Pakistan Journal of Commerce and Social Sciences
2018, Vol. 12 (1), 229-252
Pak J Commer Soc Sci

Age-Structure, Human Capital and Economic Growth in Developing Economies: A Disaggregated Analysis

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Abstract

It is attempted to explore the role of change in age-structure and human capital in economic growth of developing countries. A disaggregated panel analysis of 67 developing economies across regions and income groups over the time period of 1960-2014 is conducted. Difference Generalized Method of Moments (Diff-GMM) is employed to overcome the panel-specific problems particularly endogeneity and reverse-causation. The results reveal that changes in age-structure and human capital positively influence economic growth at all disaggregated levels. However, the effect is more powerful in relatively developed regions and high income groups. There is high speed of convergence for less developed economies and vice versa. It may be concluded that change in age-structure and human capital affect the regional and income groups of the economies by different magnitude and pace. Based on empirical results, the Sub-Saharan Africa and low-income economies where transition in age-structure is in its initial phase, population policies should be focused on reducing fertility to accelerate the economic growth. Human capital growth should be another part of the policy for having the demographic dividends.

Keywords: age-structure, economic growth, economic regions, human capital, developing economies, demographic dividends.

1. Introduction

The economies undergo the change in age-structure by the passage of time and they experience the variation in economically active and dependent population. The phenomenon is known as age-structural transition. The dynamics of age-structure positively influence the economic growth and general standard of living (Bloom et al., 2001; Kelley and Schmidt, 2005; Mason, 2005; Choudhry and Elhorst, 2010; Uddin et al., 2016). However, such type of benefit is acquired through certain pathways. The first pathway is the rise in labor supply due to change in age-structure. The magnitude of this benefit depends on the capacity of the economy to absorb additional labor force. When working-age population growth rate is greater than the total population growth rate, the potential window of opportunity for this benefit is opened. The working-age population produces more than it consumes so per-capita output is increased. The added part of the

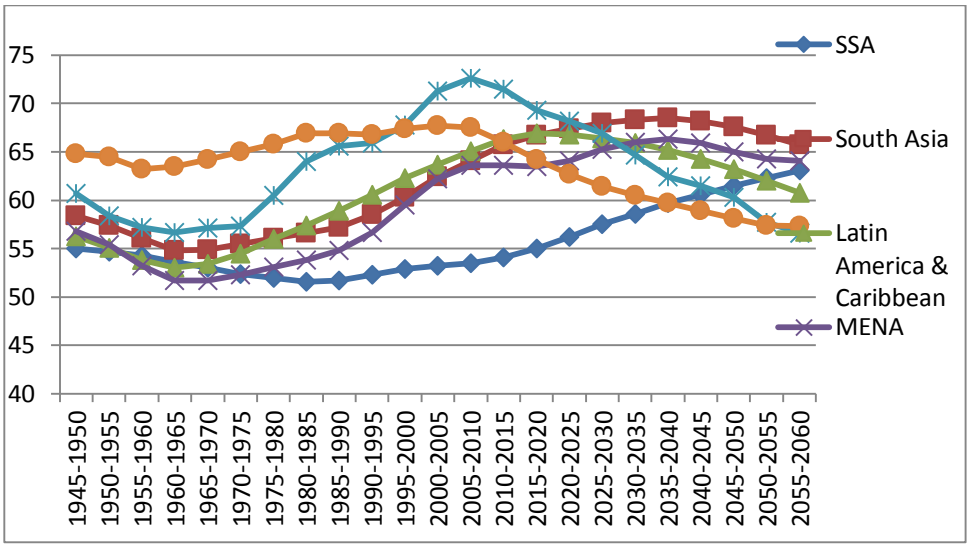
output obtained through the change in age-structure is termed as demographic benefit or demographic dividend (Bloom et al., 2009). Second pathway is the rise in savings, i.e. by increase in ratio of working-age population to dependent population there is higher level of savings in the economy which consequently results into higher level of capital and investment (Bloom et al., 2003a; Mason and Lee, 2004; Lee and Mason, 2006). It results into increased output (Lee et al., 2000). The third pathway that is most important is the rise in human capital due to change in age-structure. The change in age-structure starts by firstly decrease in mortality rate and decrease in fertility rate. The decrease in fertility improves both quantity and quality of human capital because low fertility instigates parents to spend more time and resources on children's education and health. Finally, we can say that mechanically there may be an increase in economic growth per-capita in response to increase in working-age population and decline in dependency ratio (Choudhry and Elhorst, 2010; Bloom et al., 2012).

Since the global economic crisis of 2007-08, a number of economies have gone through a decline in economic growth. These economies are still striving to cope with such type of recession. The population giants like China and India remained intact of growth slowdown during this recession. The dynamics of age-structure is accounted for keeping these economies safe. This phenomenon motivates the researchers to embark the role of age-structure in economic growth. The age-structure transition is taking place in economic regions and income groups of the world at varying pace and timings. One of the important pathways to explain the effect of age-structure on economic growth is human capital formation. The question arises whether all the global economic regions and income groups of the developing economies are having the benefits of demographic dividend equally and role of human capital is same in all economic regions and income groups. The hypothesis is based on the evidence that economies at different stages of development have varying effects of fertility dynamics (Lehr, 2009)[1]. Before analysis it would be better to have an overview of demographic trends in developing regions.

2. Trends of Age-Structure in Developing Regions

According to demographic transition model, all the countries of the world encounter age-structure transition once in their lifetime. It doesn't happen in all the countries simultaneously, but it occurs at varying pace and timings. The change in working-age population in developing regions and more developed region of the world is shown in figure 1.

[1] The economic regions and income groups vary in many ways. For instance, the differences in economic growth within East and South Asia are attributed to difference in education progression in the region (Siddiqui and Rehman, 2016).



Source: United Nations (2015) World Population Prospects

Figure 1: Working-Age Population

The Figure 1 depicts the trend of change in working-age population for different regions of the world. A rise in working-age population indicates the provision of potential window of opportunity for increase in economic growth that is termed as demographic dividend (Kelly and Schmidt, 2005).

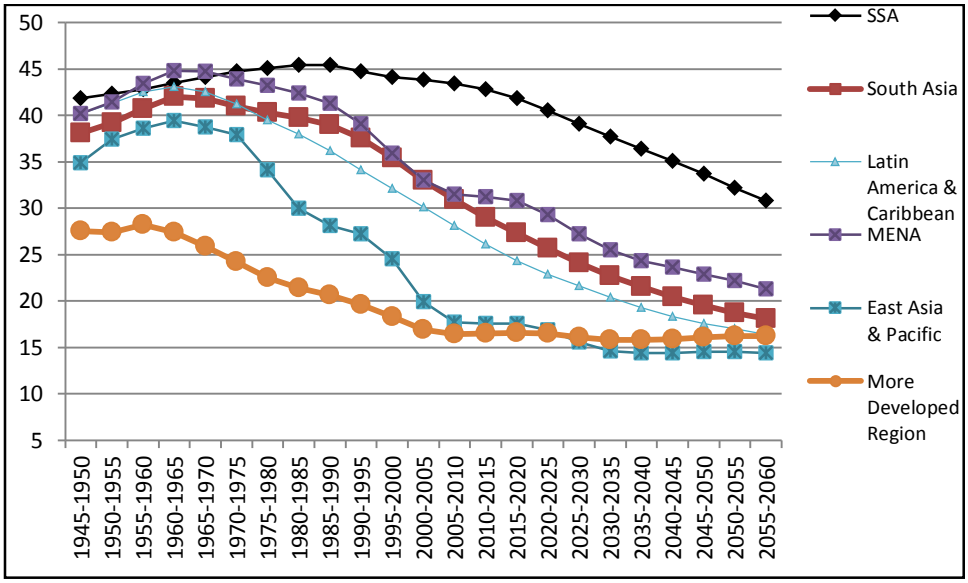
The working-age population started to increase in South Asia (SA), Latin America & the Caribbean (LAC), Middle East & North Africa (MENA) and East Asia and Pacific (EAP) just after when it started to increase in developed region of the world in early 1960s. However, the Sub-Saharan Africa (SSA) is a particular case where process of such transition has been started since early 1990s. The process of drop in mortality and fertility rates in SSA and SA is behind the change in working-age population. The SSA is again a specific case where fertility is still high and it is declining with a slow rate as well. Moreover, the region is experiencing low life expectancy and high population growth rate (Attanasio et al., 2006).

The ratio of working-age population in SSA up to 2060 is lagging those in other regions due to late start of demographic transition. The other phenomenon attached with this region is that it has faced problems of wars and diseases (particularly infectious diseases such as AIDS) which badly affected the economic activity and productive life of the people (Bloom et al., 2013).

Currently the working-age population is increasing in all the regions of developing world so the economies are enjoying the potential window of opportunity for economic growth. In 2010 the developed region had been reached its climax in the working-age population and then it started to decline. Now the region is experiencing decline in working-age population and accumulation of old-age dependent population. It is turning into region of

ageing population. Australia is facing the process of aging population (Uddin et al., 2006) while Japan has already suffered from aging population (An and Jeon, 2006).

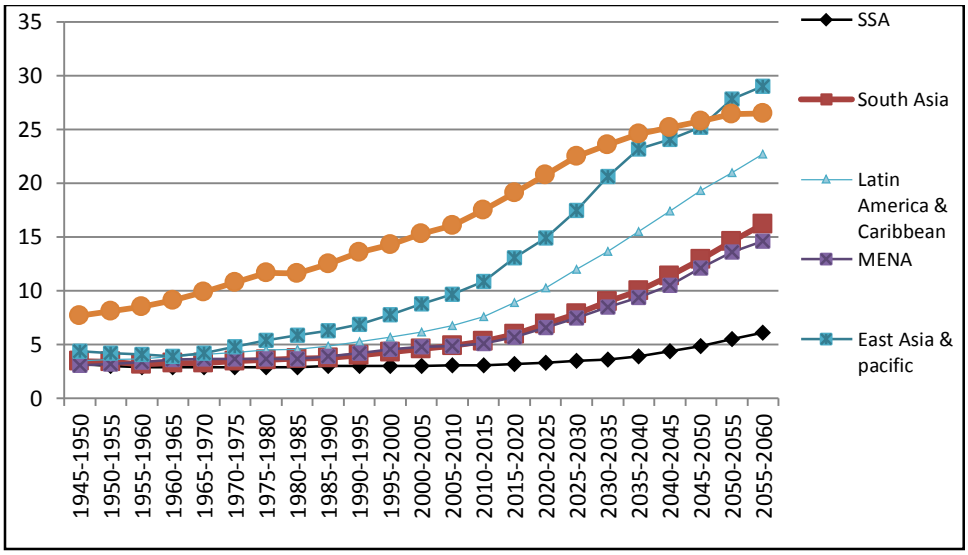
The figures of developing regions describe a vital trend but it doesn't reveal the complete story of age-structural dynamics and economic growth. Besides the share of working-age population, the youth and old-age dependency ratios are equally important (Choudhry and Elhorst, 2010; Song, 2013). The youth and old-age dependency ratios as percentage of working-age population of developing regions and more developed region are shown in figures 2 and 3 respectively.



Source: United Nations (2015) World Population Prospects

Figure 2: Youth Dependency in Developing Regions and More Developed Region

In figure 2 youth dependency has been declining since 1960s for all of the regions of developing world except SSA. However, the more developed region is at the end of this phenomenon by reaching at lowest level of youth dependency in 2010. Currently the youth dependency is decreasing in all regions of developing world. In SSA although the youth dependency is declining but it is comparatively higher than other developing regions. It explains that SSA is at the early stage of demographic gift (Bloom et al., 2016). The EAP is the region with lowest youth dependency in the developing regions. The figures confirm the varying levels of demographic dynamics for different developing regions.



Source: United Nations (2015) World Population Prospects

Figure 3: Old-age Dependency (Percentage Ratio of Old-Age to Working-Age)

The figure 3 expressed that old-age dependency is continuously increasing in all regions of the developing world and this trend is expected to continue for several coming years. Currently old-age dependency is highest in EAP in developing regions while SSA has the lowest old-age dependency. In the more developed region old-age dependency is much higher than in the developing regions.

United Nations' long-run projections (United Nations 2015) confirm the phenomenon that developed region will face stagnation in working-age population over the next decade while there will be a rise in working-age population of developing regions in the same time period. The developed region has reached at the end of age-structural transition and leading towards ageing population. The potential demographic window of opportunity is closed to this region. Uddin et al. (2016) concluded that advantages of age-structure will disappear from Australia due to increased dependency ratio and aging population.

The demographic window of opportunity is open for SSA and MENA. It is starting to close for EAP as well as LAC that is supported by the empirical work in the literature. For instance, Mason and Kinugasa (2005) concluded that East Asian economies have enjoyed a lot of demographic dividend but in the coming decades they would have been facing sufferings if the proper economic policies are not framed and implemented. Choudhry and Elhorst (2010) explained that population dynamics are expected to have a negative effect on economic growth of China in the coming forty years. Guzman et al. (2006) concluded that Latin America & Caribbean are going through the process of demographic dividend which was started several decades ago. Bloom et al. (2009) enlightened that Africa is in a state of age-structural transition. From the demographic point of view, there is a great

opportunity for Africa to reap maximum benefits from the upcoming gift (Bloom et al., 2016).

The developing economies may be disaggregated into income groups like the low-income economies, low middle-income economies, high middle-income economies and high-income economies. These income groups have different stages of demographic transition. So the variations in stages of demographic transition in regions and income groups of developing economies may have different levels of effect of age-structure and human capital on economic growth (Lehr, 2009).

The objective of the current study is to investigate the role of age-structure and human capital in economic growth of developing economies disaggregated by regions and income groups.

3. Existing Literature

The age-structure, human capital and economic growth have been attempted by a number of studies in different perspectives for various economies and groups of the economies. The literature has identified different characteristics of the economies for having favorable effects of age-structure transition. For instance, Malmberg (1994) pointed out that change in saving behavior due to shifts in the age-structure has played an important role in the momentum of Swedish economic performance. Growth was accelerated by reaching a large bulk of population at the peaks of human capital accumulation and savings in the life cycle. However, it was decelerated when the dependency ratio increased. Bloom and Williamson (1998) concluded that young dependency ratio in East Asia has contributed to economic growth of the region. The study further elaborated that South Asia will gain from the change in age-structure in future. Lee et al. (2000) employed macro-simulation analysis on micro-data of Taiwan and concluded that demographic factors were the determinants of saving rate in the economy. The study also found that saving rate remained higher during transition period as compared to pre-transition and post-transition periods. The magnitude of rise in saving rate depends on the speed of transition.

Salehi-Isfahani (2002) has found the existence of demographic window of opportunity for Iran that is based on human capital formation. The study explained that decline in fertility increases investment in human capital by the parents. It also increases female labor force participation. The country has the demographic dividends by reducing fertility and absorbing the working-age population (Bloom et al., 2011 for South Asia).

For Africa the fertility and mortality are still high and a variety of factors are responsible for the phenomenon. Conley et al. (2007) have focused on ecology of malaria transmission and agriculture productivity. The results have shown that infant mortality is the most important factor for explaining fertility rate followed by farm productivity. It demonstrates that age-structural transition in Africa was started with child survival which instigated parents to desire fewer children. The study further demonstrated that GDP per-capita, female literacy rate and urbanization do not matter for fertility.

A major part of the economic performance of Ireland during 1990s has been attributed to demographic changes (Bloom et al., 2003b). The population dynamics in the form of increasing ratio of working-age population to total population and decreasing the child and

old-age dependency has contributed 46 percent in economic growth of China, 39 percent in India and 25 percent in Pakistan (Choudhry and Elhorst, 2010).

Lehr (2009) concluded that fertility dynamics cannot operate in the same way in countries at different phases of development. The development stage of the countries matters for the demographic dividend to reap. In the countries at initial stage of development, the decline in fertility contributes positively to productivity and it boosts the primary school enrollment of children. On the other hand, in the countries at their higher stage of development its decline negatively influences the productivity.

Lee and Mason (2010) explained that lower fertility rate increases human capital investment that is a major driver to create second demographic dividend. However, Bloom et al. (2003a) evidenced that fertility transition has negatively contributed in economic performance of Africa. Wei and Hao (2010) have shown that significant contribution of demographic structure to economic growth is largely attributed to lower youth dependency ratio resulting from decline in fertility in China. They have also found a feedback effect of economic growth to demographic behavior through the mechanism of birth rate, marriage age and life expectancy.

Fang (2010) explained that China is expected to approach the Lewis turning point at which the working-age population transformation from agriculture to industrial sector slows down resulting in high wages and consequently high cost of production in industrial sector. Therefore, there is a need for increase in total factor productivity to have sustainable growth. For China and India Bloom et al. (2013) concluded that improved health, increased trade openness and labor force ratio to population has contributed in economic growth. Bloom et al. (2011) concluded that there are large differences in the effects of changes in age-structure on economic growth across socioeconomic groups of South Asia in early stage of the transition.

Hosseini (2012) explored that Iran is going to enter the third stage of age-structural transition. It is needed to manage the dividend of this transition efficiently to transform it into sustainable economic growth. The comprehensive population policies are required to have the objective. For India, Aiyar and Mody (2013) concluded that level as well as the growth rate of the working-age population has a massive effect on economic growth.

Bloom et al. (2013) explained that it is necessary to determine the speed of age-structural transition to know what steps are required to capture the demographic dividend. The nations which are at early phase of age-structural transition should enforce policies to accelerate transition. For this purpose, infant mortality rate must be reduced by investing in health and child care. The countries which are at middle phase of transition should enforce population policies to reduce fertility rates.

Cuaresma et al. (2014) analyzed the global panel of countries and concluded that if the effect of human capital is controlled no evidence exists that age structure enhance labor productivity. The educational attainment is the key to explain productivity and income growth. A substantial part of the demographic dividend is an educational dividend. Zhao and Zhu (2016) evidenced that contribution of demographic factor in economic growth of South Korea and Japan is 8 percent and for Chinese Main it is 6.3 percent.

The reviewed theoretical and empirical literature evidenced that both the changes in age-structure and human capital play an important role in fostering economic growth of groups of nations and single countries under certain policy frameworks. However, the peculiar relationship among them for regional groups of economies and income groups of economies is lacking in the literature. Furthermore, the nature of association among age-structure, human capital and economic growth is differing for countries and groups of the countries. These mixed results might be due to differences in approaches of analysis, socioeconomic nature of the economies and stage of economic development. The literature is deficient in disaggregated studies. Instead of determining the general and overall behavior of the developing world (or even countries), it is important to explore it on disaggregated samples. The current study bridges this gap by investigating the role of age-structure and human capital in economic growth of developing world disaggregated by regions and income-groups.

4. Economic Model and Econometric Technique

To see the impact of age-structure and human capital on economic growth of the developing economies the theory of economic growth under neoclassical framework (Solow, 1956) is adopted. The Cobb-Douglas formulation can be written as:

$$Y_{it} = A_{it} K_{it}^{\Omega} N_{it}^{1-\Omega} \quad \ldots\ldots\ldots (1)$$

Where Y_{it} indicates output level, A_{it} is the total factor productivity (TFP), K_{it} is the physical capital, N_{it} is labor force and Ω is the physical capital sensitivity of output for the i'th economy in t'th time period. Following the tradition of endogenous models of economic growth, it is assumed that the mechanisms which are endogenous in nature constituting the TFP and changes in physical capital converge ultimately to a steady state level which in this case yields:

$$\langle Y_i/N_i \rangle^{ss} = A_i{}^{ss} \langle {K^{ss}}_i/N_i \rangle^{\Omega} \quad \ldots\ldots\ldots (2)$$

In equation (2), ss is the representation of steady-state level. There are endogenous factors that determine the steady-state level of physical capital and TFP, hence determining the steady-state level of per-worker output is given as:

$$y_i^{ss} = Z_i \Pi \quad \ldots\ldots\ldots (3)$$

Where $y_i^{ss} = \ln\langle Y_i/N_i \rangle^{ss}$ is the steady-state level of per-worker output in natural logarithmic form for ith country. While, Z is the variables' matrix determining the TFP and physical capital's steady-state in this equation. From the endogenous growth theory, following can be deduced:

$$y_{g_{it}} = \psi \langle {y^{ss}}_i - y_{it} \rangle \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

In equation (4), ψ is the speed of adjustment parameter and y is the per-worker initial output in natural logarithmic form. This equation states that the actual per-worker output will converge to steady-state path slowly and hence involving time lag. So, the growth of per-worker output is proportional to the gap or distance between a country's initial and steady-state level of per-worker output. This feature of neoclassical economy is termed as conditional convergence assuming that poorer is the country, faster will be the growth rate

of per-worker output in it (Mankiw et al., 1992; Salai-Martin, 1996; Barro, 1996). Simple manipulation of equations (3) and (4) yields the following:

$$y_{g_{it}} = \psi \Pi Z_{it} - \psi y_{it} \quad \ldots\ldots\ldots\ldots \quad (5)$$

The equation (5) is in per-worker output and due to changing age-structure it cannot be assumed equivalent to the per-capita output previously presumed by Solow (1956) therefore we transform it based on framework by Bloom et al. (2000) into per-capita output. So we can write the expression as:

$$Y_{it}/P_{it} = Y_{it}/P_{it}.\ N_{it}/N_{it} = Y_{it}/N_{it}\ .N_{it}/N_{it} \quad \ldots\ldots\ldots\ldots\ldots \quad (6)$$

Where P_{it} is the total population of "ith" economy in time period "t". The expression (6), by taking natural logarithmic transformation yields the following expression:

$$\tilde{y}_{it} = y_{it} + \ln\langle N_{it}/P_{it}\rangle \quad \ldots\ldots\ldots\ldots\ldots \quad (7)$$

In equation (7), $\tilde{y}_{it}$ and y_{it} are the per-capita and per-worker output levels respectively in natural logarithmic form. Moreover, (N_{it}/P_{it}) represents the per-capita worker. This expression can be rewritten into growth rate form as:

$$\tilde{y}_{g_{it}} = y_{g_{it}} + N_{g_{it}} - P_{g_{it}} \quad \ldots\ldots\ldots\ldots \quad (8)$$

After manipulation and substitutions of expressions (7) and (8) in equation (5) we have the following expression:

$$\tilde{y}_{g_{it}} = \varphi_0 + \varphi_1 \tilde{y}_{it} + \varphi_2 Z_{it} + \varphi_3 N_{g_{it}} + \varphi_4 P_{g_{it}} + \varphi_5 \tilde{n}_{it} + e_{it} \quad \ldots\ldots\ldots \quad (9)$$

The expression (9) is further augmented to incorporate the economically active population termed as working-age population, in order to estimate the impact of age-structural changes of population on economic performance of countries.

$$\tilde{y}_{g_{it}} = \phi_0 + \phi_1 \tilde{y}_{it} + \phi_2 Z_{it} + \phi_3 \widetilde{W}_{it} + \phi_4 \tilde{n}_{it} + \nu_{it} \quad \ldots\ldots\ldots \quad (10)$$

The equations (9) and (10) are the fundamental expressions dealing with the objectives of the current study incorporating the influence of growth rate of labor force, population growth rate and working-age population on economic growth. Where e_{it} and ν_{it} are the stochastic parts of the equations known as error terms. In addition, $\widetilde{W}_{it}$ represents the working-age population per-capita. The matrix Z_{it} contains the variables of trade openness, life expectancy, physical capital and human capital[2] which are key variables in growth rate form for t-time period for ith country.

The annual time series data of 67 developing countries for the time period 1960 to 2014 has been utilized to see the impact of age-structure and human capital on economic growth. The sample selection is based on data availability. The growth rate of GDP per-capita is used as a proxy for economic growth and gross capital formation as a proxy for physical

[2] Ogundari and Awokuse (2018) concluded that education and health as measures of human capital are preferred to be included in the analysis simultaneously as they are not perfect substitute to each other. We have included the life expectancy and human capital simultaneously in the analysis.

capital stock. The variable of trade openness is constructed by dividing the total trade by real GDP. Similarly, variable of working-age population per-capita is constructed by dividing the working-age population by total population. Total labor force, working-age population, total population, labor force participation rate and life expectancy are collected from World Development Indicators (WDI). The data of human capital[3] per-capita is taken from the Penn World Table 8.1. The data of developing countries has been divided into sub-samples based on two criteria given by WDI. Firstly, it is divided into five regions and secondly, it is divided into four income groups (see Appendix A and B for sub-samples).

We have utilized the Difference Generalized Method of Moments (Diff-GMM) technique, primarily used by Blundell and Bond (1999), in order to avoid several econometric problems like endogeneity and reverse causal connection. In this way, firstly, the regressors might be correlated with the error term. Secondly, time invariant individual characteristics which are termed as fixed effects might be correlated with the regressors. These fixed effects are part of the error term that consists of unobserved individual-specific effects and the observation specific error terms. Finally, the existence of lagged dependent variable might give rise to autocorrelation. In order to avoid the first two problems mentioned above, fixed effects IV estimator would also be a possible option but due to weak instruments (exogenously taken) it would give biased estimators just like OLS estimator. Therefore, to cope with these problems, Arellano-Bond System and Difference GMM estimators are preferable. Through the transformation of the explanatory variables by first differencing removes the country specific fixed effects. Similarly, the first differenced lagged regressand is instrumented with its previous levels which make avoiding the autocorrelation problem. Among the GMM family, for small samples, the use of System GMM is not feasible because due to greater range of instruments used it can cause small sample bias (Mileva, 2007). As we have small samples, so we have used Diff-GMM. The analysis is divided into two parts, i.e. for developing economies disaggregated by region and income. For each group there are two types of model specifications. First type of specification incorporates the variables of age-structure (working-age population, labor force participation, labor force growth rate and population growth), convergence variable and growth rate of physical capital as a control variable. However, the second specification also includes the human capital and its growth rate along with other economic variables like life expectancy growth rate and trade openness.

For the suitability of estimation method, Sargan-test of over-identifying restrictions and Arellano-Bond AR-test are used. The prob-value of Sargan-test is high which implies that the null-hypothesis of instruments as a group is exogenous and it cannot be rejected. The test for AR(1) in first difference rejects the null-hypothesis of no autocorrelation. However, the test of AR(2) in first difference does not reject the null-hypothesis for both specifications in case of all regions and income groups. The incorporation of robust standard errors auto-corrects the panel-specific autocorrelation and heteroscedasticity.

[3] Human capital index taken from Penn World is based on years of schooling and returns on education. However, Hanushek (2015) and Hanushek et al. (2015) have questioned the use of school attainment as a measure of human capital but human capital measured by cognitive skill is prerequisite for economic growth.

5. Results and Discussion

The results of Diff-GMM (of two specifications) for developing economies disaggregated into regions and income groups are presented in table 1 and 2 respectively.

Table 1: Results of Diff-GMM for Age-Structure and Human Capital Effect on Economic Growth of Economies Disaggregated By Region

	Specification 1					Specification 2				
Variables	**SSA**	**SA**	**LAC**	**MENA**	**EAP**	**SSA**	**SA**	**LAC**	**MENA**	**EAP**
Convergence Variable										
$\tilde{y}_{it}$ (Per-worker output)	-0.899 [0.468]*	-0.495 [0.256]*	-0.362 [0.192]*	-0.402 [0.227]*	-0.312 [0.167]*	-0.853 [0.463]*	-0.541 [0.286]*	-0.378 [0.199]*	-0.412 [0.219]*	-0.352 [0.192]*
Demographic Variables										
$\widetilde{W}_{it}$ (Working age population per-capita)	0.021 [0.711]	1.483 [1.258]	0.705 [0.624]	1.596 [1.062]	0.812 [0.421]*	0.067 [0.039]*	1.539 [0.732]**	0.748 [.386]*	1.600 [0.761]**	0.784 [0.382]**
$\tilde{n}_{it}$ (Labor force per-capita)	0.258 [1.005]	0.957 [0.496]*	1.719 [0.889]*	0.532 [0.285]*	1.012 [0.539]*	0.275 [0.149]*	0.885 [0.081]***	1.791 [0.853]**	0.517 [0.249]**	1.992 [1.123]*
$N_{g_{it}}$ (Labor force per-capita growth rate)	0.502 [0.779]*	1.372 [0.742]*	1.658 [0.873]*	1.793 [1.012]*	1.985 [1.091]*	0.581 [0.302]*	1.359 [0.619]**	1.589 [0.785]**	1.751 [0.851]**	1.782 [0.982]*
$P_{g_{it}}$ (Population growth)	0.069 [0.557]	0.749 [0.865]	0.825 [1.905]	0.657 [1.225]	0.247 [2.077]	0.063 [0.442]	0.798 [1.571]	0.809 [1.104]	0.629 [0.514]	0.258 [1.025]
Economic Variables										
$K_{g_{it}}$ (Physical capital growth rate)	0.990 [0.909]*	2.856 [1.538]*	2.089 [1.154]*	2.524 [1.395]*	1.296 [0.697]*	1.212 [0.625]*	2.699 [0.841]***	2.128 [0.984]**	2.557 [1.121]**	1.337 [0.596]**
$L_{g_{it}}$ (Life expectancy growth rate)						0.196 [0.109]*	0.398 [0.013]***	0.847 [0.459]*	0.059 [0.028]**	0.914 [0.487]*
$T_{g_{it}}$ (Trade openness)						0.711 [0.369]*	0.497 [0.282]*	1.185 [0.612]*	0.318 [0.153]**	0.498 [0.277]*
$H_{g_{it}}$ (Human capital growth rate)						0.120 [0.071]*	0.098 [0.045]**	0.134 [0.059]**	0.219 [0.117]*	0.084 [0.047]*
H_{it} (Human capital)						0.080 [0.847]*	0.176 [0.079]**	0.045 [0.020]**	0.058 [0.014]***	0.297 [0.161]*
Sargan Test of Over-identifying Restrictions										
Prob.	0.2287	0.5927	0.2608	0.3099	0.2481	0.5109	0.4621	0.3041	0.4301	0.5106
Arellano-Bond Test for Autocorrelation										
Prob. AR(1)	0.0213	0.0024	0.0191	0.0114	0.0194	0.0361	0.0352	0.0357	0.0295	0.0047
Prob. AR(2)	0.1542	0.4418	0.1471	0.5407	0.4293	0.6281	0.5137	0.5491	0.7611	0.4907

Note: Data range from 1960-2014 with 5 year interval. Robust standard errors are in parenthesis.
*, ** and *** denote 10, 5 and 1 percent level of significance respectively.

5.1 Economies Disaggregated by Region

The results revealed that working-age population has positive impact on economic growth of EAP in first specification and of all regions, i.e. SSA, SA, LAC, MENA and EAP in second specification. Generally the results are supported by Prskawetz et al. (2007) and An and Jeon (2006) who concluded that age-structure has positive effect on economic growth (Bloom et al., 2001). Song (2013) explained that rapid growth rate in East, South-east and South Asian economies is attributed to working-age population and growth of working-

age population. Choudhry and Elhorst (2010) have also shown the positive impact of working-age population in economic growth of 70 economies. The case of SSA is slightly different from other regions. The coefficient of working-age population for SSA is insignificant in first specification and is barely significant with smallest coefficient in the second specification. It reveals the fact that transition in SSA has just started. Bloom et al. (2016) narrated that although the fertility rate and dependency ratio in Africa are high but they have started to decline. They will fall further in coming decades. The ratio of working-age population to dependent population will be greater than Asia, Europe and North America. In this way Africa has a considerable potential to enjoy demographic dividend. For SA, the coefficient is insignificant in the first specification while significant in the second specification with second highest magnitude. The result is corroborated by figure 1 where working-age population is increasing in SA. For MENA, the coefficient of working-age population is highest. The working-age population is increasing in MENA as depicted by figure 1. For EAP the working-age population is contributing in economic growth while coefficient is not as high as that of SA and MENA. The figure 1 expressed that EAP has reached at the point of demographics where its working-age population has started declining and phenomenon of population ageing is going to the pipeline. The figure 2 expressed that old-age dependency ratio is not only rapidly increasing in EAP but it is highest among all the regions. Mason and Kinugasa (2005) has explained that East Asia has enjoyed the demographic dividend in the last four decades of 20th century and it is going to end if proper policies are not framed and implemented. Similarly Bloom and Williamson (1998) concluded that lower young dependency in East Asia has positively contributed to the economic development of the region. For LAC the coefficient is almost equal to that of EAP but the working-age population is still increasing.

We have included the labor force per-capita and labor force per-capita growth rate in the analysis to see its impact on economic growth of the regions. The labor force has shown positive impact on economic growth of all the regions except SSA in the first specification. However, the coefficient of labor force participation for SSA is lowest in the regions. On the other hand, LAC and EAP are the regions having comparatively higher coefficients of labor force participation. It has positive impact on economic growth of all the regions in second specification. It reveals that the labor force has a positive role in determining economic growth of developing regions (Bloom et al., 2010), although it is contradicted by Cuaresma et al. (2014).

The labor force growth rate has also shown positive impact on economic growth of all regions in both specifications. In both specifications the coefficient for SSA is lowest in all the regions explaining the specific case of SSA. It may also be inferred from the results of labor force and labor force growth rate that not only the growth rate of labor force contributes in economic growth but its level also contributes positively.

The impact of population on economic growth has been widely discussed in the literature. Two parallel thoughts and empirical evidences are given by the economist. A group of researchers has argued that population growth augment the economic growth (Grossman and Helpman, 1991; Kremer, 1993). It is based on the findings of Kuznet (1960) that population affects the economic growth through increased production, consumption and savings. Barro (1991) explained that population growth has a negative effect on economic

growth (Mankiw et al., 1992; Mason, 2003). It routes back to views of Solow (1956) that population restricts the economic development. In the current analysis the population growth has shown statistically insignificant effect on economic growth of all regions in both specifications. It implies that the population growth is not important for economic growth of the developing economies that is supported by the findings of Fang (2010). Feyrary (2002) has also found no significant effect of population growth on economic development. Guest (2011) opined that for the economic development of the economies the population size has no significant effect but the age-structure of the population matters (Macunovich, 2012). However, Song (2013) has evidenced the negative effect of total population on economic growth.

The results of current analysis showed that the growth rate of physical capital positively affects the economic growth of all regions in both specifications. The widely used growth models support the results (Bose and Haque, 2005; Bond et al., 2010; Bloom et al., 2010). The infrastructure in the form of roads, railway lines, airports, sources of energy transmission, dams, machinery, etc. enhance the output.

The life expectancy growth rate, human capital growth rate and human capital along with trade openness have been added in second specification. The results have shown that life expectancy growth rate positively affects economic growth of developing economies in all regions. It is consistent with the findings of Bloom et al. (2004). Ogundari and Awokuse (2018) have also demonstrated that in SSA, the life expectancy as a measure of human capital augments the economic growth. As a proxy of population health it increases labor productivity and quality, foreign direct investment (Alsan et al., 2006) and domestic investment and school enrolment (Lorentzen et al., 2005).

It is speculated that trade openness enhances the economic growth as increased imports and exports enhance the GDP growth rate through efficient resource allocation, capacity utilization, economies of scale, improved technology and foreign competition. The trade openness has shown positive impact on economic growth of all the regions of developing countries. It is supported by Helpman and Krugman (1985) and Awokuse (2003, 2008). It explains the notion that market liberalization policies encourage the international trade to boost economic growth.

Human capital in the life span of relevant literature has augmented economic development through different channels. It initiated from Schultz (1961) and Becker (1975) and is recently evidenced by Mayer-Foulkes (2001), Thomas and Frankenberg (2002), Bloom et al. (2004), Orgundari and Abdulai (2014), and Orgundari and Awokuse (2018). Generally it is based on three pillars of education, training and health. The impact may be through productive labor force, adaptation of technology, lesser loss of working hours, improved mental and physical capabilities, increased ability and wages, etc. Eggleston and Fuchs (2012) explained that longer life expectancy results into longer working-age and it instigates to save more for long time period. During longer life the people improve human capital largely and make sufficient inventions during their longer life. It makes contribution in the economic prosperity of the nations. In the current analysis the principal variable of human capital, both in growth rate and level form has shown positive impact on economic

growth of all the regions. However, the highest impact of human capital growth is for MENA and of human capital is for EAP. It explained that not only the growth of human capital is important for growth of the economies but the level of human capital also matters. It gives evidence to the notion of Mankiw et al. (1992). Siddiqui and Rehman (2016) have evidenced the role of human capital in economic growth of South and East Asia. Issa (2005) explained that human capital directly stimulates the economic growth. It effectively diminishes mortality and fertility rate which enhance the economic growth. Cuaresma et al. (2014) explained that improvement in educational attainment as a part of human capital not only drives the fertility down but it is an important driver of productivity and economic growth. Glewwe et al. (2014) have concluded that education as a measure of human capital enhances economic growth in SSA, although the effect is comparatively weaker than other countries possibly due to poor quality of education. Similarly, Ogundari and Awokuse (2018) have shown that in SSA the human capital measured by primary and secondary school enrolment has positive impact on economic growth. Collins and Bosworth (1996) and Rodrik (1998) explained that human capital accumulation was the key factor in boosting growth rate in East Asia in the last four decades.

The lagged dependent variable of per-worker output has shown negative effect on dependent variables for all the regions in both specifications. It confirms the conditional convergence. However, the magnitude of convergence coefficient is highest for SSA. It explains that the economies with comparatively lower level of income when controlled for other variables converge swiftly rather than those already reached at comparatively high level of income. It is supported by the mainstream findings of Mankiw et al. (1992), Salai-Martin (1996) and Barro (1996).

5.2 Economies Disaggregated by Income

This part of analysis is concerned with the role of age structure and human capital in developing economies disaggregated by income. Developing economies are disaggregated into income groups by WDI as: low-income economies (LIE) (the economies with a GNI per-capita of $1,045 or lesser in 2014); lower-middle-income economies (LMIE) (the economies with a GNI per-capita of $1,045 to 4,125 in 2014); upper-middle-income economies (UMIE) (the economies with a GNI per-capita of $4,125 to 12,736 in 2014); and high-income economies (HIE) (the economies with a GNI per-capita of $12,736 or more).

The results expressed in table 2 revealed that working-age population has positive impact on per-capita output only for HIE in the first specification. However it has positive effect for all income groups except LIE in the second specification. It has an important implication, i.e. the working-age population is an important source of economic growth in developing economies (Bloom et al., 2011; Aiyar and Mody, 2013). In low-income-economies it is not affecting the economic growth due to lack of proper policy interventions to facilitate labour market mechanism for labour absorption. On the other hand in high-income economies it has an important role. Lehr (2009) opined that development stage of the economies matters for having the demographic dividend (Romer, 2012).

Table 2: Results of Diff-GMM for Age-Structure and Human Capital Effect on Economic Growth of Economies Disaggregated By Income

	Specification 1				Specification 2			
Variables	**LIE**	**LMIE**	**UMIE**	**HIE**	**LIE**	**LMIE**	**UMIE**	**HIE**
Convergence Variable								
$\widetilde{y}_{it}$ (Per-worker output)	-0.921 [0.492]*	-0.450 [0.265]*	-0.352 [0.195]*	-0.209 [0.119]*	-0.801 [0.433]*	-0.402 [0.218]*	-0.337 [0.179]**	-0.213 [0.121]*
Demographic Variables								
$\widetilde{W}_{it}$ (Working age population per-capita)	0.118 [0.842]	1.825 [1.598]	1.726 [2.035]	1.854 [0.966]*	0.066 [0.443]	1.683 [0.889]*	1.785 [0.873]**	1.749 [0.931]*
$\widetilde{n}_{it}$ (Labor force per-capita)	0.211 [0.119]*	0.896 [0.699]	0.812 [1.056]	0.622 [0.352]*	0.240 [0.126]*	0.999 [0.524]*	0.739 [0.390]*	0.695 [0.318]**
$N_{g_{it}}$ (Labor force per-capita growth rate)	0.491 [0.261]*	1.423 [0.781]*	1.499 [0.774]*	1.991 [1.096]*	0.601 [0.308]*	1.432 [0.691]**	1.490 [0.728]**	2.054 [0.962]**
$P_{g_{it}}$ (Population growth rate)	0.077 [0.437]	0.426 [1.354]	0.443 [1.759]	0.562 [2.364]	0.085 [0.395]	0.497 [1.454]	0.486 [1.256]	0.602 [1.094]
Economic Variables								
$K_{g_{it}}$ (Physical capital growth rate)	3.254 [2.846]*	2.806 [1.309]**	2.721 [1.491]*	1.491 [0.816]*	3.154 [1.637]*	2.912 [1.382]**	2.714 [1.224]**	1.524 [0.750]**
$L_{g_{it}}$ (Life expectancy growth rate)					0.770 [0.401]*	0.733 [0.351]**	0.187 [0.083]**	0.686 [0.381]*
$T_{g_{it}}$ (Trade openness)					0.699 [1.028]	0.916 [0.419]**	1.231 [0.681]*	1.285 [0.591]**
$H_{g_{it}}$ (Human capital growth rate)					0.039 [0.023]*	0.092 [0.051]*	0.093 [0.042]**	0.228 [0.113]**
H_{it} (Human capital)					0.017 [0.009]*	0.081 [0.038]**	0.055 [0.031]*	0.175 [0.079]**
Sargan Test of Over-identifying Restrictions								
Prob.	0.2933	0.2359	0.4914	0.4718	0.2217	0.5417	0.7120	0.3149
Arellano-Bond Test for Autocorrelation								
Prob. AR(1)	0.0391	0.0148	0.0281	0.0364	0.0383	0.0114	0.0476	0.0133
Prob. AR(2)	0.3515	0.5440	0.2533	0.4551	0.3812	0.3947	0.6122	0.5271

Note: Data range from 1960-2014 with 5 year interval. Robust standard errors are in parenthesis.
*, ** and *** denote 10, 5 and 1 percent level of significance respectively.

The labor force has positive impact on economic growth of LIE and HIE (in first specification) and all the income groups (in second specification). It explains that the labor force positively determine economic growth of all income groups (Mason, 2005; Bloom et al., 2010). The labor force growth rate has also shown positive influence on economic growth of all income groups in both specifications. The coefficient of labor force participation growth rate of HIE is highest in all income groups for both specifications. It explains that labor force growth rate contributes more in economic growth rate of HIE as compared to other income group of the economies. It is based on the fact that the economies of HIE have good policy interventions to absorb labor force and the quality of labor force is better as compared to other groups of the economies so labor force is more productive in these economies.

The population growth rate has shown statistically insignificant effect on economic growth of all the income groups in both specifications. It explains that population growth rate neither accelerate nor decelerate the economic growth of developing economies (Ferary, 2002; Fang, 2010) but the labor force at level and growth of labor force contribute towards economic growth (Guest, 2011; Macunovich, 2012). The working-age population also matters for the economic growth. It is supported by the results of the same economic model for economies disaggregated by regions (section 5.1).

The results have shown that physical capital is an important determinant of economic growth of developing economies. It has positive effect on economic growth of developing economies for all income-groups in both specifications (Bloom et al., 2012; Bond et al., 2010). It is corroborated by the results of same economic model for economies disaggregated by region (section 5.1). All the regions of developing economies are positively influenced by physical capital growth.

The coefficient of physical capital growth in highest for LIE among all income groups of the developing economies and in both specifications. On the other hand the coefficient is lowest for HIE among all income groups in both specifications. It reveals that LIE need physical capital while the HIE have comparatively sufficient bulk of physical capital.

The growth rate of life expectancy, trade openness, human capital growth rate and human capital have been added in the same specification. The life expectancy has shown positive impact on economic growth of developing economies in all income groups in the second specification. It is corroborated by the previous results of same economic model for regions of developing economies where all regions of developing economies have positive impact of life expectancy on their economic growth. The results are also supported by a number of studies (Bloom et al., 2004).

The trade openness has shown positive effect on economic growth of all income groups except LIE. The trade openness has also shown positive impact on economic growth of all regions of developing economies (section 5.1). It confirms the findings of Helpman and Krugman (1985) and Ogundari and Awokuse (2018). The no significant effect in LIE explains the lower ratio of these countries' trade in global trade.

The human capital has been included in two forms, i.e. human capital growth rate and human capital. The results of second specification have shown that it has positive effect (in both forms) on economic growth in all income groups (Mankiw et al., 1992; Issa, 2005; Cuaresma et al., 2014; Siddiqui and Rehman, 2016; Ogundari and Awokuse, 2018). The results are supported by the results of same economies disaggregated by region (section 5.1) where all the regions of developing economies have same type of results. However the coefficient of human capital and human capital growth rate both have highest value for HIE and lowest for LIE among all income groups of economies. It explains that impact of human capital on economic growth varies by level of development.

The convergence variable has negative sign for all the income groups in both specifications confirming the conditional convergence. However, the magnitude of convergence is highest for LIE and lowest for HIE among all income groups. The explanation may be that the economies with low initial levels of income or output converge to their steady state path with greater pace than those already reached at high levels of output.

We have seen the role of age-structure changes and human capital in economic growth of developing economies disaggregated by region and income. The regional comparison of impact of age structure on economic growth of developing countries reveals that working-age population has least effect in SSA and highest in MENA. The effect in MENA is 26 times higher than in SSA (second specification). Similarly the impact of labor force and labor force growth has lowest effect in SSA and highest in EAP. For EAP the effect is 7 and 3 times higher than SSA for labor force and labor force growth respectively (second specification).

The human capital has the highest impact on the economies of EAP and lowest impact on those of LAC. The impact on LAC and MENA is almost same. The EAP economies have 7 times high benefit of human capital than LAC in the perspective of economic growth. However, the impact of human capital growth rate is lowest in EAP and highest in MENA, LAC and SSA. It explains the law of marginalization, i.e. the EAP has reached near to optimum level of human capital in developing economies. Further increase in human capital will enhance the economic growth but at comparatively lower rate. On the other hand LAC and SSA have comparatively lower level of human capital, the change in human capital will result into comparatively higher benefits in the form of human capital. It is corroborated with the results of human capital at level where human capital is contributing highly in EAP and lowly in LAC. If we make the comparison of disaggregation by income it makes clear that signs of all the coefficients are according to the theory but there is difference in the magnitudes of coefficients. The coefficient of working-age population is smallest for LIE in all income groups. It reveals the fact that in LIE the economies are just to start the change in age-structure. They have still high age dependency and low working-age population ratio. Bloom et al. (2011) confirmed that the effect of change in age-structure varies by socioeconomic status of the nations.

Similarly, labor force and labor force growth are having lowest magnitude of coefficient for LIE in all other income groups. It also explains that demographic dividends are lowest for LIE which conferred that demographic dividend depends upon the level of development. The human capital (level form and change) has effect on economic growth of the income groups with different magnitude. The HIE have higher effect while LIE have lower effect. It confers that human capital also differently affects the economic growth of countries at different development stage.

6. Conclusion

The focus of the study was to investigate the role of age-structure and human capital in economic growth of developing countries disaggregated by regions and income-groups. The research question was if the demographic dividends are equally obtained by the regions and income groups of developing economies or they differ. For the purpose data of developing countries for the years 1960 to 2014 was converted into five-year intervals of time periods. It was disaggregated into regions and income-groups through the classifications of World Development Indicators (WDI). The methodology used was Difference GMM which is from the family of Arellano-Bond GMM estimators. The Diff-GMM is used due to its well performance even in the small cross-sectional units. The

findings of the study explain that the age-structure and human capital positively impact the economic growth of developing economies disaggregated by region and income group. It provides the evidence of role of age-structure and human capital in economic growth. It is supported by Azomaho and Mishra (2008) who confirmed that demographic changes have direct and feedback effects on economic growth of the developing economies.

The answer to the question is that benefits of age-structure and human capital in the form of economic growth differ for different regions and income groups of the developing economies. The maximum benefits of age-structure are being obtained by the MENA and EAP and minimum benefits are being obtained by SSA. The human capital has highest impact on economies of EAP and lowest on those of LAC. However, human capital growth rate benefits highly to the economies of MENA and lowest to economies of EAP.

The LIE have the minimum benefits of age-structure and maximum benefits are obtained by HIE and UMIE. Similarly the human capital and human capital growth maximally benefits the HIE and minimally LIE. In our sample the entire LIE are the sub-Saharan African countries.

The demographic divided is not automatic to demographic transaction but parallel proper socioeconomic policies are required (Mason and Kinugasa, 2005). For sub-Saharan Africa and low-income economies the process of declining the fertility has begun. The process can be accelerated by national population policy focusing to reduce fertility. It will lead to decline in youth dependency relative to working-age population per-capita which will affect economic growth in the long-run. For these countries, the reduction in population growth and fertility rate will attract the possible demographic gift by accelerating the changes in age-structure. The East Asian miracle is a renowned example of obtaining this benefit.

Human capital growth is another area where there is a need for low-income economies to focus as human capital is theoretically connected with working-age population and labor force for their productivity.

The opportunity to get benefits due to changes in age-structure as it is the case of high-income economies is not for ever but it is a transitory phenomenon. The opportunity window will ultimately be closed and the stage of population aging will be started where most of the developed world is today.

The possible dimensions for further research are the role of sex distribution of age-structure and human capital in economic growth. Another area may be the use of cognitive development as a proxy of human capital in the same type of analysis.

Acknowledgement

The authors are thankful to the reviewers for their valuable comments and proposals to improve this article.

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Appendix A

Developing Countries Disaggregated by Regions				
Sub-Saharan Africa (SSA)	**South Asia (SA)**	**Latin America and the Caribbean (LAC)**	**Middle East and North Africa (MENA)**	**East Asia and Pacific (EAP)**
1. Niger	1. Pakistan	1. Panama	1. Syrian Arab Republic	1. Papua New Guinea
2. Rwanda	2. Sri Lanka	2. Peru	2. Tunisia	2. Philippines
3. Senegal	3. Bangladesh	3. Venezuela, RB	3. Algeria	3. Thailand
4. South Africa	4. India	4. Argentina	4. Iran, Islamic Rep.	4. China
5. Sudan	5. Nepal	5. Belize	5. Iraq	5. Fiji
6. Swaziland		6. Bolivia		6. Indonesia
7. Togo		7. Brazil		7. Malaysia
8. Zambia		8. Colombia		
9. Zimbabwe		9. Costa Rica		
10. Benin		10. Cuba		

11. Botswana		11. Dominican Republic		
12. Burundi		12. Ecuador		
13. Cameroon		13. El Salvador		
14. Central African Republic		14. Guatemala		
15. Cote d'Ivoire		15. Guyana		
16. Gabon		16. Haiti		
17. Gambia		17. Honduras		
18. Ghana		18. Jamaica		
19. Kenya		19. Mexico		
20. Lesotho		20. Nicaragua		
21. Liberia				
22. Malawi				
23. Mali				
24. Mauritania				
25. Mauritius				

Appendix B

Developing Countries Disaggregated by Income groups			
Low-Income Economies	**Lower-Middle-Income Economies**	**Upper-Middle-Income Economies**	**High-Income Economies**
1. Niger	1. Pakistan	1. Panama	1. Uruguay
2. Rwanda	2. Papua New Guinea	2. Peru	2. Chile
3. Togo	3. Philippines	3. South Africa	3. Latvia
4. Zimbabwe	4. Senegal	4. Thailand	4. Argentina
5. Benin	5. Sri Lanka	5. Tunisia	5. Venezuela
6. Burundi	6. Sudan	6. Turkey	
7. Central African Republic	7. Swaziland	7. Paraguay	
8. Gambia, The	8. Syrian Arab Republic	8. Algeria	
9. Haiti	9. Zambia	9. Belize	
10. Liberia	10. Bangladesh	10. Botswana	
11. Malawi	11. Bolivia	11. Brazil	
12. Mali	12. Cameroon	12. China	
13. Nepal	13. Cote d'Ivoire	13. Colombia	
	14. El Salvador	14. Costa Rica	
	15. Ghana	15. Cuba	
	16. Guatemala	16. Dominican Republic	
	17. Guyana	17. Ecuador	
	18. Honduras	18. Fiji	
	19. India	19. Gabon	
	20. Indonesia	20. Iran, Islamic Rep.	
	21. Lesotho	21. Iraq	
	22. Mauritania	22. Jamaica	
	23. Nicaragua	23. Malaysia	
	24. Kenya	24. Mauritius	
		25. Mexico	