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Impact of Demographic Transition on Economic Growth of Pakistan

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Abstract The global process of demographic transition has had profound and far reaching social and economic implications for the world. Pakistan is in the third stage of demographic transition and this scenario is marked with new options, opportunities, challenges and vulnerabilities. This paper examines the impact of demographic transition and economic growth of Pakistan by using the time series data over the time period of 1974 to 2011. The study used the bound testing approach to co-integration; Autoregressive Distributed Lag (ARDL) model was also applied for analyzing the long run relationship whereas Error Correction Mechanism (ECM) was applied for analyzing the short run link of the demographic variables with economic growth. The numerical simulation of the study exhibited that the demographic transition positively affected the economic growth in the long run and negatively in the short run. The cohesive policy was also suggested to capitalize the demographic gift.

Keywords: *demographic transition, gross domestic product, rate of natural increase, life expectancy, working age population, window of opportunity and ARDL*

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1. Introduction

The demographic transition theory has a unique prominence in the field of population studies and this paradigm has also worldwide value and worth. Demographic Transition is a multi-phase process in which a country's population attributes are changed with the passage of time and the interaction of mortality transition and fertility transition cause variations in the population growth.

The demographic transition's occurrence and duration is different in different regions across the world. This transition has taken 50 to 150 years to complete. The developed countries have completed the process of demographic transition while it is incomplete in the developing countries. Western Europe and Eastern Europe experienced population growth decline at the culmination of 19th century and at the beginning of 20th century while it prevailed in Latin America and Asia in the last decade of 20th century (Oded, 2005).Latin America started its transition in the decade of 1960s. The East Asian countries are at the most important stage of this transition. Some of Arab and African nations have not hitherto started the demographic transition or they are in the initial phases of this process (Bloom et al, 2001). So, this transition has spread globally and will be completed by 2100 (Lee, 2003).

There are three or five stages through which every population passes and moves towards modernity (Chesnais, 1992). Notestein (1945) defined the three phases and Becker (1949*)* subdivided it into two phases. This five phase distinction was reiterated by Davis (1950) and defined the fifth stage differently (Chesnais, 1992). The most developed nations are in the fourth stage while developing nations are in the second and third stage. Laundry contradicted to the other writers and assumed that there is no ultimate equilibrium but a permanent disequilibrium (Chesnais, 1992). The nations of the world have more or less passed the phases of the demographic transition (Black, 2002).

Pakistan is the 6th most populous nation of the world with a population of 184.35 million (ESP, 2012-13). Previously, according to the census of 1998, it was world's 7th populous country with 130.5 million people. UN projected that Pakistan would be the third populous nation in the world by the year of 2050. According to the UN projections, it will be the 3rd populous country of the world by 2050 (Sathar, 2001). Under the prevailing situation it is projected that Pakistan will stand at fifth rank in terms of population in the year 2050 (ESP, 2012-13). Pakistan's population rose from 30 million at the time of its creation to 185 million in 2010. According to the present trends it is likely to increase 11-fold between the period of 1947 and 2050 (Burki, 2011).

Terlecky referred economic growth to a sustained rise in quantity of physical goods produced and services provided in an economy for a specific time period (Greenwald, 1982). Economic growth represents the growth of a nation's possible GDP or productivity

(Samuelson & Nordhaus, 1995). Modern economic growth means ability to yield goods and services per capita to the growing population; and in modern economic growth, the rate of structural conversion of the economy is rising (Kuznets, 1973).

Demographic transition is not only comprised of population growth trends but much more along with economic consequences (Weil, 2005). The global demographic transition changed economic and demographic lifecycle of the individuals and restructured the compositions of populace (Lee, 2003). It is contended that demographic transition affects economic growth and prosperity significantly. The changing age structure due to demographic transition has economic implications like high youth dependency, low tax revenues and savings (Nayab, 2006). Demographic Transition affects productivity and this is due to the size and structure of cohort of working age population (Fyerer, 2007). Industrialization and fertility are inversely related; industrial revolution leads to a high standard of living and aspiration for greater affluence and luxury which in turn limits the reproduction process (Chesnais, 1992). It has also for reaching economic implications for the fortune of nations. High populations lead to high per capita incomes when stimulus to human capital and spread of knowledge is greater than declining returns to natural resources (Becker *et al*, 1999).

Demographic transition in Asian Pacific countries resulted in bulging labor force, higher earnings, investments, taxes and finally to an unprecedented economic growth. This phenomenon of robust economic growth will continue for at least two or more decades (Mason, 1997). So, demographic transition is one facet of economic transition (Tiffen, 1995). The change in age structure of the population into different ages is vital factor for the economic growth and productivity (Bloom and Williamson, 1998; Mason, 2005). Along with demographic transition working-age adults grow and cause a potential opportunity of prompt economic growth (Bloom et al., 2002). Young people (0-14 years) need influx of investment in health and education, working age size or prime-age adults (15-64 years) provide labor and they save also. The persons above age of 65 years entail health care and pension. If the number of population of working age grows more this leads to faster economic growth and general economic welfare. The changing age structure, a higher saving rate, better human capital and increased life expectancies prompt economic growth (Mason, 2005).

2. Review of Literature

Numerous researchers expounded and magnified the impact of demographic transition on economic growth by using time series as well as cross sectional data. The literature shows the mixed results regarding the role of demographic transition. Population along with aggravating dependency, poverty and depressing educational opportunities burdened the economies (Easterline, 1967; Eastwood and Lipton, 2001). Demographic transition increased the life expectancy, years of healthy life, increased the ratio of retirees, population ageing and migration in Europe from the third world (Attanasio *et al,* 2006; Lee& Mason, 2007; Suntoo, 2012). The growth rate of population and dependency ratio in 97 countries exhibited the negative aftermath of demographic transition (Prskawetz *et al,* 2007).

Population growth in Pakistan also impacted economic growth adversely and it was a limiting factor to the economic development (Afzal, 2009). Demographic transition in China triggered the social costs like population ageing, abnormal sex ratio, millions of lifelong involuntary bachelors, tragic predeceases of children, prospect of loneliness and misfortune for large number of parents (Feng, 2011).

Demographic transition in Asian Pacific Countries resulted in bulging labor force, higher earnings, investments, savings, taxes and finally unprecedented economic growth (Mason, 1997). South Asia's economic growth may also be ascribed to the demographic transition as fall in birth rate led to decrease in the proportion of dependents to working age persons, bulking volume of labor force, productivity and increasing effect on economic growth (Gomez and de Cos, 2003).

High fertility led to an income inequality while decreased fertility caused to escape from the Malthusian trap, income distribution and an increase in income (Dahan and Tidon, 1998; Jemna, 2011; Canning, 2011). On the other, the rise in real GDP per capita had positive impact on demand for children while upward shock in wages and reduction in mortality had negative impact on fertility rate (Honroyiannis and Paperton, 2002). In the case of US, economic development raised wages and labor was replaced by capital and resulted in a fertility drop (Greenwood and Sgeshadri, 2002).

The working age population steered economic growth while population growth and dependency ratio affected economic growth negatively (An and Jeon, 2006; Nguyen, 2008; Bloom and Finlay, 2009; Choudhry and Elhorst, 2010). The work force also would drop the capital to labor ratio and would boost the marginal productivity of capital and developed regions would turn into debtor regions (Marchiori, 2011).

The window of opportunity had profound and lasting economic implications and most of the countries are fortifying from this window of opportunity (Reher, 2011). This window of opportunity would not be opened for china in 2020; however it would stay opened for India and Pakistan up to 2050 (Choudhry and Elhorst, 2010). The estimation of role of the demographic transition in Pakistan also proclaims the existence of demographic dividend (Hussain *et al,* 2009; Mehmood *et al* 2012).

3. Econometric Methodology and Empirical Results

In order to examine the co integrating relationship between demographic transition and economic growth, the time series data of Pakistan for the time period 1974 to 2011 was used. The included variables were Natural Log of Gross Domestic Product, Rate of Natural Increase, Life Expectancy, Gross Domestic Saving Rate and Total Literacy Rate. The data was acquired from the World Development Indicators, Pakistan Bureau of Statistics and Economic Surveys of Pakistan (various issues).

In the time series analysis, the stationarity of the variables is tested by Unit Root Tests like Augmented Dickey-Fuller (ADF) prior to the causality tests. If variables are stationary at I(0) and I(1) then ARDL approach to co-integration is applied. Its objective is to avoid I(2) which causes spurious results and we cannot interpret the value of F statistics. The Autoregressive Distributed Lag (ARDL) was introduced by Pesaran and Shin (1997) and later on revised and developed by Pesaran et al (2001). It is convenient and efficient for small sample sizes and computations. ARDL approach to co-integration also provides unbiased results for the long run models (Harris and Sollis). It is applied for the estimation of long run coefficients and standard errors by using Akaike Information Criterion (AIC) or Schwarz Information Criterion (SIC). Schwarz Information Criterion (SIC) is consistent and slightly better in performance (Pesaran and Shin, 1997).

To find out the existence of long run relationship among the variables, bound testing (ARDL) under Pesaran et al (2001) approach is employed. By means of F Test, the null hypothesis of no co-integration among the variables against the happening of co-integration among the variables is denoted as:

HO: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

i.e., there exists no co-integration among the variables.

H1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$

i.e., there exists co-integration among the variables.

The asymptotic distribution of the F static is nonstandard under the null hypothesis of no integration amongst the variables. Pesaran et al (2001) tabulated two critical values for the co-integration test. The lower critical bound assumes all variables are I(1) while upper bound assumes that they are I(0). When the calculated F-static is above the upper bound critical value then null hypothesis is rejected and it indicates co-integration. If F-static falls below the lower bound critical value then null hypothesis cannot be rejected which show the lack of co-integration. When calculated F value is with in the lower and upper bound then result is inconclusive.

The Error Correction Mechanism (ECM) is that kind of time series which measures the impact of one time series on another and corrects the error in another. ECM is applied to examine the short run dynamics of the model. ECM also measures the speed of return or adjustment to equilibrium after deviation. The ECM determines that current change in dependent variable is proportional to sum of both current change in independent variables and the partial correction for the degree to which lagged dependent variable deviated from the equilibrium value corresponding to lagged independent variable (the equilibrium error) (Shittu et al, 2012).

As a first step, the stationarity of the variables is tested by Augmented Dickey-Fuller (ADF) Test at the level and at first difference to know the order of integration. Augmented Dickey Fuller (ADF) test is based on testing the presence of unit root as under,

Null hypothesis H0: $\delta = 0$ Non-stationary

Alternative hypothesis H1: $\delta \neq 0$ Stationary

The T values are determined by Schwartz Bayesian criterion (SBC) and for the all series optimum lag selection is 9.

Table 1. ADF Test of Stationarity at Level

Variables	At level		
	ADF Test Statistics With Trend	Critical Value	Probability
LGDP	-1.150876	-3.200320	0.9059
RNI	-5.654810***	-4.252879	0.0003
LE	-6.906228***	-4.243644	0.0000
WAP	0.382845	-3.209642	0.9983
GDSR	-1.179150	-3.200320	0.9002
TLR	-0.460661	-3.200320	0.9811

*, ** and ***indicate the level of significance in test statistics at 10%, 5% and 1% respectively against the null hypothesis of unit root. When statistical value is greater than the tabular value by ignoring the sign then variable is stationary. The Table 1 shows that RNI and LE variables are stationary at level with 1% level of significance while LGDS, WAP and TLR are not stationary at level.

Table 2. ADF Test of Stationarity at 1st Difference

Variables	At 1st difference		
	ADF Test Statistics With Trend	Critical Value	Probability
LGDP	-4.449558***	-4.234972	0.0058
RNI	-3.893993**	-3.562882	0.0245
LE	-2.651719	-3.209642	0.2617
WAP	-3.257552*	-3.209642	0.0911
GDSR	-7.473598***	-4.234972	0.0000
TLR	-4.627716***	-4.234972	0.0037

*, ** and ***indicate the level of significance in test statistics at 10%, 5% and 1% respectively against the null hypothesis of unit root. When statistical value is greater than the tabular value by ignoring the sign then variable is stationary. The Table 2 shows that RNI and LE variables are stationary at level with 1% level of significance while LGDS, WAP and TLR are not stationary at level.

The variables are I(0) or I(1) so that Autoregressive Distributive Lag Model (ARDL) is applied to determine the co-integration for evaluating the long run relationship among the variables. F-test for the bound testing and Error Correction Mechanism (ECM) are also applied.

4. The ARDL Model

The model developed to check the impact of demographic transition on economic growth of Pakistan includes the direct demographic effects (RNI, LE and WAP) and indirect demographic (LE and TLR) effects as followings:

$$LGDP = \beta_0 + \beta_1 RNI + \beta_2 LE + \beta_3 WAP + \beta_4 GDSR + \beta_5 \mathbf{TLR} + \mu$$

The General form of Autoregressive Distributed Lag Model (ARDL) is

$$\Delta \mathbf{LGDP} = \beta_0 + \beta_1 \Delta \mathbf{RNI} + \beta_2 \Delta \mathbf{LE} + \beta_3 \Delta \mathbf{WAP} + \beta_4 \Delta \mathbf{GDSR} + \beta_5 \Delta \mathbf{TLR} \beta_6 + \mathbf{RNI}(-1) + \beta_7 \mathbf{LE}(-1) + \beta_8 \mathbf{WAP}(-1) + \beta_9 \mathbf{GDSR}(-1) + \beta_{10} \mathbf{TLR}(-1) + \beta_{11} \mathbf{LGDP}(-1) + \mu_t$$

Where, LGDP, RNI, LE, WAP, GDSR, TLR, β_s and μ_t represent Natural Log of Gross Domestic Product, Rate of Natural Increase, Life Expectancy, Gross Domestic Saving Rate, Total Literacy Rate, Coefficients and the white noise residual. Here Δ shows the difference of the mentioned variables whereas (-1) shows the lag. In this model there are lagged values of the dependent variables and lagged value of the explanatory

variable. All the estimations in this paper are carried out in EViews 7 and Micro fit 5. The above mentioned ADF test results show that variables are integrated at different levels.

After applying the bound F-test, following result was attained

Table 3. Result of bound F-testing

Critical values at 95% level of significance		F-calculated
Lower bound I(0)	Upper bound I(1)	6.2723
2.9819	4.3270	

The Table 3 shows that the lower bound is 2.9819 while the upper bound is 4.3270 at 95% level of significance. The calculated F-test value with the bound is 6.2723 by using intercept and no trend as presented by Pesaran et al (2001). So null hypothesis of no co-integration is rejected and alternative hypothesis is accepted according to the F-Calculated value. The value of F-Statistics shows the overall significant effect of the model. So, the calculated result shows that there is a co-integration among the variables and long run relationship exists amongst the variables.

To investigate the parameters, ARDL technique was used and lags length 2 was selected on the foundations of Schwarz Bayesian criteria. The long run results are shown in Table 4.

Table 4. Estimated Long Run Coefficients by using the ARDL Approach

Variable	Coefficient	Standard Error	T-Ratio [Prob]
RNI	-.46492*	.16481	-2.8210[.009]
LE	.098380*	.026650	3.6915[.001]
WAP	.017614**	.0097855	1.8000[.083]
GDSR	-.0029579	.0025137	-1.1767[.249]
TLR	.011528*	.0044666	2.5810[.015]
C	9.0728	1.8228	4.9775[.000]

*Shows the 1% significance of coefficients, ** Shows the 5% significance of coefficients, *** Shows the 10% significance of coefficient

The results of Table 4 show that the most important factors in the demographic transition have played a vital role in the economic growth of Pakistan. The coefficient of the RNI (Rate of Natural Increase) is -.46492, which indicates that 1 unit increase in RNI (Rate of Natural Increase) brings 46% decrease in economic growth in the long run. The T-value of RNI (Rate of Natural Increase) is -2.8210, which shows that there is a significant effect of (Rate of Natural Increase) upon the economic growth. The rate of natural increase (population growth) worsens the situation by lowering investment and savings rate. Rapid population growth (RNI) also raises dependency ratio and burdens the economy (Afzal, 2009). High population growth disrupts the per capita growth prospects and contributes to poverty significantly (Klasen et al 2007).The neoclassical growth model (Solow 1956) vowed that population growth decreases economic growth because of capital dilution. Barro (1991, 1997) found that population growth was negatively and population size was positively associated with per capita output growth (Prskawetz et al, 2007).

The coefficient of LE (Life Expectancy) is 0.098380, which shows that 1 unit increase in LE (Life Expectancy) brings 9.8% increase in economic growth in the long run. The T-value of LE (Life Expectancy) is 3.6915, which shows that there is a significant effect of LE (Life Expectancy) upon economic growth. The increase in life expectancy promotes investment in human capital and savings and lead to more productivity (Cervellati and Sunde, 2009). The longevity of life increases the utility of life and stirs the additional investment in human capital and long living probability justifies it (Cervellati, 2001).

The coefficient of WAP (Working Age Population) is 0.017614, which shows that one unit increase in WAP (Working Age Population) brings 1.76% increase in economic growth in the long run. The T-value of WAP (Working Age Population) is 1.8000, which illustrates that there is a significant effect of WAP (Working Age Population) upon economic growth. The distribution of the population age structure may foster the economic growth, if working age population is the big chunk of total population share (Choudhry & Elhorst, 2010). The changes in age structure affect economic growth along the process of demographic transition but potential opportunity is not being utilized. The working age group provides labor as well as contributes to the savings (Choudhry & Elhorst, 2010). Increasing working age population decreases dependency ratio and thus output per capita grows (Eastwood & Lipton, 2010). The human behaviors like labor supply, savings and criminal activities are intrinsically age-specific. The studies contrast in the age-specific features. More often, the youth and old-age dependency ratio signify the different phases of the demographic transition. Age structure also affects consumption, labor force participation, demand for money and investments in housing. The age structure is consistent with life cycle hypothesis and supports it. During prime age people earn more and consume less while in early and old age they consume more. So the working age population impact growth of GDP per capita positively and significantly (Prskawetz et al, 2007).

The coefficient of GDSR (Gross Domestic Saving Rate) is 0.0029579, which indicates that 1 unit increase in GDSR (Gross Domestic Saving Rate) brings 0.2% negligible decrease in the economic growth in the long run and this change is negative. The T-value of GDSR (Gross Domestic Saving Rate) shows the insignificant effect. In Pakistan Age dependency ratio of working-age population is more than 64% and this may be the reason of low savings (WDI, 2012). Kogel (2005) opined that high youth dependency depress the total factor productivity and lower savings. Increased family sizes lower the savings and ultimately causes negative impact on economic growth. Solow's model advocates that saving has no impact on the per capita and total output due to capital deepening (Prskawetz et al, 2007). Saving's impact is negative due to high inflation and downturn. From 1960 to 1965, inflation rate was 19% in Korea which resulted in negative return of savings. Savings do not affect in those countries which are close to the technological frontier (Aghion et al, 2006).

The coefficient of TLR (Total Literacy Rate) is 0.011528, which states that 1 unit increase in TLR (Total Literacy Rate) brings 1.15% increase in economic growth in the long run. The T-value of TLR (Total Literacy Rate) is 2.5810, which shows that there is a significant effect of TLR (Total Literacy Rate) on economic growth of Pakistan. Thehuman capital (longer life and education) had a robust growth-prompting effect over all eras and areas (Prskawetz et al, 2007).

To estimate the short run relationship among the variables Error correction model (ECM) was used. The results of the short run are shown in Table 5.

Table 5. Error Correction Representation for the Selected ARDL Model

Variable	Coefficient	Standard Error	T-Ratio [Prob]
ΔRNI	-.26839*	.10412	-2.5777[.015]
ΔLE	-.69499*	.21340	-3.2567[.003]
ΔWAP	-.37718*	.11827	-3.1892[.003]
ΔGDSR	-.0017076	.0016306	-1.0472[.303]
ΔTLR	.0066551*	.0032702	2.0351[.051]
ECM(-1)	-.57729	.16808	-3.4347[.002]

Here in Table 5 *Shows the 1% significance of coefficients, ** Show the 5% significance of the coefficients and *** Show the 10% significance of coefficient.

The ECM (Error correction Term) is -0.57729 which shows that 57.729 % convergence in short run to long run within a year with a change of RNI (Rate of Natural Increase), LE (Life Expectancy) and WAP (Working Age Population) GDSR (Gross Domestic Savings) and (TLR) Total Literacy Rate variables. In short run all variables except TLR impact economic growth negatively so that demographic transition impedes economic growth in the short run.

Table 6. Results of R-Squared

R-Squared	R-Bar-Squared
.61348	.50304

In Table 6 the value of R^2 is .61348 which shows that 61.34% variation in economic growth is due to demographic variables.

Table 7. Result of W-Static

Critical values at 95% level of significance		W- Static
Lower bound I(0)	Upper bound I(1)	37.6338
17.8914	25.9618	

In Table 7 W-static has been estimated and the value of W-Static is 37.6338 which is above the upper bound. Here we reject the null hypothesis of no level effect. The critical value bounds are computed by stochastic simulations by using 2000 replications

Table 8. Results of Diagnostic Tests

Test Statistics	LM version	F version
Serial Correlation	*CHSQ(1)=.38614 [.534]*	F(1,27)=.28475 [.598]*
Functional Form	*CHSQ(1)=.79307 [.373]*	F(1,27)= .59140 [.449]*
Normality	*CHSQ(2)=.42913 [.807]*	Not applicable*
Heteroscedasticity	*CHSQ(1)=2.0071 [.157]	*F(1,35)=2.0076 [.165]*

The results of the diagnostic test in Table 8 indicate that there is no problem of serial correlation and heteroscedasticity. Where the values for LM version and F version are greater than 0.05 so here null hypothesis (that shows there is serial correlation) is rejected and alternative hypothesis (there is no serial correlation) is accepted. This result also indicates that there is a correct functional form and results also show that error term is normally distributed. Similarly there is no problem of heteroscedasticity.

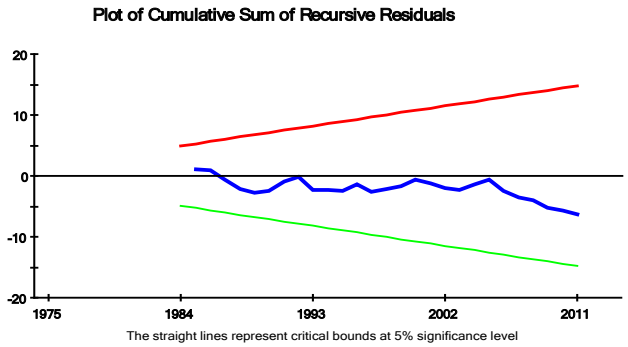
5. Stability of the Model

The stability of the model is very important issue and unstable model does not remain valid in the testing circumstances. The CUSUM and CUSUMSQ tests are applied to assess the stability of the model (Pesaran et al 1997) and these tests were developed by Brown et al (1975). These tests are cumulative sums and sums square of residuals that are plotted against time. The hypothesis of the test is as following:

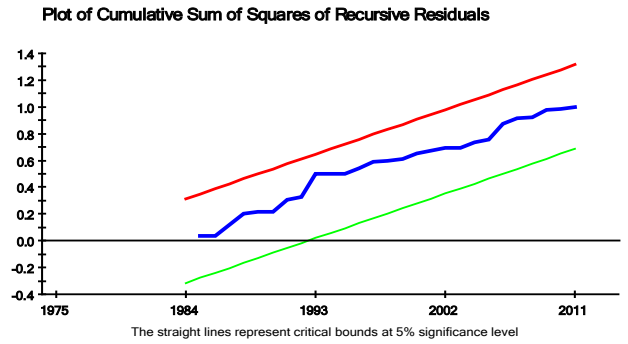
H0: All coefficients are stable in the model

H1: All coefficients in the model is unstable

Plots of CUSUM and CUSUM Q are within the boundaries, if the plot line does not crosses the boundary at any level then accept the Null hypothesis and reject the alternative hypothesis. If the plot line crosses the boundary at any level then reject the null hypothesis and accept the alternative hypothesis. Both the plots show that line within the boundaries at 5 percent significance level. Therefore these tests reveal that model is stable and accept the Null hypothesis.



In this figure CUSUM statistics fall within the 5% significance level.



The figure shows that the plots of CUSUM and CUSUMSQ statistics are well existed within the critical bounds and implying that all coefficients of the short run model (ECM) are stable.

6. Conclusion

The empirical analysis shows that the coefficients of the variables, rate of natural increase, life expectancy, working age population, and total literacy rate are in line with the theory, but variable of gross domestic saving rate deviate from the benchmark estimations due to ground realities. The coefficients of the growth of working-age,

life expectancy, and total literacy rate are positive and significant. Contrary to this the coefficients of rate of natural increase and gross domestic saving rate appear to be negative but prior is significant and later insignificant. So that demographic transition impacts economic growth significantly in the long run. In the short run the demographic variables of model show a significantly negative impact on economic growth except total literacy rate. Demographic variables may boost or slow down economic growth during a process of demographic transition but this is temporary phenomena. So a significant part of economic growth can be attributed to demographic transition.

The demographic dividend is not an involuntary marvel, but it requires an integrated and cohesive policy framework in health, education and in labor sectors to reap this dividend and capitalize the window of opportunity in Pakistan. Family Planning policies should be carried out with new zeal and spirit to stop the momentum of rate of natural increase which is stressing our resources and hampering economic growth. Retirement age should be extended and new pension policies should be formulated to get the benefits of healthy and longer lives. The utmost importance should be given to increase the education and skill training of the working age population to exploit their potential optimally. Government should make concerted efforts to increase the women participation in work force and huge investments are required in education sector to develop the young generations to utilize their full potential. Saving rates are very low and are not fully utilized; efforts should be made to raise the level of savings and their productive utilization.

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