Research Report No. 49

RETURNS TO EDUCATION: THE CASE OF FERTILITY

SOCIAL POLICY AND DEVELOPMENT CENTRE

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The purpose of this research is to observe the impact of the individual and aggregate-level education on the fertility rate. The empirical investigation has been extended to observe the determinants of fertility using aggregate district data. The estimated coefficients of the macro fertility model establish a case for higher education for women to achieve a noticeable reduction in the fertility rate. Moreover, the impact of the general level of education of a district, after controlling the level of economic development, appears an important element in the fertility response model.

1. INTRODUCTION

Since Malthus' time, population growth has been a key determinant in the analysis of the extension of poverty within a country and/or a region. One way to study the behavior of population growth is by understanding the determinants of fertility rates. The comprehension of these determinants could then be used for guidance in the formulation of socio-economic policies for effective poverty alleviation.

Although women's education has been one of the most thoroughly studied determinants of fertility, the research in this area is still far from being exhausted. For example, several causal links seem plausible in light of existing empirical evidence, but we have inadequate knowledge about their relative importance.

A review of the existing literature on fertility determinants strikes for its commonality in one interesting aspect: most of the work done so far estimate the determinants of fertility using a micro-data approach. That is, the source of information is the household or, in several cases, the women. The explanation for this commonality is quite straightforward. Since the economic theories of fertility assume that parents have the number of children they do because in actual fact they desire approximately that number, given certain costs, it can be perfectly understood why studies use data on households to estimate fertility determinants.

Another important, and not so widely recognized challenge, is to find out whether education at the aggregate level has any effect on a woman's fertility above and beyond that of her own education. The possible importance of 'mass education' was discussed by Caldwell (1980) many years ago, and has been touched upon in a review by Cleland and Jejeebhoy (1996); however, little empirical evidence has so far been accumulated. Recently, Kravdal (2000)

empirically searched for aggregate-level effects of education on fertility using data on Zimbabwe and found some evidence of the effects of district education on women's fertility. Conceptually, in addition to the effects of women's education, there may be a 'spill-over' from other people's education through, for example, social learning. Uneducated women who live in societies where a large proportion are literate, or where the average educational level is high, may have a fertility different from that of uneducated women elsewhere. Also the better-educated may be influenced by the educational distribution in the community. If aggregate education has, on the whole, a substantial reducing effect, fertility will decline more sharply in response to an increase in women's education than as suggested by the estimates of individual-level effects.

This research, therefore quantifies the effects of education on fertility using macro data at the district level. It includes both aggregate (district education level) and individual (education level of married women) in a fertility model, along with other variables that are determinants of fertility. The paper is organized as follows. Fertility behavior at the macro level is modeled in the following section. This section also provides the definition of the variables used in this study and data sources. Results are presented in section 3, while the last section provides the conclusions of the paper.

2. MACRO FERTILITY MODEL AND DEFINITION OF VARIABLES

Economic theories of fertility assume that parents have the number of children they do because they desire approximately that number, given the costs of birth control. This demand for children, at a household level, is affected by many socio-economic factors such as the level of human capital of family members, family income and assets, and the experience of child mortality. By extension, fertility rates at a macro level can be modeled as:

$$F = \alpha + \beta_i[SLE] + \gamma_i[MWE] + \delta_i[DC] + \kappa(IMR) + \lambda_i[PD] + \mu \qquad \textbf{(1)}$$

The dependent variable *F* denotes the fertility rate, which is taken here as the average number of children per married women in a particular district. Aggregate-level effects of education on fertility are represented by district School Life Expectancy (*SLE)*[1]. The *SLEs,* described in detail later, are computed separately for male and female. *MWE* is a vector of educational attainments by married women and includes various levels of education. District characteristics are taken care of by *DC*, which is a matrix and is composed of three column vectors. First, Index of Economic Development (IED) is included to proxy the level of income and development of a district. Second, the health status of district is incorporated, which is measured through first level health institutions (Rural Health Centre, Basic Health Unit, Sub-Health Centre, Mother Child Health Centre, Dispensaries, Reproductive Health Units and Mobile Health and Family Planning Units) per 1000 population[2]. It is hoped that these facilities would cause a decline in the fertility rate due to an increase in health and family planning consciousness. The third vector is the proportion of female participation in the labor force, which is also hypothesized to have an inverse relationship with the fertility rate. Infant Mortality Rate[3] (*IMR)* is measured by the number of children that died before turning one year old out of 1000 ever born alive. Micro-level studies on fertility behavior indicate a direct relationship between fertility and infant mortality and therefore, reflect the desire through replacement. *PD* is a vector of provincial dummy variables to capture the

[1] SLE is a flow variable and depicts the current enrollment situation in a district; therefore, it is preferred over adult literacy rate, which is a stock variable.

[2] The data for district health facilities is taken from Pakistan Health & Population Welfare Facilities Atlas, Planning and Development Division, Government of Pakistan (2000).

[3] As can be noted in equation (1), IMR is treated as an exogenous variable. One assumption could be that IMR is endogenously determined. This specification is also tested using Two-Stage-Least-Square technique. The results were not statistically sound, but the relationship between IMR and fertility were positive in both specifications.

differences and dissimilarities in provinces regarding non-measurable genetics, environmental and locational aspects.

With the exception of the composite IED, all variables are constructed using Pakistan Population Census (1998) data[4]. The computational detail of SLE and IED is provided in the following sub-sections, while the average values of the variables used in multivariate regression analysis are furnished in the following table.

TABLE 1
VARIABLES USED IN MACRO FERTILITY RESPONSE MODEL
[AVERAGE LEVEL]

Variables	Overall	Provinces			
		Punjab	Sindh	NWFP	Balochistan
Fertility Rate	4.49	4.66	3.94	4.83	4.32
School Life Expectancy – Male (Years)	6.70	7.87	5.96	7.35	5.02
School Life Expectancy – Female (Years)	4.02	5.90	3.62	3.33	2.46
Literate Married Women (%)	14	23	13	10	6
Married Women–Below Secondary (%)	9	16	8	6	4
Married Women–Secondary or Higher (%)	4	6	5	4	2
Index of Economic Development (%)	32.67	38.05	38.69	26.84	27.32
Female Labor Force Participation (%)	2	2	3	1	2
District Health Status (Institutions per '000' population)	0.12	0.08	0.06	0.12	0.24
Infant Mortality Rate **	140	126	185	90	178
Number of Districts	100	34	16	24	26

**Generally in demographic surveys, IMR is computed on the basis of 3 years' averages. In the Population Census, data is only available for one year. Therefore, these estimates seem overestimated and are thus indicative.

[4] Except for the Index of Economic Development and district health status, all other variables are computed separately for urban, rural and overall Pakistan.

2.1 School Life Expectancy (SLE)

According to the World Education Report (UNESCO, 1995), the SLE is defined as "the number of year of schooling which the child can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular future age is equal to the current enrollment ratio for that age". Taking the reference age-range to be 5-24, SLE for *ith* district may be expressed as:

$$SLE_i = \sum_{i=5}^{24} E_{ij}$$

where E_{ij} is the enrollment rate at age j in district i. Thus, SLE expresses in a compact form the enrollment position for the district over the 19-year schooling cycle. As Ram (1999) pointed out, the advantage of SLEs is that they are based on enrollment rates in the standard age-range for schooling, and the difficulty of combining enrollment rates for three conventional levels is avoided.

Student population in different age-cohorts is taken from the Population Census (1998). For this exercise, overall, urban and rural SLEs are computed separately for males, females and combined enrollments.

2.2 Index of Economic Development (IED)

As National Accounts do not report Gross Domestic Product at the district level, the district's economic development is represented by a composite development index. Various attributes or indicators have been integrated to develop a composite Index of Economic Development. These indicators measure the economic potential and achieved levels of income and wealth; extent of mechanization and modernization of agriculture; housing quality and access to basic

residential services; and the development of transport and communication network. A brief description of individual indicators is given below.

Household income and wealth is the most discussed welfare attribute in literature. Direct income data at provincial or district levels are not available; therefore various proxies are used to estimate the income and wealth position of a district. For the rural economy, *cash value of agricultural produce per rural person* and *livestock per rural capita* are used. All major and minor crops are considered to estimate the district's cash value from agriculture. This indicator is based on the aggregation of 43 crops, including fruits and vegetables. Different types of livestock have been aggregated by assigning weights as recommended by the FAO (Pasha and Hassan,1982) to reflect the capital value of various animals and poultry. For the urban part of a district, *per capita value added in large-scale manufacturing* is used to proxy the level of urban income. Value added by the small-scale component could not be included due to the lack of data. On the assumption that there may be a direct link between the number of bank branches in a district and the volume of bank deposits, *number of bank branches per capita* is used as a crude measure of the district's wealth. *Per capita car ownership* is also used to proxy the district's income and wealth in the urban areas.

Modernization of agriculture is another area of development which has direct or indirect effects on the prosperity and standard of living of the rural population. To capture the process of mechanization in agriculture, *tractors per 1000 acres of cropped area* is used. *Consumption of fertilizer per 100 acres of cropped area* is also used as the indicator of modernization in agriculture. In addition, *irrigated area per 100 acres of cropped area* is used to capture the access to canal irrigation systems and tube-wells.

Shelter is one of the basic needs, and housing conditions are one of the key determinants of the quality of life. For IED, the *proportion of households using electricity, gas and inside piped water connections* is used. The quality of housing stock is represented by the *proportion of houses with cemented outer walls and RCC/RBC roofing*. *Rooms per persons* is used to proxy adequate housing in a district.

Three indicators have been included to portray the level of development of the transport and communication sector in a district. Roads and the transportation network have a significant impact on socialization and modernization. Therefore, *metalled road mileage per 100 square miles of geographical area* of a district is included in the index. With regard to the availability of transport vehicles, a summary measure, viz., *passenger load carrying capacity* is included. Different vehicles are aggregated assigning weights as recommended in Pasha and Hassan (1982). *Number of telephone connections per 1000 persons* is also used to observe the distribution of this important indicator of the standard of living.

Diverse sources are used to gather data for the above indicators. Major sources include; District Census Reports (1998), Provincial Census Reports (1998), Agriculture Statistics of Pakistan (1998-99), Provincial Development Statistics, Crop Area Production (1997-98), Census of Manufacturing Industries (1995-96). Further, to fulfill the missing gaps or for updating various information, unpublished data is obtained from the provincial Bureaus of Statistics, State Bank of Pakistan and the Ministry of Agriculture.

The index is constructed along the lines proposed by Filmer and Pritchett (1999) through the use of the Principal Component Analysis (PCA) on the fore mentioned indicators. The PCA searches for the linear combinations of the variables selected that account for the maximum

possible variance in the data. The exercise was undertaken on the full sample and factor scores of principal components were used to construct the index of economic development.

3. RESULTS

Graph 1 portrays an obvious relationship between fertility and the educational attainment of married women. One important observation emerges. Although, the educational attainment below secondary level reduces fertility, the impact is not so pronounced as in the case of higher education. This observation clearly necessitates the need for higher education for women.

As the Census data do not provide information regarding infant mortality by education levels, Graph 2 is plotted using the data from Pakistan Integrated Household Survey (PIHS). Similar trends are evident from this graph. However, the decline in infant mortality rate at the highest level of education, i.e., 'tertiary', is much sharper than in the case of fertility. Particularly, in the rural context, this is the only education category that significantly affects the decrease in the infant mortality rate.

The above discussed graphs, albeit while indicating an important link between fertility and educational attainments of married women, do not control for other possible interaction, which may affect the fertility rate. For instance, they do not control for the level of the district's development, available health facilities, female labor force participation etc; therefore, a macro model (equation 1) of fertility at district level is estimated to quantify the net impact of individual-level and aggregate-level education on the reduction of the fertility rate.

Table 2 through Table 7 provide Ordinary Least Square (OLS) estimates of the macro fertility model[5]. All regressions are statistically significant. R^2 ranges from 0.41 to 0.57 in various regressions, pointing at a good fit of the model. Majority of the estimates are statistically significant and showing the expected relationship with the fertility rate. The proxy used to represent district health facilities[6], albeit depicts an inverse relationship with the fertility rate, is not statistically significant; this indicates low coverage, and less effective health and reproductive health facilities. The coefficient of Infant Mortality Rate, in all regression confirms a direct relationship with the fertility rate. However, the marginal effect seems very small, and also the urban coefficient is not statistically significant. Moreover, female labor force participation portrays a negative relationship with the fertility rate, but the coefficients are statistically not significant.

The followings sections provide some comments regarding the relationship between fertility and the core variables: economic development, aggregate-level education and individual-level education.

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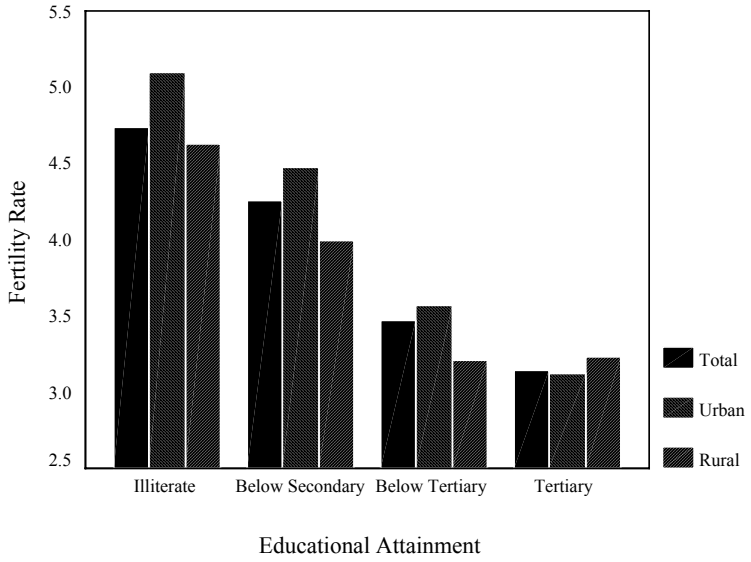
[5] To econometrically evaluate the model specification, an important statistical test (White, 1980) is applied. Basically it consists of taking the residuals from the model to be tested, and regressing the squares of these residuals on the (unduplicated) squares and cross-products of the model regressors. Then, under the null hypothesis, test statistic (nR^2) is distributed as a chi-square with degree of freedom equal to the number of regressors in the test regression.

White's test for the joint null hypothesis of no-specification-error and homoskedasticity is not rejected at the 5 percent level for any regression (Table 2 through Table 7). Therefore, the model used appears econometrically reasonable and theoretically close to what is feasible.

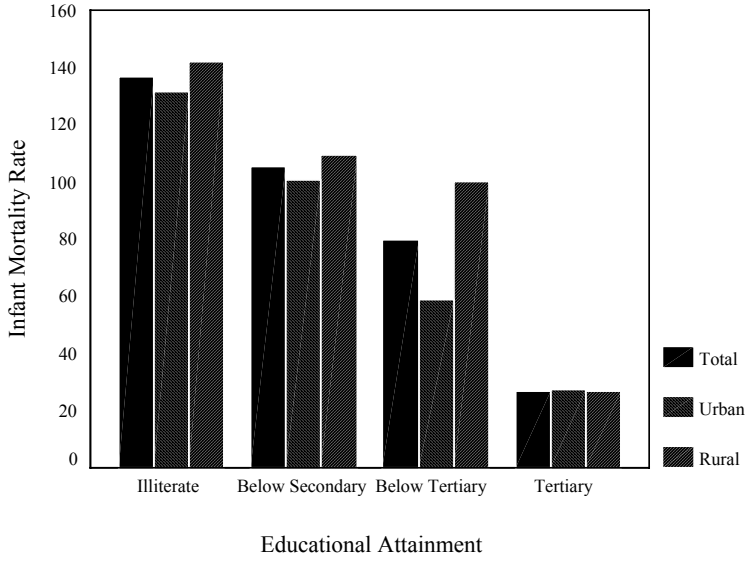
[6] Other health related variables viz., per capita hospital bed availability, per capita availability of doctors, access to safe drinking water, proportion of children who have completed vaccination, are also tried in the macro fertility response model, but non of these appeared statistically significant.

CHART 1
FERTILITY RATE AND EDUCATIONAL ATTAINMENT OF MARRIED WOMEN



Source: Pakistan Population Census, 1998

CHART 2
INFANT MORTALITY RATE AND EDUCATIONAL ATTAINMENT OF MARRIED WOMEN



Source: PIHS data, 2001-2002

TABLE 2
REGRESSION RESULT [OVERALL PAKISTAN]
DEPENDENT VARIABLE: TOTAL FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.06	0.03	-1.96	0.05
Index of Economic Development ^2	0.00	0.00	2.24	0.03
Index of Economic Development ^3	0.00	0.00	-1.89	0.06
School Life Expectancy – Female	-0.08	0.06	-1.35	0.18
School Life Expectancy - Male	0.16	0.05	3.17	0.00
Literate Married Women	-2.20	0.84	-2.61	0.01
Female Labor Force Participation	-7.37	4.75	-1.55	0.12
Infant Mortality Rate	0.00	0.00	1.93	0.06
District Health Status	-0.87	0.67	-1.29	0.20
Proportion of Urban Population	-0.01	0.00	-1.79	0.08
Dummy Variable – Sindh Province	-0.91	0.15	-5.91	0.00
Dummy Variable – NWFP Province	-0.14	0.17	-0.87	0.39
Dummy Variable – Balochistan Province	-0.37	0.19	-1.98	0.05
(Constant)	5.10	0.46	11.05	0.00
R-squared	0.52	F-statistic		7.05
Adjusted R-squared	0.45	D-W Statistics		1.97

Notes: ***Prob.*** reflects the level of significance.

TABLE 3
REGRESSION RESULT [OVERALL PAKISTAN]
DEPENDENT VARIABLE: TOTAL FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.06	0.03	-2.08	0.04
Index of Economic Development ^2	0.00	0.00	2.34	0.02
Index of Economic Development ^3	0.00	0.00	-1.95	0.05
School Life Expectancy – Female	-0.09	0.06	-1.49	0.14
School Life Expectancy - Male	0.17	0.05	3.27	0.00
Married Women (Below Secondary)	-0.99	0.98	-1.01	0.32
Married Women (Secondary or higher)	-4.21	0.90	-4.67	0.00
Female Labor Force Participation	-5.84	4.45	-1.31	0.19
Infant Mortality Rate	0.00	0.00	2.06	0.04
District Health Status	-1.00	0.66	-1.51	0.14
Proportion of Urban Population	-0.01	0.00	-1.47	0.14
Dummy Variable – Sindh Province	-0.90	0.15	-5.81	0.00
Dummy Variable – NWFP Province	-0.03	0.17	-0.17	0.86
Dummy Variable – Balochistan Province	-0.30	0.19	-1.58	0.12
(Constant)	5.00	0.45	11.10	0.00
R-squared	0.53	F-statistic		6.82
Adjusted R-squared	0.45	D-W Statistics		2.02

Notes: ***Prob.*** reflects the level of significance.

TABLE 4
REGRESSION RESULT [RURAL PAKISTAN]
DEPENDENT VARIABLE: RURAL FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.07	0.03	-2.19	0.03
Index of Economic Development ^2	0.00	0.00	2.44	0.02
Index of Economic Development ^3	0.00	0.00	-2.21	0.03
School Life Expectancy – Female	-0.13	0.07	-1.81	0.07
School Life Expectancy - Male	0.18	0.05	3.51	0.00
Literate Married Women	-1.24	1.18	-1.05	0.30
Female Labor Force Participation	-5.10	3.69	-1.38	0.17
Infant Mortality Rate	0.00	0.00	2.07	0.04
District Health Status	-0.95	0.64	-1.48	0.14
Dummy Variable – Sindh Province	-1.00	0.15	-6.64	0.00
Dummy Variable – NWFP Province	0.05	0.17	0.29	0.77
Dummy Variable – Balochistan Province	-0.24	0.19	-1.28	0.21
(Constant)	4.93	0.45	10.92	0.00
R-squared	0.56	F-statistic		9.28
Adjusted R-squared	0.50	D-W Statistics		1.92

Notes: ***Prob.*** reflects the level of significance.

TABLE 5
REGRESSION RESULT [RURAL PAKISTAN]
DEPENDENT VARIABLE: RURAL FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.07	0.03	-2.16	0.03
Index of Economic Development ^2	0.00	0.00	2.41	0.02
Index of Economic Development ^3	0.00	0.00	-2.21	0.03
School Life Expectancy – Female	-0.12	0.07	-1.90	0.06
School Life Expectancy – Male	0.18	0.05	3.52	0.00
Married Women (Below Secondary)	-1.71	1.32	-1.30	0.20
Female Labor Force Participation	-5.14	3.72	-1.38	0.17
Infant Mortality Rate	0.00	0.00	1.99	0.05
District Health Status	-0.91	0.65	-1.41	0.16
Dummy Variable – Sindh Province	-1.01	0.15	-6.74	0.00
Dummy Variable – NWFP Province	0.03	0.17	0.15	0.88
Dummy Variable – Balochistan Province	-0.26	0.19	-1.36	0.18
(Constant)	4.94	0.45	10.95	0.00
R-squared	0.57	F-statistic		9.36
Adjusted R-squared	0.51	D-W Statistics		1.91

Notes: ***Prob.*** reflects the level of significance.

TABLE 6
REGRESSION RESULT [URBAN PAKISTAN]
DEPENDENT VARIABLE: URBAN FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.04	0.02	-1.71	0.09
Index of Economic Development ^2	0.00	0.00	1.49	0.14
Index of Economic Development ^3	0.00	0.00	-1.09	0.28
School Life Expectancy – Female	0.25	0.09	2.88	0.01
School Life Expectancy - Male	-0.18	0.08	-2.24	0.03
Literate Married Women	-3.98	0.94	-4.24	0.00
Female Labor Force Participation	-6.26	4.36	-1.43	0.16
Infant Mortality Rate	0.00	0.00	0.68	0.50
District Health Status	-0.01	0.64	-0.02	0.99
Dummy Variable – Sindh Province	-0.53	0.19	-2.86	0.01
Dummy Variable – NWFP Province	0.02	0.17	0.14	0.89
Dummy Variable – Balochistan Province	-0.55	0.22	-2.55	0.01
(Constant)	6.55	0.52	12.49	0.00
R-squared	0.41	F-statistic		4.75
Adjusted R-squared	0.33	D-W Statistics		2.08

Notes: ***Prob.*** reflects the level of significance.

TABLE 7
REGRESSION RESULT [URBAN PAKISTAN]
DEPENDENT VARIABLE: URBAN FERTILITY RATE

Variables	Coefficients	Std. Error	t-Statistic	Prob.
Index of Economic Development	-0.04	0.02	-1.84	0.07
Index of Economic Development ^2	0.00	0.00	1.63	0.11
Index of Economic Development ^3	0.00	0.00	-1.17	0.25
School Life Expectancy – Female	0.21	0.08	2.84	0.01
School Life Expectancy - Male	-0.14	0.07	-1.92	0.06
Married Women (Below Secondary)	-1.64	0.94	-1.74	0.09
Married Women (Secondary or higher)	-5.54	0.84	-6.57	0.00
Female Labor Force Participation	-5.75	4.12	-1.40	0.17
Infant Mortality Rate	0.00	0.00	1.12	0.27
District Health Status	-0.09	0.60	-0.15	0.88
Dummy Variable – Sindh Province	-0.48	0.19	-2.58	0.01
Dummy Variable – NWFP Province	0.26	0.17	1.58	0.12
Dummy Variable – Balochistan Province	-0.37	0.20	-1.79	0.08
(Constant)	6.01	0.48	12.60	0.00
R-squared	0.46	F-statistic		5.24
Adjusted R-squared	0.37	D-W Statistics		2.21

Notes: ***Prob.*** reflects the level of significance.

3.1 Economic Conditions and Fertility

The relationship between economic conditions and fertility, at best remains unclear. Once children can be regarded as a special type of commodity, in the economic parlance, a feasible relationship between income and fertility is not difficult to visualize. A rise in income is likely to be associated with higher fertility. The rationale behind this positive income-fertility relationship is that, holding everything else constant, higher income implies greater resources available to support a large family; in accordance, if children are assumed to be consumer durables with a positive income elasticity, higher income will lead to the consumption of more children (Becker, 1960). But the value or utility of children has not been invariant over time and space. With a rise in income, a greater concern for the quality of children rather than their quantity may become the dominant concern. And since quality children usually require greater investment than return, a rise in income might in fact lead to a reduction in fertility. Furthermore, a majority of the later studies tend to support this negative association.

This empirical investigation suggests a cubic relationship between fertility and the level of economic development. At very low levels of development, an inverse relationship exists perhaps due to high costs of children. The positive relationship, at the medium level of development, between standard of living or economic development and fertility is evident from the estimated macro model. This suggests more demand for children as income rises. Quite understandably, the relationship is negative at the highest level of development. The phenomenon, both in urban and rural areas, supports the findings of fertility studies at the micro level. However the coefficients, in case of urban areas, indicate weak significance levels.

3.2 Aggregate-Level Effects of Education on Fertility

Several of the causally intermediate factors, which affect fertility may depend not only the woman's own education, but also on that of other women. As pointed out by, for example, Montgomery and Casterline (1996), other women may exert an effect because of social learning, social influence and more indirect mechanisms. The individual woman may learn directly from others by communication and observation. It is not only factual knowledge that is likely to be transmitted, but also attitude as well as understanding of possible consequences of different actions. To be more specific, one possibility is that uneducated women may have greater knowledge of contraception and more modern views about its acceptability if they live in a society where relatively more women have attended school for some years than if they lived elsewhere.

The aggregate-level effect of education on fertility is measured through the indictor of the district SLE, which is close to the average length of education in the district. Mixed results are obtained from the estimated model. In the case of rural areas, a statistically significant and negative relationship between female SLE and fertility is evident. Nonetheless, the coefficient of male SLE is positive and surprisingly the situation is entirely reverse in the case of urban areas.

In almost all micro-level studies of fertility determinants, male literacy or years of schooling turn out insignificant, after controlling for the level of female education. The macro estimates of fertility present interesting, but opposite results. In rural areas, the aggregate effect of female schooling is a reduction in fertility, whereas in urban areas, aggregate male schooling is a significant factor attributing in the decline of the fertility rate. This situation warrants further research in this direction to seek possible explanations. However, it is worth

indicating that the index of Economic Development represents the overall level of the district's development and it is not feasible to prepare separate development indices for rural and urban areas[7]. This factor may be a cause for the diverse effect of aggregate-level education on fertility.

3.3 Individual-Level Effects of Education on Fertility

There are several plausible reasons why women with some secondary education for example, usually display a lower fertility rate than the uneducated. To summarize very briefly, and without professing to produce a complete list of mechanisms, fertility desires are thought to have been influenced by the individual woman's education because of the following reasons; 1) the high opportunity costs of childbearing involved in some types of work that may be offered to the better-educated woman, 2) the cash expenses and children's reduced contribution to domestic and agricultural work as a result of children's schooling, which tends to be encouraged by the educated mother (quality v/s quantity of children), 3) the reduced need for children as old age security, 4) the higher prevalence of nucleated families, which may reduce fertility partly because childbearing costs are high due to the absence of economies of scale, 5) stronger preferences for consumer goods or other sources of satisfaction, and 6) a lower infant and child mortality, influencing desires through replacement (Kravdal, 2000).

One reason why education may operate through these channels is that schooling generally makes the woman able to read and write, increases her knowledge about the outside world, and provides her with certain practical and theoretical skills that enhances her productivity. In addition, a woman's position relative to a man may be involved. While their 'economic

[7] See footnote 4.

autonomy', 'physical autonomy' and 'decision-making autonomy' (Jeheebhoy, 1995) are likely to depend to a large extent on community norms and institutional structures, there may also be individual variations determined by individual factors. If she has an education, she may, for example, be allowed by the family to work outside. This will add to the effect of her literacy and skills, and possibly reduce fertility desire (Kravdal, 2000).

In this study, two specifications are used to quantify the impact of women's schooling on the aggregate fertility rate. In the first specification, the proportion of literate married women (formal schooling) is used irrespective of the level of educational attainments, while in the other specification, two alternative variables are used; first, the proportion of married women in a district, who have education below the secondary level, and second, those who have obtained secondary or higher education.

Results indicate significant impacts of education on women's fertility. The coefficient associated with 'Literate Married Women' is negative and, barring rural areas, is highly significant. But more importantly, the marginal effects of 'Married Women – Secondary or higher' is striking. The coefficient is 4 to 5 times higher than that associated with the 'Married Women – Below Secondary' category. These results clearly justify the case of higher education to women. In rural areas, however, the results are not so definite (low level of statistical significance), indicating the dominance of cultural and community norms.

4. CONCLUDING REMARKS

The main objective of this empirical investigation was to observe and quantify the impact of women's education on fertility using aggregate cross-section data for the districts of Pakistan. The objective is achieved by estimating a macro model of fertility with variables, School Life

Expectancy at the district level, Education of Married Women, Index of Economic Development, District Health Status, Female Labor Force Participation, Infant Mortality Rate, and some locational and regional variables.

The fact that a women's education influences her fertility, and is usually negative, is firmly established in a macro scenario. The study also noticed the importance of higher education in reducing fertility, which is more pronounced in urban areas. An additional fertility-depressing effect of the general educational level in the community, net of its aggregate determinants, is certainly not intuitively implausible either. However, such a spill-over effect from educational investments has yet to be well demonstrated empirically. In this study, negative effects of aggregate female education, in rural areas and aggregate male education in urban areas are found statistically significant.

As a bye-product, the study also exhibited a weak relationship between health and reproductive health facilities and fertility rate. While positive but with low marginal effects, higher infant mortality rates also add to the aggregate fertility. The economic condition of the districts and fertility holds a cubic relationship. Fertility rates are negative with the low and high levels of development.

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