ISSN Online: 2709-7625
ISSN Print: 2709-7617
Vol.4 No.4 2021

MACROECONOMIC DYNAMICS OF FERTILITY IN PAKISTAN

Muhammad Irfan Chani[1], Amatul R. Chaudhary[2]

Abstract

This study aims to investigate some socio-economic and demographic determinants of fertility in Pakistan. For this purpose, thirty annual observations were included in the dataset. This annual data was collected from World Development Indicators by World Bank. The study used Ng-Perren unit root test was used to check the stationarity of the time series data and Autoregressive Distributed Lag (ARDL) model was used to check the cointegration. The estimates for Pakistan indicated that income per capita, population density, and female labour force participation rate had negative association with total fertility rate. These estimates were statistically significant at five percent level of significance. The coefficient of child mortality rate indicated that child mortality was statistically insignificant factor in explaining variation in total fertility rate in Pakistan at five percent level of significance. The coefficient of interest rate in the regression of total fertility also lacked statistical significance at five percent significance level. The results of ARDL test of cointegration indicated that all the variables considered in the regression model had long run equilibrium relationship.

1. Introduction

The study of economic consequences of population growth has a long tradition in economic literature. We find discussion on economic effects of rapid population growth in the work of Petty (1690) and Godwin (1793). According to Smith (1776), every species of animals naturally multiply in proportion to the means of their subsistence, and no species can ever multiply beyond it. To quote him:

"In civilized society it is only among the inferior ranks of people that the scantiness of subsistence can set limits to the further multiplication of the human species." (Smith, 1776).

Population growth may be viewed as an important determinant of economic growth. Fertility plays an important role in determining the rate of population growth. It can also reduce economic growth by restricting women's role in economic activities because they would have to spend their time in bearing and rearing children which they could otherwise, spend in some productive economic activities in industrialized societies. The growing value of time and the increased emphasis on schooling and other ingredients of human capital explain the decline in fertility.

An overview of worldwide statistics shows that there are huge differences of fertility rate across countries (World Bank, 2011). Large differences in total fertility rate across the countries have also been reported by United Nations (2011, 2013) which ranges from 1.0 for Macao to 7.4 for Niger. This study will identify the factors which are responsible for these differences. By using standardized coefficients, the study will also highlight the relative importance of the factors responsible for variation in total fertility rates.

1.1 Objectives

The objectives of this study are the following:

To investigate some economic determinants of fertility in Pakistan

To examine some demographic determinants of fertility in Pakistan

To investigate the relative importance of each determinant (mentioned above) of fertility in Pakistan

2. Literature Review

Over the past few decades, most of the work on endogenous population and economic growth has been theoretical. Only a few empirical studies have examined the effects of population growth and fertility on economic growth (Brander & Dowrick, 1994; Ehrlich & Lui, 1991; Wang et al., 1994; Winegarden & Wheeler, 1992). However, in earlier literature on neoclassical growth models with endogenous fertility, there was no

[1] Assistant Professor, COMSATS University Islamabad, Vehari Campus, Pakistan
[2] Vice Rector (Academics) & Dean Faculty of Social Sciences, National College of Business Administration and Economics (NCBA&E), Lahore, Pakistan

empirical evidence for the dependence of fertility on major macroeconomic variables in an economy linked to the international capital market. As a result, the interactions between fertility and macroeconomic variables have not been resolved, and the causes of short-run and long-run fertility variations have not been discovered.

The empirical work on the issue appears to be consistent with the theoretical analysis of Barro and Becker (1989) in the sense that fertility should be considered an endogenous variable to the labour market, the capital markets, and the growth process. In particular, wage, interest rate, and output shocks are responsible for the variations of the fertility rate. Furthermore, the results suggested that an increase in fertility growth was responsible for higher economic growth only in the long run.

The relationship between fertility and saving has also been ambiguous. The higher saving arising from lower fertility can be considered as first round effect only. A second round effect may be a positive income effect and a negative substitution effect from the lower interest rate that results from lower fertility. Both of these effects tend to lower savings in response to lower fertility and therefore works in the opposite direction to the first round effect on saving. The second round effect of low fertility on saving may be different when the demand for loanable funds increases due to lower interest rate which may give rise to savings and economic growth as well as more demand for loanable funds may enhance the saving for borrowing regions in response to lower fertility (Guest & McDonald, 2002).

The effect of lower fertility on living standards in Australia has been studied by Guest and McDonald (2002) and Guest (2006). They showed that, in the case where the interest rate was constant, lower fertility was likely to result in an improvement in living standards throughout the planning period. The reason was that there were two consumption dividends that accrued as soon as fertility dropped. These were the dividends from lower youth dependency and from lower capital widening requirements. These were eventually offset by higher old age dependency. The net effect was a gain which can be smoothed out and resulted in higher living standards throughout. Where the interest rate was endogenous, the result was somewhat different in a sense that optimal consumption was initially higher, but subsequently lowered, under lower fertility and there remained a small net discounted gain from lower fertility.

Croix and Doepke (2003) developed a theoretical link between income inequality and growth. The study found that spread in the income distribution increases the fertility differential between the rich and the poor. Consequently lowers education and therefore growth.

Córdoba and Ripoll (2012) introduced credit frictions into Barro-Becker model and found that there was a negative relationship between fertility and individual wage income which could be obtained when the inter-temporal elasticity of substitution is larger than one. The study also explained the quantity-quality trade-off by concluding that individuals with higher wage income chose more schooling and fewer children.

There is negative relationship between female participation in labour market and fertility of female on sociological and economic grounds. If we see the sociological aspect of female participation in labour market, it is reducing the traditional role of female as mother and homemakers. So there is negative relationship between female employment and fertility of female. On the other hand, if women prefer their economic wellbeing and healthy life, then they may also prefer to have a few children. If we look at the economic and social life of female, it seems difficult to manage the work with children. This leads working women to prefer less children (United Nations, 1985).

Mammen and Paxson (2000) extended the work of Goldin (1995) and found that the relationship of female per capita income and female participation rate in labour force was U-shaped. They found in the poor and agriculture economies female participation in paid jobs was high because in these economies family and job could be handled easily. But in low urbanized and middle income countries where manufacturing sector was dominant, it was difficult for women to manage work and family at the same time. So the fertility rates were high in middle income countries.

Kravdal (2002) found the negative relationship between community education and fertility rates. The results of the study confirmed the neoclassical notion which emphasized that investment in formation of human capital enhanced female labour force participation rate. This enhancement in participation of female in labour force changed household behavior about preferred number of children and reduced fertility rate in long run.

Pakistan observed a remarkable decline of about 40 percent in fertility during 1980 to 2006. In recent years there are signs of decline in fertility but the pace of decline seems to be slow. Even after such huge decline, progress in fertility reduction may not be considered as success story as fertility rate in Pakistan is still highest in the South Asian region excluding Afghanistan (World Bank, 2010).

The recent literature on fertility and economic growth highlights quite different picture than Malthusian propositions. Industrial revolution changed the picture that was portrayed by Malthus (1798). Becker and Barro (1988) considered degree of altruism for fertility decisions and consumption smoothing by current and future generations over the life time of family instead of individuals. In this framework technological progress was positively associated with economic growth and negatively linked with fertility rate. Becker et al. (1990) supported this idea and argued that in the era of rapid technological progress human capital was the key factor for enhancing the pace of economic growth. So the returns to human capital were increasing and were making the investment in human capital more profitable. Thus the increasing investment in human capital reduced the fertility rate.

Azariadis and Drazen (1993) explained the fertility decline in face of rapid economic growth in different perspective. The study argued that in a setting where fertility decisions were taken on the basis of future consumption in old age, then an increase in labour wages made the children relatively less valuable for parent. So the higher labour market wages in high growth periods caused the reduction in fertility rate. Heckman and Walker (1990) and Schultz (1985) were of the view that increase in women's wages as compared with male wages could play a positive and effective role in fertility decline.

Growth theories considered increase in fertility as a source of decline in per capita capital. Barro (1991) and Mankiw et al. (1992) argued that population growth diluted the capital which had negative effect on per capita income growth. They also reported negative coefficient of population growth in cross-country growth regression.

Doepke (2005) reported that in the year 1861, there were on average five children per woman in England over her reproductive period. Survival rate of children till the age of ten years was seventy percent at that time. But till 1951, the average number of children per women decreased to two children with the increase in survival rate of children till the age of ten years by ninety-five percent. Industrializing economies observed demographic transition during that period due to decline in both fertility and mortality rates. Many of economists have tried to build macroeconomic theories on the basis of demographic transition which were attributed to economic growth in long run. Most of these economic theories focused on fertility declines to explain the linkages between economic growth and demographic transitions and one could observe least focus of the economists on decline in mortality rates in this regard (Galor & Weil, 2000; Greenwood & Seshadri, 2002). In contrast to the views of the economists, demographers concentrated on the relationship of fertility decline and decline in mortality to explain the transitions. They were of the view that decline in mortality led the economies to fertility decline and both the variables have cause and effect relationship (Jones & Schoonbroodt, 2010).

Bhattacharya and Chakraborty (2012) argued that dynamics of Barro-Becker model of fertility could not explain the fact that declining child mortality led to decline in net fertility in demographic transition everywhere. Their study augmented social norms to make the model more realistic. The study concluded that increase in child surviving probabilities lowered the net fertility by influencing the household preferences.

Spataro and Fanti (2011) extended Diamond (1965) overlapping generations model which stated that welfare would increase when interest rate would be lower than population growth rate. The extension was made by augmenting endoginity of fertility and it proved that Diamond's assertion was not sufficient for welfare. The lower interest rate might lead to higher level of optimal debt which might lead to increase in child rearing cost and lower fertility rate. Population growth higher than interest rate might even worse the welfare in the presence of endogenous fertility.

Literature discusses various channels through which female paid work may influence the fertility rate. These channels include female age at first pregnancy, delay in transition to parenthood, paid work after marriage and female human capital. Morgan and Rindfuss (1999) argued that age at first pregnancy determined cumulative fertility of a women and this was empirically valid for United States. Tsuya and Mason (1995) studied the case of Japan and indicated that higher female education and female participation in labour market, by opposing their domestic traditional role, led to postponement of parenthood. Women participating in paid labour had high probability of postponing the first birth as compared with non-working females in USA. These delays were mostly due to the higher opportunity cost of child care for working women with higher level of human capital (Hoem, 1996; Rindfuss et al., 1996).

3. THEORETICAL FRAMEWORK, ECONOMETRIC METHODOLOGY AND DATA SOURCES

a) THEORETICAL FRAMEWORK

After Malthus, a long debate among demographers and economists seems to be continued. Different frameworks were suggested for conducting the studies on economic determinates of fertility rate. Writing of Becker (1960) may be considered one of the pioneering study which presumes children as a commodity which, like other consumable commodities, can have satisfaction for parents and can give them benefits like capital goods and requires investment. This framework of Malthus along with the emergence of family economics as well as overlapping generation models in economic sphere and their applications in macroeconomics refined this framework for macroeconomic analysis. In this work theory of Altruism, tradeoff between quality and quantity of children, intergenerational transfers and value of time, cost and benefits on investment in human capital of children in an open economy where financial institutions work well are also considered.

This study aims to investigate different economic and demographic determinants of fertility in Pakistan. We shall explore the extent to which income per capita and other determinants are responsible for fertility rates. The study will consider Pakistan as a case study.

Our model is estimated for Pakistan and the following regression model is estimated:

$$TFR_t = \beta + \beta Y_t + \beta PD_t + \beta CMR_t + \beta FLP_t + \mu_t \qquad (1)$$

where,

TFRt = Total Fertility rate (births per woman) at time 't'.
Total Fertility rate is defined as births per woman.

Yt = Economic growth measured by real gross domestic product (GDP) per capita, in US dollars, at time 't'.

PDt = Population Density at time 't'.

CMRt = child mortality rate at time 't'.

FLPt = Female labour force participation rate at time 't'.

b) ECONOMETRIC METHODOLOGY

Keeping in view nature and properties of the data, the study divided the analysis is consisted of time series data analysis for Pakistan. As the selection of econometric tools

and tests is concerned, the nature of data is time series which includes thirty annual observations. Time series data usually have time trend and is non-stationary in nature. For non-stationary data, simple regression estimates using Ordinary Least Square (OLS) are spurious (Granger & Newbold, 1974). In such case, OLS estimates are reliable if cointegrating relationship exists among the variables (Phillips, 1986).There is a large variety of unit root tests to detect the stationarity or non-stationarity of time series. Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are among the widely used unit root tests. But the power properties of these tests are not considered appropriate and reliable when they are used for small samples. Ng-Perron unit root test and Dickey-Fuller Generalized Least Square (DFGLS) unit root test are considered more appropriate and reliable for small samples. Although DFGLS test has comparatively better power properties but it is not considered reliable for small samples because it suffers from size distortion (Ng & Perron, 2001).

Ng and Perron (2001) introduced a unit root test with better power properties and it is also considered more appropriate for small samples as compared with other available unit root tests(Harris & Sollis, 2003). To check the distortion of size and power, Ng and Perron (2001) performed and reported simulation. The results show that the consistency and performance of Ng-Perron test make it more preferable than DFGLS test. To test the stationarity or non-stationarity of time series, this study uses the Ng-Perron test of unit root.

Cointegration tests are used to check the existence of equilibrium relationship among the variables. Engle and Granger (1987) introduced the concept and first test of cointegration. Later on Stock and Watson (1988), Johansen (1988, 1991, 1992, 1995), Johansen and Juselius (1990), Pesaran and Shin (1999) and Pesaran et al. (2001) also worked on this idea and introduced their tests of cointegration. The tests developed by Johansen and Juselius(1990) and Pesaran et al. (2001)are among the famous and frequently used tests of cointegration. Cointegration test introduced by Pesaran et al. (2001) is also known as Autoregressive Distributed Lag (ARDL) bound testing approach to cointegration. This approach is preferred over other available tests of cointegration due to its flexibility in use.

ARDL bound testing approach allows to check the cointegration when some variables are stationary at level and others are stationary at first difference. It can also check the cointegration among the variables when they all are stationary either at level or at first difference. Unlike residual based cointegration tests, ARDL bound testing approach is developed on the basis of Unrestricted Vector Error-Correction Model (UECM) and is more robust (Pattichis, 1999). Small sample biasedness of cointegration tests can also be addressed by using the ARDL approach to test the existence of cointegration (Mah, 2000). Problem of endogenity of regressors can also be addressed by using bound testing approach to cointegration (Alam & Quazi, 2003). To check the cointegration among the variables, included in our analysis, this study uses ARDL bound testing approach to cointegration.

c) DATA SOURCES

Data for total fertility rate, gross domestic product per capita, child mortality rate, population density, female labour force participation rate and interest rate is taken from World Development Indicators online database by World Bank.

4. EMPIRICAL RESULTS

This section presents the empirical estimates of the study related to Pakistan. The section aims to estimate the impact of income, population density, female labour force participation and child mortality on total fertility rate in Pakistan. To solve the purpose, the study checks the stationarity of the data, then existence of long run equilibrium relationship through cointegration test and long run coefficients of the regression model.

A. Data Stationarity

Results of unit root test, to check the stationarity of time series data, are reported in the Table 4.1 given below. Schwarz Information Criterion (SIC) is used for optimal lag selection in Ng-Perron test. The results indicate that total fertility rate, income per capita, population density, female labour force participation and child surviving probabilities are non-stationary but the variable of interest rate is stationary at level. This indicates that the null hypothesis of unit root or non-stationarity cannot be rejected, at one percent, five percent as well as for ten percent level of significance, for all variables except interest rate in level form. The results also indicate that all variables are stationary in first difference form at various levels of significance and their level of significance is indicated through stariks (*) in the table. In first difference form the null hypothesis of unit root can be rejected for all variables. Thus, it can be concluded that the variables involved in our analysis of fertility model for Pakistan have mixed order of integration. Total fertility rate, income per capita, population density, female labour force participation and child surviving probabilities are integrated of order one or I(1) and interest rate is integrated of order zero or I(0).

Table 4.1: Ng-Perron Unit Root Test

At Level				
Variable	**Ng-Perron Test Statistics**			
	MZa	**MZt**	**MSB**	**MPT**
TFR	1.67799	3.89103	2.31886	392.353
Y	0.64971	0.31659	0.48727	20.4886
PD	-0.77416	-0.33217	0.42907	13.8586
CMR	1.42756	2.44709	1.71417	207.516
FLPR	2.04727	1.45600	0.71119	45.5641
R	-9.19467**	-2.13199	0.23187	2.71094
At 1st Difference				
Variable	**Ng-Perron Test Statistics**			
	MZa	**MZt**	**MSB**	**MPT**
TFR	-15.8026***	-2.81061	0.17786	1.55154
Y	-11.6489**	-2.41306	0.20715	2.10448
PD	-34.7008***	-4.16448	0.12001	0.70865
CMR	-9.32293**	-2.15799	0.23147	2.63197
FLPR	-13.8127***	-2.62753	0.19023	1.77549
R	-13.5524**	-2.53081	0.18674	2.07901

*, ** and *** represent that we may reject the null hypothesis of unit root at 10%, 5% and 1% level of significance respectively based on MZa static critical values (-5.700, -8.100 and -13.800).

B. Lag Selection

Table 4.2 presents the estimates of different lag selection criteria, like Final prediction error, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion, using Vector Auto-Regressive (VAR) framework. By taking care of number of time series values, number of variables included in the regression model lag requirements of VAR based cointegration test, the results suggest optimum lag length of one.

Table 4.2: Lag Order Selection Criteria Based on VAR

Lag	FPE	AIC	SC	HQ
0	5104.303	22.72709	22.96283	22.80092
1	3.08E-05*	3.771791*	5.186235*	4.214777*

* indicates lag order selected by the criterion
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C. Results of Cointegration Test

ARDL bound testing approach to cointegration has been used to check the long-run relationship of total fertility rate, income per capita, population density, female labour force participation and child surviving probabilities and interest rate.

Table 4.3 reports the results of ARDL cointegration test. Wald based F-statistic is used to test the null hypothesis of no cointegration among the variables mentioned above. The calculated value of F-statistic is 84.983. This value is greater than the critical value of upper bound, presented in the same table, at five percent level of significance.

This suggests that the null hypothesis of no cointegration, among the variables included in the model, may be rejected at five percent level of significance. Thus, the estimate of ARDL test of cointegration show that the total fertility rate, income per capita, population density, female labour force participation and child surviving probabilities and interest rate are in long run equilibrium relationship.

Table 4.3: Bound Testing Approach to Cointegration
ARDL (1, 1, 0, 1, 0)

F-Statistic (Wald-Test) = 111.9496		
Level of Significance	**Pesaran et al. (2001)**	
	Lower Bound Value	**Upper Bound Value**
5%	3.3566	4.7919
10%	2.7510	3.9768

As evidence presented in Table 4.3 shows that the existence of long run equilibrium relationship among the variables used in the present study. Therefore, the long run coefficients presented in Table 4.4 are reliable. These long run coefficients tell about the effect of income per capita, population density, female labour force participation and child surviving probabilities on total fertility rate in Pakistan.

Table 4.4: Long Run Relationships

Dependent Variable: TFR				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Y	-0.033397	0.014660	-2.278060	0.0315
PD	-0.024952	0.013509	-1.847062	0.0766
CMR	0.001488	0.021801	0.068262	0.9461
FLPR	-0.053517	0.028304	-1.890806	0.0703
C	10.01536	-	-	-

The results given in Table 4.4 reveal that income per capita negatively affects the total fertility rate in Pakistan. This result is statistically significant based on t-statistic and corresponding p-value. The negative sign of the coefficient of population density shows that population density has negative relationship with total fertility rate. Increase in population density may result in decrease in total fertility rate. Based on t-statistic and corresponding p-value, coefficient of population density is

statistically significant. Child mortality rate inversely affects total fertility rate in Pakistan but the estimates show that role of child surviving probabilities measured through child mortality rate is statistically insignificant. This significance is checked through t-statistics. Female labour force participation rate negatively affects total fertility rate in Pakistan.

Table 4.5: Scaled Coefficients for Table 4.4

Variable	Standardized Coefficient	Elasticity at Means
Y	-0.061075	-0.015614
PD	-0.826473	-0.779588
CMR	0.026159	0.032868
FLPR	-0.156295	-0.153601
C	NA	1.915935

Table 4.5 presents the standardized regression coefficients for the long run estimates given in Table 4.28 for Pakistan. The magnitudes of standardized coefficients show that population density explains the highest variation in total fertility in Pakistan and it is followed by female labour force participation and per capita income. Child mortality rate has the lowest magnitude of its standardized coefficient but its regression coefficient reported in Table 4.4 is insignificant.

The statistics indicate that female labour force participation is very low in Pakistan. It not only low as compared with average of worldwide sample but it is also low as compared with that of low income countries. Pakistani government can encourage and take measures to enhance the labour force participation rate in order to reduce fertility rate as well as to enhance the pace of economic growth. This finding is similar to that of Schultz (1985) in case of Sweden which proves that with more enhancement of female labour intensive industry, total fertility rate can be controlled. So government should take initiatives to encourage the investment in female labour intensive industries as a part of birth control policy.

Table 4.6: Diagnostic Tests for ARDL Model

Serial Correlation (Breush-Godfrey Serial Correlation LM Test)	F-statistics = 0. 57874	Probability = 0.456
Heteroskedasticity Test (White Heteroskedasticity Test)	F-statistics = 0.39760	Probability = 0.534

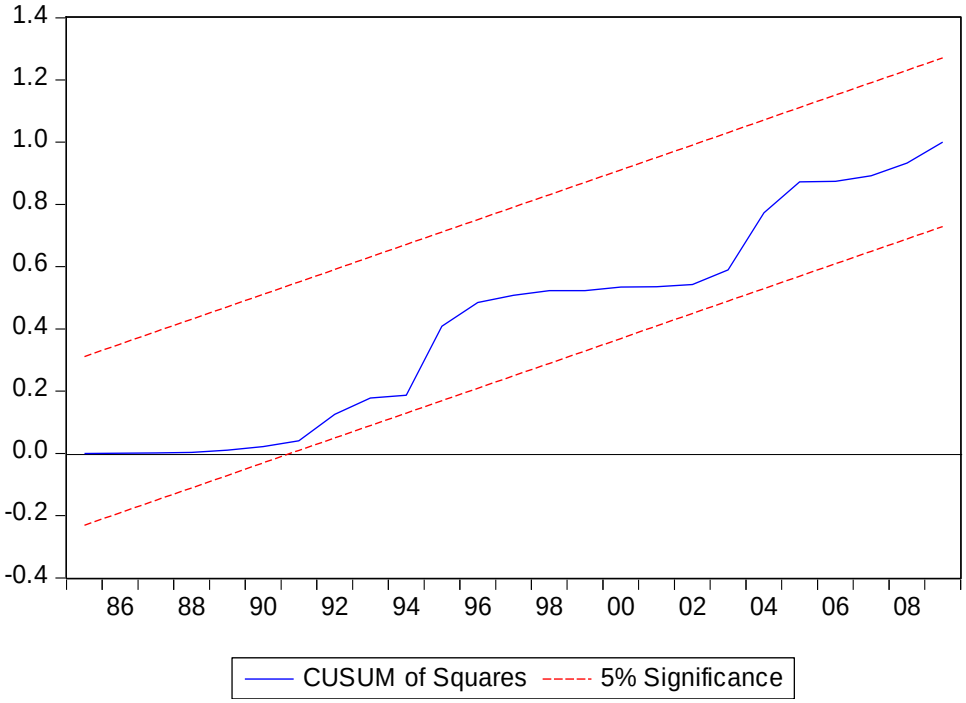

Figure 4.1: Plot of Cumulative Sum of Recursive Residuals for the Regression Estimates Presented in Table 4.4

The estimates of diagnostic tests presented in Table 4.6 indicate that our ARDL model fulfil the assumptions like there should be no autocorrelation and no Heteroskedasticity in residual series of the model. Similarly, figure 4.1 indicates that log run parameters reported in table 4.4 are stable and consistent.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This study investigated the determinants of total fertility rate for the case of Pakistan. The first hypothesis, for Pakistan, stated that growth rate of income per capita did not affect total fertility rate. It was rejected against the alternative hypothesis that income per capita negatively affected the total fertility rate. The second hypothesis which stated that female labour force participation rate did not affect total fertility rate could not be accepted against the alternative hypothesis that female labour force participation rate negatively affected total fertility rate. The third null hypothesis describing that child mortality did not affect total fertility rate could not be rejected against the alternative hypothesis that child mortality positively influenced total fertility rate. Similarly, the fourth null hypothesis showing that population density did not affect total fertility rate was rejected against the alternative hypothesis that total fertility rate was negatively influenced by population density.
So, these findings rejected our three null hypotheses regarding fertility determinants in Pakistan.

The estimates for Pakistan indicated that income per capita, population density, and female labour force participation rate had negative association with total fertility rate. These estimates were statistically significant at five percent level of significance. The coefficient of child mortality rate indicated that child mortality was statistically insignificant factor in explaining variation in total fertility rate in Pakistan at five percent level of significance. The results of ARDL test of cointegration indicated that all the variables considered in the regression model had long run equilibrium relationship.

The standardized regression coefficients for the long run estimates of Pakistan showed that population density explained the highest variation in total fertility rate and it was followed by female labour force participation and growth rate of income per capita. Child mortality rate had the lowest magnitude of its standardized coefficient but its regression coefficient was insignificant.

Our estimates showed that female labour force participation in Pakistan is very low (almost one third of world average). So Pakistan has a wider space to control high birth rates by encouraging female participation in productive economic activities. Econometric analysis also highlighted that the

increase in female labour force participation significantly reduces total fertility rate in Pakistan. This result suggests that enhancement in female labour force participation can be used as an effective tool to control the total fertility rate and population growth.

REFERENCES

Alam, I., & Quazi, R. (2003). Determinants of Capital Flight: An econometric case study of Bangladesh. *International Review of Applied Economics, 17*(1), 85.

Azariadis, C., & Drazen, A. (1993). Endogenous Fertility in Models of Growth. *Revista de Análisis Económico, 8*(2), 3-18.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics, 106*(2), 407-443. doi:10.2307/2937943

Barro, R. J., & Becker, G. S. (1989). Fertility Choice in a Model of Economic Growth. *Econometrica, 57*(2), 481-501. doi:10.2307/1912563

Becker, G. S. (Ed.) (1960). *An Economic Analysis of Fertility*. Princeton, USA: Princeton University Press.

Becker, G. S., & Barro, R. J. (1988). A REFORMULATION OF THE ECONOMIC THEORY OF FERTILITY. *Quarterly Journal of Economics, 103*(1), 1-25.

Becker, G. S., Murphy, K. M., & Tamura, R. (1990). Human Capital, Fertility, and Economic Growth. *Journal of Political Economy, 98*(5), S12-S37. doi:10.2307/2937630

Bhattacharya, J., & Chakraborty, S. (2012). Fertility choice under child mortality and social norms. *Economics Letters, 115*(3), 338-341. doi:10.1016/j.econlet.2011.11.029

Brander, J. A., & Dowrick, S. (1994). The Role of Fertility and Population in Economic Growth: Empirical Results from Aggregate Cross-National Data. *Journal of Population Economics, 7*(1), 1-25. doi:10.2307/20007418

Diamond, P. A. (1965). National Debt in a Neoclassical Growth Model. *The American Economic Review, 55*(5), 1126-1150. doi:10.2307/1809231

Doepke, M. (2005). Child mortality and fertility decline: Does the Barro-Becker model fit the facts? *Journal of Population Economics, 18*(2), 337-366. doi:10.1007/s00148-004-0208-z

Ehrlich, I., & Lui, F. T. (1991). Intergenerational Trade, Longevity, and Economic Growth. *Journal of Political Economy, 99*(5), 1029-1059. doi:10.2307/2937657

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica, 55*(2), pp. 251-276.

Galor, O., & Weil, D. N. (2000). Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and beyond. *The American Economic Review, 90*(4), 806-828. doi:10.2307/117309

Godwin, W. (1793). *An Enquiry Concerning Political Justice, and its Influence on General Virtue and Happiness*. London: G.G.J. and J. Robinson.

Goldin, C. (1995). 3 The U-Shaped Female Labor Force Function in Economic Development and Economic History. *Investment in Women's Human Capital*, 61.

Granger, C. W. J., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics, 2*(2), 111-120. doi:Doi: 10.1016/0304-4076(74)90034-7

Greenwood, J., & Seshadri, A. (2002). The U.S. Demographic Transition. *The American Economic Review, 92*(2), 153-159. doi:10.2307/3083393

Guest, R. S. (2006). Population ageing, capital mobility and optimal saving. *Journal of Policy Modeling, 28*(1), 89-102. doi:10.1016/j.jpolmod.2005.05.010

Guest, R. S., & McDonald, I. M. (2002). Would a Decrease in Fertility Be a Threat to Living Standards in Australia? *Australian Economic Review, 35*(1), 29.

Harris, R., & Sollis, R. (2003). *Applied Time Series Modeling and Forecasting*. West Sussex, England: Wiley & Sons Ltd.

Heckman, J., & Walker, J. (1990). The third birth in Sweden. *Journal of Population Economics, 3*(4), 235-275. doi:10.1007/bf00179336

Hoem, B. (1996). *Some features of recent demographic trends in Sweden*. Retrieved from Stockholm Research Reports in Demography No 104, Stockholm, Sweden:

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2-3), 231-254. doi:Doi: 10.1016/0165-1889(88)90041-3

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica, 59*(6), pp. 1551-1580.

Johansen, S. (1992). DETERMINATION OF COINTEGRATION RANK IN THE PRESENCE OF A LINEAR TREND. *Oxford Bulletin of Economics and Statistics, 54*(3), 383-397. doi:10.1111/j.1468-0084.1992.tb00008.x

Johansen, S. (1995). *Likelihood-based Inference in Co-integrated Vector Autoregressive Models*. Oxford: Oxford University Press.

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money. In (Vol. 52, pp. 169-210).

Jones, L. E., & Schoonbroodt, A. (2010). COMPLEMENTS VERSUS SUBSTITUTES AND TRENDS IN FERTILITY CHOICE IN DYNASTIC MODELS. *International Economic Review, 51*(3), 671-699.

Kravdal, Ø. (2002). Education and fertility in sub-Saharan africa: Individual and community effects. *Demography, 39*(2), 233-250. doi:10.1353/dem.2002.0017

Mah, J. S. (2000). An empirical examination of the disaggregated import demand of Korea—the case of information technology products. *Journal of Asian Economics, 11*(2), 237-244. doi:Doi: 10.1016/s1049-0078(00)00053-1

Malthus, T. R. (1798). *An Essay on the Principle of Population*. London: J. Johnson, in St. Paul's Church-yard.

Mammen, K., & Paxson, C. (2000). Women's Work and Economic Development. *The Journal of Economic Perspectives, 14*(4), 141-164. doi:10.2307/2647079

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics, 107*(2), 407-437. doi:10.2307/2118477

Morgan, S. P., & Rindfuss, R. (1999). Reexamining the link of early childbearing to Marriage and to subsequent fertillty. *Demography, 36*(1), 59-75. doi:10.2307/2648134

Ng, S., & Perron, P. (2001). Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power. *Econometrica, 69*(6), 1519-1554.

Pattichis, C. A. (1999). Price and income elasticities of disaggregated import demand: results from UECMs and an application. *Applied Economics, 31*(9), 1061-1071. doi:10.1080/000368499323544

Pesaran, M. H., & Shin, Y. (1999). An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis. In S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*. Cambridge: Cambridge University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics, 16*(3), 289-326.

Petty, W. (1690). *Political Arithmetick* (Third ed.). London: Robert Clavell.

Phillips, P. C. B. (1986). Understanding Spurious Regressions in Econometrics. *Journal of Econometrics, 33*(3), 311-340.

Rindfuss, R., Morgan, S. P., & Offutt, K. (1996). Education and the changing age pattern of American fertility: 1963–1989. *Demography, 33*(3), 277-290. doi:10.2307/2061761

Schultz, T. P. (1985). Changing World Prices, Women's Wages, and the Fertility Transition: Sweden, 1960-1910. *Journal of Political Economy, 93*(6), 1126.

Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*. Chicago: University Of Chicago Press.

Spataro, L., & Fanti, L. (2011). The Optimal Level of Debt in an OLG Model with Endogenous Fertility. *German Economic Review, 12*(3), 351-369. doi:10.1111/j.1468-0475.2011.00534.x

Stock, J. H., & Watson, M. W. (1988). Testing for Common Trends. *Journal of the American Statistical Association, 83*(404), 1097.

Tsuya, N. O., & Mason, K. O. (1995). changing gender roles and below-replacement fertility in Japan. In K. O. Mason & A. M. Jensen (Eds.), *Gender and family change in industrialized countries* (pp. 139-167). USA: Oxford University Press.

United Nations. (1985). *Women's Employment and Fertility: Comparative Analysis of World Fertility Survey Results for 38 Developing Countries*. Retrieved from Population Studies, No.96. New York:

United Nations. (2011). *World Fertility Report 2009*. Retrieved from New York, USA:

United Nations. (2013). *World Population Prospects: The 2012 Revision*. Retrieved from New York, USA:

Wang, P., Yip, C. K., & Scotese, C. A. (1994). Fertility Choice and Economic Growth: Theory and Evidence. *The Review of Economics and Statistics, 76*(2), 255-266. doi:10.2307/2109880

Winegarden, C. R., & Wheeler, M. (1992). The Role of Economic Growth in the Fertility Transition in Western Europe: Econometric Evidence. *Economica, 59*(236), 421-435. doi:10.2307/2554888

World Bank. (2010). *Fertility Decline in Pakistan 1980-2006: A Case Study*. Working Paper No. 63071, Washington D.C., USA: The World Bank.

World Bank. (2011). *World Development Indicators*. Washington D.C., USA: The World Bank.