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The Impact of Physical and Human Capital Development on Economic Growth in Developing and Developed Countries: A Comparative Panel Data Approach

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Abstract

This research used panel data of 74 developing and 47 developed countries over the period of seven years (2005 -2011) to investigate and compare the impacts of physical and human capital development on economic growth in these two regions. The results from fixed effects method employed revealed that physical capital such as investment proxy by gross fixed capital formation is not positively and significantly contributing to economic growth in developing regions until investment from other sources such as FDI and other growth determinants were taken into account. The reverse is the case for developed countries with this had positive and significant effect on GDP in almost all the model specifications. Infrastructure and innovation technology prove positive and significant in developing countries while they were not significant in developed countries which may be due to catching up effect through technology externalities and knowledge spillover. Human capital contributes to GDP in developed region through investment flow in primary and tertiary education. However, the result further showed that developing countries have neglected basic primary and secondary education with focus on tertiary education which may lack quality to contribute to GDP due to poor foundation as a result of poor attention to primary and secondary education.

Keywords: Panel data, Fixed effect, Physical capital, Human capital, Economic growth, Knowledge spillover.

Contents

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1. Introduction

1.1. Background of the Study

The growth of any economy has been found in a great number of literatures to be influenced by its level of physical and human capital. There is no country that can achieve sustained economic development without substantial investment in human capital (Ogujiuba, 2013). Harbison (as cited in Adelakun (2011)) refers to human capital as the abilities and skills of human resources while human capital development refers to the process of acquiring and increasing the number of persons who have the skills, education and experience which are critical for the economic growth of any country. Hence, education and health are closely related components of human capital that work together and make individuals more vigorous and productive (Javed *et al.*, 2013).

The developing countries are arguably more endowed with human resources in the world compare to developed countries in term of population. However, these are not amounted the kind of human capital for economic growth because human resources required for economic growth need to possess some level of skills that will enhance their productivity. This has largely been attributed to poor schooling system, and poor health system resulting to low life expectancy and high mortality rate which are all antidotes to human capital development. Moreover, the importance of physical capital in terms of capital formation to create enabling environment for growth cannot be over-emphasized. Rostow (1960) argued that necessary investment needs to be made in three key economic sectors such as technology, infrastructure and transportation system for rapid economic growth to take place. However, the level of infrastructure in many developing countries does not encourage economic activities to thrive. The small scale business and enterprises which form the real sector of many of these countries may find it difficult to grow and contribute meaningful impacts to economic growth. Meanwhile, the essence of comparing the cross-country results of both developing and developed economies to empirically examine what the countries in both regions do differently in exploiting their physical and human capital for economic growth. This will provide guidelines for policy makers in both regions, the areas of the economy sectors that need more attention for sustainable economic growth.

However, in a more specific terms, the findings from this study provide answers to the following research questions:

1) To what extent has education and health system in developing and developed countries influence their economic growth?
2) To what degree has physical capital in terms of investment and infrastructure influence economic growth in developing and developed countries?
3) What level of influence does technological advancement and innovation has brought to economic growth in developing and developed countries?

2. Literature Review

2.1. Economic Growth and Determinants in Developed and Developing Regions- Facts And Figures

Economic growth is not the same across the globe. It is believed that countries in Europe, America and other developed continents tend to have higher GDP compare to their counterparts in developing and emerging economies. This can be depicted Figure 2.1 below as countries in European Union have higher GDP put together over the periods of 14 years than their counterparts in East Asia, Latin America and Sub-Saharan Africa regions.

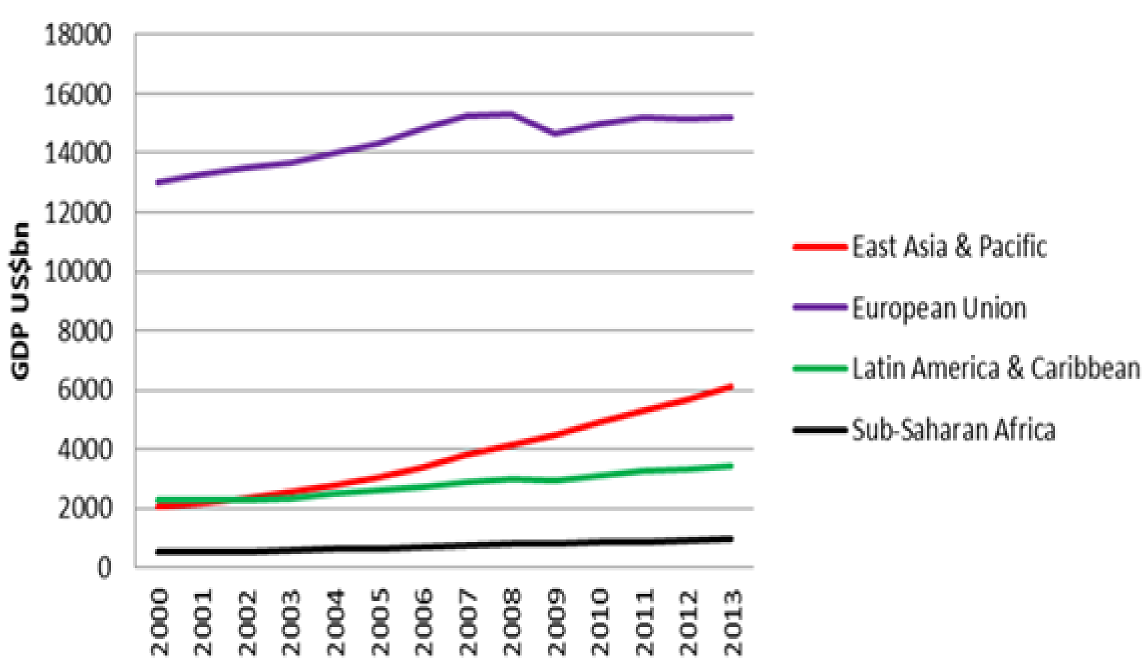

Figure-2.1. GDP Trends in European Union and Developing Regions 2000-2013

Source: Plotted by author using data from World Bank Development Indicator (2015)

However, looking at the relationship between GDP and human capital index in 2013 from Figure 2.2 below, it is evident that higher GDP in developed countries as shown in Figure 2.1 above could be attributed to the commitment of these countries to human capital development (comprising education, health and wellness) compare to their developing counterparts.

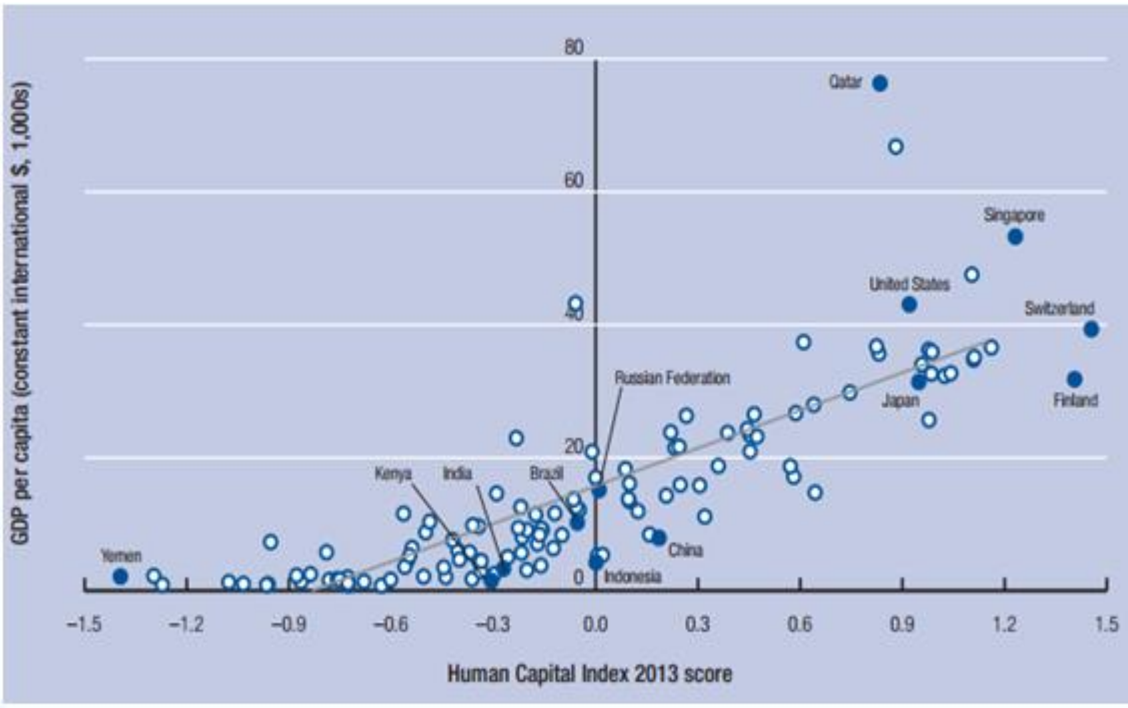

Figure-2.2. Relationship between GDP per capita and Human Capital Index
Source: World Economic Forum (2013)

In the above figure for instance, Japan, United States, Finland, Switzerland, Singapore and Qatar have higher human capital index score between 0.9 and 1.5 in 2013 compare to their counterparts in developing countries which their HCI score were even negative except countries like Indonesia, Russia, and China which could be seen as emerging economies. It can also be observed that corresponding GDP per capita for the aforementioned high-income countries are hovering around USD$20,000 and above while developing countries were all below that figure.

Moreover, physical capital in terms of gross fixed capital formation and foreign direct investment could be seen as avenue in which technology and other major infrastructure could be promoted and subsequently lead to economic growth through productivity as a result of enabling environment created by the factors mentioned above.

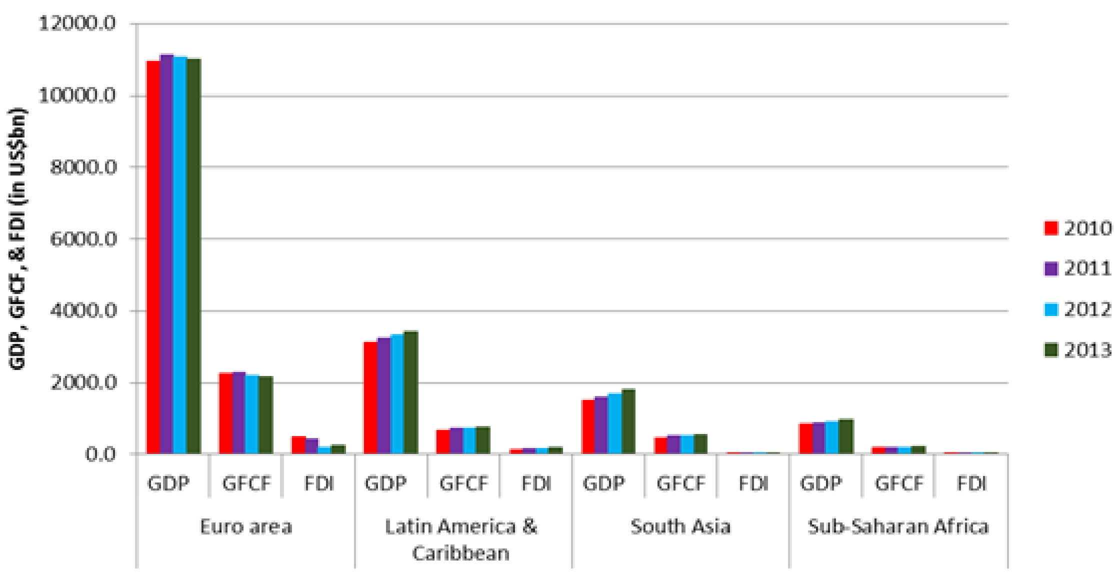

Figure-2.3. Trends in GDP, Gross Fixed Capital Formation and FDI from Euro Area, Latin America, South Asia and Sub-Saharan Africa, 2010-2013
Source: Plotted by author using data from WBDI (2015)

In Figure 2.3 above, GDP and gross fixed capital formation in Euro Area initially increased in 2011 before started declining from 2012. This is contrary to other 3 developing regions as the level of GDP starts increases in 2010 so also the gross fixed capital formation. The same goes with FDI relationship between GDP and FDI. Meanwhile, despite the decline, the level of GDP and the two form of capital formation are higher in Euro Area compare to other regions. However, the situation described for developing countries above could be attributed to the fact that even though there is investment in physical capital but there is insufficient one in human capital that will utilise the technology and infrastructure for economic growth. That is why Appleton and Teal (1999) argue that human capital and investment in physical capital such as machine that will match the skills acquired through human capital development are necessary as both can complementarily contribute to economic growth.

2.2. Theoretical Literatures

Investigating the impact of economic growth especially from physical and human capital perspectives cannot be completed without reviewing the general ideas, thoughts and contributions of early economics scholars as well as empirical findings. For this reason, the theoretical frameworks of this research are discussed under three categories which are classical, neoclassical and endogenous growth models. The empirical findings from related studies in order to confirm the validity or otherwise of the postulations in theories were also reviewed.

2.2.1. Classical Theories of Economic Growth

The emphasis of classical school for economic growth to occur is basically investment and capital accumulation. Prominent economic models associated to this school include Harrod-Domar growth model of early 1940s with emphasis on savings and investment as main determinants of economic growth; Walt Rostows' linear-stage growth model of 1959 emphasized that economic growth need to pass through five standard stages.

In addition, structural change growth model by Arthur Lewis in 1960 established the need for economy to move from subsistence agricultural-based to industrialised one. In the same period, Chenery et al. came up with the pattern of development which include a shift from agricultural to industrial production; the steady accumulation of physical and human capital; change in consumer demands with emphasis shifting from the production of food and basic necessities to desires for diverse manufactured goods and services. However, Itagaki (1963) described the sequential process of Rostow's theory as inevitable for all the countries as not all of them actually follow these sequential stages in growth attainment. Okwuosa (2015) describes United States, Canada, New Zealand and Australia as countries that did not pass through traditional society stage and even derived their preconditions from already advanced country like United Kingdom. Gallo (2002) also agreed with Harrod-Domar's theoretical strand that the amount of savings and investment play a significant role in the process of economic growth. He therefore describes economic growth as a rise in per capita income and national product as a result of rise in investment greater than the amount necessary to replace depreciated capital.

Meanwhile, Ray (as cited in Gallo (2002)) argued that emphasis on savings and investment by Harrod-Domar holding other factors of production constant is not sufficient enough to increase growth, as there is always the possibility of increasing the output by using additional labour with improved and more intensified techniques.

Todaro and Smith (2011) argue that savings and investment are necessary conditions for accelerated rates of economic growth but not sufficient conditions. According to them necessary conditions are well-integrated financial and capital markets, highly developed transport facilities, a well-trained and educated workforce, good and efficient governance capable of converting new capital effectively into higher level of output. One of the criticisms levelled against Lewis' model was that it neglects traditional agricultural sector by transferring labour to modern sector until there is no labour in the former which could lead to shortage of food (Wang and Piesse, 2010).

Prados (2005) argued that in development pattern, there is no implication that single unique paths, through which all economies have to pass must exist. Another argument against Chenery's pattern of development is that the approach may run the risk of leading the practitioners to draw the wrong conclusions about the causality- in effect, to pursue wrong economic development policy (Todaro and Smith, 2011).

2.2.2. Solow's Neoclassical Growth Model

The model was developed in 1940s and 1950s by Robert Solow and Trevor Swan respectively. The model introduced labour into already established model by classical school theorists like Harrod-Domar by augmenting Cobb Douglas production function: $= \boldsymbol{K}^{\propto} \, (\boldsymbol{AL})^{\boldsymbol{1-\alpha}}$. However, while this is a welcome development as labour is also one of the critical factors contributing to GDP in any economy, but productivity factor of labour (AL) were determined outside the model. This made Solow to argue that an economy will reach a steady state (i.e a diminishing return to capital in the long run) where per capita output, capital stock and consumption will grow at a common constant rate equalling the exogenously given rate of technological progress. This argument led to the emergence of endogenous growth theories by Romer (1989) and Mankiw *et al.* (1992).

2.2.3. Endogenous Growth Theories

There are two major proponents of these theories as mentioned in the above subsection. Their models directly responded to the weaknesses of Harrod-Domar and Solow models which both explained savings and technological knowledge in their models exogenously. Romer argued that diminishing returns to capital can be eliminated by the link between state of knowledge and the amount of investment (as cited in Rafael and De La (2000)). Basically, Romer explained in his model how investment in technological progress or knowledge (A) in Solow's model will enhance labour productivity and in turn increase output.

However, Mankiw *et al.* (1992) eventually came up with their influential contribution, and present a simple extension to the Solow model by allowing human capital as a separate input into an otherwise standard Cobb-Douglas production function with Harrod-neutral (i.e., labour augmenting) technological progress Schütt (2003). Mankiw *et al.* (1992) argue that there will be constant increasing return to scale of reproducible factor such as human capital through technology advancement augmented by innovation as a result of deliberate development of human capital via research and development.

2.3. Empirical Literatures

2.3.1. Impact of Education and Health

Education and health had been described as two main components of human capital stressing that while education enhances the quality of human capital, health on the other hand improves the efficiency and effectiveness of human capital (Ada and Acaroğlu, 2014). The idea here is that labour productivity will affect economic growth positively through skilful and healthy labour. Barro (1992) found that countries with a higher level of educational attainments grow faster for a given level of initial per capital GDP and for values of policy –related variables. Similarly, average schooling years were found to yield a rise in GDP growth of about 0.5% points in a panel data investigation of human capital and economic growth in OECD countries by Middendorf (2005).

Tiruneh and Radvansky (2007) carry out a panel data investigation of human capital contribution on European economic growth between the period of 1995-2009 and they found that secondary school enrolment, and labour force with primary, secondary, and tertiary education are all significantly and positively influence GDP per capital growth rates. Idrees and Siddiqi (2013) compare the impacts of public education expenditure on economic growth in developed (G-7) nations and developing countries using panel data cointegration method. They found that ''the impact of public education expenditures on economic growth is greater in the case of developing countries as compare to the developed countries, which they conclude as sign of the “catching-up effect” in developing countries’’.

Son *et al.* (2013) panel data investigation of education impact on economic growth for five groups of EU member states(both developing and developed) revealed that both quantitative (measured by average schooling year) and qualitative (scores on skill tests) features of human capital have positive and significant influence on economic growth in these countries. Bloom *et al.* (2004) found in a panel study of countries for the period between 1960 and 1990 that health has a positive and statistically significant effect on economic growth. It suggests that a one-year improvement in a population’s life expectancy contributes to an increase of 4% in output. Eggoh *et al.* (2015) examine the relationship between education, health and economic growth among 49 African countries between 1996 and 2010. They found that public expenditures on education and health have a negative impact on economic growth, whereas human capital stock indicators proxies by primary and secondary enrolment have a slight positive effect. They also found that education and health expenditure could complementarily influence economic growth positively. Somayeh *et al.* (2013) investigate effect of health on economic growth in 16 developed and 14 developing countries using panel unit root and panel data approach. They found that found that capital stock and life expectancy have a statistically significant positive effect on economic growth in both groups of countries.

2.2.2. Impact of Physical Capital

(a) Investment

This study examined other physical capital variables apart from traditional gross capital formation. These include foreign direct investment, infrastructure, and natural resources. Three of Chenery’s pattern of development characteristic features such as international trade, urbanisation and resource use (as cited in Todaro and Smith (2011)) serve as one of the justifications for including the above mentioned physical capital. These forms of capital vary from one country to another.

Kubík (2010) found that physical capital contribute significantly 50% to output on the average in 73 countries between 1960 and 1990 using panel data from six different sources. A linkage analysis in Bangladesh between 1986 and 2008 also reveals that level of capital formation caused significant positive effects on changes in real GDP (Adhikary, 2011). Similar results were found in Pakistan using data for the period of 1972-73 to 2010-11 (Ali *et al.*, 2012). Meanwhile Lucas (as cited in Benhabib and Spiegel (1994)) suggests that one reason why physical capital does not flow to poor countries may be linked to the fact that these countries are poorly endowed with factors complementary to physical capital. This justification was eventually linked to the negative and significant relationship found between income-to-capital ratio and income level (Benhabib and Spiegel, 1994).

(Roy and Mandal, 2012) was another empirical study which has panel observation of 27 Asia countries for the period of 1974 to 2010. They found negative and statistically significant relationship between gross fixed capital formation and economic growth. It was however, argued that ‘’domestic investment proxy by gross domestic capital formation is not conducive to economic growth for Asian economies due to the mismatch between capital requirement and saving capacity’’ (Roy and Mandal, 2012).

Similarly, Azat (2014) found that GDP per capital income had insignificant negative relationship with gross fixed capital formation in 8 Central European economies (CEE) between 2005 and 2010 but ignore on insignificant ground. However, Cu *et al.* (2013) found in their panel data investigation of 5 countries in ASEAN region that gross fixed capital formation has a positive and significant effect on gross domestic product.

Ndambiri *et al.* (2012) examine the determinants of economic growth in 19 Sub-Saharan Africa countries using Generalised Method of Momentum panel technique between 1982 and 2000. Physical capital proxy by gross capital formation alongside human capital significantly contributes to the economic growth among these countries. Similarly, Fayissa and Nsiah (2010) found positive and significant relationship between GDP per capita and gross fixed capital formation in 18 Latin American countries between 1980 and 2005.

Harrod-Domar growth model assume closed economy where investment require for economic growth is determined by the amount of savings. One of the model’s weaknesses is that developing countries could borrow where domestic investment is insufficient to achieve economic growth. However, literature has criticised this assumption claiming that this has resulted to huge debt profile for many developing countries with repayment problems (Nyandat, 2014).

(b) Foreign direct investment

Meanwhile, several empirical literatures have found that encouraging FDI could complement domestic investment and then lead to economic growth. There are mixed empirical results on the above as some findings revealed inverse relationship between FDI and growth especially in developing countries. Also the simultaneity problem causing bidirectional relationship used to produce ambiguous results.

Cu *et al.* (2013) found that FDI had a negative and significant effect on GDP in panel study of ASEAN-5 countries. They argue that the negative effect may be due to indirect effect such that FDI does not generate employment good enough to boost the economy.

Behname (2012) found that capital formation and foreign direct investment had positive and significant effect on gross domestic product (GDP) in South Asia countries. The study uses panel data between 1977 and 2009. Similarly, Fayissa and Nsiah (2010) found positive and significant relationship between GDP per capita and FDI in 18 Latin American countries between 1980 and 2005.

In another study of developing countries, Mallick and Moore (2006) found in a panel study of 60 developing countries that ‘’FDI flows exert beneficial complementarity effects on the domestic capital formation across all income-group countries, thus suggesting that external finance does positively contribute to economic growth’’.

Similarly, Borensztein *et al.* (1998) found FDI from industrial countries to 69 developing countries in their cross-country study as vehicle for the transfer of technology, contributing relatively to growth than domestic investment.

Their findings further revealed that FDI would contribute to economic growth only when the host countries have a minimum threshold of human capital and sufficient absorptive advanced technology capability.

Meanwhile, a panel data investigation of OECD and non-OECD countries carried out by Luiz and Mello (1999) reveals that FDI would only contribute to economic growth of the recipient's economy with upgraded technology and knowledge spillovers.

Similarly, an increase in annual GDP growth between 0.3 and 0.71 percentage points had been attributed to an increase in FDI share of GDP in 43 Sub-Saharan Africa between 1980 and 2009 (Juma, 2012).

(c) Infrastructure

There is no infrastructural development whether in energy, transportation, aviation & port and/or power sector that can really thrive without the support of telecommunication facilities and its allied products. This accounts for the importance of telecommunication infrastructure as life wire upon which other infrastructural facilities contribute to economic growth. The effect of this category of infrastructure on economic growth had been established by a number of literatures.

Telecommunication developments were found statistically and positively correlated with the real GDP per capita of 24 countries from low income, middle income and income groups between the period of 1985 and 2003. These results were based on the empirical panel data investigation by Zahra *et al.* (2009).

Similarly, Sahin *et al.* (2014) examine in their panel data investigation, the infrastructure effects on economic growth of three groups of European Union countries (EU 12, EU 15 and EU 27) between the period of 1980 and 2010 using generalised momentum method (GMM). They found ''that telecommunications investments have positive effects on growth in all groups, energy investments have positive effects in EU 15-EU 27 groups and investments on railway and road have positive effects only in EU 27group.''

Mahyideen *et al.* (2012) in their 5 ASEAN's panel data investigation for the period between 1980 and 2010 also revealed that all the 4 infrastructural development proxies including number of subscriptions for both fixed line and mobile phone, number of telephone lines, the number of mobile cellular subscription are statistically and significantly correlated with economic growth proxy by GDP per capita.

Evidence from developing countries in a study carried out by Sridhar and Sridhar (2007) shows that there are positive impacts of mobile and landline phones on national output, even when they control for the effects of capital and labour. Economic development had been linked with a critical mass telecommunication infrastructure. Röller and Waverman (2001) found that mass presence of telecommunication infrastructure using penetration rate of line per capita had significant effect on GDP in 21 OECD countries over 20 year periods. Similarly, in a dynamic fixed panel data investigation of 22 OECD countries for the period of 1980 to 1992 by Datta and Agarwal (2004) found that 'telecommunication infrastructure is both statistically significant and positively correlated with growth in real GDP per capita growth for these countries even after controlling for the effects of investment, government consumption, population growth, openness, past levels of GDP, and lagged growth''. However, it has been argued further that telecommunications investment is subject to diminishing returns, suggesting thereby that countries at an earlier stage of development are likely to gain the most from investing in telecom infrastructure (Datta and Agarwal, 2004).[1]

(d) Innovation and technological advancement

Innovation as a result of research and development had been theoretically linked to technological advancement which in turn enhances productivity of labour (Mankiw *et al.*, 1992). In view of this, high-technology exports percentage of manufacturing has been described as products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery (WBDI, 2015). However, a number of empirical studies have also established this endogenous technology progress position of growth model. Benhabib and Spiegel (1994) found that human capital can positively influence economic growth through two mechanisms. First, through the rate of domestically produced technological innovation; second, through the speed of adoption of technology from abroad, this can be through FDI in case of developing countries especially. Kilavuz and Altay (2012) also found that high-tech manufacturing industry export contribute positively and significantly to economic growth in 22 developing countries investigated. Hence, it is expected that this factor should have positive and significant effect on growth in developed countries being industry-oriented.

(e) Other factors affecting economic growth

Trade openness, natural resources endowment, population and tax policy cannot be overemphasized in economic growth literature. According to Chenery's patterns of development empirical exposition (as cited in Todaro and Smith (2011)) ''in addition to accumulation of capital, both physical and human, a set of interrelated changes in the economic structure of a country are required for transition from a traditional economic system to a modern one''

The structural changes being referred to simply involve factors responsible for economic function such as production transformation, composition of consumer demand, international trade, natural resources, urbanisation and population density. These are all macro and socio economic factors determining economic growth in every country and their impacts vary from country to country.

3. Data Sources and Research Methods

3.1. Data Collection and Sample Size Description

The study uses secondary sources mainly from WDI to collect data. The explanatory variables of interest are broadly classified into four categories and these are: human capital development, physical capital including infrastructure, innovation & technology advancement and other control variables (including trade openness, FDI, population, tax policy, e.t.c).

Table-3.1. Data description

[1] See also China case in Ding and Haynes (2006).

S/N	Procxy	Description	Microeconomic indicators	Source
1	LnGDP	GDP constant 2005 U$$/ WDI	Economic growth	WDI
2	EDI NDX	Mean years of schooling for adult aged 25 years+based on educational attainment & Expected years of schooling based on enrolment by age at all levels of education (min. 15 and Max. 18 years	Human capital development (Education) — Panel A	HDI
	HEI NDX	Life expectancy at birth, (Min. 35 and Max. 85 years)	Human capital development (Health) — Panel A	HDI
	PRYSE	School enrollment, primary (% gross)	Human capital development (Education) — Panel B	WDI
	SWW	School enrollment, secondary (% gross)	Human capital development (Education) — Panel B	WDI
	TSE	School enrollment, tertiary (% gross)	Human capital development (Health) — Panel B	WDI
	LEXP	Life expectancy at birth	Human capital development (Health) — Panel B	WDI
	HEX	Health expenditure, total (% of GDP)	Human capital (Health facilities)	WDI
3	GFC	Gross fixed capital formation (% of GDP)	Domestic investment	WDI
	INFR	Fixed telephone subscriptions (per 100 people)	Infrastructural development	WDI
	HETECH	High-technology exports (% of mfg. exports)	Innovation & technology advancement	WDI
4	FDI	Foreign direct investment, net inflows (% of GDP)	Foreign investment inflow	WDI
	LPOP	Population ages 15-64 (% of total)	Availability of labour	WDI
	TROP	Trade (% of GDP)	Trade openness	WDI
	NTR	Total natural resource rents (% of GDP)	Resource endowment	WDI
	TAX	Total tax rate (% of commercial profits)	Tax policy	WDI

Notes:
1 Natural log dependent variable
2 Human capital components
3 Physical capital components
4 Control variables-other factors that can influence economic growth

WDI- World Development Indicator
HDI- Human Development Index

Source: Author's compilation from WBDI (2015)

There had been mixed results using these proxies in a number of studies both in developed and developing countries (Barro, 1992; Benhabib and Spiegel, 1994; Appleton and Teal, 1999; Ranis *et al.*, 2000; Tatoğlu, 2011; Son *et al.*, 2013; Ada and Acaroğlu, 2014; Eggoh *et al.*, 2015). This study therefore used both index and school enrolment and reconciles the differences as shown in the above table ****. Another human capital health proxy used is health expenditure (% of GDP).

The sample size contain 74 developing countries made up of 49% Sub-Saharan Africa (SSA), 11% Middle East & North Africa (MENA), 18% Latin America & Caribbean (LAC), 5% East Asia & Pacific (EAP), 11% Europe & Central Asia (ECA) and 7% South Asia (SA). However, 47 developed countries were majorly sampled from high income countries. The nature of observed data is panel because it comprises many countries as explained above for the period of seven years 2005 to 2011. This is sometimes called cross-section time-series data because it combines both cross-sectional data and time series data in the observation.

3.2. Research Methods

This study employed quantitative research method which involves the generation of data in quantitative form and subjected to rigorous quantitative analysis in a formal rigid fashion (Kothari, 2004). The quantitative analysis techniques used are panel (*fixed-effects & random-effects*) and cross-sectional regression techniques.

However, this study basically used fixed-effects and random-effects model in order to eliminate endogeneity problem in the panel observation which may have been caused by unobserved variable which might have correlated with regressor and residual i.e error term. For instance education quality which could enhance skills and performance for productivity and economic growth were not observed in this study's model. However, the use of *pooled OLS model* estimation may be inconsistent and bias as it assumes that the intercepts are the same for all the countries. Thus, deny the heterogeneity or individuality effect that may exist among the countries in the panel observation.

Meanwhile, *fixed-effects model* allows for heterogeneity or individuality effects among countries in the panel observation and hence each has its own intercept value. It accounts for the fact that though intercept may differ across countries but does not vary over time. *Random-effects model* also identify time-invariant effects but with common intercept value which resulted to a very important assumption upon which random-effect approach could be consisted and free from bias estimation.

3.3. Models Specifications

This study empirically employed Mankiw, Romer and Weil human capital model as human capital was included in the aggregate neo-classical Cobb-Douglas production functions stated below (as cited in L'Angevin and Laïb (2005)):

$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta}$

where Y, K, H, L respectively total output, physical capital, human capital and labour, α and β the partial elasticity of production with respect to the two forms of capital, A Harrod-augmenting technical progress and t time and $\alpha + \beta < 1$.

The above model can be re-written as simple production function with technical progress A treated as endogenous variable (Dewan and Hussein, 2001):

$Y = f(K, H, L, A)$

Hence, two separate econometric functions could be derived from equation 3.8 by substituting human capital variables of interest. The first econometric function by substituting first set of human capital proxy is as follows:

$$GDP = f(GFC, INFR, EDINDX, HEINDX, HEX, HTECH)$$

The second econometric function after incorporating second set of human capital proxy (i.e school enrolment at all education level and life expectancy at birth):

$$GDP = f(GFC, INFR, PRYSE, SSE, TSE, LEXP, HEX, HTECH)$$

Where ***GFC*** is gross fixed capital formation, ***(PRYSE, SSE, and TSE)*** are primary to tertiary school enrolments, ***INFR***- infrastructure, ***HTECH***- high-tech innovation, ***LEXP***- life expectancy, ***HEX***-health expenditure, ***EDINDX***-education index and ***HEINDX***– health index.
Equation *** and *** can be represented in econometric models form respectively as follows:
Panel a specification:

$$lnGDP_{it} = \beta_0 + \beta_1 GFC_{it} + \beta_2 INFR_{it} + \beta_3 EDINX_{it} + \beta_4 HEINDX_{it} + \beta_5 HEX_{it} + \beta_6 HTECH_{it} + \cdots + \varepsilon_{it}$$

Panel B specification:

$$lnGDP_{it} = \beta_0 + \beta_1 GFC_{it} + \beta_2 INFR_{it} + \beta_3 PRYSE_{it} + \beta_4 SSE_{it} + \beta_5 TSE_{it} + \beta_6 LEXP_{it} + \beta_7 HEX_{it} + \beta_8 HTECH_{it} + \cdots + \varepsilon_{it}$$

Where $\boldsymbol{lnGDP_{it}}$ represent natural log of gross domestic products for ***i*** individual country at specific ***t*** time period and $\boldsymbol{\varepsilon_{it}}$ is error term. All other variables remain as described in previous page.

However, the above two separate panel models (using fixed-effects and random-effects regression techniques) for both developing and developed countries were subjected to econometric analysis. The **Hausman test** then applied in order to compare and choose appropriate and efficient estimate between fixed-effects and random-effects in each of the model category (Dewan and Hussein, 2001; Tvartani, 2007).

A cross section analysis was also carried out for both developing and developed countries for the last four years of the sample years (i.e 2008-2011) in order to examine the efficacy of cross section regression technique and panel regression technique. These two methods had been used in a number of literatures earlier cited in this study.

4. Analysis and Interpretation of Research Findings

4.1. Descriptive Statistics Results

The descriptive statistics of both developing and developing countries are shown in Table 4.1 below. The number of panel observations (N) for both developing and developed countries are 239 and 243 respectively. The average GDP for both regions within the period observed (2005-2011) were USD$102.25 billion and USD$973.82 billion respectively. The standard deviation represents the variability of each data within the sample. It is a measure that is used to quantify the amount of variation or dispersion of a set of data values (Wikipedia, 2015). It explains how widely the values in a data set are spread around the mean. Hence, the larger the standard deviation, the more spread out the observation as shown in Table 4.1 below. In 2011 and 2005 Ukraine and Niger recorded maximum and minimum education index scores of 0.79 and 0.15 respectively in developing region. These are lower than those recorded in developed region as Australia and Saudi Arabia recorded 0.92 and 0.62 in 2009 and 2005 respectively.

Table-4.1. Descriptive statistics

	Developing countries					Developed countries				
Variables	**Mean**	**Std. Dev.**	**Max.**	**Min.**	**N**	**Mean**	**Std. Dev.**	**Max.**	**Min.**	**N**
GDP (USD$bn)	102.25	238.61	1326.24	0.82	239	973.92	2358.33	13816.14	6.81	243
EDINDX	0.53	0.15	0.79	0.15	239	0.82	0.06	0.92	0.62	243
HEINDX	0.71	0.13	0.91	0.40	239	0.90	0.05	0.97	0.79	243
PRYSE	103.88	16.23	149.95	50.04	239	102.28	4.75	118.43	91.02	243
SSE	64.37	26.90	101.32	10.10	239	104.05	10.34	147.62	84.71	243
TSE	24.72	19.30	79.25	0.49	239	66.98	16.23	113.98	10.33	243
LEXP	66.38	8.15	79.56	45.86	239	78.62	2.94	82.93	70.87	243
HEX	6.22	1.95	12.49	2.79	239	8.67	2.17	17.10	2.22	243
GFC	23.13	5.69	46.73	12.81	239	22.87	4.26	36.75	10.47	243
INFR	11.04	10.13	37.00	0.16	239	41.44	13.02	69.51	15.28	243
HTECH	6.71	10.44	70.79	0.00	239	14.56	9.36	60.66	0.26	243
FDI	5.00	4.53	27.52	-1.77	239	7.17	28.55	430.64	-16.15	243
TROP	80.46	32.84	203.83	33.11	239	92.98	46.75	349.85	24.77	243
TAX	43.74	14.17	112.90	8.10	239	43.69	16.95	107.40	14.50	243
NTR	10.44	12.63	68.36	0.00	239	3.84	9.92	64.77	0.00	243
LPOP	61.02	7.01	72.28	47.49	239	67.37	2.17	72.83	62.12	243

Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

In developing region, the maximum GDP of USD$1.326.24 trillion was recorded by India in 2011 while the minimum of USD$0.820 billion was recorded by Burkina Faso in 2007. However, in developed countries, the maximum GDP value of USD$13.816.14 trillion was recorded by United States in 2011 while the minimum GDP of USD$6.8 billion was recorded by Argentina in 2005.

4.2. Correlation Results

The correlation matrix in Table 4.2 A shows the level of correlation among the variables of interest for developing countries. It also helps to detect multicollinearity.

Table-4.2A. Correlation Matrix- Developing countries

VARIABLES	LOG(GDP)	EDINDX	HEINDX	PRYSE	SSE	TSE	LEXP	HEX	GFC	INFR	HTECH	FDI	TROP	TAX	NTR	LPOP
LnGDP	1.000															
EDINDX	0.325	1.000														
HEINDX	0.449	0.716	1.000													
PRYSE	0.072	0.309	0.158	1.000												
SSE	0.397	0.910	0.784	0.130	1.000											
TSE	0.339	0.805	0.686	0.008	0.779	1.000										
LEXP	0.449	0.734	0.998	0.154	0.798	0.708	1.000									
HEX	-0.370	0.031	0.016	-0.059	-0.066	0.160	0.013	1.000								
GFC	0.091	0.006	0.129	-0.050	0.110	0.016	0.134	-0.119	1.000							
INFR	0.272	0.748	0.684	0.013	0.777	0.766	0.694	0.183	0.028	1.000						
HTECH	0.244	0.057	0.007	-0.040	0.041	0.012	0.015	-0.118	-0.041	-0.023	1.000					
FDI	-0.190	0.232	0.134	-0.014	0.162	0.207	0.145	0.164	0.273	0.152	-0.056	1.000				
TROP	-0.332	0.495	0.307	0.052	0.426	0.365	0.319	0.162	0.089	0.318	-0.094	0.439	1.000			
TAX	0.269	-0.021	0.007	-0.086	0.083	0.052	0.004	-0.261	0.113	-0.059	-0.043	-0.198	-0.221	1.000		
NTR	0.126	0.057	-0.167	-0.157	0.085	-0.034	-0.152	-0.324	0.088	-0.100	0.012	0.113	-0.148	0.160	1.000	
LPOP	0.407	0.825	0.778	0.102	0.898	0.729	0.790	-0.084	0.159	0.787	-0.009	0.110	0.433	0.046	0.088	1.000

Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

However, secondary school enrolment and life expectancy are highly correlated with education index and health index with score index of 0.910 and 0.928 respectively. This is expected and does not constitute any multicollinearity problem as these variables were used in different models.

Table-4.2B. Correlation Matrix- Developed countries

VARIABLES	LOG(GDP)	EDINDX	HEINDX	PRYSE	SSE	TSE	LEXP	HEX	GFC	INFR	HTECH	FDI	TROP	TAX	NTR	LPOP
LnGDP	1.000															
EDINDX	0.083	1.000														
HEINDX	0.526	0.188	1.000													
PRYSE	0.244	-0.167	0.136	1.000												
SSE	0.096	0.471	0.331	-0.016	1.000											
TSE	0.088	0.520	0.074	-0.092	0.266	1.000										
LEXP	0.493	0.200	0.991	0.134	0.342	0.066	1.000									
HEX	0.536	0.307	0.495	0.121	0.203	0.236	0.492	1.000								
GFC	-0.135	0.071	-0.164	-0.194	0.070	0.141	-0.210	-0.225	1.000							
INFR	0.315	0.345	0.651	-0.037	0.294	0.142	0.653	0.567	0.010	1.000						
HTECH	0.147	0.347	0.323	-0.003	0.071	0.093	0.323	0.326	0.049	0.558	1.000					
FDI	-0.124	-0.080	-0.004	-0.086	-0.030	-0.273	0.007	-0.060	-0.056	0.067	-0.019	1.000				
TROP	-0.517	0.020	-0.308	-0.197	-0.082	-0.340	-0.266	-0.217	0.072	-0.090	0.008	0.459	1.000			
TAX	0.277	-0.077	-0.035	0.464	-0.113	0.166	-0.050	0.114	-0.055	-0.129	-0.176	-0.119	-0.280	1.000		
NTR	-0.027	-0.381	-0.183	-0.090	-0.069	-0.336	-0.189	-0.428	-0.116	-0.424	-0.296	-0.031	-0.108	-0.235	1.000	
LPOP	-0.258	0.084	-0.313	-0.144	-0.206	0.090	-0.319	-0.186	0.392	-0.226	0.045	0.035	0.374	-0.221	-0.179	1.000

Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

As mentioned above, the same applicable to developed countries as life expectancy and health index are highly correlated with 0.991. Apart from these, there is no incident of other independent variables being highly correlated with another which to some extents, indicate no multicollinearity problem.

4.3. Analysis of Panel Regression Results

Table 4.3 shows the Panel A results where education index and health index (as described in Table 3.1) were used human capital proxy for both developing and developed regions. The pooled OLS regression results in column 1 for both regions indicate that the model is not fit enough as a result of R square of 0.2299 and 0.3991 respectively. This means that only 23% and 40% variations in GDP can be explained by independent variables of both regions respectively. However, the F statistic test of 18.71 and 31.999 shows that all the predictors in the models jointly influenced GDP by 19% and 32% in both developing and developed regions respectively. Also, the linear relationship between GDP and all the predictors in the model are entirely significant (at P-value<0.01). Although, Durbin Watson test result was very low but this may be due to small sample years.

Table-4.3. Panel A: Summary of Panel Regression (Using Human Capital Index)

	without control variables				with control variables	
	Model 1		Model 2		Model 3	
	Pooled OLS		Fixed-effects		Fixed-effects	
Dependent variable: lnGDP	**Developing**	**Developed**	**Developing**	**Developed**	**Developing**	**Developed**
Constant	22.1311**	8.9954**	19.6848**	19.9087**	17.5823**	18.1505**
	(0.6751)	(2.2314)	(0.1655)	(0.5043)	(0.3505)	(0.5616)
Regressors:						
GFC	-0.0239	0.0217	-0.0007	0.0090**	0.0027*	0.0079**
	(0.0136)	(0.0188)	(0.0012)	(0.0010)	(0.0012)	(0.0009)
INFR	-0.0106	-0.0163	0.0125**	0.0002	0.0083**	0.0002
	(0.0137)	(0.0091)	(0.0023)	(0.0009)	(0.0022)	(0.0008)
HTECH	0.0356**	-0.0267**	0.0015	-0.0001	0.0013	-0.0005
	(0.0072)	(0.0075)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
EDINDX	1.9020*	0.3015	1.9222**	1.6554**	1.3324**	1.1816**
	(0.8396)	(1.3447)	(0.269)	(0.2855)	(0.2533)	(0.2756)
HEINDX	3.2586**	16.6002**	4.2933**	5.4299**	3.6198**	4.9530**
	(0.8745)	(2.3825)	(0.3353)	(0.6944)	(0.3068)	(0.6727)
HEX	-0.2088**	0.3037**	-0.0156**	-0.0268**	-0.0198**	-0.0209**
	(0.0434)	(0.0451)	(0.0062)	(0.0065)	(0.0057)	(0.0064)
						Continue

					-0.0018	-0.0001
FDI					(0.0013)	(0.0001)
					-0.0004	-0.0014
TAX					(0.0007)	(0.0009)
					-0.0008	0.0002
TROP					(0.0005)	(0.0003)
					-0.0002	0.0016
NTR					(0.0011)	(0.0014)
					0.0500**	0.0400**
LPOP					(0.0063)	(0.0047)
R-squared	0.2299	0.3991	0.9988	0.9995	0.9990	0.9996
Durbin-Watson Test	0.0279	0.0207	0.5298	0.6848	0.6056	0.8529
Observation	383	296	383	296	377	282
F-statistic	18.7132	31.9925	3808.402	9784.497	4311.123	10650.420
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hausman Test			14.2620	21.1045	67.3743	40.1130
Prob.			0.0268	0.0018	0.0000	0.0000

Notes: The standard errors are in parenthesis,**and* indicate significant at p<0.05 respectively; see appendix I for the results of random-effects as compared with fixed-effects using Hausman test above.
Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015

Meanwhile, there is positive relationship between human capital proxy by education and health index in both developing and developed regions as shown in Figure 4.1. However, the causal effects relationship results and level of significance are shown in Table 4.3. In developing region, the results shows that for every 1% point increase in education and health performance index, GDP correspondingly increases by 19.0% and 32.6% points at (P-value<0.05) and (P-value<0.01) respectively. Moreover, education index had positive effect on GDP in developed region but not significant. However, coefficient of health index in developed region is far higher than that of developing region with every 1% point increase in health performance index, the GDP increases by 16.60 point (at P-value<0.01).

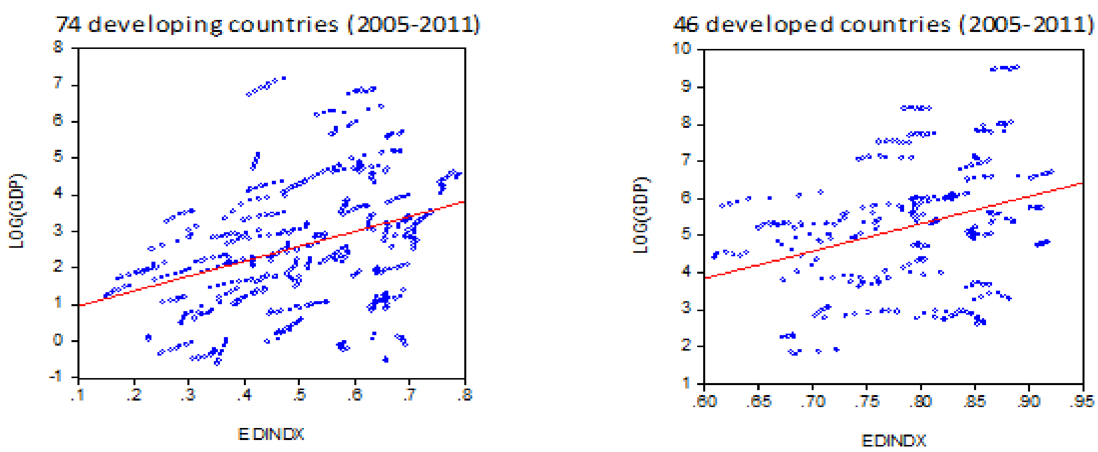

Figure-4.1. Relationship between GDP and education index
Source: Author's research outputs from pooled cross-country regression via E-Views (2015)

However, there is negative relationship between GDP and health expenditure in developing region within 7 years panel observation while this relationship was positive in developed region as shown in Figure 4.2 below. The same relationship exists when school enrolments and life expectancy were used as human capital proxy (See appendix III and IV).

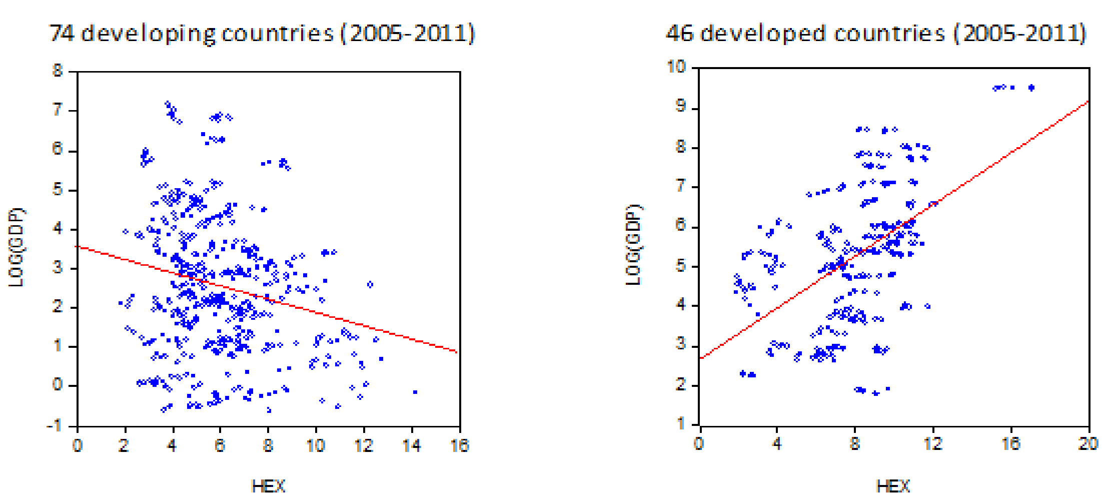

Figure-4.2. Relationship between GDP and Health expenditure (% of GDP)
Source: Author's research outputs from pooled cross-country regression via E-Views (2015)

However, Table 4.3 shows causal effect results and level of significance of the relationship depicted in Figure 4.2 above. For developing region, GDP decreases by 20.8% point for every 1% point increase in health expenditure (at P-value<0.01) while for developed region, GDP increases by 30.37% point for every 1% point increase in health expenditure (at P-value<0.01). The physical capital proxy by gross fixed capital formation and other allied physical capital such as telecommunication infrastructure had negative effects on GDP in developing region while only infrastructure exerts negative effects on GDP in developed region as shown in Table 4.3 above. However, these effects are not significant in both regions. Meanwhile, Innovation and high technology advancement proxy by high-tech manufacturing exports had effect on GDP but the effect was positive in developing region while it was negative in developed region.

Meanwhile, these pooled OLS regression results may not be consistent as it fails to recognise country specific effects by treating countries in the panel observation as same. Hence, having applied Hausman test, fixed efects results were found appropriate as shown in column 2 and 3 of Table 4.3 with R square of 0.99 indicating that 99% variations in GDP can be explained by predictors and confirm the fitness of the model. F- statistic also indicates that all predictors in the model are jointly influence GDP at 1% significance level. Contrary to pooled OLS results, both education and health performance index positively and significantly influence GDP in developing region with every 1% point increase in both human capital index GDP correspondingly increases by 19.2% point and 42.9% point (at P-value<0.05). The explanatory power of education performance index for developed region increase contrary to pooled OLS results, with every 1% point increase, GDP also increases by 16.6% point (at P-value<0.01). Health performance index still retained its positive and significant effects on GDP for both regions while health expenditure still having negative and significant effects on GDP in both regions.Gross fixed capital formation became significant (at P-value<0.01) in developed region from fixed effects model results and the effect is positive indicating that GDP increases by 0.9% point for every 1% point increase in gross fixed capital formation. However, in developing region, the relationship was not significant and the effect is negative.

However, after controlling for FDI, tax, trade openness, natural resources and population with working age (15-65 years), the effects of education index, health index, gross fixed capital formation on GDP remain positive and significant in both regions. Health expenditure's negative and significant effects remain the same in both regions. As expected tax exerts negative effect on GDP in both regions but not significant. Population of age 15-65 years also have positive and significant effects on GDP in both regions.

Table 4.4 below shows results of Panel B where human capital is proxy by primary, secondary and tertiary school enrolment and life expectancy. It comprises of pooled OLS, random effects, and fixed effects models for both developing and developed regions.

Table-4.4. Panel B: Summary of Panel Regression (Using school enrollment & life expectancy)

	without control variables				**with control variables**	
	Model 1		**Model 2**		**Model 3**	
	Pooled-OLS		**Random-effects**	**Fixed-effects**	**Fixed-effects**	
Dependent variable: lnGDP	**Developing**	**Developed**	**Developing**	**Developed**	**Developing**	**Developed**
Constant	19.7950** (1.1361)	-0.3244 (3.3637)	18.0603** (0.3913)	21.701** (0.5014)	16.471** (0.5163)	19.986** (0.6361)
Regressors:						
GFC	0.0034 (0.0154)	0.0500 (0.0210)	0.0020 (0.0014)	0.0137** (0.0013)	0.0047** (0.0015)	0.0114** (0.0012)
INFR	-0.0003 (0.0154)	-0.0129 (0.0101)	0.0107** (0.0030)	0.0009 (0.0009)	0.0061* (0.0029)	-0.0002 (0.0009)
HTECH	0.0332** (0.0082)	-0.0335** (0.0091)	0.0026** (0.0009)	-0.0024** (0.0008)	0.0018* (0.0009)	-0.0011 (0.0008)
HEX	-0.3525** (0.0481)	0.3568** (0.0507)	-0.0094 (0.0075)	-0.0055 (0.0066)	-0.0096 (0.0070)	0.0085 (0.0067)
PRYSE	0.00451** (0.0054)	0.0646** (0.0181)	-0.0001 (0.0013)	0.0081** (0.0017)	0.0008 (0.0014)	0.0057** (0.0016)
SSE	-0.0162** (0.0064)	-0.0147 (0.0091)	0.0011 (0.0013)	-0.0002 (0.0010)	0.0009 (0.0013)	-0.0006 (0.0010)
TSE	0.0274** (0.0076)	0.0074 (0.0053)	0.0070** (0.0014)	0.0054** (0.0007)	0.0025 (0.0014)	0.0044** (0.0007)
LEXP	0.0867** (0.0182)	0.2256** (0.0411)	0.0796** (0.0062)	0.0384** (0.0064)	0.0658** (0.0063)	0.0249** (0.0068)
FDI					0.00006 (0.0016)	-0.00003 (0.0001)
TAX					-0.0011 (0.0010)	-0.0029* (0.0012)
TROP					-0.0011 (0.0006)	0.0013** (0.0004)
NTR					0.0008 (0.0014)	0.0017 (0.0018)
LPOP					0.0452** (0.0079)	0.0475** (0.0065)
R-squared	0.4115	0.4314	0.6598	0.9995	0.9992	0.9996
Durbin-Watson Test	0.0579	0.0340	0.5537	0.9988	0.7915	1.0016
Observation	244	253	244	253	239	243
F-statistic	20.5359	23.1447	56.9601	9132.276	3329.835	9676.342
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hausman Test			14.7941	26.5473	41.8944	50.2677
Prob.			0.0633	0.0008	0.0001	0.0000

Notes: The standard errors are in parenthesis; ** and * indicate significant at p≤0.01 and p≤0.05 respectively; see appendix II for the results of random-effects as compared with fixed-effects using Hausman test above.

Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

The pooled OLS regression in column 1 revealed that physical capital proxy by gross fixed capital formation and telecommunication infrastructure does not have significant effect on GDP in both developing and developed regions. Meanwhile, life expectancy exerts significant and positive effect on GDP in both developing and developed regions. Innovation and technological advancement proxy by high-tech manufacturing exports have significant effects on GDP in both regions but the effect is negative for developed world while it proves positive in developing region. Only primary school enrolment was significant and had positive effect on GDP in developed region while enrolment from primary to tertiary school turn significant in developing region but secondary school enrolment influences GDP negatively. However, the panel regression results in column 2 and 3 having applied Hausman test revealed that random effect estimate is appropriate for developing region meaning that country specific effects associated with unobserved variables are not correlated with error terms. Meanwhile, fixed effect estimate proves appropriate in the case of developed region. Exactly like result in Panel A, gross fixed capital formation had positive and significant effect on GDP in developed region while it is not significant in developing region but infrastructure exerts positive effect in both regions. However, this effect was significant in developing region but not significant in developed region. Moreover, contrary to OLS results, primary and tertiary school enrolments in developed region were significant (at P<0.01) and influence GDP positively while only primary enrolment had positive and significant relationship with GDP in developing region. Meanwhile, having controlled for tax, FDI, trade openness, natural resources and population, none of the human capital development proxies had significant effects on GDP in developing region except life expectancy. However, primary and tertiary school enrolments as well as life expectancy still exert positive and significant effect on GDP (at P<0.01) in developed region. The explanatory power of physical capital in developing region also increased as it influences GDP significantly and positively. As expected, tax exerts negative effects on GDP in both regions but significant (at P<0.05) in developed region.

4.4. Analysis of Cross-Section Regression Results

Table 4.5 below presents the results of single cross section regression of developing region from 2008 to 2011. Only health expenditure proves significant with negative effects in all the four years of analysis even when school enrolments and life expectancy were used as proxy for human capital development.

Table-4.5. Single Cross-Section Regression Results: Developing Countries (2008 - 2011)

	Using Human Capital Index				Using School Enrolment & Life Expectancy			
Dependent Variable: lnGDP	**2008**	**2009**	**2010**	**2011**	**2008**	**2009**	**2010**	**2011**
Constant	21.7913**	22.5605**	22.0119**	22.2335**	20.2314**	21.8019**	19.6615**	22.2215**
	(1.88756)	(2.0351)	(1.9765)	(2.0718)	(3.4087)	(3.8226)	(3.6000)	(3.5736)
Regressors:								
GFC	-0.0175	-0.0136	0.0075	-0.0136	0.0101	-0.0028	0.0138	-0.0269
	(0.0377)	(0.0371)	(0.0399)	(0.0376)	(0.0471)	(0.0434)	(0.0448)	(0.0436)
INFR	-0.0063	-0.0059	-0.0185	-0.0434	0.0098	-0.001	-0.0468	-0.0635
	(0.0406)	(0.0387)	(0.0367)	(0.0391)	(0.0509)	(0.050)	(0.0426)	(0.0495)
HTECH	0.0353	0.0392	0.0487*	0.0389	0.0317	0.0251	0.0683	0.0442
	(0.0241)	(0.0209)	(0.0245)	(0.0243)	(0.0254)	(0.0224)	(0.0385)	(0.0327)
EDINDX	1.3673	2.3027	2.5521	4.4508				
	(2.4000)	(2.4027)	(2.3694)	(2.7223)				
HEINDX	3.7064	2.6245	2.3094	2.0882				
	(2.4795)	(2.4058)	(2.4344)	(2.6200)				
PRYSE					0.0043	0.0036	0.0192	-0.0071
					(0.0180)	(0.0170)	(0.0148)	(0.0162)
SSE					-0.0137	-0.0133	-0.0142	-0.0090
					(0.0213)	(0.0199)	(0.0191)	(0.0208)
TSE					0.0203	0.0282	0.0381	0.0501*
					(0.0215)	(0.0213)	(0.0216)	(0.0236)
LEXP					0.0731	0.0713	0.0711	0.0789
					(0.0605)	(0.0608)	(0.0557)	(0.0608)
HEX	-0.1718	-0.2730*	-0.2255*	-0.2857*	-0.3116*	-0.4436**	-0.3984**	-0.3903**
	(0.1238)	(0.1191)	(0.1089)	(0.1176)	(0.1519)	(0.1558)	(0.1234)	(0.1407)
R-squared	0.2460	0.2821	0.2651	0.2706	0.3823	0.4518	0.5248	0.4710
Durbin-Watson Test	2.1817	2.2482	2.2967	2.2734	2.7202	2.4576	1.8630	2.0628
Observation	72	72	73	72	71	71	70	69
F-statistic	2.5550	3.0776	2.8853	2.9067	1.9341	2.5756	3.5891	2.8935
Prob.	0.0318	0.0127	0.0175	0.0171	0.0992	0.0335	0.0062	0.0190
Serial Correlation LM Test	3.8613	3.1438	3.9081	0.2243	0.3841	1.1717	3.8144	0.0000
Prob.	0.1451	0.2077	0.1417	0.8939	0.8253	0.5566	0.1485	1.0000
Heteroskedasticity Test:	6.6874	4.9726	4.7413	7.1582	5.7876	4.9789	2.7994	13.5164
Prob.	0.3507	0.5473	0.5774	0.3065	0.6710	0.7598	0.9463	0.0953
Jarque-Bera Normality Test	1.4112	1.5081	1.3281	0.2243	2.7285	1.1315	0.8866	0.0581
Prob.	0.4938	0.4705	0.5148	0.8939	0.2556	0.5679	0.6442	0.9714

Notes: The standard errors are in parenthesis; ** and * indicate significant at p≤0.01 and p≤0.05 respectively
Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

Table-4.6. Single Cross-Section Regression Results: Developed Countries (2008 - 2011)

	Using Human Capital Index				Using School Enrolment & Life Expectancy			
Dependent Variable: lnGDP	**2008**	**2009**	**2010**	**2011**	**2008**	**2009**	**2010**	**2011**
	9.1455	8.7314	6.3571	7.8401	1.7516	-0.8375	-5.6607	-2.4584
Constant	(5.8693)	(6.0616)	(6.1790)	(6.2210)	(9.3088)	(10.0620)	(10.1133)	(10.4566)
Regressors:								
	-0.0749	0.101	0.1442*	0.1303*	-0.0600	0.1052	0.1536	0.1181
GFC	(0.0576)	(0.065)	(0.0643)	(0.0635)	(0.0816)	(0.0769)	(0.0683)	(0.0675)
	-0.0401	-0.02	-0.0211	-0.0183	-0.0319	-0.0164	-0.0222	-0.0035
INFR	(0.0271)	(0.0261)	(0.0244)	(0.0239)	(0.0326)	(0.0332)	(0.0278)	(0.0273)
	-0.0310	-0.0219	-0.0125	-0.0214	-0.0431	-0.0138	-0.0232	-0.0465
HTECH	(0.0211)	(0.0232)	(0.0222)	(0.0247)	(0.0274)	(0.0375)	(0.0286)	(0.0347)
	1.4511	-1.3539	1.7812	0.2188				
EDINDX	(3.7400)	(3.7269)	(3.9726)	(4.2631)				
	19.3489**	15.1497*	14.1087*	14.7233*				
HEINDX	(6.3318)	(6.8698)	(6.6087)	(6.5096)				
					0.0358	0.0464	0.0978*	0.1222*
PRYSE					(0.0493)	(0.0506)	(0.0481)	(0.0541)
					-0.0240	-0.0220	-0.0057	-0.0070
SSE					(0.0285)	(0.0265)	(0.0238)	(0.0219)
					0.0225	-0.0094	-0.0008	-0.0125
TSE					(0.0165)	(0.0182)	(0.0138)	(0.0163)
					0.2817*	0.2543*	0.2100	0.1551
LEXP					(0.1141)	(0.1256)	(0.1264)	(0.1278)
	0.2875*	0.4211**	0.4078**	0.3606**	0.3574*	0.4076**	0.4239**	0.4354**
HEX	(0.1275)	(0.1301)	(0.1172)	(0.1153)	(0.1597)	(0.1445)	(0.1279)	(0.1293)
R-squared	0.4520	0.4804	0.5194	0.4951	0.5077	0.4758	0.5600	0.5301
Durbin-Watson Test	1.2579	1.2178	1.2533	1.3944	1.4457	1.2822	1.2305	1.3151
Observation	43	42	41	40	36	34	36	36
F-statistic	4.9491	5.3924	6.1250	5.3925	3.4802	2.8363	4.2950	3.8080
Prob.	0.0009	0.0005	0.0002	0.0006	0.0070	0.0218	0.0020	0.0041
Serial Correlation LM Test	3.6433	3.0216	1.8171	0.1892	0.0000	0.0000	0.0000	0.0000
Prob.	0.1618	0.2207	0.4031	0.9097	1.0000	1.0000	1.0000	1.0000
Heteroskedasticity Test:	10.2379	7.0215	4.0836	5.4857	3.8392	6.5361	2.1393	6.3138
Prob.	0.1150	0.3189	0.6654	0.4832	0.8713	0.5874	0.9764	0.6121
Jarque-Bera Normality Test	1.0906	1.7983	2.1214	1.0857	1.8091	1.1823	2.5430	1.4448
Prob.	0.5797	0.4069	0.3462	0.5811	0.4047	0.5537	0.2804	0.4856

Notes: The standard errors are in parenthesis; ** and * indicate significant at p≤0.01 and p≤0.05 respectively;
Source: Author's research outputs via E-Views 7 using World Bank (WDI) and UNDP (HDI) data (2015)

However, Table 4.6 below presents cross section regression results of developed region where health performance index and primary school enrolment were found to be significant (at P<0.05) and exert positive effects on GDP in 2011. There is also positive and significant relationship between health expenditure and GDP in 2011. Meanwhile, different statistical tests were carried out in order to ensure that the above cross section regressions are free from error and bias. Hence Breusch Godfrey serial correlation LM test shows that no serial correlation exist (at p-value>0.05). Jarque-Bera normality test also confirmed that errors are normally distributed with (p-value>0.05). Heteroskedasticity test also informed that there is no standard errors bias which could render t-statistics or F-statistics useless. It is a situation whereby the variability of a variable is unequal across the range of values of a second variable that predicts it Taylor (2013). However, based on the above analysis, it can be concluded that human capital development in form of quality health status measured by life expectancy index and basic primary education had been the catalyst behind economic growth in developed region throughout the four years. Meanwhile, only health expenditure had significant effect on GDP in developing region and this effect was negative while it was positive in developed region but this could be due to corruption in health sector of developing region.

4.5. Discussion, Comparison and Implication

4.5.1. Physical Capital

The discussion and comparison are based on panel results. It could be observed from Table 4.3 that the results of fixed effects estimates having acknowledged endogeneity problem shows that GDP increases by 0.91% point for every 1% point increase in gross fixed capital formation (at P-value<0.01) in developed region[2]. The cross-section regression result in Table 4.6 showed that gross fixed capital formation had positive and significant effects on GDP of developed countries in 2010 and 2011 (at P-value<0.05) when HDI was used as human capital proxy.

However, it was negative effect in developing region with GDP declined by 0.07% point but not significant. This could be attributed to mismatch between capital requirement and saving capacity as well as low rates of investment in terms of physical capital in developing regions (Appleton and Teal, 1999; Roy and Mandal, 2012). Meanwhile, after controlling for FDI and other growth determinants as shown in Table 4.3 gross fixed capital formation in developing region turns positive (at P-value<0.05) while this remains positive and significant (at P-value<0.01) in developed region.

However, when school enrolments were used as proxy for human capital in Table 4.4 gross fixed capital formation in developed region remains positive and significant even after controlling for other growth determinants variables while it was not significant in the case of developing region until when FDI and other determinants were introduced into the model. The implication is that domestic investment is not sufficient enough for economic growth

[2] See the findings from EU and OECD countries in Son, Noja, Ritivoiu and Tolteanu (2013). and Queirós and Teixeira (2014). respectively. Murthy and Chien (1997). Also found that physical capital measured by real investment ratio to real GDP plays a significant role in economic growth of OECD countries if complements with technology know-how.

in developing region compare to developed region due to poor savings unless other growth factors are taken into account. This means there is need to mobilise capital from other source such as FDI as Mallick and Moore (2006) found positive complementary effects of FDI and domestic capital formation on GDP per capita in 18 Latin American countries regardless of income group.

4.5.2. Telecommunication Infrastructure and High-Tech Exports

The results in column 2 and 3 from Table 4.3 and 4.4 revealed that infrastructure development in terms of ICT facilities and innovative technology advancement proxy by high technology manufacturing exports were positively and significantly influence GDP in developing region. This could be attributed to the speed of adopting technology from abroad through FDI (Benhabib and Spiegel, 1994). Technology externalities and knowledge spillover through FDI had made infrastructure and innovation technology development contribute immensely to economic growth in developing region (Luiz and Mello, 1999).

However, in developed region, results in column 2 and 3 from Table 4.3 and 4.4 revealed that telecommunication infrastructure and high technology manufacturing had negative effects on GDP in developed region but not significant. The implication is infrastructure and technology advancement are not driving force behind economic growth in this region within the period observed even after controlling for other growth determinants. This could be attributed to the concept of diminishing return to capital going by most neo-classical theories indicating that developed countries tends to benefit at earlier stage of infrastructure development in terms of contribution to economic growth. Datta and Agarwal (2004) argued that this benefit becomes less significant as telecommunications infrastructure is more developed.

4.5.3. Human Capital Development (Education and Health Capital)

The results in column 2 and 3 from Table 4.3 shows that education and health index as proxy for human capital development exhibit positive and significant effects on GDP in both regions though the beta value of health index for developed region is higher than developing region by average 1.2 points. This implies that there is more commitment to health and wellness of human capital in developed region compare to developing region. This consistent with the findings of number of growth literatures in developed countries (Gyimah-Brempong and Wilson, 2004; Ecevit, 2013; Şen *et al.*, 2015).

Meanwhile, health expenditure exhibits significant inverse relationship with GDP in both regions and from the entire panel results (both Table 4.3 and 4.4). This could be attributed to corruption in health sector in developing region especially Africa (Agbenorku, 2012). However, the situation is different in developed countries as several literatures have attributed this adverse effect to higher proportion of national income as health expenditure on ageing labour force who might not be productive as the younger ones (Isabe and Poças, 2012; Churchill *et al.*, 2015)

Moreover, the results in column 2 and 3 from Table 4.4 confirm that human capital development through education contribute to economic growth in developed countries than developing countries. For instance, the results of model 2 from Table 4.4 show that commitments to primary and tertiary education in developed countries contribute about 0.8% and 0.5% points to GDP respectively for every 1% point increase in the enrolment rate at these two levels of education. Meanwhile, only tertiary school enrolment had positive and significant effect on GDP in developing countries with 0.7% point increase in GDP for every 1% point increase in number of potential human capital in tertiary institution. Similar results were again found in model 3 from Table 4.4 for both regions.

This study also identified concern about the choice of proxy for human capital in terms of education like other growth studies. For instance, Barro (1992) used school enrolment as flow of investment in human capital while student-teacher ratio was used as quality of education. Zaman (2012) criticised the use of school attainment and school enrolments as perfect proxy while he supports education quality measured by mathematics and science test score. Meanwhile, Wo ßmann (2003) supports the use of education attainment and average year of schooling while describing school enrolment as imperfect.

The above shows that there is no consensus yet on human capital measurement in economic growth literature and that is why this study uses different proxies. However, education index measured by mean years of schooling for adult aged 25 years plus (education attainment) and expected years of schooling showed positive and significant effects on GDP in both regions (see model 2 and 3 in Table 4.3). Although, the results of model 2 and 3 in Table 4.4 were quite different when school enrolments were used as proxy for human capital in terms of education. Only tertiary school enrolment had positive and significant impacts on GDP in developing countries while both primary and tertiary enrolment positively and significantly influence GDP in developed countries. The implication here going by school enrolment proxy's results, is that developing countries neglect primary education which is the foundation for any form of human capital development and that is why the qualities of university products in this region are not contributing enough to the economic growth because educational foundation in terms of primary school education is poor.

Meanwhile, when health index proxy and life expectancy were compared, the effect was positive and level of significant on GDP was same for both regions except the big coefficient exhibits by health index proxy (see Table 3.1 for the description of health index and life expectancy).

5. Conclusion and Recommendations

5.1. Conclusion

The objective of this paper is to examine how physical and human capital development had impacted the economic growth in developing and developed countries and what policy makers in both regions could do in order to make best use of these two resources (physical and human capital) for the economic growth.

However, the overall empirical results of this paper based on fixed effects outcome show that physical capital in terms of investment measured by gross fixed capital formation does not contribute to economic growth in developing countries unless other growth determinants such as FDI, trade openness, e.t.c are taken into account. However, gross fixed capital formation contributes positively and significantly to GDP in developed countries in all the models specified.

Meanwhile, Infrastructure and innovative technology prove positive and significant in developing countries than developed ones which had been attributed technology externalities and knowledge spillover through the speed of adopting technology from abroad via FDI (Benhabib and Spiegel, 1994; Luiz and Mello, 1999). This can also be related to catching up effect of convergence hypothesis of neo-classical Solow growth model of 1956.

It was also discovered that developing countries have only concentrated on developing human capital through tertiary education neglecting primary education which is the foundation for all levels of education. However, investment flow in basic and higher education proxy by primary and tertiary school enrolments were found positively and significantly contributing to GDP in developed countries. Meanwhile, health expenditure exerts negative and significant effects on GDP in both regions although a number of growth literatures have attributed these effects to the high proportion of government expenditure on ageing work force which manifest in high life expectancy especially in developed countries. This category of workforce might not be productive or resist innovation and change (Isabe and Poças, 2012; Churchill *et al.*, 2015).

5.2. Recommendations

In light of the findings of this research, efforts of the policy makers in developing countries should be geared towards improving primary and secondary education as these are foundations for higher education. There is possibility that poor primary education system could affect the products of secondary and later graduates from university making them not relevant or productive in the economy.

There is over reliance on investment from abroad in developing countries as this made gross fixed capital formation not significant until other factors like FDI and trade openness were taken into account. This investment from abroad in form of FDI and trade openness does not themselves impact GDP positively as shown in Table 4.3 and 4.4 (model 3). However, they does contribute indirectly by serving as conduit pipe through which technology flown into developing region coupled with improved infrastructure.

Meanwhile, it may look as if everything is well with the developed countries but this is far from the truth as there is need for developed countries to encourage knowledge and skills development among their nationals. More than half of the educated persons in developed countries like UK and USA acquired their doctorate and professional qualification in these countries and remain important part of labour force contributing to the economic growth of these countries (Dodani and LaPorte, 2012).

However, the argument above is that this has constituted brain drain as majority of these skilled and professional workers are foreigners from developing countries. This could also lead to brain gain in the long run as these foreign professionals might decide to return to their home country with all skills and technology know-how acquired to develop their countries. This again brings us back to convergence hypothesis through catching up effect of technology externalities and knowledge spillover as demonstrated by endogenous growth literatures (Romer, 1989; Romer, 1990; Benhabib and Spiegel, 1994; Luiz and Mello, 1999).

5.3. Limitations of the Study for Further Research

This research had faced data availability limitations like any other quantitative studies. The researcher however, still collect the available data that reasonably serve as alternative ones without grossly affected the overall research results.

- Data on important proxy for infrastructure like electricity (power) in developing countries are not available for huge number of countries. This forced researcher to use alternative one i.e telecommunication line (per 100 people) which has been widely used in growth literature (Datta and Agarwal, 2004; Mahyideen *et al.*, 2012; Sahin *et al.*, 2014)
- Data for research and development expenditure is very problematic to source for developing countries. This forced the researcher to use high-technology exports to measure innovation & technology advancement. This proxy has been described as export with high R&D intensity (WBDI, 2015). It has also been used in empirical literature (Kilavuz and Altay, 2012).
- This research employed cross-section regression to complement the results of within transformation fixed effects and random effects methods as Least Square Dummy Variable (LSDV) is practically difficult to use due to large number of countries involve in the panel observation. Though the degree of freedom is exhausted in within transformation method due to elimination of intercept but the results had been argued to be same with LSDV (Dougherty, 2012).

This research does not investigate convergence issue in either developing or developed regions as many growth studies have done in the past. It will be good if future research can take a look at the situation especially for the recent periods like the ones covered by this study.

Finally, quite numbers of recent growth literatures are now shifting attention from quantitative human capital proxy such as school enrolment to qualitative measure like mathematics and science test score (Zaman, 2012). Even old literature like Barro (1992) used student-teacher ratio as proxy for education quality. Hence, future growth research should include this proxy as measure of human capital quality.

References

Ada, A. and H. Acaroğlu, 2014. Human capital and economic growth: A panel data analysis with health and education for MENA region. Advances in Management & Applied Economics, 4(4): 59-71.

Adelakun, J., 2011. Human capital development and economic growth in Nigeria. European Journal of Business and Management, 3(9): 29-38.

Adhikary, B., 2011. FDI, trade openness, capital formation, and economic growth in Bangladesh: A linkage analysis. International Journal of Business and Management, 6(1): 16-28.

Agbenorku, P., 2012. Corruption in Ghanaian healthcare system: the consequences. Journal of Medicine and Medical Science-International Research Journal,, 3(10): 622-630. S., I. Chaudhry and F. Farooq, 2012. Human capital formation and economic growth in Pakistan. Pakistan Journal of Social Sciences, 2032(2011): 2229-2240.

Ali, S., I. Chaudhry and F. Farooq, 2012. Human capital formation and economic growth in Pakistan. Pakistan Journal of Social Sciences, 32(1): 229-240.

Appleton, S. and F. Teal, 1999. Human capital and economic development. Available from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/00157612-FR-ERP-39.PDF [Accessed 6 Jun. 2015].

Azat, D., 2014. GMM estimation and Shapiro-Francia normality test: A case study of CEE economies. International Journal of Economic Sciences, 3(1): 12-26.

Barro, R., 1992. Human capital and economic growth. Available from https://www.kansascityfed.org/publicat/sympos/1992/s92barro.pdf [Accessed 17 Aug. 2015].

Behname, M., 2012. Foreign direct investment and economic growth: Evidence from Southern Asia. Atlantic Review of Economics, 2(1). Available from http://www.unagaliciamoderna.com/eawp/coldata/upload/14_Foreign_Direct_Investment.pdf [Accessed 25 Jun. 2015].

Benhabib, J. and M. Spiegel, 1994. The role of human capital in economic development evidence from aggregate cross-country data. Journal of Monetary Economics, 34(2): 143-173.

Bloom, D., D. Canning and J. Sevilla, 2004. The effect of health on economic growth: A production function approach. World Development, 32(1): 1-13.

Borensztein, E., J.D. Gregorio and J. Lee, 1998. How does foreign direct investment affect economic growth? Journal of International Economics, 45(1): 115-135.

Churchill, S., S. Yew and M. Ugur, 2015. Effects of government education and health expenditures on economic growth: A meta-analysis. Monash Business School Discussion Paper, 40(15). Available from http://econstor.eu/bitstream/10419/110901/1/Human_Capital_Paper.pdf [Accessed 20 Aug. 2015].

Cu, G.O., S.H. Kim and P.A. Naga, 2013. ASEAN-5 countries: Panel data analysis on the impact of foreign direct investment, openness, and fixed capital formation on the economic growth. Academia. Available from https://www.academia.edu/4408795/ASEAN-5_countries_Panel_Data_Analysis_on_the_Impact_of_Foreign_Direct_Investment_Openness_and_Fixed_Capital_Formation_on_the_Economic_Growth.

Datta, A. and S. Agarwal, 2004. Telecommunications and economic growth: A panel data approach. Applied Economics, 36(15): 1649-1654.

Dewan, E. and S. Hussein, 2001. Determinants of economic growth panel data approach. Working Paper, 1(4): 1-51.

Ding, L. and K. Haynes, 2006. The role of telecommunications infrastructure in regional economic growth in China. Australian Journal of Regional Studies, 12(3): 281-302.

Dodani, S. and R. LaPorte, 2012. Brain drain from developing countries: How can brain drain be converted into wisdom gain? Journal of the Royal Society of Medicine, 98. Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1275994/pdf/487.pdf [Accessed 20 Aug. 2015].

Dougherty, C., 2012. Fixed effects regressions: LSDV method. London School of Economics and Political Science Learning Resources. Available from http://learningresources.lse.ac.uk/140/ [Accessed 20 Aug. 2015].

Ecevit, E., 2013. The impact of life expectancy on economic growth: Panel cointegration and causality analyses for OECD countries. International Journal of Social Sciences, 16(1): 1-14.

Eggoh, J., H. Houeninvo and G. Sossou, 2015. Education, health and economic growth in African countries. Journal of Economic Development, 40(1): 93-111.

Fayissa, B. and C. Nsiah, 2010. Can remittances spur economic growth and development? Evidence from Latin American countries (LACs). Department of Economics and Finance Working Paper Series. Available from http://econpapers.repec.org/paper/mtswpaper/201006.htm.

Gallo, C., 2002. Economic growth and income inequality: Theoretical background and empirical evidence. 9-13. Available from https://www.ucl.ac.uk/silva/bartlett/dpu/publications/.../WP119.pdf [Accessed 19 Jun. 2015].

Gyimah-Brempong, K. and M. Wilson, 2004. Health human capital and economic growth in Sub-Saharan African and OECD countries. Quarterly Review of Economics and Finance, 44(2): 296-320.

Idrees, A. and M. Siddiqi, 2013. Does public education expenditure cause economic growth? Comparison of developed and developing countries. Pakistan Journal of Commerce and Social Sciences, 7(1): 174-183.

Isabe, D.S.A. and A. Poças, 2012. The interrelations between health, human capital and economic growth. Empirical Evidence from the OECD Countries and Portugal. Tese De Doutoramento Em Economia, Apresentada à Faculdade De. Available from https://estudogeral.sib.uc.pt/bitstream/10316/23323/1/Tese%20Doutoramento%20Ana%20Pocas.pdf [Accessed 19 Aug. 2015].

Itagaki, Y., 1963. Criticism of rostow's stage approach: The concept of stage, system and type. Developing Economies, 1(1): 1-17.

Javed, M., S. Abbas, A. Fatima, M. Azeem and S. Zafar, 2013. Impact of human capital development on economic growth of Pakistan: A public expenditure approach. World Applied Sciences Journal, 24(3): 408-413.

Juma, M., 2012. The effect of foreign direct investment on growth in Sub-Saharan Africa. A Degree Thesis Submitted to Department of Economics, Amherst College, United States. Available from https://www.amherst.edu/media/view/434456/original/Juma,%20Mary-Ann%20Thesis.pdf.

Kilavuz, E. and T.B. Altay, 2012. Export and economic growth in the case of the manufacturing industry: Panel data analysis of developing countries. International Journal of Economics and Financial Issues, 2(2): 201-215.

Kothari, C., 2004. Research methodology: Methods and techniques. 2nd Edn., New Delhi: New Age International (P) Limited.

Kubík, R., 2010. Looking for the right human capital proxy. Review of Economic Perspectives, 10(2): 61-70.

L'Angevin, C. and N. Laïb, 2005. Education and growth in a panel of 21 OECD countries. Available from http://www.mtk.ut.ee/sites/default/files/mtk/dokumendid/9757fae6d1a6f3fd343b28526b50fe1f.pdf [Accessed 17 Aug. 2015].

Luiz, R. and D. Mello, 1999. Foreign direct investment-led growth: Evidence from time series and panel data. Oxford Economic Papers, 51: 133-151. Available from http://dept.ku.edu/~empirics/Courses/Econ915/papers/FDI_panel.pdf [Accessed 26 Jun. 2015].

Mahyideen, J., N. Ismail and L. Hook, 2012. A pooled mean group estimation on ICT infrastructure and economic growth in ASEAN-5 countries. International Journal of Economics and Management, 6(2): 360-378.

Mallick, S. and T. Moore, 2006. Foreign capital in a growth model. Review of Development Economics, 12(1): 1-23.

Mankiw, N., D. Romer and D. Weil, 1992. A contribution to the emprics of economic growth. National Bureau of Economic Research Series, 3541: 1-44. Available from http://eml.berkeley.edu/~dromer/papers/MRW_QJE1992.pdf [Accessed 24 Apr. 2015].

Middendorf, T., 2005. Human capital and economic growth in OECD countries. SSRN Journal. Available from http://repec.rwi-essen.de/files/DP_05_030.pdf [Accessed 20 Jun. 2015].

Murthy, V.N.R. and I.S. Chien, 1997. The empirics of economic growth for OECD countries: Some new findings. Economics Letters, 55(3): 425-429.

Ndambiri, H., C. Ritho, S. Ng'ang'a, P. Kubowon, F. Mairura, P. Nyangweso, E. Muiruri and F. Cherotwo, 2012. Determinants of economic growth in Sub-Saharan Africa: A panel data approach. International Journal of Economics and Management Sciences, 2(2): 18-24.

Nyandat, C., 2014. Models of growth and development. GAKSU: 1-4. Available from http://www.gaksu.com/allpdf/960_notes.pdf [Accessed 18 Jul. 2015].

Ogujiuba, K., 2013. The impact of human capital formation on economic growth in Nigeria. J Economics, 4(2): 121-132.

Okwuosa, O., 2015. A critical analysis of rostow's model of development. Academia: 20-23. Available from http://www.academia.edu/7468777/A_CRITICAL_ANALYSIS_OF_ROSTOWS_MODEL [Accessed 21 Jun. 2015].

Prados, D.L.E.L., 2005. European patterns of development in historical perspective? Economic History and Institutions Series, 10(10). Available from http://orff.uc3m.es/bitstream/handle/10016/419/wh057910.pdf?sequence=1 [Accessed 23 Jun. 2015].

Queirós, A. and A. Teixeira, 2014. Economic growth, human capital and structural change: An empirical analysis. FEP Economics and Management: 1-27. Available from http://wps.fep.up.pt/wps/wp549.pdf [Accessed 24 Jun. 2015].
Rafael, A. and T.B. De La, 2000. Endogenous growth, R&D and labour variety. Available from http://eprints.ucm.es/6702/1/0005.pdf [Accessed 20 Jul. 2015].
Ranis, G., F. Stewart and A. Ramirez, 2000. Economic growth and human development. World Development, 28(2): 197-219.
Röller, L. and L. Waverman, 2001. Telecommunications infrastructure and economic development: A simultaneous approach. American Economic Review, 91(4): 909-923.
Romer, P., 1989. Endogenous technological change. National Bureau of Economic Research Working Paper, 3210. Available from http://www.nber.org/papers/w3210.pdf [Accessed 20 Aug. 2015].
Romer, P., 1990. Endogenous technological change. Journal of Political Economy, 98(5). Available from http://www.jstor.org/stable/pdf/2937632.pdf?acceptTC=true [Accessed 20 Aug. 2015].
Rostow, W., 1960. The stages of economic growth: A non-communist manifesto. 3rd Edn., New York: Cambridge University Press. pp: 1-49.
Roy, S. and K. Mandal, 2012. Foreign direct investment and economic growth: A cross-country exploration in Asia using panel cointegration technique. Department of Economics, University of Calcutta, India: 1-30. Available from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiIt4eAwL3KAhWFPQ8KHVjKAY8QFgghMAA&url=https%3A%2F%2Feditorialexpress.com%2Fcgi-bin%2Fconference%2Fdownload.cgi%3Fdb_name%3DFEMES12%26paper_id%3D381&usg=AFQjCNFfcEEoxjq2Ua4lKNyyH_Iq3LPS4Q&sig2=5BuwWwuJka1uB8NwyG3XhA&bvm=bv.112454388,d.ZWU&cad=rja.
Sahin, O., N. Can and E. Demirbas, 2014. The effects of infrastructure determinants on economic growth: European union sample. Eurasian Journal of Business and Economics, 7(13): 11-27.
Schütt, F., 2003. The importance of human capital for economic growth. Institute for World Economics and International Management: 1-63. Available from http://www.iwim.uni-bremen.de/publikationen/pdf/W027.pdf [Accessed 24 Jun. 2015].
Şen, H., A. Kaya and B. Alpaslan, 2015. Education, health, and economic growth Nexus: A bootstrap panel granger causality analysis for developing countries. Economics Discussion Paper. School of Social Sciences, The University of Manchester. Available from http://www.socialsciences.manchester.ac.uk/medialibrary/economics/discussionpapers/EDP-1502.pdf.
Somayeh, H., M. Teymoor and S. Mina, 2013. Effect of health on economic growth: A panel data study of developed and developing countries. European Online Journal of Natural and Social Sciences, 2(3): 1273-1278.
Son, L., G. Noja, M. Ritivoiu and R. Tolteanu, 2013. Education and economic growth: An empirical analysis of interdependencies and impacts based on panel data. Timisoara Journal of Economics and Business, 6(19): 40-54.
Sridhar, K. and V. Sridhar, 2007. Telecommunications infrastructure and economic growth: Evidence from developing countries. Applied Econometrics and International Development, 7(2): 38-61.
Tatoğlu, F., 2011. The relationships between human capital investment and economic growth: A panel error correction model. Journal of Economic and Social Research, 13(1): 77-90.
Taylor, J., 2013. Confusing stats terms explained: Heteroscedasticity (Heteroskedasticity). Stats Make Me Cry. Available from http://www.statsmakemecry.com/smmctheblog/confusing-stats-terms-explained-heteroscedasticity-heteroske.html [Accessed 12 Aug. 2015].
Tiruneh, M. and M. Radvansky, 2007. The contribution of human capital to European economic growth: An empirical exploration from a panel data. Institute of Economic Research: 1-8. Available from http://ecomod.net/system/files/Tiruneh_Radvansky_Ecomod2011_1.pdf [Accessed 24 Jun. 2015].
Todaro, M. and S. Smith, 2011. Economic development. 11th Edn., Essex: Pearson Education Limited.
Tvartani, 2007. Fixed effects models and neighborhood studies vartanian: SW 541. Available from http://www.learningace.com/doc/345927/e46d32be0dfca8512c9b3b0db6c0e36e/fixed-effects-models1 [Accessed 15 Jun. 2015].
Wang, X. and J. Piesse, 2010. The microfoundations of dual economy models. Economics Discussion Paper Series, 10(10): 1-25.
WBDI, 2015. World bank. Available from http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS.
Wikipedia, 2015. Definition of standard deviation. Wikipedia. Available from https://en.wikipedia.org/wiki/Standard_deviation.
Wo ßmann, L., 2003. Specifying human capital. Journal of Economic Survey, 17(3): 239-270.
World Bank Development Indicator, 2015. World bank. Available from http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS.
World Economic Forum, 2013. The human capital report. Insight Report. Cologn/Geneva: World Economic Forum.
Zahra, K., P. Azim and A. Mahmood, 2009. Telecommunication infrastructure development and economic growth: A panel data approach. 1-22. Available from http://www.pide.org.pk/psde24/pdf/18.pdf [Accessed 22 Jun. 2015].
Zaman, M., 2012. Human capital and economic growth: An empirical investigation using panel data. Journal of Humanities and Social Science, 4(6): 43-56.

Bibliography

Alfaro, L., A. Chanda, S. Kalemli-Ozcan and S. Sayek, 2003. FDI and economic growth: The role of local financial markets. SSRN Journal. Available from http://econweb.umd.edu/~kalemli/jiefinal.pdf [Accessed 21 Jun. 2015].
Barberá, D.L.T.R., 2000. Endogenous growth, R&D and labour variety: 1-3. Available from http://eprints.ucm.es/6702/1/0005.pdf [Accessed 19 Jul. 2015].
Bhattacherjee, A., 2012. Social science research: Principles, methods, and practices. 1st Edn., Florida: Creative Commons Attribution-NonCommercial-ShareAlike.
Dawson, C., 2002. Practical research methods: A user-friendly guide to mastering research. 1st Edn., Oxford, United Kingdom: Baseline Arts Limited.
Domar, E., 1947. Expansion and employment. American Economic Review, 37(1): 34-55.
Dritsakis, N., E. Varelas and A. Adamopoulos, 2006. The main determinants of economic growth: An empirical investigation with Granger causality analysis for Greece. European Research Studies, 9(3-4). Available from http://www.ersj.eu/repec/ers/papers/06_34_p4.pdf [Accessed 27 Jul. 2015].
Emmanuel, O., V. Wujung and S. Emmanuel, 2014. Mechanisms of the influence of human capital on economic growth: A panel data analysis of the CEMAC region. Asian Economic and Financial Review, 4(5): 625-640.
Fields, G., 2004. Dualism in the labor market: A perspective on the lewis model after half a century. Manchester School, 72(6): 1-18.
Garrido, L., 2014. Pattern of development. A review of the literature for an empirical update. 1-3. Available from https://www.gtap.agecon.purdue.edu/resources/download/7030.pdf [Accessed 22 Jun. 2015].
Greener, S., 2008. Business research methods. 1st ed. [ebook] Bookboon. Available from http://bookboon.com/en/introduction-to-research-methods-ebook [Accessed 27 Jun. 2015].
Gyimah-Brempong, K. and M. Wilson, 2004. Health human capital and economic growth in Sub-Saharan African and OECD countries. Quarterly Review of Economics and Finance, 44(2): 296-320.
Harrod, R., 1939. An essay in dynamic theory. Economic Journal, 49(193): 14-33.
Hirota, Y., 2002. Reconsidering of the lewis model: Growth in a dual economy. Okayama University Economics Society Magazine, 34(1): 49-55.
Hox, J. and H. Boeije, 2005. Data collection, primary vs. Secondary. Encyclopedia of Social Measurement, 1. Available from http://www.joophox.net/publist/ESM_DCOL05.pdf [Accessed 30 Jun. 2015].
Ickes, B., 1996. Endogenous growth models. 1-26. Available from http://grizzly.la.psu.edu/~bickes/endogrow.pdf [Accessed 23 Jun. 2015].
Mankiw, N., D. Romer and D. Weil, 1990. A contribution to the emprics of economic growth. National Bureau of Economic Research Series, 3541: 1-44. Available from http://www.nber.org/papers/w3541.pdf [Accessed 24 Apr. 2015].

McCallum, B., 1996. Neoclassical vs. Endogenous growth analysis: An overview. 41-79. Available from https://www.richmondfed.org/~/media/richmondfedorg/publications/research/economic_quarterly/1996/fall/pdf/mccallum.pdf [Accessed 23 Jun. 2015].

Parr, J., 2001. On the regional dimensions of rostow's theory of growth. Review of Urban & Regional Development Studies, 13(1): 2-19.

Qian, J., 2014. Dealing with endogeneity. Available from http://jhqian.org/ec310/06endogeneity.pdf [Accessed 15 Jun. 2015].

Rajasekar, S., P. Philominathan and V. Chinnathambi, 2013. Research methodology. 2, 9. Available from http://arxiv.org/pdf/physics/0601009.pdf [Accessed 24 Jun. 2015].

Rostow, W., 1959. The stages of economic growth. Economic History Review, 12(1): 1-16.

Saunders, M., P. Lewis and A. Thornhill, 2009. Research methods for business students. 5th Edn., Edinburgh Gate, England: Pearson Education Limited. pp: 3,10, 34, 60, 108, 113, 137-138, 256.

Schmidheiny, K., 2014. Panel data: Fixed and random effects. Short guides to microeconometrics fall 2014, Unversity at Basel. Available from http://www.schmidheiny.name/teaching/panel2up.pdf [Accessed 15 Jul. 2015].

Schwab, K. and X. Sala-i-Martín, 2014. The global competitiveness report 2014–2015. Insight Report Geneva: World Economic Forum.

Söderbom, M., 2011. Econometric II lecture 6: Panel sata part I. Department of Economics, University of Gothenburg. Available from http://www.soderbom.net/metrix2/lec6_7.pdf [Accessed 15 Jun. 2015].

Vanm, D.B.H., 2013. Growth theory after keynes, part I: the unfortunate suppression of the harrod-domar model. Journal of Philosophical Economics, 7(1): 1-23.

Wallace, M. and A. Wray, 2011. Critical reading and writing for postgraduates. 2nd Edn., London: SAGE Publication Limited. pp: 178, 199.

Walliman, N., 2011. Research methods: The basics. 1st Edn., New York: Routledge.