EVADING LAW OF DIMINISHING RETURNS, A CASE OF HUMAN CAPITAL DEVELOPMENT

[1]Dr Noman Arshed, [2]Dr Hafeez ur Rehman , [3]Muneeba Nazim , [4]Asma Saher.

[1]Department of Economics
University of Management and Technology Lahore Pakistan
Email: noman.arshed@umt.edu.pk
[2]Department of Economics
University of Management and Technology Lahore Pakistan
Email: hafeez.rehman@umt.edu.pk
[3]Department of Economics
University of Management and Technology Lahore Pakistan
Email: muneebanazim1@gmail.com
[4]ORIC
University of Management and Technology Lahore Pakistan
Email: asma.saher@umt.edu.pk

ABSTRACT

For decades economic growth determinants have been the centre of attention among theoretical and development economists. Theoretical economists have built models of economic growth, while development economists were concerned about how these growth models behave in the long run. Previouslyresources were considered as an engine to growth, but they were prone to diminishing returns. The more recent models emphasized the role of knowledge augmented labor which may defy diminishing returns. For this, human capital is proposed as one of the main ingredients to economic growth as proposed by both neo-classical and new growth models. This studyanalyseswhether there is a precedence of the law of diminishing returns in sixty-six lower-income nations of the world.And determine whether the indicators of human capital index (HCI) can ease this diminishing return. The HCI is developed into four sub-indexes which are Capacity, Deployment, Development and Know-how. We used the robust OLS method to find how therefour sub-index of human capital work in this group of countries. The results show that the convergence hypothesishints atthe law of diminishing returns for sample countries. But by investing in human capital, or one of its sub-components, the intensity of diminishing returns will be eased.

Keywords: Law of Diminishing Returns, Developing Countries, Moderator Model, Cross-sectional Regression; Knowledge Based View

1. Introduction

In the recent era, the development and growth rate of nations is one of the foremost vital concerns of economists since it is not as it were approximate the individuals living standards, but it is additionally possessing superior political and societal position over distinctive nations (Milanovic & Squire, 2005). Beholding the USA might be a good case. The per capita GDP of USA upgraded nearly tenfold between 1870 to 1990. But in asimilar period, Africa's GDP expanded only threefold. This fast development made the US a superpower among nations. Recently, we can see this type of fast development and political movement among China and few other countries of the world. Indeed, the improvement of growth rates of newcomers like Taiwan and Korea and has made enthusiastic development economists desirous of establishing development models. Certainly, by increasing members of BRICs, the power of economic stability are fluctuating from the so-called G7.

Hence, the difference betweendeveloped underdeveloped and the driving force of development always attracts economists. So muchresearch hasbeen conducted to determine why few countries are wealthy whereas other nations are

underdeveloped, and what are the indicators that spur the development rate of nations to catch up to the developed nations. Can nations reach a stage where developed nations face the law of diminishing returns?

1.1. Law of Diminishing Returns

The economic convergence term is used when an underdeveloped economy reaches a higher level of growth like a developed economy by growing faster thanthe developed economy. Since 1980s, term convergence has been generally debated in the viewpoint of growthand productivity were established to describe development.The discussion on convergence came into sharp attention when the neoclassical growth models (NCGM) presented by (Solow, 1956) and were interrogated by (Romer, 1986). The notion of convergence was initially testing by Solow models. According to Solow, returns of production inputs are diminishing, and a nation converges to a steady-state of balanced capital. Of course, firstly, the convergence phenomenon was inside a country, and afterwards, it was stretched across nations.

According to the Solow model, in terms of GDP to meet the identical steady-state, underdeveloped nations grow faster than developed nations. It explains the unconditional convergence by the new growth theory. Hence for capital growth and increasing returns of inputs, rich nations should grow quicker.

1.1.1 Types of Convergence

Base theories are outlined for the convergence hypothesis, and it cannot be discussed without it. The two different types of convergence are defined in theeconomic literature:

1. **Absolute convergence (σ-convergence):**

This type of convergence talked about an identical growth path, which means that all nations grow to a similar point in the long run. The fact behind this phenomenon is that rich countries have a higher level of both types of capital, and that is why they have faced diminishing returns while low-income countries gain because they do not have too much capital they enjoy the "advantages of backwardness"(Todaro& Smith, 2011). Taiwan, China, and South Korea are the best examples that take advantage of these advantages and manage themto sustain the growth rate.

2. **Conditional convergence(β-convergence)**:
This type of convergence states that in the long-run, growth level converges to a specific path defined by countries' saving rates and population growth.Inthis type, the initial level of growth of a country is not important and negatively related toincome per person. The name of this convergence is conditional because it includes policy variables (propensity to save, population growth rate, technological progress, etc.). According to diminishing returns, rich countries diminish the gains from inputs as they exhaust more profitable production ventures.

1.2 analysis of convergence through growth models

Previous research studies sparingly discussed the convergence hypothesis. According to them, a nation starts its journey from an earlier industrial stage and become fully industrialize, then their norms, productivity and technological development become almost identical. Berkeley Professor of Economics, Clark Kerr of University of California (1960s), introduces Convergence theory in detail.

The development in growth models hascome over time. The first growth model used to test theconvergence hypothesis was (Solow, 1956; Swan, 1956) model of the neoclassical exogenous growth model (NCGM). However, later, Romer (1986) talked about the endogenous growth model (NGM) because of the limitations of this model according to empirical indication.Endogenous growth model consists of the Schumpeter evolutionary growth model and a fresher version of the NCGM as well. The R&D based model by (Jones, 1998) and the statement (R&D is important intensity instead of inputs and distance to frontiers) of (Aghion & Howitt, 1998) expanded the NGM. However, at the same time, the Schumpeterian framework and the neoclassical models ran parallel to each other.

1.3 Human Capitalas a potential source

In Neo-Classical and New growth models, there is a factor that plays an essential role is human capital. However, both these models take a different way to look at this factor. In the neoclassical growth models, human capital affects growth rate by entering into production function, and capital takesthe edge from this factor too.Whereas in the new growth models, it is a cause of technological alteration and technology transfer, and it can affect development through different

ways, such as innovation, imitation, R&D activities and global trade(Eberhardt & Teal, 2010; Ha &Howitt, 2007; Harris, 2011; Madsen, 2008).

Both per capita income and investment in individuals are related to each other. Knowledge is the best input, which means if we invest in education, it producesmagnified outcomes and returns of this input areup surgedas per (New Growth model). Romer studied the association between knowledge, technology and per capita income in different times. He aimed to check the return of knowledge and he concludes that this input hasa special characteristic that never diminishes the output and it creates positive externalities too, and no other input is rival of this (Romer, 1990)

Literature provides many definitions of human capital, but in simple people can make innovations and values, and it is a skill of the individual by which he competes with this global world. Just skills are not expressinghuman capital nor education because it possesses the quality of increasing return, so we say that it is dynamic thought rather than fixed(The Global Human Capital Report, 2017).

In development economics, a very clear theoretical contribution of human capital is present. However, empirical results have been varied. Different approaches like cross section, time series and panel data study are conducted on human capital. However, the outcomes diverse greatly under different types of conditions. Benhabib and Spiegel (1994) showedinsignificant results of human capital and others showingan inverse relationship between human capital and growth (Pritchett, 2001). These diverse explanations are because of proxy issues and wrong information. Another study quardictly relates education and income diversity, Asian nations are selected for study and estimate research by using panel cointegration, the result reveals negative relation between dependent and independent variablesat low levels (Arshed, Hassan&Bukhari, 2019).

In both empirical and theoretical research, human capital accumulation has been broadly identified as an engine of economic growth and development. We recognize the role of human capital in any country by that no nation has attained sustained economic development without substantial investment in human capital. Numerous researches have emerged to examine the channels through which human capital can influence economic growth (Barro & Salai-i-Martin, 1995; Temple, 1999). Much of these studies have stressed the complementary association between human and physical capital, observing how inequities in these two frameworks and human capital externalities can influence economic development. The highly educated, such as scientists and technicians, seem to benefit from understanding and familiarising fresh or existing notions into production procedures.Since above studies illustrate thathuman capital surge economic development is expected tocounter diminishing returns exogenously.

1.3.1   Measuring Global Human capital

Thereare four thematic dimensions from sub-indexes of the global human capital index shown in table 1. The most commonly used HC indicator is capacity only, but this research discus the capacity indicator of human capital and deployment, which covers employment and worker's presence and development, which is about skill and quality of education system and know-how shows the availability of skilled workers.

Table 1 Structure of the Global Human Capital Index

COMPONENT	INDICATOR
Capacity	Literacy and numeracy
	Tertiary education attainment rate
	Primary education attainment rate
	Secondary education attainment rate
Deployment	Labor force participation rate
	Underemployment rate
	Employment gender gap
	Unemployment rate
Development	Primary education enrolment rate
	Tertiary education enrolment rate
	Skill diversity of graduates
	Quality of primary schools
	Secondary education enrolment rate
	Extent of staff training
	Vocational education enrolment rate
	Quality of education system
	Secondary enrolment gender gap
Know-how	Availability of skilled employees
	Medium-skilled employment share
	Economic complexity
	High-skilled employment share

Source: The Global Human Capital Report (2017)

Education, health, sanitation, nutrition, or experience are different proxies used in different studies, but there was a need tomeasure human capital holistically. The current study is different from all former studies because it uses a different indicator for human capital: HCI (Human capital index) extracted from "The Global Human Capital Report, 2017". There are four sub-indexes of HCI, used in the study to examine the ability to negate diminishing returns in 66 low-income countries shown in appendix table 1. This study is unique to all other studies due to the four sub-indexes of human capital: Capacity, Deployment, Development, and Know-how.

Humans are the major source of the countries as (Barney, 1991) stated that rare, valuable and inimitable resources are used to gain competitive advantage, and human capital is one of the resources (Hanif, Arshed & Farid, 2020). Knowledge base view is seen to understand the possible sources for competitive advantage through human capital (Chen & Min, 2004). Based on the resource based view and knowledge based view, this study argues that economies can foster their growth by developing human capital.The development in the human capital by the developing countries might help them innovate when the rules of the international economy are changing, which had previously led to a divergence of developing economies. Thus, this research aims to test whether the law of diminishing returns exists in 66 lower-income countries of the world. Moreover, the indicators of human capital are capable of easing thisdiminishing return.This HC index is made by four sub-indexes, which are Capacity, Deployment, Development and Know-how. The study aims to use these sub-indexes to find whether any of these sub-indexes can help developing economies negate diminishing returns.The research questions of the study are presented as:

1. Is there evidence of diminishing returns for selected developing economies?
2. Which sub index of human capital index can ease diminishing returns in selected developing economies?

The hypotheses of the present study are shared as:

Null Hypothesis – 1 - There is no evidence of Diminishing Returns
Null Hypothesis –2 - Human capital overall cannot ease Diminishing Returns
Null Hypothesis – 3 - Capacity cannot ease Diminishing Returns
Null Hypothesis – 4 - Deployment cannot ease Diminishing Returns
Null Hypothesis – 5 - Development cannot ease Diminishing Returns
Null Hypothesis – 6 - Know-How cannot ease Diminishing Returns

2. **Literature Review**

The property of diminishing returns intheeconomic growth model proposes explanations for why underdeveloped nations may catch up with developed nations over time regarding per capita income. In specific, the Solow-Swan Neo-Classical growth model forecasts that capital will come from developed to underdeveloped nations, thus encouraging quicker economic development in the end. The diminishing return to scale to capital is the fundamental assumption. This shows that the returnsto capital are higher in an underdeveloped nation, which isrelatively poorly endowed with capital, than in capital well-endowed developed economies. Rassekh(1998),De la Fuente(1997) and Quah(1996) estimated increasing empirical literature on catch-up effect and complete summaries.The indications of a study that take a sample of large nations cut across the region and income level not support absolute convergence. A small cluster of nations demonstrated convergence better than large samples of nations; especially amid nations at same income levels. Ben David(1998) and Chatterji(1992) conducted a study in which they estimate empirical evidence of catch-up effect between two groups of developed and underdeveloped nations while they fail to do so for middle-income nations. Galor(1996) and Quah(1997) provided theoretical explanations for the catch-up effect and club hypothesis, according to which convergence will happen between subgroups as different to wide-ranging samples of nations.

Numerous researches have studied the convergence of income per capita earlier, and systematically two comprehensive methodological opinions can clarify the convergence procedure across nations. First is the technological hypothesis, where technology flows from developed countries to developing countries, causing convergence in per capita output levels; this view is quite dominant in classical economists like Adam Smith, David Ricardo, David Hume and Alfred Marshal. The second view is derived from the transitional dynamics of the neoclassical growth models. Neoclassical growth models predict that if countries have different capital-labour ratios, their growth paths will eventually converge to a steady-state growth path because of diminishing returns to capital when capital is abundant in developed countries. However, basic assumption remains that the same convergence depends on the simplifying assumptions that markets are perfectly competitive, technical change is exogenous, and the level of technology is the same. Thus, any failure of convergence can be attributed to the breakdown of these assumptions.

2.1 Diminishing returns underconvergence

Here various arguments suggest how convergent growth is obtained by poor countries.

Diminishing marginal returns.According to this, by increasing input, the return of extra units decreases;hence, investing in capital raises GDP per capita, but itscontinuous increment decreases the marginal benefit of growth, same case with labor.

Improved technology is another factor that supports convergence because, by advancing in technology, a poor country reaches the level of growth of high-income nations. The economist (Alexander Gerschenkron, 1904–1978) purpose a term "the advantages of backwardness" which means that low-income nations learn how to use this technology, which was invented by rich nations. His view behind this term is that poor nation takes some extra advantage of convergence.

2.2. Human capital theory

The thought of investment in human capital introduced by Theodore Schultz & Gary Becker, 1950s and 1960s.According to this concept, if a nation invests in individuals, its analogue to investment in physical capital. Their research demonstrates that how much investment in human capital is beneficialfor a nation. Human capital is a good means of production which does not face diminishing returns. In other words, just as firms decide to invest in new machinery to increase their production, individuals can invest in their education to gain future benefits.

The first category covers the studies, which demonstrate a positive and significant influence of human capital onproductivity development. The authors of these studies are (Hicks, 1980; Wheeler, 1980; Weede, 1983; Landau,1983 & 1986; World Bank, 2000; Grammy & Assane, 1996; Ojo & Oshikoya, 1995; Barro, 1991). There is a study by Barro (1991), in which his objective was to study the association betweenhuman capital and real per capita GDP, he took 98 countries for his study, and the time period which he uses was between 1960 and 1985. In his study, human capital was proxied by school enrolment rates. The findings demonstrate that if poor countries have a high level of investment in human capital, they can converge to wealthier countries.

Study conducted by (World Bank, 2000) shows that it is the huge investment in both levels of education (elementary and lower secondary) that positively described the expansion miracle practiced in East Asia. Recently, another research conducted by Jimenez and King (2012) from the World Bank shows that human capital is an important factor in East

Asia's continuing development. Another study demonstrates the positive contribution of human capital and economic development conducted by (Idris & Rahmah, 2012) in Pakistan's case.

Across-country study conducted by (Gemmell, 1996) to estimate the economic progress and human capital relationship. A sample of industrialized and underdeveloped nations are utilized for the research. The research uses the (Mankiw et al., 1992) model and data used by (Summers & Heston, 1991). The estimation procedure used in the research is adopted by (Mankiw et al., 1992). Findings show positive and significant connections among dependent and independent variables.

The second category of research found a negative and/or insignificant association between human capital and economic development. The researcher of these studies includes (Benhabib & Spiegel, 1994; Jovanovich et al., 1992; Islam, 1995; Caselli et al., 1996 & Pritchett, 2001).

By considering the importance of this topic (Benhabib & Spigel, 1994) researched human capital by using some growth theories like (exogenous and endogenous) growth theory and the data that use in the study was taken by (Summers & Heston, 1991) study. Results were interesting: that human capital variable was insignificant when regressing standard Cobb–Douglas production function.

The third category shows cross-country studies that impact human capital is not equivalent for all nations or groups of countries. Sometimes it shows a positive bond among human capital and development in some countries and negative in others. There is a study thatuses fifty-eight nations for the time period 1960-1986, this research uses pooled data and the study was conducted by (Lau, Jamison & Luat, 1991). This research evaluated a cumulative production function, usingthe proxy for human capital,that is average educational achievement of the employees. In Africa, the results showedthat the impact of primary education variable is adverse, Middle East and North Africa, also insignificant influence in South Asia and Latin America, and positive and significant influence only in East Asia. On the other hand, in Africa, the results show that secondary education has a negative and significant effect for the secondary education model.

The fourth category of research studies initiates an insignificant connection between human capital and economic growth. (Behrman, 1987; Dasgupta & Weale, 1992) for example, have examined that variations in adult literacy and fluctuations in output are not significantly associated with each other. According to World Bank (1995), the partial correlation among growth and educational development is less. In (Pritchett, 2001), cross-national data was taken to find no connotation among increases in human capital associated with growing informative achievement of workers and the rising rate of yield per person.

3. The Methodological and TheoreticalFramework

The theoretical background of the study is explained in this section examined. Furthermore, the hypothesis of our study will be sub divided into many portions, which is directed associated with our study purposes. The research is based on 66 low-income countries. So, the variety of variables being used as determinants for finding out the main reasons behind it, the study only focusses on human capital. The data collection procedure stated.Thenumerousmethodstoevaluatethedataincludesnormality,correlation matrixand significance tests. Moreover, the methodology used in our study is simple OLS because cross sectional data set.

3.1 Analysis of the Framework

This research study is carried out to light how investment in human capital by underdeveloped nations becomes developed countries. The independent variables included are Capital, Labor and the Human capital index. The impact of human capital on the well-being of nations is extensively documented in the economic growth and development models. Barro(1991),Barro and Lee(1993) andBarro(1997) concluded that human capital has a power to understand the variation of income levels in cross countries. Different methods are explained to analyze the influence of human capital on GDP in endogenous growth model (Romer, 1990). Babini (1991)and O'Neill(1995) studied the impact of human capital on different countries and found contradictory results, whereas (Cohen, 1996; Pritchett, 1997) identified that differences in human capital across the countries limit the convergence. Romerian backgrounds are taken by (Benhabib & Spiegel,1994) to deliberate the (Nelson & Phelps, 1966) clue about the role of human capital and adopt the technological expansion.

Figure 1 provides the convergence model with economic growth of 2017 is assessed against past GDP and controlled for labor and physical capital resource. This study has included five dimensions of human capital, which will moderate the convergence relationship.

Figure1Theoretical framework
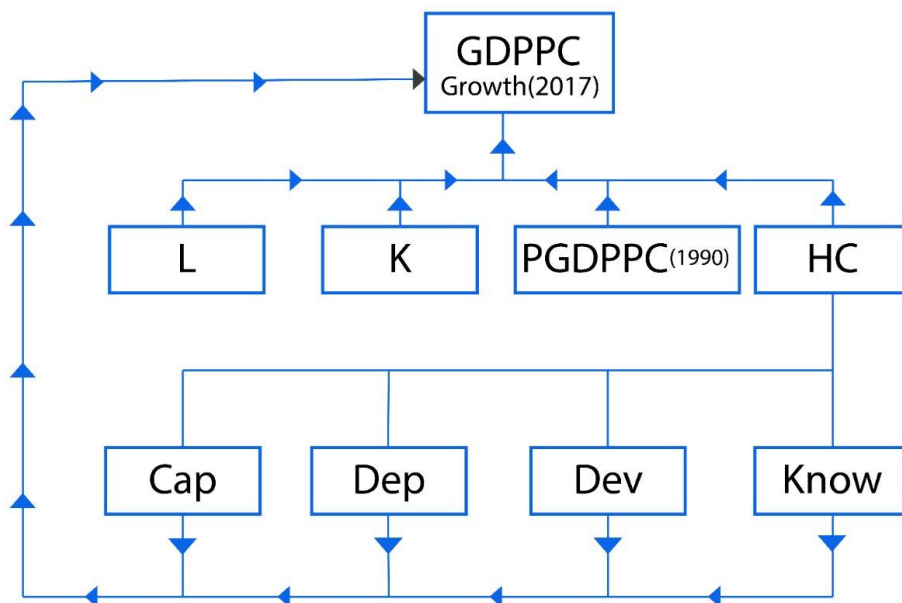
3.3 Data Description

Thestudyusedthecross-sectionaldataofsixty-six low-income countries. The sample period of GDPPC is taken for three years 1990, 2016, 2017 and other variables are only for 2017. The study takes the data of dependent variable Gross Domestic Product in constant dollars from World Bank and data for Labor and Capital are also extracted from the same source, the capital is proxy of Gross fixed capital formation (% of GDP). An important variable used in the study is Human Capital and its four elements,making this study different from all studies. Human capital data is collected from "The Global Human Capital Report 2017" which World Economic Forum issues. Human development index extracted from this report is used in the study, and four elements make this index of Human capital: Capacity, Deployment, Development and Know-how.

Table 2 Variables Representation and their source

Names	Symbol	Transformation	Data Source
GDP per capita growth	GDPPC	GDP per capita (constant LCU)	WDI
Labor	L	Labor force, total	WDI
Capital	C	Gross fixed capital formation %of GDP	WDI
Human capital index	HCI	HCI (index)	The Global Human Capital report 2017
Capacity	CAP	Human capital (index)	The Global Human Capital report 2017

Deployment	DEP	Human capital (index)	The Global Human Capital report 2017
Development	DEV	Human capital (index)	The Global Human Capital report 2017
Know-How	KNO	Human capital (index)	The Global Human Capital report 2017

3.4 Functional Form

The functional form described the relationship of the dependent variable with their independent variables.

The functional form of this study is:

$$\text{GDPPC growth (2017)}_t = \alpha + \beta_1 \text{GDPPC(1990)}_t + \beta_2 L_t + \beta_3 C_t + \beta_4 \text{GDPPC(1990)} * \text{HCI}_t + \mu_t \quad \text{..... (1)}$$
$$\text{GDPPC growth (2017)}_t = \alpha + \beta_1 \text{GDPPC(1990)}_t + \beta_2 L_t + \beta_3 C_t + \beta_4 \text{GDPPC(1990)} * \text{CAP}_t + \mu_t \quad \text{..... (2)}$$
$$\text{GDPPC growth (2017)}_t = \alpha + \beta_1 \text{GDPPC(1990)}_t + \beta_2 L_t + \beta_3 C_t + \beta_4 \text{GDPPC(1990)} * \text{DEP}_t + \mu_t \quad \text{..... (3)}$$
$$\text{GDPPC growth (2017)}_t = \alpha + \beta_1 \text{GDPPC(1990)}_t + \beta_2 L_t + \beta_3 C_t + \beta_4 \text{GDPPC(1990)} * \text{DEV}_t + \mu_t \quad \text{..... (4)}$$
$$\text{GDPPC growth (2017)}_t = \alpha + \beta_1 \text{GDPPC(1990)}_t + \beta_2 L_t + \beta_3 C_t + \beta_4 \text{GDPPC(1990)} * \text{KNO}_t + \mu_t \quad \text{..... (5)}$$

Where,

The predicted variable is per capita GDP growth in 2017 in whole equations, and GDPPC 1990 is independent variable is all fiveequations, Labor and Capital are also independent variables and exist in all equations. But Human Capital and its four indicators are used in each equation which make six different equations. The purpose of using two different GDP is that to estimate the difference between two different time periods by using Human capital and its four indicators.

The five models (equation 1 to 5) are framed to examine the convergences with policy variables like human capital index, also known as policy models. The variable names and their proxies are mentioned above in detail table 1. Data were drawn from World developmentindicator(WDI), The Global Human Capital Report 2017, since 1-year data of HCI is available so this study had used cross section OLS approach.

3.5 Basic Model

Linear regression is a common name of Ordinary Least square regression (OLS). It tends to minimizethe sum of squared differences between dependent and independent variables to estimate the optimal coefficients. This method is used for estimation in this study because of cross-sectional data.The diagnostics are applied to assess OLS are heteroscedasticity using Breusch-Pagan method;multicollinearityusingvariance inflation factor (VIF), normality using Shapiro-Wilk W, miss-specification using linktest, functional form using RESET test and influential observation using cook's distance.

The study used the natural logarithm of the variables. The purpose behind the natural log is to linearize the model by shrinking the intensity of heteroscedasticity and converting coefficients into elasticities (Gujarati, 2009; Benoit, 2011). Hence it is expected that taking log on the variables will remove heteroscedasticity, linearize to sort miss-specification and create a correct link function. This study has also removed Yemen from the sample as it was indicated as an outlier using cook's distance. Lastly, this study has used robust OLS to counter any remaining autocorrelation and other issues.

4. Results and EstimationAnalysis

Inthefirstsection,we analyze the descriptive statistics, normality tests and scatter plots. Then in the second part of this section we discuss the Ordinary least square model. The results will be analyzed according to the objective of theresearch.

4.1 Descriptive statistics

In order to simplify the data into meaningful terms, descriptive statistics are used to see how has the theory worked in the empirical data in Table 3. All other variables have a mean value greater than their standard deviation, stating that all

variables are under dispersed except for GDP growth. This illustrates that GDP growth variable is extremely diverse from designated nations, whereas other variables resemble each other. The nature of GDP growth shows that human capital is the reason for countries closeness and breakingof the catch-up effect. Table 3 shows that by investing in human capital countries, the current Gross domestic product improves because now the following knowledge base view (KBV).

Table 3 Descriptive Statistics

Variables	Mean	Std. Dev.	Max.	Min.	Skewness	Kurtosis	JB Test Prob.	Obs.
GDPG	0.015	0.108	-0.082	0.087	0.000	0.000	0.000	66
PGDP	10.92	2.424	6.424	17.78	0.041	0.582	0.0104	66
LK	3.091	0.473	0.440	4.319	0.000	0.000	0.000	66
LL	16.08	1.514	12.67	20.48	0.212	0.272	0.237	66
LHCI	4.028	0.132	3.568	4.266	0.0041	0.074	0.007	66
LCAP	4.045	0.307	3.271	4.440	0.001	0.606	0.011	66
LDEP	4.130	0.195	3.531	4.502	0.021	0.078	0.023	66
LDEV	4.012	0.185	3.537	4.301	0.045	0.671	0.116	66
LKNO	3.862	0.124	3.556	4.127	0.094	0.854	0.229	66

Based on skewness and kurtosis the data is not normal statistically but using the large sample size, this study is assuming asymptoticnormality.

4.2 Matrix of Correlation

Table 4 shows the association among the variables. It explains that each variable in the matrix correlated with the other variable.

Table 4Correlation Matrix

	GDPG	PGDP	LK	LL	LHCI	LCAP	LDEP	LDEV	LKNO
GDPG	1								
PGDP	0.064	1							
LK	0.755	0.140	1						
LL	0.087	0.413	0.082	1					
LHCI	0.456	-0.054	0.166	0.134	1				
LCAP	0.203	-0.143	-0.008	0.079	0.813	1			
KDEP	0.380	0.125	0.293	0.116	0.332	-0.081	1		
LDEV	0.375	-0.137	0.150	0.116	0.785	0.697	-0.105	1	
LKNO	0.211	-0.032	0.023	0.081	0.596	0.398	-0.029	0.531	1

The table 4 shows an estimation of correlation among the explanatory variables. Basically, it is part of diagnostics to check the multicollinearity in the independent variables. For this purpose, we use the VIF benchmark of that all the value less than 10, which means variables are not interrelated.

4.3 Graphical Evidence of Human Capital Effect

Figure 2 provides the association of present growth with past GDP with the coloring based on human capital index. Here we can see that for all incidences, the high human capital in increasing the association value between present GDP growth with past GDP

Figure 2 Graphical Representation of Data
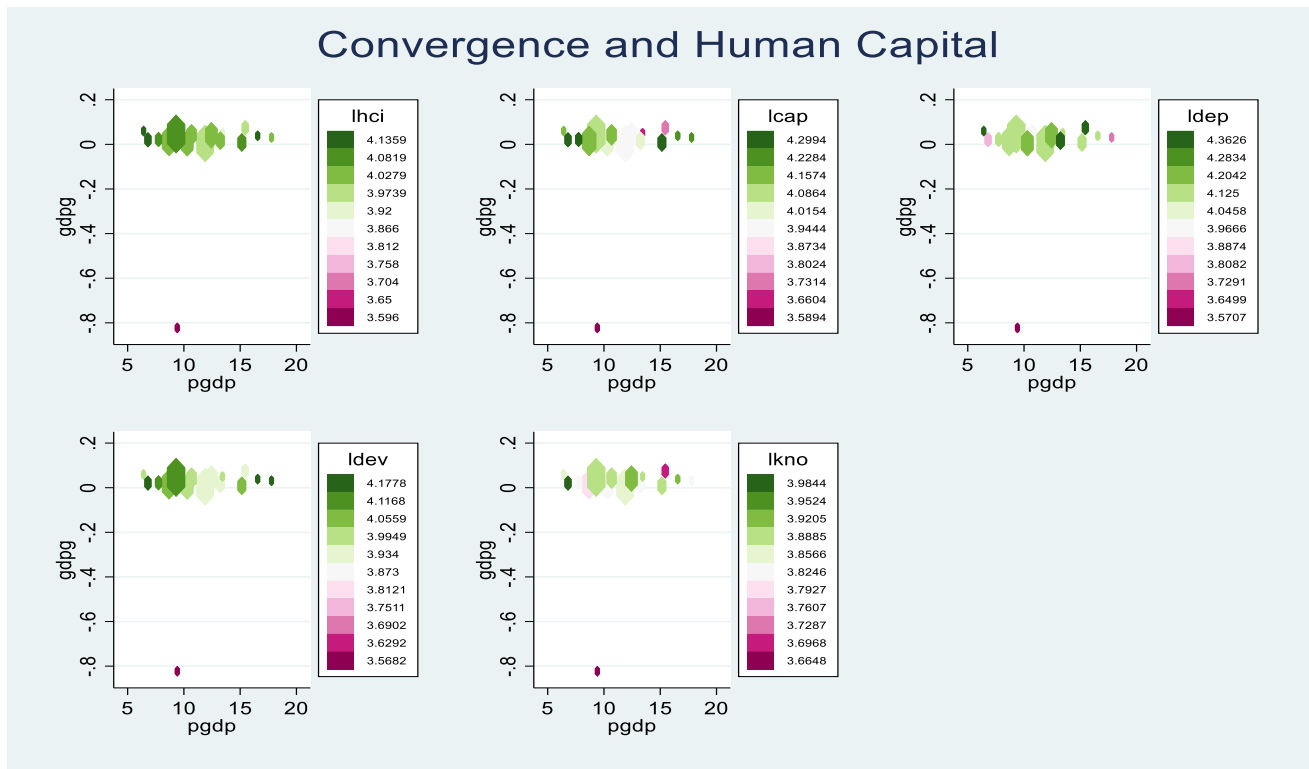
4.4 Model Estimates

Table 5 provides the estimates of equation 1 to 5 using robust OLS method. The results of equation 1 are explained in table 5, which are based on the 65 observations. The significant F-test showsTHE validity of model, and R-square shows 28% explanatory variable (past GDP, Labor force, Capital and PGDP*Human capital)successfully explain the change in the dependent variable.The estimation shows for low-income countries,so first coefficient means that if there was 1% higher GDP in the past, it is leading at 0.02% lower growth today. This is hinting the presence of the catch-up effect and law of diminishing returns for the sample countries. Further, if countries focus on human capital policy by increasing 1% HCI, they will ease the law of diminishing returns by 0.005%. It means that for every 1% increase in HCI, there is a 0.005% increase in the negative coefficient of past GDP; hence, a time will come to zero (i.e. at a 4% increase in HCI). At this point, the phenomenon of diminishing return will not be able to slow down economic growth.Figure 3 also illustrates the results showing higher Human capital, which means increasing investment in human capital present GDP increase.

Table 5Moderating Role of Human capital Indicators

Regression Estimations Dependent variable GDP Growth					
	HCI Model	CAP Model	DEP Model	DEV Model	KNO Model
Variables	Coefficients (Prob.)	Coefficients (Prob.)	Coefficients (Prob.)	Coefficients (Prob.)	Coefficients (Prob.)
PGDP	-0.020 (0.036)	-0.026 (0.013)	-0.026 (0.061)	-0.053 (0.002)	-0.065 (0.012)
LK	0.038 (0.000)	0.175 (0.000)	0.166 (0.127)	0.167 (0.000)	0.174 (0.000)
LL	0.002 (0.176)	0.000 (0.943)	0.001 (0.002)	-0.000 (0.939)	0.000 (0.870)
PDGP * LHCI	0.004 (0.046)				
PDGP*LCAP		0.006 (0.014)			
PDGP*LDEP			0.005 (0.002)		
PDGP*LDEV				0.013 (0.002)	
PDGP*LKNO					0.016 (0.014)
Cons.	-0.127 (0.003)	-0.127 (0.004)	-0.124 (0.005)	-0.124 (0.003)	-0.126 (0.004)
F statistics	6.05	24.25	21.69	26.63	24.24
Prob > F	0.0004	0.0000	0.000	0.000	0.000
R-square	0.2872	0.1613	0.5871	0.6359	0.6138
Adj R-square	0.2346	0.5886	0.5601	0.6120	0.5885

The results of equation 2 are explained in table 5, which are based on the 65 observations. The significant F-test show validity of model, and R-square shows 16% explanatory variable (past GDP, Labor force, Capital and PGDP*Capacity) successfully explain the change in the dependent variable. The estimation shows for low-income countries,so first coefficient means that if there was 1% higher GDP in the past it is leading at 0.02% lower growth today. This is hinting the presence of catch-up effect and law of diminishing returns for the sample countries. Further, if countries focus on capacity policy by increasing 1% CAP, they will ease the law of diminishing returns by 0.005%. It means that for every 1% increase in CAP there is 0.005% increase in the negative coefficient of past GDP; hence a time will come, it will become zero (i.e. at a 4% increase in HCI). At this point the phenomenon of diminishing return will not be able to slow down economic growth. Figure 4 also illustrates the results in which show higher capacity, which means increasing investment in the capacity present GDP increase.

The results of equation 3 are explained in table 5, which are based on the 65 observations. The significant F-test shows validity of model and R-square shows 58% explanatory variable (past GDP, Labor force, Capital and PGDP*Deployment) successfully explain the change in dependent variable. The estimation shows for low-income countries so first coefficient means that if there was 1% higher GDP in the past it is leading at 0.02% lower growth today. While p-value of this coefficient is significant at 10% significance level. This is hinting the presence of catch-up effect and law of diminishing returns for the sample countries. Further, if countries focus on deployment policy by increasing 1% DEP, they will ease the law of diminishing returns by 0.005%. It means that for every 1% increase in DEP there is 0.005% increase in the negative coefficient of past GDP hence a time will come it will become zero (i.e. at a 4% increase in DEP). At this point the phenomenon of diminishing return will not be able to slow down economic growth.Figure 5 also illustrates the results in which show deployment, which means increasing investment in the deployment present GDP increases.

The results of equation 4 are explained in table 5, which are based on the 65 observations. The significant F-test shows validity of model and R-square shows 63% explanatory variable (past GDP, Labor force, Capital and PGDP*Development) successfully explain the change in the dependent variable. The estimation shows for low-income countries so first coefficient means that if there was 1% higher GDP in the past it is leading at 0.05% lower growth today. This is hinting the presence of catch-up effect and law of diminishing returns for the sample countries. Further, if countries focus on development policy by increasing 1% DEV, they will ease the law of diminishing returns by 0.005%. It means that for every 1% increase in DEV there is 0.005% increase in the negative coefficient of past GDP hence a time will come, it will become zero (i.e. at a 4% increase in DEV). At this point, the diminishing returns phenomenon will not be able to slow down economic growth. Figure 6 also illustrates that the results show higher development, which means increasing investment in the development sub-index present GDP increases.

The results of equation 5 are explained in table 5, which are based on the 65 observations. The significant F-test shows validity of model and R-square shows 61% explanatory variable (past GDP, Labor force, Capital and PGDP*Know-how) successfully explain the change in dependent variable. The estimation shows for low-income countries so first coefficient

means that if there was 1% higher GDP in the past it is leading at 0.06% lower growth today. This is hinting the presence of catchup effect and law of diminishing returns for the sample countries. Further, if countries focus on capacity policy by increasing 1% KNO, they will ease the law of diminishing returns by 0.005%. It means that for every 1% increase in KNO there is 0.005% increase in the negative coefficient of past GDP hence a time will come it will become zero (i.e. at a 4% increase in KNO). At this point the diminishing returns phenomenon will not be able to slow down economic growth. Figure 7 also illustrates the results showing higher know-how, which means increasing investment in the know-how presents GDP increase.
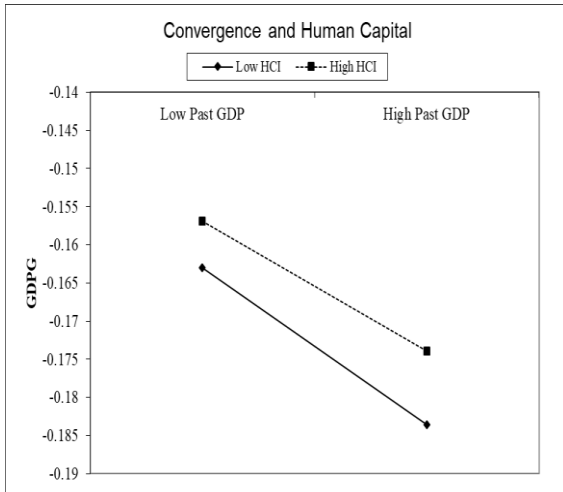
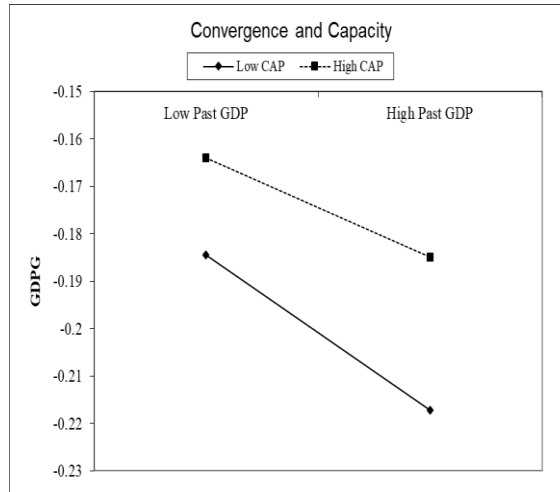Figure 3 Moderating Role of Human Capital
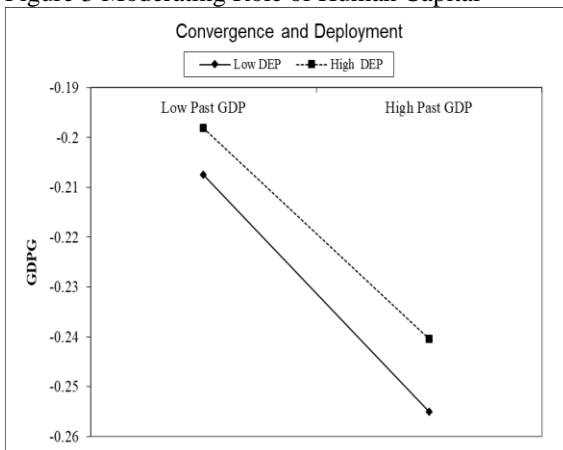

Figure 4 Moderating Role of Capacity

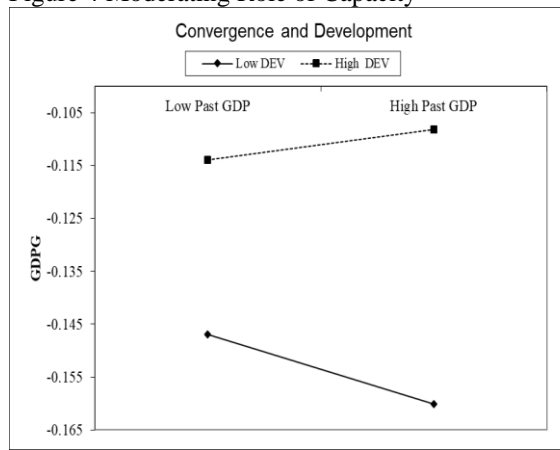Figure 5 Moderating Role of Deployment
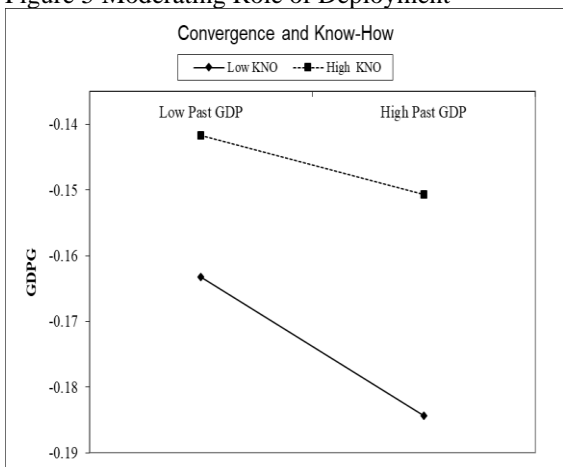

Figure 6 Moderating Role of Development

Figure 7 Moderating Role of Know-How

5. Conclusion

The convergence process states that lower-income countries converge to high-income nations and have to face diminishing returns. If the nation's objective is to grow GDP per capita by increasing human and physical capital investment, then convergence occurs. In the low-income nations, due to investing in both type of capitals, the combination of workers and new skills attain. While the nations with higher GDP per capita, however, level of investment equivalent to that of the under-developed nations is not expected to have as great influence, because in the rich nations the capital investment is already high. Thus, the gain from this marginal investment become a smaller amount.

The diminishing returns of the production of rich countries allow poor countries to converge and produce any alternative of input or invest in the people to increase or compete with the rich ones. The invention of new technology and building of institutescreates a climate that helps poor economies increase the returns of a factor of production. Investment in knowledge andtechnology can offset diminishing returns.

The current study intention is to see the influence of human capital on GDP growth per capita in sixty-six low income countries. The data is collected from "The Global Human Capital Report 2017" which World Economic Forum issues. The purpose of the report is to measure the computable elements of the world's expertise. The intention of using this report in this study is to peroxided human capital by those indicators which are not used earlier to provide a comprehensive valuation of country's human capital. The elements of Human Capital that use in the Report are Capacity, Deployment, Development and Know-how.

The study also uses GDP of two different years the reason is to compare both GDPs and stress the role of Human capital by adopting human capital or by investing in human capital how under-developed nations converge toward rich countries. We used the simple OLS method to find how these four sub index of human capital work in this group of countries. The results show that the decreasing rate of current GDP growth by investing in the previous GDP is the hint of catch-up-effect and law of diminishing returns for sample countries. But by investing in human capital, capacity, development and know-how, the diminishing return phenomenon will not be slow down economic growth. The research concludes thatsub-indexes of human capital shows that by investing in them, the poor nations converge. The study outcome emphasis the important role of the human capital and conclude that for reaching the high level and increase the level of comfort of the individuals,the countries should invest in human capital.

According to economists of the development economy, there is a significant relationship between the quality of human resources and economic development. In the endogenous growth model, human capital is a source of increasing returns to scale. Romer (1986, 1990) studies also show the connection among economic development, knowledge and technological advancement. He conducts the association among economic development and the marginal gain of human capital. By the view of Romer, novel thoughts have exclusive features; they are non-rival products. These features can produce optimistic externalities and increasing returns to scale.In both empirical and theoretical research, human capital accumulation has been broadly identified as an engine of economic growth and development. We recognize the role of human capital in any country by that no nation has attained sustained economic development without substantial investment in human capital. Numerous researches have emerged to examine the channels through which human capital can influence economic growth (Barro & Salai-i-Martin, 1995; Temple, 1999).

Based on the outcomes this study has provided, the followingare few policy implications that can be noted.

1. Pursuing human capital policy can help counties, especially developing counties, counter the law of diminishing returns, which would have cost them slow growth.
2. The results confirmed that the overall human capital index and its four constructs could help in evading the looming diminishing returns.
3. Most effective is the know-how sub index of human capital, which provides the highest ease against diminishing returns based on the empirical estimates. Based on this, the policymakers should focus on increase the availability of skilled employees and their demand in the economy. These actions would be translated into an increase in economic complexity (which increases knowledge-intensive exports).

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Appendix Table 1:

Sample Countries	
Bangladesh	Morocco
Benin	Nicaragua
Burundi	Nigeria
Chad	Pakistan
Ethiopia	Paraguay
Gambia	Philippines
Guinea	Senegal
Kenya	Sri Lanka
Kyrgyz Republic	Ukraine
Madagascar	Vietnam
Malawi	Yemen
Mali	Zambia
Mozambique	Albania
Myanmar	Algeria
Nepal	Argentina
Rwanda	Brazil
Tajikistan	Bulgaria
Tanzania	China
Uganda	Colombia
Armenia	Costa Rica
Bolivia	Dominican Republic
Cameroon	Ecuador
Cote d'Ivoire	Iran
Egypt	Jamaica
El Salvador	Jordan
Ghana	Malaysia
Guatemala	Mauritius
Guyana	Mexico
Honduras	Namibia
India	Peru
Indonesia	Romania
Lesotho	South Africa
Mauritania	Turkey