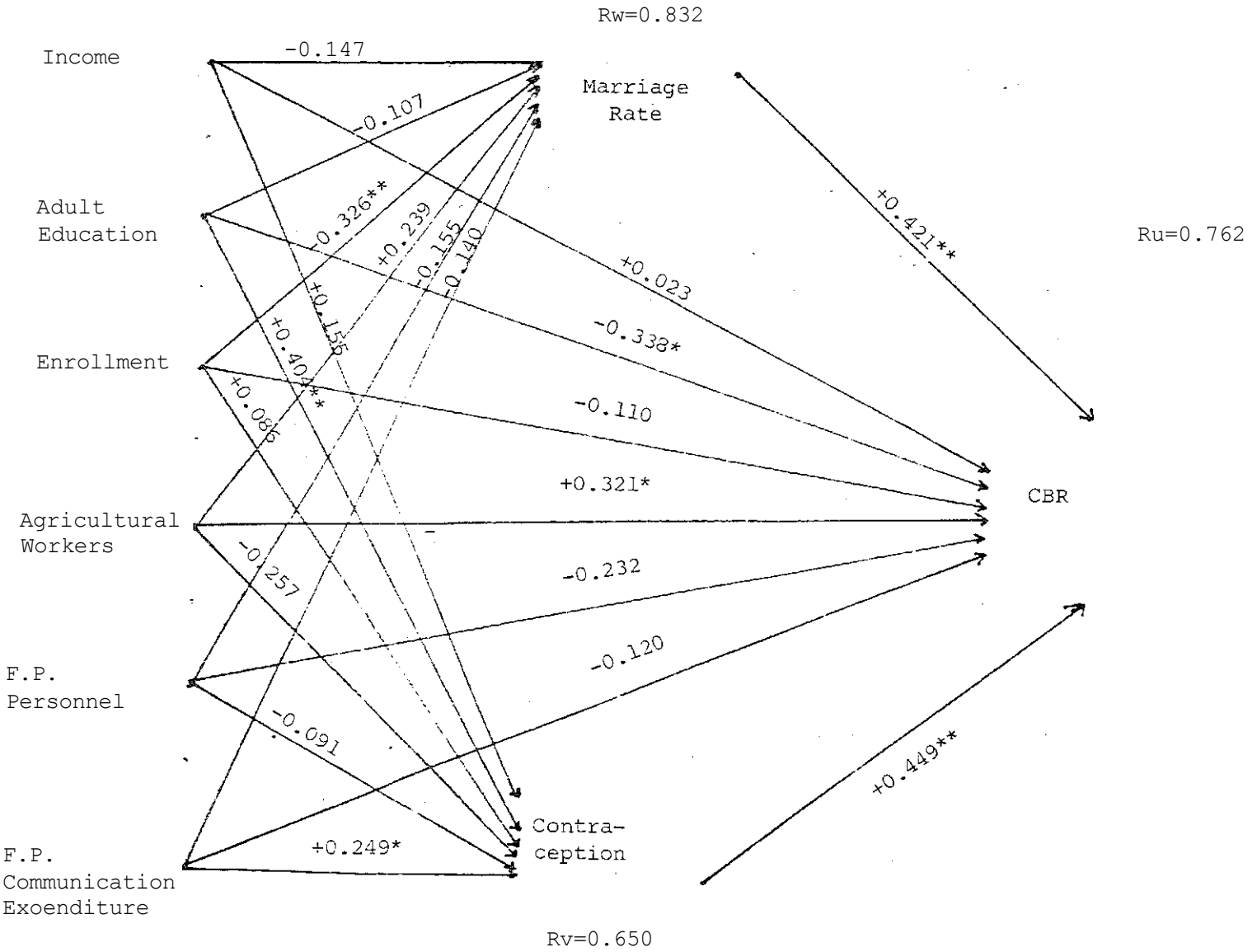


**Path coefficients significant at 1 to 5 percent level.

* Path coefficients significant at 10 percent level

FIGURE-3

PATH DIAGRAM OF EFFECTS OF SOCIO-ECONOMIC, DEMOGRAPHIC AND PROGRAMME VARIABLES ON CRUDE BIRTH RATE (CBR)



**Path coefficients significant at 1 to 5 percent level.

* Path coefficients significant at 10 percent level.

Table 2: Decomposition of Total Effects of Exogenous Variable on Fertility

Path Effect	Proportion married	Income	Education	Enrollment Ratio	Agricultural Labor Force	Family Planning-Personnel	Family Planning Comm. Expen.	Couple Years of Protection	Composite variable
				Model - I					
Direct Effect	0.371	-0.084	-0.434	-0.073	0.284	-0.326	-0.210	0.338	-
Indirect Effect	-	-0.016	0.097	-0.092	0.002	-0.032	0.032	-	-
Through marriage	-	-0.055	-0.040	-0.121	0.089	-0.058	-0.058	-	-
Through contraception	-	0.039	0.137	0.029	-0.087	-0.131	0.084	-	-
Total Effect	0.371	-0.100	-0.337	-0.165	0.286	-0.415	-0.178	0.338	-
				Model - II					
Direct Effect	0.457	-	-	-	-	-0.216	-0.163	0.05	-0.150
Indirect Effect	-	-	-	-	-	-0.026	-0.053	-	-0.172
Through marriage	-	-	-	-	-	-0.013	-0.064	-	-0.200
Through contraception	-	-	-	-	-	-0.013	-0.011	-	-0.028
Total Effect	0.457	-	-	-	-	-0.242	-0.216	0.05	-0.322
				Model - III					
Direct Effect	0.421	0.023	-0.338	-0.110	0.321	-0.232	-0.120	0.449	-
Indirect Effect	-	0.008	0.039	-0.007	0.250	-0.139	0.061	-	-
Through marriage	-	-0.062	-0.142	-0.046	0.135	-0.098	-0.051	-	-
Through contraception	-	0.070	0.181	0.039	0.115	-0.041	0.112	-	-
Total Effect	0.421	0.031	-0.299	-0.117	0.571	-0.371	-0.059	0.449	-
				Model - IV					
Direct Effect	0.517	-	-	-	-	-0.125	-0.100	0.191	-0.081
Indirect Effect	-	-	-	-	-	-0.062	-0.031	-	-0.120
Through marriage	-	-	-	-	-	-0.014	-0.073	-	-0.226
Through contraception	-	-	-	-	-	-0.048	0.042	-	0.106
Total Effect	0.517	-	-	-	-	-0.187	-0.131	0.191	-0.201

Table 3: Correlation Matrix of Variables in *Path* Model

	1	2	3	4	5	6	7	8	9	10	11	12	13
Crude Birth Rate	1.000	0.878	-0.11[illegible]	-0.254	-0.284	0.235	-0.242	0.500	-0.128	-0.053	-0.031	-0.360	-0.207
Total Fertility Rate		1.000	-0.24[illegible]	-0.414	-0.298	0.265	-0.306	0.530	-0.102	-0.196	-0.171	-0.250	-0.343
Income			1.00[illegible]	0.258	0.201	-0.281	0.308	-0.288	-0.192	0.099	0.169	0.036	0.044
Education				1.000	0.176	-0.216	0.782	-0.253	-0.186	0.200	-0.067	0.374	0.818
Enrollment Ratio					1.000	-0.174	0.236	-0.430	-0.064	0.165	-0.286	0.481	0.333
Agricultural Labour Force						1.000	-0.128	0.328	0.505	-0.328	0.094	-0.060	-0.251
Urbanization							1.000	-0.337	-0.074	0.174	-0.116	0.498	0.898
Proportion Married								1.000	0.084	-0.221	0.127	-0.512	-0.469
Family Planning Personnel									1.000	-0.437	0.072	-0.051	-0.137
Family Planning Expenditure										1.000	-0.041	-0.054	0.251
Couple Years of Protection											1.000	0.278	0.650
Log Density												1.000	0.603
Development Variable													1.000
Mean	40.807	6.487	661.915	29.051	27.023	44.990	22.228	85.272	0.208	3.944	20.755	5.008	3.854
Standard Deviation	3.970	0.527	253.827	9.822	24.190	12.584	16.603	5.348	0.100	2.093	7.056	0.881	15.070
Coefficient of Variability	0.097	0.081	0.384	0.338	0.895	0.280	0.747	0.063	0.482	0.531	0.340	0.018	0.256

16 percent indirectly that was more pronounced through nuptiality (55 percent) than contraception. There could be two reasons for this insignificant effect of income. Firstly, it was not lagged prior to fertility and secondly the effect was most probably taken away by the powerful proxy variable education. The effect of others was not so apparent.

What emerges out from the analysis of model 1 is that the programme was effective mostly through the impact of social development variable of education signifying its spread and growth among the areal units. However, the programme input of communication helped increase the programme contraception reflecting mass media effect on attitudinal change in stimulating demand for contraception.

Instead of using four socio-economic variables in Path Analysis a composite socio-economic variable developed elsewhere was utilized in model-II /19/. The results of this model are not as illuminating and relevant as those of model I in explaining conceptual aspect of economic theories of fertility for policy purposes. The development variable affected fertility mostly through intermediate variables. This could be due to high level of aggregation of development variables for developing a single composite variable. The policy suggestions based on single composite variable becomes difficult to offer due to its inappropriateness in netting out the effect of specific developmental inputs influencing fertility that are lost mainly due to aggregation.

Model III and IV represent CBR as dependent variable to the Path Analysis. The comparison of effects with those of model I and II show that some changes in these path coefficients which were affecting fertility directly have occured. This is bacause of the methodological differences in the measurement of TFR and CBR. However, as pointed out

FIGURE-2

PATH DIAGRAM OF EFFECTS OF SOCIO-ECONOMIC, DEMOGRAPHIC AND PROGRAMME VARIABLES ON TOTAL FERTILITY RATE (TFR)

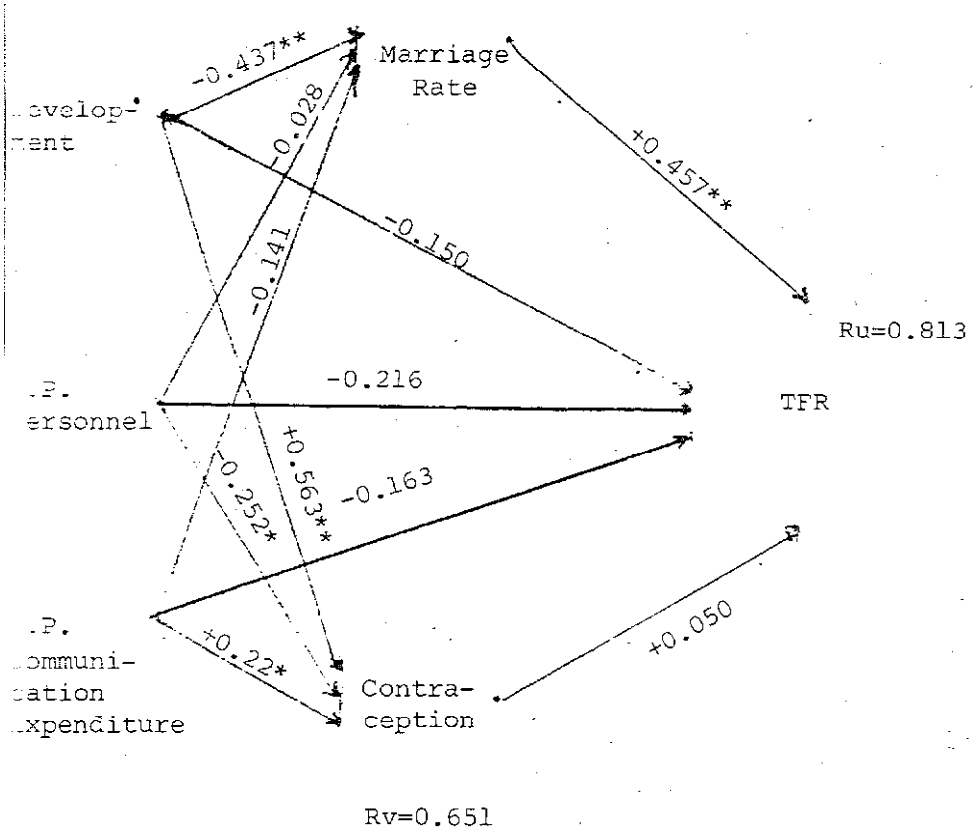
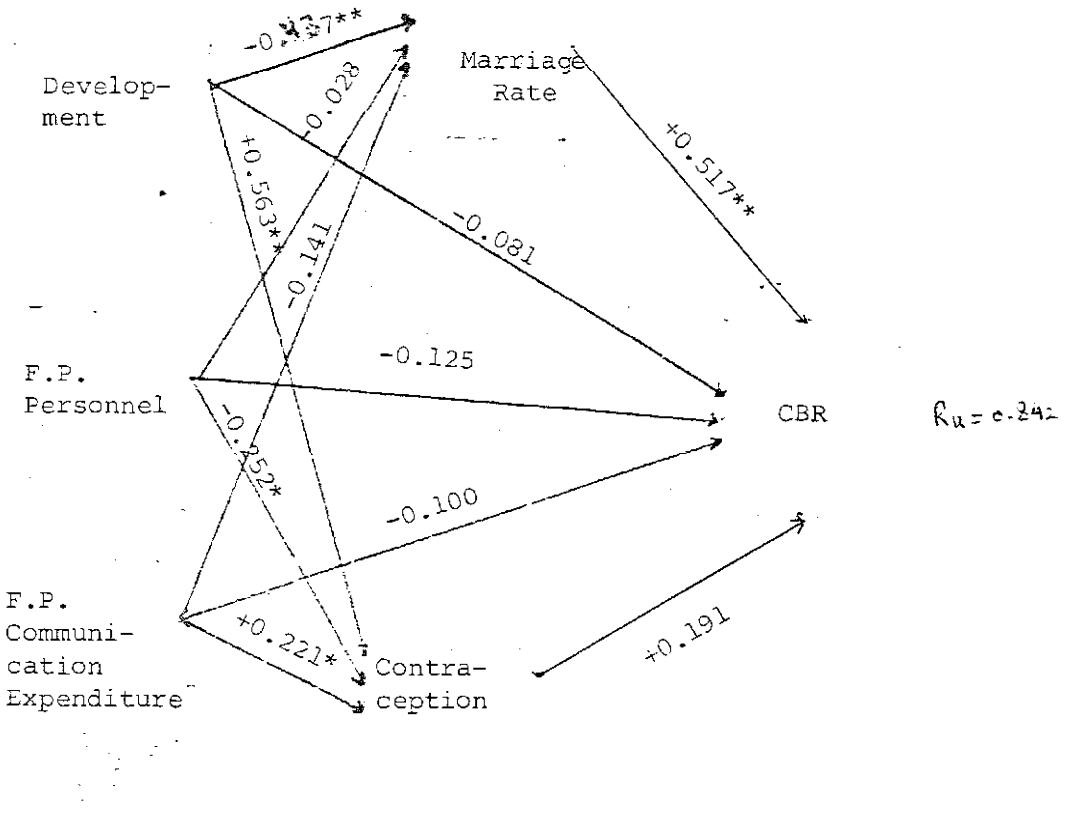


FIGURE-4

PATH DIAGRAM OF EFFECTS OF SOCIO-ECONOMIC DEMOGRAPHIC AND PROGRAMME VARIABLES ON CRUDE BIRTH RATE (CBR)



**Path coefficients significant at 1 to 5 percent level.

* Path coefficients significant at 10 percent level.

earlier in the section on methodology and in technical note, the derivation of CBR is subject to a some what severe data limitations of constant relative age specific fertility rate (ASFR) and age mis-reporting that might have resulted in somewhat weakening of direct path coefficients from developmental and programme variables to CBR.

POLICY IMPLICATIONS

The results of the analysis suggest that fertility is affected not only by level of socio-economic development but separately by nuptiality and contraception. The salient feature of this analytical study is the way in which contraceptive adoption is determined in a whole framework of socio-economic analysis. The dominant factor affecting contraceptive adoption is the variable of education followed by programme variables. Education which encompasses the component of enrollment and also serves as a proxy for income delays marriages, induce family planing adoption and subsequently alters the fertility behaviour. This also implies that educated couples are engaged in substitution of quality over quantity of their children. The demand models of fertility, therefore, appears to be operative under such circumstances in Pakistan. The policy suggestions of this analysis are that improvement in distribution of education be effectively implemented so as to impart the benefits of education to all areas through spread of educational opportunities. The other policy suggestion is that programme activities be intensified in those areas which are comparatively cost effective in programme operation.

The impact of expenditure on family planning communication suggest that this was the only programme input variable which increased

acceptance by stimulating demand for contraception through motivation. It may be added that contraceptive use guided by development implies the use was already motivated due to favourable behaviour towards the adoption of innovations whereas the use guided by programme communication was the result of programme efforts that under-scores the importance of repeated mesrage of family planning through mass media. Therefore, it is an urgent need to enhancing the activities of programme in the field of mass communication. Moreover, the managerial and administrative skills of programme personnel involved in the programme need to be organized so that effective utilization of their services is made at the interface level for planned output.

SUMMARY AND CONCLUSIONS

The areal analysis of fertility was carried out by employing socio-economic, demographic and programme variables at district level. Technique of Path Analysis was utilized to determine the direct and indirect effects of socio-economic and programme variables on fertility. The measures of fertility employed in the study were TFR and CBR derived by indirect technique of estimation. The path analytical results based on TFR as a dependent variable appeared to be significant and consistent. The social development variable of education appeared to be a significant variable to affect fertility directly as well as through intermediate variables of nuptiality and contraception. The indirect effects of Path Analysis, however, showed that adult education worked through contraception whereas enrollment affected fertility through nuptiality. The programme input variable expenditure was observed to be affecting fertility through contraception whereas personnel affected fertility directly. The direct effect of programme

appears to be spurious in the context of casual ordering of variables in the model. However, if accepted it could be presumed that attitudinal changes due to personnel's efforts led to both programme and non-programme contraception and this effect through contraception was probably concealed by the work of catalytic effect. In a traditional society like Pakistan where majority of population is in rural areas with predominant agricultural setting, the effect of agricultural workers showed a resistence to delayed marriages and adoption of contraception.

Appendix

TECHNICAL NOTE

This note describles the procedure adopted for estimation of Total Fertility Rate (TFR) and Gross Reproduction Rate (GRR) for the 39 programme district populations by application of Rele Method /22/. The basic approach followed by Rele was to derive a relationship between the Child-woman Ratio (CWR) and the Net Reproduction Rate (NRR) among a set of stable populations. Lotka's formula of stable population was adopted to derive the above relationship. Using conventional notation, Lotak's formula can be written as:-

$$C(a) = b\, e^{-ra} p(a)$$

where,

c(a) = Proportion of Population in age group a, a+da

b = Intrinsic birth rate

r = Intrinsic growth rate

P(a) = Survival ratio from birth to age group a, a+da

In discreet form for quinquinneal age group, the age structure of the stable population can be shown as under:-

$$C(a, a+5) = b\, e^{-r(a+2.5)}\, {}_5L_a$$

On the basis of this relationship, the measure of Child Woman Ratio was derived in stable population which yielded an equation depicting almost a linear relationship between the Child-woman Ratio (CWR) and the Net-Reproduction Rate (NRR) for any given level of mortality. The linearity was further improved by selecting the age range for the Child-woman Ratios such as $\frac{C(0-4)}{15-19}$ and $\frac{C(5-9)}{20-54}$. In order to convert

the Child Woman Ratios into Gross Reproduction Rates, polynominal of zero degree to Child Woman Ratio and Gross Reproduction Rate in stable populations for various mortality levels were fitted with Gross Reproduction Rate surving as dependet variable.

The derivation of Crude Birth Rate (CBR) from the Child-Woman Ratio (CWR) involves the estimation of intrinsic birth rate from the Child-Woman Ratio and then the estimation of Crude Birth Rate (CBR) from the intinsic birth rate. Since the relationship between the Child-woman Ratio and Intrinsic Birth Rate in stable population is curvilinear, a second degree polynomial was fitted to stable population of various mortality levels with intrinsic birth rate as dependent variable. For deriving Crude Birth Rate (CBR) from Intrinsic Birth Rate the following relationship was utilized:-

$$\frac{\int_G P(x)\ f(x)}{\int_G P(x)} \cdot \frac{\int_S P(x)}{\int_S P(x)\ f(x)}$$

where

P(x) = Population in age group

f(x) = Age specific fertility rate

b = Intrinsic birth rate

G and S = Denote the given and stable population.

Since actual age specific fertility rates for the given and stable populations are not usually available, relative age specific fertility rate derived by the United Nation for age groups, 15-19 to 40-44 were utilized for deriving the weighted sums.

As pointed out above, conversion of Child Woman Ratios (CWR) to levels of fertility can only be achieved at a certain level of

mortality. As such the first task was to determine the level of mortality in Pakistan around the period 1972 to 1981. Abridged Life Tables were constructed for the male and female population of Pakistan based on PGS data for the years 1976, 1977 and 1978. The mortality data was adjusted for possible underenumeration in the adult age groups, whereas to avoid under enumeration in young age groups mortality levels for the 1975 PFS survey were employed. The average e_o^o from both sexes from this exercise turned out to be 54 years. The second task was to examine the age structure of children for the district populations. Children in age group (0-4) were observed to be under enumerated. This under enumeration was adjusted by applying Pressat's Technique for the mortality level of 54 e_o^o /25/.

The conversion of Child Women Ratios C(0-4) and C(5-9) to Gross Reproduction Rate (GRR) were achieved by the application of regression beta coefficients obtained through linear interpolation. The conversion of Child Woman Ratio (CWR) to Intrinsic Birth Rate was similarly achieved through the application of regression beta coefficients obtained through linear interpolation. In order to arrive at the measure of Crude Birth Rates (CBRs), Intrinsic Birth Rates were subjected to multiplication through the two measures described earlier. The measures were derived through the application of relative age-specific fertility rates to female population.

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