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EMPIRICAL SCRUTINY OF DEMOGRAPHIC DIVIDEND OF ECONOMIC GROWTH: TIME SERIES EVIDENCE FROM PAKISTAN

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Abstract
This study empirically examines the impact of demographic variables on economic growth in Pakistan. It is done by augmenting the work of Mushtaq (2006) and Hussain, Malik & Hayat (2009) by employing more sophisticated econometric technique on data for the period 1970-2009 to estimate long-runrelationship between the variables by applying Johansen cointegration technique. Estimation through Fully Modified Ordinary Least Squares (FMOLS) of cointegrating vector reveals the existence of demographic dividend in Pakistan. The findings of this paper highlight the importance of man power planning to benefit from the surge of working age population and to forge the existing youth into future productive human capital to sustain the demographic dividend. This can be done by formulating and implementing a wholesome man-power plan spanning from academia to industry, for benefitting from the abundant factor of a labor-surplus economy.

Keywords: Labor Force, Demographic Dividend, Savings, Economic Growth, Fully Modified OLS, Labor-surplus economy

1. Introduction

Notestein (1945) refers demographic transition as a process where a country experiences declining mortality andrising fertility, both of which contribute to population growth. With the passage of time, the reduction in mortality triggers a steady and continuous decline in fertility. Such all leads to noteworthy changesin population composition of a country which can have implications for economic growth of that country.However, the nature of the impact of population on economic growth is not straightforward and may not independently influence economic growth. Factors like trade policies, industrial policies, education, governance, culture geography, savings and capital accumulation. This paper, however, includes savings as one of the auxiliary variables.

Out of developing countries, population estimates for Pakistan 2011 are approximately 1.57 percent and it ranks 6th among other nations in terms of population. The relationship between population composition and economic growth has been reignited because of demographic transition taking place in Pakistan in the form of declining fertility and mortality rates.

To fill the gap of existing research in this area,this paper scrutinizes the impact of population composition on the economic growth in Pakistan.

1.1 Demographic U-Hypothesis

Generally demographic transition is segmented in to three stages: high fertility/high mortality, high fertility/low mortality, and low fertility and low mortality. Such sort of demographic transition may effect an economic growth with an inverted U-shaped relationship; usually termed as demographic U-hypothesis. In its1stand 2ndstages, the labor supply and saving rate continuously increase thus the demographic effect on growth may appear to be positive; the 'demographic dividend' of economic growth. But in the 3rd stage, a large population mass keeps moving upward to the older generation as the labor supply and saving rate decrease (An & Jeon, 2006).

2. Literature Review

While the transition theory lies at the center of modern scientific demography, economists have made few attempts to understand its causal link with economic performance [see Bloom, Canning and Seville (2001)].Following is the review of some of them.

Easterline (1967) found population growth as delimiting factor in progress of a developing country. A larger number of young people put extra pressure on the available scarce resources.But he also points out an opportunity foruplifting the economy, by providing better opportunities to the working class.He also warns about the complexity of relationship between population and economic growth by emphasizing on need for country case studies to learn from their actual experiences.

Dahan&Tsiddon (1996) used a simple model of fertility choice in junction with the well-documented differences in returns to human capital across rich and poor to determine the co-determination of size of family and investment in human capital. They discoveredinverted U-shaped changes in the process of economic development fertility and income distribution. In

the first stage fertility increases and income inequality widens and then fertility declines income becomes equally distributed whileHuman capital becomes abundant and economic growth per capita takes off.However, this study resorts to the assumption that dependent and working-age populations grow at different rates, which is not always true.

Higgins and Williamson (1997) analyzed that unlike working individuals whose contributions to output and savings tend to increase in size more with their consumption while opposite holds for(non-working) young and the old people. As a result, the output per capita tends to increase when the population of working age individuals is large. It depressed when the large part of the population consists of (non-working) young and the old people.

Bloom and Williamson (1998) examined that East Asia has dramatic transition during 20th Century due to demographic transition as this transition resulted in an increase in the share of working-age population. Such increases per capita productive capacity of the country. Their analysis shows that population growth has transitional effect on economic growth. This implies thateconomic growth gets affected only when the dependent and working-age populations grow at dissimilar rates.

Bloom and Canning (1999) investigated the connection between population and economic growth, emphasizing demographic transition as the process underlying population growth in most developing countries. They found that high rates of population growth are temporary consequences of a decline in mortality rates, which precedes a decline in fertility. Perhaps, this situation also suggests sizable changes in the age distribution of the population.

Galor (2004) examined that demographic changes is the primary force in the transition of economy from stagnation to growth. It results in reduction in fertility rate and population growth it enables to convert the share of factor accumulation and technological progress into growth of income per capita.

Bum A.N. and Jeon (2006) inquired the relation between demographic changes and economic growth. He used annual data for the period 1970-2003 for Korea and used Fully Modified Ordinary Least Squares (FMOLS)for estimation to find that there exists the demographic dividend of economic growth in Korea. Their results warn that Korean economic growth may vanish in the near future as the member of old people will increase and youth might not be present to replace them.

Mushtaq (2006) uncovers lack of long-run relationship between population and per capita income in Pakistan for the period 1960-2001. He used unit root results followed by Johansen's procedure that shows no long-run cointegrating relationship. It can be inferred from his analysis that, the population lacks the ability to contribute to economic growth. An implication being that the productivity of labor is low or the proportion of productive labor is low in the overall population.

Hussain, Malik & Hayat (2009) using the data from 1972-2006 investigated the impact of demographic variables of Pakistan.Variables used were GDP, Infant mortality, total fertility rate, wage rate, labor force and population. They used OLS after checking for its suitability by employing the stationarity tests. Authors found that the infant mortality and total fertility and growth of labor forceare negatively related witheconomic growth while wage rateis positively related. In their opinion, demographic transition has resulted into massive labor force which Pakistan's economy has failed to engage in productive employment.

3. Objectives

The current study augments the work of Mushtaq (2006) and Hussain, Malik & Hayat (2009) by employing more sophisticated econometric technique to a more meticulous proxy for demographic transition. The hypothesis is hypothesized as follows:

H_A: There exists a demographic dividend of economic growth in Pakistan.

4. Data and Methodology

Demographic transition is proxied by age dependency ratio (ADR)which is the ratio of dependents (people younger than 15 or older than 64) to the working-age population (those agedfrom 15-64).Higher the value of ADR, more is the proportion of dependents as compared to working class in the population. Economic growth is measured by GDP per capita in local currency (in constant terms) and savings by adjusted net savings (%age of GDP). Data of concerned variables is taken from World Development Indicators (WDI) spanning from 1970 to 2009, allowing us to use 40 observations for our time series analysis. EViews Standard Version 7.1 is used for all estimations.Before conducting the inferential analysis, summary statistics of data is depicted in appendices using line charts and boxplots.

5. Empirical Results

5.1 Stationarity Tests

In first step, the order of integration of the variablesis inquired. Table 1 gives the results of the augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) unit root test procedure. All the variables are nonstationary at levels for the ADF unit root tests. Phillips-Peron tests give the same results and reject the null hypothesis of unit root at 5% level of significance. Accordingly, ADF tests on first differences are performed and show the rejection of the null hypothesis in each series. Same holds for Phillips-Peron tests. Both ADF and PP statistics show that all the variables are integrated of order one I(1).

Table 1: ADF and PP Tests

Test	Variables	Constant, Trend
I	II	III
Augmented Dickey Fuller (ADF)	ΔLYPC	-4.405
	ΔADR	-5.753
	ΔS	-8.819
Phillips &Perron (PP)	ΔLYPC	-4.367
	ΔADR	-5.807
	ΔS	-8.819

Notes: (i)t-statistics estimates listed in column III.
(ii) All the ADF and PP test show stationarity at 1st difference with significance at all levels (1%, 5% & 10%).

5.2 Cointegration Analysis

Table 2 summarizes the results of the cointegration analysis between GDP, saving rate, dependency ratio. The test for cointegration used here is the maximum likelihood approach employing both the maximum eigenvalue and trace statistics. It is employed to find a long run relationship between the dependent and independent variables. Two or more variable are said to be cointegrated if their linear combination is integrated to any order less than 'd'. If trace statistics and eigenvalue is greater than critical value at 5% then there exists long run relation between variables. It is known that Johansen's cointegration tests are very sensitive to the choice of lag length. Firstly, a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Schwarz Criterion (SC) and the Likelihood Ratio (LR) test are used to select the number of lags required in the cointegration test. In particular, the tests suggest that VAR=4 should be used in the estimation procedure of cointegration to avoid over-parameterization of the estimated models.VAR results show that there exists a long run relationship between GDP (per capita), saving rate, and dependency.

Table 2: Johansen-Juselius Likelihood Cointegration Tests

H_o: No. of cointegrating equations (CE)	No trend in data (1) intercept in CE		Linear trend in data (2) intercept in CE		Linear trend in data (3) intercept and trend in CE	
Trace test[a]	**Trace test**	**5% critical value**	**Trace test**	**5% critical value**	**Trace test**	**5% critical value**
None	44.74	35.19	30.40	29.80	51.60	42.92
At most 1	15.70	20.26	9.26	15.49	28.50	25.87
Max-eigenvalue test[b]	**Max-eigen**	**5% critical value**	**Max-eigen**	**5% critical value**	**Max-eigen**	**5% critical value**
None	29.04	22.30	21.14	21.13	23.12	25.82
At most 1	9.62	15.89	7.67	14.26	20.84	19.39

[a]Trace test indicates 1 CE in columns (1) and (2) and 2 CEs in column (3) at the 5% level.
[b]Max-eigenvalue test indicates 1 CE in columns (1) and (2) and 2 CEs in column (3) at the 5% level.
[c] Optimum lag length is '4' in this case which is selected using the SIC and AIC.

5.3 Vector Error Correction Model

The Vector Error Correction (VEC) term is obtained from the cointegration relation identified and it measures the magnitude of past disequilibrium. It is negative (-0.061792). Negative ECM term signifies convergence i.e. short run divergence may converge into long positive equilibrium. More precisely, about 6% disequilibrium in LYPC is adjusted per annum.Moreover ECM is statistically significant which reveals the stability of model. ECM coefficient for LADR shows convergence towards equilibrium in the long run but S shows divergence from equilibrium.

$$\Delta LYPC_t = \alpha_1 + \sum_i \alpha_{11}(i)\Delta LYPC_{t-i} + \sum_i \alpha_{12}(i)\Delta \mathrm{LADR}_{t-i} + \sum_i \alpha_{13}(i)\Delta \mathrm{S}_{t-i} + \beta_1 Z_{t-1} + e_{1t}$$

5.4 Fully Modified Ordinary Least Squares (FMOLS)

Cointegrating equations can be estimated on the basis of VAR model results. If series are cointegrated at first difference I(1), Fully modified ordinary least squares (FMOLS) is suitable for estimation. FMOLS was originatedbyPhillips and Hansen(1990) that provides optimal estimates of cointegrating regressions. FMOLS modifies least squares to explain serial correlation effects and for the endogeneity in the regressors that arise from the existence of a cointegrating relationship (Phillips & Hansen, 1990).

$$X_t = \hat{\Gamma}_{21} D_{1t} + \hat{\Gamma}_{21} D_{1t} + \hat{\epsilon}_t \quad (8)$$

or directly from the difference regressions

$$\Delta X_t = \hat{\Gamma}_{21} \Delta D_{1t} + \hat{\Gamma}_{21} \Delta D_{1t} + \hat{v}_t \quad (9)$$

Let $\hat{\Omega}$ and $\hat{\Lambda}$ be the long-run covariance matrices computed using the residuals $\hat{v}_t = (\hat{v}_{1t}, \hat{v}_{2t}')'$. Then we may define the modified data

$$y_t^+ = y_t - \hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{v}_2 \quad (10)$$

and an estimated bias correction term

$$\hat{\lambda}_{12}^+ = \hat{\lambda}_{12} - \hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{\Lambda}_{22} \quad (11)$$

The FMOLS estimator is given by

$$\hat{\theta} = \begin{bmatrix} \hat{\beta} \\ \hat{\gamma}_1 \end{bmatrix} = (\Sigma_{t=1}^{T} Z_t Z_t')^{-1}\left(\Sigma_{t=1}^{T} Z_t y_t^+ - T\begin{bmatrix} \hat{\lambda}_{12}^+ \\ 0 \end{bmatrix}\right) \quad (12)$$

Where $Z_t = (X_t', D_t')'$. The key to FMOLS estimation is the construction of long-run covariance matrix estimators $\hat{\Omega}$and $\hat{\Lambda}$.

Before describing the options available for computing $\hat{\Omega}$and $\hat{\Lambda}$, it will be useful to define the

scalar estimator

$$\hat{\omega}_{1.2} = \hat{\omega}_{11} - \hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{\omega}_{21} \quad (13)$$

Whichmay be interpreted as the estimated long-run variance of υ_{1t}conditional on υ_{2t}. If desired, degree-of-freedom correction to$\hat{\omega}_{1.2}$ can be applied.

5.5 Estimation Results of the FMOLS

Table 3 depicts the estimation results from the FMOLS estimation. The saving rate has positive sign while dependency ratio appears with a negative one. This shows that the changes of the age structure stimulate the economic performance because dependency ratio rapidly decreased in Pakistan during 1970-2009. Where savings rate has positive relationship with income per capita.While savings rate and dependency ratio have negative relationship.This indicates towards the exists a 'demographic dividend' in Pakistan.

Table 3: Cointegration Regression Estimates using FMOLS

Estimation Technique	Constant	Coefficients			Adj. R^2	Long Run Variance
	C	LYPC(-1)	LADR	S		
FMOLS	0.2936	0.976	-0.012	0.002	0.994	0.0002
	(0.3407)	(0.0162)	(0.0451)	(0.0005)		

Note: Standard errors in parenthesis.

6. Conclusion

Our findings suggest that a rise in the rate of economic growth due to rising share of working age people in a population in Pakistan – Demographic dividend exists for Pakistan. Our results dissent from that of Mushtaq (2006) and Hussain, Malik & Hayat (2009). This can be attributed to meticulous proxy of demographic transition and a more rigourous econometric methology. Because of declining population growth and consequent changes in age structure, the proportion of working age population has increased offering a window of opportunity referred to as demographic dividend. Pakistan's working age population has bulged and dependency ratio has declined. Demography provides policy makers a crystal ball to formulate policies for tomorrow andto benefit from this increased working-aged population, suitable policy formulation is required. The young labor force of Pakistan needs to be converted into more productive human capital by investing in education, skill up-gradation and research. Consequently, this working labor force could be absorbed by the labor market of the economy. However, only a vibrant economy can create employment opportunities for the new entrants in the labor market. In a nut shell, need is to formulate and implement a wholesome man-power plan spanning from academia to industry, for benefitting from the abundant factor of a labor-surplus economy.

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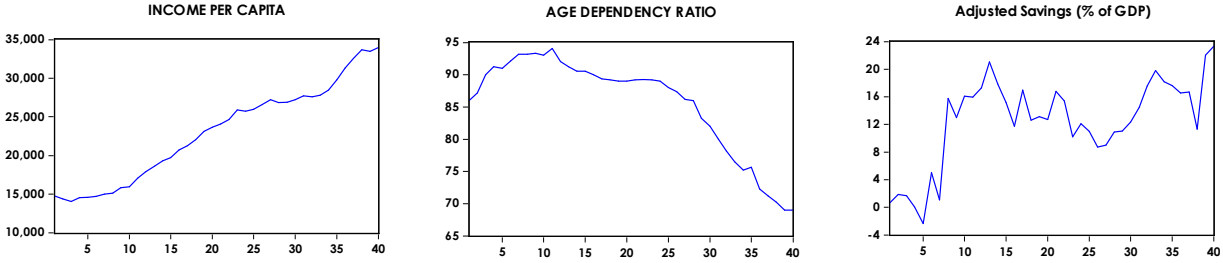
APPENDICES

A 1: LINE CHARTS FOR VARIBLES USED



A 2: BOXPLOTS FOR VARIBLES USED