Role of Education on Economic Growth: the Quality and Quantity Measures.

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ABSTRACT

Over the years most of the countries in the world have been faced with several socio-economic problems that have retard rapid economic growth. In an attempt to find a permanent solution to this problem studies have shown that the educational sector of every country is a leading instrument for promoting economic growth. The study analyses the role of the quality and quantity of education in promoting economic growth. The study further examines this impact on economic growth using the generalized least square (GLS) panel regression techniques and using annual data for 2000, 2003, 2006, 2009, and 2012 for 23 OECD member countries. The findings show that both government expenditure, school attainment and the quality of education measured by the PISA test scores has significant effects on economic growth. This study recommends that both the public and private sector should collectively revamp the education sector through increase in capital expenditure on education, and a good salary scheme and other incentives should implement to motivate teachers performance, as teachers have a significant role to play in improving the performance of the student.

Keyword: Economic growth, Education, High School Enrollment, Gross Domestic Product per Capita, Government Expenditure, and PISA test score.

ÖZ

Uzun yıllardır dünya üklelerinin birçoğu ekonomik büyümelerini yavaşlatan sosyo-ekonomik problemlerleüzleşmektedirler. Birçok çalışma, bu sorunun köklü bir şekilde çözülmesi için eğitim sektörünün ekonomik büyümedeki rolüne vurgu yapmaktadırlar. Bu çalışma eğitimdeki miktar ve kalite verilerinin ekonomik büyümeye etkilerini incelemektedir. Bu amaçta, bu çalışma Generalized Least Squares (GLS) panel regresyon teknikleri ve 23 OECD ülkesinin yıllık 2000, 2003, 2006, 2009 ve 2012 yılı verilerini kullanmıştır. Sonuçlar eğitime ayrılan devlet harcamaları, okullaşma oranları ve PISA test sonuçlarıyla ölçülen eğitimdeki kalite verilerinin tümünün de ekonomik büyümeye positif ve önemli etkileri olduğunu göstermiştir. Çalışma hem develet hem de özel sektörün eğitime yatırım yapmasını, öğretmenlerin performanslarını artırmaya yönelik motivasyon artırıcı uygulamalar uygulanmasına vurgu yapmaktadır.

Anahtar Kelimeler: Ekonomik büyüme, Eğitim, Orta öğrenime katılım oranı, Kişi başı gayrı safi yurtiçi hasıla, hükümet harcamaları, ve PISA test sonuçları.

I dedicate this work to my entire Family

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LIST OF ABBREVIATIONS

WDI	World Development Indicator
GDP	Gross Domestic Product
EFA	Education for All
FTE	Full Time Equivalent
OECD	Organization for Economic Cooperation and Development
PISA	Programme for International Student Assessment
OLS	Ordinary Least Square
UNESCO	United Nation’s Educational Scientific and Cultural Organization
DEIES	U.S, Department of the Education Institute of Education Sciences
FE	Fixed Effect
RE	Random Effect
HSE	High School Enrollment
Obsv	Observation
Min	Minimum
Max	Maximum
Std. dev	Standard Deviation

Chapter 1

INTRODUCTION

There is a great diversity among the countries of the world in terms of their income per person (prosperity) and also in their economic growth rates. According to the World Bank Development Indicators (WDI) report of 2011, the GDP per capita of the United States of America was about $ 45335.89 (U.S Dollars) in 2012, while that of Nigeria was $ 2295.26 (U.S dollars), Japan's GDP per capita in the year 2012 was $ 36942.20 (U.S dollars) and that of Germany was $ 38219.83 (U.S dollars). This evidence reflects that there is a strong difference among countries income per person.

The contemporary issues of variation among countries have become a puzzle to unravel by the world economists, which have long searched for the causes and factors that prompt this variations. There have been various growth literatures on the study, which this research is building on, to investigate the impact of education on economic growth.

Human capital plays an important role as one of the factors impacting the economic growth. Indeed there is also a big diversity among the education level attained by the world countries and this may very well be one of the main causes of diversity in economic performance. Base on the data from the World Bank development indicator (2011), countries like Singapore, Finland, New Zealand, Norway, Sierra Leone and Togo with similar sizes of population but they have diverse levels of educational attainment and differences in their economic performance respectively. Most literature review shows that the level of human educational attainment is itself a Secondary effect of academic achievement. That is, if schools do a better job of teaching their students, then the students are more likely to complete high school, more likely to go on to college, and this will lead to human capital accumulation and economic growth in the long run.

The literature which included education usually uses the following variables as proxies for human capital level of a country:

- High school enrollment
- Budget spent for education
- Average years of schooling

The choice of these variables as explanatory variables is due to two (2) reasons:

1. They are a good proxy for education level
2. They are really easily available. In particular, majority of the countries in the world have available and easily accessible data on these three variables.

Research findings from Education for all (EFA) global monitoring report (2005) established the fact that the distribution of personal income on society is basically associated with the years of schooling an individual has attained. Literally, this means that individuals with more years of schooling will have higher life time income.

From several other empirical works, like research finding by Anthonia T. (2012) shows that recurrent expenditure on education has significant effects on economic growth. It is clear that countries around the world are investing a significant amount in education to enhance economic growth.

On the other hand, the quality of education which should definitely impact on how people get and thus impact on economic growth often have been ignored due to lack of data.

1.1 Problem of study

Eric et al, (2007), offered a new insight on the fact that the expenditure on education per person or years of schooling by individuals does not guarantee economic growth. Rather the quality of education determined by cognitive skill is related to individual earnings as well as economic growth than mere years of schooling.

A general assumption is mostly made with shape policy debate centering on the contribution of education to economic growth in both developed and developing countries. This debate assumes that increases in expenditure on education in the form of improvements in school size, teachers' salaries, class size etc. will automatically lead to improvement in educational quality as well as economic growth. We note that the significance of any budgetary finance or investment in education depends on the productivity of the investment itself.

Some economists are of the opinion that positive educational quality will lead to increase in productivity of individuals which will further translate to increase in overall economic productivity and stimulate economic growth.

According to Stephen and Ethan (2008), there exist concrete evidence that the quality of human resources, measured by Academic achievement (e g., test scores) or by the Level of education (e.g., high school graduation). The quality of the skills acquired by individuals is positively correlated to the income of individuals, productivity and economic growth. The gap in literature with respect to the aforementioned conclusion is as follows; how does the quantity and quality of education impact positively on economic growth?

In summary to what extent does a country where students have higher student test scores and high school attainment which measures quality of education, grow faster than other countries with low quality education? Most empirical work utilized the standard student test scores to measure quality of education among different countries, while others identified cognitive skill as the important dimension for measuring the quality of education.

1.2 Aim of the Study

This study tries to fill the gap in literature stated in the problem from the previous section by using relatively new data from Program for International Student Assessment (PISA) education testing performance as a proxy for quality of education.

Research evidence indicates that the advanced developed nations like the United States invest more capital per person in education compared to less developed countries. The national center for education statistics reports that in 2010 the United States spent about $11,826 per full time equivalent (FTE) on students in both elementary and secondary levels of education. This amount is higher than that of the Organization for Economic Cooperation and Development (OECD) average of $8,501. Despite the amount expanded per student, evidences from the Programme for

International Student Assessment (PISA) test result shows that students test score performance grades in mathematics and science seem to be low compared to that of other developed countries like Finland -which spends about $6, 84728 on education. Also, some developing countries like China which spends far less amount compared to other developed countries on education have been able to achieve greater success in terms of exam scores and quality of education.

It is very difficult to ascertain if it is the amount of money spent on education or the years of schooling or the quality of education that students get out of schooling that matters most for economic growth. Therefore, this research aims to investigate how the quantity and quality of education impacts economic growth. This is because some countries may have same budgetary expenditure devoted to education per person annually with equal years of schooling but might still differ in terms of the quality of education delivered- reflected in exam scores per candidates.

Panel data of 23 OECD member countries was used to make an empirical analysis on the impact of the quality of education on economic growth. The data will be that of the standardized test of student's performance in cognitive skills in the PISA science literacy examination for year 2000, 2003, 2006, 2009, and 2012. This data will be used as a proxy for the quality of education.

1.3 Organizational Structure

This thesis is categorized into eight (8) chapters.

The first chapter sets the background of the study of the impact of educational outcome on economic growth. It further entails the problem of the study, the aim of the study, which the study tried to fill the gap in this literature by using relatively new data from PISA education testing performance as a proxy for quality of education. Finally the detail of the methodology used and the organizational structure is entailed in this chapter.

Chapter (2) highlights and reviews similar literature works on the subject matter. It reviewed parallel cases for countries with significant outcome in their drive towards economic growth. Examples of these countries are OECD member countries namely; USA, East Germany, West Germany, Finland and Sweden etc.

Chapter (3) highlights some of the major theoretical works, Solow growth model and the augmented Solow growth relating to the impact of human capital in enhancing economic growth Romer, and Mankiw.

Chapter (4) highlights a brief description the empirical specification; the estimated regression model and the economic expected signs for each of the variables used in the model.

Chapter (5) highlights the various types of data used for the empirical analysis which includes the number of countries and the explained and explanatory variables used.

Chapter (6) highlights the estimated techniques which is the panel data technique.

Chapter (7) reveals the estimation results.

Finally chapter (8) highlights the conclusions and recommendations based on the study.

Chapter 2

LITERATURE REVEIW

2.1 Introduction

Over the years various works have examined the relationship between the quality gotten from the outcome of education and economic growth. Some economists have emphasized different means through which quality of education may affect economic growth. Some economists claim that it is increase in government expenditure on education that leads to economic growth. Some others have stressed the level of school attainment obtained by individuals as the driving force to economic growth.

2.2 Empirical Literature focusing on the Quality of Education an Economic Growth

The following empirical works have found significant positive effect of the outcome of education measured by the quality on economic growth.

Barbara and John (2000), reviewed some empirical macro econometric literature on productivity and education, focusing on the UK policy. The study used pooled samples of developing countries and OECD countries between the period of 1978 and 1998. They used a panel regression analysis, to investigate the correlation between human capita which is generally measured by formal education and economic performance. The results obtained showed that there is convincing evidence that the quality of human capital increases productivity in the economy, and hence leads to economic growth.

The empirical study by Andrea and Stefano (2001), investigated the causal impact of a qualitative labor force gotten through education on economic growth in 21 OECD member countries over a period of 1971 to 1998. The authors made use of a cross-section regression analysis and pooled cross- section time series regression to determine the long-run relationship between growth and human capital. The human capital augmented growth equation was estimated using a consistent econometric technique (PMG), the average number of formal education of the working age population was used as a proxy for human capital. The results obtained showed that there is a positive and significant impact of qualitative human capital accumulation on economic growth.

Lee (2010) examined the importance of education in enhancing economic growth of 75 countries between the periods 1960-2000. The study used conditional dummy and educational attainment for the age group of 15 and above in the population in 1960. The results revealed that education helps to accelerate growth in a cross-section of economies once continental dummies are being controlled for.

Using the Generalized Methods of Moments (GMM), Zhang and Zhuang (2011) examined the impact of the accumulation of human capital on economic growth in China the results reflects that tertiary education had played a significant role than primary and secondary levels of education on economic growth. Moreover, the role of the human capital composition on regional economic growth is very relevant to the level of development. The provinces that are more developed benefit more from tertiary education, while underdeveloped provinces depend more on primary and secondary education.

Eric and Ludger (2007) both theoretically and empirically examined the role of education in promoting economic performance, placing much emphasis on the role of educational quality, rather than just the school attainment. The study uses a cross-country panel regression analysis covering 14 OECD countries between a period of 1960 and 2000 and estimate the model by OLS. The study made use of performance from the PISA international test as a proxy to measure the quality of education. The results obtained showed that the quality of education, which is measured base on the knowledge obtained as depicted in tests of cognitive skills, is more important in achieving economic growth than mere quantity of education.

Eldridge (2011) study the role of the quality of education of the labour market as a driving force for economic growth in South Africa. The study used a cross- country panel regression technique for the period between 1965 to 1975, 1975 to 1985 and 1985 to 1995. The result obtained showed that the level of school attainment as a proxy for educational quality contributes about 0.4% to the annual GDP in South Africa. The results also showed that the quality of the educational outcome basically the ability of the school system to impact cognitive skill is a basic determinant of the performance of the labour, force which in turn enhances economic growth.

Simon and Francis (1998) explained Africa's achievements over the years in the formation and accumulation of human capital through education and the impact on economic growth. The study used a cross- country panel regression of the top 10 leading economies in Africa between periods of 1960 to 1995. The result obtained shows that the quality of human capital accumulated acquired through education remains the major factor in accounting for the disparity in growth rate across countries in Africa. The study considered the complexity of the role of the quality of human capital in Africa's growth and development, which is as a result of inadequacy in the investment in education and health. The study suggested that Africa's earlier investment in education will enhance the welfare of the future generation and in turn lead to long-run economic growth.

Dowrick (2002) theoretically and empirically reviewed some studies that explained the relationship between educational quality and economic growth and (research and development) RD. The authors found out that research and development are sources that enhance economic performance. Public expenditure and participation in education has increased drastically during 19^{th} and 20^{th} centuries, GDP has also increased spuriously within this time period.

The study by Eric (2013) examined the role of the human capital as a drive to economic growth in developing countries with much emphasis on school attainment. Over the years there has been this wide gap between developed and developing countries, the developing countries have tries to cover this gap through level of school attainment. The authors concluded that developing countries can only improve their economic performance and close the gap between them and developed countries by improving the school quality, not just school attainment. The authors highlighted the determinants of skill to include school inputs, neighborhoods, peers, or general institutional structures which in turn improve the human capital and lead to improvement in individual productivity as well as economic productivity.

2.3 Empirical Works that Found Significant Impact of Education Expenditures on Economic Growth

On the other hand, several authors used government spending on education as an explanatory variable to explain educations impact on growth. Below are some literature reviewed;

Antonia (2012) analyzes the impact of education on economic growth in Nigeria between periods of 1985 to 2007. The author used primary and secondary data for the analysis, the analysis incorporates regression of Ordinary Least Square (OLS) using the sample years 1985 to 2007. The estimated regression results show a positive relationship between gross capital formation recurrent expenditure and real economic growth. The study finding and conclusion shows that it is the increase in recurrent expenditure on education that impacts on economic growth. The academic qualification of teachers also has a role to play in the academic performance of students. Generally, the author advocated for an increase in government expenditure on education in the form of construction of new school structures, subsidies for school fees for all individuals, good salary for teachers, this will foster economic growth.

Ernest (2011) presents and examines the direct and indirect effect of public expenditure on economic growth. The integrated sequential dynamic computable general equilibrium (CGE) model was adopted to examine the effect of an increase in government expenditure on education on the economic performance of Africa. The study explored the effect of different policies on the long run growth and poverty reduction in leading Africa economies over the period of 2004 and 2015. The study concluded that the impact of government spending is best analyzed within a computable general equilibrium micro simulation framework given the wide nature of the economy.

Ararat (2007) carried out an empirical analysis to investigate the role of education on the economic growth in Ukraine and Russian federation which are the two largest economies of the former soviet bloc. The paper estimated the importance of educational level basically secondary and tertiary education for enhancing substantial economic growth in these countries. The study employed the model of endogenous economic growth and system of log-linear and linear equations accounting for different time lags. The estimates reveal that there is little or no significant effect of education attainment on economic performance. The results gotten from the system equation proves that a 1% increase in the access of the population to education which can only be possible through increase in government expenditure on education, will in the long run lead to an increase in the GDP per capita growth.

2.4 Empirical Works focusing on the effect of Average Years of School, and High School Attainment on Economic Growth

The following are examples of empirical work that found out that it is the level of school attainment that determines human capital accumulation and impacts on the economic growth.

Dawn et al. (2013) examine the relationship between high education and economic growth in the United Kingdom within 1982 to 2005. The authors highlight the long term benefits of attaining a degree- level education and the impact on the economic performance. The authors adopted the integration and correction model (ECM) approach to estimate the GDP growth model. They also made a replicate of the Gemmell (1996) model of over 15 countries within 1982 and 2005. The evidence from the results proves that a percentage increase in the share of the labour force with high education increases the GDP in the long run by about 0.2-0.5%. The accumulation of the graduate skills contributes about 20% to the GDP growth rate in the UK within this time period.

2.5 Empirical Paper that Found a Positive Effect of both the Quantity and Quality of Education on Economic Growth

Menbere and Marek (2011) empirically examined the extent to which investment in human capital accumulation contributes to growth dynamics of the European Union between the periods of 1995 to 2009. The authors used a panel data set covering 21 European Union member countries and estimated the model by OLS. The study used school enrolment, labour force with primary, secondary and tertiary education and research and development expenditures as proxies to measure human capital accumulation. The result from the study reveals that all the education variables have positively significant impact on GDP per capita growth rate.

Chapter 3

THEORITICAL FRAMEWORK

3.1 Human Capital

According to Mankiw (2003), human capital is the skill and knowledge that individuals acquire through means like education from early childhood, programs such as head start to on- the job training for adults in the labour force. Human capital raises the ability to produce goods and services in the economy, human capital is also an important tool in explaining differences in international standard of living.

Loosely speaking, human capital refers to stock of characteristics and knowledge a worker possesses which can be innate or acquired through education that contributes to his or her productivity.

This research work focuses on education as a fundamental of human capital; education plays a vital role in determining the growth rate of any country. Through education countries absorb and use modern technology, and develop the capacity for self-sustaining growth and development. In the section below I present some of the variables used for measuring level of education.

3.2 Proxies Used In Measuring Input and Output of Educational Performance

3.2.1 Input

3.2.1.1 Expenditure on Education

This can be either public (government expenditure) or private expenditure by individuals on education. Public expenditure is significant in improving the education system in any economy of the world. Increase in government expenditure on education leads to increase in the quality and quantity of human capital, comparable to social and physical capital, which contributes significantly in the economic performance. Public expenditure can be in form of increase in school facilities, increase in school size, increase in teacher's salary, and more scholarship for students, subsidization of student fees.

3.2.2 Output – Quantity

3.2.2.1 School Enrolment

According to United Nations (UN) education indexes the gross enrolment index is used as a proxy to measure the number of student enrolled in school at several different grade levels (tertiary, secondary and primary schools). The gross enrollment ratio is calculated by most countries by dividing the number of individuals who are actually enrolled by the number of children who are of the corresponding school enrolment age.

3.2.2.2 School Attainment

According to the US census bureau glossary educational attainment is a term commonly used to refer to the highest degree of education an individual has completed.

3.2.3 Output-Quality

3.2.3.1 Educational quality

The educational quality is used to determine the outcome student gets from education, most empirical studies have used international standardized test like the PISA test of student’s performance as a proxy to measure educational quality.

3.3 Sources of Human Capital

3.3.1 Schooling

Investment in schooling is very important in human capital formation. Through schooling workers can learn and absorb information, ideas, and new technologies.

3.3.2 Innate ability

Workers can have different amount of skills/human capital base on innate differences. Biological research have proven that some component of IQ are generic in origin, as a result of this component even when individuals have the same access to investment opportunities and same economic constraint they may have different amount of skill.

3.3.3 Training

This is a form of human capital acquired after schooling; it is basically associated with some set of skill that is necessary for certain industry or useful with a particular set up technologies. Most firms invest in the training of workers and most workers invest in specific technologies that firms will use in the future.

3.3.4 Pre-labour market influence

Sociologically, pee groups affects individuals basically before they join the labour market for instance the decision on where to live made by parents will be a deciding factor of whether the children will be exposed to a good or bad pre-labour market influence.

3.4 Economic Growths

Economic growth as defined by Mankiw (2007) as an increase in the market value of the goods and services produced by an economy over time. Economic growth is the increase in national output which is a result of improved technology, formulation and accumulation of human and physical capital, and increase in in quality and quantity of resources.

3.5 Basic Theory of Human Capital

3.5.1 Solow Growth Model

The Solow – Swan (1956) closed economy neoclassical model is a model that explain the relationship between growth, saving and investment. It was an extension of the Harrod-Domar model. It introduces labor and technology into the growth equation inclusive with capital accumulation. The model describes the influence of saving, population growth and technology on economic growth. The Solow model revealed that, capital accumulation is dependent on saving rate which leads to higher level of output and faster growth. The model used a Cobb-Douglas production function in which growth is a function of labor, capital and technology. This is given by the equation below; $Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}$

The model built an equation for capital accumulation, which is given by;

$$K^* = Sy - \delta k$$

Where δ represents depreciation rate,

Sy depicts saving rate as a fixed proportion of income, and

k represent capital stock.

The relationship between population growth, saving and capital of the Solow model can be illustrated with the help of a diagram.

The diagram below illustrates a situation when population growth decreases and its impact on capital stock and output.

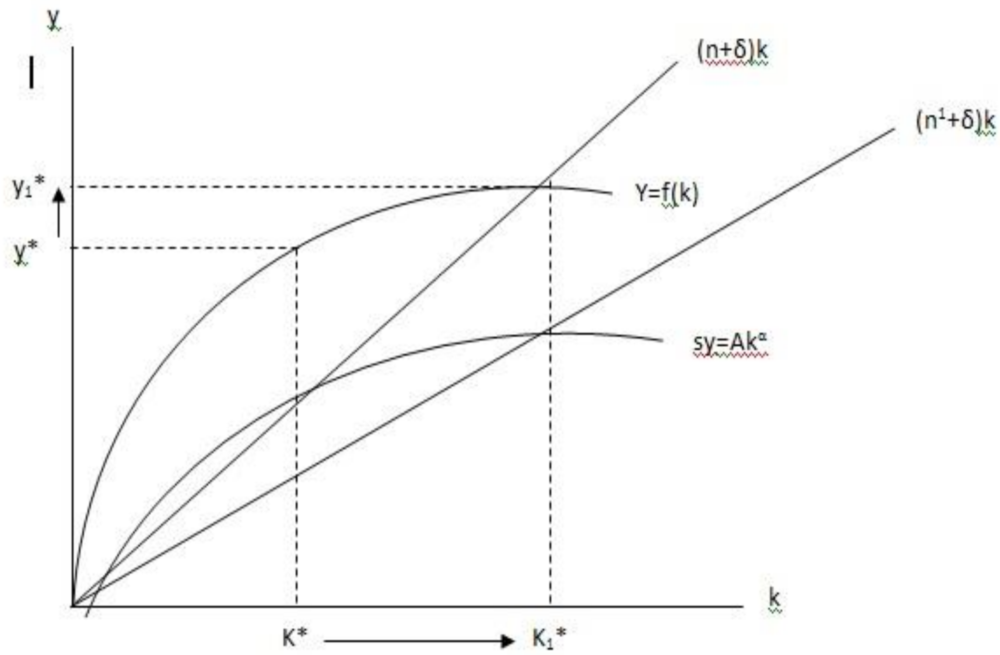


Figure 3.1: Graphical Illustration of the Solow Model when Population Growth Decreases.

In the above diagrammatic illustration, when there is a decrease in population growth rate from (n) to (n^1) the (n + δ) curve will rotate to the right (n^1 + δ), this change resulted to a higher level of capital stock k* which eventually increases the level of output from y* to $y_{*1.}$ This pushes up the level of capital stock, which at the end resulted in increase in growth rate. The same analysis can be done for saving (s) and technology (A) respectively

3.5.2 Solow – Swan Model with Human Capital. Mankiw, Romer and Weil (M-R-W)

The Solow growth model show how growth in the capital stock, advancement in technology and growth in the labour force interact and affect economic growth. The main weakness of the Solow-swan model in its original form is that it does not acknowledge the impact of human capital on economic output.

Gregory Mankiw, David Romer and David Weil (1992) tested Solow model with empirical data. They saw that it performed well, but they suggested that it would fit the data even better if they modify the model to include human capıtal. . In the MRW human capital augmented model, marginal product and output are minimal (lower) in the poor countries, since they have less human capital than the richer ones. They changed the production function into:

$$Y = AK^{\alpha} H^{\beta} L^{1-\alpha-\beta} \quad (1)$$

Where $\alpha + \beta < 1$, because there is decreasing returns to capital inputs.
K = physical capital, H = human capital level of skills that a worker, L = labour
A is again technological progress.

The production equation (1) assumes constant returns in variables H, K and L. With a level of technology (A), Production can be doubled if inputs are doubled, therefore instead of hiring L amount of labour 2L workers can be hired and each supplied with $k = \frac{K}{L}$ of physical labour meaning the physical capital input doubles, and each is been endowed with $h = \frac{H}{L}$ defines human capita level of skills per worker, same amount of ***h*** of human capital, so human capita as an input to production doubles.

The capital accumulation equation still remain the same as before in the original solow model:

$$\dot{K} = S_K Y - \delta_K K \tag{2}$$

And the human capital accumulation equation becomes

$$\dot{H} = S_H Y - \delta_H K \tag{3}$$

The production function in per capita terms is written as,

$$y = \frac{Y}{L} = \quad y = k^{\alpha}(Ah)^{1-\alpha} \quad where \quad h = \frac{H}{L} =, \quad k = \frac{K}{L}$$

from the original Solow model the saved fraction of income at each period (sY), which the MRW human capital augmented model break it up, and partly invested some part of the income saved in human capital (S_H) and other in physical capital (S_K), in a way that;

$$S = S_h - S_K \tag{4}$$

Thus, these leave us with two basic dynamic equations:

$$\dot{k} = S_K Y - (n + \delta_K)k \tag{5}$$

$$\dot{h} = S_H Y - (n + \delta_H)h \tag{6}$$

İn the steady state $\frac{\dot{k}}{k} = 0$ and $\frac{\dot{h}}{h} = 0$

and

$$\frac{\dot{k}}{k} = \frac{S_K y}{k} - (n + \delta_k) = SAk^{\alpha-1}\, h^{\beta} - (n + \delta_k) = 0 \tag{7}$$

From the above equation (7) we arrive at the steady state human capital stock per person (h_{ss})

$$h = \left(\frac{n + \delta}{SA}\right)^{\frac{1}{\beta}} k^{\frac{1-\alpha}{\beta}} \tag{8}$$

where α < 1-α

and

$$\frac{\dot{h}}{h} = \frac{s_H y}{h} - (n + \delta_h) = SAk^{\alpha}\, h^{\beta-1} - (n + \delta_h) = 0 \tag{9}$$

And the steady state capital per person (k_{ss}) will be:

$$k = \left(\frac{n+\delta}{SA}\right)^{\frac{1}{\alpha}}\, h^{\frac{1-\beta}{\alpha}} \tag{10}$$

since $1 - \beta > \alpha$

Since in the steady state $\frac{\dot{k}}{k} = 0$ and $\frac{\dot{h}}{h} = 0$ the equation (7) and (9) are equated together which gives:

$$SAk^{\alpha-1}\, h^{\beta} - (n + \delta_k) = 0 = \frac{s_H y}{h} - (n + \delta_h) = SAk^{\alpha}\, h^{\beta-1} - (n + \delta_h)$$

With the use of mathematical techniques, putting together the steady state value of k and h, we have:

$$h = \frac{n + \delta_k}{n + \delta_h} k \frac{S_H}{S^K} \tag{11}$$

This proofs that in the steady state $\frac{\dot{k}}{k} = 0$ and $\frac{\dot{h}}{h} = 0$.

Therefore, in steady state:

$$y^{ss} = (k^{ss})^{\alpha} (h^{ss})^{\beta}$$

The implication of the MRW constructed human capital augmented model is that rich countries are rich because they have a high saving rate (s), low population growth rate (n), high level of technology (A), and they allocate a larger amount of their time to accumulating new skills, this means they have a larger human capital. Loosely speaking countries with more educated labor force will be richer with this extension of theSolow model.

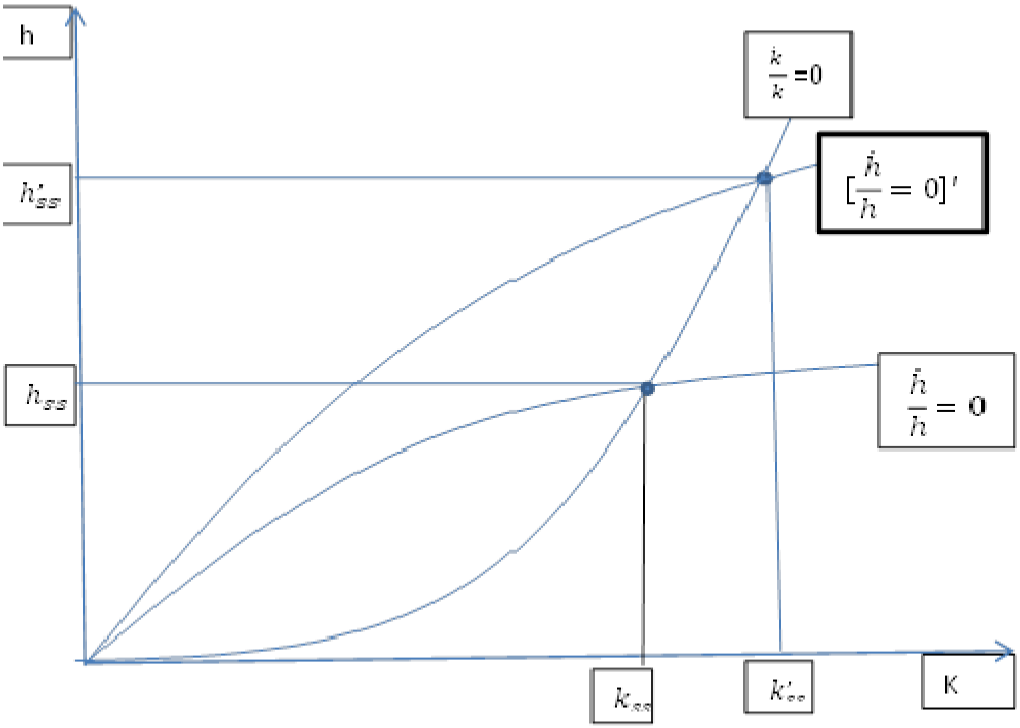


Figure 3.2: An Increase in the Investment Rate in Human Capital

Source: Hans J and Whitta J, lecture note 7 on Solow Model with Human capital.

In the above diagrammatic illustration, when there is an increase in S_H which means more accumulation of human capital, but as a result of the increase in stock of human capital this generates an increase in output an increase in physical capital accumulated. The physical capital will increases because of the constant rate of investment on physical capital, this explains the reason why k_{ss} and h_{ss} increases to k_{ss}' and $h^{ss'}$ as seen in figure 3.2. Since the physical capital stock per person (k_{ss}) and the human capital stock per person (h_{ss}) increases during the transition to the new steady state, therefore $y_{ss} = (k_{ss}) (h_{ss})$ must be increasing.

Chapter 4

EMPERICAL SPECIFICATION

As mentioned from the previous chapters, the interest of the study is to capture the effects of education on economic growth, where both the quality and quantity measures of education are used. Over the sample period, we can assume that country specific characteristics are time- invariant, so we had to control for such factors to get an unbiased estimators.

The assessment of the impact of education on economic growth; we have conducted with (both quality and quantity measures) the pooled panel model technique, formulated as:

Model (1)

$GDPcap_{it} = \alpha_0 + \alpha_1 MATHS_{it} + \alpha_2 HSE_{it} + \alpha_3 LF_{it} + \alpha_4 GNS_{it} + \alpha_5 TGE_{it} + U_{it}$

Model (2)

$GDPcap_{it} = B_0 + B_1 MATHS_{it} + B_2 GEE_{it} + B_3 LF_{it} + B_4 GNS_{it} + B_5 TGE_{it} + U_{it}$

Model (3)

$GDPcap_{it} = B_0 + B_1 MATHS_{it} + B_2 HSEit + B_3 GEE_{it} + B_4 LF_{it} + B_5 GNS_{it} + B_6 TGE_{it} + U_{it}$

i –country and t –year

GDPcap= Gross Domestic Product per capita

LF = Labour force

MATHS = average combined PISA mathematics literacy score

HSE = high school enrollment, (% gross)

GEE= government spending on education (% of total government expenditure)

GNS = Gross National Savings

TGE= General government total expenditure (% of GDP)

B_1 B_2 B_3 B_4 B_5 B_6 = are the parameters to be estimated

U_{it} = is the error term that varies over cross- section units time.

Based on literature reviewed the signs of the variables in the model are expected as follow

Table 1: The variables and their economic expected signs

DEPENDENT VARIABLE	GDP PER CAPITA	
INDEPENDENT VARIABLE	EXPECTATED SIGN	EXPLANATION
PISA MATHEMATICS SCORE	+	Is a system of international assessment that measures 15-years olds capability mathematics literacy. The aim of PISA is to evaluate education systems worldwide by testing the knowledge and skills of student within

		this age group. It is expected to have a positive effect on GDP per capita, countries with high PISA scores have good educational standard and thus increase in economic well-being.
PUBLIC SPENDING ON EDUCATION	+	Increase in public spending on education is a form of investment in education, which leads to the formation of human capital, and that makes a very important contribution to economic growth. The expected positive relationship shows that the reallocation of government expenditure to education sector is significant in explaining

		economic growth.
LABOUR FORCE	+	It is expected that labour force should have a positive effect on GDP per capita. i.e. the greater the number of individuals and their efficiency of labour force the higher the level of productivity in an economy
GROSS NATIONAL (DOMESTIC) SAVINGS	+	More savings results in more investment in both human and physical capital which ultimately results in higher economic growth.
SCHOOL ENROLLMENT, SECONDARY	+	The gross enrollment ratio is calculated by most countries by dividing the number of individuals who are actually enrolled

		by the number of children who are of the of the corresponding school enrolment age. It is expected that a direct relationship should exist between school enrollment and GDP per capita.
GENERAL GOVERNMENT TOTAL EXPENDITURE (% of GDP)	+	Keynesian view that the growth of government expenditure results in the growth of GDP. It is expected that increase in government expenditure will lead to increase in GDP per capita.

Chapter 5

DATA

There is a need to investigate the impact of education on economic growth across countries of the world; basically the OECD member countries have achieved a reasonable level of economic growth with the help of education. The objective of this study is to review and analyses the role of education in promoting economic well-being. This section will lay out the detail about the data used for the empirical analysis.

Twenty three (23) countries which are members of the organization for economic cooperation and development (OECD) are selected for this study because they provide sufficient data for the analysis (table 1). The data covers the period 2000, 2003, 2006, 2009, 2012. The analysis is started as from 2000; because this was the first year that the program international student assessment test PISA was conducted. The PISA test is administered every 3 year since 2000, the observation on all variables are complete for all of the countries selected therefore the panel data is a balanced panel data set.

The other OECD member countries such as Estonia, Slovenia, Israel, Turkey, Germany, Netherlands, Slovak, Chile, were not included in the analysis, because they didn’t take part in the PISA assessment in some years that the exam was conducted. Greece and Australia were not included into the analysis due to lack or insufficient observation for dependent variable.

Table 2: The OECD member countries selected for econometric analysis

Austria	Ireland
Czech public	Italy
Finland	Japan
France	Korea
United kingdom	Mexico
Hungary	New Zealand
Portugal	Denmark
Sweden	Norway
United state	Canada
Switzerland	Belgium
Spain	Poland
Iceland	

Source: national center for education statistics, PISA 2000 results.

5.1 Variables and Source

The dependent variable is the GDP per capita of each of the 23 OECD member countries used for the econometric analysis, over the sample period. The GDP per capita growth rate data are taken from world development indicator (WDI) of World

Bank (2014) with the national accounts constant U S dollars which is base recently to year 2005. The Log of real GDP per capita is used for the calculation of the growth rate.

The independent variable: public spending on education, total (% of government expenditure) data which measures government spending on education was gotten from the world development indicators. The data on high school enrolment (% gross) was collected from the world development indicator; it is calculated by the United Nations educational, scientific and cultural organization (UNESCO) institute for statistics. The data on total labor force has been calculated by the international labour organization and the labour market data base, for all the countries in the study, the source of this data is the world development indicators.

Data on the gross national savings are collected from the national statistical office data of the World Bank. Data on general government total expenditure are collected from central bank latest actual data.

Finally the set of data that were used to measure the quality of education which are PISA average math's literacy score are collected from the national center for education statistics based on the calculation of the U.S, department of education institute of education science.

5.2 The Program for International Student Assessment (PISA)

According to the U.S, department of the education institute of education sciences (DEIES) report in 2013, the program for international student assessment (PISA), which was first implemented in 2000 and is conducted every 3 years by the organization for economic cooperation and development (OECD), is a system of international assessment that measures 15-years olds capability in reading, literacy, science literacy, and mathematics literacy. The aim of PISA is to evaluate education systems worldwide by testing the knowledge and skills of student within this age group. About 70 economies have participated in the assessment program by PISA, representing about 28 million 15- year's old students globally. Basically, the PISA test is designed to assess the academic capability of students at the end of compulsory education, and to find out how these students apply their knowledge to real- life situations and be equipped for full participation in society.

The information gathered from the PISA triennial survey helps the countries and economies participating in the surveys to compare their students' performance over time and assess the impact of education policy decision. The students, their principals and teachers also answer questionnaires to provide information about the student's backgrounds, schooling environment, and learning experiences and about the broader school system and learning environment.

This research work makes use of the PISA mathematics literacy average score for analysis because of the availability of data, and the PISA test score is computed for the 23 OECD member countries. In order to avoid the problem of multi co-linearity this research work excludes the use of other PISA scores such as science literacy scores, and the reading literacy scores. Below I present some descriptive statistic about the variables included in this study for each selected country.

Table 3: Descriptive statistics for all variables used for econometric analysis

Country	Variable	Obsv	Mean	Std. dev	Min	Max
AUSTRIA	GDP/CAP	5	37462.17	2050.516	35027.3	40058.38
	HSE	5	98.86203	1.127626	97.69036	100.309
	LF	5	4145862	220727.7	3854452	4388773
	TGE	5	51.328	1.314185	49.141	52.613
	MATHS	5	505.4	6.730527	496	515
	GEE	5	11.03765	.2091938	10.77088	11.35712
	GNS	5	24.5058	.6839463	23.743	25.127
CZECH REPULIC	GDP/CAP	5	12697.93	1701.754	10378.63	14235.02
	HSE	5	94.11879	3.096483	89.12342	96.58527
	LF	5	5206328	59822.71	5133561	5280696
	TGE	5	44.56	3.346585	41.647	49.998
	MATHS	5	503.2	9.471008	493	516
	GEE	5	9.532428	.6967398	8.64954	10.52872
	GNS	5	23.07	2.225326	20.979	25.583
FINLAND	GDP/CAP	5	36498.06	2354.39	33217.07	38815.53
	HSE	5	118.8652	9.828849	107.3339	131.7543
	LF	5	2670670	48366.59	2613986	2719678
	TGE	5	50.153	3.679755	46.972	54.798
	MATHS	5	541	5.196152	536	548
	GEE	5	12.41396	.2690097	12.13969	12.775
	GNS	5	26.6922	4.30627	20.969	31.522
FRANCE	GDP/CAP	5	33482.25	865.6977	32392.16	34412.63
	HSE	5	108.5152	1.899852	106.4092	110.228
	LF	5	2.89e+07	1118008	2.73e+07	3.01e+07
	TGE	5	53.9708	2.590478	51.128	56.761
	MATHS	5	503.2	10.1094	495	517
	GEE	5	10.76107	.2793654	10.39341	11.05125
	GNS	5	21.7602	1.526619	20.008	23.794
UNITED KINGDOM	GDP/CAP	5	36945.28	1884.489	34058.66	39213.8
	HSE	5	101.1378	1.599191	98.44738	102.6237
	LF	5	3.11e+07	1245028	2.95e+07	3.26e+07
	TGE	5	40.9832	5.092843	34.005	46.818
	MATHS	5	503.6	15.53383	492	529
	GEE	5	10.76107	2793654	10.39341	11.05125
	GNS	5	17.5378	2.418763	2.418763	20.606
HUNGARY	GDP/CAP	5	10390.75	1018.215	8810.077	11380.89
	HSE	5	98.05995	2.531957	95.90943	102.2401
	LF	5	4275229	79471.24	4178897	4387408
	TGE	5	50.2506	1.46643	48.909	52.165
	MATHS	5	487.2	5.80517	477	491
	GEE	5	10.59632	0.7807138	9.94992	11.91482
	GNS	5	18.1986	1.956926	16.688	21.472

IRELAND	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	45696.19 110.1597 2033709 36.6416 500 13.43366 21.7842	2866.435 5.332606 199090.9 6.694171 7.483315 0.2524227 4.888758	41953.95 104.5557 1756229 30.56 487 13.09395 15.744	50005.42 118.3294 2216357 46.487 506 13.76119 26.485
ITALY	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	29773.05 97.62654 2.45e+07 52.451 470.6 9.56919 19.1498	886.1482 2.538576 779451.6 2.605709 12.66096 0.303214 1.706907	28807.54 93.23074 2.33e+07 49.034 457 9.05051 16.914	30972.3 99.16486 2.51e+07 55.658 485 9.8189 20.624
JAPAN	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	35326.87 101.4248 6.65e+07 37.5264 535.8 9.982662 24.905	1277.114 0.4684809 852708.5 2.389628 12.87245 0.1086187 2.635086	33956.81 100.9359 6.53e+07 34.489 523 9.85045 21.783	36942.2 101.9487 6.76e+07 39.982 557 10.15117 27.866
KOREA	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	18016.36 97.53795 2.41e+07 26.868 547.2 4.544874 33.7924	2780.488 0.8147073 1188477 0 4.32435 0.313544 1.224499	14428.75 96.72483 2.27e+07 26.868 542 4.21764 32.19	21562.26 98.88523 2.58e+07 26.868 554 5.04985 35.158
MEXICO	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	7947.225 77.6211 4.62e+07 23.6084 402 20.75998 21.9256	409.0954 4.826658 4848396 2.151421 15.32971 1.48177 0.7321402	7494.375 70.03662 4.08e+07 21.648 385 19.18616 20.745	8545.382 82.87976 5.28e+07 26.244 419 23.05553 22.663
NEW-ZELAND	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	39397.84 118.07 8660309 35.2182 520.3 19.05332 19.05332	1617.254 4.960525 356763.9 1.516558 13.28345 1.152968 1.152968	37546.79 110.6408 8157730 33.322 500 18.05889 18.05889	40699.9 124.6113 9020726 37.074 537 20.7599 20.7599

PORTUGAL	GDP/CAP	5	18106.35	276.3665	17891.38	18496.58
	HSE	5	104.1033	3.852361	97.57503	107.2291
	LF	5	54526825	119612.9	5253013	5546703
	TGE	5	45.5594	3.117408	41.615	49.76
	MATHS	5	472	14.54304	454	487
	GEE	5	11.90608	0.4120781	11.43944	12.51559
	GNS	5	14.136	3.379822	9.414	17.732
POLAND	GDP/CAP	5	8553.791	1582.385	6789.837	10575.78
	HSE	5	99.75663	3.270546	97.24561	105.2439
	LF	5	1.77e+07	542883.2	1.72e+07	1.85e+07
	TGE	5	20.1482	0.173397	18.903	21.488
	MATHS	5	493.64	17.08649	470	518
	GEE	5	11.98117	0.3536514	11.41325	12.3421
	GNS	5	17.1204	1.031812	16.218	18.811
UNITED STATES	GDP/CAP	5	43334.39	1882.928	40965.03	45335.9
	HSE	5	93.77971	.8625968	92.3248	94.43402
	LF	5	1.54e+08	5060800	1.47e+08	1.59e+08
	TGE	5	40.3842	8.329712	33.919	54.106
	MATHS	5	483.58	7.059179	474	493
	GEE	5	14.80198	1.329424	13.00392	16.0739
	GNS	5	17.5378	2.418763	14.374	20.606
ICELAND	GDP/CAP	5	51725.07	3784.515	46985.73	56136.45
	HSE	5	110.0094	3.021023	107.4036	115.0943
	LF	5	178461.2	9990.943	165913.3	188184.2
	TGE	5	45.4958	3.922458	41.641	50.959
	MATHS	5	507.02	8.826205	493	515.1
	GEE	5	16.25867	1.102985	15.25892	18.12376
	GNS	5	9.8124	4.817834	2.306	14.923
BELGIUM	GDP/CAP	5	35628.62	1236.429	34008.54	36728.8
	HSE	5	124.5548	25.50009	104.8371	159.1477
	LF	5	4634527	216398	4411565	4902331
	TGE	5	51.49	2.886291	48.475	55.117
	MATHS	5	519.86	5.839344	515	529.3
	GEE	5	12.22268	0.2731154	11.79999	12.5459
	GNS	5	22.3636	3.305584	18.963	26.601
SWEDEN	GDP/CAP	5	40395.26	2950.152	36576.19	43830.57
	HSE	5	123.0545	22.11505	99.60414	151.9077
	LF	5	4799216	216130.3	4552000	5082428
	TGE	5	54.1064	1.582592	52.116	55.672
	MATHS	5	498.6	13.18332	478	510
	GEE	5	12.99541	0.1486485	12.79998	13.21636
	GNS	5	24.5408	1.814134	22.705	27.42

SPAIN	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	25158.36 118.6233 2.13e+07 41.984 481.62 11.00309 21.1658	946.9848 7.617573 2332892 4.628802 3.670424 .1249949 2.277116	23920.93 111.4109 1.82e+07 38.35 476 10.8343 18.545	26508.19 130.8067 2.36e+07 47.805 485.1 11.13163 23.899
SWITZER- LAND	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	52399.55 92.23719 4299343 54.1064 509.72 15.481 33.4	2267.42 1.018151 259968 1.582592 48.10709 0.5038332 2.50998	49843.38 90.58457 3997815 52.116 424 14.77138 30	54995.91 93.24352 4640316 55.672 538 16.15013 37
CANADA	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	34557.79 102.0497 1.79e+07 47.332 527.5 12.61727 22.4872	1498.648 0.5586879 1186607 0 6.041523 0.2158552 1.776967	32497.23 101.4625 1.62e+07 47.332 518 12.34043 20.925	36122.79 102.608 1.93e+07 47.332 533 12.89435 24.67
DENMARK	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	46413.89 122.8924 2907398 55.659 508.86 15.21862 19.572	1484.036 3.947435 38066.58 3.004733 6.818942 0.1537307 2.457258	45339.69 117.9646 2864614 51.749 500 15.06539 16.93	48999.36 127.0543 2952487 59.203 514.3 15.40043 22.714
NORWAY	GDP/CAP HSE LF TGE MATHS GEE GNS	5 5 5 5 5 5 5	64124.89 113.8019 2498830 43.8716 494.24 15.91615 35.1622	2466.264 1.623825 130627.7 3.099503 4.559387 0.1995491 4.961275	60726.25 111.5191 2374610 39.959 489 15.76094 28.503	66739.18 116.0869 2674543 47.905 499 16.25732 40.561

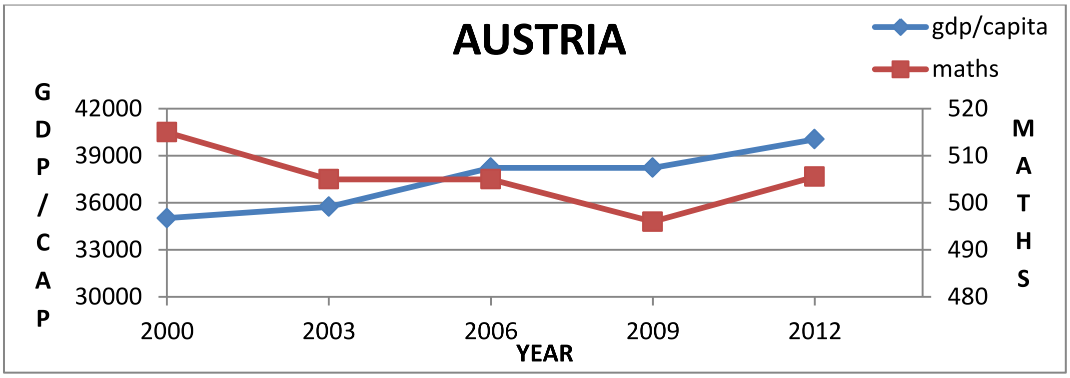
The results from the descriptive statistics for the 23 OECD member countries used for the econometric analysis contains the mean, the standard deviation, the maximum and minimum of each variable used in the model. A quick glance at the PISA math's score average (mean) for each of the countries shows that Korea has the highest Math's score average of 547.2, Finland has an average math's score of 541 and japan has a mean score of 535.8. Mexico has the lowest PISA math's score average of 402.

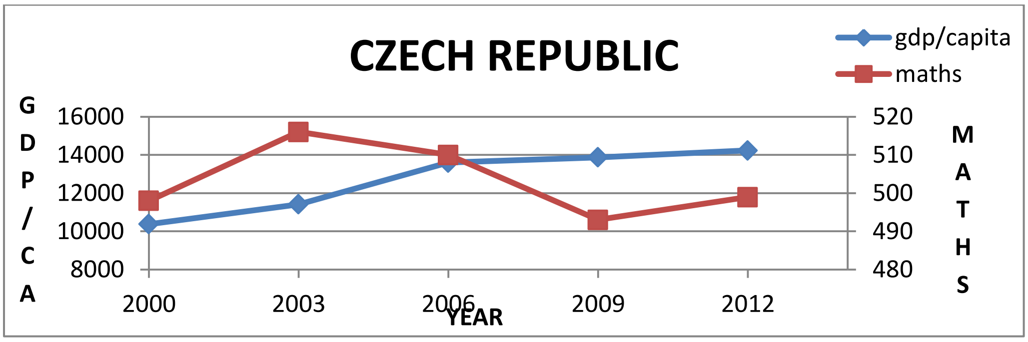
From the results in the table above the government of Mexico spends an average of 20.75998 percent of the total government expenditure on education; this is the highest average government expenditure on education as compared to the other countries. The total government expenditure on education of New Zealand is about 19.05332 percent of the total government expenditure within this period used for the analysis, This is slightly below Mexico average total expenditure on education; While Korea has the lowest average total expenditure on education of 4.544874 percent.

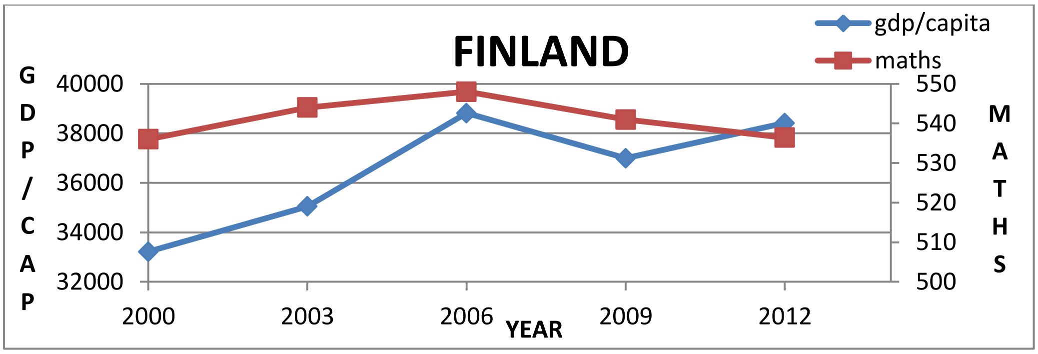
Also, in comparing the GDP per capita among these countries, Norway has the highest average GDP per capita of $64124.89 (US Dollars); while Mexico has the lowest GDP per capita of an average of $7947.225(U.S Dollars).

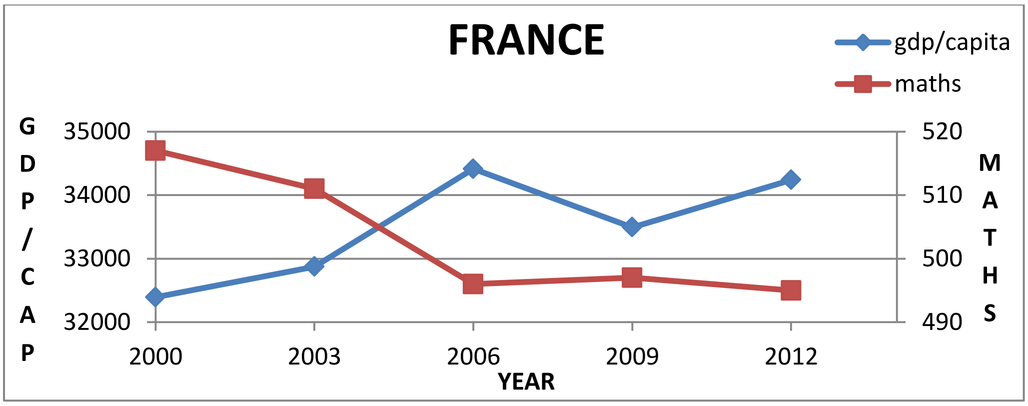
According to the results, Belgium has an average high school enrollment level of about 124.5548 percent, followed by Sweden with an average of 123.0545 percent.

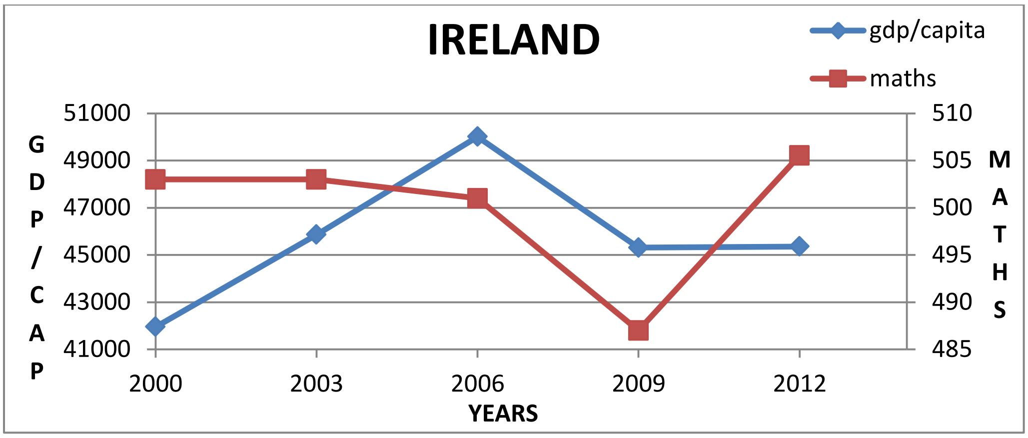
The graphs below shows the distribution trend for the 23 OECD countries used for this econometric analysis in this research work, it displays the trend of GDP per capita and the PISA Mathematics score averages in each country for the sample period. The primary axis (left side) measures the GDP per capita and the secondary axis (right side) measures the PISA mathematics test score average.

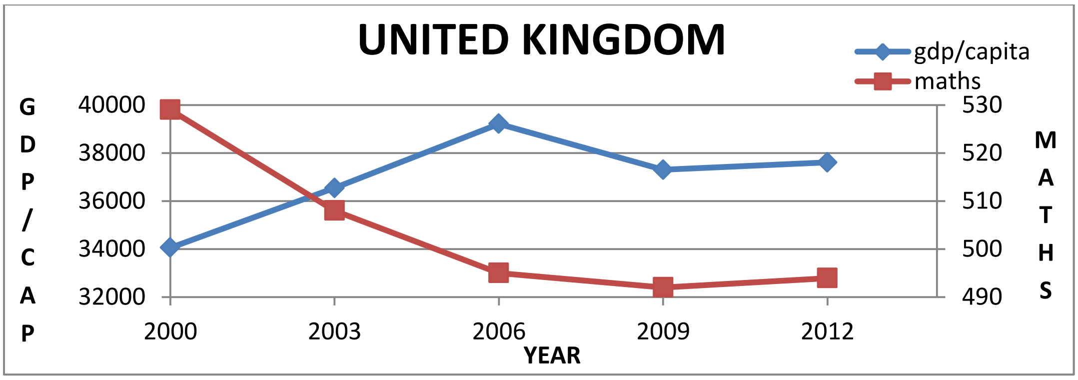

AUSTRIA
gdp/capita
maths
GDP/CAP
42000
39000
36000
33000
30000
520
510
500
490
480
MATHS
2000
2003
2006
2009
2012
YEAR

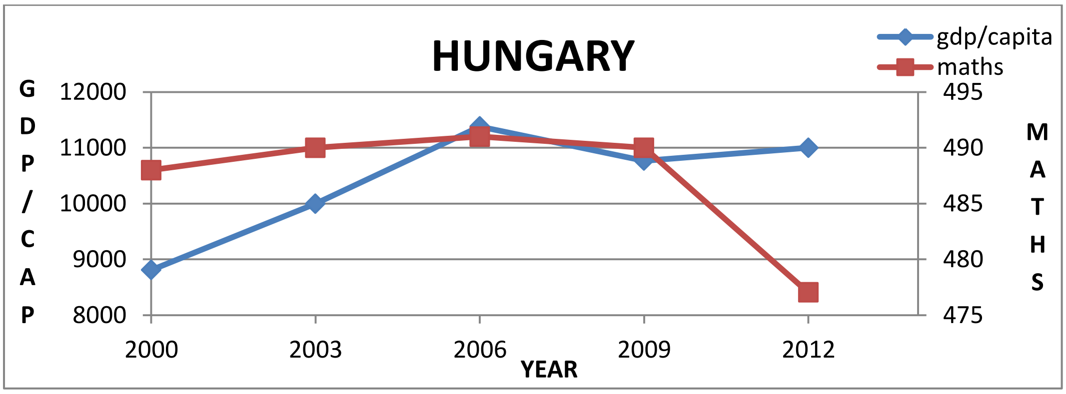

CZECH REPUBLIC
gdp/capita
maths
GDP/CA
16000
14000
12000
10000
8000
520
510
500
490
480
MATHS
2000
2003
2006
2009
2012
YEAR

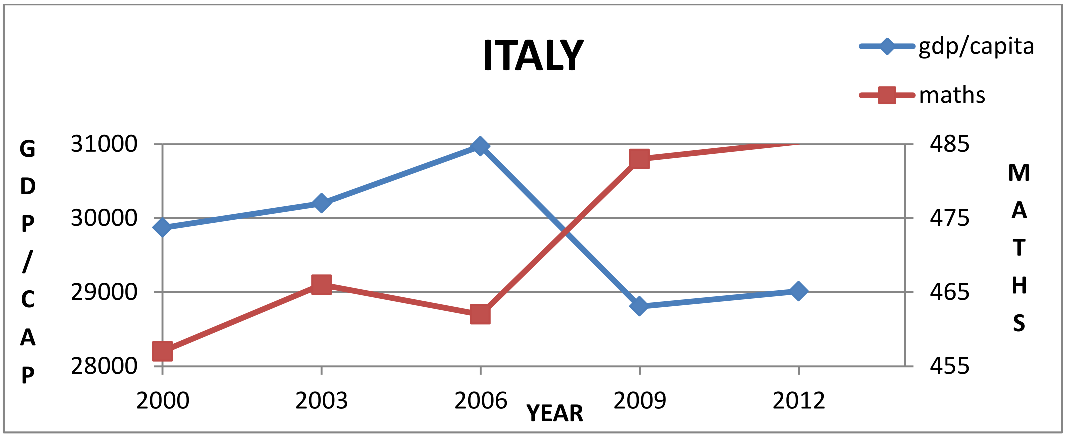

FINLAND
gdp/capita
maths
GDP/CAP
40000
38000
36000
34000
32000
550
540
530
520
510
500
MATHS
2000
2003
2006
2009
2012
YEAR

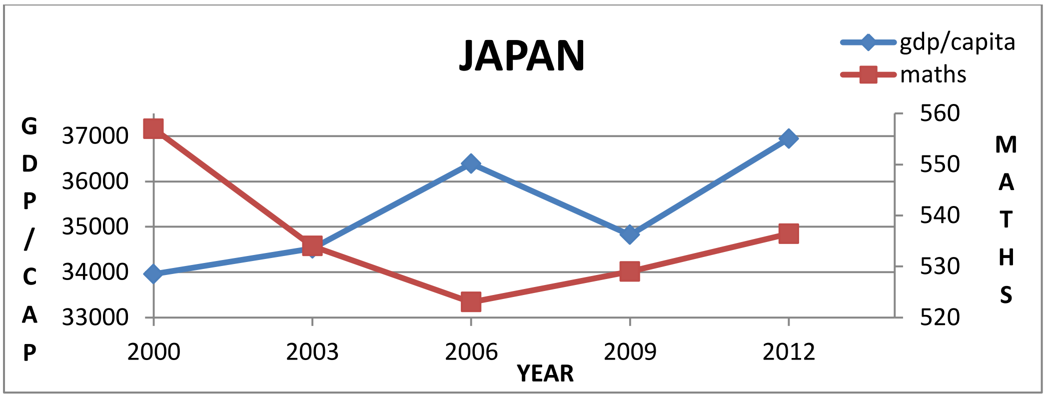

FRANCE
gdp/capita
maths
GDP/CAP
35000
34000
33000
32000
520
510
500
490
MATHS
2000
2003
2006
2009
2012
YEAR

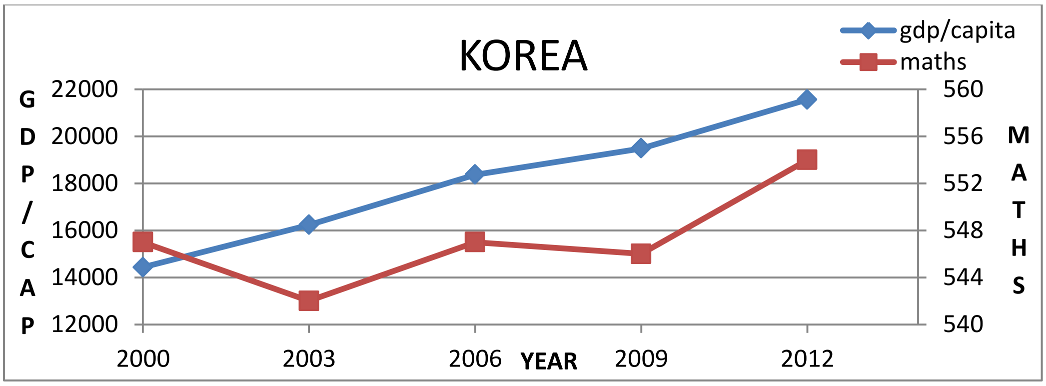

IRELAND
gdp/capita
maths
G D P / C A P
51000
49000
47000
45000
43000
41000
510
505
500
495
490
485
M A T H S
2000
2003
2006
2009
2012
YEARS

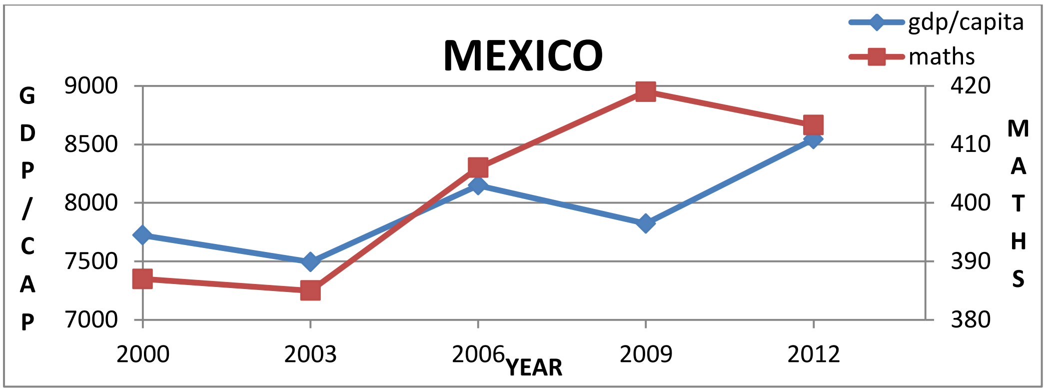

UNITED KINGDOM
gdp/capita
maths
G D P / C A P
40000
38000
36000
34000
32000
530
520
510
500
490
M A T H S
2000
2003
2006
2009
2012
YEAR

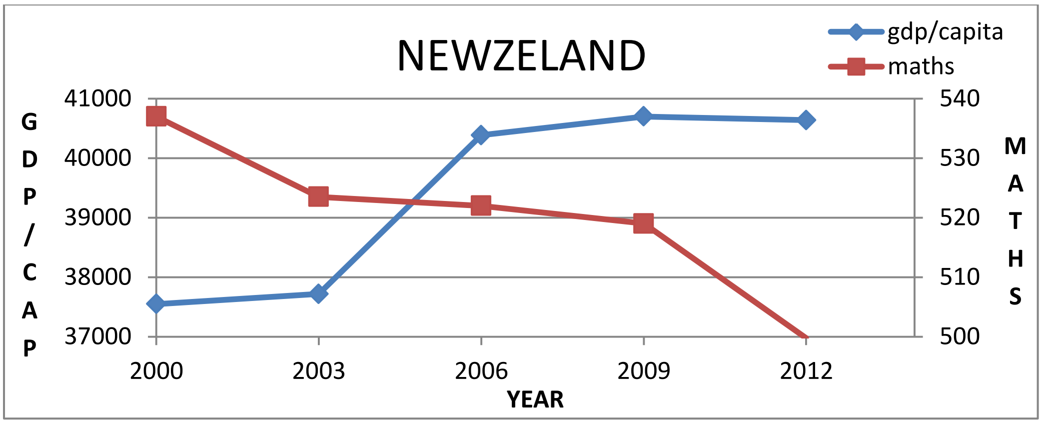

HUNGARY
gdp/capita
maths
G D P / C A P
12000
11000
10000
9000
8000
495
490
485
480
475
M A T H S
2000
2003
2006
2009
2012
YEAR


ITALY
gdp/capita
maths
G D P / C A P
31000
30000
29000
28000
485
475
465
455
M A T H S
2000
2003
2006
2009
2012
YEAR


JAPAN
gdp/capita
maths
G D P / C A P
37000
36000
35000
34000
33000
560
550
540
530
520
M A T H S
2000
2003
2006
2009
2012
YEAR


KOREA
gdp/capita
maths
G D P / C A P
22000
20000
18000
16000
14000
12000
560
556
552
548
544
540
M A T H S
2000
2003
2006
2009
2012
YEAR


MEXICO
gdp/capita
maths
GDP/CAP
9000
8500
8000
7500
7000
MATHS
420
410
400
390
380
2000
2003
2006
2009
2012
YEAR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maths
GDP/CAP
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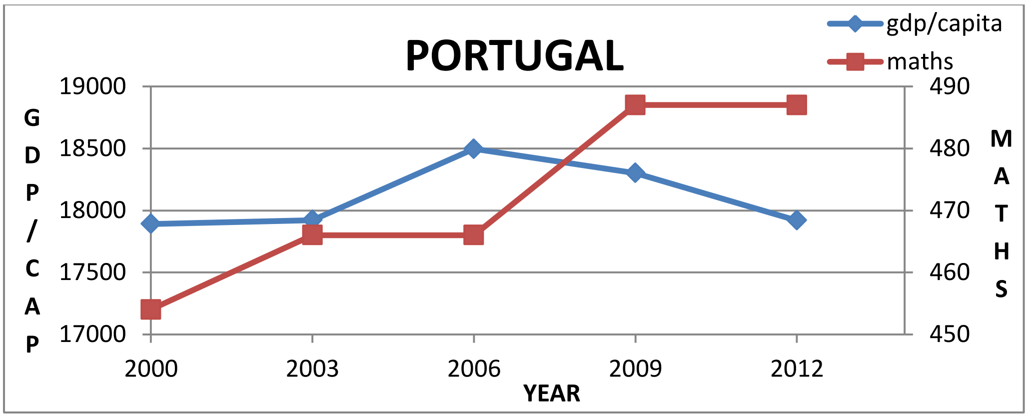
YEAR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18000
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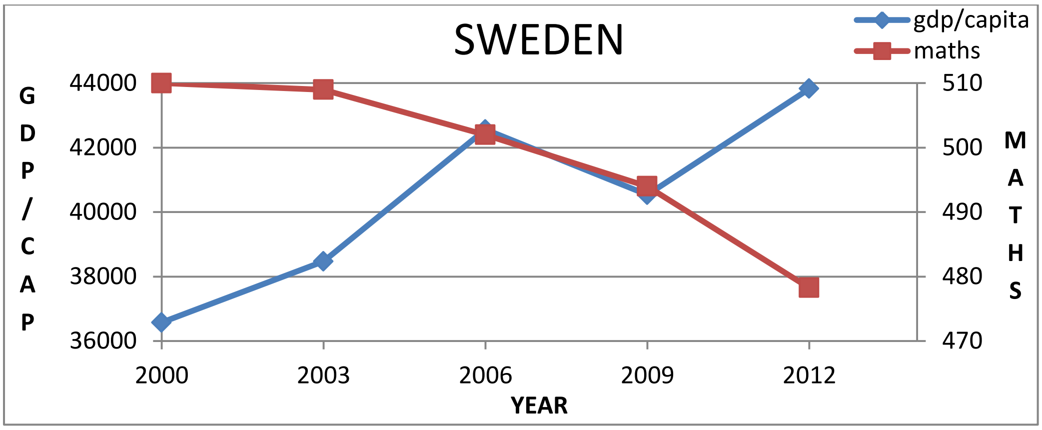
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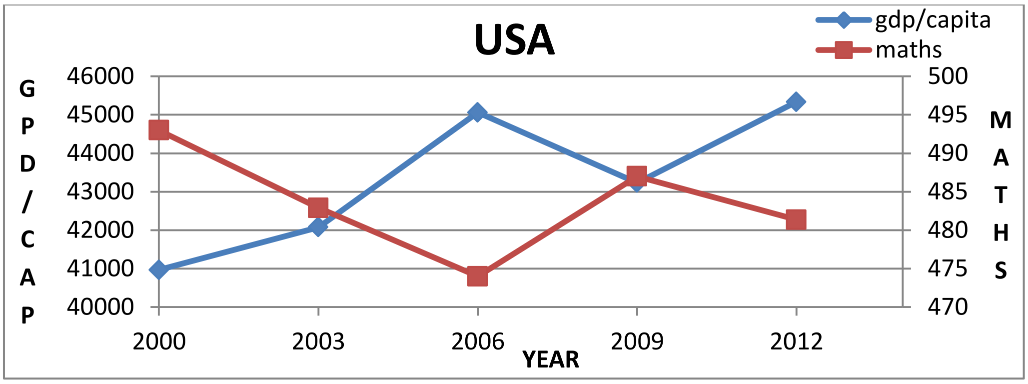
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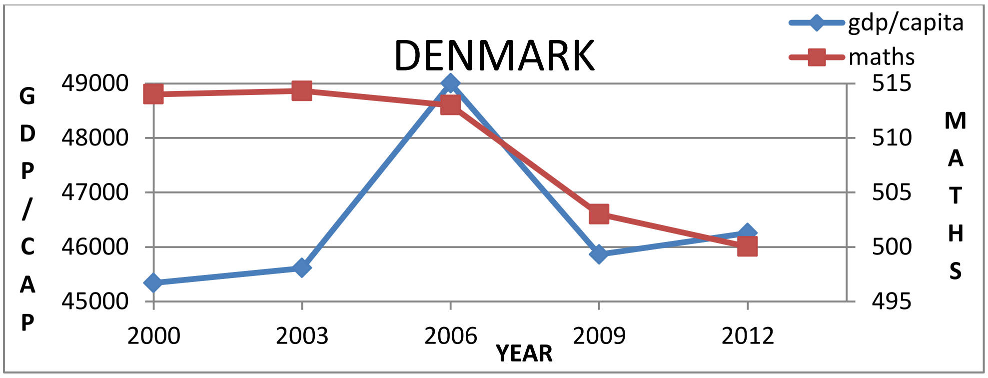
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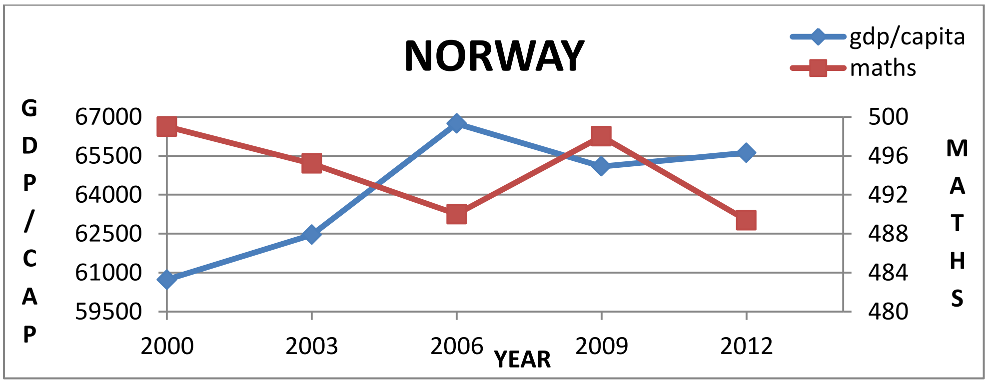
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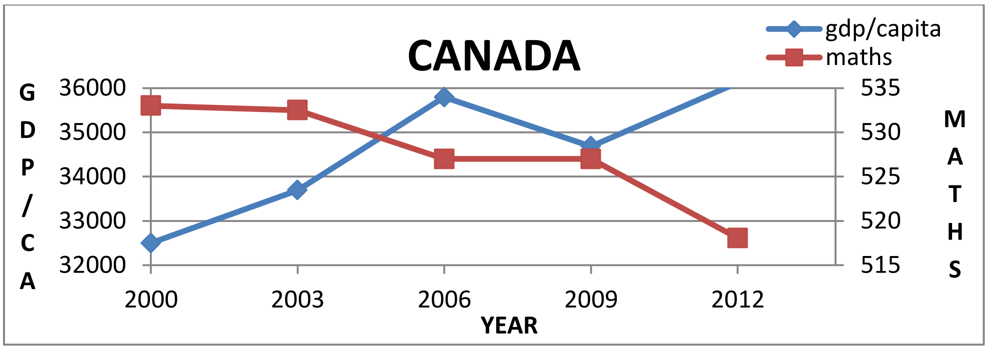
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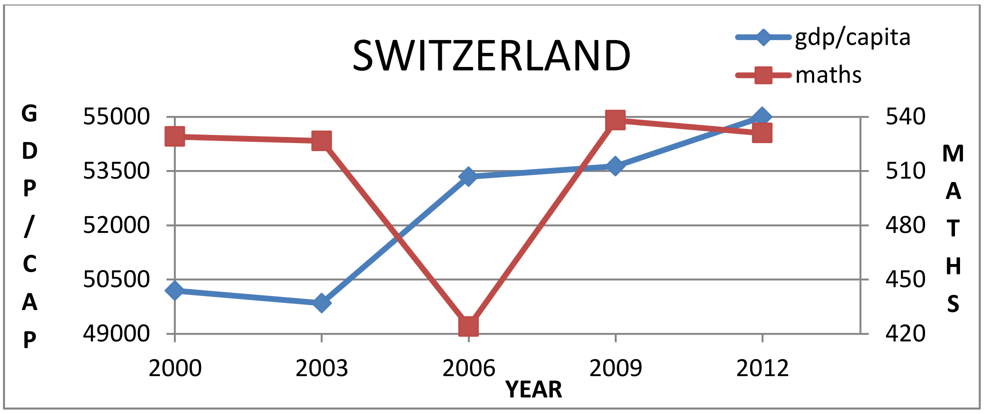
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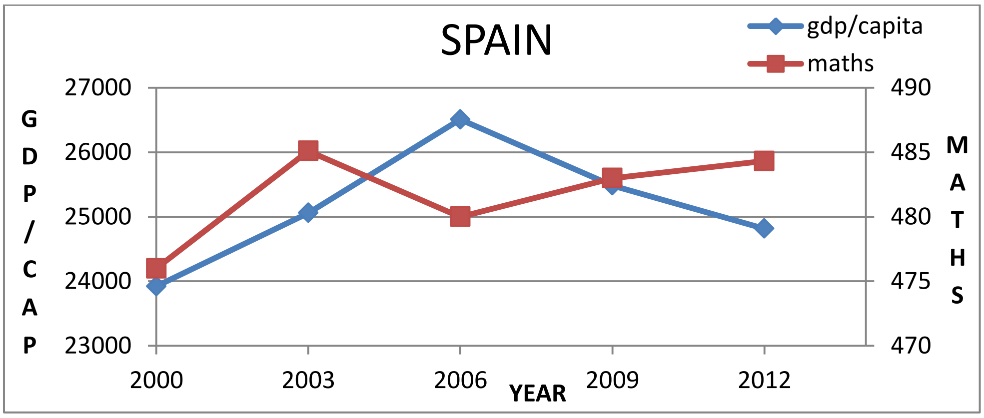
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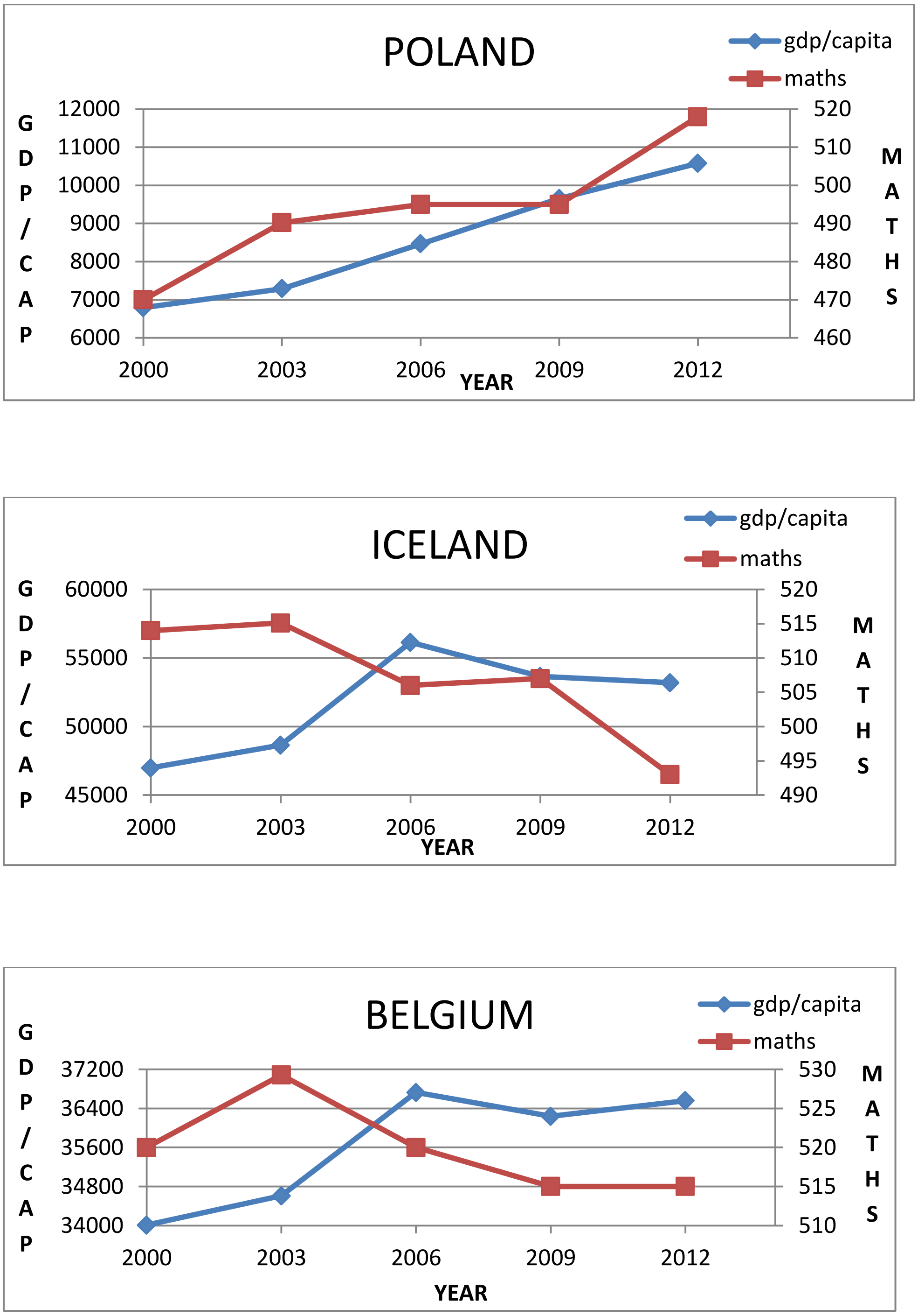

Figure 3.3: Trend of GDP/Capita and PISA math's score for the selected countries

The trend shows how the PISA mathematics tests score and the GDP per capita varies over the sample period for each country. The graphs help one get familiar with the averages of the PISA test score and GDP per capita for each country and how they varied over time. As we can see, for some countries, there is a uni-directional movement for both the test score and GDP per capita, for many countries though there is no such relationship. Nevertheless the test has an explanatory power of a cross-sectional data.

Chapter 6

ESTIMATION TECHNIQUES

The basic issues to be addressed in this chapter are Stationarity, unit root, and co-integration test of panel data, as well as issues of Hetero-scedasticity, cross-sectional correlation, and within-group correlation in panel data estimation.

The data used for the analysis in this study is a balanced panel data with 23 countries covering 5 years. Panel data is also referred to as cross-sectional time series data; this means that a panel data has both cross-sectional data and time series data components.

6.1 Panel Data Estimation Techniques

Whenever we deal with panel data, we have to first choose between modeling the regression for fixed or random effect. These two types of analyses make conceptually contrasting assumptions about effect as either random or fixed:

6.1.1 Fixed Effect

Fixed-effects (FE) are used only when the researcher is interested in analyzing the impact of variables that vary over time. If the data comes from a limited cross-sectional population with longer time series, then fixed effect model will be the correct choice. Fixed effect model is a method of pooling cross-section and time series data. In such models, the variables for each unit can vary over time while the unobserved variables specific to each unit do not change overtime. This model takes into consideration the heterogeneity or individuality in the data by allowing each individual (in this case each country) to have its own intercept value, that is each individual has a different intercept term but same slope parameter.

The equation for the fixed effects model becomes:

$Y_{it} = \alpha_i X_{it} + \beta_1 + u_{it}$ [eqn 6.1]

Where

α_i (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).

Y_{it} is the dependent variable (DV) where i = entity and

t = time.

X_{it} represents one independent variable (IV),

β_1 is the coefficient for that independent variable (IV),

u_{it} is the error term

On the other hand, if the data is from a large cross-sectional population, then one can view individual effects as randomly distributed across cross-sectional units.

6.1.2 Random Effects Models

In the random effects model, individual differences are also captured by intercept, but it is also assumed that the differences across units are random and uncorrelated with the explanatory variables. The model is expressed as:

$Y_{it} = \alpha + \beta X_{it} + u_i + \varepsilon_{it}$ [eqn 6.2]

Here α is individual-specific effect while u_i is the normal error term. For random-effects models, α_i is included in the error term and each individual has the same slope parameter and a composite error term with 2 parts. Here, as mentioned above, error term has two components: u_i, individual error and $\varepsilon_{it,}$ random element that vary both over time and across units. The composite is the sum of two error terms.

The basic distinction between the fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not. (Borenstein, Hedges and Rothstein, 2007)

One advantage of random effects is that it allows for inclusion of time invariant variables (i.e. gender). In the fixed effects model these variables are absorbed by the intercept.

6.2 Pooled- OLS Models

In the pooled- OLS model all observations are given an equivalent treatment as well as the OLS , in this case the error term captures "everything" Naive, ignores time and space because it also ignores the heterogeneity or individuality that may exist in the data as is the case in this study. The pooled model specifies constant coefficients which is the usual assumption for a cross-sectional analysis. The model in general is described thus:

$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + u_{it}$ [eqn 6.3]

Where

Y= dependent variable

X_2, X_3= independent variables

i stands for the i $_{th}$ cross-sectional unit, i = 1, ..., N

t stands for the t$_{:th}$ time period, i = 1, ...,T

6.3 Fixed or Random

- Hausman Test:

  Given a model and data in which fixed effects estimation would be appropriate, a Hausman tests whether random effects estimation would be almost as good. Hausman test is carried out to determine. The test is carried out to determine whether there is significant difference between Fixed and Random effects estimators. When there is no significant difference between them, the Random effects estimator is preferable since it is more efficient, but if they differ significantly, then the fixed effects estimator is preferable.

	H_0 is true	**H_1 is true**
b_1 (RE estimator)	Consistent Efficient	Inconsistent
b_0 (FE estimator)	Consistent Inefficient	Consistent

- Breusch-Pagan Langrange multiplier test (LM):

The Breuch-Pagan Langrange multiplier test is used to test for the Random-effects model based on the OLS residual. The test is used to decide between simple OLS regression and random-effects regression. The null hypothesis in the LM test is that variances across entities are zero. This means that there is no significant difference across units (i.e. no panel effect).

In the case of this study, nether of this test will be used because the pooled panel data model was used for the analysis, and another limiting factor is time constraint, thus implementation of the fix or random effect will not be efficient.

Chapter 7

ESTIMATION RESULTS AND DISCUSSION

7.1 Results

This chapter contains the interpretation of the results obtained from the OLS regression analysis, the regression were conducted using STATA 11 statistical software. As previously introduced, three econometric models were formulated. The main difference between the three econometrics models is that the first model includes the HSE [high school enrollment, (% gross)] variable. The HSE variable is calculated by most countries by dividing the number of individuals who are actually enrolled in high school by the number of children who are of the corresponding school enrollment age.

Model two on the other hand includes the GEE variable (government spending on education) which is a percentage of the total government expenditure. Finally model three contains both the high school enrollment variable and government spending on education variable. The models are restated here as follows:

Model (1)

$$LGDPcap_{it} = \alpha_0 + \alpha_1 LMATHS_{it} + \alpha_2 HSE_{it} + \alpha_3 LLF_{it} + \alpha_4 GNS_{it} + \alpha_5 TGE_{it} + U_{it}$$

Model (2)

$$LGDPcap_{it} = \beta_0 + \beta_1 MATHS_{it} + \beta_2 GEE_{it} + \beta_3 LLF_{it} + \beta_4 GNS_{it} + \beta_5 TGE_{it} + U_{it}$$

Model (3)

$LGDPcap_{it} = \beta_0 + \beta_1 MATHS_{it} + \beta_2 HSE_{it} + \beta_3 GEE_{it} + \beta_4 LLF_{it} + \beta_5 GNS_{it} + \beta_6 TGE_{it} + U_{it}$

Where:

LGDPcap = log of GDP per capita

LLF = log of labour force

LMATHS= log of PISA Mathematics score

HSE = high school enrollment (% gross)

GNS = log of gross national savings

TGE = total government expenditure

GGE= government spending on education

Table 4: Pooled Panel Model Estimation Results

DEPENDENT VARIABLE: LGDPPC			
INDEPENDENT VARIABLES	MODEL 1	MODEL 2	MODEL 3
LMATHS	1.933077 (0. 5971694)***	4.587659 (0.6932826)***	3.870037 (0.6657623)***
LLF	4.87e-09 (1.12e-09)***	3.97e-09 (8.59e-10)***	4.78e-09 (8.67e-10)***
HSE	0.0128048 (0.0042919)***		0.0083467 (.0033032)***
GNS	0.015776 (0.0089554)**	0.0176945 (0.006643)***	.0195348 (0.0066378)***
TGE	0.024731. (0.0042857)***	0 .0292667 (0.0034077)***	0.0268947 (0.0034965)***
GGE		0.0869747 (0.0115316)***	.0803397 (0 .0103879)***
CONSTANT	-4.622682 (3.379458)	-21.10507 (4.299981)***	-17.3954 (4.033729)***

Number of observations	115	115	115
R-squared (R^2)	0.46670	0.6322	0.6322
Adjusted (R^2)	0.44730	0.6104	0.6206
F- stat (p-value)	0.0000	0.0000	0.0000

Robust Standard errors in parentheses below the estimated coefficient
*** (p<0.01), ** (p< 0.05), * (p< 0.1)

The empirical Results obtained from the first model exhibit high conformity with economic expectations, the key independent variables which are, PISA mathematics literacy score and the high school enrollment variable have a positive impact on gross domestic product per capita. The result shows that a 1% increase in the high school enrollment causes gross domestic product per capita to increase by about 1.3%. The result is significant at 1%. Furthermore, the estimated results show that a 1 point increase in the PISA mathematics score causes the gross domestic product per capita to increase by 1.93%, which is also significant at 1%. This indicates that log of PISA mathematics score has a greater effect on log of gross domestic product per capita than high school enrollment.

The impact of gross national savings on log of gross domestic product per capita is also positive. The result indicates that if the annual percentage of gross national savings in a country is raised by 1%, gross domestic product per capita will rise by about 1.58%. The result is significant at 1%.

Log of labour force have positive effects on log of gross domestic product per capita, a 1% increase in the size of the labour force leads to a 4.9% increase in gross domestic product per capita. In the case of total government expenditure as obtained in the result, a 1% increase in the share of total government expenditure of the total GDP leads to a 2.5% increase in gross domestic product per capita. The Both results are significant at 1%.

The Adjusted R^2 result for model one shows that the pooled OLS estimator can explain about 44.73% of the variation in log of gross domestic product per capita.

The second model also reports empirical findings that conform significantly to expected outcomes. In this model, log of PISA mathematics test score has a positive effect on log of gross domestic product per capita. For a 1 point increase in the log of PISA mathematics test score this leads to 4.6% increase in the gross domestic product per capita. This result is significant at 1%. Moreover, the positive coefficient on the total government expenditure on education shows that, a 1% increase in the total amount of expenditure spent by the government on education out of the total government expenditure increases gross domestic product per capita by 8.69%.

The estimated results also show a positive relationship between gross national savings and log of gross domestic product per capita. A 1% increase in gross national savings results in a 1.8% increase in gross domestic product per capita. The result is significant at 1%.

The impact of both log of labour force on the log of gross domestic product per capita is likewise positive. While a percentage increase in log of labour force yields a 3.97% increase in gross domestic product per capita, the result is significant at 1%.

Just like the case in model one, total government expenditure shows a positive relationship with log of gross domestic product per capita, and the result is strongly significant at 1%. A 1% increase in total government expenditure results in 2.7% increase in gross domestic product per capita.

The adjusted R^2 results show that the pooled OLS estimator is successful in explaining 61.04% of the total variation in log of gross domestic product per capita.

The third (3) model captures at the same time the effect of the two quantitative variables of education on the log of gross domestic product per capita. This model includes both the high school enrollment variable and total government expenditure on education.

The third model also conforms to economic expectation, just like the case in model one and two, the log of PISA mathematics score shows a positive relationship with the log of gross domestic product per capita, and the result is strongly significant at 1%. It shows that a 1 point increase in the PISA mathematics score increases the log of gross domestic product per capita by 3.87%

The impact of both log of the high school enrollment and the total government expenditure on education are likewise positive. While holding all other variables constant a percentage increase in the high school enrollment yields a 0.83% increase in gross domestic product per capita, and holding the high school enrolment constant a percentage increase total government expenditure on education leads to a 8.0 percentage rise in gross domestic product per capita. This result is significant at 1%.

The estimated results also show a positive relationship between log labour force and log of gross domestic product per capita. A 1% increase in log of labour force leads to a 4.78% increase in gross domestic product per capita. The result is significant at 1%.

Moreover, the positive coefficient on the gross national savings shows that the greater the amount of savings accumulated annually the greater the gross domestic product per capita, the result shows that a 1% increase in the gross national saving leads to a 1.95% increase in the log of gross domestic product per capita.

A quick view of the estimated results show that in model 3 when the high school enrolment and government expenditure variable was included in the model, there was no high degree of correlation between supposedly independent variables being used to estimate the GDP per capita variable. Although there was a significant change in the adjusted R^2 in model (1) and (2) when the quantitative variables where included independently, but no significant change between the adjusted R^2 in model (2) and (3) when the two variables where included at the same. The estimated results show that there is no case of Multicollinearity in the third model.

7.2 Discussions

The result from this work shows that increase in the PISA mathematics test score, the high school enrollment rate, and the increase in government expenditure on education drives improvements in economic performance. It however further shows that the impact of the PISA mathematics test score on economic performance is higher in the second model as compared to model one and two. As earlier stated in the previous chapters the PISA mathematics test is a proxy that is used to measure the quality of education, the result from the three models shows that the increase in the quality of education which is the PISA mathematics test score will improve the economic performance. It can also be deduced from the fact that the coefficient of Log of PISA maths score increased significantly from 1.933077 in model one to 4.587659 in model two when total government expenditure on education was introduced into the regression equation. This shows that the impact of PISA mathematics test score increases more with the presence of total government expenditure on education. These findings are in tandem with previous empirical findings. See Barbara and John Van (2000), Eric & Ludger (2007), Gregory Mankiw, David Romer and David Weil (1992).

Also, results on gross national savings, labour force lend credence to growth theories such as Harrod-Domar model, Solow-Swan model and M-R-W model. They all show positive relationships with gross domestic product per capita.

The Adjusted R^2 results from the three models show that the pooled OLS estimator explains the variation in gross domestic product per capita within each country over time quite well. The adjusted R^2 in model (3) is bigger than that of model (1) and (2) and The Adjusted R^2 result for model (3) shows that the pooled OLS estimator can explain about 62.06% of the variation in log of gross domestic product per capita.

Chapter 8

CONCLUSION AND RECOMMENDATION

8.1 Conclusion

This research work is motivated by doubts which have risen about the role of the quality and quantity of economic growth. This variety of doubts emanates from different points of view ranging from whether research work has been able to provide concrete evidence of the impact of education on economic growth to whether the improvement in other institutional sectors of the economy might be more effective in fostering economic growth.

8.1.1 The Quality of Education

The quality of education which is measured by what people know has a significant effect on the income of individuals, on the income distribution in the country and on the economic performance (growth). Most of the earlier studies on education have concentrated on school attainment or schooling quantity as the main determinants of education in relation to economic growth, but this focus rather distorted analysis and policy discussion from analysis. Accounted evidence shows that economic growth is strongly affected by the skill of individuals, and the cognitive skill of individuals is a significantly determined by the quality of education acquired through schooling or training. Individual earnings are systematically related to cognitive skills; likewise the distribution of skills in an economy is strongly related to income distribution and economic growth. Although other factors also contribute to economic growth like having a functional economic institutions such as open labour market well established property rights, and trade openness. These factors will not just contribute to economic outcome but may also magnify the benefits of quality education.

Moreover, this research provides concrete evidence to prove that the quality of education is causally related to economic growth. The quality of education may come from the formal system of schooling, from influence from friends, peer group and other students and from parents. A developed economy is basically characterized with a more skilled population, which almost certainly includes a large population of educated individuals with high level of skills and productivity.

8.1.2 Spending on Education and Student Outcome

Any economy that desires to achieve economic growth most give a very high preference to education, by ensuring that a large portion of its population have easy access to education. Mainly the educational sectors contribute immensely to the increase in the output per worker as well as economic growth.

The empirical evidence from this study shows that, developed countries mostly members of the OECD accords a reasonable amount of its budgetary allocation to the educational sector of the economy, it also shows a strong causal impact of skills on the growth outcome of an economy.

This research shows that there is a strong relationship between government spending on education and student outcome. It also reveals the international association between spending levels and the PISA mathematical literacy test performance conducted mainly by OECD member countries.

From the evidence of the analysis it is a well-known fact that funding of educational sectors like building of class rooms and laboratories, increment in teachers' salaries and improvement in their welfare , helps in enhancing knowledge of students and increase the economic productivity or economic growth. It is a well-known fact that if individuals have good condition and environment for learning they will enjoy and assimilate knowledge faster.

8.2 Recommendation

Evidence has shown that funding of education is a burden that is becoming too much on the shoulders of the government across countries of the world. It is also true that to revamp the educational sector there is need for a collective effort from both the private and public sector. Therefore the private sector should be motivated to contribute more in improving and achieving educational goals.

There is mounting evidence that the quality of teachers is an important input to student performance. The major problem that is faced in most countries in terms of schooling policy is lack or inadequate incentive for improved student performance. Neither the school personnel nor the students are significantly motivated for high performance. Without out this incentives one may be amazed to find out that added resources does not consistently derive an improvement in student outcome.

The study shows increase in resource put into education and the student performance plays a significant role in economic growth across countries of the world. The following are some recommendations and policies that can improve the overall student performance.

The private sectors can contribute to education by organizing mentorship programs, seminars, career development programs. Some commercial firms and multinational firms can go into partnership with the educational sector and government to finance scholarships for individuals, to finance some research works and to aid teachers to embark on further studies and research work at all levels. Increase in scholarship opportunity and training grants can also be provided by the government for individuals studying within and outside the country.

As earlier stated that teachers contribute massively to student performance, teachers can be motivated to perform better if their working condition is is pleasant enough. Good salary schemes and other incentives should be implemented by both the public and private sector to increase teacher's morale; this will make teachers more efficient in their duties because teachers serve as catalyst for socio- economic and intellectual development of individuals and the economy as a whole.

Reliable accountability system that measures student performance is necessary, when schools have accurate record of student performance they will have the ability to make appropriate decision that will lead to better outcome in the future.

In an attempt to find out how education policies in developing countries can create the competencies and learning achievement required for citizens to prosper in the future, one will find out that the main constraint is the institutional reform and not an increase in the resource in the current institutional system. Basically for investment in education to transmit into student learning all the individuals involved most be given the appropriate incentives that will make them act in the right way to advance student performance.

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