Co-Integration Between Fertility and Human Development Indicators: Evidence from Pakistan

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Abstract

The main focus of this paper is to investigate the long run co-integration and short run dynamics between fertility decline and development indicators in Pakistan. Bound Testing approach (ARDL) and VECM are applied on annual time series data from 1971-2010 after finding mixed order of integration of the series through Ng -Perron unit root test. The results show that long run co-integration and short run dynamics exist between total fertility rate and Human Development Indicators (secondary school enrollment, life expectancy at birth and GDP per capita). Secondary school enrollment and life expectancy at birth prove the negative and significant impact on fertility, while GDP per capita indicated the positive but insignificant impact on fertility. The findings of study suggest that more resources should be invested in human capital formation through the provision of better education and health facilities to keep the fertility on declining.

Keywords: Fertility, School Enrollment, Life Expectancy, GDP per Capita, Pakistan.

1. INTRODUCTION

Because of changes in socio-economic conditions, fertility decline is one of the important phenomena occurring in Pakistan like many other developing countries. Finding out the reasons behind this fertility decline is a complex matter in developing countries. Different theories have been presented by demographers and researchers to explain it. According to socioeconomic and demand theories of fertility, there are social and economic factors behind the incentives for fertility decline. Individual decisions are affected by the level of income, life expectancy of children, education, social status, etc. [1-2].

On the other hand, diffusion and innovation theories consider that appearance and spread of new techniques play the pivotal role in limiting fertility. A number of scholars think that new thoughts about childbearing are the important prerequisites of fertility decline. At the same time, the majority of scholars believe that both the socio-economic changes and new thoughts and techniques have played an important role in current fertility declines. The difference lies only in their relative importance [3-6].

At the beginning decade of this century, nearly all developed countries of the world are evidencing the below-replacement fertility rate. This trend is being observed in many under-developed countries. So the macro comparison of fertility rate among the countries has become a topic of debate [7-8]. There are many outstanding aspects which highlight the convergence towards low fertility among many countries of the world. It was primarily believed that replacement rate is naturally stabilized by fertility rate but after that it was realized that there were some socio-economic factors which decide replacement rate for a society. The replacement rate for sustainable population is considered a common idea in developed European countries where per woman fertility rate tends towards very low. Therefore, during the last 15 years, unprecedented low fertility rate (1.3 per woman) was witnessed in Europe.

Pakistan stands at the sixth position among the most populous countries in the world, with the population of 177.1 million. However, she has achieved the objective of fertility transition from 1970 to 2010. Fertility rate has declined from 7 percent during 1970-75 to 4 percent during 2005-10. In the late 1980s, the fertility rate began to decline in Pakistan after a long period of sustained high fertility, dropping by 40 percent over the past two decades. This trend continues and fertility rate declined rapidly from 6.3 to 4.8 during the decade of 1991-2000, but in the subsequent decade 2000-2010, there is slow decline from 4.8 to about 4.0 children per women during her child bearing age [9].

The benefits and costs of children have been changed because of socioeconomic development of the country. These changes have affected the preference of the parents for large family size to a small family size. As a result, demand for the use of contraceptives and abortion among the families has increased, which further lowered the fertility in the country. Family planning programs made this transition more possible by decreasing the cost of birth control.

On the other hand, as for as the development indicators concern, Pakistan has improved its position with the passage of time. Secondary school enrollment has improved from 16.1 percent in 1972 to 33 percent in 2009. Life expectancy increases from 55 years in 1972 to 66.6 years in 2009. Per capita income (at constant prices) which was only rupees 14000 in 1972, reaches the higher level of rupees 33985 in 2009 [10].

This paper tries to find the long-run relationship as well as the short-run dynamics between fertility transition and development indicators in Pakistan empirically, using the modern co-integration technique; the ARDL bound testing approach, developed by Pesaran et al. [11].

2. LITERATURE REVIEW

Two types of demographic literature are available which highlight the degree of relationship between socio-economic development and fertility rate. The first type of literature highlights the relationship between fertility levels and development while the second type explains association between the development and fertility decline.

Our focus is on the second type of literature because we are interested to explore some long run as well as short run relationship between development and fertility transition. Economic and social institutions affect the reward structures of child bearing and therefore the reproductive motivation and fertility [12-13]. Great fertility decline was observed during the era of intensive modifications in socioeconomic structure of chin [14-15].

Family planning programs and other variables may facilitate social and economic factors in declining fertility. However, effects of development are stronger than those of family planning programs [16-19]. Fertility decline might be attributed to changes in social life resulting from urbanization and industrialization. Because of these changes, mortality decreases which paved a way for increase in family size, there is less desire for children and fertility rate is declined [6].

In the same way, while testing the socioeconomic theories of development for fertility in case of two countries give different results because of family structure, institutions and policies differences. The case may be different because if one government gives especial incentives for childrearing but other does not do that [20-21].

Statistical data collection agencies do not take into account the time opportunity cost of children, measurement of mobility strategies and non-availability of perfect labor market and family risk measurement methods. Frequently, most of the social scientists use proxies for the measurement of these type variables: for example the Prussian dataset is arranged and constructed by Galloway et al. [1]. Normally, social scientists considered the decline in fertility is occurred because of main development indicators like GDP per capita, level of urbanization and non-agricultural employment in the country. But the Change of developmental indicators is not always depicted the true picture of the problem.

Watkins [22] depicted the example of Kenyan society. They enjoyed rapid economic growth followed by economic crisis. During rapid economic growth lots of development took place in urban sector of the economy with upward trend in education and economy and became more dreadful after this boom. So in this way high economic growth and urbanization do not consider true indicators of fertility decline, because in the period of economic crisis the normal relationship between fertility and socioeconomic development indicators become doubtful.

An alternative framework is the demand and supply side relationship of variables, but the macro changes are based on geographical situations rather than governmental administrative or other efforts. The case study of Kerala (the Indian State), the economic policies and political and social justice for development can be seen in the form of land reforms and sufficient increase in wages of agriculture labor [23]. The main drawback of these policies is that there is bit change in fertility decline, although major changes in socioeconomic structure have been introduced. Moreover, data about fertility from India do not depict the true picture of the problem.

3. METHODOLOGICAL FRAMEWORK AND DATA SOURCES

For developing the model for fertility and development indicators in Pakistan, we follow the theoretical framework of Ainsworth, Beegle and Nyamete. [24]. The regression model is given in equation (1) in log form.

$$LFRTL_t = \beta_0 + \beta_1 LGDPP_t + \beta_2 LLXEP_t + \beta_3 LSSE_t + \varepsilon_t \quad (1)$$

Where, FRTL, GDPP, LXEP, SSE represent the total fertility rate, GDP per capita, life expectancy at birth and secondary school enrollment respectively. The subscript t' is the representation of time period and ε is for error term. The study uses the time series data from 1971 to 2010, so t ranges from 1 to 40.

Data Sources

For our analysis in this study we use total fertility rate as dependent variable, secondary school enrollment, life expectancy at birth and GDP per capita as independent variables. The time period for the study is from 1971 to 2010. Data for all four variables is taken from World Development Indicators (WDI) online database by World Bank [25].

Econometric Methodology

Stationarity of the data is one of the main concerns for finding the co-integrational relationship of the variables. Ng-Perron [26] has better properties than other stationarity tests.

This test is based upon Generalized Least Square (GLS) method. On the basis of statistical properties, Ng-Perron test has advantages over the other existing tests. Therefore, it is preferred for small sample size of data [27]. So for checking the problem of unit root in the data, we utilized Ng and Perron [26] test.

Autoregressive Distributed Lag (ARDL) Approach for Co-Integration

In the literature of econometrics, there are many methods for evaluating the co-integrational relationship among variables; the most commonly used method is Engle-Granger [28] and Johansen-Juselius [29] tests. The common feature of all these tests is that they require same order of integration, and some time become useless when the variables have mix or dissimilar order of integration.

The most advanced method to find co-integration is Autoregressive Distributed Lag (ARDL) Approach which is developed by Pesaran et al. [11]. It is also called the bound testing procedure. It is argued that ARDL has a numerous advantages over conventional techniques like Engle-Granger [28] and Johansen-Juselius [29] co-integration approaches. For applying the bound testing procedure to find long run relationship between fertility and development indicators (secondary school enrollment, life expectancy at birth and GDP per capita) following the unrestricted error correction model is employed.

$$\Delta LFRTL_t = \beta_1 + \beta_2 t + \beta_3 LFRTL_{t-1} + \beta_4 LGDPP_{t-1} + \beta_5 LLXEP_{t-1} + \beta_6 LSSE_{t-1}$$

$$+\sum_{h=1}^{p} \beta_h \Delta LFRTL_{t-h} + \sum_{j=0}^{p} \gamma_j \Delta LGDPP_{t-j} + \sum_{k=0}^{k} \phi_k \Delta LLXEP_{t-k} + \sum_{m=0}^{m} \varphi_m \Delta LSSE_{t-m} + u_t \quad (2)$$

If there is long run co-integration among the variables exist, then for finding short run relationship we use the Vector Error Correction Model (VECM). The VECM is explained as under:

$$\Delta LFRTL_t = \beta_1 + \beta_2 t + \sum_{h=1}^{p} \beta_h \Delta LFRTL_{t-h} + \sum_{j=0}^{p} \gamma_j \Delta LGDPP_{t-j} + \sum_{k=0}^{k} \phi_k \Delta LLXEP_{t-k}$$

$$+\sum_{m=0}^{m}\varphi_m \Delta LSSE_{t-m} + \omega ECT_{t-1} + u_t \qquad (3)$$

4. EMPIRICAL RESULTS AND DISCUSSION

The data is in logarithmic form. For the selection of maximum lag length Schwarz Information Criterion is utilized. Ng-Perron [26] test is used for checking the stationarity level of series. Estimated results of unit root test are presented in table 1. According to these results, only one variable total fertility is stationary at level, so its order of integration is I(0). Secondary school enrollment, life expectancy at birth and GDP per capita are non-stationary at level but at first difference these variables become stationary and have the order of integration I(1). So variables in our model have mix order of integration.

Table-1: Unit Root Estimation

At Level				
Variable	**Ng-Perron Test Statistics**			
	MZa	**MZt**	**MSB**	**MPT**
$\Delta LFRTL_t$	-14.0019**	-2.44217	0.17442	2.49996
$\Delta LGDPP_t$	0.32904	0.19089	0.58013	24.8161
$\Delta LLXEP_t$	1.47843	1.35121	0.91395	64.5798
$\Delta LSSE_t$	0.81012	0.51733	0.63858	31.3008
At 1st Difference				
Variable	**Ng-Perron Test Statistics**			
	MZa	**MZt**	**MSB**	**MPT**
$\Delta LFRTL_t$	-5.52739	-1.57483	0.28491	4.67653
$\Delta LGDPP_t$	-16.9732*	-2.87517	0.16940	1.58258

$\Delta LLXEP_t$	-6.13667***	-1.75167	0.28544	3.99239
$\Delta LSSE_t$	-17.0615*	-2.90108	0.17059	1.47333

*, ** and *** represent 10%, 5% and 1% level of significance respectively for that rejection of the null hypothesis of unit root.

For investigating the long run relationship among total fertility, secondary school enrollment, life expectancy at birth and GDP per capita ARDL approach is utilized. The results of ARDL co-integration test, based on equation (3) are reported in table 2. Wald statistics is used to test the null hypothesis. The value of F-Statistic is greater than the upper bound value and is significant at 5 percent which shows the existence of co-integration among the variables of the model.

Table 2: The Results of ARDL Co-integration Test

ARDL (1, 1, 1, 1, 0)

F-Statistic = 53.1368*		
Level of Significance	**Pesaran et al. [11]**	
	Lower Bound Value	**Upper Bound Value**
5%	3.6114	4.8407
10%	2.9627	4.0806

*denote the significant at 5 per cent level. Critical bounds values computed by Pesaran et al. [11], with unrestricted intercept and unrestricted trend.

Once the co-integration among the variables of the model exists we can find the long run relationship of the variables. Because in this case results of the model will be reliable, the long run results are presented in table 3.

Table 3: Long Run coefficients based on ARDL (1, 1, 1, 1, 0)

Dependent Variable: $\Delta LFERT_t$

Variable	Coefficient	t-Statistic	p-Value
$LGDPR_t$	0.09755	0.71032	0.483
$LLEXP_t$	-3.2241	-2.3699	0.024
$LSSE_t$	-.57992	-5.5075	0.000
Constant	13.8182	7.8173	0.000

The results in table 3 show that GDP per capita of Pakistan has positive relationship with total fertility rate of Pakistan. One percent increase in GDPP brings 0.09 percent increase in total fertility rate but p-value shows that it is insignificant relationship. Our results support the proposition that relation between total fertility and economic conditions is unclear. If children are considered as durable consumption commodity, there will be positive relation between income and fertility [30]. On other hand, this relation might be negative if people are concerned with the quality of children instead of quantity as more investment is required on education and health for quality children.

But in case of life expectancy at birth, total fertility rate has negative and significant (at 5 percent) relationship, this shows that 1 percent increase in life expectancy at birth affected the total fertility rate negatively by -3.2 percent. Life expectancy rate in Pakistan is gradually increasing; it is because of the decline in mortality under age five. The infant mortality rate reduces from 91 to 78 per 1,000 live births and the under-five mortality rate from 117 to 94 per 1,000 live births. In case of secondary school enrollment, total fertility has negative but highly significant relationship. This shows that 1 percent increase in the level of secondary school enrollment in Pakistan has impacted the total fertility rate negatively (-0.57 percent. The increase in secondary school enrollment increases woman's ability and knowledge for making independent and collective decision about size of family, resulting in low level of fertility. The communication between two spouses is highly correlated to female education.

The rate of female education increased three times, from 16 percent to 42 percent during the period 1981 to 2008 and the urban-rural gap of education shrank from 1:5 to 1:2 [31]. The extension in the higher education of female has significant impact on fertility through late marriages and gap among the birth of children.

After proofing the co-integration among the variables of the model, we can use VECM for finding the short run relationship in the model. Table 4 shows the results of short run dynamics. According to the results, GDP per capita has positive relationship with total fertility rate in Pakistan and this relationship is significant at 10 percent. The coefficient value of life expectancy at birth shows the negative relationship between life expectancy at birth and total fertility rate. But this relationship is insignificant unlike the relationship of the long run. The relationship of secondary school enrollment and total fertility rate is negative and significant. This shows that secondary school enrollment and total fertility rate has same kind of relationship as in case of long run.

Table 4: Short Run Dynamics based on ARDL (1,1,1,0,)

Dependent Variable = $\Delta LFERT_t$			
Variable	**Coefficient**	**t-Statistic**	**p-Value**
$\Delta LGDPR_t$	.054702	1.7655	0.087
$\Delta LLEXP_t$	-.34442	.45620	0.651
$\Delta LSSE_t$	-.056940	-6.4425	0.000
ECM_{t-1}	-.098187	-4.5497	0.000
Constant	-13.8182	-	-
$R^2 = 0.90602$ Adj-$R^2 = 0.88783$ F-Statistic = 74.7155			

Prob(F-statistic) = 0.000
Durbin-Watson = .63197

The results of the table 4 show that the error correction term is statistically significant and has a negative sign which is called the further proof of co-integration among the variables of the model. The coefficient of all the variables has theoretical correct sign which justified the strong relationship among the variables of the model.

5. CONCLUSION AND POLICY IMPLICATIONS

The aim of the study was to investigate the relationship among development indicators and reduction in total fertility rate in Pakistan. Time series data from 1971 to 2010 was used for empirical analysis. Ng-Perron [26] Unit Root Test was applied to find stationarity of the series. Results of this test revealed that the variables used in the study had mixed order of integration. Therefore, to investigate the co-integration among the variables of the model, we utilized ARDL bound testing approach. The empirical results of the study proved the existence of long run as well as short run relationship between total fertility rate and GDP per capita, life expectancy at birth and secondary school enrollment in Pakistan.

The results highlight that there is positive but insignificant relationship between total fertility rate and GDP per capita. This shows that per person income does not play an effective role in reducing total fertility rate in Pakistan. The negative and significant coefficients of both life expectancy at birth and secondary school enrollment indicate that both variables are inversely related to total fertility rate in Pakistan. Therefore, life expectancy (at birth) and secondary school enrollment have been proved the important development indicators which are contributing in the reduction of total fertility rate in Pakistan.

The important population policy instrument for Pakistan is to increase the level of secondary school education and life expectancy at birth with better health and education services. Awareness through education will be useful in reducing the demand for children. Health facilities will improve child survival and life expectancy at birth. For this purpose government should invest more in human capital. Measures to promote gender equality and women empowerment will also be helpful in declining fertility. At the same time family planning programs should be equally emphasized to facilitate the decline in fertility. Because the provision of family planning services is less expensive as an immediate measure to control the fertility. These programs should be well equipped with population education and information campaigns.

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