DOES PARENTAL EDUCATION AFFCT FERTILITY RATES? EVIDENCES FROM PAKISTAN (1976-2010)

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Abstract

The study empirically examines the relationship b/w parental education and fertility for Pakistan from 1976-2010. We have employed Johenson Cointegration and Error correction model to test the long run as well as short run relationship. Results show that infant mortality rate and old age dependency increase the fertility while per capita income, urbanization and education of both male and female reduce the fertility. The impact of male education on fertility is smaller than that of female education. The possible choices for lowering fertility rate are both implementing low infant mortality rate and promoting female education policies. Lowering fertility rate through increasing access to quality reproductive health services is an important policy.

Keywords: Fertility, Population Growth, Inflation, Urbanization, Income Per Capita, Unit Root Testing, Ordinary Least Squares, Pakistan.

1. INTRODUCTION

Education is a direct and powerful indicator of the status of a population and has a contributing effect which causes variations in the level of fertility. Singh (1989) commented that various studies brought out clearly the impact of female education on reduction of fertility. Education depresses the fertility by raising the age at marriage, strengthening the propensity to be in labor force, fostering a favorable attitude towards small size norm and improving the awareness and use of family planning methods (Patnaik 1985; Arora 1990; Vashisht *et al.,* 1991).

Education is treated as one of the decisive and highly influential factor in reproductive behavior (Josipovic, 2007). Singh *et al.,* (2002) also

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established the fact that education affects reproductive behavior of women up to marked extent and influencing fertility by reducing it. Education has become one of the most important modern social factors that influence fertility. Female education is more inversely related to fertility than male's education. It is seen that better educated women have more attitude towards fertility control as they are more likely to seek professional advice, use a contraceptive technique (Brolchain, 1988). It is also observed that spread of education among women is a crucial factor contributing to the higher degree of awareness of health problems and their utilization (Panikar 1979; Nag 1984).

Singh (1989), Patnaik (1985) and Vashish *et al.,* (1991) found that education depresses fertility by raising the age at marriage, fostering a favorable attitude towards small family norm and improving awareness of using family planning methods. These studies have clearly brought out the impact of education on reduction of fertility. Education is regarded as being the primary catalyst in reducing fertility by attaining education which in turn affect the age at marriage.

Increased participation of women in schooling and the labour market raises the economic value of their time, which increases the opportunity cost of raising children (Guilkey, 1998; Singh, 1994; Ben-Porath, 1973; Gardner, 1973; Schultz, 1973). Studies on female education and fertility conclude that female education leads to a decrease in fertility i.e. with higher levels of education, the number of children born per woman reduces (Guilkey, 1998; Ben-Porath, 1973; Gardner, 1973; Schultz, 1993; 1974; 1973). Schultz (1993) confirms that women's education is associated with smaller desired family sizes across the world. This negative relationship between women's education on the one hand and fertility and desired family size on the other is explained by a number of factors which have been explored by both economists and sociologists. First, with higher levels of education, women expectations of future earnings are very high, increasing the opportunity cost of giving birth to and raising children. Second, the longer a woman stays in school, the lower the chances of giving birth to too many children. Related to this is the fact that with more education and exposure, women acquire more information about their bodies and are more able to process that information to their advantage (Vavrus and Larsen, 2003; Singh, 1994). The positive impact of women's education on their autonomy leading to

later marriages, increased use of contraceptives and lower fertility is discussed by Mason (1986). In fact, the link between women's autonomy on fertility is much stronger than that of the husbands. More importantly, higher levels of women's education are associated with lower child mortality rates, in the order of 5-10% for each additional year of the mothers schooling (Schultz, 1993; Mensch *et al.,* 1985; Cochrane *et al.*, 1980). This is because higher levels of women's education lead to improved child care, nutrition, and basic health and better child outcomes – health and school attainment (Strauss and Thomas, 1995)

1.1 Importance of Education in Fertility Reduction

Higher levels of education are a great desire in many developing countries, both for individual and national development (UNESCO, 1994; UN, 1996; Republic of Uganda, 1992). This is even more so for females who, due to a number of factors, most of which are gender-related, have long been disadvantaged in various social aspects (Taylor, 1985; Wamahiu, 1997; Republic of Uganda, 1995; 1998c). Several traditional societies consider female education as un- important and for many reasons girls will easily drop out of school while the boys continue to higher levels. For example, if a family has two children, a boy and girl, and it faces income constraints forcing one of the children to drop out of school, it would be girl to drop out. Girls are also more involved in household chores, before and/or after school in comparison to their male counterparts. Girls may also drop out of school because of pregnancy, which does not affect the boys. Lack of separate sanitary facilities for girls and boys in schools can cause girls to drop out of school especially when they reach adolescent age.

Consequently, girls education, and performance has remained behind that of boys, forcing governments and non-governmental organizations (NGOs) to direct efforts towards the promotion of education, especially for the females. It is also noteworthy that TFR[1] is significantly lower in urban areas than in rural areas. One reason for the urban-rural differential is the concentration of women with secondary and higher levels of schooling in urban areas and also the greater access to contraceptives and other medical facilities in urban areas. In addition many women in the urban areas are engaged in the labour market, thus

[1] Total Fertility Rate

finding it relatively more expensive to have many children. Women who have completed primary schooling or those with some secondary schooling have a lower TFR than women without schooling. It is noted, however, that the differential between the fertility of women with primary schooling and those with no schooling is small.

Many studies revealed a strong inverse relationship between age at marriage and the total fertility rate. The higher the age at marriage shortens the reproductive span which in turn reduces the fertility rate (Chaudhary 1984; Jolly 1981; Kaur, 2000). Demographers such as Cochrane and Zachariah (1983) have estimated that if marriages were postponed from the age of 16 to 21, the number of births would decrease by 20-30%. Gangadharan and Maitra (2003) have also observed that the age at marriage and age at first birth is also significant in the process of demographic change because higher the age at first birth is typically associated with lower fertility rate.

1.2 Female Labour-Force Participation and Fertility

Basic to the theory of fertility behaviour is the assumption that the various activities requiring the input of human time are mutually exclusive, implying that not too many activities can be undertaken at the same time. If out of the total available time T, an individual spends Tw working for a wage, then the time available for home production activities, That is (T – Tw) where the individual is employed in the organized market sector, this is a reasonable assumption. However, in a developing country, the assumption of mutual exclusiveness of the formal and informal activities requiring the input of a woman's time may be unrealistic, especially for the uneducated and marginally educated women. Home production activities would in this case, and particularly for the woman include household chores, cooking, fetching water, firewood, taking care of the children, etc., some of which are carried out the same time.

The relationship between women's labour market participation and fertility may greatly depend on the level of education. Increased schooling substantially enhances women's labour market opportunities through increased market wages and the substitution effects between time-intensive activities (including producing and raising children) and income and leisure that may occur (Birdsall, 1988; Schultz, 1993). Estimates show that the negative effect of women wages on fertility is much bigger than

that found for men (Lam and Duryea, 1999), a suggestion that women's labour market participation and increased education increase the value of their time making it relatively more expensive to bear more children as opposed to engaging in income-generating activities. In addition, with higher levels of education and earnings (actual and potential), women are more capable to invest in the human capital of their children, thus substituting quality for quantity in terms of the number of desired children (Becker, 1991; Lam and Duryea, 1999).

Female labour force participation in the informal sector versus the formal sector markets generates one other effect that may have a bearing on the response of fertility to educational attainment. A number of factors such as seniority, continuity of employment and the maintenance of regular working hours, that are crucial to women employed in the formal sector, have little influence on the expected life time wage rates of women employed in the informal labour market. As a result, the disruption of employment is of much less consequence to women in the informal labour market. It is therefore, inevitable that most women working in this sector are usually those with very little or no education. But these factors are crucial where the source of employment is the formal sector, and may greatly limit the age at which a woman decides to give birth and the number of children born.

The main objective of the present study is investigate the relationship between parental education and fertility for Pakistan from 1976-2010. We will also examine the effect of other social-economic variables on fertility; infant mortality rate, per capita income, urbanization and old age dependency.

The study is organized in 5 Sections: The Section 1 has been detailed earlier. Section 2 contains a detailed critical literature review. Section 3 is devoted to discussing the analytical foundations for the empirical analysis and the sources of the data used for the present study. Section 4 contains the estimates of our empirical analysis. Section 5 concludes the study with the conclusions and policy implications, suggestions and limitations of the study and directions for possible future research.

2. REVIEW OF LITERATURE

Economic theory does not provide clear guidance as to direction of the effect of education on fertility. Theory emphasizes mechanisms pushing in both directions. On the one hand, more educated women will have better labor-market opportunities (Becker 1960; Mincer 1963; Willis, 1973). If participation in the labor market precludes women from bearing and raising children, this implies that more-educated women will have lower completed fertility and likely delayed fertility. On the other hand, to the extent that children represent a normal good, wealthier women will choose to have more of them. More-educated women may be wealthier because education has a direct effect on their own earnings and/or because it has an indirect effect on their husband's earnings via assortative matching in the marriage market (Becker, 1981).

Previous literature emphasizes also the role of several other channels. For example, under positive assortative mating, a woman's education is causally related to her partner's education (Behrman and Rosenzweig, 2002). An exogenous increase in a woman's education affects her permanent income through a spouse-related multiplier effect. Another causal mechanism works through the effect of education on women's knowledge about contraception or reproductive health (Grossman, 1972; Rosenzweig and Schultz, 1989).

Neoclassical theory suggests that as investment in human capital increases and as more women participate in the labour market, the fertility behaviour of households is bound to change, in favour of fewer children (Singh, 1994). Empirical evidence from both developed and developing countries unambiguously reveals that female education is associated with a decrease in fertility (Sackey, 2005; Lam and Duryea, 1999; Ainsworth *et al.,* 1996; Vavrus and Larsen, 2003; Singh, 1994; Ben-Porath, 1973; Gardner, 1973; Schultz, 1973).

From a theoretical perspective, the predicted effect of an exogenous increase in a woman's education on her fertility is ambiguous because it depends on different substitution and income effects. Economists emphasize several causal channels by which education could affect fertility choices. One of the most discussed channels is the labor

market channel as proposed in the standard microeconomic model of fertility (Becker *et al.,* 1960).

The model assumes that education increases a woman's permanent wage, but the consequent effect on fertility is unclear. On the one hand, higher earnings raise the opportunity costs of leaving the labor market to rear children (Becker, 1965; Willis, 1973). This substitution effect tilts women's optimal fertility choices towards fewer children. On the other hand, higher earnings should be positively related to fertility because families can afford more children (Becker *et al.,* 1960). This income effect may be however weaker if parents with higher income prefer children of higher quality (Becker and Lewis, 1973). The more parents invest in each child, the fewer children they can afford.

In light of the strong correlation between education and other characteristics influencing fertility, it is not surprising that the empirical evidence on the education-fertility relationship is inconclusive. Black, Devereux, and Salvanes (2008) uncover large teen fertility effects exploiting compulsory schooling reforms in the US and Norway. In contrast, McCrary and Royer (2011) find no effects when they utilize variation in educational attainment due to school starting rules. Currie and Moretti (2003) estimate significant fertility responses to college openings but have crude measures of fertility.[1]

Economic explanations of the negative correlation between women's education and fertility are often based on the New Home Economics theory (Becker 1981). They reason that more educated, better earning women have higher opportunity cost of time than women with less education. Child raising is a time intensive task, so the cost of children increases with the wage rate if child care is done as part of household production, using parent's time.[2] The higher cost exerts a negative

[1] Within the economics literature, empirical work on the fertility effects of education is more complete for developing countries, where recent large national pushes to increase education can be used to identify the fertility effects of education. Examples include Breierova and Duflo (2004), Osili and Long (2008), and Duflo, Dupas, and Kremer (2011). These still tend to focus on teen outcomes, in part because the affected cohorts are too young to have completed their fertility.

[2] The value of time as a reason for fertility differences between more and less educated women has been assumed, for example, in models of economic growth with endogenous

substitution effect which reduces the demand for children, and this effect is usually assumed to dominate the ambiguous income effect.[1]

This negative relationship between women's education is explained by a number of factors, which have been explored by both economists and sociologists. First, the longer a woman stays in school, the longer they defer giving birth to their first child. This lowers the chances of giving birth to too many children. Moreover, with more education and exposure, women acquire more information about their bodies and are more able to process that information to their advantage (Vavrus and Larsen, 2003; Singh, 1994). The positive impact of women's education on their autonomy, leading to later marriages, increased use of contraceptives and lower fertility is discussed by Mason (1986). Indeed, the link between women's education and fertility is much stronger than that of the husband's (Ainsworth *et al.,* 1996).

A number of studies, using data from both developed and developing countries show that female education is associated with a decrease in fertility, (Sackey, 2005; Lam and Duryea, 1999; Ainsworth *et al.,* 1996; Vavrus and Larsen, 2003; Guilkey, 1998; Ben-Porath, 1973; Gardner, 1973; Schultz, 1973; 1974; 1997; 2008). In addition to the importance of women education, higher levels of education of people in the community have a strong negative impact on fertility.

Although an extensive empirical literature documents a negative association between female education and fertility, a causal relationship is difficult to establish because of potential reverse causality and selection on unobservable factors. Some recent studies approach these problems by using exogenous variation from school entry policies (see, e.g., McCrary and Royer, 2011) or changes in compulsory schooling laws (see, e.g.,

fertility (Becker et al. 1990, Galor/Weil 1996, de la Croix/Doepke 2003, SchÄafer 2005, Kimura/Yasui 2007).

[1] The income effect on the demand for children is ambiguous if parents are altruistic: If child related expenditures raise parents' utility, a rise in income would be used to "buy" more children and to spend more on each of them. But higher expenses per child increase the cost of children, reducing demand for them possibly more than the direct positive income effect, so the total income effect could be negative without implying that children are an inferior good (Becker/Lewis 1973).

Black *et al.,* 2008; Monstad *et al.,* 2008; Silles, 2011) as instruments for education.

A review of the relevant literature specifically on Pakistan found no association between literacy and fertility when the 1961 Census district-level data were used by Duza (1967). However, two smaller city-based sample studies found more significant negative associations between the two variables (Mzal *et al.,* 1976).

An elaborate study Khan and Sirageldin (1979) based on the National Impact Survey (1969) used a simultaneous-equation model and found that wife's education affected completed family size negatively in rural areas but did not seem to be relevant in urban areas. This study included both measures of income and husband's education each of which has differing effects in rural and urban areas and may be reflective of interaction between residence and these socio-economic variables. Hirsch *et al.,* (1981) find a positive relationship between educational attainment of the parents or raisers and the desired family size of teenage women in the US.

Sathar (1984) explored the relationship between female education and fertility in Pakistan based on data from the Pakistan fertility Survey 1975. Only light differentials were identified between women with no education and those who had primary or less schooling. However, women with more than primary education had notably lower fertility. Also the role of the intermediate variables such as proportions married, length of breast-feeding and contraceptive use had significant associations with female education.

Lakshmi and Bandyopadhyay (1986) study the effect of occupation, education and economic status of couples on fertility by using the Data of 386 couples of different socioeconomic status from Dehra Dun City (Uttar Pradesh) during 1981- 82. Results after analysis revealed that education up to graduate level for men and high school level for women is effective in increasing age at marriage which in turn reduces fertility. Husband's family income plays a positive role for reduction in fertility. Occupation of husband is also a determining factor for control of fertility.

A United Nations study in rural Maharashtra (1993) supported the role of female education as a determinant of fertility change by affecting the delay of age at marriage and use of contraceptives to limit family size. Pick et al. (1988) clearly revealed the negative impact of education on determinants of fertility change in Mexico by regression analysis. Chaudhary (1984) found that education is the strongest correlated variable with use of contraception and also one of the significant variables explaining fertility in Bangladesh.

According to Subbarao and Raney (1995), female education increases the value of women's time in economic activities by raising labour productivity and wages, with a consequential rise in household incomes and a reduction in poverty using district-level data. Female education also produces social gains by improving health (the women's own health and the health of her children), increasing child schooling, and reducing fertility.

Shirahase (2000) analyzing the decline in fertility in relation to increasing levels of educational attainment in Japan using data from the 1995 Social Stratification and Mobility (SSM) survey. Results confirmed that educational background is of great importance in reaching the life stage of marriage, the decision of whether to give birth or not, which is directly reflected in the declining birthrate, is strongly influenced by age at marriage. Moreover, it has been proposed that men's participation in housework be promoted to confront the declining birth rate in Japan.

Khaur (2000) found an inverse relationship between the level of education and fertility has emerged but seems to be no such strong inverse relationship between the level of income and fertility. As such, education helps in controlling the growth of population. Study concludes that the level of literacy is more effective in controlling the family size than the level of income. Education is positively related to the awareness and use of family planning devices.

Drèze and Murthi (2001) using district-level data of India and empirically find that female education is the most important determinant of fertility They also found that the indirect effect of parental education through the change in opportunity costs of parents is also tested by including predicted parental wages, also estimated by education.

Drèze and Sen (2002) argued that women's emancipation (through basic education, economic independence, political organization and related means) tends to have quite a strong impact on fertility rates. This linkage has been widely observed in international comparisons, but it is consistent also with recent experiences of remarkably rapid fertility reduction. Through this connection with demographic change, the role of women's agency extends well beyond the interest of today's women and even beyond the interests of all living people today, and has a significant impact on the lives of future generation.

Kravdal (2002) found a strong negative impact of the level of education at community level on fertility rates using demographic and health surveys data for 22 Sub-Saharan African countries. These findings confirm the neoclassical theory which suggests that as investment in human capital increases and as more women participate in the labour market, the fertility behaviour of households is bound to change, in favour of fewer children.

Philipov *et al.,* (2004) using fertility intentions data from Bulgaria and Hungary found no effect of educational attainment on the intention of ever having a first child for those without children but a positive effect on ever having a second child. Engelhardt (2004) finds a positive but not statistically significant relationship between having the highest post-secondary degree (Matura) and the total desired number of children among women in Austria.

Heiland, *et al.,* (2005) investigates the relationship between education and desired family size in Western Europe using rich individual-level data from West Germany and found that more educated men and women are more likely to prefer a family of three or more children over a family of two children compared to individuals with average schooling. They also found that some evidence that the more educated are less likely to favor childlessness or the one-child family over having two children. Replication of the analysis with multinational data indicates that this novel relationship holds more broadly in Western Europe. Since, higher education is associated with lower realized fertility and confirms that the gap between desired and actual fertility is largest for the more-educated.

Foster and Rosenzweig (2006) also analyzed the fertility decline in India using panel data from 1971 to 1999 by incorporating predicted wages into the fertility equation. They found evidence on the importance of changes in the implicit cost or shadow price of children and women as sources of fertility change. The main departure of study is that they use individual education in estimating male and female wage equations.

Nahar and Rahman (2006) examined the factors associated with women's age at first marriage and interval between marriage and birth during 1983-1985 and 1992-1994. They documented that age at marriage was steadily rising in rural areas of Bangladesh, and the increase was strongly associated with increased female education. However, education of women has opposite effects on childbearing i.e. on the first birth (fertility). There was an indication that educated women tend to have their first birth as early as possible after marriage.

Toor (2007) observe the impact of the individual and aggregate-level education on the fertility rate in Pakistan. The majorities of the estimates are statistically significant and show the expected relationship with the fertility rate. 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 for the level of economic development, appears an important element in the fertility response model. The Study also exhibited a weak relationship between health and reproductive health facilities and fertility rate in Pakistan.

Josipovi (2007) investigated that role of education in fertility behaviour has to be understood in the context of the long-term fertility decline in Slovenia and in 18 other 'developed' countries. It is unrealistic to expect sudden radical changes in fertility behaviour. We also should not expect inventions of a redeeming factor in the field of fertility theory that would explain all the theoretical qualms. He selected heterogeneous geographical regions of Slovenia and their population structure as well as selected population groups throughout Slovenia. The analysis brings to the fore evidence in support of the thesis on a curved relationship between education and fertility. It is concluded that disparities in fertility rates among women with dissimilar levels of education in the studied territories

were slowly diminishing through time, or have converted into other kinds of factor relations.

Bbaale (2008) used the Demographic and Health Survey 2006 to examine the relationship between female education and labour-force participation on the one hand, and fertility rates on the other for Uganda. Results confirmed the hypotheses that female education, especially at the secondary and post-secondary levels reduces fertility and increases their likelihood of being engaged in the labour force. While, the partner's education is also negatively related to the number of children born, the magnitude is much smaller. They also found that despite the near universal knowledge of family planning methods in Uganda and the importance of contraceptives in fertility reduction their usage is limited to less than half of the women in Uganda. Findings further show that access to or use of contraceptives is positively associated with the education of both the woman and her partner.

Katsushi, *et al.,* (2008) empirically investigates the determinants of fertility, drawing upon large nationwide household data sets in India constructed by the National Sample Surveys (NSS) and National Family Health Surveys (NFHS) over the period 1992-2006. Results clear a negative and significant association between the number of children and mother's education and father's education becomes increasingly important in reducing fertility. Results suggest that national and state governments should improve social infrastructure, such as school at various levels, promote both male and female education, and facilitate female labour market participation to slow down population growth.

Ferre (2009) uses data from the Kenyan Demographic and Health Surveys of 1989, 1993, 1998, and 2003 to uncover the impact of staying one more year in school on teenage fertility. Author find that adding one more year of education decreases by at least 10 percentage points the probability of giving birth when still a teenager. Study confirms that education has a strong influence on early reproductive outcomes, and that legislation aimed at improving educational outcomes may have spillover effects on to the fertility decisions of teenagers. As the timing of the first birth is often an indicator of future fertility patterns, reduced teenage fertility may also help reduce long-term fertility, a goal for most developing countries with high fertility rates. Study concluded that "The

increase in the education of women and girls contributes to greater empowerment of the women, to a postponement of the age of marriage, and to a reduction in the size of families."

A more recent literature attempted to address these earlier empirical challenges by employing regression discontinuity designs. For example, McCrary and Royer (2011) exploit a discontinuity in exact date of birth, though they are unable to examine the impact of *completed* education and are limited to measuring fertility over a narrow age range.

Above findings sharply contrast with the recent evidence for other European countries by Fort *et al.,* (2011) and Braakmann (2011) concluded that more education significantly increases the number of births. We interpret these different patterns for Germany mainly as the result of high opportunity costs of childrearing, compared to other countries. Specifically, our results are consistent with previous evidence that German mothers experience the highest wage penalty for motherhood in the Western world (Gangl and Ziefle, 2009). They found that the high permanent wage losses appear to be related to statistical discrimination against mothers in the German labor market.

Studies for countries and population groups with higher levels of fertility generally find negative effects of education on fertility (see, e.g., Osili and Long (2008) for Nigeria, Lavy and Zablotsky (2011) for Arabs in Israel). Analyses using compulsory schooling reforms in the U.S. and several European countries usually suggest that increased education leads to a postponement of the first birth away from teenage motherhood (see, e.g., Black *et al.,* (2008) for the U.S. and Norway, Silles (2011) for Great Britain and Northern Ireland). However, increased education does not necessarily affect completed fertility because women can catch up an initial reduction in births at later ages (see, e.g., Monstad *et al.,* (2008) for Norway, Fort (2009) for Italy, Geruso *et al.,* (2011) for U.K.).

Geruso, *et al.,* (2011) analyzed using data Information on educational attainment comes from the 1975-2002 UK Labor Force Survey (LFS). Analysis reveals that additional year of schooling had a significant impact on teen fertility, reducing it by around 20% at ages 16 and 17 and had at most a negligible effect on teen abortions. This implies that the teen fertility effects reflect a reduction in conceptions. Results

prove that cannot reject that an additional year of schooling had no impact on post-teen fertility and no impact on completed family size.

Bbaaleet, *et al.*, (2011) used the Demographic and Health Survey of 2006 to examine the relationship between female education, contraceptive use, and fertility rates in Uganda. Findings of the paper revealed that female education, especially at the secondary and post-secondary levels, increases the likelihood of using contraceptives and reduces fertility. While the partner's education is also negatively related to the number of children born, the magnitude is much smaller. As a result, measures that aim to educate women beyond secondary level are needed. The government programme to extend free education at the secondary level is an important measure that may help to reduce fertility and should therefore be strengthened.

Aldieri, *et al.*, (2011) analyzed the correlation between the level of education and the number of children in Italy by selecting 10,720 Italian families from the 2004-2007 European Union Statistics on Income and Living Conditions dataset. There is a significant negative correlation between the level of education and the number of children.

McCrary and Royer (2011) explored school entry rules in two U.S. states (California and Texas) and do not find any causal effect of education on fertility; neither on the incidence of motherhood, nor on the timing of first births. Recent contributions by Fort et al. (2011) and Braakmann (2011) show contradictory evidence from mandatory schooling reforms in Europe. Their results suggest that more education significantly increases the number of births.[1] The estimated effects may differ across studies because education affects fertility through different channels, but also because the importance of these channels may vary across countries, subpopulations, or levels of education.

Nag and Singhal (2013) found the complex relationship between mean age at marriage, education and fertility among Uttar Pradesh migrant families of Ludhiana district. The sample size comprises 1000 migrant families from U.P. belonging to age range of 15 to 50 years. Higher education and age at marriage could bring the reduction in fertility rate. Women education has a significant effect on fertility than men. Education opens economic opportunities for women and relationship of education to women's working status was found positive and level of literacy is more

[1] The authors attribute their finding to a positive effect of education on the stability of marriages

effective in controlling family size. Thus education helps in depressing fertility. Educational level of both husband and wife had a negative impact on fertility and couples who were more educated tend to have fewer children.

3. Methodology and Model Specification

Following the theoretical work of Becker (1960, 1981, 1992) and Becker and Lewis (1973), Sah (1991), Cigno (1998) it is possible to derive an equation for fertility where the demand for children is affected by many socio-economic factors such as the experience of child mortality, family income, old age dependency, urbanization and the level of human capital of parents.

$$FERT_t = \beta_0 + \beta_1 IMR_t + \beta_2 PCRGDP_t + \beta_3 OLDDEP_t + \beta_4 URBAN_t + \beta_5 FED_t + \beta_6 MED_t + \upsilon_t \quad (1)$$

Where FERT is fertility rate, IMR is infant mortality rate, PCRGDP is per capta real GDP, OLDDEP is old age dependency, URBAN is urbanization, FED is female education at university level and MED is male education at university level. Infant mortality rate and old age dependency are expected to be positively related with fertility rate. Urbanization and education of both female and male are expected to negatively affect the fertility while per capita income is ambiguous.

3.1 Unit Root Test: Augmented Dickey Fuller Test

An augmented Dickey-Fuller test is a test for a unit root in a time series sample. An augmented Dickey-Fuller test is a version of the Dickey-Fuller test for a larger and more complicated set of time series models. When the series of error term is not white noise then in that we keep on introducing lag terms of dependent variable until we get white noise series of error terms. The general form of ADF test can be written at level and first difference as follows:

$$\Delta Y_t = a y_{t-1} + \sum_{i=1}^{n} \beta \Delta Y_{t-1} + \delta + Y_t + \xi_t \quad (2)$$

$$\Delta\Delta Y = a_1 \Delta Y_{t-1} + \sum_{i=1}^{n} \beta \Delta\Delta Y_{t-1} + \delta + \gamma_t + \xi_t \quad (3)$$

Table 1: Description and Sources of Variables

Variable	Description
PCRGDP	Log of per capita real GDP **Source:** World Development Indicators (WDI)
FERT	Fertility rate (births per woman) **Source:** World Development Indicators (WDI)
FED	Log of university education, female **Source:** State Bank of Pakistan (SBP)
MED	Log of university education, male **Source:** State Bank of Pakistan (SBP)
IMR	Infant mortality rate (per 1000 live births) **Source:** World Development Indicators (WDI)
OLDDEP	Old age dependency (% of working age population) **Source:** World Development Indicators (WDI)
URBAN	Urban population (% of total) **Source:** World Development Indicators (WDI)

3.2 Co-integration Test

Co-integration is an econometric technique for testing the correlation between non-stationary variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then series is called co-integrated. The purpose of co-integration is to make OLS a BLUE. Standard regression analysis is said to be best, linear unbiased. The co-integration approach generally solves the problem by expanding the model in to a system of equation in which each variable may influence every other variable. The statistical significance of the dependence of each variable on every other variable can be tested. If two or more series are individually integrated (in the time series sense) but some linear combination of them has a lower order of integration, then the series are series are said to be co-integrated. A common example is where the individual series are first – order integrated I(1) but some (co integrated)vector of coefficients exists to from a stationary linear combination of them .for instance , a stock market index and the price of its associated futures contract move through time , each roughly following a random walk. Testing the hypothesis that there is a statistically significant connection between the futures price and the spot price could now be done by testing for the existence of a co -integrated combination of the two series (if such a combination has a low order of integration in

particular if it is I (0), this can signify an equilibrium relationship between the original series, which are said to be co-integrated.)

3.3 Vector Error Correction Model

An error correction model is a dynamic system with the characteristics that the deviation of the current state from its long-run relationship will be fed into its short-run dynamics. An error correction model is not a model that corrects the error in another model. A Vector Error Correction Model (VECM) can lead to a better understanding of the nature of any nonstationary among the different component series and can also improve longer term forecasting over an unconstrained model. The VECM form is written as:

$$\Delta y_t = a_0 + \sum_{i=1}^{m} \beta_i \Delta y_{t-i} + \sum_{i=0}^{m} \delta_i \Delta x_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta z_{t-i} + \lambda ECT_{t-1} + \xi_t \qquad \textbf{(4)}$$

The error correction term indicates the speed of adjustment to restoring equilibrium in the dynamic model. The ECM co-efficient shows how quickly/slowly variables return to equilibrium and it should have a statistically significant co-efficient with a negative sign.

4. Results and Discussions

Table 1: Results of ADF Unit Root Test

variables	**level**			**1st difference**			**order of integration**
	Intercept	Trend &intercept	None	Intercept	Trend & intercept	None	
IMR	-0.260301 (-2.96) LAG(1)	-3.070315 (-3.56) LAG(1)	-1.29848 (-1.96) LAG(1)	-3.80767* (-2.96) LAG(0)	-3.67992* (-3.56) LAG(0)	-2.3593* (-1.96) LAG(0)	1(1)
FERT	-2.802317 (-2.96) LAG(3)	-3.284965 (-3.56) LAG(3)	-1.25026 (-1.96) LAG(3)	-3.70354* (-2.96) LAG(3)	-3.56609* (-3.56) LAG(3)	-3.2551* (-1.96) LAG(3)	1(1)
OLDDEP	-1.659191 (-2.96) LAG(0)	-2.363464 (-3.56) LAG(0)	-0.37056 (-1.96) LAG(0)	-5.391575 (-2.96) LAG(0)	-5.303828 (-3.56) LAG(0)	-5.43204 (-1.96) LAG(0)	1(1)
FED	-1.227821 (-2.96) LAG(0)	-1.040795 (-3.56) LAG(0)	-1.69303 (-1.96) LAG(0)	-4.93483* (-2.96) LAG(0)	-5.86108* (-3.56) LAG(0)	-4.1499* (-1.96) LAG(0)	1(1)
MED	-0.403445 (-2.96) LAG(0)	-1.756289 (-3.56) LAG(0)	-1.74499 (-1.96) LAG(0)	-6.15539* (-2.96) LAG(0)	-6.09685* (-3.56) LAG(0)	-5.6568* (-1.96) LAG(0)	1(1)
PCRGDP	-0.925548 (-2.96) LAG(0)	-1.320890 (-3.56) LAG(0)	-1.14490 (-1.96) LAG(0)	-5.40851* (-2.96) LAG(0)	-5.68580* (-3.56) LAG(0)	-3.7570* (-1.96) LAG(0)	1(1)
URBAN	-1.105499 (-2.96) LAG(3)	-3.14839 (-3.56) LAG(3)	-1.45771 (-1.96) LAG(3)	-4.46427* (-2.96) LAG(2)	-4.52320* (-3.56) LAG(2)	-2.6397* (-1.96) LAG(2)	1(1)

Note:*Denotes the rejection of hypothesis at 5%level of significance

We test the null hypothesis of unit root against the alternative. The results of our study comprise that all variables have a unit root in their levels indicating that the levels are non-stationary. The first differenced series however, clearly rejects unit roots suggesting that the differenced variables are all stationary.

As results of unit root test show that all the variables are I(1). So we use Johansson co-integration test to test the long run relationship between inflation and its determinants. As the first step in co-integration we test the lag order of model. We determine the lag order through AIC (Akaike information criterion) using VAR (vector auto regressive).In the second step we test the null hypothesis of no co-integration against the alternative through maximum Eigen statistics.

Table 2: Results of Co-integration Test

Lags interval: 1 to 1				
Eigenvalue	**Likelihood Ratio**	**5 Percent Critical Value**	**1 Percent Critical Value**	**Hypothesized No. of CE(s)**
0.948	283.7742	131.70	143.09	None **
0.822	188.9479	102.14	111.01	At most 1 **
0.745	133.5960	76.07	84.45	At most 2 **
0.683	89.84386	53.12	60.16	At most 3 **
0.539	52.98126	34.91	41.07	At most 4 **
0.430	28.17521	19.96	24.60	At most 5 **
0.271	10.13143	9.24	12.97	At most 6 *

Note: *(**) denotes rejection of the hypothesis at 5%, 1% significance level. L.R. test indicates 7 cointegrating equation(s) at 5% significance level

Results of Maximum Eigen statistics show the evidence of four long run co-integration relationships in our model. We reject the null hypothesis of six co integrating relations against alternative of seven co-integrating relations.

4.1 Normalized Cointegrating Coefficients

$$FERT_t = \beta_0 + \beta_1 IMR_t + \beta_2 PCRGDP_t + \beta_3 OLDDEP_t + \beta_4 URBAN_t + \beta_5 FED_t + \beta_6 MED_t + \upsilon_t \quad (5)$$

Table 3: Dependent Variable: FERT

Variables	Coefficients	Standard Error	t.- Statistics
IMR	0.21	0.009	21.460*
PCRGDP	-1.81	0.123	-14.610*
OLDDEP	0.13	0.033	3.968*
URBAN	-1.62	0.090	-18.003*
FED	-0.13	0.026	-4.852*
MED	-0.04	0.033	-1.078
C	51.31	3.025	16.958

Note: * show the significance at 1% level of significance

Infant mortality positively affects the fertility as expected; a 1 % increase in infant mortality brings a 0.21 % increase in fertility. A high infant mortality rate means a high risk of child's death before growing up. High child mortality rate implies that parents will cover their risk of losing children by producing more children. High infant mortality rate is positively correlated with malnutrition of children, low number of doctors, birth unattended by midwives, and no access to health services, remote areas, uneducated parents, and poverty.

A rise in per capita income is associated with lower fertility; a 1 % increase in per capita income brings a 1.80 % decrease in fertility. With a rise in income, a greater concern for the quality of children rather than their quantity may become the dominant concern. Since quality children usually require greater investment than return, a rise in income might in fact lead to a reduction in fertility.

Fertility declines in response to an increase in women's education, a 1 % increase in women education at university level brings a 0.12 % decrease in fertility**.** Higher female education will correlate with higher opportunity to get good jobs, better salary and higher career advances, however it will also increase the opportunity cost for bearing children. Mothers with higher level of education get married later, have higher employment opportunities, have a higher relative wage, have a relatively stronger preference for child quality, and have higher consumption aspirations. All these factors, in turn, are expected to lower the demand for children.

The improvement in male education also negatively affects the fertility; a 1 % increase in male education at university level brings a 0.03

% decrease in fertility. The impact of male education on fertility is smaller than that of female education, because women bear the primary responsibility for child-rearing. It is also possible, in principle, for male education to matter more than female education, *e.g.* if fertility decisions are dominated by men. Indeed, most of the studies that have investigated both effects support the hypothesis that female education has a greater impact on fertility than male education.

The sign of proportion of urban population is negative and significant, a 1 % increase in urbanization brings a 1.62 % decrease in fertility. The shift of the economic structure from agricultural to industrial or service sector lowers the fertility rate. In order to survive in urban area, both male and female parent need to work in order to satisfy basic needs. Therefore, having more children in urban area increase both direct costs such as meals, education, babysitter and maid, and also an opportunity cost especially for working mother. The urban community is usually more concerned with quality of children rather than quantity of children. They produce fewer children and allocate more resources to increase living qualities for their children. This finding is also similar to Rosenzweig (1977).

The old age dependency positively affects the fertility; a 1 % increase in old age dependency brings a 0.12 % increase in fertility. Becker (1960) said that for most parents, children are viewed as durable goods, primarily a consumer's durable, which yields money income, satisfaction, to parents. Therefore, the theory of the demand for consumer durables is also a useful framework for analyzing the demand for children.

4.2 Error Correction Model

After Estimating long run coefficients we move toward VAR (vector error correction) model.

$$\Delta FERT_t = \beta_0 + \beta_1 \sum_{i=1}^{n} \Delta FERT_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta IMR_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta PCRGDP_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta OLDDEP_{t-i} +$$

$$\beta_5 \sum_{i=0}^{n} \Delta URBAN_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta FED_{t-i} + \beta_7 \sum_{i=0}^{n} \Delta MED_{t-i} + \eta ECT_{t-1} + \upsilon_t \quad \textbf{(6)}$$

Table 4: Dependent variable: ΔFERT

Variables	Coefficients	Standard Error	t. Statistics
ECT(-1)	**-0.104**	0.017	-6.028*
D(FERT(-1))	0.589	0.078	7.486*
D(IMR(-1))	0.005	0.006	0.785
D(PCRGDP(-1))	0.066	0.024	2.698**
D(OLDDEP(-1))	0.001	0.007	0.083
D(URBAN(-1))	-0.075	0.068	-1.098
D(FED(-1))	-0.004	0.008	-0.540
D(MED(-1))	2.49E-05	0.006	0.004
R-squared	0.995	S.E. equation	0.004
Sum sq. resids	0.000	Log likelihood	133.453

Note: *, ** show the significance at 1and 5 % respectively

Short run co-efficient estimates obtained from the ECM indicate that the estimated lagged error correction term (EC_{t-1}) is negative and significant suggesting that the speed of adjustment of fertility, in case of an exogenous shock, towards the equilibrium in the long run is 10% every year. Thus the equilibrium is stable. Short run results show that previous period's fertility, infant mortality rate, per capita income and old age dependency positively affect the fertility in current period. Previous period's urbanization and female education negatively affect the fertility. Most of the variables lose their significance in short run.

5. Conclusion

The trade-off between the number of children and the human capital invested in each child—i.e., between fertility and education—is a crucial ingredient of unified growth theory, which models the transition from Malthusian stagnation to sustained growth in a unified framework. The main objective of this empirical investigation is to observe and quantify the impact of parental education on fertility for Pakistan from 1976-2010. We develop a single equation model by incorporating some social-economic variables; infant mortality rate, per capita income, urbanization, old age dependency, education of male and female.

We employ Johenson Cointegration and Error Correction model to test the long run as well as short run relation b/w parental education and fertility. Results show that infant mortality rate and old age dependency

increase the fertility while per capita income, urbanization and education of both male and female reduce the fertility. The impact of male education on fertility is smaller than that of female education. Short run results further provide the proof for the existence of long run relationship. Short run results show that equilibrium is stable.

The results of the present study lead to some policy implications;

The possible choices for lowering fertility rate are both implementing low infant mortality rate and promoting female education policies. Policy should also focus on improving health and educational services in the rural areas. Lowering fertility rate through increasing access to quality reproductive health services is an important policy. Fewer children mean healthier and well-educated families as well as reduced government burdens to allocate budget on widening access of health and education services.

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