Pakistan Economic Review
3:2 (Winter 2020), pp.22-43

DEMOGRAPHIC CHANGES AND SOURCES OF ECONOMIC GROWTH: A COMPARATIVE STUDY OF AFRICAN AND ASIAN REGIONS

Faiza Mehmood, Faiza Azhar Khan and Zainab Jehan[1]

Abstract

The present study aims at analyzing the impact of demographic changes on sources of economic growth, namely, physical capital, human capital and TFP growth for African and Asian regions for the time span 1960–2017. Demographic changes have emerged as one of the important determinants of economic growth of a country. In this respect, the African and Asian regions present an interesting comparative case with successful and slow demographic transition respectively. The growth rate of population in the Asian region is decreasing while it remained constant in the African region over the last fifty years. Dynamic Panel System GMM estimation technique is used and four different demographic variables namely, population growth rate, fertility rate, old age dependency ratio and young age dependency ratio are used for analyzing the impact of demographic changes on aforementioned sources of economic growth. Results support the negative impact of demographic changes on sources of economic growth; however, the size of impact is different for each proxy of demographic change and with respect to different sources of growth. The impact of demographic variable is higher for Asian countries thanfor the African countries, which support the demographic dividend argument for the Asian countries.

Keywords: Demographic Dividend, TFP Growth, Human Capital, Dynamic panel System GMM, Demographic age structure

JEL Classification: J11; O40; O57

1. INTRODUCTION

During the last three centuries the population of the world has accelerated rapidly and the world population has reached to 7.6 billion in 2018 (World Bank, 2018). Furthermore, over time, not only the population growth has increased but there is also an immense change in the population age structure. These population changes are not only affecting the social structure of the human society but also have brought changes into the economic system. Economists have also concluded that demographic factors are likewise critical in explaining economic growth. As, Kelley and Schmidt (2005, pp. 277) stated "*What has changed with the evolution of modeling in the 1990s is a clearer interpretation of the channels and sizes of demographic changes on the economy".*

[1]Authors are respectively MPhil Graduate and Assistant Professors in Department of Economics, Fatima Jinnah Women University, The Mall Rawalpindi, Pakistan. The paper is based on the M. Phil thesis of the first author (Email of corresponding author: faiza.fjwu@gmail.com).

To begin with, Adam Smith (1776) was the first one to relate the economic growth with the division of labor. However, the field of demographics emerged with Malthus (1798, pp.4), according to Malthus *"Population, when unchecked, increase in a geometrical ratio, subsistence only increase in an arithmetical ratio".* Few earlier studies about demographics were made by Graunt (1662), Price (1771) and Morgan (1838) respectively (Kreager, 1988).Later on Solow (1956)and Swan (1956) in their neoclassical growth model rendered population growth important for explaining economic growth.[2]

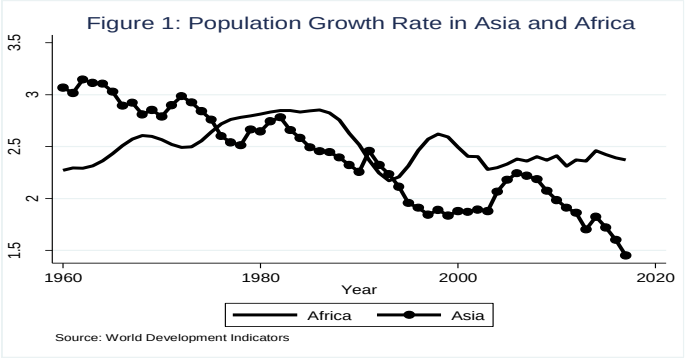
The opinion of economists about the impact of population changes on economic growth is divided into three different dimensions. First is the pessimistic view, which is linked with Malthus (1798). Higher population is believed to distresses the economy by affecting the behavior of savings and investment together with putting more pressure on balance of payment and infrastructural facilities (Bloom et al., 2001). However, after 1980s, the optimistic views about impact of population were famous (Bloom et al., 2001). Economists as Kuznets (1967) and Simon (1981) consider the increase in population beneficial for the economy due to economies of scale and increase in human capital stock. Conversely, in recent years, some economists also concluded that by controlling other variables there is little impact of population on economic growth which gave rise to the third view about the impact of population that is neutralism. They neglect the importance of demographic changes in world's economic development.

However, aforementioned literature on the relationship between population and income growth has overlooked a noteworthy feature of changing age structure of population. Despite having parallel population growth rates, age structures of different countries can be different subsequently having varying impacts on income/economic growth (Bloom et al., 2001). Countries with relatively more old and young age populations may experience lower economic growth as compared to, countries with a high proportion of working age population. Difference in population age structures is ensued from varying fertility and mortality rates over time that can additionally be linked to the demographic transition of countries. Presently, majority of the developing countries in the world are characterized by declining mortality and fertility rates, which can result in increasing percentage of working age population in total population (Batini et al., 2006). This may create an opportunity of demographic dividend for these developing countries given that countries are directing their policies for improving the education, health and employment opportunities of the young population (Bloom et al., 2001; Bloom and Finlay, 2009). Demographic dividend can enhance economic growth of a country through increases in physical capital, human capital and productivity. It is worth mentioning that the East Asian growth miracle can also partly be attributed to demographic dividend (Bloom and Williamson, 1998).

[2]According to the neoclassical growth model increase in population results in economic stagnation.

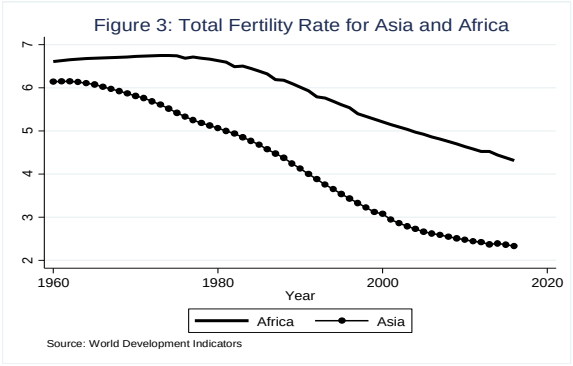
The topic of demographics is more important in the labor-surplus countries. Due to high birth rates, these countries are having natural advantage in the form of surplus labor. However, by providing better education, these human resources can be converted into human capital. In this context, the comparative analysis of demographic changes for the African and Asian regions is very interesting due to differences in the demographic situation of both regions. According to the recent estimates, 60 percent of the world population lives in Asia and the second largest contributor in the world population is Africa with its share of 16 percent. In 1950s the demographic situation of both regions was similar but later the population growth rate and age dependency ratios have been showing a declining trend for Asia and not for the Africa (UN, 2015). To begin with, Figure 1 shows the population growth for Asian and African regions for the time period 1960-2017. The trends are illustrating relatively sharp decrease of population growth for Asian countries and with some fluctuations, approximately a constant trend for African countries.

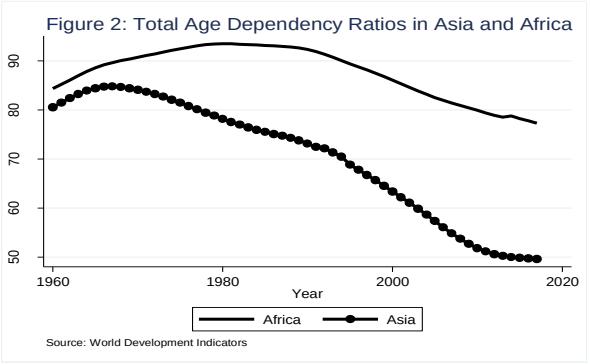
Besides population growth, Figure 2 depicts the age dependency ratios for African and Asian regions. In 1960, the dependency ratio in Africa was 84.5 and in Asia it was 80.2. However, since the late 1970s, the age dependency ratio for Asian countries showed decreasing trend. However, in African region dependency ratio kept on increasing until 1990s and afterwards it shows sluggish decrease. Resultantly in recent years, huge difference between the dependency ratios of both regions can be observed with the value for Africa being 78.6% and for Asia it is 50.5% in 2015. Likewise, trends of fertility rates in Figure 3 show contrasting picture for two regions. Total fertility rate (TFR) for Asia has been sharply decreasing since early 1970s but for Africa it started declining slowly during and after 1980s. Therefore, recently the TFR is 4.5 in Africa and 2.5 in Asia.



Over the course of time, various demographic variables have been considered important in their impact on economic growth. Initially, the literature has only focused on population size, however later the researchers have diverted their focus from population size to population age distribution (Bloom et al., 2001). These changing population age structures are because of varying fertility and

mortality rates over time, which may further be linked to the demographic transition of countries. A great number of studies have analyzed the impact of demographic age structures on economic growth. Nevertheless, it is worth noting that demographic variables affect economic growth through its various sources namely, physical capital, human capital and total factor productivity (TFP). However, most of the literature has pondered upon the relationship between demographics and economic growth but there are quite a few studies on the impact of demographic variables on sources of economic growth. It is imperative to study the socio-economic impact of changes in demographics on the sources of economic growth.





A voluminous amount of literature has analyzed the direct impact of different demographic change indicators on economic growth. However, the impact of demographic changes on economic growth is not only direct but also conditional on various channels such as physical capital, employment and human capital. It is therefore important to analyze how and to what extent the impact of demographic changes on economic growth varies through these channels. In this respect, the African and Asian regions present an interesting comparative case with successful and slow demographic transition respectively. The growth rate of population in the Asian region is decreasing while it remained constant in African region over the last fifty years. As mentioned above, demographic situation of both regions was quite similar in 1950s but later the population growth rate and age dependency ratios have been showing a declining trend for Asia and not for the Africa (UN, 2015)

The study is unique in its attempt to analyze the impact of demographic changes on sources of economic growth for African and Asian countries. Determinants of three sources of economic growth, namely, physical capital, human capital and TFP are being analyzed for the sample of African and Asian countries for this purpose. The rest of the study is organized as follows. Section 2 presents a comprehensive review of existing theoretical and empirical literature. Section 3 discusses the methodology used and the data. Results and discussions are presented in Section 4 and finally section 5 concludes the paper with few policy recommendations.

2. LITERATURE REVIEW

In the economic growth literature specifically, in the growth accounting exercises, human capital, physical capital and total factor productivity (TFP) are considered as basic sources of economic growth. It is imperative to look at the impact of demographic changes on these sources of economic growth. To begin with the relationship between demographic changes and TFP, according to some theories, population growth results in increasing the size of the market which can lead to economies of scale and hence a positive impact on TFP(Simon, 1992; Kremer, 1993). However, Prskawetz et al. (2007) explains that increased population growth decreases the level of savings and there will be less investment in research and development, which consequently cause low TFP growth (Turner, 2009).There are a variety of theoretical models explaining the relationship between demographics and TFP. Kremer (1993) build a model integrating technology with population growth and predicted a positive relationship between the rate of technological progress and population growth.[3] Recently, Mehmood and Azim (2014) have argued in *Demo-Tech-TFP model*, that improved demographic features and human development index can enhance the relationship between information technology and TFP.

Few of the empirical studies on the relationship between age structure and TFP are contributed by Bernanke and Gurkayank (2002), Kogel (2003) and Park and Shin (2012). Bernanke and Gurkayank (2002), Kogel (2003) and Park and Shin (2012) concluded negative impact of age dependency ratios on TFP while, Feyrer (2007), reported a positive relationship between working age population and aggregate productivity. Further, findings of the Werding (2008) showed that the contribution of old age and young age groups is comparatively less than the contribution of working age population in the productivity growth of the world countries. In contrast to the above mentioned panel studies, Izmirlioglu (2008) examined the relationship between age structure and economic growth through the channel of technological progress using the data of United States and indicated that in the long run speedy growth of TFP can result from high population growth.

[3]In his model Lee (1988) had explained the relationship between demographics and TFP growth. Kremer (1993) model was also based on Lee's (1988) model.

One of the key mechanisms relating demographic changes with economic growth is physical capital (Haldar and Mallik, 2010; Bassanini and Scarpetta, 2001). Neoclassical theory believes that the main effect of population growth on economy transfers through bringing changes into capital intensity (Prskawetzet al., 2007).Quite a number of studies have used life cycle models for illustrating the relationship between age and investment, which shows that the investors' decision about portfolio investment usually change with their age (Goyal, 2004).[4]According to the life cycle investment model, younger and older people are expected to invest less and investment by the middle age people is relatively high (Goyal, 2004; Schultz, 2005).Additionally, Bakshi and Chen (1994) relates equity investment with population age and argued that at different stages of life-cycle, an investor's investment needs in terms of type of assets to hold are different. Moreover, according to the *life-cycle risk aversion hypothesis,* older people get more risk averse with the time and invest more in equities.

Finally, the relationship between savings and population growth is also described by two effects, i.e., *dependency effect* and *growth effect*. According to the former, decrease in the fertility rate decreases the households' overall expenditures and resultant increase in savings. While, according to the latter, when population is growing rapidly, it initially results in increasing the young age population. Afterwards it increases the working age population and working age population intends to save more as compared to the old age group. Hence, concluding a positive relationship between population dynamics and investment (Prskawetzet al., 2007).

There are relatively few studies on the impact of demographic variables on physical capital. Goyal (2004) while analyzing the relationship between age structure of the population and stock market outflows and stock returns for USA supports the life cycle model and indicate that outflow from the capital market is positively related with the changes in old age population and negatively related with the fraction of middle age population. Similarly, Batini et al. (2006) concluded that changes in population have significant impact on private investment through bringing changes in both the marginal product of capital and the consumption (savings) decisions. However, according to Bosworth and Chodorow-Reich (2006), the impact of demographic changes on savings and investment is not robust. Another study by Asongu (2015)revealed a significant relationship between investment and population for the long-run but not for the short-run.

Demographic variables are believed to have strong impact on the level of human capital. Initially, Robertson (2002) attempted to analyze the impact of demographic shocks on human capital by using Uzawa-Lucas model. The study has shown that any unanticipated increase in unskilled labour due to any demographic shock or a permanent decrease in unskilled labour will result in

[4] See the study of Bergantino (1998)

reducing the investment in human capital.[5] Moreover, according to human capital theory, the age structure can bring changes in life cycle human capital by affecting the earnings and resultantly, the level of labor supply over a lifetime (Malmberg, 1994).Similarly, demographic variables can also effect the investment in human capital since larger families have fewer resources per child. Moreover, population aging diverts more resources from education to healthcare and older people have lesser time to enjoy the output of the training and education (Picchio et al., 2018).

The impact of demographic changes on factor accumulation has been analyzed by Pritchett (1999) who reported a weak and positive impact of demographic changes on human capital but no impact on physical capital per worker. The study of Ludwig et al. (2012) for US economy concluded that demographic change can affect the welfare of the society through increase in wages, declines in rates of return (on in capital) and changes in pension contributions and benefits. Moreover, analysis by Fertig et al.(2009) from Germany supported a negative effect of increase in relative cohort size on educational accomplishments of males and females.

Few of the researchers such as Lee and Mason (2010) and Fougere et al. (2009) have used the overlapping generations (OLG) models for evaluating the link between demographic changes and human capital. Lee and Mason (2010) have shown that low fertility rate will increase the per capita intensity of capital accumulation and countries with lower fertility rates have higher expenditures on human capital per child. On the other hand, Fougere et al. (2009)reported that after 1980s population ageing induces youngsters to invest more on education when they are young. However, initially when youngsters are spending more time for education instead of labor market, the economy has to face the cost for population aging, but later on when youngsters are able to provide more skilled labor then the cost of population aging will decrease.

3. METHODOLOGY AND DATA

Given these viewpoints, the aim of the study is to analyze the unexplored aspect of demo-economic relationship i.e. to examine the comparative impact of demographic variables on three sources of economic growth, namely, physical capital, human capital and TFP.

In order to estimate the impact of population dynamics on sources of economic growth, growth accounting technique is the baseline specification of the study. Growth accounting technique provides a breakdown of observed economic growth into components related with changes in factor inputs and a residual comprises of technological progress and other elements named as TFP. Writing the general production function as:

[5]Demographic shock means a sudden increase in population growth or labour force increase due to migration.

$$Y_t = A_t\, f\,(K_t, H_t) \qquad (1)$$

In equation (1), Y_t shows the aggregate output, K_t is the stock of physical capital, H_t is the augmented human capital and the level of technology is represented by A.

Differentiating equation (1) with respect to time and solving yields:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha_k \frac{\dot{K}}{K} + \alpha_H \frac{\dot{H}}{H} \qquad (2)$$

α_K and α_H show the shares of physical and human capital in the total output, respectively.

Based on equation (2), three independent models i.e. determinants of TFP, human capital and physical capital are estimated. The framework adapted for the analysis is based on different empirical studies especially Pritchett (1999), Kogel (2003) andPark and Shin (2012). Empirical models are given below:

$$K_{it} = b_{0i} + b_1 K_{it\text{-}1} + b_2 DV_{it} + b_3 Y_{it} + b_4 PR_{it} + b_5 FD_{it} + b_6 HK_{it} + b_7 GC_{it} + b_8 IR_{it} + b_9 DV_{it} * D_i + m_{1it} \qquad (3)$$

$$HK_{it} = \gamma_{0i} + \gamma_1 HK_{it-1} + \beta_2 DV_{it} + \gamma_3 PX_{it} + \gamma_4 PR_{it} + \gamma_5 Y_{it} + \gamma_6 FDI_{it} + \gamma_7 DV_{it} * D_i + \mu_{2it} \qquad (4)$$

$$TFP_{it} = a_{0i} + a_1 TFP_{it\text{-}1} + b_2 DV_{it} + a_3 HK_{it} + a_4 RER_{it} + a_5 FDI_{it} + a_6 TO_{it} + a_7 DV_{it} * D_i + m_{3it} \qquad (5)$$

Where '*i*' stands forthe cross sections (48 African and 37 Asian countries) and't' stands for the time period (1960-2013).$TFP_{it}$is Total Factor Productivity growth (annual percentage);DV_{it}represents specific demographic variables, young age dependency ratio, old age dependency ratio, population growth rate (annual %), total fertility rate (number of births per woman);K_{it}indicates gross fixed capital formation (% of GDP);TO_{it} is trade openness (trade as % of GDP); $HK_{it}$is used forhuman capital per person; Y_{it}shows GDP growth rate (annual %); FDI_{it}indicates foreign direct investment net inflows (as % of GDP); IR_{it} represents real interest rate (%); PR_{it}indicates personal remittances received (% of GDP); $FD_{it}$is financialdevelopment (taken as M_2 as % of GDP); RER_{it}represents real exchange rate;$GC_{it}$is government consumption expenditures (% of GDP); $PX_{it}$is public expenditure on education, total (% of government expenditures); $DV_{it}D_i$ indicates the interaction term of specific demographic variable and dummy of region (Asia=1 and Africa=0); μ_i, are error terms of above models.

By following the existing literature demographic variables usedin the study are old age dependency ratio, young age dependency ratio(Kelley and Schmidt, 2005and Park and Shin, 2012), population growth rate(Bloom and Williamson, 1998), Azomahou and Mishra (2008) among others)and fertility rate(Lee and De Gregorio, 2003) and Barro, 1998& 2003).

The sample of the study is based on a panel of 49 African countries and 37 Asian countries for the period 1960-2017. The major data source is *World Development Indicators by the World Bank.* However, data for some variables is also retrieved from *Penn World Tables (PWT) 8.0.*For this study the TFP growth is calculated by using growth accounting method mentioned above.

The models presented above represent dynamic panel equations with endogenous regressors.It is worth noting that few existing studies in the literature take into account the important aspect of dynamic panel modeling.[6]In the recent time with the easy accessibility to data for big panels, economists are more interested in evaluating the long run growth which consequently needs the use of dynamic panel models. Moreover, GMM is more appropriate for panel data studies where number of cross-sections is more than number of time-periods (N>T). Recently, estimation techniques as the first difference GMM and system GMM methods have got more importance in panel data studies [Höffleret al.(2001)]. For the reason that these techniques not only bring the solution of the endogeneity but also control the country-specific factors [Levine et al.(2000)]. Therefore, dynamic panel system GMM estimation technique by Arrellano and Bover (1995) and Blundell and Bond (1998) is used for separate estimation of each equation. One of the important advantages of GMM is that in dynamic GMM techniques the lagged variables and difference variables which are not related to the error term are utilized as instruments [Roodman (2009)].

4. RESULTS AND DISCUSSIONS

This section deals with the discussion of the estimated models. Each model of the study is estimated with different indicators of demographics, separately, to avoid the problem of multicollinearity and to separately analyze the impact of each demographic variable on the sources of economic growth. For the comparison of results across regions, the interaction term of region and eachdemographic variable is also included in all these equations.

4.1. Physical Capital Impact of Demographics

Results regarding the impact of selected demographic variables on physical capital are reported in Table1.All demographic variables used in the model of

[6]The existing literature on demographics and the sources of growth employed different estimation techniques including Generalized Least Square, 2 Stage Least Square (2SLS), 3 Stage Least Square (3SLS), Vector Auto Regression (VAR), ARDL and Logit model etc.

physical capital are statistically significant. Starting with population growth, Table 1 shows that increase in the population growth results in a reduction in investment. It is believed that with the increase in population, households have to spend more on consumption and save less that would result in fewer funds for investment. Similarly, according to the investment-diversion effect, the high population growth strongly diverts the public and personal investments from growth-oriented projects to social security projects (Bloom, et al. 2001; Park and Shin, 2012).

The next focused demographic variables are dependency ratios. Both young and old age dependency ratios have an adverse impact on physical capital. According to the life cycle theory, the decisions related to the saving and investment differs with respect to different stages of life. Older people have fewer incentives to save and younger people do not have income to save. So generally, younger and older people save less as compared to the working age population. Moreover, an increase in overall dependency ratio leads to a decrease in the savings of working age population (Kogel, 2003).

In addition, the coefficients of old age dependency ratio (0.498) and young age dependency ratio (0.060) are showing that the impact of old age dependency ratio is stronger on physical capital as compared to young age dependency ratio. Due to increase in the older population, government has to incur high expenditures on healthcare, housing, social security and pension allowances of older population which is adversely effecting investment.

In order to discuss the regional differences for the impact of demographics, an interaction term of region dummy with each indicator of demographic variable is introduced. This interaction term helps in identifying whether the demographics have different impact on the sources of growth in both regions. Since our dummy is constructed with a value one to Asia, therefore, the impact of each demographic variable for Asia is computed by summing up the direct impact of each demographic indicator and the interaction term. Whereas, the impact for Africa is obtained by looking into the direct impact of each indictor, only.

For physical capital model, the interaction term of population growth, and both types of dependency ratios with regional dummy appears as positive. In particular, the size of interaction term for population growth is quite high. By combining the direct and interaction impact, we observe that the population impact is positive for Asia while it is negative for Africa(b_2).

The overall impact of dependency ratio, by combining the direct and interaction impact, appears negative for Asia. However, the size of the adverse impact is less for Asia than Africa. In addition, the adverse impact of ODR is higher in both regions as compared to the impact of YDR. A major component of Asian economic success is investment in physical assets, which largely came from domestic savings. As from above mentioned trends of demographic variables, it can be observed that the population growth rate and young age dependency ratio are decreasing at a higher rate in Asian region as compared to the African region.

From the said trends, it is evident that the age structure of the Asian region is favorable for high savings and investment ratios. This enables Asian people to save and invest more. Moreover, lack of skilled labour, infrastructure and conducive investment climate are few reasons for lesser investment in Africa.

Table 1. Physical Capital Impact of Demographics

	POP (a)	**YADR (b)**	**OADR (c)**
C	3.699* (2.74)	8.684* (1.99)	4.379* (2.53)
HK_{it}	-0.545 (-1.11)	-1.831 (-1.28)	-0.280 (-0.46)
$GDPG_{it}$	0.132* (2.51)	0.133** (2.70)	0.123* (2.40)
$GFCF_{it-1}$	0.862*** (21.29)	0.845*** (20.03)	0.861*** (20.01)
FD_{it}	-0.010 (-1.28)	-0.012 (-1.62)	-0.004 (-0.34)
IR_{it}	-0.103* (-2.32)	-0.106* (-2.66)	-0.094* (-2.46)
GC_{it}	0.099 * (1.84)	0.150* (2.30)	0.101* (1.95)
PR_{it}	0.030 (1.22)	0.041* (2.04)	0.051* (2.00)
POP_{it}	-0.695* (-2.36)	-	-
$POP_{it}D_i$	1.321* (1.87)	-	-
YDR_{it}	-	-0.060* (-1.91)	-
$YDR_{it}D_i$	-	0.040* (2.33)	-
ODR_{it}	-	-	-0.498* (-1.88)
$ODR_{it}D_i$	-	-	0.404* (2.12)
Diagnostics			
Hansen test of over identified restriction	0.571	0.526	0.538
AR(2) test	0.685	0.671	0.666

*Notes: The estimation is done using System GMM. Regressions, of columns a, b and c are estimated with three variables of demographic changes, population growth, old age and young age dependency ratio, respectively.t statistics of the respective coefficients are mentioned in (). Significance level at 1%, 5% and 10% denoted by ***, ** and * respectively, p values of Hansen test and the tests of the AR(2) are also reported. where: Hansen test: (Ho=all instruments are valid), Arellano-Bond test for AR(2): (Ho= no Autocorrelation)*

Moving towards other regressors in the model, the findingsshow a statistically significant impact of K_{it-1}on current physical capital (K_{it}) which implies that current level of physical investment shows persistence with respect to its previous level. The coefficient of GDP growth, in all three equations of the physical capital, is positive and significant.The accelerator theory of investment also advocates the positive impact of GDP growth on investment.The basic theoretical determinant of investment and a policy variable i.e. interest rate, is also statistically significant in all equations, and is negatively affecting the investment level in sample countries.Since, interest rate is the cost of borrowing money, so with the increase in cost of investment,the overall investment level will decrease (Greene and Villanueva,1991).

Personal remittances are appeared statistically significant in column b and c**.** The results show that 1 percent increase in the remittances will increase physical capital. There is evidence that the remittance receiving households usually tend to save and invest more as compared to the other households (Bjuggren et al., 2010). Another variable included in the model of physical capital is government consumption expenditures,GC_{it},results show a positive impact of the government expenditures on investment. Through multiplier effect of demand, an increase in the government spending can result in stimulating the investment (Chinweoke et al.,2014).

4.2. Human Capital Impact of Demographics

Table 2 presents the results for the determinants of human capital in columns a, b, c and d.Keeping in view the significance of the fertility rate for human capital, it is used as an additional demographic variable in the model of human capital.

The results show that population growth rate is affecting human capital negatively. Higher population leads to low per capita income that reduces education expenditures and results in low education level in developing countries. Furthermore, higher population growth rate can also become a constraint in improving the education facilities in the developing countries and further leads to low level of education in these countries (Rosenzweig, 1987; Pritchett, 1999; Prskawetz et al., 2007).

As far as the impact of age structure of population on human capital is concerned young age dependency ratio and old age dependency ratio, YDR_{it} , and ODR_{it},are affecting the human capital negatively with the coefficient values of 0.004 and 0.120, respectively. The negative sign of the young age dependency ratio is unconventional, because it is generally perceived that youngsters are having more incentives to get education then older people. The negative relationship between young age dependency ratio and human capital is based on the fact that youngsters are unable to take decision about their education due to financial constraints. Secondly, if unemployment rate is higher in the country then it is a disincentive for youngsters to get education (Fougère and Mérett, 1999). Thirdly,

both Asian and African regions do not have enough resources to provide education facilities to the growing younger population (Bound and Turner, 2002).

Table 2. Human Capital Impact of Demographics

	POP (a)	**FRT (b)**	**YADR (c)**	**OADR (d)**
C	0.106 (0.78)	0.263 (1.40)	0.607 (0.89)	0.847 (1.61)
Y_{it}	-0.039 (-1.26)	-0.046 (-1.31)	-0.098 (-0.91)	-0.112 (-1.08)
HK_{it-1}	0.918*** (31.94)	0.902*** (22.49)	0.901*** (24.35)	0.866*** (31.08)
FDI_{it}	0.083** (2.23)	0.100* (1.91)	0.090** (2.33)	0.118** (3.13)
PX_{it}	0.012 (0.49)	0.005 (-0.27)	0.019 (-0.55)	0.039 (1.05)
PR_{it}	-0.009* (-1.86)	-0.012*** (-2.00)	-0.007** (-2.22)	-0.007* (-1.75)
POP_{it}	-0.069* (-1.83)	-	-	-
$POP_{it}D_i$	0.264* (1.74)	-	-	-
FRT_{it}	-	-0.028* (-1.77)	-	-
$FRT_{it}D_i$	-	0.064* (2.53)	-	-
YDR_{it}	-	-	-0.004* (-1.69)	-
$YDR_{it}D_i$	-	-	0.005* (1.97)	-
ODR_{it}	-	-	-	-0.120* (-2.68)
$ODR_{it}D_i$	-	-	-	0.108** (3.15)
Diagnostics				
Hansen test for over identified restriction	0.791	0.817	0.695	0.793
AR(2) test	0.364	0.398	0.298	0.282

*Notes: The estimation is done using System GMM . Regressions of columns a, b, c, and d are estimated with four variables of demographic changes, fertility rate, population growth ,old age and young age dependency ratio, respectively.t statistics of the respective coefficients are mentioned in (). Significance level at 1%, 5% and 10% denoted by ***, ** and * respectively, p values of Hansen test and the tests of the AR(2) are also reported . where: Hansen test: (Ho=all instruments are valid) , Arellano-Bond test for AR(2): (Ho= no Autocorrelation)*

The old age dependency ratio is also affecting human capital adversely because, population aging diverts more resources from education to healthcare. Moreover, the older people have lesser time to enjoy the outcome of the training and education (Fougère and Mérette, 1999). Another demographic variable, included in the model of human capital is fertility rate. Coefficient of FRT_{it} is statistically significant with negative sign. An increase in the fertility rate tends to decrease the time and financial resources of a family devoted for human capital; thus leading to lower levels of education.

By looking into the interaction term effect, we can observe that the interaction of population growth is positive and statistically significant. By joining the direct and interaction effect, we observe that the impact of population growth turns out as positive for Asia, however, it is negative for Africa. This finding implies that population growth is adding to the stock of human capital. In the similar vein, the impact of fertility, for Asia, turns out as positive for human capital. This implies that in Asia, the family planning schemes were more successful which have resulted in decreasing the fertility rate or more appropriately slowing down growth in fertility rate. Thus, with fewer numbers of kids, the parents are able to invest more on each child's education (Cincottaand Engelman, 1997).

Moving towards the age dependency ratios, the findings reflect that the interaction terms of both types of dependencies is positive. The overall impact (combining the direct and the interaction impact) of YDR appears marginally positive for Asia implying an accumulation of human capital stock with increase in young age groups in the population. Conversely, ODR appears to have an adverse impact on human capital in both regions. Notably, the size of ODR in Africa is significantly larger than the impact of ODR in Asia. This implies that overall; age structuring is more harmful for Africa as compared to Asia. As the Figure presented above shows that the age dependency ratio is declining with a faster pace in Asia, thus, imposing less penalty for the region.

Among other determinants, the lagged value of the human capital, the coefficient of HK_{it-1} is positive and significant. The next variable is FDI_{it} , which on the one hand encourages the level of education in a country, and on the other hand highly educated labor force attracts more FDI inflows. Our findings highlight a favorable impact ofFDI_{it}on human capital. In developing countries, with the increase in FDI inflows, the demand for skilled and trained labors increases which boosts the level of education (Afza and Nazir, 2007; Yildirim and Tosuner, 2014). Surprisingly, remittances have negative impact on human capital. Acosta et al. (2007) explains multiple reasons for an adverse impact of remittances on human capital such as absence of one parent and lack of incentives for higher education. Such findings are also reported by Nasir et al. (2011) for Pakistan and Lopez-Cordova (2005) for Mexico.

4.3. TFP Growth Impact of Demographics

Finally, Table 3 portrays the impact of demographic variables on TFP growth.[7]Among the demographic variables, population growth appears insignificant in the model with RER but statistically significant and positively effecting TFP growth without RER. Population growth is also an indicator of labor force. An increase in population growth also indicates increase in labor force, therefore, it brings positive changes in productivity by creating economies of scale, innovations and specialization (Simon, 1992 and Kremer, 1993). Njikam et al. (2006) have found positive impact of population growth on TFP growth for a number of African countries.

As far as age structures are concerned, the impact of old and young age dependency ratios is statistically significant and negative. With increase in the young and older people, the proportion of economically active population decreases. Moreover, with the increase in dependent people, the ratio of investment on the research and development activities decreases, which eventually reduces the TFP growth [Park and Shin, 2012; Kogel, 2003). Notably, the size of the adverse impact of the old age dependency ratio is higher as compared to the young age dependency ratio. Since, in ageing societies increasing old-age dependency ratio not only brings reduction in overall labor supply, but also declines the relative labor supply of young workers. Consequently, a reduction in TFP growth is experienced in these countries.

Moving towards the impact of demographic indicators conditional on regional dummy, the findings state that the interaction term of a regional dummy and population growth is positive implying a positive impact of population growth on TFP growth in both Asia and Africa. It is important to note that, the positive impact of population growth for Asia (the sum of direct and interaction term) is almost twice as of Africa. The interaction term for both dependency ratios is also positive. However, the total impact of dependency ratios appears as negative for Asia and Africa. Notably, the magnitude of the adverse impact is much smaller for Asia than Africa. Similar to the other demographic indicators, the adverse impact of ODR stays higher than the YDR for both regions, verifying the fact that dependency in terms of old age is more harmful for TFP growth than young age dependency.

Among other determinants, the coefficient of lagged TFP growth, the coefficient of TFP_{it-1} isposition and significant implying a feedback effect. Similarly, FDI also has a positive impact on TFP growth though knowledge spillover effect. Trade openness has significant positive impact on TFP growth only in third equation of the TFP growth. The other two models of TFP show an adverse impact of trade openness on TFP growth. Trade openness in developing countries results in higher imports and a smaller increase in exports which builds pressure

[7]As exchange rate is an important predictor of TFP growth in developing countries, however, appropriate number of observations on the real exchange rate data is not available. Therefore, TFP growth model is estimated by with and without exchange rate.

on balance of payments. Moreover, the supply constraints in developing countries hamper these countries to cope with tough competition in the world market (Njikam et al., 2006).The adverse impact of trade openness for TFP growth is supported by the studies ofNijikam et al. (2006). Financial development is inversely related toTFPgrowth. The negative impact of financial development might be due to inefficient allocation of the financial resources. As the study by Hsieh and Klenow (2008) shows that misallocation of resources in productive sectors can result in deterioration of the productivity growth. Moreover, repressive financial system hampers the financial development and results in misallocation of resources, thus, reduce the productivity growth.

Table 3. Total Factor Productivity Growth Impact of Demographics

	Estimation With RER			Estimation Without RER		
	POP (a)	OADR (b)	YADR (c)	POP (d)	OADR (e)	YADR (f)
C	1.342 (0.13)	9.172* (1.77)	46.977 (1.81)	-0.323 (-0.14)	14.761*** (4.50)	50.371* (1.88)
HK_{it}	-0.519 (-0.17)	-0.628 (-0.32)	-11.463 (-1.65)	1.333 (1.25)	-0.204 (-0.19)	-9.951 (-1.39)
TFP_{it-1}	-0.349 (-1.60)	0.439* (1.79)	0.648*** (8.96)	0.303* (2.27)	-0.019* (-0.10)	0.199 (1.02)
FD_{it}	-0.001 (-0.03)	-0.046* (-2.34)	-0.064* (-2.21)	-0.034* (-1.96)	-0.049* (-1.83)	-0.215* (-2.03)
RER_{it}	0.002 (0.58)	0.005 (1.16)	-0.002 (-0.20)	-	-	-
FDI_{it}	1.754** (2.94)	0.515* (1.84)	0.860* (1.71)	0.039 (0.38)	0.509* (1.88)	1.188* (2.43)
TO_{it}	-0.098* (-2.33)	-0.001 (-0.08)	-0.034 (-1.30)	0.007 (0.98)	-0.001 (-0.13)	0.0002 (0.01)
POP_{it}	4.267 (1.66)	-	-	1.214* (2.00)	-	-
$POP_{it}D_i$	4.311* (1.71)	-	-	0.163* (1.81)	-	-
ODR_{it}	-	-0.739* (-1.79)	-	-	-1.096** (-2.96)	-
$ODR_{it}D_i$	-	0.689* (2.18)	-	-	0.712* (2.58)	-
YDR_{it}	-	-	-0.269 * (-1.80)	-	-	-0.331* (-1.73)
$YDR_{it}D_i$	-	-	0.100* (1.70)	-	-	0.197** (3.25)
Diagnostics						
Hansen test for over identified restriction	0.955	0.986	0.986	0.535	0.365	0.486
AR(2) test	0.164	0.242	0.300	0.103	0.484	0.119

*Notes: This estimation is done using the System GMM. Regressions of columns a, b and c are estimated with three variables of demographic changes, population growth rate, old age and young age dependency ratio respectively. t statistics of the respective coefficients are mentioned in (). Significance level at 1%, 5% and 10% denoted by ***, ** and * respectively, p values of Hansen test and the tests of the AR (2) are also reported. where: Hansen test: (Ho=all instruments are valid) , Arellano-Bond test for AR(2): (Ho= no Autocorrelation)*

Results also indicate that the adverse impact of population growth and age structure is higher for Africa. As, previously discussed that decrease in the population growth rate and dependency ratios is higher for Asian countries as compared to the African countries, so the decreasing trends of population growth and dependency ratio have favorable impact on TFP growth of Asian region.

5. CONCLUSIONS

The present study is intended for an empirical analysis of the impact of demographic changes on different sources of economic growth for Asian and African countries. The study is first of its kind to empirically analyze the impact of demographic changes on sources of growth and to compare these effects for the Asian and African countries. The findings of the study support the pessimistic views about population dynamics i.e.negative impact of population growth and dependency ratios on different sources of economic growth. Similarly, neoclassical growth model and endogenous growth models have also explained the negative impact of high population growth on economic growth. Results also depicts that the impact of the demographic variables is stronger on the Asian countries as compared to the African countries.

According toresultseach source of growth, namely, physical capital, human capital and TFP are negatively affected by the demographic variables. Results explicate that with the increase in population growth rate, saving rate is going to decrease which eventually decreases the investment. Similarly, with a decrease in the population,per person educational expenditures will increase. Moreover, with the decrease in the fertility rate people would be able to spend more on their children's education. Finally, the negative impact of demographic variables on TFP indicates that, increase in the population decreases the investment in research and development activities, which further decreases the TFP. High growth rate of old and young population in the country means lower ratio of productive population and hence lower TFP.

It is imperative to note from the results that the negative impact of the old age dependency is stronger than young age dependency ratio. As, the ratio of the older population is increasing in the world day by day. According to world labor organization "*increasing ratio of old age population in total population is one of the biggest problems of this century"*. As our analysis is about Asian and African regions, the older people in these regions usually have less savings, so government has to incur high expenditures on healthcare, housing, social security and pension allowances of older population. Moreover, overall increase of the older population results in population stagnation and decrease the labor supply.On the other hand, increase in young age population initially increases the burden on the economy but eventually can open the window of opportunity in the future. That is why old age population is more adversely affecting sources of economic growth in both Asian and African regions as compared to the young age.

Furthermore, the study also revealed that the impact of all demographic variables is stronger for Asian counties as compared to the African region.Since, as already noted, population dynamics is a main source of Asia's economic success. Some Asian countries especially East Asian countries have adopted the most successful family planning policies in the world. Asia is also successful in increasing the age at marriage and has alsocontrolled the marital fertility. Important factors such as urbanization, women education, and income can contribute to decrease the fertility rate.On the contrary, African countries are able to bring improvement in above mention factors to a lesser extent. African countries, e.g. Kenya and Ghana and Asian countries, e.g. Indonesia and Thailand have started the organized family planning programs more or less at the same time. Although, Asian countries are more successful in implementing these programs.One of the reasons of the failure of these programs in Africa was the less demand of family planning programs. Therefore, countries with higher fertility rate have to bring improvements in their family planning programson the one hand and the need to improve the economic opportunities to absorb the excess labor on the other. Moreover, negative impact of young age dependency ratio on sources of growth rise the need of implementing better policies related to youth, as countries with high youth age dependency ratio can still get benefit from this window of opportunity.

References

Acosta, P., Fajnzylber, P., López, H., (2007). The impact of remittances on poverty and humancapital:evidence from Latin American household surveys. In: Ozden C., Schiff, M. (Eds.),*International Migration, Economic Development and Policy*. Washington DC: World Bank and Palgrave McMillan.

Afza T. and Nazir M. S. (2007).Economic Competitiveness and Human Resource Development: an FDI Perspective. *Pakistan Economic and Social Review*, 45(2),167-180.

Arellano, M. and Bover, O. (1995). Another Look at the Instrumental Variable Estimation for Error-Components Models. *Journal of Econometrics*, 68(1), 29-52.

Asongu S. A. (2015). Long-Term effects of population growth on aggregate investment dynamics: Selected country evidence for Africa. *African Journal of Economic and Management Studies*, 6(3), 225-250.

Azomahou, T. and Mishra, T.(2008). Age dynamics and economic growth: Revisiting the nexus in a nonparametric setting. *Economics Letters*, 99(1), 67-71.

Bakshi G. S. and Chen Z. (1994).Baby Boom, Population Aging, and Capital Markets. *Journal of Business*, 67(9), 165-202.

Bassanini A. and Scarpetta S. (2002). Does human capital matter for growth in OECD countries? A pooled mean-group approach.*Economics Letters*, 74(3), 399-405.

Batini N.,Callen T. and McKibbinW. (2006). *The Global Impact of Demographic Change*. Washington DC: International Monetary Fund.

Bernanke B. S. and Gürkaynak R. S. (2002). Is Growth Exogenous? Taking Mankiw, Romer, and Weil seriously.*NBER Macroeconomics Annual,*16, 11-57.

Bjuggren P. O., Dzansi J. and Shukur G. (2010). 'Remittances and Investment'*Working Paper Series in Economics and Institutions of Innovation*, Paper No. 216, Royal Institute of Technology, *CESIS*.

Bloom D. E. and Freeman R. B. (1986).The effects of rapid population growth on labor supply and employment in developing countries. *Population and Development Review*, 12(3), 381-414.

Bloom D. E., Canning D. and Sevilla J. (2001). 'Economic Growth and the Demographic Transition.'*NBER Working Paper no*. 8685, National Bureau of Economic Research.

Bloom D.E. and G. Williamson (1998). 'Demographic transitions and economic miracles in emerging Asia.' *World Bank Economic Review,*12 (3), 419-55.

Bloom, D.E. (2006). Booms, busts, and echoes: How the biggest demographic upheaval in history is affecting global development". *Finance and Development*, 43(3), 8-13.

Blundell, R. and Bond, S. (2000). GMM Estimation with Persistent Panel Data: An Application to Production Functions.*Econometric Reviews*, 19(3), 321-340.

Bosworth B. and Chodorow-Reich G. (2007). Saving and Demographic Change: The Global Dimension.' *Working Paper*, Center for Retirement Research at Boston College.

Bound, J. and Turner, S., (2002). Going to war and going to college: Did World War II and the GI Bill increase educational attainment for returning veterans?. *Journal of Labor Economics*, 20(4), 784-815.

Brander, J. A., Dowrick, S. (1994). The Role of Fertility and Population in Economic Growth. *Journal of Population Economics*, 7(1), 1-25.

Chinweoke, N., Onydikachi, M. and Nwabekee, C.E. (2014). Financial Intermediation and Economic Growth in Nigeria (1992 – 2011), *TheMacrotheme Review*, 3 (6), 124-142.

Cincotta, R. P., and Engelman, R. (1997).Economics and rapid change: The Influence of Population Growth.*Population Action International*, 3, 30.

De Morgan A., (1838). *An Essay on Probabilities, and Their Application to Life Contingencies and Insurance Offices* (Vol. 132).London: Longman, Orme, Brown, Green & Longmans.

Fertig M., Schmidt C. M. and Sinning M. G. (2009). The impact of demographic change on human capital accumulation. *Labour Economics*, 16(6), 659-668.

Feyrer J. (2007). Demographics and Productivity.*The Review of Economics and Statistics*, 89 (1), 100-109.

Fougère M. and Mérette M. (1999).Population ageing and economic growth in Seven OECD Countries. *Economic Modeling*, 16 (3), 411-427.

Fougère M.; S. Harvey;J. Mercenier and M. Mérette (2009).'Population ageing, time allocation and human capital: A general equilibrium analysis for Canada.' *Economic Modeling*, 26 (1), 30-39.

Goyal A. (2004).Demographics, stock market flows, and stock returns.*Journal of Financial and Quantitative Analysis*, 39 (1), 115-142.

Greene, J. and Villanueva, D., (1991). Private investment in developing countries: an empirical analysis. *Staff Papers*, *38*(1), 33-58.

Gruant, J. (1662). *Natural and Political Observations*.London: Arson Publisher.

Haldar, S.K. and Mallik, G., (2010). Does human capital cause economic growth? A case study of India. *International Journal of Economic Sciences & Applied Research*, *3*(1), 7-25.

Hsieh, C.T. and Klenow, P.J.(2009). Misallocation and manufacturing TFP in China and India. *The Quarterly journal of economics*, 124(4), 1403-1448.

Izmirlioglu Y. (2008). The impact of population ageing on technological progress and TFP growth, with application to United States: 1950-2050.' MPRA Paper No. 24687.

Kelley A. C. and R. M. Schmidt (2005). 'Evolution of recent economic-demographic modeling: A synthesis.' *Journal of Population Economics*, 18(2), 275-300.

Kogel T. (2003). Youth dependency and total factor productivity. *Journal of Development Economics*, 76 (1), 147-173.

Kreager, P. (1988). New light on Graunt. *Population Studies*, 42(1),129-140.

Kremer M. (1993). 'Population growth and technological change: One million BC to 1990.' *The Quarterly Journal of Economics*, 108(3), 681-716.

Kuznets, S. (1967). Population and economic growth. *Proceedings of the American Philosophical Society*, 111(3), 170-193.

Lee R. and Mason A. (2010).Fertility, human capital, and economic growth over the demographic transition.' *European Journal of Population/Revue européenne de Démographie*, *26* (2), 159-182.

Lee, J.W. and de Gregorio Rebeco, J.(2003). Growth and Adjustment in East Asia and Latin America. *Documentos de Trabajo (Banco Central de Chile)*, 245, 1-66.

Lee, Ronald (1988). Induced Population Growth and Induced Technological Progress: Their Interaction in the Accelerating Stage,*Mathematical Population Studies*, 1(3),265-88.

Levine, R., Loayza, N. and Beck, T., (2000).Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, 46(1), 31-77.

Lopez-Cordova, E. (2005). Globalization, migration and development: The role of Mexican migrant remittances.*Economía Journal*, 6 (1), 217-248.

Ludwig A., Schelkle T., and Vogel E. (2012).'Demographic change, human capital and welfare.' *Review of Economic Dynamics*, 15 (1), 94-107.

Malmberg B. (1994). Age structure effects on economic growth-Swedish Evidence.' *Scandinavian Economic History Review*, 42 (3), 279-295.

Malthus, T.R., (1798). *An essay on the principle of population*. London: digitalizzazione Project Gutenberg.

Mehmood B. and Azim P. (2014). Total factor productivity, demographic traits and ICT: empirical analysis for Asia. *InformaticaEconomică*, 18(1), 8-16.

Nasir M. and Tariq M. S. and Rehman, F.(2011).The Effect of Foreign Remittances on Schooling: Evidence from Pakistan. PIDE Working Papers no. 66. Pakistan Institute of Development Economics.

Njikam O.; J. N. Binam and S. Tachi (2006).Understanding Total Factor Productivity Growth in Sub-Saharan Africa Countries.' *Les Cahiers du SISERA*.Working Paper No.003.

Park D. and Shin K. (2012). Impact of population Aging on Asia's Future Growth. In: Donghyun Park & Sang-Hyop Lee & Andrew Mason (ed.), *Aging, Economic Growth, and Old-Age Security in Asia*. Cheltenham, UK: Edward Elgar Publishing , 83-110.

Picchio, M., Suetens, S. and van Ours, J.C., (2018). Labour supply effects of winning a lottery. *The Economic Journal*, 128(611), 1700-1729.

Price R., (1771). Observations on the proper method of calculating the values of reversions depending on survivorships. *Philosophical Transactions of the Royal Society of London*, 60, 268-276.

Pritchett L. (1999). *Population growth, factor accumulation and productivity*.Washington DC: World Bank.

PrskawetzA., and Lindh T. (2007). *The Relationship between Demographic Change and Economic Growth in the EU*. Vienna: Austrian Academy of Sciences Press.

Robertson P. E. (2002).Demographic shocks and human capital accumulation in the Uzawa–Lucas Model. *Economics Letters*, 74 (2), 151-156.

Roodman D. (2009). How to do xtabond2: An introduction to "Difference" and "System" GMM in Stata. *The Stata Journal*, 9(1), 86-136.

Schultz T. P. (2005). 'Demographic Determinants of Savings: Estimating and Interpreting the Aggregate Association in Asia.' IZA Discussion Paper No. 1479.

Simon J. (1992). *Population and Development in Poor Countries: Selected Essays*.NJ: Princeton University Press.

Simon J. L. (1981). *Population: The ultimate resource*.Princeton: Princeton University Press.

Smith, A., (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*.London: printed for W. Strahan and T. Cadell.

Solow, R. M. (1956), A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics,* 70(1), pp.65-94.

Swan, T. W. (1956). Economic Growth and Capital Accumulation.*Economic Record,* 32 (2), 334-361.

Turner, A., (2009). Population priorities: the challenge of continued rapid population growth. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 364(1532), 2977-2984.

UN (2015).'World Population Prospects: The 2015 Revision' Department of Economic and Social Affairs Population Division, United Nations, New York.

Werding M. (2008). 'Ageing and Productivity Growth: Are There Macro-Level Cohort Effects of Human Capital?' CESIFO Working Paper No. 2207.

Yildirim, D.C. and Tosuner, O.,(2014). The effects of FDI on human capital stock in Central Asian Turkic Republics. *Eurasian Journal of Business and Economics*, 7(14), 51-60.