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ROLE OF GENDER BIAS AND PARENTAL EDUCATION AS DETERMINANTS OF COUPLES' FERTILITY DECISIONS IN PAKISTAN: BAYESIAN ECONOMETRIC ANALYSIS

Abstract. *Understanding the role of socioeconomic and cultural factors in couples' fertility decisions is imperative to slow down population growth in developing countries. This study is conducted to analyze the role of parental education and gender bias about son preference in births along with other conventional factors in shaping couples' fertility behavior (completed fertility) in Pakistan. Bayesian inference is employed to estimate the model using national level survey data. The study explores negative association of parental education and couples' decision to have number of children while son preference in birth is likely to aggravate fertility rate in Pakistan. However, maternal education seems to be the effective tool to reduce gender bias in births. These results are in line with Quantity-Quality theory and both channels, i.e. rational choice theory as well as imitation, seem to be effective. U type quadratic income effect and positive impact of paternal as well as maternal employment also support Quantity-Quality trade-off. Couple employment inversely affect fertility rate. Moreover, some demographic factors also have significant effect on couples' fertility decisions. Overall, the empirical results provide support to the neoclassical theory of fertility. Education can be considered as the best instrument to reduce fertility rate and to overcome social and cultural norms causing gender bias about son preference in births. Cultural norms in South Asian countries are homogeneous, the analysis in this study might be relevant to the whole South Asian region.*

Keywords*: Fertility, Son preference, Parental Education, Bayesian inference, Pakistan.*

JEL Classification: A13, C11, D91, J13, O53

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1. Introduction and Literature Review

Sustainable Development Goals (SDGs) set by UNO in 2015 provide world development agenda for 2016-30. UN projection about world population up to 2030 is 8.5 billion, i.e. addition of one billion people, and major part of this addition is expected to be in developing countries. Achievement of SDGs requires low population growth in developing countries. It is because widespread poverty, environmental degradation, depletion of natural resources, and poor economic and social development are closely linked up with high population growth. Therefore, understanding of socioeconomic factors shaping couples' fertility decisions may be helpful to devise effective population policies and ultimately to achieve SDGs. A good deal of research has been conducted to reach such an understanding. Becker (1960) and Becker and Lewis (1973) were the pioneer studies to develop a theoretical framework where couple's fertility decision was modeled as an endogenous variable to the economic and social system. Literature provides a number of studies following and extending the theoretical framework of Becker (1960) and Becker and Lewis (1973). Effects of socioeconomic and demographic factors including education, employment, income, social status, health status and households' specific characteristics on couples' fertility decisions have been modeled for various developing countries e.g., Bangladesh (Husain & Bagmar, 2015), and India (Sengupta *et al*. 2012) etc. Historically, social scientists analyzing couples' fertility behavior are divided into two camps: those who consider socioeconomic factors using rational choice theory (Becker (1960); Becker and Lewis (1973) and those who are advocates of imitation (Coale and Watkins, 1986) stressing cultural norms as of primary importance (see Lee, 2015). A number of researches analyzing couples' fertility behavior consider cultural factors within rational choice theory (Baudin, 2010). Studying the impact of education on fertility behavior lies at the heart of rational choice theory as it creates public awareness of reproductive health and lowering fertility rate. Most of the empirical researches in fertility literature support quantity-quality trade-off due to inverse relationship between number of children and parental education developed by Becker and others (Angrist *et al*., 2010). However, the exact nature of the relationship between fertility and education is ambiguous, resulting in a lot of arguments and counter arguments (See e.g. Lucas, 2002). It is because role of education itself is a function of other socioeconomic or cultural factors. Son's preference in births is one of the important cultural factors that affect couples' fertility decisions in most of the developing countries having patriarchal family system in Asia and Africa (Chaudhuri, 2012). This type of gender bias matter for public policy if it affects the level of aggregate fertility because parents having sons' preferences would continue to born children until they have a desired number of male babies (Basu and De Jong, 2010). Such cultural norms may divert the effect of education on fertility. Hence, the rational decision that a couple makes regarding fertility might be recognized without having to neglect cultural norm of sons' preference in developing countries. Understanding which mechanism matters most, i.e. rational choice or cultural norms, is key for policy design because it is different to understand, how norms evolve and are transmitted as compared to studying how people respond to incentives. Hence, role of son preference in births, parental education and interactions of the two variables in shaping couples' fertility decisions is important for policy making in developing countries.

Pakistan, having 210 million population, is the 6^{th} most populous country of the world where sons' preferences in births is deeply embedded in society (See, e.g. Atif *at al*. 2016; Channon, 2017) due to the traditional structure of family systems. According to population census 2017, population growth rate is 2.4% which is still high as compared to many other developing countries. It may adversely affects long-term development and SDGs, especially when GDP growth is less than 5% for the last many financial years. Two-way strategy may be effective to achieve long-term goals, i.e. policies to enhance economic growth as well as lowering population growth rate. Literature shows limited studies related to couples' fertility decisions in Pakistan (See e.g. Butt & Jamal, 1993; Hakim & Nausheen 1994; Hashmi & Zafar, 1997) consider national level survey data from the decade of 1980s. These previous studies have missed an important cultural factor, i.e. gender bias in births due to sons' preferences, for analysis of completed fertility of a couple. This type of gender bias may have important policy implications for high population growth in Pakistan. Moreover, it may divert positive role of education in decreasing fertility rate. Hence, testing the role of gender bias in births with and without parental education along with conventional socioeconomic factors as determinants of couples' fertility decisions in Pakistan is major objective of the study. For this purpose, Bayesian methodology is applied to conduct the analysis. Bayesian inference facilitates incorporation of prior information and hence, it may increase precision of estimates compared to classical inference provided prior information are useful (See Akbar *et al*. 2019). This paper contributes to the debate of rational choice theory and imitation for developing countries also.

2. Material and Methods

2.1. Specification of model

The model is specified for number of living children up to the reproductive age of a woman (spouse) in a household i.e. the completed fertility of a couple, an approach generally in line with other economics-based estimation models (see e.g., Winkelmann & Zimmermann, 1994; Wang & Famoye, 1997). Following the neoclassical theory of fertility, we include explanatory variables which are common in studies related to couples' fertility decisions provided availability of data. Quality-quantity approach presented by Becker (1960) and Becker and Lewis (1973) suggests that education, family income and employment determine future earnings as well as time cost of raising children and, hence are considered as explanatory variables for modeling couples' fertility decisions. We follow nonunitary modelling practice where husband and wife may have different preferences regarding fertility decisions and they are more likely to assert their own preferences as their bargaining power in the household increases. Hence, employment and education are categorized on the basis of gender dimensions. Keeping in view the availability of data, five categories of employment are considered, i.e. paternal paid employment, paternal employment as employer (No mother has been reported as employer in the data), maternal paid employment, couple paid employment, and agricultural employment. Category of the couples where both partners are unemployed or self-employed is taken as the base category. According to Becker and Lewis's (1973) quantity-quality approach, the net effect of family income is ambiguous depending on the relative strength of the income effect to the substitution effect. However, a threshold level may alter relative strength of the two effects. Hence, besides couples' income, square of couples' income is also taken as explanatory variable in order to test quadratic income effect of rising income on fertility decisions. Education is also considered with gender dimension, i.e. paternal education and maternal education in years, in this study.

Sociologists consider social and cultural constraints as the major determinants of fertility. Son preference is very common in South Asian countries. Pakistani society is a traditional male dominant society where sons are preferred over daughters. Girls are considered as dependent family members whereas sons are taken as financial supporters in future (Atif *at al*. 2016). It is a common phenomenon that this type of gender bias builds social pressure on the couples having only female children to give birth more children. Hence, sex ratio, i.e. percentage of female children, is taken as proxy variable of gender bias which is expected to be significant and direct effect on fertility decisions. The sex ratio at last birth is a better indicator of the extent to which women and men are trying to have sons— specifically, through differential stopping behavior. Two interaction terms are also considered in order to test effectiveness of paternal education and maternal education for gender equity in fertility decisions. Fertility decisions might differ between rural and urban households as well as between different racial and ethnic groups. Geographically, Pakistan consists of four provinces which are also considered as racial, ethnic and cultural divisions of the society. The people of these four provinces are likely to differ in culture, customs and social norms as regards fertility decisions. Hence dummy variables representing residential status (Rural versus urban) and province of origin are also taken as explanatory variables. On the basis of above discussion, the following model is specified.

$$Y_i = f\left(R_i, I_i, I_i^2, EM_i^H, EM_i^W, H_i^A, EM_i, EM_i^{HW}, E_i^H, E_i^W, P_i^{kp}, P_i^B, P_i^S, F_i,, F_i^{HE}, F_i^{WE}\right)$$

Here Y_i represents number of living children up to reproductive age of wife in the ith household. Detailed descriptions of the variables along with abbreviations are given in Table 1.

2.2. Data Description and Construction of Variables.

Data of all the variables are taken from Households' Income, Expenditure and Consumption Survey (HIECS) 2015-16. HIECS is a national level survey (excluding AJK and FATA) which is conducted after every two years by Pakistan Bureau of Statistics Available at official website. HIECS 2015-16 was conducted by employing two stage stratified sampling scheme where 1668 representative sample blocks were selected from all over Pakistan at first stage. At the second stage, 16 households were selected at random from each block and hence, 24238 households were finally interviewed. Respondents were required to provide their information at the time of interview. Households with only one live female partner of age more than 45 years are selected. Among these, the households for which data of all the variables used by the study are separated i.e. 7097 out of 24238 households. Construction of variables is explained in Table 1.

Table 1. Variables Descriptions

Abbreviation	Variables' Description
R_i	Residential Status where Urban=1 and Rural=0
I_i	Natural log of Couple total income as continuous variable
I_i^2	Natural log of Square of couples' total income
Em_i^H	Paternal paid employment=1 and zero otherwise. (The base category for all employment dummies is the households where both partners are unemployed or self-employed)
Em_i^W	Maternal Paid employment=1 and zero otherwise
H_i^A	Households' Agricultural employment=1 and zero otherwise
Em_i	Paternal employment as Employer=1 and zero otherwise
E_i^H	Paternal education in years (Completed education)
E_i^W	Maternal education in years (Completed education)
P_i^{Kp}	Couple's belonging to KPK province=1 and zero otherwise
P_i^B	Couple's belonging to Baluchistan province=1 and zero otherwise
P_i^S	Couple's belonging to Sind=1 and zero otherwise
F_i	Sex ratio, i.e. female children as percentage of total children used as proxy of gender bias for sons in births
Em_i^{HW}	Interaction term representing couple paid employment where both partners are employed=1 and zero otherwise.
F_i^{HE}	Interaction term of gender bias and paternal education in years
F_i^{WE}	Interaction term of gender bias and maternal education in years

2.3. Estimation Methods.

Bayesian Poisson regression framework is employed to estimate the above specified model. Bayesian methodology bases on the assumption that model's parameters are random variables whose estimates can be obtained on the basis of posterior distribution using sample data and other valid prior information. Derivation of likelihood function, construction of priors, construction of posterior distribution, simulation of estimates from the posterior distribution by using MCMC simulations and Gibbs sampling algorithm, and testing significance of estimates on the basis of Highest Posterior Density (HPD) interval are the important steps of Bayesian inference. Bayesian HPD intervals are interpreted with probability statement. Hence, the specified model is estimated using Bayesian framework. Details of Bayesian inference are provided by Zellner (1971), and Brooks & Gelman (1998).

Most of the studies analyzing fertility decisions of couples are estimated using Poisson regression model due to discrete and non-negative nature of the dependent variable "Number of children". Let Y_i be a random variable representing the number of children of ith couple. If Y_i follows Poisson distribution with λ as the expected number of children then the basic Poisson regression model will be as follows.

$$f(y/\lambda) = \frac{e^{-\lambda}\lambda^{y}}{y!} \; ; \; y = 0,1,2,3,\ldots \tag{1}$$

Poisson regression model assumes that $E(y/x) = var(y/x) = \lambda$. Here λ is determined by regressing it upon the explanatory variables. Since Y cannot be negative and therefore, λ_i is taken in exponential form as $\lambda = \exp(x'\beta)$. Hence the conditional probability function will be

$$f(y/x) = \frac{\exp(-\exp(x'\beta))\,(\exp(x'\beta))^{\wedge}y}{y!} \qquad y = 0,1,2,\ldots\ldots.. \tag{2}$$

The above probability function is used to derive likelihood function which is then used to estimate parameters of the model by employing maximum likelihood technique.

Bayesian inference using informative priors requires derivation of likelihood function, selection of prior densities and derivation of posterior density. Winkelmann (2008, p. 242-245) provides details of Bayesian inference for Poisson regression model. Likelihood function of the Poisson regression model is represented as follows.

$$L(\beta/y,x) \propto \prod_{i=1}^{n} \exp[-\exp(x_i'\beta)]\,[\exp(x_i'\beta)]^{yi} \tag{3}$$

According to Winkelmann (2008, p. 242), no conjugate prior exists for the $(k \times 1)$ vector of β in the Poisson regression model. Even with a non-informative prior, this expression is not the kernel of any known parametric distribution for β.

Assuming normal prior for β, *i.e.* $g(\beta) = \emptyset(\beta/\beta_0, B_0^{-1})$, the posterior density can be written as follows.

$$P(\beta/y) \propto \prod_{i=1}^{n} \exp[-\exp(x_i'\beta)]\,[\exp(x_i'\beta)]^{yi} \exp[-1/2\,(\beta-\beta_0)' B_0^{-1}(\beta-\beta_0)] \qquad (4)$$

Prior densities of the parameters are normal with unknown means and variances. Estimates of means and variances for prior densities are obtained by estimating the specified model using Poisson regression model under classical framework while considering data of HIES 2013-14.

Using these prior estimates, posterior mean estimates of the parameters are simulated from the above posterior density by conducting Markov Chain Monte Carlo (MCMC) simulations using Gibbs sampling algorithm. Large numbers of simulations are conducted while burning and thinning some of the estimates. Averages and standard deviations are obtained from the final selected simulation results and HPD intervals are used to test significance of parameters. Various diagnostic tests are applied in order to establish validity of the estimated Bayesian Poisson regression model. These tests include trace plots, density plots, Autocorrelation plots, Raftery-Lewis test, Heidelberger-Welch (stationarity) test and Half-width test.

3. Results and discussion

This section contains estimation results and discussion. In order to choose between Poisson and negative binomial regression, it depends on the nature of distribution of the dependent variable. Table 2 contains descriptive statistics of the dependent variable which shows that mean and variance of the dependent variable are almost same and hence equidispersion assumption of Poisson regression fulfills. Moreover, insignificance of Pearson goodness-of-fit test statistics and Deviance goodness-of-fit test statistics presented in Table 3 imply that Poisson regression model gives valid results because the response variable is not over dispersed. Hence Poisson regression model can be justified in order to analyze the determinants of fertility decisions.

Table 2: Descriptive Statistics of the dependent Variable

Y-Variable	Sample size	Mean	Variance	Min. Value	Max. value
HIECS 2015-16	7097	3.6261	3.6976	1	14
HIES-2013-14	3824	4.0601	4.0930	1	13

The specified model is estimated using Bayesian Poisson regression framework while considering data of HIECS 2015-16 as current information and data of HIES 2013-14 as prior information. For Bayesian inference of the model, parameters are assumed to follow normal distribution which requires means and variances of the prior normal densities of parameters. We consider data of HIES 2013-14 as prior information and data of all the variables are taken for 3800 households out of 17000 households from this survey. Selection of the households depends on availability of data of all the variables included in the specified model. The specified model is estimated using data of HIES 2013-14 as prior information. Classical Poisson regression framework is employed which gives us means and variances of prior densities of the parameters (See Table 3) for Bayesian inference. However, insignificant prior estimates are replaced with non-informative normal priors, i.e. zero mean and unit variance. Using these informative normal priors, the specified model is estimated under Bayesian Poisson regression framework using R and WinBUGS softwares jointly where WinBugs is called from R using R2WinBUGS package. Hence, Bayesian estimates are obtained by conducting 500000 MCMC simulations with 20 thinning and 50000 burnings. MCMC simulations are conducted by using Gibbs sampling algorithm to get posterior mean estimates along with posterior standard errors and 95% Highest Posterior Density Interval (HPDI). Various diagnostic tests are applied to establish validity of Bayesian Poisson regression model. Graphical projection of three among these diagnostic tests is given in Figures. Trace plots of all parameters presented in Figure 1 show that means and variances are stable which imply that the chain seems to have reached convergence. All density plots presented as Figure 2 show normality. Autocorrelation plots in Figure 3 show that MCMC samples are independent which also indicates a well mixing of the chain in all parameters. Some other diagnostic tests are presented in Table 4. Heidelberger-Welch reveals convergence of all parameters as null hypotheses of stationarity accept in all parameters. Half-width test show that the sample size is adequate to achieve convergence of chain in all parameters. All estimates of Raftery-Lewis test statistics are greater than ‘1’ which implies that the Markov Chain sample is sufficient to achieve the desired accuracy. It may be concluded that all diagnostic tests establish validity of posterior mean estimates given in Table 3.

The estimates of paternal education and maternal education are significant with negative sign. These results implies that couples prefer to have fewer children as opportunity cost of raising children increases, i.e. increasing returns to education results in fertility decline. These findings support the neoclassical theory of demand for children. Comparison of magnitude of the estimates indicates that maternal education shows larger effect on family size than doe’s paternal education. It is because the opportunity cost effect applies mainly to women as mothers have to spend more time on child-rearing than fathers in Pakistani society. Estimate of son’s preference in birth indicates that the couples are expected to have more children as the proportion of female children increases. It is because the society follows cultural norms and sons are preferred over daughters. These cultural norms induce most of the couples to give birth of more children until birth of required number of sons and therefore, the results supports imitation view. However, negative significant estimate of the interaction term representing son preference and maternal education implies that educated women prefer to have less children even though proportion of female children increases. Insignificant estimate of interaction term representing son preference and paternal education implies that paternal education is not effective for gender equity in births. The results of parental education and sons' preferences are consistent with the hypothesis that educated mothers tend to have a higher preference for child quality in line with rational choice theory. Higher maternal education level increases mothers' access to, and awareness of family planning, bargaining power, access to global communication networks, and opportunity cost of children due to higher labor force participation (Breierova and Duflo, 2004). It may be concluded that son preference in births is raising fertility rate in Pakistan. However, maternal education is playing positive role to break up these cultural norms that would be helpful to reduce population growth rate in Pakistan. Positive role of paternal education for declining fertility rate is offset by son preference in births. These results are in line with Imai and Sato (2010) for India. Hence, it may be concluded that although both channels, i.e. rational choice as well as imitation view in Pakistan, work but rational choice theory under the impact of education seems to be more effective in shaping couples' fertility decisions.

Income shows significant negative impact on fertility which indicates that couples desire less children as income increases. It is because people prefer to invest more money in improving quality of their children with rising income which raises cost of child and the number of children desire falls. Hence, substitution effect overcomes income effect. However, positive significant estimate of square of income shows a quadratic income effect on couples' fertility decisions. It is because the couples whose income crosses a threshold level, they don't have to face trade-off between quantity and quality of children due to sufficient resources. Such families prefer to have more children while considering children as durable goods following social and cultural norms of the society. In this later case, income effect overcomes substitution effect in couples' fertility decisions. The estimated U type income effect on fertility decisions may be considered as fertility Kuznets curve. These results support ambiguity mentioned by Becker (1960) and Becker and Lewis (1973) i.e. "the effect of family income is ambiguous depending on the magnitude of setting income and substitution effects". Positive estimates of paternal paid employment and maternal paid employment indicate that paid employment induces people to have more children. These results are in line with the earlier literature of fertility (Shreffler & Johnson, 2013). It is because paid employment of either husband or wife is considered a safe and stable source of income. Such couples may prefer to have more children while considering children as durable goods. However, estimate of the interaction dummy representing couple paid employment is significant and negative.

Table 3. Estimation Results of Poisson Regression Models

Variables' abbreviations	Parameters' Description	Prior Estimates of means and [variance]	Bayes mean Estimates [S.E.] (95% HPDI)
	α(Intercept)	0.9673047 [0.0628705]	0.6793** [0.001489] (0.5752; 0.7780)
Residential Status	β_1	0 [1]	-0.04596** [0.0001561] (-0.07611; -0.01545)
Couple income	β_2	-0.0498128 [0.0132799]	-0.1332** [0.0006681] (-0.1601; -0.1059)
Couple income square	β_3	0.0081624 [0.0010923]	0.01698** [0.00004966] (0.01482; 0.01907)
Paternal paid employment	β_4	0 [1]	0.08513** [0.0001570] (0.05635; 0.1141)
Maternal paid employment	β_{10}	0.1372079 [0.0404653]	0.08411** [0.0003311] (0.01894; 0.1476)
Head operating agricultural activities	β_6	-0.0829847 [0.0250196]	0.03161 [0.0002108] (-0.009197; 0.07353)
Paternal employment as Employer	β_5	0 [1]	-0.003619 [0.0004381] (-0.08377; 0.07313)
Paternal education	β_{11}	-0.0082127 [0.0033849]	-0.009194** [0.00002947] (-0.01371; -0.004706)
Maternal education	β_{12}	-0.0211068 [0.0051208]	-0.02064** [0.00002997] (-0.02658; -0.01487)
Couple' belonging to KPK	β_7	0.1726119 [0.0224606]	0.09736** [0.0001694] (0.06491; 0.1296)
couple' belonging to Baluchistan	β_8	0.4136196 [0.0265611]	0.2939** [0.0002270] (0.2537; 0.3344)
couple' belonging to Sind	β_9	0.1778563 [0.0203652]	0.1205** [0.0001654] (0.08805; 0.1532)
Gender bias for sons	β_{13}	0.0034451 [0.0003691]	0.0057** [0.000003] (0.005150; 0.006357)
Couple Paid employment	β_{14}	-0.1632506 [0.0541699]	-0.1275** [0.0004521] (-0.2161; -0.03797)
Gender bias and paternal education	β_{15}	0 [1]	-0.00007 [0.0000005] (-0.0001602; 0.00002446)

Gender bias and maternal education	β_{16}	0 [1.00]	-0.0001717** [0.0000005696] (-0.0002861; -0.00005867)
Deviance Goodness of Fit		3896.499 (0.1526)	
Pearson Goodness of Fit		3825.79 (0.4119)	
Pseudo R2		0.0376	

Table 4: Diagnostic tests of Bayesian Poisson Regression estimates

Parameters' Description	Raftery-Lewis Diagnostics	Heidelberger Welch test (P Value)	Half-Width test
α	1.680	Passed (0.4581)	Passed
β_1	1.010	Passed (0.3225)	Passed
β_2	8.110	Passed (0.4496)	Passed
β_3	5.750	Passed (0.4448)	Passed
β_4	1.070	Passed (0.0997)	Passed
β_{10}	1.002	Passed (0.4838)	Passed
β_6	1.010	Passed (0.6505)	Passed
β_5	1.006	Passed (0.2938)	Passed
β_{11}	1.030	Passed (0.6231)	Passed
β_{12}	1.000	Passed (0.4929)	Passed
β_7	1.050	Passed (0.5909)	Passed
β_8	1.050	Passed (0.4819)	Passed
β_9	1.010	Passed (0.5190)	Passed
β_{13}	1.102	Passed (0.1606)	Passed
β_{14}	1.010	Passed (0.8209)	Passed
β_{15}	1.094	Passed (0.7451)	Passed
β_{16}	1.003	Passed (0.2243)	Passed

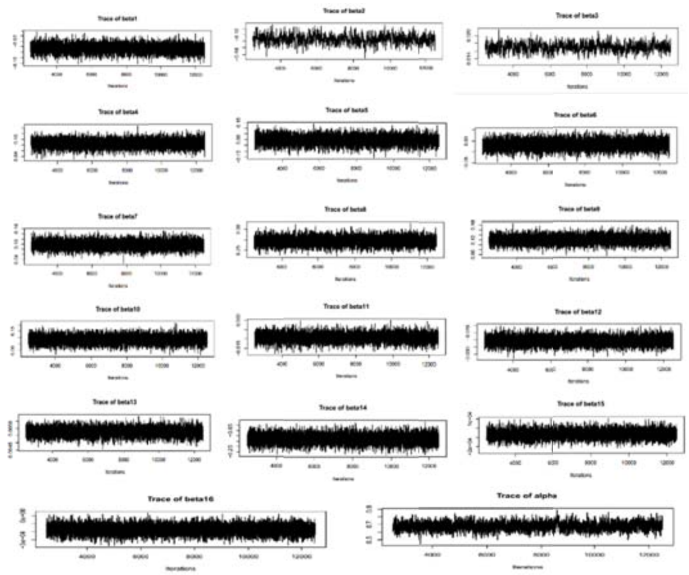

Figure 1: Trace tests of parameters

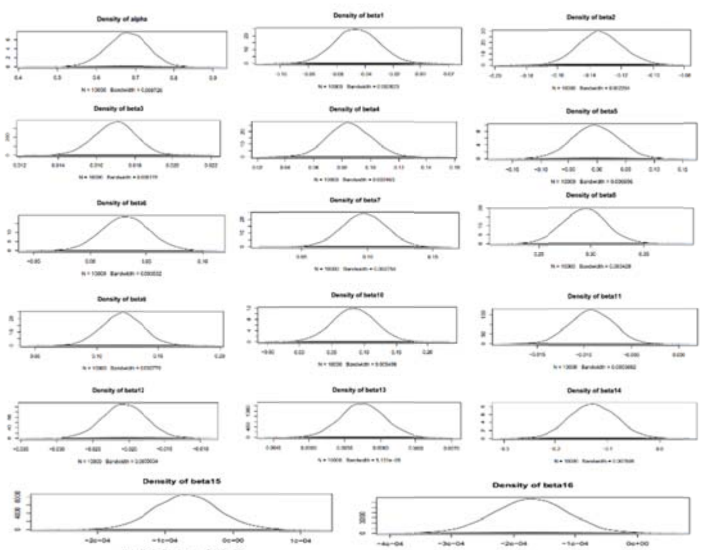

Figure 2: Density Plots of Bayesian Estimates

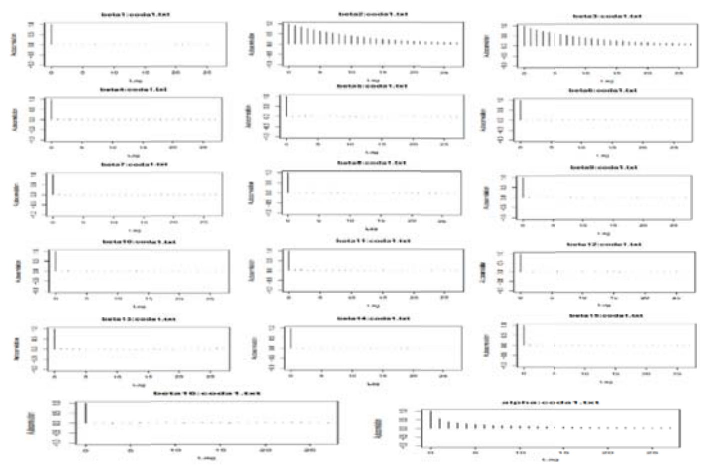

Figure 3: Autocorrelation Plots of Bayesian estimates

It shows that the households where both partners are paid employed prefer to have less children than the couples where both partners are unemployed. The reason may be that such couples are facing time constraints due to their employment. It supports the theory that as the opportunity cost of raising children increases, couple prefers fewer children. Estimates of the dummies representing paternal as employer and agricultural employment are insignificant.

Estimates of dummy variables representing cultural and demographic belongings of couples to the three provinces i.e. Baluchistan, KPK and Sind, are significant and positive. It shows that couples who belong to these three provinces tend to have more children than Punjab i.e. benchmark category. It is because literacy rate in Punjab is high compared to the other three provinces. These results are in line with provisional results of population census 2017 in Pakistan. Coefficient estimate of residential status is significant with negative sign which shows that couples residing in urban areas tend to have less children than the couples residing in rural areas. The results can be explained by both higher benefits and lower costs of children in rural areas.

4. Conclusions and Policy implications

Lowering of fertility rate is considered as the vital factor for economic development of developing countries. Understanding socioeconomic and cultural factors that affect couples' fertility decisions has significance for policy making. Literature of fertility shows that a number of studies have been conducted for analyzing the impact of socioeconomic factors under rational choice theory and cultural factors using imitation view. Role of parental education, which is at the center of rational choice theory, is ambiguous in developing countries due to traditional family system and other demographic and cultural factors. Moreover, son preference in births is important cultural element shaping couples fertility decisions in developing countries like Pakistan. Hence, this study develops a fertility model in order to know about the impact of parental education and son preference in births along with other conventional socioeconomic determinants on couples' fertility decision.

The estimation results reveal that couples desire fewer children as paternal and/or maternal education level increases. Comparison of the two estimates shows that maternal education level is more effective to lessen fertility rate as compared to paternal education level. These results are in line with quantity-quality trade-off presented by neoclassical theory of demand for children. The study explores significant role of son preference in births on couples' decisions to have more children. Following imitation view, sons' preferences may be considered one of the important cultural factor contributing in higher fertility rate in Pakistan. Moreover, increasing maternal education level helps to overcome the adverse impacts of son preference but the negative effects of higher paternal education are offset by positive effects of son preference in shaping fertility behavior of couples. The results of parental education and sons' preferences are consistent with the hypothesis of rational choice theory, i.e. quantity-quality trade-of. Hence, it may concluded that although both channels, i.e. rational choice as well as imitation view, work but rational choice theory under the impact of education seems to be more effective in shaping couples' fertility decisions. Hence, maternal as well as paternal education can be considered as effective tool for family planning. Public policy may focus to raise female education level in order to control high population growth rate in Pakistan. U type quadratic income effect on expected number of children desired by the couples is explored in Pakistan. It implies that couples prefer quality over quantity of children with rising income. As income increases above a threshold level where couples don't have to face trade-off between quantity and quality of children due to sufficient resources, they desire more children while considering children as durable goods due to cultural norms. Paternal paid employment and maternal paid employment show significant positive impact while agricultural employment and paternal employment as employer are insignificant for fertility decisions. It implies that permanent income induces people to have more children. However, negative estimate of couple paid employment supports neoclassical theory stating that couples prefer to have fewer children as opportunity cost of time increases. Moreover, urban couples are expected to have less children compared to rural couples. Estimates of cultural dummies support provisional results of Population Census 2017 implying that the families belonging to Punjab are expected to have less number of children compared to the other three provinces. Overall, the results are in line with rational choice theory and the impact of cultural norms may be overcome by devising incentive base policies.

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