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RESEARCH PAPER

Impact of Dependency Ratio on Economic Growth among Most Populated Asian Countries

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ABSTRACT

Demographic transition through different channels significantly influences economic growth. Malthusian view postulated as dependency ratio adversely affects economic growth while Julian Simon's view is quite different, highlighted the long-run benefits of the population in the range of 5 to15 years on economic growth. This study can be a valuable addition in research to analyzing the association of dependency ratio and economic growth of the five most populated Asian countries (Bangladesh, China, Indonesia, India, and Pakistan). Empirical findings of the study indicated that a total dependency and younger dependency ratio has a positive and significant influence on economic growth in both short-run and long-run scenarios while the old dependency ratio shows a negative influence on economic growth in the long run while short-run results are unpredictable. There is a need for state-based proper policy measures in focusing the higher financing in human capital development specifically in education and health.

Introduction

In the current scenario, over the past half-century world population is estimated to increase almost triple (United Nations (UN), 2019) and the highest population growth rate is estimated in emerging and developing economies (Choudhry and Elhorst, 2009; United Nations (UN), 2019). The consequences of an increase in rapid population on economic growth have fascinated a lot of consideration and currently burning issues of discussion regarding the literature. The scenario of growth rate in per capita income regarding the association impact of population growth and long-run economic growth is still controversial not only between economists and demographers but also in policymakers (Piketty, 2015; Bucci et al., 2018). Demographic transition is the consequence of dramatic variations in population age structure, boom and burst of babies, low fertility emergence and sequential development in life expectancy as experienced in both developing and developed countries in post world war II (Prettner et al., 2013; Mason et al., 2016). Challenges cause stresses to the elderly and the growth of labor forces turns

negative or slows down while investment intensification in physical and human capital promotes economic growth (Miller and Babiarz, 2014). Human capital investment in the course of mass formal education has considerably augmented in both developed countries from a couple of centuries while in developing countries from the last century (Hanushek and Woessmann, 2012; Ashraf et al., 2013).

This study aimed to find out the impact of the dependency ratio on economic growth among the five most populated Asian countries. There were some significant reasons selections these five, China, India, Indonesia, Pakistan and Bangladesh most populated Asian countries. Firstly, in the recent scenario, these five countries indicated as emerging economies of the world due to economic growth (Organization for Economic Co-operation and Development (OECD), 2018). Secondly, these five countries are indicated among the eight highest populated countries of the world and represent an estimated 44.7% population of the world (UN, 2019). Thirdly, these five countries are passing through these demographic transitions but different periods and paces. This paper is categorized into five sections like the introduction of the study elaborated in the first section, the theoretical background in section two and the third section elaborates the literature review of the study. The material and method of the study are explained in section four, results and discussion in section five while the conclusion and suggestion are indicated in the last section of the study. In this study, the dependency ratio represents the population age structure (Rosado and Sanchez, 2017). The study tried to examine the impact of dependency ratio on the economic growth of five China, India, Indonesia, Pakistan and Bangladesh most populated Asian countries.

Literature review

Population growth association to economic growth

Population growth remained the center of discussion regarding the estimating impact of demography and economic growth in previous studies and there were highlighted three significant scenarios regarding population growth impact on the economy (Bucci, 2008). Firstly, population growth consequently causes slow down economic growth regarding the pessimistic approach as supported by some significant studies (Malthus, 1798; Kelley, 1988; Kelley and Schmidt, 1995; Song, 2013; Liu and Hu, 2013). Malthus (1798) justified as population growth due to limited technology in production procedure develop pressure to fix economic resources as land outpace food supply and consequently cause famine and slow down both population and economic growth. Kelley and Schmidt (1995) and Kelley (1988) acknowledged a negative association in economic growth and population-related to developing countries as Kelley (1988) analyzed as inefficient institutions and markets, inadequate natural resources and weak property rights are major factors of a negative relationship. Kelley and Schmidt (1995) justified the negative impact of economic growth due to higher crude death and crude birth as offsetting the effect on economic growth in 1960 and 1970 while these effects outweighed 1980 in a sustained pessimistic approach. The studies of Song (2013) and Liu and Hu (2013) focused on the Asian region and showed a negative correlation between the growth of population and economic growth.

Secondly, positive association in the growth of population and economic growth is postulated in the optimistic approach which is significantly supported in some prominent studies (Kuznets, 1967; Choudhry and Elhorst, 2009; Rizk, 2018). Higher economies of scale are permitted owing to growth in the labor force, larger saving, higher stock of knowledge and larger domestic market as the positive association in the population growth and economic growth as supported by some significant proponents works (Kuznets, 1967). Jones, (1997) and Kremer, (1993) expanded the endogenous growth model as an infusion of technological advancements through capital investment in labor caused to rise in economic growth in scenario population growth. Tamura, (2006) constructed the model of general equilibrium human capital investment affected by adult mortality rate.

Demographic structure association with economic growth

Demographic structure impact on economic growth as more specifically investigated research has in a recent era focused by researchers. There are contradictory findings regarding using the approach of estimation demographic structure and economic growth association due to differences in growth and level of the population regarding age groups it impacts differently on economic growth as investigated by some prominent researchers in their studies (Kelley and Schmidt, 2005; Kogel, 2005; Zhang *et al*. 2015; Uddin *et al.* 2016; Yi and Li, 2017). Bloom and Williamson (1998) investigated the positive outcomes of working-age proportion on economic growth denoted the first dividend in the demographic scenario.

Channels in the course of demographic structure offset economic growth

In the current scenario, another aspect which researchers tried to explore are the significant channels in the course of demographic structure that might influence economic growth as highlighted in some studies (Boblic *et al*., 2017; Nduku and Simo-Kengne, 2017; Ahmad and Khan, 2018; Tshabalala *et al*., 2018). Lehman, (1953) find out the results that working people aged 30 to 40 years more productive regarding innovation. Malmberg, (1994) estimated Swedish data in focusing the association of demographic structure and economic growth and highlighted that higher working-age population generate more savings and growth patterns highly related to lifecycle hypothesis in the working-age scenario.

Developing countries have higher severity of dependency ratio and the most populated countries of the world specifically need to address this scenario which is the significant gap in this literature. This study, it is tried to address this gap by focusing on the Asian region and prominently the five most populated Asian countries as China, India, Indonesia, Pakistan, and Bangladesh to investigate the impact of dependency ratio on economic growth.

Material and Methods

This study focused five most populated Asian countries China, India, Indonesia, Pakistan and Bangladesh due to some significant reasons; firstly these five countries

represent almost 44.73% population of the world as China (18.59%), India (17.71%), Indonesia (3.51%), Pakistan (2.81%) and Bangladesh (2.11%) and among eight most populated countries of the world (UN, 2019). Secondly, these five developing countries are currently emerging economies of the world and these most populated countries represent an almost higher dependency scenario which causes a significant impact on economic growth (International Monetary Fund (IMF), 2018). Lastly, these five countries have passed and gone through different demographic transition phases so these estimates will help in highlighting this scenario in these countries.

Figure of study area

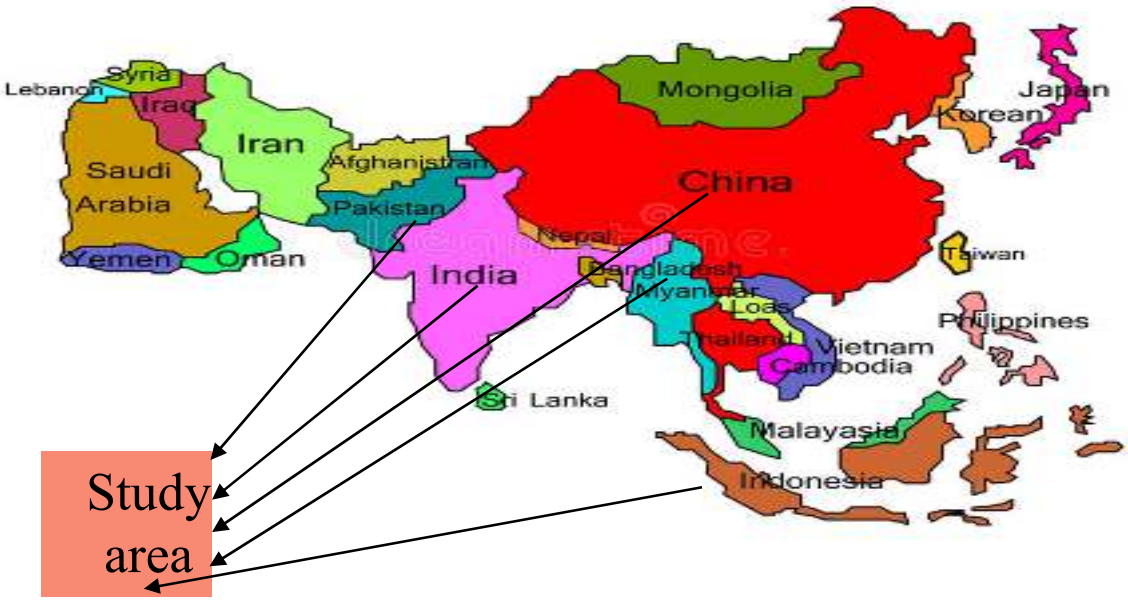

Figure: Map of study area

This study used secondary data from 1982 to 2017 of these five Asian countries for empirical estimation of the study from various secondary sources of World Bank (World Development Indicators), and State Bank of Pakistan (SBP) various publications. Gross domestic product growth, total dependency ratio, younger dependency ratio, old dependency, and gross saving were significant variables as used in this study for empirical estimation of the study.

Empirical Model of the study

Econometric methods and models used in this study as elaborated in this section. According to the panel data set to validate the association dependent and independent variables this study used several methods and models.

Model's functional form of the study is as follows

GDP growth = f (dependency ratio, gross saving)

The general panel regression model is following

$$GDPG_{it} = \delta_0 + \delta_1 TDR_{it} + \delta_2 GS_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots (1)$$

In equation (1) i denotes the number of countries, t as time while GDPG is the dependent variable as GDP growth. $\delta_0, \delta_1,$ and δ_2 denoted as coefficients of respective variables, TDR is the total dependency ratio and GS is gross saving.

For younger age dependency ratio:

$$GDPG_{it} = \delta_0 + \delta_1 YDR_{it} + \delta_2 GS_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots (2)$$

Equation (2) indicates YDR as a younger dependency ratio.

For old-age dependency ratio as denoted in equation (3)

$$lnY_{it} = \delta_0 + \delta_1 ODR_{it} + \delta_2 GS_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

The old dependency ratio is denoted with the notion of ODR as given in the above equation (3).

Levin, Lin, and Chu (LLC), Hadri used the continuous parameters ηi = η, constant across the cross-sections. In another scenario, Im, Pesaran, and Shin (IPS), Fisher- PP and Fisher- ADF parameters test used as a specific cross-section. All test mentioned above has some properties and flaws. Asghar *et al*. (2015) explained that to obtain more appropriate results of stationarity move to four different tests that are used to check out the stationarity for panel data.

In 2003 the Im- Pesaran and Shin presented the tests for panel unit- root with the following equation:

$$\bar{t}_T = \frac{1}{N}\sum_{i=1}^{N} t_{i,t}(p_i) \quad \ldots\ldots\ldots\ldots\ldots (4)$$

Where Pi is the lag order and $t_{i,t}$ is used for ADF statistics

Pesaran *et al*. (1995, 1999) introduced a new technique Pooled Mean Group (PMG) in ARDL (Autoregressive Distributed Lags) for the estimation of non-stationary dynamic panels. According to consistency with the literature, the panel ARDL approach is applied when data has a mixed order of integration for panel series and study objective to check

the long-term relationship. ARDL technique is more appropriate for estimation according to data of the study so employed in this study for empirical estimation.

The model specification is given below

$$GDPD_{i,t} = \left(TDR_{i,t}, YDR_{i,t}, ODR_{i,t}, GS_{i,t}\right) \quad (5)$$

The panel ARDL equation for this model is:

$$\Delta GDPG_{i,t} = \beta_0 + \beta_1 TDR_{i,t-1} + \beta_2 YDR_{i,t-1} + \beta_3 ODR_{i,t-1} + \beta_4 GS_{i,t-1} + \beta_5 GDPG_{i,t-1} + \sum_{i=0}^{p} \alpha_i \Delta TDR_{i,t-1} + \sum_{i=0}^{p} \beta_i \Delta YDR_{i,t-1} + \sum_{i=0}^{p} \gamma_i ODR_{i,t-1} + \sum_{i=o}^{p} \varphi_i GS_{i,t-1} + \sum_{i=1}^{p} \lambda_i \Delta GDPG_{i,t-1} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots (6)$$

In equation (6) GDPG explains Gross domestic product growth, TDR as the total dependency ratio, younger dependency ratio as YDR, ODR as old dependency ratio while GS indicates Gross saving and no of cross-section, i = 1,2, …,5 and the time, t = 1982, 1983, …, 2017

Dumitrescu and Hurlintest of causality

To elaborate on cross-sectional heterogeneity and dependency, this study has applied a panel causality test presented by Dumitrescu and Hurlin (2012). Given present literature, causality study is based on a useful association that is expressed in the following way:

Economic Growth = f (dependency ratios and gross saving)

GDP growth is used for economic growth while dependency ratio (DR) is used for the (TDR) total dependency ratio, the (YDR) young dependency ratio, and the (ODR) old dependency ratio. Dumitrescu and Hurlin, (2012) tests are considered more appropriate for the panel causality test. The test technique considers the heterogeneous causal associations and the heterogeneous regression model used for Granger causality testing. The linear regression for panel model pursued by (Dumitrescu and Hurlin, 2012) as given below in equation (7)

$$y_{i,t} = \alpha_i + \sum_{j=1}^{J} \beta_i^j y_{i,t-j} + \sum_{j=1}^{J} \gamma_i^j x_{1i,t-j} + \sum_{j=1}^{J} \delta_i^j x_{2i,t-j} + \sum_{j=1}^{J} \varphi_i^j x_{3i,t-j} + \sum_{j=1}^{J} \omega_i^j x_{4i,t-j} + \varepsilon_{i,t} \quad \ldots\ldots\ldots\ldots (7)$$

In equation (7) the notion of y is GDP growth and x are the vectors of the independent variable as total dependency ratio (TDR), the young dependency ratio (YDR), the old dependency ratio (ODR) and gross saving (GS).

Table1: Panel unit root results

Variables	LLC		IPS	ADF-Fisher		PP-FISHER	
	None	Intercept	Intercept	None	Intercept	None	Intercept
GDP Growth	-1.132 (0.128)	-6.221* (0.000)	-5.423* (0.000)	13.837 (0.180)	50.499* (0.000)	12.730 (0.239)	48.952* (0.000)
Gross Saving	-10.485 (0.000)	-9.768** (0.000)	-10.159** (0.000)	132.353 (0.000)	97.816** (0.000)	252.919 (0.000)	94.145** (0.000)
Total dependency ratio	-1.966 (0.024)	-1.856** (0.031)	-1.908** (0.028)	15.422 (0.117)	24.376** (0.006)	13.825 (0.181)	18.412** (0.048)
Younger dependency ratio	-3.069* (0.001)	-1.743 (0.040)	0.468 (0.680)	19.534* (0.034)	7.060 (0.719)	192.393 * (0.000)	17.203 (0.070)
Old dependency ratio	-1.777** (0.037)	1.074 (0.858)	-0.858 (0.195)	30.521** (0.000)	20.269 (0.026)	25.491** (0.004)	19.663 (0.032)

Note: The * sign indicates that values stationary on level and ** represent stationary on 1st difference.
Note: The level of significance at 5%.

Results and Discussion

The panel unit root test estimates are presented in table 1 as explained that some variables are stationary at a level while some are stationary at 1st difference. GDP growth and younger dependency ratio were the order of integration are I (0) while Gross saving, TDR and ODR were the order of integration is I (1) that indicate stationary at 1st difference. Bound F-tests stated that for this model there is cointegration (long-run associations) since the panel's calculated F-statistics were greater than the upper critical value, even at the point of 1 percent meaning as indicated in table 2. Estimation indicated as F-statistics dropped above the bottom band of 99 percent compared to critical values of Pesaran et al., (2001) that cause to rejects the null hypothesis (there is no cointegration) and concludes cointegration among the variables of regression.

Table 2: panel F-statistics to check the presence of long term association

K[a]	F- statistic	5% critical value		1% critical value	
		Upper-bound	Lower-bound	Upper-bound	Lower-bound
4	11.6346	4.01	2.86	5.06	3.74

Note: In the table independent variables represent by [a]
Note: upper bound and lower bound values were achieved through the study prepared by Pesaran et al. (2001)

5.1 Panel ARDL Approach

Panel autoregressive distributed lag (ARDL) model was used that estimated both long-run and short-run impacts of the model in the study and these estimates of both types were explained separately.

Table 3: Long run coefficient results of ARDL Estimation

Variables	Coefficients	Std.error	t-Statistics	Probability
TDR	0.09	0.01	8.34	0.00
YDR	0.11	0.01	9.92	0.00
ODR	-1.48	0.39	-3.72	0.00
GS	0.24	0.03	7.27	0.00
Note: Values are significant at 1 % level of significance. Note: values are adjusted at 2 decimal places.				

The long-run estimates of the Panel Autoregressive Distributive Lag model are elaborated in Table 3. These results specify a positive association between TDR and GDP growth (annual %) as indicated to a one percent increase in TDR consequences in a 0.09 % rise in GDP in the long run. These conclusions are similar to the study by Choudhry and Elhorst, (2010) dissimilar to these studies by Uddin *et al*., (2016) and Rosado and Sanchez, (2017). These studies by Uddin *et al*., 2016 and Rosado and Sanchez, 2017 find out the negative association between TDR and GDP growth because in both countries Australia and Ecuador had a large old population in the study period and had a problem with the aged population.

The results showed that in the long run, YDR was also a positive influence on GDP growth in these most populated Asian countries as indicating a one % increase in YDR consequently increasing 0.11 % in GDP growth. These results alike the study of Boblic *et al*., (2017) as focused on the younger dependency ratio with saving rate and current account and analyzed the positive impact of the young dependency ratio on current account and saving.

The long-run estimates of the ARDL model indicated a negative and significant association exists between ODR and GDP growth. The coefficient of ODR is -1.48 as denotes a one percent increase in the old dependency ratio (ODR) will reduce GDP growth by 1.48%. This scenario analyzed as such relationship suggests as ODR increase it will slow down the growth level of the economies and these findings are similar with the study of Wongboonsin and Phiromswad, (2017) as resulted in ODR negative impacts on economic growth in developing and developed nations the reason of aged population less productive and more expenditures like health expenditures and for all needs.

ARLD long-run estimates indicated the positive association in gross saving (GS) and GDP growth with the gross saving (GS) coefficient of 0.24. This direction shows the

association of more gross-saving (GS) promotes finance for government investment that is more beneficial for economic growth. These results are similar to the study of Rosado and Sanchez, (2017) as the estimated positive effect of saving rate on economic growth in Ecuador the reason of savings increase consequently increases the investment level and further increases the economic growth.

Error correction approach was used for estimating parameters in the short run for speed of adjustment indicated as the ultimate step of the ARDL technique and these short-run findings are presented in table 4. The results of the significant term of error correction prove the existence of a stable association in the short run among the variables of the study. In the error correction estimation, negative value shows convergence towards long-term equilibrium while positive value shows divergence towards equilibrium. The short-run estimates of the error correction approach of the study are significant and the negative value showed the series is stable and equilibrium, in the long run, is achievable.

Table 4: Panel ARDL results of short term

Variables	Coefficient	Std. Error	t-Statistics	Probability
ECT(-1)	-1.49	0.49	-2.99	0.00
D(TDR (-5))	-3.73	1.61	-2.31	0.02
D(YDR (-5))	-4.60	2.60	-1.76	0.08
D(ODR)	-0.47	2.85	-0.17	0.87
D(GS)	0.48	0.16	2.94	0.00
Note: values are adjusted at two decimal places Note: only significant lags are present except ODR.				

Panel Causality Test

The estimates of the panel causality test as elaborated in table 5 show strong causalities among gross domestic product growth (GDPG), the total dependency ratio (TDR), and the younger dependency ratio (YDR). Firstly, bi-directional causality between GDPG and GS, TDR and GS, ODR and GS, and YDR and TDR. Secondly, uni-directional causality from TDR, YDR, and ODR to GDPG, and ODR to TDR and YDR. There is no causality among GDP growth to TDR, YDR, and ODR while GS and YDR have no causality either bi-directional or uni-directional and the scenario of TDR and YDR has no cause to ODR.

Table 5:Dumitrescuand Hurlin Causality outcomes

Causality directions	W-stat	Zbar-stat	P value
GS → GDPG	6.98*	4.67*	0.000003

GDPG → GS	11.07*	8.63*	0.0000
TDR → GDPG	5.12*	2.87*	0.0040
GDPG → TDR	2.74	0.57	0.5667
YDR → GDPG	5.12*	2.87*	0.0041
GDPG → YDR	2.99	0.82	0.4143
ODR → GDP	6.49*	4.19*	0.00003
GDP → ODR	1.72	-0.42	0.6769
TDR → GS	3.99***	1.78***	0.0745
GS → TDR	3.96***	1.75***	0.0795
YDR → GS	3.54	1.34	0.1798
GS → YDR	3.75	1.55	0.1209
ODR → GS	4.55**	2.31**	0.0203
GS → ODR	5.27*	3.01*	0.0026
YDR → TDR	6.09*	3.81*	0.0001
TDR → YDR	6.33*	4.04*	0.00005
ODR → TDR	5.86*	3.58*	0.0003
TDR → ODR	3.72	1.52	0.1266
ODR → YDR	6.24*	3.95*	0.00008
YDR → ODR	3.42	1.23	0.2197
Note: W-stat and Zbar-stat are adjusted at 2 decimal places. Note: *, **, and *** are represent 1%, 5%, and 10% level of significance.			

Conclusion and suggestions

Dynamics in demographic structure in the world scenario and specifically in the Asian region is the burning issue of this region, causing imbalances in resources and population growth consequently significantly impacting economic growth. Demographic structure in the context of economic growth in the five most populated Asian countries was not examined in any study. In this study impact of age dependency on economic growth tried to explore specifically in the scenario of the five most populated Asian countries. This research work used time-series data from 1982 to 2017 and employed the Panel ARDL technique and Dumitrescu and Hurlin's (2012) causality test for empirical estimation. The findings of the study indicated as in long run TDR and YDR positively impact economic growth whereas in the short run these negatively impact economic

growth in these five Asian countries. The results of ODR negatively impact economic growth in the long run while the short-run impact of ODR on economic growth is insignificant while gross saving positively impacts economic growth regarding short-run and long-run scenarios.

In the scenario of the conclusion there need for some policy measures for consistency and increasing economic growth specifically in developing countries. Firstly there is a need for more state-based financing in human capital specifically in schooling and heath as the more educated and skilled population with a sound health status is more productive for the economy and will tolerate the economic fruit if extra hands can catch jobs. Secondly promoting more feasible economic for promoting FDI and increasing human capital expertise through advanced technology and training to the working population.

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