PUBLIC EDUCATION EXPENDITURE AND ECONOMIC GROWTH IN NIGERIA: 1970 - 2010

BY

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Being

A Thesis Submitted in Partial Fulfilment of the Requirement for the Award of

Doctor of Philosophy (PhD) in Economics of

Covenant University, Ota, Ogun State

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2013

DECLARATION

I, **Ese S. URHIE,** declare that this thesis is my own original work and that no portion of the work referred to in this thesis has been or will be submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Ese S. URHIE ----------

Signature & Date

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Covenant University a dissertation/thesis entitled: "Public Education Expenditure and Economic Growth in Nigeria: 1970 - 2010" in partial fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) in Economics of Covenant University, Ota, Nigeria.

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DEDICATION

This thesis is dedicated to Almighty GOD who has made all things beautiful in His time.

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Theoretical and empirical evidences support the prime role of public education expenditure in rapid and persistent economic growth. However, available statistics in Nigeria does not seem to support this view. An average of 5.72 per cent of public expenditure was spent on education between 1970 and 2010. During the same period, economic growth was not only inconsistent, but averaged 0.6 per cent. Public education expenditure, no doubt promotes educational attainment which could be regarded as a proximate target. It could also have a direct effect on economic growth through the multiplier effect of government spending. These relationships are seldom captured by empirical studies especially those based on Nigerian data. Also issues such as endogeneity problem associated with growth empirics are often overlooked. This is evident in the specification of empirical models and consequently the lack of consensus in the results obtained. In a nutshell, the channel through which public education expenditure affects economic growth is not yet well understood. This study examines the direct and indirect effects of both public recurrent and capital expenditure on education and economic growth in Nigeria from 1970 to 2010.The Instrumental Variable Two Stage Least Squares (IV2SLS) estimation technique which ensures both unbiased and consistent coefficient estimates is employed. The result reveals that public education expenditure has both direct and indirect effects on economic growth. The indirect channel has been more relevant for economic growth in Nigeria. Thus, total public education expenditure can promote economic growth without necessarily first improving education attainment.. The study also reveals that public recurrent education expenditure (pree) and public capital education expenditure (pcee) have different effects on economic growth. The regression results suggest that capital expenditure has greater effect on education (proxied by secondary school education) while recurrent expenditure has greater effect on economic growth. However, to maximize the benefits from public education expenditure, strategies that ensure greater efficiency of public education expenditure were suggested.

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Theoretical and empirical evidences support the prime role of public education expenditure in rapid and persistent economic growth. However, available statistics in Nigeria does not seem to support this view. An average of 5.72 per cent of public expenditure was spent on education between 1970 and 2010. During the same period, economic growth was not only inconsistent, but averaged 0.6 per cent. Public education expenditure, no doubt promotes educational attainment which could be regarded as a proximate target. It could also have a direct effect on economic growth through the multiplier effect of government spending. These relationships are seldom captured by empirical studies especially those based on Nigerian data. Also issues such as endogeneity problem associated with growth empirics are often overlooked. This is evident in the specification of empirical models and consequently the lack of consensus in the results obtained. In a nutshell, the channel through which public education expenditure affects economic growth is not yet well understood. This study examines the direct and indirect effects of both public recurrent and capital expenditure on education and economic growth in Nigeria from 1970 to 2010.The Instrumental Variable Two Stage Least Squares (IV2SLS) estimation technique which ensures both unbiased and consistent coefficient estimates is employed. The result reveals that public education expenditure has both direct and indirect effects on economic growth. The indirect channel has been more relevant for economic growth in Nigeria. Thus, total public education expenditure can promote economic growth without necessarily first improving education attainment.. The study also reveals that public recurrent education expenditure (pree) and public capital education expenditure (pcee) have different effects on economic growth. The regression results suggest that capital expenditure has greater effect on education (proxied by secondary school education) while recurrent expenditure has greater effect on economic growth. However, to maximize the benefits from public education expenditure, strategies that ensure greater efficiency of public education expenditure were suggested.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The foremost macroeconomic objective of governments in virtually all countries is the achievement of rapid and sustainable economic growth with price stability. Consequently, the ultimate aim of macroeconomic policy is to increase the material welfare of the community (Iyoha 2002, Vaish 2002). The achievement of economic growth leads to greater economic prosperity. Increasing overall prosperity improves the lives of those able to partake in the system. People are better able to provide for their needs and fulfil their wants, without the use of force. This rising prosperity is empirically linked to higher overall levels of human happiness and betterment. Conversely, without economic growth, economies stagnate and nations are unable to provide for the well-being of their citizens. Economic failure historically causes a loss of trust and social upheaval, frequent and ugly triggers of social conflicts. It behoves one to recognize this and do what is possible to remedy it (Zipfel, 2004).

An examination of available data show that Africa's gross national income (GNI) per capita declined by almost 10 per cent between 1980 and 2004 (African Development Bank 2006; 37). Specifically, Nigeria's GNI per capita declined from US$652 in 1980 to US$390 in 2004. Ironically, some countries

in Asia such as, the Republic of Korea, Singapore, Taiwan and Thailand (the Asian Tigers) tripled their per capita income within the same period (Maddison, 2001). The poor performance in Africa could be attributed to the slow or negative growth rate in the member countries (Easterly 2001, and Artadi and Sala-i-Martin 2003).

At an average economic growth rate of 0.602 per cent (between 1970 and 2010), it will take Nigeria more than a century to double its 1970 per capita income. However, available statistics show that Republic of Korea, Singapore, Malaysia, and United States of America (USA), as at 2007, have already increased their per capita income by 7.6, 6.7, 5.0, and 2.1 folds respectively (see United Nations Statistical Division). This does not come as a surprise considering the average economic growth rate of these countries during the period under review.

There is a rich literature (theoretical and empirical) on the determinants of long run economic growth, which include natural, economic, political, sociological and geographical factors (Solow 1956, Lucas 1988, Barro 1990, Aghion and Howitt 1992, Sala-i-Martin 1997, Maddison 2001, Rogers 2003, Zipfel 2004, and Harberger 2005). A review of existing literature shows a continuous extension of the factors that determine economic growth. This is due partly to the inability of existing theories to explain growth (or lack of growth) patterns. The shortcomings of the exogenous growth theory (such as its inability to account for observed growth and lack of convergence among

countries) led to the development of the endogenous growth theory. Subsequently, other factors such as institutions, poor infrastructure, imperfect capital and goods markets and geography, amongst others have been identified to have significant impact on the growth slowdown of developing countries. However, in recent times there has been a heated debate on the efficacy of both the exogenous and endogenous growth theories in the explanation of growth process in the world.

In an attempt to unravel the factors behind the tragedy of economic growth in Africa, Artadi and Sala-i-Martin (2003) identified the following as significant factors: expensive investment goods, low levels of education, poor health, adverse geography, closed economies, too much public expenditure and too many military conflicts. They contended that if the values of these determinants in Africa had been those of the Organization for Economic Co-operation and Development (OECD) countries, the economic performance of Africa would have been better than was experienced.

In a similar vein, available statistics show the median per capita income growth in developing countries (which include all African countries) to be zero between 1980 and 1998 in spite of numerous policy reforms aimed at economic growth. Hence, Easterly (2001) classifies the period as a lost decades for developing countries. He opined that in accordance with the standard growth regression model, Africa should have experienced a growth in per capita income above 2.5 per cent (which is the average growth rate of per

capita income between 1960 and 1979). Easterly suspects factors like increase in world interest rate, the increased debt burden of developing countries, the growth slowdown of the industrialised world, and skill-biased technical change to be responsible for the stagnation in developing countries.

The need for this study is best captured by Handelman (2006) who noted that the challenges facing the less developed countries of Africa, Asia, Latin America, the Caribbean, and the Middle East today appear daunting. They include political, economic and social challenges, which are capable of provoking warfare, internal violence, and massive human suffering. According to Handelman, these challenges are not peculiar to less developed countries only. They are also found in industrialized economies. However the scope and persistence of the developing world's political, economic and social challenges pose a concern for both domestic governments and the world at large. In concluding their article on *The Economic Tragedy of the XXth Century: Growth in Africa*, Artadi and Sala-i-Martin (2003) stated that "Africa's growth performance was the largest economic disaster of the 20th century. We can prevent it from being the largest disaster of the next century". In other to prevent the repeat of the economic disaster of the past, the history and experiences of advanced countries is very relevant.

Studies have shown that investments in human capital are essential for sustaining economic growth over time (see section 2.2.2.) The law of diminishing returns suggest that investments in physical capital and land

eventually fail to result in economic growth. Yet, countries such as the United State, Japan, and many European nations have sustained economic growth over the past century. Thus, much of the growth in per capita income and economic productivity have been attributed to heavy investment in capacity building of workers and a better educated labour force. Data on economic output and human capital across countries from 2000 to 2005 shows a positive correlation between the level of economic output and human capital - measured by the combined indexes of education and health in Human Development Index. (See Human Development Report 2009).

According to the United Nations Development Programme (UNDP 2005;24), gaps in opportunity for education remains large. It noted that in an increasingly knowledge-based global economy, about 115 million children worldwide are denied the most basic primary education. Most of these children are in Sub Saharan Africa (SSA) and South Asia. Moreover, while the primary enrolment gap may be closing, the gap between rich and poor countries measured in terms of average years of education is widening. This is before taking into account differences in educational quality. Undoubtedly, these inequalities of today are the global social and economic inequalities of tomorrow.

The role of human capital in achieving sustainable economic growth and the responsibility of the public sector in this regards has been recognized by Weisbrod (1962:106). According to Weisbrod, "investment in future

productivity is occurring increasingly outside the private market and in intangible forms. Our traditional conception of investment as a private market phenomenon and only as tangible plant, machinery and equipment must give way to a broader concept which allows not only for government investment but also for intangible investment in the quality of human capital". He also maintained that more attention should be paid to the adequacy of the level of expenditure on people. This idea was recently encapsulated in a model of economic growth. Thus, the role of human capital in the adoption and improvement of technology has been demonstrated by endogenous growth theorists such as Romer (1986, 1990), Lucas (1988), and Becker, Murphy & Tamura, (1990). Another class of models known as the "AK type", replaced the assumption of diminishing marginal productivity of capital with the non-diminishing marginal productivity of the accumulable factor of production to achieve positive and sustainable steady state growth rate in the economy. These include Jones and Manueli (1990) and Rebelo (1991).

Education has been identified as the most vital instruments in the process of economic growth and development. However, one issue that has not been adequately addressed is its provision in the required quantity and quality. For instance, while secondary school gross enrolment ratio in 2007 stood at 101 percent for high income countries, the value was 38 percent for low income countries (LDCs). Even at that, Nigeria's value stood at 32 percent which was six percent lower than the average for LDCs (World Development Indicators

2011). The nature of education, the prevailing economic system and government priority are factors that could influence its level in any economy.

Furthermore, though education is generally believed to play a crucial role in the process of economic growth, its relative importance and transmission mechanism remain unclear. In view of the above, this study sets out to evaluate the effects of public education expenditure in educational output and economic growth in Nigeria.

1.2 STATEMENT OF THE RESEARCH PROBLEM

Studies on the relationship between public education expenditure and economic growth present mixed results (see section 2.2.4.2). Most empirical studies have supported the endogenous growth theory which stipulates that public policy is instrumental to improvement in economic growth rate (Lucas 1988; Barro and Sala-i-Martins 2004). Initial studies on the effect of public expenditure on growth centred on the aggregate values of government expenditure measures. Subsequent studies addressed the effects of the components of government expenditure in terms of functional and economic divides. Most of these studies found public expenditure on education to be most significant (Poot, 1999; Odedokun, 2001). Consequently, recent researches have focused on the effect of public education expenditure on economic growth. Just like total government expenditure, the functional

components also have their economic components (that is recurrent and capital expenditure); which serve different purposes. However, very few studies have considered this issue (see Oluwatobi and Ogunrinola 2011).

Generally, most studies on the relationship between public education expenditure and economic growth have adopted a partial approach. While some evaluate the effect of public education expenditure on economic growth, others analyze the effect of education on economic growth: thus, ignoring the link between education expenditure and education. The expected positive influence of education expenditure on the level of education may be elusive especially in highly corrupt economies. In this case, only the direct effect of public education expenditure will be felt. Few studies such as Jung and Thorbecke, (2001) and Baldacci, Clements, Gupta and Cui, (2004) which examined the relationship among public education expenditure, educational attainment and economic growth in a concise manner adopted the aggregate values of education spending. In addition, Jung and Thorbecke adopted a neoclassical multisector computable general equilibrium (CGE) approach, while Baldacci et *al* used a panel data regression model. These studies failed to test for endogeneity.

In Nigeria, average public education expenditure to total government expenditure between 1970 and 2010 is 5.72 per cent. It ranged between 0.51 and 10.8 per cent during the period under review (CBN Statistical Bulletin, 2008). On the contrary, average economic growth rate for the period (1970 –

2010) was 0.6 percent. This ranged between -15.4 per cent (in 1981) and 30.5 per cent (in 2004) during the period under review. At this growth rate, it would take more than a century for Nigeria to double its 1970 per capita income.

The statistics presented above indicates that the investment in education has not produced the desired level of human capital and economic growth in Nigeria.

1.3 RESEARCH QUESTIONS

The issues raised above have provoked series of questions which this study attempts to provide answers.

i. How effective is public education expenditure in promoting education and economic growth?

ii. What is the nature of the relationship between public education expenditure and economic growth?

iii. Do public recurrent and capital education expenditure have the same effect on education and economic growth?

iv. To what extent does the endogenous growth theory explain growth trend in Nigeria?

v. Through what channel has public education expenditure influenced economic growth in Nigeria?

1.4 OBJECTIVES OF THE STUDY

The main objective of the study is to evaluate the relationship between public education expenditure and economic growth in Nigeria.

Specific objectives of the study are to;

i. Estimate the effect of public education expenditure on educational output in Nigeria.
ii. Estimate the effect of public education expenditure on economic growth in Nigeria.
iii. Evaluate the effect of education on economic growth in Nigeria.
iv. Examine the relative effectiveness of recurrent and capital expenditures on education in Nigeria.
v. Estimate the effect of both recurrent and capital education expenditures on economic growth in Nigeria.

1.5 HYPOTHESES OF THE STUDY

The following hypotheses were tested in this study.

i. There is no significant difference between the estimated effect of aggregate public education expenditure and those of its components.

ii. Public education expenditure has no significant effect on education in Nigeria.

iii. Education has no significant effect on economic growth in Nigeria.

iv. Public education expenditure has no significant effect on economic growth in Nigeria.

1.6 SCOPE OF THE STUDY

The study is based on data from Nigeria between 1970 and 2010. Public education expenditure could be measured in various ways –ratio of education expenditure to total government expenditure; ratio of education expenditure to gross domestic product; per capita expenditure on education; total absolute value of budgetary allocation to education; and proportion of education expenditure devoted to the three levels of education. Although emphasis was on a modified version of the ratio of education expenditure to total government expenditure, the first two measures were also employed to test for the robustness of the model.

Basically, there are three tiers of education in Nigeria – primary, secondary and tertiary. The study focused on secondary school education because it is the level of education required to ensure industrialization which results in sustained economic growth (O' Callaghan, 2002). Both the quantity and quality of education have been found to be instrumental in enhancing economic growth. However, due to insufficient data, the study is restricted to the quantity of education. Also, the different measures of education include

enrolment rate, completion rate and average years of schooling. This study adopts enrolment rate. Other measures were not considered due to the dearth of data.

1.7 SIGNIFICANCE OF THE STUDY

Growth models offer useful predictions that aid policy decisions. Misspecification of a regression model will lead to biased coefficient estimates, which will invariably lead to misleading policy recommendations. The adoption of policy options emanating from inaccurate findings could render government intervention, especially in the education sector inefficient. It takes a good understanding of the relationship among investment in education, its outcome, and economic growth to design an appropriate policy measure that will enhance the adequate supply of education in an economy. Thus, a representative model that takes into consideration the inter-relationship among public education expenditure, education attainment and economic growth will ensure appropriate allocation and use of public funds.

The outcome of this study will serve as a guide to policy makers in the Ministries of Finance, Education and the National Planning Commission as well as other relevant government department and agencies interested in the development of the education sector in particular and the economy in general. It will also serve as a useful reference for future researchers in this field.

1.8 DEFINITION OF TERMS

i. Public Education Expenditure (PEE)

This refers to federal government expenditure on education. The two measures adopted in this study are ratio of government expenditure on education to total government expenditure; and ratio of government expenditure on education to gross domestic product (GDP). Derivatives of these variables are, Public Recurrent Expenditure on Education (PREE) and Public Capital Expenditure on Education (PCEE).

ii. Outcome

Outcome as used in this study refers to educational attainment. Two major indicators used in the literature are enrolment rate and average years of schooling. Budgetary outlay is regarded as input. Its output includes schools, materials, and number of teaching and non-teaching staff employed. Thus, the Outcome of PEE is different from the outcome of education which is economic growth as depicted in Table 1.1 below..

It is important to note that the efficiency of PEE determines its output. Although the output of PEE determines its outcome, it does not guarantee it. Reason is that the influence of other factors such as the opportunity cost of education may outweigh the effect of the provision of schools and other

materials. In view of this using education as a proxy for PEE may not be appropriate.

Another education variable is the number of schools, teachers and materials (STM). This could be regarded as an input whose output is enrolment. Assuming regular attendance, completion and quality, the consequences of enrolment (which constitutes an outcome) include literacy and numerate skills (for primary education), adaptation to current technology (for secondary education), and the creation and dissemination of knowledge (for tertiary education).

Table 1.1 Relationship between input, output and Outcome of Education Variables

INPUT	**OUTPUT**	**OUTCOME**
PEE	Schools	Education (Enrolment)
Schools	Access to Primary Education Access to Secondary Education Access to Tertiary Education (Enrolment)	Literacy / Numeracy, Adaptation to Technology & Creating and Disseminating new Knowledge
Education (Enrolment)	Literacy Adaptation to Technology Creating new Knowledge	Economic Growth

Source; Author's design

1.9 OUTLINE OF THE STUDY

The study is divided into five chapters. Following this introductory chapter, chapter two is devoted to a review of theoretical, empirical and methodological literature relating to the issue of public investment and economic growth. Two endogenous growth models which form the backbone of this study are outlined in chapter three. The chapter also contains the research design for the study. Other issues addressed are the method of estimation as well as the definition of variables and sources of data. Chapter four presents a trend analysis of the main variables in the study. Following the trend analysis are the regression results for the study and discussion. Based on the major findings from the analysis of regression results, some policy implications were presented. Chapter five concludes the paper with summary and recommendation for further studies.

CHAPTER TWO

LITERATURE REVIEW

Economic growth theories and models seek to explain and predict how; economies develop (or not) over time; barriers to growth can be identified and overcome; government can induce, sustain, and accelerate growth with appropriate development policies. Researchers have and continue to identify factors that either promote or hinder rapid economic growth both in developed and developing countries (Zipfel, 2004). In spite of this common knowledge, developing countries (especially those in Sub-Saharan Africa) still wallow in the throes of low economic growth and poverty. Consequently, this chapter reviews both theoretical and empirical studies on the 'drivers' and hindrances to rapid economic growth.

The chapter is divided into three sections. Section 2.1 appraises both the neo-classical growth theory and the various versions of endogenous growth models. Section 2.2 surveys the empirical literature on the effect of public finance on education attainment and economic growth. The third section highlights some methodological issues bothering on data measurement and model specification.

2.1 THEORETICAL REVIEW

Economic growth theorists since Adam Smith have discussed a plethora of different means and manners to stimulate and sustain economic growth. However, the fundamental model has remained the same. The different theories are more of variations on a theme than fundamental disagreements, at least on the factors; land, labour, and capital (generally construed as physical capital). The disagreements occurred on resolving what the most efficient uses were and arrangements of these three factors and by who they should be controlled (Zipfel, 2004, Romer, 2007). The aim of this section is to highlight the thinking of modern economists on the process of economic growth. The starting point is a consideration of the neoclassical growth model and 'new', or endogenous, growth theory. Contemporary growth theories as well as those that explain the effect of public finance on economic growth are also examined.

2.1.1 Neo–classical Growth Theory

Solow (1956) developed a model that revolutionized the understanding of growth theory. Solow recognized that the inputs of physical capital and labour, did not encapsulate all of the information relevant to understanding the size, strength, and growth potential of a particular economy. Building on pioneering work that enquired into the effects of technological progress on an economy,

Solow understood that a significant portion of economic output is dependent on the rate of technological progress of the economy being studied.

Solow added technology to the production function equation. However, he added it as a variable that existed exogenously from the neoclassical model's production function equation (Cortright, 2001). This exogenous technology variable was meant to account for any discrepancies between what certain levels of capital and labour would indicate as the output and actual output, especially in cross-country comparisons. More importantly, it provided a vehicle for explaining the rate of growth over time.

There is, however, a major weakness to Solow's model. By keeping technology outside of the equation, Solow's model could not explain "why" or "how", or from where technological progress came from (Cortright, 2001). The model therefore lacks quite a bit of explanatory power. However, this drawback was quickly recognized and many studies have researched and theorized different ways to account for technology and technological progress.

One important implication of Solow's work was the theory of income convergence (Barro, 2001). Convergence is based on the diminishing returns to capital that were first recognized by Malthus and Ricardo. The theory of convergence states that cross-country economic differences will shrink over time due to the diminishing returns to capital.

However, this is a gross oversimplification of the economic realities and differences between most countries. Economic convergence is not true in an absolute sense. However, it is accepted as being conditionally correct. Essentially, convergence is an important effect; however, its effects only apply when all other variables are held constant (Barro and Sala-i-Martin, 1992, 1995, Mankiw, Romer, and Weil, 1992, McCallum, (2003),

While Solow's model made great headway in the quest for understanding economic growth, it did not have adequate explanatory power to account for output and to predict growth. The obvious shortcoming is that the long-run per capita growth rate is determined entirely by an element – the rate of technological progress - that is outside the model. The long-run growth rate also depends on the growth rate of population, another element that is exogenous to the standard theory. Thus, economists continued their work into alternative and more refined ways to account for economic output and growth over time.

It should be noted that the foregoing discussion does not imply that the neoclassical analysis was unproductive. On the contrary, it played a major and essential role in the development of dynamic general equilibrium analysis, the basis for much of today's economic theory. It is only as a theory of growth that it is here being criticized.

2.1.2 Endogenous Growth Models

Following the shortcomings of the Solow model, Romer (1986) and Lucas (1988) attempted to 'endogenize' the sources of growth, so that the rate of growth would be determined within the model. The scholars of this time introduced new theories of technological discovery and adaptation that accounted for spill over effects, that is, the entirety of benefits from technological discovery can never fully be understood since one discovery can cause benefits in other areas that are not always understood or even recognized (Cortright, 2001; Barro, 2001). This theory allowed economists to argue that technology causes increasing returns to scale. Instead of capital being limited by diminishing returns to scale, capital can be utilized in ever more efficient manners. Not only does this counterbalance the diminishing returns to scale, technology effectively offsets diminishing returns and allows theoretically limitless growth possibilities. The new economic theory discoveries allowed economists to better understand and explain the "how" of growth.

The endogenous growth literature has produced two distinct approaches on how to incorporate human capital into models of economic growth (Schütt, 2003). The first, which is due to Lucas (1988), regards the accumulation of human capital as the engine of growth. The second approach emphasizes the role of the human capital stock in the process of innovation and adoption of new technologies (Romer, 1990).

2.1.2.1 Growth Driven by Human Capital Accumulation

In the model formulated by Lucas (1988), human capital enters into the production function in the way in which technology does in the Solow model, that is, in labour-augmenting form. The economy consists of identical individuals (or representative agents) who are maximizing life-time utility. Agents have control over two variables: the level of consumption, and the allocation of time between work and skill acquisition. The first variable determines the accumulation of physical capital, while the second variable affects an agent's future productivity. The model assumes technology to be constant. Population growth is taken as exogenous.

The linearity assumption in the Lucas model implies that the growth rate of human capital is independent of its level. In other words, no matter how much human capital has been accumulated, a given effort always produces the same percentage increase. Romer has offered a possible explanation why this may be plausible. The acquisition of skills may in fact facilitate or prepare learning (Romer, 2001: 134). He states that in primary school, children are taught basic knowledge (such as literacy) which may not improve their ability to contribute to production by very much. Instead, it may be a prerequisite for the acquisition of productivity-enhancing skills throughout the rest of their education and their professional career.

Since there are no diminishing returns to the acquisition of skills, human capital can grow without bound, thereby generating endogenous growth. The properties of the steady state in the Lucas model depend on whether there are external effects of human capital.

2.1.2.2 Human Capital and Technological Change

A second category of endogenous growth models maintains the assumption underlying the Solow model that technological progress is at the heart of economic growth. However, by no longer leaving technological change unmodeled, these theories acknowledge that a large portion of inventions is the result of purposeful research and development (R&D) activities carried out in reaction to economic incentives. This changes the role for human capital, which enters into these models as a catalyst of technological progress rather than as an independent source of sustained growth.

Nelson and Phelps (1966) were the first to contend that people's educational attainment may have a significant influence on their ability to adapt to change and introduce new technologies. Accordingly, a higher level of human capital would speed up the process of technological diffusion in the economy. This would enable countries lagging behind the world technology frontier to catch up faster with the technological leader. However, in the model developed by Nelson and Phelps, the evolution of the best-practice level of technology is left

exogenous, so that human capital only plays a role in helping countries narrow the gap to the technological frontier. Romer (1990) has extended this concept beyond the adoption of existing technologies to the creation of new ones, starting from the observation that R&D activities require highly skilled labour as the single most important input. A major implication of both of these approaches is that technological progress, and thus growth, depends on the stock of human capital (as opposed to its accumulation). In the Romer model, a one-time increase of the stock of human capital is sufficient to augment the rate of economic growth forever

Generally, Parente (undated) distinguished between two categories of endogenous growth literature; these are models of imperfect competition and models of perfect competition. Models of imperfect competition consist of studies that explicitly model the decisions of private agents to undertake costly research and development (R&D). These studies introduce imperfectly competitive elements to the models by conferring monopoly power to the successful innovator. Without the potential to earn monopoly profits, no self-interested agent would incur the costs to engaging in R&D activities. The pioneer papers in this literature are Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992). More recent efforts in this literature, for example Jones (1995), Segerstrom (1998), and Young (1998) are variations on these original papers intended to remove an undesirable prediction of these models, namely that countries with larger populations have

higher growth rates and possibly higher levels of per capita output. The prediction known as the scale effect is not borne out by the data. Most economists agree that technological change is the source of sustained increases in per capita output. Most economists further agree that the creation of this knowledge is the result of research and development efforts undertaken by individuals and firms. Parente argued that the main reason the United States is so much richer today compared to 200 years ago is because of new inventions and discoveries made over this time. This branch of endogenous growth theory, therefore, has the potential to improve our understanding of how knowledge has grown and how the leading industrialized countries have been able to double their incomes approximately every 35 years over the last two centuries. R&D models, however, do not help us understand why the whole world is not rich. Currently, there are huge differences in living standards between countries.

On the other hand, not all endogenous growth theory models R&D as the source of sustained economic growth. A large number of authors have constructed models whereby private agents do not undertake R&D and yet there is sustained growth. These models do not have to deviate from the assumption of perfectly competitive markets. These models tend to focus on the decision of agents to accumulate capital, where capital can be tangible or intangible in nature. The key abstraction of these models for generating this result is that there are no diminishing returns to reproducible capital at the

aggregate level. The pioneer works in this branch of the endogenous growth literature are Romer (1986), Lucas (1988), and Rebelo (1991). These models have the property that cross-country differences in policy or preferences lead to permanent differences in growth rates of per capita output. Several of these models can be interpreted as models of technology adoption, since technology adoption in one way or another represents the accumulation of intangible capital.

In summary, the endogenous growth theory provides a theoretical framework for analyzing persistent growth of output that is determined within the system governing the production process. One key assumption of these models is increasing returns to scale. The models also address technological spillovers and other positive externalities that may be present in the process of industrialization. An important implication of the new growth theory is that economies with increasing returns to scale do not necessarily reach a steady-state level of income. The models also do not conclude that poor countries will grow faster than rich countries, so there is no expectation of convergence. Thus, income disparities may persist or even enlarge if richer countries make investments that encompass larger externalities.

In developing countries, the potentially high rates of return on investment (low capital-labor ratios) are often greatly eroded by lower levels of complementary investments in human capital, infrastructure, or R&D. Thus the new models

emphasize the importance of investments in human capital and potential gains from technology transfer from the technologically advanced countries

In conclusion, the new growth theory remains dependent on some of the traditional neoclassical assumptions that are inappropriate for developing countries - for instance, that there is but a single production function (that is, all sectors are symmetrical). Economic growth in developing countries is frequently impeded by inefficiencies arising from poor infrastructure, inadequate institutional structures, imperfect capital and good market. Because endogenous growth theory overlooks these factors, its applicability to development is limited, especially when country-to-country comparisons are involved. The empirical studies of the predictive value of endogenous growth theories have offered only limited support to date. Rather, exogenous growth theory is much more useful for this purpose.

2.1.3 Contemporary Endogenous Growth Theory

In view of the short comings of the endogenous growth model highlighted above, and following the seminal work of Barro (1991), the recent empirical literature on economic growth has identified a substantial number of variables that are partially correlated with the rate of economic growth (see Durlauf, Johnson and Temple 2004 for an extensive review). Contemporary theorists now look at a plethora of variables and study their importance and ability to

explain economic growth and prosperity. These variables include, Human capital (Bils and Klenow, 2000); Economic institutions and freedoms (North 1970, Benson 1989, Mattei 1997, Gwartney 2001); Political Freedoms (Lipset, 1959, Przeworski and Limongi, 1993, Florini 1998, Quinn and Woolley 2001, Diamond 2003, Zakaria, 2003); democracy (Rodrik 1996, Barnes 2001, Quinn and Woolley 2001); Geography (Bloom, Sachs, Collier, and Udry 1998, Ross 2001, Acemoglu, Johnson, and Robinson, (2004); and Culture (Granato, Inglehart, and Leblang 1996, Landes 1999, Harrison 2000, Barro and McCleary, 2003).

In view of these determinants, Kibritcioglu and Dibooglu asserted that endogenous growth models, no matter whether they are "scale" or "AK-type" emphasize the important role of governments' fiscal, technology, as well as education and health policies in the process of economic development. They also leave some room to historical, cultural and sociological factors as determinants of long-run growth.

2.1.4 Public Finance in Models of Economic Growth

The aim of this section is to outline the main theoretical approaches used in modelling the linkage between fiscal policies in general and public expenditure in particular and economic performance.

Generally, there are two schools of thought on the role of government in economic growth (Ram, 1986). Those that support adverse effect argue as follows; first, government operations are often conducted inefficiently. Second, regulatory process imposes excessive burden and costs on the economic system. Third, many of governments' fiscal and monetary policies tend to distort economic incentives and lower the productivity of the system. On the contrary, proponents of positive effect argue as follows: First, government harmonizes conflicts between private and social interests. Second, government prevents members of the country from exploitation by foreigners. Third, securing an increase in productive investment and providing a socially optimal direction for growth and development

It is common knowledge that fiscal policies cannot bring about changes in long-run growth of output in a neoclassical growth model. The introduction of endogenous growth models that incorporate the government sector has led to the opposite conclusion that fiscal policies can affect the long-run growth rate of an economy (Barro and Sala-i-Martin 1992, Futagami, Morita and Shibata 2003).

Attempts to explain the long-term rate of growth endogenously were initiated by Romer (1986) and Lucas (1988). Since then, many researchers have examined the effects of fiscal policy using endogenous growth models along the lines suggested by Atkinson and Stiglitz. Their models assume that tax revenue is redistributed to households. Barro (1990), on the other hand,

develops a simple and elegant model of endogenous growth in which the government uses tax revenue to finance government expenditure and this expenditure enters into the production function as a productive input. Furthermore, Barro proves that in his model, maximizing the national growth rate is equivalent to maximizing social welfare.

Following Barro (1990), Futagami, Morita and Shibata (2003) developed an endogenous growth model which incorporates public capital along with private capital and focused on the following three issues. First, they proved the existence and uniqueness of the steady-growth equilibrium under certain conditions. Second, they characterized the steady-growth equilibrium and the stability of the transitional dynamics. Third, they investigated the dynamic effects of a change in the income tax on the transitional path of the economy and on lifetime welfare.

In distinguishing their model from Barro's own, Futagami, Morita and Shibata (FMS) contended that Barro regards public services which are flow variables as a productive input in private production and, as a result, his model essentially reduces to a version of the "'AK" model in which there are no transitional dynamics. In contrast with his model, FMS model included two state variables: private and public capital stocks; hence it has transitional dynamics. Consequently, they suggested a reexamination of Barro's result on the optimal policy as well as the character of the transitional dynamics.

They rationalized their modelling strategy of incorporating public capital into the model instead of public services on the following points;

> First, many public infrastructure such as highways, airports, and electrical and gas facilities are stock variables in nature. Indeed, in the theoretical literature on public investment, it is commonly assumed that the stock of public capital, instead of the flow of public services, is a productive input to private production. Second, and more importantly, there are several empirical studies supporting the importance of public capital in private production.

While differentiating between flow and stock variables, none of the theories distinguished between the different types of public investment. Not only do recurrent and capital expenditure serve different purposes, their transmission mechanism also differ.

2.2 EMPIRICAL REVIEW

From the above theoretical review of the determinants of economic growth, it is obvious that the theory of economic growth considers how models offer different, but related, explanations of the process of growth. The major questions include the following: (i) what are the most important components of output growth? (ii) Why do some countries grow faster than others?

This section is divided into four sub-sections. The first section is a general review of empirical studies on the determinants of economic growth. The second section reviews the relationship between education and economic growth; the third section is on the effect of public finance as well as its components on economic growth. The fourth section reviews specific studies relating to public education expenditure, level of education and economic growth.

2.2.1 Determinants of Economic Growth

Economists use growth accounting analysis to test empirically the neoclassical growth theory, and to evaluate the effect of physical capital accumulation on output growth. The results of the early growth accounting exercises raise questions about the role of capital accumulation in output growth.

By emphasizing factor accumulation, the neoclassical model neglects differences in productivity growth and technological change captured by the large residual. In addition to its inability to explain cross-country real GDP per capita differences, and the failure of the convergence hypothesis, the neoclassical model also fails to explain the differences in real rates of returns on capital (Mankiw, 1995). By defining capital to include physical and human capital, Mankiw finds that the results more closely resemble the theoretical prediction of the neoclassical model. The works of Barro and Sala-i-Martin

(1992, 1995), Mankiw, Romer, and Weil (1992) argue from a similar perspective.

Endogenous growth theory, initiated by Romer (1986) and Lucas (1988), departs from neoclassical theory and focuses on explaining the Solow residual. The theory considers the effects of variables such as trade, human capital, and endogenous technology on output growth, and the different mechanisms of technology diffusion. Technological change becomes endogenous to the model and output growth becomes the outcome of forces that belong to the model. The "technological leader" countries generate technology (or knowledge). Technology diffuses through the trade of goods to the "follower" countries. Developed countries devote natural resources and human capital to invent new technology, while developing countries invest in human capital and their political and economic institutions to foster the diffusion and absorption of foreign technology.

Psacharopoulos (1994) shows that with education yielding high returns at the individual and social level, the high returns are also reflected at the level of the economy. From his review of the literature he concludes that introducing human capital or the quality of labour into the production function has explained a large portion of the residual. This conclusion confirms his findings, which show that investment in education explains twice the percentage of economic growth in African countries as it does in the developed economies.

Easterly and Levine (2001) identify four stylized facts, suggesting that growth economists should focus on total factor productivity (TFP) and its determinants rather than factor accumulation. First, much of the empirical evidence accumulated to date indicates that factor accumulation explains only a portion of the observed cross-country output growth. Second, Easterly and Levine argue that increasing divergence rather than convergence in per capita income levels occurs, which emphasizes TFP with increasing returns to technology. Third, time-series data show that physical capital accumulation persists over time and in most countries while per capita output growth does not persist. This fact suggests that models of steady-state growth (such as the Solow model) may fit the experience of the United States and other developed countries, but will not fit the experiences of many developing countries. Finally, a tendency exists for the factors of production to "fly" to the same places, which causes an increased concentration of economic activity. In such circumstances, it is more appropriate to use models with technological complementarities rather than the neoclassical model with homogenous technology. Renewed interest in productivity as a source of output growth leads to the development of new methods for the decomposition of output growth into input and productivity growth.

The sources of TFP growth differ between developed and developing countries. Technological innovations provide the main source of TFP growth in advanced countries. Developing countries face the challenge of acquiring

and absorbing foreign technology. In these countries, productivity growth depends on making the best use of the imported technology. These two components of TFP growth, innovation and absorption, determine cross-country differences in per capita income growth rates.

Another contentious issue is the composition of technology. As noted above, almost all growth theories agree that the "level of technology" (the constant "*A*" in the typical production function, $Y=F(K,L,A)$) is an important determinant of growth, at least along a transition towards the steady state. From a macroeconomic perspective, there are many things other than the "engineering" level of technology which can be thought of as "the level of technology," *A* (Doppelhofer, Miller, and Sala-i-Martin, 2000). In other words, a lot of factors may affect the aggregate amount of output, given the aggregate amount of inputs. These may include market distortions, distortionary taxes, maintenance of property rights, degree of monopoly, weather, attitudes toward work, and so on. Hence, creative theorizing will generate models that "predict" that any of these or other variables should be included in the growth regression.

The evidence that countries catch-up in TFP, but not in per capita income, reflects the findings of several empirical studies. Benhabib and Spiegel (1994) construct capital stocks for 133 countries, and assume a standard growth accounting decomposition with labour, physical capital, and human capital as inputs into production. They discover evidence of convergence in TFP. While

labour and physical capital accumulation positively affects output growth, the coefficient of human capital is negative, but insignificant. The failure of human capital to explain output growth provides a surprise, since most governments dedicate tremendous effort and resources to educate their citizens.

Those results lead Benhabib and Spiegel (1994) to suspect that simply including human capital as an additional input leads to model misspecification. Rather, they suggest that human capital affects TFP growth through the adoption and implementation of new technologies. They present a model where they decompose TFP growth into two separate components: a catch-up term and a technological change component. Instead of including human capital as an input in production, however, the authors suggest that human capital affects income indirectly through its effect on TFP.

It has now been established that long-term economic growth has been greatly influenced by the literacy level of the population. Classic cases are the examples of Japan, Korea and Taiwan, where the educated base provided the necessary institutions and infrastructure for industrial advances that generated economic successes beyond anyone's dreams. In fact, the rising level of human capital in these countries will continue to increase the technological levels and promote the upgrading of the industrial structures. Examining sources of Chinese economic growth, Hu and Khan (1997) found that contrary to the tradition, efficiency was the driving force behind the Chinese economic

boom, with sharp productivity increases explained by economic reforms that started in 1978. Little was said about education. In general, we need more information to explain the variation in factors contributing to output growth, more so as sector analyses may give different outcomes. Recently Easterly and Levine (1999) have stressed that most of the income and growth differences across nations are accounted for by the "residual"—total factor productivity—and not factor accumulation, which tends to persist while growth does not. These stylized facts of economic growth seem to be seen in developed economies more than in the developing economies.

Ghura's (1997) study of Cameroon's growth performance used an endogenous growth model, which is quite differently specified from the growth accounting model. According to him, investment, human capital and policy variables substantially influence economic growth. He categorized investment into public and private investment, with both types influencing growth. The labour factor was adjusted for human capital development. There seem to be some methodological problems in estimation, although the results tend to be somewhat plausible. Some of the right-hand variables were found to be non-stationary and therefore needed "differencing". And, accordingly, because of co integration, an error correction model is usually required. This procedure was not followed.

Iyoha and Oriakhi (2002), attributed the poor growth performance of Nigeria to the misallocation of the huge revenue from the petroleum sector. This

misallocation was identified to be a consequence of poor governance, corruption, and ineffective macroeconomic policies.

2.2.2 Education and Economic Growth

Theoretically, improvement in education and by extension human capital affects economic growth through increase in productivity, greater innovation and the adoption of new technology. However, the empirics lack a general consensus in this regard. The possibility of a causal relationship in the other direction has also been suggested. The reasoning is that low income reduces households' opportunities to send their children to school. The review is in two broad categories; (i) cross-country studies, and (ii) case studies.

i) Cross-country Studies

Cross-country studies are often based on virtually all countries of the world, or a combination of both developed and developing countries. Others are based on specific economic / regional groupings such as OECD countries, Asian countries, and Africa / Sub-Saharan Africa countries.

Early cross-country studies on the effect of education on economic growth include Barro (1991), Barro and Lee (1994). Barro's (1991) econometric specification was not based on any growth theory. He regressed economic growth on initial levels of income, initial levels of human capital, fertility rates

and investment ratios. Human capital was proxied by primary and secondary school enrolment rates. Barro found primary and secondary education to have positive and significant impact on the growth rate of GDP per capita. Barro and Lee (1994) used census and enrolment data to construct average years of schooling of adult population. The years of schooling variable was constructed for both men and women in primary, secondary and tertiary education. The study, which is based on 129 countries, found that the average years of male secondary schooling is significant and positively related to economic growth. On the contrary, the average years of female secondary schooling has a significantly negative effect. Also, all measures of both primary and tertiary education were insignificant. Based on data from 64 countries and using a multivariate OLS regression, Johnes (2006) also found a positive and significant relationship between education and economic growth. His model was however, found to be fragile when subjected to statistical tests.

The effect of increases in various levels of education appears to vary greatly with the level of a country or region or economic group's development [Gemmel (1996), Sianesi and Reenen (2000) Keller (2004)]. Gemmel found both the initial level and the subsequent growth of tertiary education to be positively and significantly related to per capita income growth in OECD countries. Similarly, Sianesi and Reenen argue that primary and secondary skills are more suitable for growth in the poorest and in intermediate

developing countries respectively, while tertiary skills are important for growth in OECD countries.

Using a log-linear model in the study of ten Asian countries, Andreosso-O'Callaghan (2002) found a positive and significant relationship between human capital (proxied by literacy rate and secondary education) and economic growth. Although, he noted the possibility of a feedback from economic growth to educational development, this was not tested. Francis and Iyare (2006) applied cointegration and Vector Error Correction models to analyze the causal relationship between education and development in three Caribbean countries – Barbados, Jamaica, and Trinidad and Tobago. The study was based on annual time series data from 1964 to 1998. While education was proxied by expenditure on education, development was proxied by gross national income per capita. For each of the countries, the results show that per capita gross national income drives education. On the contrary, education causes per capita gross national income only in Jamaica in the short-run. The finding that education does not cause per capita gross national income in either the short or long run in Barbados, and Trinidad and Tobago contradict most of the theoretical expectations.

ii) Case Studies

Obviously, most empirical growth studies use country comparative data, either averaged across a sample of years or taken over several years in panel data

format. Only few studies have attempted time series analysis within an individual country. The preference for cross-country studies is not unconnected with the desire for a large sample size. Few time series studies on the effect of education on economic growth include; Jenkins (1995), Asteriou and Agiomirgianakis (2001), Monteils (2002), and Loening (2005). Jenkins' study based on the UK used annual data from 1971 to 1992 and it proxies the stock of human capital by three series measuring workforce qualifications. These series are used as key determinants of aggregate output, alongside physical capital, total workforce, capacity utilisation and a time trend. The overall result confirms the finding that investment in human capital increases productivity. The study also shows that highly-qualified workers are found to contribute almost twice as much to productive efficiency as those with no qualifications at all. The relatively small sample size (12) mean that the unrestricted estimates are imprecisely determined and such results cannot be regarded as robust.

Asteriou and Agiomirgianakis (2001) used cointegrated regressions to explore the long-term relationship between formal education and GDP in the Greek economy. This study finds a significant relationship between primary, secondary and higher education enrolments and GDP per capita. The main direction of causality runs through the education variables to economic growth, but in the case of higher education, there exist reverse causality. Loening (2005) conducted a similar study based on the Guatemala economy

from 1951 to 2002. The results show that a better-educated labour force has a positive and significant impact on economic growth. Primary and secondary education was found to be most important in productivity growth. These results were found to be robust when the model was subjected to changes in the conditioning variables, data issues and endogeneity. Contrary to the positive and significant impact reported above, Monteils (2002), found a negative relationship between human capital and economic growth.

2.2.3 Public Expenditure and Economic Growth

Generally, there are two opposing views on the impact of government size on economic performance (Ram 1986). One view holds that a large government size is detrimental to efficiency and economic growth because government operations are often conducted inefficiently. According to Diamond (1989), the supporters of this view argue that government consumption crowds out private investment, hampers economic growth in the short run and diminishes capital accumulation in the long run. On the contrary, the other view contends that a large government size promotes economic development through the creation of enabling environment for the market to thrive (Lin, 1994). For example, enhancing the quality of human resources (through expenditure on education) has a significant impact on economic growth (Roux, 1994 and Okojie, 1995) This view emanates from Keynesian macroeconomic thought, which believe that public spending contributes positively to economic growth;

that is, an increase in the government consumption is likely to lead to an increase in employment, profitability and investment through multiplier effects on aggregate demand. Thus, government spending augments the aggregate demand, which provokes an increased output depending on expenditure multipliers (Saad and Kalakeck, 2009).

Empirical studies on the relationship between public expenditure and economic growth have adopted either the aggregated or disaggregated approach. With respect to studies that adopt the disaggregated approach, the general view is that public expenditure, notably on physical infrastructure or human capital is growth–enhancing, while government consumption is expected to be growth retarding (Barro, 1990); thus, the concept of productive and unproductive government expenditure (Odedokun, 2001). Kweka and Morrissey (2000) however, noted that in empirical work it is difficult to determine which particular item of expenditure should be categorised as investment and which as consumption. Most empirical studies have supported either of the two views stated above. Few, however, have found no relationship. It is important to note that these results differ by country / region, analytical method employed, and categorization of public expenditure. Initial studies on this topic focused on the aggregate size of government spending, while recent studies emphasize the composition of public expenditure.

2.2.3.1 Government Size and Economic Growth

Robinson (1977) used the ratio of government revenue to GDP as a proxy for government size, and found a positive correlation between government size and economic growth. On the other hand, Landau (1983, 1986) reports a negative relation between growth in government spending and the growth rate in real per capita GDP. Landau used the share of government consumption to GDP as a proxy for government size. Similarly, using data from OECD countries, Saunders (1985) regressed the percentage change in real GDP on the share of the total government spending in GDP. He finds negative relation between average economic growth and average share of total government expenditure in GDP. Ram (1986) derived an equation for economic growth from two separate production functions, one for the government sector and the other for the nongovernment sector.' Three different specifications of the growth equation were estimated using data for 115 countries covering the period 1960-80. His result shows that the overall impact of government size on growth is positive in almost all cases. His findings imply a relatively larger role for governments in developing countries, especially if the factor productivity in the government sector is higher than in the non-government sector. Rao (1989) attributed the sharp contrast in both Ram and Landau's findings to significant differences in their models and in the specification of government size variables. He noted that Ram's model has a better theoretical foundation compared to the multiple-regression approach of Landau. On the

other hand, Landau used a variety of government expenditure components as against aggregate government consumption used by Ram. These issues were re-examined by Rao (1989). He concluded that Ram's results are of limited significance because causation at best is bidirectional in a few countries, and there is little direct evidence to support the type of causation implied in the Ram model. Kormendi and Meguire (1985) study was based on post-war data from 47 countries and found no significant relationship between average growth rates of real GDP and average growth rate or levels of the share of government consumption spending in GDP. Following Kormendi and Meguire (1985), Grier and Tullock (1987) studied 115 countries on a cross-sectional, time series analysis, using data averaged over 5-year intervals. They found evidence of a negative relationship between the growth rate of real GDP and the growth rate of the government share of GDP. (Erkin 1988) examined the effect of government (consumption) expenditure on economic growth for a sample of 96 countries, and discovered a negative effect of government expenditure on growth of real output. Conte and Darrat (1988) examine the effect of government spending on output using one-sided Granger-causality analysis. Their findings are mixed but indicate no significant relation between government spending and growth in output for most of the countries. Grier and Tullock (1989) define the government variable as a growth rate in the share of government consumption in GDP and test the model using 30-year data from 24 OECD countries and 20-year data from developing countries. They report negative and significant relation between the share of government

consumption in GDP and the growth in GDP in both samples. Khan and Reinhart (1990) develop a growth model that examines separately the effects of public sector and private sector investments. Using cross-section data from a sample of 24 developing countries, they find that public investment has no direct effect on economic growth. Barro (1990) defines the government's productive expenditure alternatively as a ratio of gross domestic product and as a ratio of the sum of private and public investments. He finds insignificant relation in both specifications. In another similar study, Aschauer (1990) reports positive and significant relation between government spending and the level of output. Barro (1991), using a sample of 98 countries for the period 1970-1985, found a negative relationship between the output rate and the share of government consumption expenditures. However, when the share of public investment was considered, Barro found a positive but statistically insignificant relationship between public investment and the output growth rate. Lindauer and Velenchik (1992) concluded that there is no significant direct relation between government expenditure and economic growth. However, they argue that government spending may positively affect economic growth indirectly through its influence on the efficiency of the private sector allocation of inputs. Nelson and Singh (1994) examine the effect of overall government size, measured by the central government revenue as a percent of GDP, on the average growth rate of GDP. They find no relation between growth in government spending and the growth rate in GDP. Ghura (1995) tests the relation between government consumption as a percent of

GDP and economic growth using data from developing countries. He finds significantly negative relation between government consumption and the growth in per capita real GDP. Devarajan, et al. (1996) examine the relation between the share of total government expenditure in GDP and the growth in per capita real GDP and found negative and significant relationship between the two. Using an endogenous growth model of the U.S. economy in which government purchases directly affect both the utility of consumers and the productivity of firms, Ghali (1997) examined the relationship between government expenditure and economic growth in Saudi Arabia using the series of the growth rate in per capita real GDP and the share of government spending in GDP. He found no consistent evidence that government spending can increase Saudi Arabia's per capita output growth. Erkin (1998) examined the relationship between government expenditure and economic growth, by proposing a new framework for New Zealand. The empirical results showed that higher government expenditure does not hurt consumption, but instead raises private investment that in turn accelerates economic growth. Knoop (1999) using time series data from 1970 to 1995 finds that reducing the size of government reduces economic growth and welfare. Al-Yousif (2000) indicates that government spending has a positive relationship with economic growth in Saudi Arabia. Folster and Henrekson (2001) found a robust negative relationship between government expenditure and growth. The study was based on advanced countries between 1970 and 1995. Their estimated coefficient suggested that a 10 percentage increase in government expenditure

is associated with a decrease of 0.7 percentage point in growth rate. In Sweden, Peter (2003) examined the effects of government expenditure on economic growth for the period 1960-2001. The result shows that government spends too much and it might slowdown economic growth. Ramayandi (2003) investigated the impact of government size on economic growth using a sample of time series data on Indonesia (1969-1999). He found consistent evidence that the share of government consumption spending decreases economic growth. Mitchell (2005) argued that the American government expenditure has grown too much in the last couple of years and has contributed to the negative growth. The author suggested that government should cut its spending, particularly on projects/programmes that generate least benefits or impose highest costs. Sáez and García (2006) studied the relationship between government expenditure and economic growth in the EU-15 countries. The results obtained based on regressions and panel techniques suggest that government spending is positively related with economic growth in the EU countries. Gregoriou and Ghosh (2007) used the heterogeneous panel to investigate the impact of government expenditure on economic growth. The authors employed the GMM technique, and discovered that countries with large government expenditure tend to experience higher growth, but the effect varies from one country to another. Komain and Brahmasrene (2007) studies the relationship between government expenditures and economic growth in Thailand, by employing the Granger causality test. The results showed that government expenditures and economic growth are

not co-integrated. However, the results indicated a unidirectional relationship, as causality runs from government expenditures to growth. Furthermore, the results illustrated a significant positive effect of government spending on economic growth. Olugbenga and Owoye (2007) investigated the relationships between government expenditure and economic growth for a group of 30 OECD countries during the period 1970-2005. The regression results showed the existence of a long-run relationship between government expenditure and economic growth. In addition, the authors observed a unidirectional causality from government expenditure to growth for 16 out of the countries, thus supporting the Keynesian hypothesis. However, causality runs from economic growth to government expenditure in 10 out of the countries, confirming the Wagner's law. Finally, the authors found the existence of feedback relationship between government expenditure and economic growth for a group of four countries. In India, Ranjan and Sharma (2008) examined the effect of government development expenditure on economic growth in India from 1950-2007. The authors found a significant positive impact of government expenditure on economic growth. Based on Barro's (1990) endogenous growth model, Taban (2010) re-investigate the linkages between government spending and economic growth in Turkey with the bounds testing for cointegration approach developed by Pesaran et al. (2001) and the modified WALD (MWALD) causality test developed by Toda and Yamamoto (1995). The study covered the sample period from 1987:Q1 to 2006:Q4. He found the share of the total government spending, and the share of the

government investment to GDP to have negative impacts on the growth of real per capita GDP in the long run. Nevertheless, there is no evidence of cointegrating relation between government consumption spending to GDP ratio and per capita output growth. The MWALD causality test indicates strong bi-directional causality between the total government spending and economic growth. Whereas no statistically significant relationship between the share of the government consumption spending to GDP and economic growth, a unidirectional causality was been found running from the per capita output growth to the ratio of the government investment to GDP

2.2.3.2 Composition of Public Expenditure and Economic Growth

Due, partly to the lack of general consensus among researchers on the effect of aggregate public expenditure / revenue on economic growth and concern about the number of studies that report negative relationship, emphasis has shifted in recent times to the evaluation of the different components of these variables. According to Odedokun (2001), this will help identify which of them is 'productive' and 'unproductive' (Barro and Sala-i-Martin, 1992). Classification of aggregate government expenditure has been done either along functional or economic divides (Kweka and Morrissey, 2000). Economic classification involves disaggregating total government spending into capital and recurrent expenditure. Current spending is further classified into five categories; (i) expenditure on goods and services; (ii) wages and salaries; (iii)

interest payments; (iv) subsidies; and (v) others (Odedokun, 2001). On the other hand, government expenditure items, whether recurrent or capital are usually classified into four major (functional) groups, namely: administration, economic services, social and community services, and transfers (Akpan, 2005; CBN Annual Report and Statistical Bulletin).

Economic Classification of Public Expenditure

Ogiogio (1995) revealed a long-term relationship between government expenditure and economic growth. Moreover, the author's findings showed that recurrent expenditure exerts more influence than capital expenditure on growth. Devarajan et al (1996) studied the relationship between the composition of government expenditure and economic growth for a group of developing countries. The regression results illustrated that capital expenditure has a significant negative association with growth of real GDP per capita. However, the results showed that recurrent expenditure is positively related to real GDP per capita. Fajingbesi and Odusola (1999) investigated the relationship between government expenditure and economic growth in Nigeria. The econometric results indicated that real government capital expenditure has a significant positive influence on real output. However, the results showed that real government recurrent expenditure had only marginal effect on growth. Based on a sample of 39 low-income countries in the 1990s, Odedokun (2001) examined the effects of different categories of government

expenditure, revenue and deficits on economic growth in developing countries. Based on panel data of annual series over three decades for 103 countries, the results suggest that the effects of the fiscal variables on growth vary across countries. But broadly, capital expenditure was found to have a negative impact on growth, just as current expenditure on goods and services. However expenditure on wages and salaries is growth-promoting. Gupta et al (2005) noted that higher capital outlays are associated with more buoyant growth, while higher current expenditures and domestic financing of the deficit are associated with less favourable economic performance

Functional Classification of Public Expenditure

Other studies have investigated the impact of particular (functional) categories of public expenditure on economic growth. Devarajan *et al* (1995) , using a sample of 14 OECD countries, found that spending on health, transport and communication have positive impacts, while spending on education and defence did not have a positive impact. On the contrary, Donald and Shuanglin (1993) investigated the differential effects of various forms of expenditures on economic growth for a sample of 58 countries. Their findings indicate that government expenditures on education and defence have positive influence on economic growth, while expenditure on welfare has insignificant negative impact on economic growth. Niloy et al (2003) used a disaggregated approach to investigate the impact of public expenditure on economic growth for 30

developing countries in 1970s and 1980s. The authors confirmed that government capital expenditure in GDP has a significant positive association with economic growth, but the share of government current expenditure in GDP was shown to be insignificant in explaining economic growth. At the sectoral level, government investment and expenditure on education are the only variables that had significant effect on economic growth, especially when budget constraint and omitted variables are included. Ramirez (2004) used Mexican data for the period 1955 to 1999, and found that public infrastructure, which comprises transport, communications, water and sewer systems, education and health care; positively affects growth. Akpan (2005) disaggregated public expenditure into capital, recurrent, administrative, economic service, social and community service, and transfers to ascertain which of them enhance growth, and those that do not. The author concluded that there was no significant association between most components of government expenditure and economic growth in Nigeria. Saad and Kalakeck (2009) examined the growth effects of government expenditure in Lebanon over a period from 1962 to 2007, with a particular focus on sectoral expenditures. Four major sectors - defence, education, health, and agriculture- were considered. They used a multivariate cointegration analysis to examine the effect of each sector on economic growth. The results reveal that government spending on education has a positive effect on growth in the long-run and negative impact in the short-run; while spending on defence has a negative effect on economic growth in the long run and insignificant impact in

the short-run. As to health spending, it is negatively correlated to growth in the long-run and there is insignificant linkage in the short-run. Finally, spending on agriculture is found to be insignificant in both cases. Nurudeen and Usman (2010) examined the effect of both economic and functional classification of government expenditure on economic growth. The results reveal that government total capital expenditure, total recurrent expenditures, and government expenditure on education have negative effect on economic growth. However, rising government expenditure on transport and communication, and health results to an increase in economic growth.

In summary, the evidence on the effect of public expenditure on economic growth is mixed; however, evidence of positive and statistically significant effect of human capital investment on economic growth seem to dominate.

2.2.4 Public Education Expenditure, Outcome and Economic Growth

The divergence between private and social rate of returns to education is the rationale for intervention by the state in ensuring equity in opportunity across the population. Other motives include; market failure, social cohesion and nation-building. With respect to the effect of sectoral expenditure on economic growth, Poot (1999) notes that 'the most conclusive result in the literature relate to the positive impact of education expenditure on growth'. This

assertion has further been supported by recent studies such as Niloy et al (2003), and Saad and Kalakeck (2009). The proximate goal is to ensure both the provision of education facilities (output) as well as the quantity and quality of education of all school age children (outcome). The ultimate goal of public education expenditure is to ensure rapid and sustained economic growth. A review of empirical studies on these two objectives is presented below.

2.2.4.1 Public Education Expenditure and Outcome

Although the gap in enrolment at both primary and secondary level between high and low income countries is reducing, there is still much difference especially at the secondary school level. As at 2007 gross secondary school enrolment in high income countries is 99.9 per cent, while that of low income countries stands at 36.3 per cent (UNESCO Institute for Statistics). An examination of public education expenditure between these two groups of countries also reveals the same trend. For instance, in Luxembourg, average public expenditure on education per pupil in primary school between 2003 and 2006 was US$9953. In the same period, Congo recorded US$39 (Human Development Report, 2009). Notwithstanding the fact that access to education does not necessarily imply enrolment, a number of studies have examined the extent to which public education expenditure has been instrumental to the level of education attainment.

The role of education in economic growth has been well documented. Thus, considering the nature of education (merit good), especially at the lower levels, public investment becomes a necessary means for ensuring adequate quantity and quality. However, the evidence on the effect of public education expenditure on education attainment is mixed. Many studies found a strong relationship between public education expenditure and measures of education attainment. Such studies include Gupta, Verhoeven and Tiongson, (1999); McMahon, (1999); Lopes, (2002); Anyanwu and Erhijakpor, (2007); Baldacci et al, (2008); Amin and Ntilivamunda, (2009); Diawara (2009); and Fadiya, (2010). On the contrary, Landau, (1986); Noss, (1991); Anand and Ravallion, (1993) and Al-Samarrai (2002) found a weak relationship. Rather, they attributed the development of the education sector to other factors such as per capita income, family background or parental education (Appleton, Hoddinot, and Mackinnon, 1996).

Gupta, Verhoeven and Tiongson (1999) applied both ordinary least squares (OLS) and two stage least squares (2SLS) estimation techniques to a sample of 50 developing and transition countries. Their result shows that education spending has a positive and significant effect on secondary school enrolment. Also, a five percentage point increase in public education expenditure increases gross secondary enrolment by one percentage point. McMahon (1999) finds a negative and significant relationship between per pupil expenditures and the primary gross enrolment rate, and a positive and

significant impact of total education expenditure as a proportion of GNP. The results of the McMahon study suggest that increasing primary education expenditure while holding per pupil expenditures constant, has a positive and significant impact on the primary gross enrolment rate. The positive effect of public education expenditure on education attainment is also supported by other cross-country studies based on Africa. Lopes (2002) used data on 48 Sub-Sahara African countries for the period 1980 – 1999. Except for the ratio of education expenditure to total government expenditure all other measures of public education were found to have positive effect on education. Anyanwu and Erhijakpor (2007), using panel data of African countries from 1990 to 2002, examined the effect of public expenditure on educational enrolment with illustration from Nigeria and other SANE (South Africa, Algeria, Nigeria, and Egypt) countries at the primary and secondary school levels. The results show that government expenditure on education has a positive and significant direct impact on primary and secondary education enrolment rates. Using panel data from 118 developing countries in 1971–2000, Baldacci et al. (2008) estimate a non-linear model to capture the spending-outcome relationship. They account for the interaction between education and health, and control for governance and the higher growth attributable to better human capital and country income levels. The fixed-effects model is utilized to make the most out of limited cross-country time series data, and minimize distortions from heterogeneity. Baldacci et al. find strong evidence that public expenditure on education directly results in increased better educational outcomes. However, the

positive effects of education spending are reduced in countries suffering from poor governance. Also, based on 27 African countries for the period 1960 – 2005 on a five-year basis, Diawara (2009) found that public expenditure on education is positively and significantly associated with the primary and secondary education outcome. Amin and Ntilivamunda (2009) studied the relationship between education expenditure and outcome in Senegal, with the outcome being the primary school gross enrolment and completion rate. Both measures of education employed (ratio of education expenditure over GDP and education expenditure over total public budget) were found to have positive effect on education outcome. Fadiya (2010) applied Johansen cointegration technique to investigate the determinant of educational outcome in Nigeria between 1975 and 2008. The result shows a positive but insignificant relationship between government education expenditure and education outcome.

Leclercq (2005) and Hanushek (2006) present a survey of the empirical studies that examine the relationship between educational spending and outcomes in developed and developing countries. The main conclusion from this literature supports Gupta, Verhoeven and Tiongson's (1999) findings since the results have shown the ambiguous impact of school resources factors on education outcome. This ambiguity, however, seems to be valid for rich nations only because, as attested by Wößmann (2001), resources may render positive effects at very low endowment levels prevailing in many developing countries.

Anand and Ravallion's (1993) empirical results indicated that there was no significant relationship between education outcomes and public spending on education. Using UNESCO data and focusing on primary school education, Al-Samarrai (2002) examined the relationships between school resources (public spending on primary education, spending per pupil, pupil-teacher ratio) and educational performance (primary gross and net enrolment rates, primary survival and completion rates). The cross-country analysis shows that the link between educational access and performance and public education spending is weak. Besides, Al-Samarrai suggests that the levels of household spending, the effectiveness of the public expenditure management system and the composition of public education spending are important factors explaining the weak link.

Several factors have been adduced for the weak relationship between public education expenditure and education attainment. While Al–Samarrai (2002) attributed it to poor data, omitted variables and inefficient resource utilization, Woβmann (2001) and Diawara (2009) identified the state of development of the country or region concerned as a limiting factor. It is believed that resources may render positive effects at very low endowment levels prevailing in many developing countries.

2.2.4.2 Public Education Expenditure and Economic Growth

Following the overwhelming findings of the positive effect of public education expenditure on economic growth as observed in section 2.2.3.2 above, several studies have specifically examined the effect of public education expenditure on economic growth.

Musila and Balassi (2004) applied cointegration technique to investigate the relationship between government education expenditure per worker and economic growth in Uganda during the period 1965-1999. Their results show that education expenditure per worker has a positive and significant impact on economic growth both in the long run and short run. In this study, average level of education per worker was used as a proxy for education expenditure. This was based on the assumption that the average level of education per worker is directly proportional to the average expenditure on education per worker. This assumption may not hold in situations where expenditure on education is not used efficiently. Based on data from Nigeria between 1977 and 2007, and using the same analytical technique as Musila and Balassi, Dauda (2009) also found a positive and significant long run relationship between investment in education and economic growth. This study did not only assume direct proportionality between the level of education and average expenditure on education per worker, it also glossed over the issue of endogeneity between education and economic growth. The use of total public education expenditure in its aggregate form precludes that both recurrent and

capital expenditure have the same effect on both education and economic growth.

From the above it could be observed that studies on the effectiveness and efficiency of public education expenditure either relate it to its outcome (such as enrolment rate, literacy rate, completion rate, and average years of schooling), or to economic growth. There is no doubt that as a component of aggregate government expenditure, education expenditure (in line with the Keynesian theory) could have a direct effect on economic growth. It is also true that public investment in education promotes education attainment, which in turn affects economic growth – indirect effect. Furthermore, Bils and Klenow (2000) noted that most studies tend to establish correlation between education and economic growth, but not the direction of causation. Neglecting these issues could lead to misspecification of empirical growth models.

Among the few studies that have considered all three variables (public education expenditure, education attainment and economic growth) in a concise manner, are Jung and Thorbecke, (2001) and Baldacci, Clements, Gupta and Cui, (2004).

Jung and Thorbecke employed a computable general equilibrium (CGE) approach to study 'the impact of public education expenditure on human capital, growth and poverty in Tanzania and Zambia'. The simulation result

by Jung and Thorbecke suggests that education expenditure can raise economic growth.

Baldacci, Clements, Gupta, and Cui (2004), used a recursive system of equations to examine both the direct and indirect channels linking public education spending, human capital, and economic growth. A sample of 120 developing countries from 1975 to 2000 was employed. The result show that public spending on education have a positive and significant direct impact on the accumulation of education, and consequently on higher economic growth. The use of a recursive system of equations was based on the assumption of zero contemporaneous correlation of the disturbances. This assumption was however, not tested. Furthermore, Gujarati and Porter (2009: 714) argued that "although recursive models have proved to be useful, most simultaneous equation models do not exhibit a cause-and-effect relationship. Therefore, OLS in general, is inappropriate to estimate a single equation in the context of a simultaneous-equation model".

2.3 METHODOLOGICAL REVIEW

The empirical evidence of the relationship between public education expenditure and economic growth presented in section 2.2.4 reveal mixed results. These results differ according to the research design adopted; which include theoretical background, model specification, and sample selection. It also varies with the econometric technique, measurement of variable and data

employed. Rogers (2003), however, noted that most empirical models are not based on any specific theoretical model.

Glewwe, Maiga, and Zheng (2007: pp. 9-14) identified six econometric problems that could lead to biased estimates of parameter derived from models of economic growth. Some of these problems relate to cross-country studies, while others are general.

(i) Parameter heterogeneity; in cross country studies, the impact of explanatory variables is assumed to be the sane across all countries. When the study includes both developed and developing countries, this assumption fails. This is because in reality, both developed and developing countries have different characteristics.

(ii) Dynamic misspecification – the issue of response lag associated with many economic policies necessitates the use of distributed lag and dynamic model. For instance, investment in education may take a long time to have effect on economic growth or such effect may be spread over time. This implies that education should enter the model with lag variables. However, the non-availability of data for such variables in series makes the use of this method impossible.

(iii) Model uncertainty and omitted variable bias: Two reasons for omitting variables are lack of data and insufficient degree of freedom. For instance, data for school quality is scarce. According to Glewwe et al, years of

schooling overestimate human capital in a country with low quality schools and vice versa.

(**iv) Outliers:** an outlying observation or outlier is an observation that is much different in relation to the observations in the sample. The inclusion or exclusion of such an observation, especially if the sample size is small, can substantially alter the results of regression analysis.

(v) Endogeneity; Numerous studies have found a positive and significant relationship between education and economic growth. It is also possible for economic growth to influence the level of education. If this is true for a growth model that includes education as one of its regressors, education will be correlated with the error term, which will result in biased OLS estimates. (see Francis and Iyare, 2006)

(vi) Measurement errors;

It has been established theoretically that the existence of endogeneity bias and measurement errors in the regressors renders the OLS estimation inconsistent and biased (Verbeek, 2004). The instrumental variables (IV) technique can be used to correct for both endogeneity and measurement error.

Sturm, Kuper and Haan, (1996), identified five different ways the relationship between public investment and economic growth has been modelled. These are the production function approach, the behavioural approach, the VAR approach, the cross-section growth regression and the use of structural

econometrics model. Apart from the VAR approach, most models are single-equations models which are sensitive to problems of causation and multicollinearity. This is also true of the structural models. One disadvantage of the VAR approach is that it is not based on any economic theory.

The common practice is to specify economic growth as a function of public education expenditure. Thus, causality runs from public education expenditure to economic growth. The reverse is intuitively plausible. Also, studies have found a bi-causal relationship between economic growth and public expenditure on education. Furthermore, some studies that model education attainment have found economic growth to be instrumental.

Results obtained from empirical studies are veritable tools for policy makers. Therefore, robustness of such results cannot be overemphasized. Achieving an unbiased and consistent coefficient estimates require a thorough understanding of the relationships among the variables being studied. Consequently, this section evaluates the results presented in section 2.2.4 in the light of the method employed.

Jung and Thorbecke (2001), adopted a neoclassical multisector computable general equilibrium (CGE) approach with optimizing agents and flexible prices. Educated labour (which promotes GDP), is determined as a function of education expenditure, which in turn is a function of total government expenditure. It should however, be noted that increased government expenditure may not necessarily result in increase in education expenditure.

This is often determined by the priority the government attached to the sector. Education expenditure in this model is seen to influence labour supply. The model regards the outcome of education expenditure as exogenous. Also, the authors assumed both recurrent and capital expenditure in education to have the same efficiency.

Baldacci *et al* (2004) adopted a panel data regression approach. A recursive systems model was specified. This model also suffers from the endogeneity bias. Furthermore, the education expenditure variable was used in its aggregate form.

2.4 Summary of Review of Related Literature

Though growth theories have evolved over time, there seem to be a consensus on its main determinants. However, growth empirics have presented mixed results. Major sources of the diverse results include model design - which starts with the identification of relevant theory, and the construction of the transmission process between variables of interest. The measures of variables employed also vary. Most growth empirics lack theoretical foundation upon which credible model specification is based.

Consequently, studies that examine the relation between public education expenditure (PEE) and economic growth either regard PEE as an exogenous variable or use the outcome of PEE (literacy rate, enrolment rate, completion

rate or average years of education) as a proxy. Considering the fact that the relationship between PEE and education attainment may not be linear and perfect (as outlined in section 2.2.4.1) such a proxy may be weak and lead to biased results. Inefficient use of resources fuelled by corrupt practices among other factors has been identified as a major factor. More so, the assumption of exogeneity of education in growth models is not often tested.

Furthermore, all the studies reviewed employed aggregate PEE, thus assuming equal efficiency in the use of both capital and recurrent expenditure on education. The violation of this assumption may have serious consequences for estimated regression results.

In conclusion, it is important to note that the interdependence among public education expenditure, education attainment and economic growth is often ignored by empirical studies. Consequently, most studies adopt a partial approach in their analysis. While some evaluate the effect of public education expenditure on economic growth, others analyze the effect of education on economic growth: thus, ignoring the link between education expenditure and education attainment. Furthermore, studies that have analyzed all three variables in a concise manner have failed to distinguish between recurrent and capital expenditure on education. Both serve different purposes and their efficiency may vary. It is pertinent to state that on general note findings on the relationship between public education expenditure and economic growth present mixed and suspicious results.

This study attempts to fill the gaps highlighted above by employing an endogenous growth model to evaluate the effect of both recurrent and capital education expenditure on the level of education and economic growth in Nigeria.

CHAPTER THREE

THEORETICAL FRAMEWORK AND METHODOLOGY

Two endogenous growth theories that guide the design of this study are presented in this chapter. Lucas (1988) demonstrates the endogenous relationship between education and economic growth. On the other hand, Barro and Sala-i-Martin (2004) analyzed the simultaneous relationship between public spending and economic growth. Drawing from these two theories and the empirical findings on the relationship between public spending and education outcome, section 3.2 provides a schematic and analytical framework of the study. Section 3.3 presents the methodology which includes the specification of the model and estimation technique for the study. Section 3.4 highlights some methodological issues relating to the model. Section 3.5 presents the definition of variables as well as the sources of data.

3.1 THEORETICAL FRAMEWORK

Investment in education results in the development of human capital, which has been described as a key determinant of economic growth. In view of this, section 3.1.1 presents Lucas (1988) model on human capital and economic growth. As noted in section 2.2.4.1, empirical studies have found both positive and significant relationship between investment in education and its outcome.

Considering the direct effect of public expenditure on economic growth, section 3.1.2 presents Barro and Sala-i-Martin's (2004) model on the relationship between public investment and economic growth.

3.1.1 Education and Endogenous Growth

Various ways in which the change in total factor productivity can be rendered endogenous have been demonstrated by development economists. A notable one is that by Lucas (op cit). Lucas posits that the average level of human capital in any economy determines the level of total factor productivity. The model considers human capital as the 'engine' of growth because human capital accumulation raises the productivity of both labour and physical capital.

The proposition of the model is that people divide their time between work and training. This results in a trade-off because when taking on training, people give up part of their work income, but raises their future productivity, and therefore their future wages. Thus, the decisions concerning the accumulation of human capital depend on the dynamic features of the economy, which make it endogenous. Since human capital accumulation is the engine of growth, growth will itself be endogenous too.

The model assumes that consumers' welfare is given by an intertemporal constant-elasticity of substitution utility function. This implies that the

effectiveness of training, that is, the rate at which productivity rises as a result of one additional unit of training is exogenous.

Generally, the model postulates that the higher the quality of training, the higher will be the increase in the marginal product of labour that follows training and hence the higher the future wage rate. Thus, the higher incentives to training results in greater growth rate of the economy. Similarly, the higher the consumer's preference for future consumption, the more will workers be willing to forsake present consumption to dedicate themselves to training. Therefore, the higher will be the rate of economic growth.

The basic Lucas model is of the form

$$Y = AK^{\alpha}(uhL)^{1-\alpha} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.1)$$

Where Y, A, K and L are aggregate output, level of technology, capital stock and labour respectively. $0 < \alpha < 1$. The variable u is defined as the proportion of total labour time spent working, and h is what Lucas calls the stock of human capital. The production function can be rewritten in per-capita terms as

$$y = Ak^{\alpha}(uh)^{1-\alpha} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.2)$$

k denotes the per capita stock of physical capital. Eqn (3.2) is constant returns to scale production function in k and uh. Capital accumulation proceeds via the usual differential equation,

$$k = y - c - (\xi + \delta)k \quad . \quad . \quad . \quad . \quad . \quad (3.3)$$

$$\frac{dh}{dt} = \phi h(1 - u), \phi > 0 \quad . \quad .. \quad . \quad . \quad . \quad (3.4)$$

While eqn (3.4) shows that the growth rate of human capital is determined by time spent in education or training, (3.2) describes the way human capital affects current production.

According to this model, an increase in educational attainment assuming this is related to human capital, leads to an increase in output. Lucas' model implies that human capital may increase even without any increase in educational attainment. Stevens and Weale (2004) noted that although the human capital of individuals may decay over time, there is a public body of knowledge which the accumulation of human capital can add to. The implication of this is that even when educational attainment has stopped increasing, human capital can continue to increase and thus continuing growth is possible.

Although some studies have found a bi-causal relationship between human capital development and economic growth, many empirical studies seldom incorporate this dynamism in their modelling. More so, the theory attributes the growth of human capital to only time. Considering the social benefits derived from education, its 'merit-good' nature and the desire for rapid and sustained economic growth by both less developed and advanced countries most governments have attached high priority to the development of education in their countries. The positive and significant effects of public education

expenditure on both human capital development and economic growth have been supported by empirical evidences. The next section analyzes the theoretical link between public spending and long run economic growth.

3.1.2 Public Finance and Endogenous growth

The general thrust of this theory is that the inclusion of public spending within an AK model amounts to enhancing the level of technology implied by 'A' and will in consequence affect the long run per capita growth. Two strands of this theory as developed by Barro and Sala-i-Martin (2004) are presented below.

A Public-Goods Model

In the model presented in equation 3.5 below, government's purchases of goods and services, G, enter into the production function as pure public goods. Adopting a Cobb-Douglas production function, the specification for firm i is

$$Y_i = AL_i^{1-\alpha} . K_i^{\alpha} .G^{1-\alpha} . \quad . \quad . \quad . \quad . \quad . \quad (3.5)$$

where $0 < \alpha < 1$.

This equation implies that production for each firm exhibits constant returns to scale in the private inputs L_i and K_i. The aggregate labour force L, is assumed to be constant. For fixed G, the economy will face diminishing returns to the

accumulation of aggregate capital, K. If, however, G rises along with K, equation 3.5 implies that diminishing returns will not arise; that is, the production function specifies constant returns in K_i and G for fixed L_i. Consequently, the economy is capable of engendering endogenous growth. Another fact to note is that the form of the production function implies that the public services are complementary with the private inputs in the sense that an increase in G raises the marginal product of L_i and K_i.

Consider a situation where the exponent on G is less than 1- α, diminishing returns to K_i and G would set in, and these diminishing returns would rule out endogenous growth. On the contrary, if the exponent is greater than 1 – α, growth rate would tend to rise over time.

The endogenous growth theory demonstrated above has been tested using different specifications of government spending. These specifications range from the use of aggregate government expenditure to the decomposition of government expenditure. Decomposition has been either along functional lines (that is expenditure on administration, economic sector, social sector, defence, etc) or economic classifications (that is, between recurrent and capital expenditure). Most studies that focus on functional composition have found a positive and significant relationship between spending on education and economic growth. However, studies based on both economic and functional classifications are scarce.

3.2 ANALYTICAL TECHNIQUE

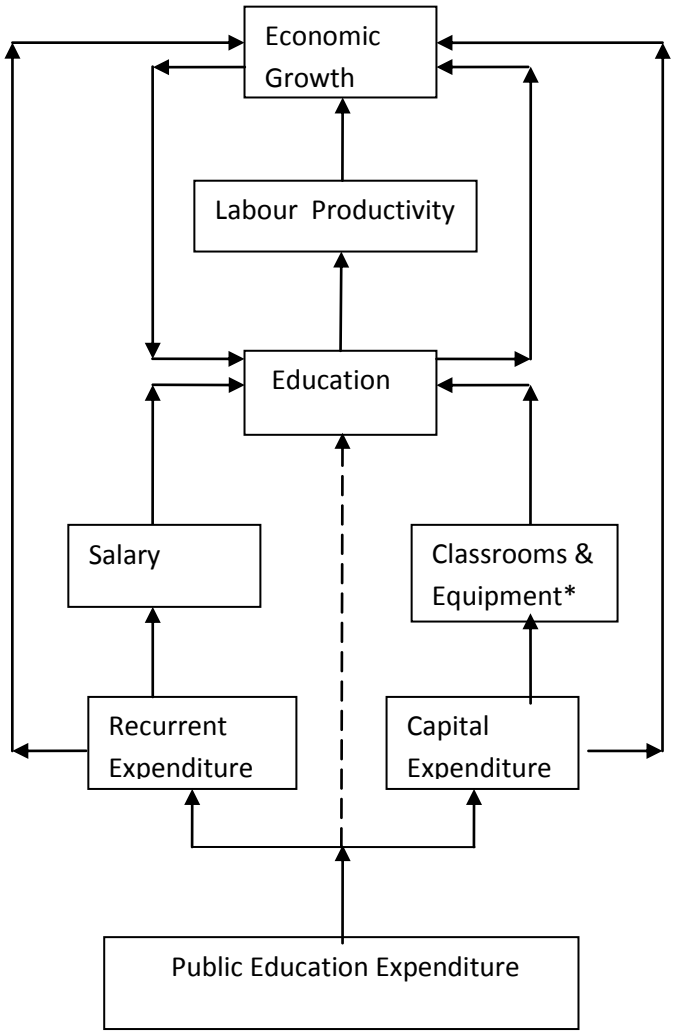
Section 2.2.4.1 presents a rich literature on the positive and significant effect of public expenditure on educational development.

The efficient use of public education expenditure will lead to a positive increase on the level of education in an economy. On the contrary, an inefficient use of resources may be counter-productive. Thus, in an environment prone to corruption, there may be a continuous increase in public education expenditure without a corresponding increase in the level of education. Apart from the quantity of education as depicted by enrolment rate, the quality of education also matters.

Thus, two countries may have same level of education but the efficiency of labour may vary. Following Lucas' version of endogenous growth model, the above schema captures the interdependence between expenditure on education and economic growth.

The above framework depicts an indirect link between public education expenditure (PEE) and economic growth, which represents Lucas' version of endogenous growth model. On the other hand, following Barro and Sala-i-Martin's model, PEE affects economic growth directly through the government expenditure multiplier. In a nutshell, PEE has both direct and indirect effect on economic growth.

Fig 3.1: Public Education Expenditure, Education and Economic Growth: A Framework



Source; Author's design

Note: Equipment include laboratories, library services and teaching aids

3.3 METHODOLOGY

3.3.1 Model Specification

Following both theoretical and empirical literature on the role of public education expenditure in models of economic growth (Ram 1986, Lucas 1988, Barro 1990, Barro and Sala-i-Martins 1992), an endogenous growth model that incorporates government spending is specified. It recognizes the interrelationship between economic growth and education in a structural equation model. The specification allows for the identification of the channels through which public education expenditure and other policy interventions affect economic growth over time.

We consider a structural equation model with the scalar dependent variable y which depends on one endogenous regressor, denoted by h and two sets of exogenous regressors, g and c.

$y = f(h, g, c)$ 3.6

where,

y : real Gross Domestic Product (GDP) per capita growth rate (grypc)

h : education

g: a vector of public education expenditure measures

c; a vector of control variables (variables that are often included in growth models)

The above equation is stated in econometric form as follow;

$y_t = \omega + \alpha h_t + \beta_i g_{it} + \delta_j c_{jt} + u_t$ . . . . (3.7)

α, β and δ are unknown parameters of interest, while u is the structural disturbances or errors term.

The set of exogenous regressors g, include the following measures of public expenditure on education – ratio of public education expenditure to total government expenditure (ptee); ratio of public recurrent education expenditure to total government expenditure (pree); ratio of public capital education expenditure to total government expenditure (pcee); ratio of public education expenditure to GDP (teey), ratio of public recurrent education expenditure to GDP (reey) and ratio of public capital education expenditure to GDP (ceey).

The second set of exogenous variables c, is made up of variables often included in growth equations. Those included in this study are initial level of GDP, physical capital, trade openness, financial depth, and inflation rate. Consequently, equation 3.7 is restated as follows;

$$y_t = ah_t + \sum_{i=1}^{6} \beta_i g_{it} + \sum_{j=1}^{5} \delta_j c_{jt} + \mu_t \quad (3.8)$$

The regression error u is assumed to be uncorrelated with g and c but is correlated with h. This correlation is as a result of the simultaneity bias arising from the simultaneous relationship between economic growth and education as illustrated by the Lucas model. This correlation leads to Ordinary Least Squares (OLS) estimator being biased and inconsistent for β.

To obtain a consistent estimator, we assume the existence of at least one instrumental variable z that satisfies the assumption

$E(u_t / z) = 0$ . . . .(3.9)

This is the condition for instrument validity. Also, the instrument z needs to be correlated with h so that they provide some information on the variables being instrumented (that is, instrument relevance).

Apart from the simultaneous relationship between education and economic growth equation (3.8), two other instances - omitted-variable bias, and errors in variables - could lead to the violation of the zero-conditional - mean assumption in economic research. Although each of these problems arises for different reasons, the solution to each is the same econometric tool: the instrumental-variables (IV) estimator.

A variable is endogenous if it is correlated with the disturbance term. The presence of an endogenous variable among the regressors in a model necessitates the use of instrumental variables or instruments. This has been demonstrated to solve the problems of biased and inconsistent parameter

estimates associated with the use of OLS technique [see Verbeek (2004, chapter 5); Cameron and Trivedi (2005, chapter 4); Baum (2006, chapter 8); and Wooldridge (2009, chapters 15 and 16)].

3.3.2 A priori Expectation

The model above has been specified based on the endogenous growth theory by Lucas (1988) and Barro and Sala-i-martin (2004), as well as the result of empirical investigation between public education expenditure and education attainment. Consequently, the following relationships are expected between the endogenous variables and their regressors.

$\frac{\partial y}{\partial h} > 0$

$\frac{\partial y}{\partial g_i} > 0, \qquad i = 1, \ldots, 6$

$\frac{\partial y}{\partial c_j} > < 0, \qquad j = 1, \ldots, 5$

$\frac{\partial h}{\partial g_i} > 0, \qquad i = 1, \ldots, 6$

3.3.3 Identification and Instrumental -Variables Estimation

Instrumental-variables estimation provides consistent estimates of the parameters of a structural equation. An instrumental variable is a variable uncorrelated with the error of a structural equation.

The structural equation (3.8) can be more simply written as:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\delta} + \boldsymbol{\zeta} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.10)$$

Where

$\mathbf{y}$ = n×1 vector for the response variable in the equation;

$\mathbf{X}$ = n×p model matrix, containing the p endogenous and exogenous predictors of the system of equation, normally including a column of 1's for the constant;

$\boldsymbol{\delta}$ = p × 1 parameter vector, containing the β's for the structural equation; and

$\boldsymbol{\zeta}$ = n × 1 error vector.

Let the n × p matrix $\mathbf{Z}$ contain instrumental variables. Then, multiplying the structural equation through by $\mathbf{Z}`$ produces

$$\mathbf{Z}`\mathbf{y} = \mathbf{Z}`\mathbf{X}\boldsymbol{\delta} + \mathbf{Z}`\boldsymbol{\zeta} \quad . \quad . \quad . \quad . \quad . \quad . \quad . (3.11)$$

In the probability limit, $\frac{1}{n}\mathbf{Z}`\boldsymbol{\zeta}$ goes to 0 because of the non correlation of the instrumental variables with the error. Consequently, the instrumental-variables estimator

$$\hat{\boldsymbol{\delta}} = (\mathbf{Z`X})^{-1}\mathbf{Z`y} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.12)$$

is a consistent estimator of **δ.**

Two assumptions are implicit in the above equation. The first is that the number of instrumental variables is equal to the number of predictors *p* in the structural equation; and second, that the cross-product matrix **Z`X** is non-singular.

If there are fewer instrumental variables than predictors (i.e., structural coefficients), then the estimating equations

$$\mathbf{Z`y} = \mathbf{Z`X}\hat{\boldsymbol{\delta}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.13)$$

are under-determined, and the structural equation is said to be under-identified.

If there are *p* instrumental variables, then the structural equation is said to be just-identified.

If there are more instrumental variables than predictors, then the estimating equations will almost surely be over-determined, and the structural equation is said to be over-identified.

Three instruments; age dependency ratio (depr), life expectancy at birth (leb) and urbanization (pupt) were identified as relevant instruments in the study. Thus, the model is over-identified.

3.3.4 Instruments Relevance

The identification of an instrument hinges on both its validity and relevance. It is often impossible to test the first property. Although the second property can be tested, the relevance of an instrument is more of a theoretical issue than a statistical one. The theoretical / intuitive relationship between each of the instruments and the endogenous variable (h) are presented below.

a) Age Dependency Ratio

This is the ratio of dependents--people younger than 15 or older than 64--to the working-age population--those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population (World development Indicators 2010). In view of the peculiar nature of education (that is merit good) for a given level of income, an increase in dependency ratio will have an adverse effect on the quantity and quality of schooling. Thus, there is an inverse relationship between age dependency ratio and educational attainment.

b) Life Expectancy at Birth

Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life (World Development Indicators 2010). Taking into consideration the private returns to education, a higher life expectancy will motivate greater investment in education.

c) Urbanization

Urban population refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects. Urbanization refers to a process in which an increasing proportion of an entire population lives in cities and the suburbs of cities. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas. The density of population in urban areas increases because of the migration of people from less industrialized regions to more industrialized areas. A continuous increase in the population of a town will over-stretch the capacity of existing facilities such as schools and other infrastructure.

3.3.5 Estimation Technique

The hypothesized simultaneous relationship between education and economic growth, and the possibility of both omitted variables and measurement error renders OLS estimators biased and inconsistent. Considering the number of excluded exogenous variables in the regression model, the study adopts the instrumental variable (IV) two-stage-least squares (2SLS) estimation technique. Presented below is the analytical procedure for a model with a single endogenous explanatory variable.

Consider the structural model [akin to (3.8)]

$$y_1 = \beta_0 + \beta_1 y_2 + \beta_2 z_1 + u_1 \quad . \quad . \quad . \quad . \quad . \quad (3.14)$$

Where,

y_1 = dependent variable

y_2 = endogenous explanatory variable [h in (3.8)]

z_1 = exogenous explanatory variable, (g and c), and

u_1 = error term

Let z_2 and z_3 be two exogenous variables not included in the model. The two exogenous variables z_2 and z_3 are uncorrelated with the error term u_1 and are both correlated with y_2

Since each of z_1, z_2 and z_3 are uncorrelated with u_1, any linear combination of these exogenous variables is also uncorrelated with u_1 and therefore any linear combination of the exogenous variables will also be a valid IV for y_2 . The best linear combination that satisfies these conditions would be a reduced form equation for y_2 as follows:

$$y_2 = \pi_0 + \pi_1 z_1 + \pi_2 z_2 + \pi_3 z_3 + v_2 \quad . \quad . \quad . \quad . \quad (3.15)$$

The above equation should satisfy the following conditions:

$E(v_2) = 0$, $\text{cov}(z_1, v_2) = 0$, $\text{cov}(z_2, v_2) = 0$, $\text{cov}(z_3, v_2) = 0$

Under certain assumptions the best IV estimator for y_2 is the linear combination

$$y_2^* = \pi_0 + \pi_1 z_1 + \pi_2 z_2 + \pi_3 z_3 \quad . \quad . \quad . \quad . \quad . \quad (3.16)$$

To ensure that there is no perfect correlation between y_2* and z_1 at least one of the following identification conditions must hold: $\pi_2 \neq 0$, $\pi_3 \neq 0$. This assumption can be tested with a null hypothesis H_0: $\pi_2 = \pi_3 = 0$ with the alternative that at least one of them is non-zero. The usual F-statistic to test this hypothesis applies.

Equation (3.16) above is estimated from the sample data as

$$\hat{y}_2 = \hat{\pi}_0 + \hat{\pi}_1 z_1 + \hat{\pi}_2 z_2 + \hat{\pi}_3 z_3 \quad . \quad . \quad . \quad . \quad (3.17)$$

Once (3.17) is estimated, the method of moments technique is used to solve for the coefficient estimates of the IV estimators from the following equations:

$$\left.\begin{aligned} \sum_{i=1}^{n} (y_{i1} - \hat{\beta}_0 - \hat{\beta}_1 y_{i2} - \hat{\beta}_2 z_{i1}) = 0 \\ \sum_{i=1}^{n} z_{i1}(y_{i1} - \hat{\beta}_0 - \hat{\beta}_1 y_{i2} - \hat{\beta}_2 z_{i1}) = 0 \\ \sum_{i=1}^{n} z_{i2}(y_{i1} - \hat{\beta}_0 - \hat{\beta}_1 y_{i2} - \hat{\beta}_2 z_{i1}) = 0 \end{aligned}\right\} \quad (3.18)$$

The IV estimators obtained in this fashion is called the 2SLS estimators. The reason it is called a 2SLS estimator is that the estimator obtained in the above

approach will be identical to those obtained if OLS is used to regress y_1 on $\hat{y}_2$ and z_1

3.3.6 Test for Endogeneity

Although the choice of what variable is regarded as endogenous depends on the researcher's intuition and economic theory, a statistical test confirms it. The statistical confirmation of endogeneity is what matters for empirical work. The essence of the test is to avoid using 2SLS which is less efficient than OLS when the explanatory variable is actually exogenous.

Hausman's Test for Endogeneity

We employ the Hausman (1978) specification test;. The idea of Hausman test is to ascertain if the estimates from OLS and IV are different. This test is conducted as follows:

Step-1: Run OLS of the reduced form regression

$$y_2 = \pi_0 + \pi_1 z_1 + \pi_2 z_2 + \pi_3 z_3 + \pi_4 z_4 + v_2. \quad . \quad . \quad .(3.19)$$

Save the residuals from this regression. Call it $\hat{v}_2$

Step-2: Run OLS of the structural equation

$$y_1 = \beta_0 + \beta_1 y_2 + \beta_2 z_1 + \zeta \hat{v}_2 + u \quad . \quad . \quad . \quad .(3.20)$$

Step-3: If the coefficient associated with $\hat{v}_2$ is found to be significantly different from zero, then we conclude that y_2 is indeed endogenous.

3.3.7 Justification of Model

3.3.7.1 The Use of Instrumental Variable Technique

The inclusion of endogenous regressors in a model biases an estimate of a regression coefficient on it toward zero. Endogeneity arises through the following means: simultaneous equation bias, omitted variable bias, measurement error bias and sample selection bias. The GDP figures used particularly for developing countries where non-market activity is prominent will definitely contain measurement error. With respect to education, vocational and non-formal education is often omitted. Another factor is the issue of omitted variables; quality of education is often omitted due to the dearth of data. Furthermore, there is a bi-causal relationship between education and economic growth [see Lucas (1988) and Francis and Iyare (2006)]. In the light of these, the use of instrumental variable technique becomes appropriate [Verbeek (2004), Cameron and Trivedi (2005), Baum (2006), and Wooldridge (2009)]

3.3.7.2 Education Vs Human Capital in growth regressions

Human capital refers to the skills and knowledge intensity of the labour force. (O'Callaghan, 2002).This is essentially acquired through schooling and training. Similarly, Mankiw, Romer and Weil (1992) considered only the education of those in the labour market. The link from human capital to growth is through improvement in labour productivity and technological advancement.

Education on the other hand means any measure of standard of education such as enrolment rate and literacy rate. Education does not only affect productivity, but also other non-market factors (such as health, fertility rate and income inequality, poverty, crime, the environment and drug use) that influence economic growth either directly or indirectly. This partly supports the use of enrolment rate instead of average years of education.

Most growth studies measure economic growth as GDP per labour – perhaps based on the definition of human capital stated above. However, in this study we define economic growth as GDP per total population. This conforms to the use of enrolment rate.

Government education expenditure does not reflect on the development of human capital alone. An increase in the salary of teachers for example boosts aggregate demand which promotes economic growth. Also, the spending on

capital expenditure boosts other sectors of the economy through the unbalanced growth hypothesis.

Education should be viewed in a broader sense than human capital. It is this type of definition that will allow the use of current level of education as against the lag which Glewwe et al (2007) proposed.

3.3.7.3 Measure of Education

Previous studies have used a variety of measures to represent education. These include literacy rate; primary, secondary and tertiary enrolment rate; combined primary, secondary and tertiary enrolment rate; and average years of schooling.

This study adopts the secondary education for the following reasons. Education promotes economic growth through three channels. First, it increases the productivity of labour through the acquisition of knowledge and skills; second, it enables the adoption of current technology; and lastly, it promotes innovation and helps in the creation of new knowledge. While primary education is suitable for productivity enhancement, secondary education is a prerequisite for the adoption of technology. Tertiary education equips citizens with the capacity to innovate and expand the frontiers of knowledge. According to the 'Structuralist School of Thought', the movement from agricultural based to an industrialized economy signifies development.

This era requires extensive technology-based development of the productive system of an economy (CBN, 2000). As hinted above, industrialization which hinges on the use of technology for production require a high level of secondary education.

Considering the relatively high level of primary school education in Nigeria and the fact that the next desirable stage of development for Nigeria is industrialization, the most appropriate level of education to consider is the secondary school level.

3.3.7.4 Quantity and Quality of Education

One would expect every graduate from any level of education to be endowed with the necessary knowledge and skills derivable from such level. But this is not often the case, especially in developing countries. Thus, the quality of education becomes a factor to consider. It suffices to say that in the drive toward the development of the education sector, the quantity of education (enrolment and completion) is a necessary condition, while the quality serves as a sufficient condition. Although both can be pursued at the same time, rationality dictates that the necessary condition be achieved before the sufficient condition. Thus, in this study, emphasis is on the quantity of education. In addition, data for measures of quality of education such as ratio of students to teachers is scanty and does not cover much of the period under review.

3.5 VARIABLES, DATA AND SOURCES

Variables included in the study, their definitions and sources are presented in the table below .

Table 3.1 Variables, Definition and Sources

S/no	Variable	Description and Measure	Sources of Data
1	Grypc	Real GDP per capita growth rate (expenditure approach) [%]	UN Statistical Division
2	Rypc	Real GDP per capita [US$]	UN Statistical Division
3	Sedu	Secondary sch enrolment rate %]	WDI
4	Ptee	Ratio of public expenditure on education to total government expenditure [%]	CBN Statistical Bulletin (2010) CBN Annual Report and Statement of Accounts (VI)
5	Pcee	Ratio of public capital expenditure on education to total government expenditure [%]	Same as Above
6	Pree	Ratio of public recurrent expenditure on education to total government expenditure [%]	Same as Above
7	Teey	Ratio of public expenditure on education to GDP [%]	Same as Above
8	Ceey	Ratio of public capital expenditure on education to GDP [%]	Same as Above
9	Reey	Ratio of public recurrent expenditure on education to GDP [%]	Same as Above
10	Capy	Gross fixed capital formation (Ratio of GDP) [%]	UN Statistical Division
11	Tpen	Trade openness (ratio of total trade to GDP) [%]	World Bank, World Development Indicators (WDI)
12	Fdep	Financial Depth (ratio of broad money supply to GDP) [%]	CBN Statistical bulletin (2010)
13	Infr	Inflation rate [%]	CBN Statistical Bulletin (2010)
14	Depr	Age dependency ratio [%]	WDI
15	Leb	Life expectancy at birth [years]	WDI

16	Pupt	Proportion of total population in urban areas [%]	WDI

Source: Compiled by Author

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

This chapter describes and explains the main variables of interest in the study. Section 4.1 presents graphical and trend analyses of public education expenditure, secondary school enrolment ratio, and real gross domestic product. The regression results based on model specified in section 3.3.1 is presented in section 4.2. Section 4.3 discusses the empirical results of the regression and summarizes the major findings. Section 4.4 presents policy implications of the major findings of the study.

4.1 ECONOMIC GROWTH, EDUCATIONAL ATTAINMENT AND PUBLIC EDUCATION EXPENDITURE IN NIGERIA

This section conducts a trend and comparative analysis of the variables of interest in the study. Section 4.1.1 presents average economic growth rate in Nigeria for the period under review. Overall as well as sub-period averages were noted. A graphical analysis of the data was also presented. A comparative and graphical analysis of education statistics in Nigeria is presented in section 4.1.2. Section 4.1.3 presents a graphical analysis of the ratio of public education expenditure to total public expenditure on one hand , and to GDP on the other.

4.1.1 Real GDP Per Capita in Nigeria

An examination of Nigeria's real GDP per capita shows that the country has been stagnant - a situation reminiscent of the pre–industrial revolution era. Real GDP per capita measured in 2005 constant US dollars (expenditure approach) was $679.7 in 1970. The highest level during the period under review was $863.2 (in 2007), while the least amount recorded was $483.6 (see Appendix 1). This trend poses a serious cause for concern when viewed against countries that were more or less at the same level of income in the past and others that have made tremendous progress over time.. Table 4.1 below shows the level gaps of GDP per capita for selected countries.

Table 4.1 Level Gaps in Real GDP Per Capita (US $) in Selected Countries

Year	1970	2010	Level Gap	% Change	Average Annual Growth Rate (in %)
S. KOREA	1920	21118	19198	999.9	6.25
MALAYSIA	1154	6050	4996	432.9	4.32
SINGAPORE	4799	33613	28814	600.4	5.06
USA	20100	41900	21800	108.5	1.88
NIGERIA	679	772	93	1.3	0.6

Source; United Nations Statistics Division, www.unstats.un.org

In 1970 South Korea's real GDP was almost three times that of Nigeria, while that of Malaysia was about double. This gap has increased to twenty seven and eight times respectively in 2010. Similarly, while GDP of South Korea, Singapore and Malaysia increased by a multiple of ten, four, and six respectively, Nigeria has remained stagnant. Fertility decline, structural change and technological progress have been identified as some factors responsible for the sustained growth experienced by these countries (Doepke 2005). All these factors have been found to be highly correlated with education (Shirahase 2000; Uematsu and Mishra 2010).

Another means to gauge the future welfare of an economy is to assess its average growth rate. This rate also determines the number of years it will take an economy to double its per capita income. Table 4.2 below shows the trend of economic growth rate in Nigeria. The first decade (1971 – 1980) recorded a positive growth rate of 2.075 per cent. The next two decades recorded negative growth rates of -3.074 and -0.508 per cent respectively. Thus, between 1981 and 2000, an average growth rate of -1.791 per cent was recorded in Nigeria.

Overall, the average growth rate for the period under review is 0.602. At this rate it will take more than a century to double Nigeria's per capita income from $679 (1971 value) to $1358. However, it would be observed that there has been a consistent positive increase in growth rate since 2000. This coincides with the era of sustained democratic process in the country. A disturbing feature that characterized economic growth rate in Nigeria prior to

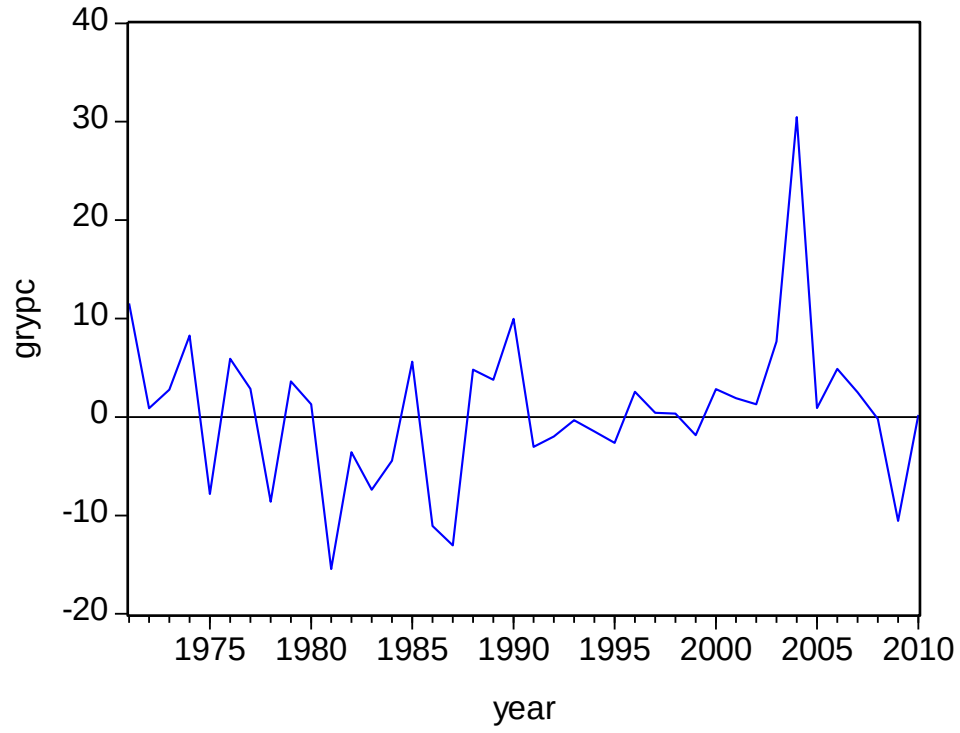
2000 is the observed swings between positive and negative growth rates (see Fig 4.1). In specific terms, economic growth within the period under review ranged between -15.4 per cent in 1981 and 30.5 per cent in 2004 (see appendices 1 and 2).

Table 4.2 Average Real GDP Growth Rate in Nigeria

PERIOD	AVERAGE REAL GDP GROWTH RATE
1971 – 1980	2.075
1981 – 1990	-3.074
1991 – 2000	-0.508
2001 – 2010	3.914
1971 – 1990	**-0.499**
1971 – 2000	**-0.502**
1981 – 2000	**-1.791**
1971 – 2010	**0.602**

Source; Computed from the data from United Nations Statistics Division, www.unstats.un.org

Fig.4.1. Real GDP Per Capita Growth Rate (%) in Nigeria



Source: Constructed from grypc data presented in appendix 1

4.1.2 Education in Nigeria

Basically, (formal) education is in three stages – primary, secondary and tertiary. It has both consumption and investment value for individuals (Riddell 2003). At the macro level, it is a key determinant of economic growth. It is also associated with a wide range of non-economic benefits such as health, income inequality and low fertility rate. Thus, education plays an important role in improving overall socioeconomic status.

Primary education equips the individual with literacy and numeracy skills or what is generally referred to as 3r's (reading, arithmetic and writing). On the other hand secondary education prepares individuals for the adoption of existing technology, while tertiary education equips candidates with the relevant skills to develop new theories and technologies through research, innovation and development. The overall development of education in Nigeria could be assessed by examining the UNDP Human Development Reports. For instance, combined gross enrolment ratio in education for 2007 was 53 per cent (Human Development Report 2009). This figure is about half what obtains in most advanced countries such as Australia (114.2%), Canada (99.3%), Denmark (101.3%), New Zealand (107.5) and United States of America (92.4%).

The actualization of Vision 20: 2020 and persistent positive economic growth rate in Nigeria will definitely depend on the transformation of the Nigerian economy from an agricultural-based to an industrial economy. It will also depend on massive investment in virtually all sectors of the economy. In view of the low state of development in the financial sector in Nigeria, this will require foreign investment. All these factors are influenced by the level and quality of education in an economy.

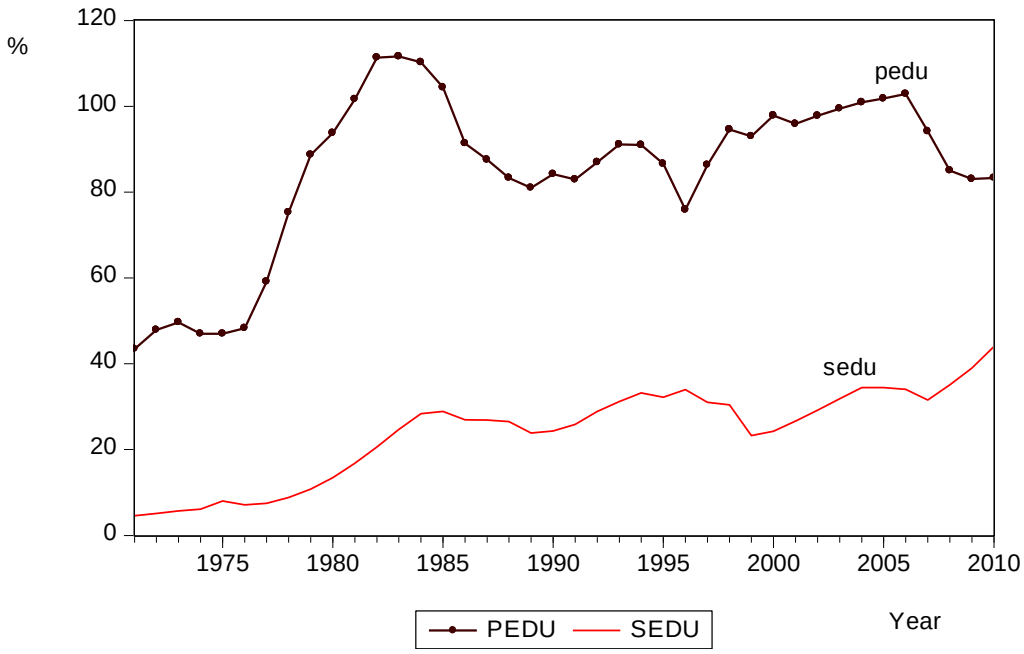
Fig 4.2 below shows the level of primary and secondary education in Nigeria. However, emphasis is on secondary school education (for reasons highlighted

in section 3.3.7.3). A striking feature of the trend is the persistent and wide gap between primary and secondary school education in Nigeria.

Secondary school enrolment rate (sedu) was 4.6 percent in 1971. The highest level ever attained is 44.05 per cent in 2010 (see Appendix 1). Average secondary school enrolment for the period under review is 23.99 per cent.

A persistent increase in secondary school enrolment rate was observed from 1971 to 1985 (except in 1976). However, an unstable trend was witnessed from 1986 to 2007. The persistent increase in sedu corresponds with the pre–SAP (structural adjustment programme) era.

Fig. 4.2 Gross Primary and Secondary School Enrolment Ratio (%) in Nigeria



Source:World Bank, World Development Indicators (2010)

The essence of deregulation policy and more recently debt-forgiveness was to enable the government invest more in the social sector such as education. However, based on available data, there is little to show for it. An examination of secondary education across selected countries crystallizes the pitiable state of education in Nigeria.

Table 4.3 below shows the growth trend of secondary education in selected countries. Countries were selected based on two conditions; first, these countries had relatively low (below 20 per cent) level of secondary school enrolment ratio in 1970, and secondly all the countries under reference have crossed the 50 per cent threshold as at 2009. In 1970, Botswana, Maldives and South Africa had gross secondary school enrolment ratio of 6.3, 1.6 and 18.7 per cent respectively. These figures had increased to 81.5, 83.7 and 93.9 per cent respectively in 2009. However, during this period, Nigeria's enrolment rate only increased from 4.3 to 30.5 per cent. Obviously, the feat attained in these countries must have been as a result of a thorough planning and implementation effort by the governments in these countries.

Apart from the fact that secondary school education is a *sine qua non* for industrialization, it is also the preparatory stage and requirement for tertiary levels of education. Consequently, governments in most developing countries have embarked on deliberate efforts to develop their education sector. At this juncture it is apposite to examine Nigeria's effort in this regard in the next section.

Table 4.3: Secondary School Enrolment Ratio in Selected Countries

(% gross)

COUNTRY	YEAR						
	1970	**1980**	**1990**	**2000**	**2005**	**2007**	**2009**
ALGERIA	11.2[a]	31.2	62	75[f]	83.2	-	-
BHUTAN	2.3	9.7[c]	-	41.3	45.6	56.3	61.7
BOTSWANA	6.3	18.3	40.1	76.2	78.5	81.5	81.5[h]
CAPE VERDE	11.4[a]	7.9	26.7[e]	65.4	82.4	82.8	81.5[i]
KENYA	16.6	30	-	39.3	47.6	51.7	59.5
HONDURAS	12.9	29.4	33.1[d]	-	-	63.8	64.5[i]
MALDIVES	1.6	4.1	-	54	83.6[g]	83.7	-
OMAN	0.17[b]	8.3	39.4	78.2	-		91.3
SOUTH AFRICA	18.7	40.2	66	85.5	95.1	95.1	95.1
NIGERIA	4.3	13.4	24.3	24.9	35.1	30.5	30.1[h]

Source: World Bank, World Development Indicators (2010)

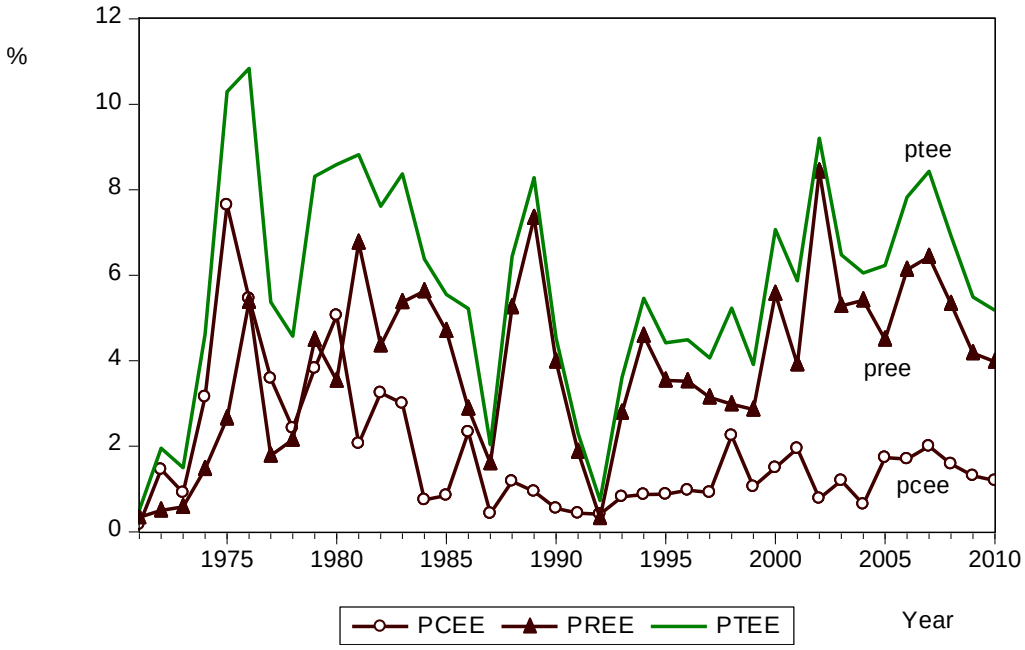
Note: a = 1971; b = 1973; c = 1982; d = 1991; e = 1993; f = 2002; g = 2006;

h = 2007; i = 2008

4.1.3. Public Education Expenditure in Nigeria

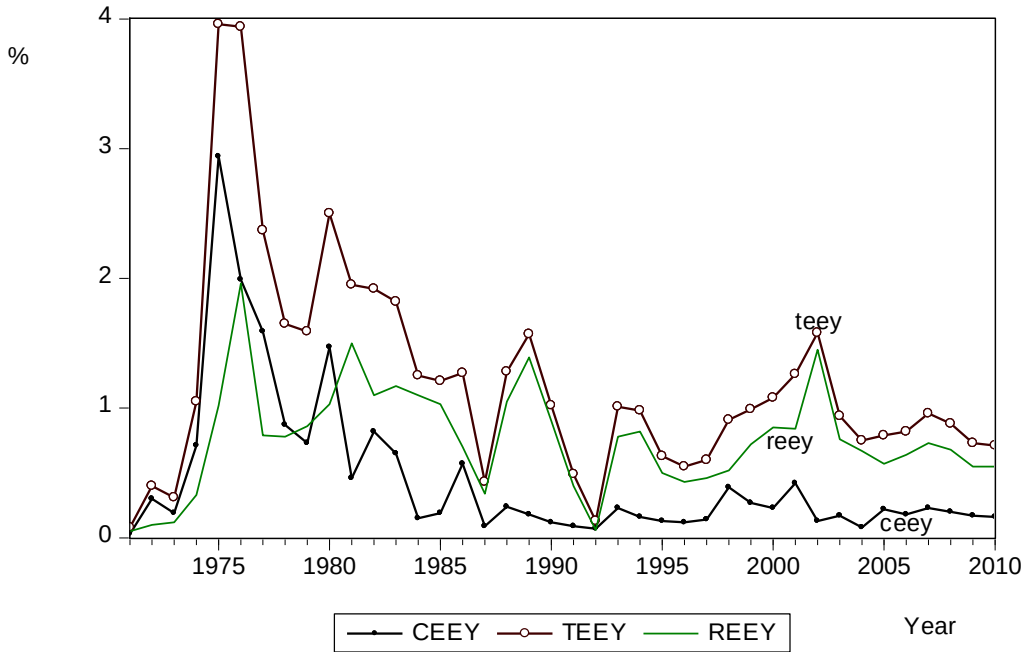
Generally, public expenditure on education is in two parts; capital expenditure is devoted to capital projects such as the construction of schools while recurrent expenditure is spent on running the schools on a regular basis. The payment of teachers' salary and purchase of teaching materials such as laboratory equipment fall under this category. There is no doubt that enrolment rate partly depends on the number and availability of schools (access factor). On the other hand, the quality of education (often measured by the ratio of repeaters to total enrolment) depends partly on the quality and number of teachers as well as the general school environment. Below is the trend of public expenditure on education in Nigeria from 1970 to 2010. Total government education expenditure as a ratio of total government expenditure (ptee) ranged between 0.5 and 10.8 per cent during the period under review (see Appendix 2). The least allocation was recorded in 1971 while the highest amount was recorded in 1976 (see appendix 1). The average amount for the period under review is 5.7 per cent. Until 1980 (except for 1979), the proportion of capital expenditure on education (pcee) was above that of recurrent expenditure (pree). However, since 1981, the reverse has been the case. A similar trend was also observed between capital expenditure on education as a ratio of GDP and recurrent expenditure (see Fig. 4.3b).

Fig. 4.3a Total, Recurrent, and Capital Expenditure on Education in Nigeria. (% of Total Government Expenditure), 1970 – 2010



Source: Constructed from ptee, pree and pcee data presented in appendix 1

Fig. 4.3b Total, Recurrent, and Capital Expenditure on Education in Nigeria. (% of Gross Domestic Product), 1970 - 2010



Source: Constructed from teey,reey and ceey data presented in appendix 1

In summary, during the period under review, the Nigerian government spent an average of 5.7 per cent of its yearly budget on the education sector. In spite of this, average economic growth in the country stood at 0.6 per cent. Does this imply that public education expenditure (ptee) is not relevant for economic growth? The next section provides a clue to this question. The analysis is based on scientific evaluation rather than on intuition. The methodology designed in chapter three serves as a guide for the analysis.

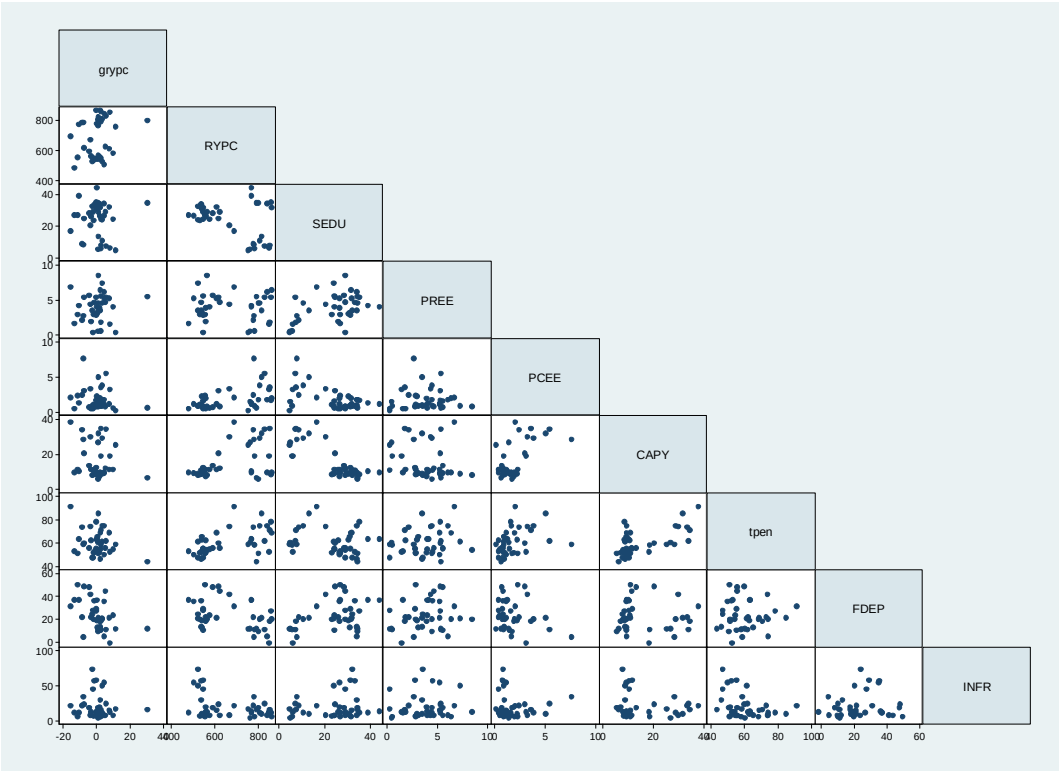
4.2 PRESENTATION AND DISCUSSION OF RESULTS

A test of the presence of outliers in the series employed and the relevance of included variables are conducted in section 4.1. The challenge (of unit roots) posed by the use of time–series data in the estimation of simultaneous equation models is addressed by evaluating the level of integration of the series used. Thus, the unit roots test of the series was conducted in section 4.2.2 using the Augmented Dickey-Fuller (ADF) approach. Section 4.2.3 presents the regression results based on equation 3.6.

4.2.1 Tests for Outlier and Added Variables

It has been noted that a single observation that is substantially different from all others in a series can make a large difference in regression results. The scatter diagram presented in Fig 4.4 does not indicate any trace of an outlier in grypc and its predictors which could cause problems in the regression analysis.

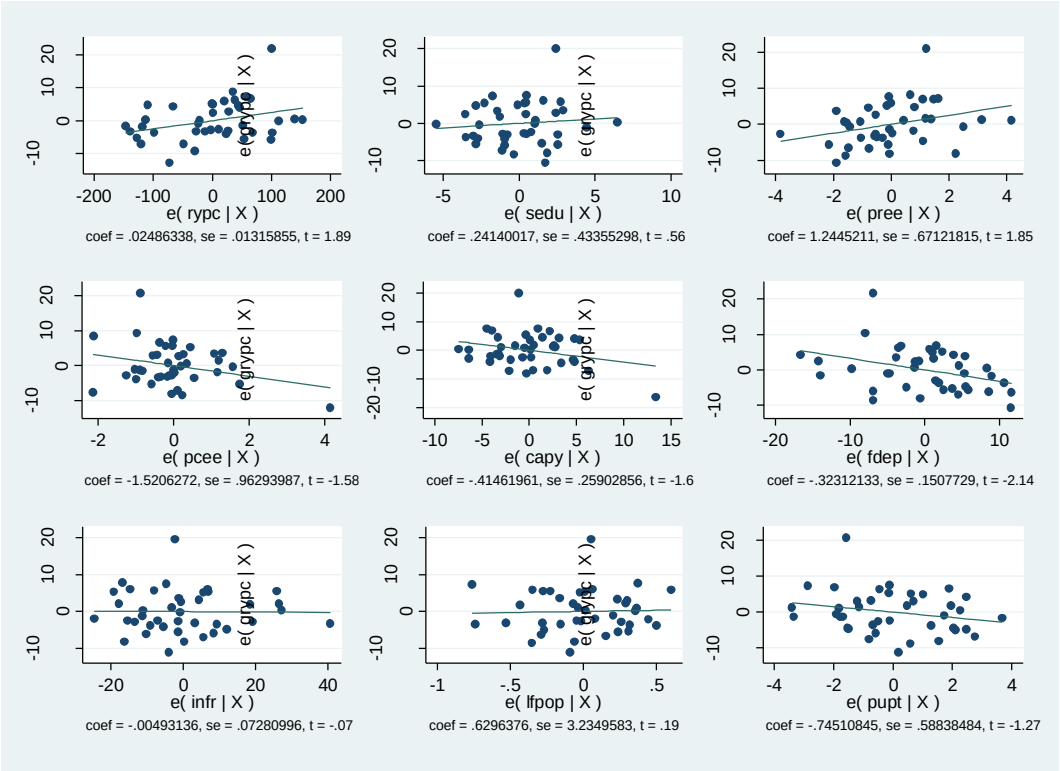
Fig. 4.4. Graph Matrix of Variables Used in the Study



Source: Constructed from data presented in appendix 1s

Several variables have been identified as significant regressors in the growth model by different researchers (see Durlauf, Johnson and Temple, 2004). Fig. 4.5 below gives a snapshot of the relationship between grypc and the explanatory variables. The level of per capita income, education and public recurrent expenditure on education are directly related to economic growth rate in Nigeria. On the contrary, public education expenditure, capital formation and financial depth are inversely related to economic growth. the level of inflation was found to be neutral.

Fig. 4.5 Added Variables Plots (avplots)



Source: Constructed from data presented in appendix 1

4.2.2 Unit Roots Test

Wooldridge (2009) noted that the validity of the usual Ordinary Least Squares (OLS) and Two Stage Least Squares (2SLS) inference procedures in time series applications hinge on the notion of 'weak dependence'. Normally, most macroeconomic time series such as gross domestic product, enrolment rate, government expenditure, investment, population and trade among others used in this study tend to violate the weak dependence requirements. That is, they have 'unit roots'. Table 4.4 below presents the results of the stationarity tests

conducted on all the series used in the study. From the test result the growth rate of real GDP per capita (grypc), trade openness (tpen), inflation rate (infr) and all the components of public education expenditure (ptee, pree and pcee) were found to be stationary in level. On the contrary, real GDP per capita (rypc), gross capita formation (capy), financial depth (fdep) and the natural log of education were stationary at first difference.

Table 4.4 Augmented Dickey-Fuller (ADF) Tests for Unit Roots

Variable	ADF Test Statistics with Constant	Order of Integration
Grypc	-5.516	I(0)
Drypc	-5.555	I(1)
Dlnsedu	-3.989	I(1)
Ptee	-3.67	I(0)
Pree	-3.855	I(0)
Pcee	-3.034	I(0)
Dcapy	-4.706	I(1)
Tpen	3.111	I(0)
Dfdep	-5.305	I(1)
Infr	-3.133	I(0)

Note: 5 % ADF Critical Value for the Test is -2.964

Source: Result based on data presented in appendix 1

4.2.3 Regression Results

Equation 3.6 (restated below) was estimated using the Instrumental Variable (IV) Two Stage Least Squares (2SLS) technique with Stata econometric software. The *ivregress* with the *2sls* estimator and the options vce (*robust*) - to control for heteroscedastic errors – as well as *first* - to provide output that additionally reports results from the first-stage regression - was used.

$$y_t = \beta_0 + \beta_1 h_t + \beta_2 g_t + \beta_3 c_t + u_t \quad . \quad . \quad ... \quad . \quad (3.6)$$

where,

y_t = GDP per capita growth rate (grypc)

h_t = secondary school education (sedu)

gt = vector of measures of public education expenditure – ratio of total public expenditure on education to total government expenditure(ptee); ratio of total public expenditure on education to GDP (teey); ratio of public recurrent expenditure on education to total public expenditure (pree); ratio of public capital expenditure on education to total public expenditure (pcee); ratio of public recurrent expenditure on education to GDP (reey); and ratio of public capital expenditure on education to GDP (ceey)

c_t = vector of control variables which have been found to influence economic growth. These are investment (capy); trade openness (tpen); financial depth (fdep); and inflation rate (infr) assumed to be exogenous.

Based on equation 3.6, Table 4.5a presents IV regression of grypc (growth rate of real GDP per capita) on the endogenous regressor sedu (secondary school education) instrumented by three instruments – depr (age dependency ratio), leb (life expectancy at birth) and pupt (urbanization) and other exogenous regressors [level of GDP per capita (rypc), the two components of public education expenditure (pree and pcee), and capital formation (dcapy)]. The result is in two parts. The first part presents results for the reduced form equation. That is the regression of sedu on all exogenous variables (both those in the structural equation and the instruments for sedu). Table 4.5b presents statistics used to test for weak instruments.

Additional results based on equation 3.6 are presented in Tables 4.6a – 4.6d. These results are used for endogeneity, hypotheses and robustness tests. The first two columns are OLS estimates, while the last two columns are IV 2SLS estimates. In Tables 4.6a and 4.6b, the first and third columns include the aggregate values of public education expenditure (ptee) as a ratio of total government expenditure. On the other hand, the second and fourth columns include the components of ptee (that is, pree and pcee). In Tables 4.6c and 4.6d, the first and third columns include the aggregate values of public

education expenditure as a ratio of GDP (teey), while the second and fourth columns include the components of teey (that is, reey and ceey).

Table 4.5a IV 2SLS Estimation of the Empirical Relationship between Public Education Expenditure and Economic Growth

```
. ivregress 2sls grypc drypc pree pcee dcapy (dlnsedu = dddepr ddleb ddpupt), first robust

First-stage regressions
-----------------------

                                                  Number of obs   =         38
                                                  F(   7,     30) =      11.90
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.5422
                                                  Adj R-squared   =     0.4354
                                                  Root MSE        =     0.0827

------------------------------------------------------------------------------
             |               Robust
     dlnsedu |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       drypc |  -.0004915   .0002255    -2.18   0.037    -.000952    -.000031
        pree |  -.0090953   .0070223    -1.30   0.205   -.0234367    .0052462
        pcee |   .0125618   .0090637     1.39   0.176   -.0059488    .0310723
       dcapy |  -.0008717   .0031511    -0.28   0.784   -.0073071    .0055638
      dddepr |   .4504659   .1119121     4.03   0.000    .2219108     .679021
       ddleb |  -1.151508   .4609496    -2.50   0.018   -2.092893   -.2101234
      ddpupt |  -1.786576   .9721817    -1.84   0.076   -3.772036    .1988839
       _cons |    .083465   .0382574     2.18   0.037     .005333     .161597
------------------------------------------------------------------------------

Instrumental variables (2SLS) regression          Number of obs =         38
                                                  Wald chi2(5)  =     773.37
                                                  Prob > chi2   =     0.0000
                                                  R-squared     =     0.9825
                                                  Root MSE      =     1.0141

------------------------------------------------------------------------------
             |               Robust
       grypc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     dlnsedu |   3.988886   2.390497     1.67   0.095    -.6964019    8.674175
       drypc |   .1483643   .0060318    24.60   0.000     .1365422    .1601864
        pree |   .1724458   .0880936     1.96   0.050    -.0002144     .345106
        pcee |  -.1904418   .1314616    -1.45   0.147    -.4481018    .0672182
       dcapy |   .1111149   .0461221     2.41   0.016     .0207173    .2015125
       _cons |  -.2421552   .4505714    -0.54   0.591    -1.125259    .6409485
------------------------------------------------------------------------------
Instrumented:  dlnsedu
Instruments:   drypc pree pcee dcapy dddepr ddleb ddpupt
```

Source: Result based on data presented in appendix 1

Table 4.5b Test for Weak Instruments

```
. estat firststage, forcenonrobust all

  First-stage regression summary statistics
```

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(3,30)	Prob > F
dlnsedu	0.5422	0.4354	0.4131	9.34458	0.0002

```
  Shea's partial R-squared
```

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
dlnsedu	0.4131	0.2995

```
  Minimum eigenvalue statistic = 7.03792

  Critical Values                       # of endogenous regressors:    1
  Ho: Instruments are weak              # of excluded instruments:     3
```

	5%	10%	20%	30%
2SLS relative bias	13.91	9.08	6.46	5.39
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	22.30	12.83	9.54	7.80
LIML Size of nominal 5% Wald test	6.46	4.36	3.69	3.32

Source: Result based on data presented in appendix 1

Table 4.6a OLS and 2SLS Estimates of the relationship between the Ratio Public Education Expenditure to Total Government Expenditure and Economic Growth.

```
. estimates table model1 model2 model3 model4, star stat (N r2 r2_a rmse)
```

Variable	model1	model2	model3	model4
dlnsedu	3.8292569*	5.3419315**	3.1351876	3.9888864
drypc	.14944766***	.14896039***	.14913026***	.1483643***
ptee	.04698161		.0425068	
dcapy	.08292481*	.11877809**	.08349176	.11111492*
pree		.18009619		.17244579
pcee		-.22521168		-.19044182
_cons	-.19696883	-.28986953	-.116356	-.24215517
N	39	39	38	38
r2	.97922153	.9827183	.97924791	.98245132
r2_a	.976777	.98009986	.97673251	.97970933
rmse	1.166674	1.0799869	1.1027827	1.0141012

legend: * p<0.05; ** p<0.01; *** p<0.001

Source: Result based on data presented in appendix 1

Table 4.6b Relationship between the Ratio Public Education Expenditure to Total Government Expenditure and Economic Growth - Extended Regressors

```
. estimates table model5 model6 model7 model8, star stats (N r2 r2_a rmse)
```

Variable	model5	model6	model7	model8
dlnsedu	4.0709559*	5.6627106*	3.6972908	4.4481672
drypc	.15001335***	.14976777***	.15002847***	.14955014***
ptee	.05234338		.04070995	
dcapy	.08672903*	.12642643**	.08855469*	.11893976*
tpen	-.01313647	-.01627519	-.01127191	-.01165075
dfdep	.02154521	.0317388	.0223952	.03210473
infr	.00395226	.00086186	.00351331	.0014858
pree		.1900625		.17463138
pcee		-.23791851		-.21799548
_cons	.46338492	.62856298	.4626153	.434255
N	39	39	38	38
r2	.97976096	.98353414	.97984477	.9833536
r2_a	.97519086	.97914325	.97514188	.97876148
rmse	1.2058583	1.1056399	1.0868082	.9876868

legend: * p<0.05; ** p<0.01; *** p<0.001

Source: Result based on data presented in appendix 1

Table 4.6c OLS and 2SLS Estimates of the relationship between the Ratio of Public Education Expenditure to GDP and Economic Growth.

```
. estimates table model9 model10 model11 model12, star stats (N r2 r2_a rmse)
```

Variable	model9	model10	model11	model12
dlnsedu	4.2123111*	5.349276**	4.1585421	4.3874173
drypc	.14967286***	.14989265***	.14968433***	.14945033***
teey	-.07885251		-.11666542	
dcapy	.09872403*	.12480969**	.10497759*	.1197548*
reey		.99503*		.92795927*
ceey		-.79414986*		-.72014639
_cons	.15967585	-.39790568	.23536525	-.31785134
N	39	39	38	38
r2	.97908984	.98240453	.97942829	.98229362
r2_a	.97662983	.97973855	.97693475	.979527
rmse	1.1703651	1.0897469	1.0979793	1.0186475

legend: * p<0.05; ** p<0.01; *** p<0.001

Source: Result based on data presented in appendix 1

Table 4.6d Relationship between the Ratio Public Education Expenditure to GDP and Economic Growth - Extended Regressors

```
. estimates table model13 model14 model15 model16, star stats (N r2 r2_a rmse)
```

Variable	model13	model14	model15	model16
dlnsedu	4.3003549*	5.8914348*	4.5499248	5.2331736
drypc	.15085193***	.15040439***	.15094548***	.1502884***
teey	-.1345499		-.18023801	
dcapy	.10282497*	.13767278**	.11177656*	.13446649**
tpen	-.00663954	-.02047502	-.00803216	-.01775178
dfdep	.02811371	.02823956	.02888327	.02878971
infr	.00611003	-.00038398	.00460868	-.00021597
reey		1.0572014		.9714494
ceey		-.86170215*		-.81718477*
_cons	.48730964	.79091563	.67080077	.71491498
N	39	39	38	38
r2	.9797159	.98323648	.98005128	.98323529
r2_a	.97513562	.97876621	.97539658	.97861055
rmse	1.2072	1.1155887	1.081226	.9911902

legend: * p<0.05; ** p<0.01; *** p<0.001

Source: Result based on data presented in appendix 1

4.2.3.1 Ptee Vs Pree and Pcee

A crucial issue in this study is that the components of public education expenditure (ptee), that is public recurrent expenditure on education (pree) and public capital expenditure on education (pcee) serve different purposes; and to that extent their effects on both education and economic growth tend to be different. We justify this claim by examining the results presented in Table 4.6a.

In Models 1 and 3, the coefficients of ptee in both the OLS and IV 2SLS estimations are positive and similar in magnitude (0.047 and 0.043

respectively). On the contrary, while pree is positive in both estimations, pcee had a negative coefficient (see Models 2 and 4). From the results presented above, the use of aggregate public education expenditure (ptee) will obviously lead to misleading conclusion on the effect of public education expenditure (ptee) on economic growth.

These findings are robust to the addition of more regressors and different concepts of public education expenditure – teey, reey and ceey (see Tables 4.6b, 4.6c and 4.6d). This informs the adoption of the disaggregated values of public education expenditure in this study.

4.2.3.2 Test for Endogeneity

The use of instrumental variable (IV) method is predicated on the assertion that education (sedu) is an endogenous variable. However, the use of IV 2SLS estimator in the absence of endogeneity problem, results in inefficient estimates relative to the OLS estimator. This underscores the need for endogeneity test. Equation 3.6 assumes education (h_t) to be endogenous. One method of verifying this assumption is to compare the coefficient estimates of h_t (sedu) in both the OLS and IV 2SLS estimations. In Table 4.6a, Model 2 represents OLS estimation, while Model 4 presents the result for the IV 2SLS estimator. The OLS estimator for sedu (5.34) differs substantially from the over-identified IV estimator (3.99). This shows that sedu is endogenous. In

addition, while the OLS coefficient of sedu is statistically significant at 1 percent, that of IV "SLS is significant at 10 percent. This confirms the loss of efficiency due to the use of instrumental variable method. It is pertinent to note that the Hausman' test failed to reject the null hypothesis that sedu is exogenous.

4.2.3.3 Test for Weak Instruments

The need for this test stems from the fact that the estimation bias of the IV estimator resulting from the use of weak instruments can be large. Another concern is that weak instruments can lead to size distortion of Wald tests on the parameter in finite samples. The weak instrument test is presented in Table 4.5b. The first part gives the estimates and related statistics for the first-stage regression. The second part collapses this outcome into a summary table of key diagnostic statistics that are useful in suggesting weak instruments. R^2 and adjusted-R^2 are 0.54 and 0.43 respectively. Thus, the use of IV estimation will reduce the loss of precision. Using F value of 9.34 or the minimum eigenvalue of 7.04, the null hypothesis of weak instruments is firmly rejected. Another statistic that points to the rejection of weak instruments hypothesis is the Shea's partial R-squared. It shows that the instruments employed account for a substantial portion of the variation in sedu relative to the other exogenous variables in the structural equation.

4.2.3.4 Robustness Test

The result presented in Table 4.5a above is subjected to two robustness tests. The first considered other variants of public education expenditure (pee) as presented in Fig 4.6a to 4.6d while the second include other control variables in addition to the main regressors. Thus, the model is robust across different estimation specifications,

Recall that g in equation 3.1 is defined as a vector of public education expenditure measures which include

- Ratio of total government expenditure on education to total government expenditure; (ptee)
- Ration of total government expenditure on education to GDP; (teey)
- A disaggregation of each of the above measures into recurrent and capital expenditure. (ptee = pree + pcee; teey = reey + ceey)

In Table 4.6a, the signs and magnitude of the coefficients of all other regressors other than measures of public education expenditure are similar to those of model 4 (the main equation for the study). Similarly, the inclusion of more regressors in model 4 did not change the magnitude, sign and significant levels of the initial ones (see model 8).

4.2.3.5 First Stage Regression (reduced form equation)

This is the result of the reduced form equation 3.9. It comprised all the exogenous variables in the structural equation (3.6) and the instruments for the endogenous variable (sedu), which are age dependency ratio (depr), life expectancy at birth (leb) and urbanization (pupt). The time series properties of these variables were conducted. They were stationary at second difference. The first-stage regression has a reasonable explanatory power. It shows that public recurrent expenditure on education (pree), life expectancy at birth leb) and urbanization (pupt) have negative effects on education attainment in Nigeria. On the contrary, capital expenditure on education (pcee) and age dependency ratio have positive effects. While public education expenditure was found insignificant, all the instruments employed for education - depr, leb and pupt - were found to be statistically significant at 1 percent, 5 percent and 10 percent respectively. This confirms the relevance of the instruments.

Consequently, based on the statistical insignificance of pree and pcee, we do not reject the null hypothesis of no significant relationship between educational attainment and public education expenditure in Nigeria.

4.2.3.6 Instrumental Variables (2sls) Regression

In the IV 2sls regression, education (sedu), per capita income (rypc), public recurrent education expenditure (pree) and capital formation (capy) have

positive and significant effect on economic growth. While sedu, pree and capy conform to *a priori* expectation, rypc does not. Based on the convergence hypothesis, there should be an inverse relationship between real income per capita (rypc) and its growth rate (grypc). On the contrary, public capital expenditure on education (pcee) has an adverse and insignificant effect on economic growth. It does not conform to a priori expectation.

The result shows that a 1 percent increase in education will increase economic growth by almost 4 percent. Similarly, a 10 percent increase in the proportion of total public expenditure allocated to recurrent expenditure on education will increase economic growth by 1.7 percent. The above result shows the potency of education in promoting economic growth.

4.2.4 Discussion of Results

4.2.4.1 Public Education Expenditure and Education Attainment

Public capital expenditure on education (pcee) has a positive but not significant effect on the level of education attainment. On the contrary, public recurrent expenditure on education (pree) has a negative and insignificant effect on education attainment. While pcee conforms to a priori expectation, pree does not. For both measures, we do not reject the null hypothesis.

One component of public education expenditure (that is pcee) partially supports Anyanwu and Erhijakpor (2007). Based on secondary school

enrolment ratio in Nigeria as well as a cross-section of countries (including Nigeria), they found both a positive and significant relationship between government expenditure as a percent of gross domestic product (GDP) and education attainment. The other component (pree), supports Amin and Ntilivamunda (2009) who adopted primary school enrolment ratio based on data from Senegal.

Pcee is essentially devoted to capital projects such as the construction of schools. This creates access to education. Thus, such expenditure, whether efficiently utilized or not will result in additional schools which increases access. This explains the positive effect shown in the result.

4.2.4.2 Public Education Expenditure and Economic Growth

In the growth equation pree has a positive and significant effect on economic growth, while pcee is both negative and insignificant. This implies an inverse relationship between public capital expenditure on education and economic growth. This is similar to the finding by Oluwatobi and Ogunrinola (2011). The positive effect of pree on economic growth could be attributed to the Barro / Sala-i-Martin theory. It is important to note that the use of ptee (which is a combination of both pree and pcee), results in a positive but insignificant relationship between total public education expenditure and economic growth

in Nigeria. The inverse relationship between pcee and economic growth could be attributed to the inefficient utilization of public education expenditure.

The pree version of public education expenditure supports Musila and Balassi (2004) and Dauda (2009). Both studies used cointegration analysis and found a positive and significant relationship between public expenditure on education and economic growth. While Musila and Balassi's study was based on public education expenditure per worker in Uganda, that of Dauda was based on total public education expenditure in Nigeria. On the other hand, pcee had a negative sign which is contrary to their finding. This could be attributed to the high level of inefficiency in public expenditure. Inefficiency in capital expenditure will have a greater adverse effect on economic growth than that of recurrent expenditure. For instance, teachers' salary can be delayed, thus affecting their efficiency. However, it is eventually paid. On the contrary, funds meant for capital projects in education may be embezzled and siphoned out of the country.

4.2.4.3 Education and Economic Growth

The result shows a positive and significant relationship between education and economic growth. While this result supports the findings of Babatunde and Adefabi (2005) and Otu, Ade and Adenuga (2006), it contradicts that of Monteils (2002). The result conforms to *a priori* expectation and is found to

be statistically significant at 10 per cent level of significance. A 1 per cent increase in education leads to about 4 per cent increase in economic growth. The high efficiency level of education in Nigeria is not surprising as the country is on the verge of becoming an industrial economy.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 SUMMARY

In spite of the continuous investment in the education sector by successive governments in Nigeria, her per capita income still ranks among the lowest in the world. This is no doubt due to the low level of economic growth which is still at its traditional level. Endogenous growth theories that relate both public finance and education to economic growth do not seem to be applicable to Nigeria. This view is however contrary to the findings of most empirical studies based on Nigerian data. An attempt to resolve this issue led to an extensive review of related literature.

An examination of existing literature revealed several methodological flaws and omissions in previous studies. Most crucial among them are; (i) the absence of a theoretical base and research design which invariably leads to misspecification of theoretical models, (ii) non-recognition and test for endogeneity between education and economic growth, (iii) the use of education outcome as a proxy for investment in education, (iv) the assumption that both public recurrent and capital expenditure on education have the same efficiency, (v) inability to analyze education expenditure, education attainment and economic growth in a concise manner, and (vi) inability to recognize both

the direct and indirect effect of public education expenditure on economic growth. All these issues were accommodated in this study.

Based on the endogenous theories propounded by Lucas (1988) as well as Barro and Sala-i-Martins (2004), in conjunction with the empirical findings of the effect of public education expenditure on education attainment, an analytical framework that depicts the transmission mechanism from education expenditure to economic growth was designed. This schema shows that education expenditure can affect economic growth through two channels. The first which is a direct effect works through the Sala-i-Martins hypothesis. The other which is an indirect link first affects the level of education in terms of quantity and quality as propounded by Lucas. It is important to note that this link has only been supported by intuition and empirical literature.

Considering the dynamic nature of the relationship between education expenditure and economic growth, a structural equation model was specified. In order to overcome the challenges of endogeneity bias, measurement errors and omitted variable bias, an instrumental two stage least square (IV2SLS) technique was adopted. The endogeneity test conducted with the use of the Hausman test confirmed that education is actually an endogenous variable in the model.

The results of the estimated equation revealed that public education expenditure could influence economic growth through two channels – direct and indirect effect. The direct effect follows Barro and Sala-i-martin's (2004)

theory, while the indirect effect works through Lucas' (1988) theory. However, public education expenditure in Nigeria during the period under review, seem to have affected economic growth through both channels. On the contrart, while pcee proves more instrumental through the indirect channel, pree is found to have a greater direct effect on economic growth.

In a nutshell, both pree and pcee have different effects on education attainment in Nigeria. While pcee has a positive effect, pree had a negative effect. Although both coefficients are not statistically different from zero, their magnitudes are quite different. Although public education expenditure has a positive effect on education attainment in Nigeria, such effect is statistically insignificant. Public recurrent expenditure on education (Pree) has a positive and statistically significant effect on economic growth in Nigeria. Pcee has a negative and statistically significant effect on economic growth in Nigeria. There is a positive relationship between education and economic growth in Nigeria. Holding all other factors constant, a 10 percent increase in pree will increase economic growth by 1.7 percent.

5.2 RECOMMENDATIONS

This section presents policy recommendations in line with the major findings of the study. It also suggests some guidelines future researchers.

5.2.1 Policy Recommendations

Enhancing the level of Education through Public Spending in Nigeria

The result shows a negative and insignificant relationship between education expenditure and the level of education. As observed earlier, access to education, which results from investment in education, does not necessarily guarantee enrolment. Other factors such as actual and opportunity cost of education may have a stronger effect on enrolment at the secondary school level. A unique feature of secondary education in Nigeria is that it has maintained virtually a constant gap from the level of primary education (see Fig. 4.2). Though Nigeria is still far from achieving primary education for all, the universal primary education policy put in place has contributed to the present (relatively higher) level of enrolment rate. An introduction of a similar policy at the secondary school level will boost the current level of less than 40 per cent enrolment rate.

The above view is however predicated on the efficiency of resource use in the education sector. Much has been said about the corrupt practices in the country. The education sector definitely is not an exception. Efforts at increasing the efficiency of expenditure in the education sector will no doubt contribute to education attainment significantly. These efforts should be combined with earlier suggestions such as empowering families economically so as to reduce their reliance on their daughters' labour for household chores, thereby releasing them to go to school (Okojie, 2002). Also, Anyanwu and

Erhijakpor highlighted issues such as sustained democracy and international commitment to aid promises as complementary factors to public education expenditure in the quest toward achieving high and quality human capital in Africa. Fadiya (2010), has suggested greater government investment in health and nutrition to complement education.

Maximizing Growth Implications of Public Education Expenditure

The result shows that public education expenditure has contributed to economic growth more through the direct channel than the indirect channel. Furthermore, public recurrent education expenditure has a positive and significant effect on economic growth. As noted earlier, while the expenditure on education may not be spent on the sector, such resources will most probably be spent in the economy. However, recurrent expenditure in form of teachers' salary will have a greater effect on economic growth through the multiplier effect than capital expenditure which is usually a lump sum. Thus, public education expenditure that targets the citizens directly such as meal subsidy to students and incentives to teachers, will not only increase the quality of education, but have a great impact on economic growth.

Enhancing the level of Education for perisitent Economic Growth.

The positive impact of education on economic growth conforms to endogenous growth theory. This study emphasized quantity of education rather than the quality. Considering the importance of education in the

economic growth of Nigeria, other factors aside public education expenditure that promote education should be given prompt attention by the government. Also, efforts should be made to address issues that could serve as obstacles to increased education. These include the level of dependency ratio and urbanization. The impact of high dependency ratio could be mitigated through tax policies that recognize such. More so, the challenges of urbanization could be stemmed by enacting policies and programmes that encourages the citing of industries in the rural areas.

5.2.2 Recommendations for Future Studies

There is no doubt that issues addressed by this study have serious implications for the estimates of growth models. However, in the process a number of constraints were encountered (see section 5.5). Future studies should address these issues with a view to improving on the results already achieved. Ideally, studies on growth empirics, especially those that adopt the endogenous growth models should always consider the endogeneity of education in the growth model.

The theoretical argument for the endogeneity of education in growth models is unambiguous. Therefore, in order to achieve unbiased and consistent coefficient estimates, empirical growth studies should always recognize and statistically test for it. Since the outcome of the test will lead to the use of

instrumental variables, the validity and strength of chosen instruments must be ascertained.

Another issue worthy of note is that the fact that estimated results do not conform to a *priori* expectation does not necessarily invalidate the stated hypothesis. Efforts should be made to employ different sets of data for the same variable. For instance, instead of GDP at current factor cost, GDP by expenditure could be used. Similarly, the ratio of public education expenditure to GDP could be used in place of ratio of public education expenditure to total government expenditure.

More so, due to the dearth of data, and the need to maintain focus, several issues on the topic were not addressed. These include measure of education; the assumption that the quality of education is at its optimum: and the assumption that public education expenditure is efficiently utilized.

Average years of schooling have been considered a more appropriate measure of education. The recent Barro-Lee data on education presented this data set. Apart from the fact that the data is in five-year interval, that of Nigeria is not available. Future studies may consider the data when they become available.

The study assumed the quality of education. It is important to note that a hundred percent enrolment rate may not guarantee rapid economic growth rate. On the contrary, few and highly talented citizens in the economy could make a huge difference in economic growth through the discovery of relevant

technologies. In a nutshell, a combination of both the quantity and quality of education are relevant for rapid economic growth. Future studies should incorporate these two aspects of education in the endogenous growth model.

The efficient utilization of public education expenditure is as important as the amount allocated. This study focused on the amount allocated. Future studies should evaluate the issue of efficiency with a view to finding out the role of corruption in the utilization of expenditure in the education sector.

Future studies should attempt to address the various issues raised with a view to improving the results already achieved.

5.3 CONCLUSION

Economists are often interested in obtaining reliable estimates of the causal effect of one variable on another. Valid estimates could be used to predict the effect of changes in policies, holding other factors constant. Unfortunately, standard regression analysis can fail to yield reliable estimates of causal effects for the following reasons; (i) omitted variable bias, (ii) reverse causality or simultaneous equation bias, and (iii) measurement error. The inability to identify and account for these issues could be attributed to poor or lack of research design, which emanates from non-adoption of a relevant economic theory. This eventually results in the misspecification of theoretical models upon which estimations are based.

The consideration of these issues in the analysis of the relationship between public education expenditure and economic growth in Nigeria has brought about new revelations.

There is no doubt that issues raised in this study are cogent. However, we recognize the fact that a solution to one problem posses its own challenges. Two major issues of concern in this study are (i) the measure of secondary education employed, and (ii) non – availability of data for public expenditure on secondary school education. Future studies should attempt to address these issues. Nonetheless, efforts at enhancing the effectiveness and efficiency of public education expenditure in Nigeria, should consider the suggestions outlined above.

5.4 CONTRIBUTION TO KNOWLEDGE

Previous studies on this topic have been based on two major assumptions. First, that expenditure on education will always result in educational attainment which will ultimately result in economic growth. Consequently, economic growth is often regressed on total public spending on education or on its proxy – education. Second, that both public recurrent and capital expenditure on education have same effect on education and economic growth. Hence, the total value is often used. On the contrary, this study has shown that the effects of pree on both education and economic growth could be different

from that of pcee. More so, empirical results have shown that increased public education expenditure may not result in increased educational outcome. These violations invariably have implications for estimated regression results and the inferences drawn from them.

The originality of this study is situated in the evaluation of both the direct and indirect effects of public education expenditure on economic growth using a disaggregated version of public education expenditure. The study reveals that public education expenditure has both direct and indirect effects on economic growth. The indirect channel has been more relevant for economic growth in Nigeria. Thus, total public education expenditure can promote economic growth without necessarily first improving education attainment.. The study also reveals that public recurrent education expenditure (pree) and public capital education expenditure (pcee) have different effects on economic growth.

In a nutshell, this study has enhanced the current understanding of the relationship between public education expenditure and economic growth.

5.5 LIMITATIONS OF THE STUDY

i. The ratio of expenditure on secondary education to total spending on education (intra-sectoral spending) seemed more appropriate. This

could not be used due to non-availability of data. Hence, aggregate expenditure on education was employed.

ii. Enrolment rate was used as a proxy for secondary education output. However, enrolment does not necessarily imply attendance and completion. The quality of education also matters. One measure of quality of education is the repetition rate. Other indicators are pupil – teacher ratio and teacher qualification and experience. International comparative test scores are often used for cross country analysis. Data for these variables are often scanty. Thus, they are not available in series.

In view of these limitations, the results obtained are interpreted with caution. Also, given the dearth of data on the quality and other measures of education, and considering Lucas' (1988) opinion that one cannot theorize about everything at the same time, further studies could address these issues.

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APPENDIX 1. DATA FOR REGRESSION

YEAR	RYPC	GRYPC	SEDU	PTEE	TEEY	PREE	PCEE	REEY	CEEY	CAPY	TPEN	FDEP	INFR	LEB	PUPT	DEPR
1971	758	0.115	4.602	0.51	0.08	0.34	0.17	0.05	0.03	25.3	0.58	10.9	16	43	23.3	85.018
1972	765	0.009	5.115	1.95	0.4	0.5	1.46	0.1	0.3	26.8	0.6	11.5	3.5	43	23.8	85.483
1973	786	0.028	5.72	1.5	0.31	0.58	0.92	0.12	0.19	18.7	0.58	10.3	5.4	44	24.4	86.005
1974	851	0.083	6.1	4.62	1.05	1.47	3.16	0.33	0.71	18.6	0.53	-1.6	13	44	24.9	86.544
1975	785	-0.08	8	10.3	3.96	2.65	7.64	1.02	2.94	28.3	0.59	4.44	34	44	25.5	87.047
1976	831	0.059	7.1	10.8	3.94	5.38	5.45	1.96	1.99	34.1	0.62	10.3	24	45	26.1	87.481
1977	855	0.029	7.494	5.37	2.37	1.78	3.59	0.79	1.59	34.5	0.71	17.7	15	45	26.7	87.819
1978	781	-0.09	8.854	4.57	1.65	2.15	2.42	0.78	0.87	33.6	0.73	21.6	22	45	27.4	88.083
1979	810	0.036	10.77	8.31	1.59	4.49	3.82	0.86	0.73	28.9	0.74	20.3	12	45	28	88.35
1980	820	0.013	13.45	8.59	2.5	3.53	5.06	1.03	1.47	31.8	0.85	21.3	10	45	28.6	88.719
1981	693	-0.15	16.83	8.82	1.95	6.76	2.06	1.5	0.46	38.1	0.91	31.1	21	46	29.2	89.244
1982	669	-0.04	20.63	7.61	1.92	4.36	3.25	1.1	0.82	29.9	0.74	41.4	7.7	46	29.9	89.942
1983	619	-0.07	24.69	8.37	1.82	5.37	3	1.17	0.65	20.6	0.6	48.5	23	46	30.5	90.759
1984	592	-0.04	28.33	6.38	1.25	5.63	0.75	1.1	0.15	13.5	0.56	47.9	18	46	31.2	91.589
1985	625	0.056	28.9	5.55	1.21	4.7	0.85	1.03	0.19	11.7	0.56	44.1	7.4	46	31.8	92.292
1986	556	-0.11	26.92	5.22	1.27	2.88	2.33	0.7	0.57	11.2	0.51	49.9	5.7	46	32.5	92.773
1987	484	-0.13	26.88	2.04	0.43	1.61	0.43	0.34	0.09	9.57	0.53	37	11	46	33.2	93.015
1988	507	0.048	26.5	6.44	1.28	5.26	1.18	1.05	0.24	9.3	0.5	34.9	55	46	33.9	93.052
1989	526	0.038	23.88	8.28	1.57	7.34	0.94	1.39	0.18	8.91	0.62	20.5	50	46	34.6	92.908
1990	578	0.1	24.31	4.53	1.02	3.99	0.55	0.9	0.12	10.9	0.55	23.7	7.4	46	35.3	92.62
1991	561	-0.03	25.9	2.31	0.49	1.87	0.43	0.4	0.09	11	0.62	21.5	13	46	36	92.22
1992	550	-0.02	28.9	0.73	0.13	0.32	0.41	0.06	0.07	10.6	0.47	27.6	45	45	36.7	91.719
1993	548	-0	31.2	3.61	1.01	2.79	0.82	0.78	0.23	12	0.55	29	57	45	37.5	91.129
1994	540	-0.01	33.2	5.46	0.98	4.59	0.87	0.82	0.16	10.7	0.52	35.5	57	45	38.2	90.482
1995	526	-0.03	32.2	4.42	0.63	3.54	0.88	0.5	0.13	7.94	0.48	24	73	45	38.9	89.813
1996	539	0.026	34	4.49	0.55	3.52	0.97	0.43	0.12	8.93	0.47	13.1	29	45	39.6	89.151
1997	542	0.004	31.03	4.06	0.6	3.14	0.92	0.46	0.14	9.45	0.65	12.4	8.5	45	40.3	88.505
1998	543	0.004	30.45	5.23	0.91	2.98	2.25	0.52	0.39	8.74	0.63	18.1	10	45	41.1	87.884
1999	533	-0.02	23.25	3.91	0.99	2.86	1.06	0.72	0.27	8.44	0.52	19.7	6.6	46	41.8	87.313
2000	549	0.028	24.28	7.07	1.08	5.57	1.5	0.85	0.23	9.38	0.55	10.1	6.9	46	42.5	86.819
2001	559	0.019	26.65	5.87	1.26	3.92	1.95	0.84	0.42	7.04	0.52	17.7	19	47	43.2	86.416
2002	566	0.013	29.16	9.21	1.58	8.43	0.78	1.45	0.13	8.16	0.54	19.5	13	47	44	86.106
2003	610	0.077	31.87	6.48	0.94	5.28	1.2	0.76	0.17	11.1	0.69	21.2	14	48	44.7	85.881
2004	796	0.305	34.44	6.05	0.75	5.41	0.64	0.67	0.08	6.31	0.44	11.7	15	48	45.5	85.734
2005	803	0.009	34.44	6.23	0.79	4.5	1.74	0.57	0.22	5.46	0.51	8.6	18	49	46.2	85.655
2006	842	0.049	34.01	7.83	0.82	6.13	1.7	0.64	0.18	9.57	0.74	4.91	8.2	50	46.9	85.632
2007	863	0.025	31.52	8.43	0.96	6.43	2	0.73	0.23	9.59	0.69	20.2	5.4	50	47.6	85.659
2008	862	-0	35.09	6.92	0.88	5.33	1.59	0.68	0.2	8.73	0.79	26.7	12	50	48.4	85.726
2009	771	-0.11	38.99	5.49	0.73	4.18	1.31	0.55	0.17	10.4	0.63	36.9	12	51	49.1	85.808
2010	772	0.002	44.05	5.18	0.71	3.98	1.2	0.55	0.16	9.75	0.63	36.3	14	51	49.8	85.878

APPENDIX 2. DESCRIPTIVE STATISTICS OF VARIABLES

. summarize grypc rypc sedu ptee pree pcee capy tpen fdep infr

Variable	Obs	Mean	Std. Dev.	Min	Max
grypc	40	.6016399	7.762335	-15.43477	30.46791
rypc	40	669.0993	129.2705	483.5681	863.2169
sedu	40	23.993	10.7296	4.60168	44.04996
ptee	40	5.720266	2.51055	.511432	10.8354
pree	40	3.889055	1.96037	.319732	8.4325
pcee	40	1.831211	1.551099	.170477	7.64201
capy	40	15.69397	9.689571	5.459013	38.11781
tpen	40	60.64869	10.77012	43.92164	91.16905
fdep	40	23.01498	12.9156	-1.601714	49.90173
infr	40	19.89203	17.07127	3.45765	72.8355

APPENDIX 3. STATIONARITY TEST

```
. dfuller grypc

Dickey-Fuller test for unit root                    Number of obs   =        39

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -5.516            -3.655            -2.961            -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000


. dfuller drypc

Dickey-Fuller test for unit root                    Number of obs   =        38

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -5.555            -3.662            -2.964            -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000


. dfuller dsedu

Dickey-Fuller test for unit root                    Number of obs   =        38

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.773            -3.662            -2.964            -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0032


. dfuller dlnsedu

Dickey-Fuller test for unit root                    Number of obs   =        38

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.989            -3.662            -2.964            -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0015
```

```
. dfuller ptee

Dickey-Fuller test for unit root                   Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.670            -3.655            -2.961            -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0046


. dfuller pree

Dickey-Fuller test for unit root                   Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.855            -3.655            -2.961            -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0024


. dfuller  pcee

Dickey-Fuller test for unit root                   Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.034            -3.655            -2.961            -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0319


. dfuller dcapy

Dickey-Fuller test for unit root                   Number of obs   =        38

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.706            -3.662            -2.964            -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0001
```

```
. dfuller dlncapy

Dickey-Fuller test for unit root                   Number of obs   =        38

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -5.794           -3.662            -2.964           -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller tpen

Dickey-Fuller test for unit root                   Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -3.111           -3.655            -2.961           -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0258

. dfuller dfdep

Dickey-Fuller test for unit root                   Number of obs   =        38

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -5.305           -3.662            -2.964           -2.614
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller dlnfdep

Dickey-Fuller test for unit root                   Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -3.814           -3.668            -2.966           -2.616
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0028
```

```
. dfuller gfdepm

Dickey-Fuller test for unit root                    Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -4.019           -3.655            -2.961           -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0013

. dfuller ddleb

Dickey-Fuller test for unit root                    Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -0.924           -3.668            -2.966           -2.616
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7801

. dfuller dddepr

Dickey-Fuller test for unit root                    Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -1.432           -3.668            -2.966           -2.616
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5670

. dfuller infr

Dickey-Fuller test for unit root                    Number of obs   =        39

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -3.133           -3.655            -2.961           -2.613
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0242
```

```
. dfuller ddpupt

Dickey-Fuller test for unit root                    Number of obs   =        37

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)              -6.445           -3.668            -2.966           -2.616
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

.
```

APPENDIX 4 REGRESSION RESULTS

(A)

```
. estimates table model1 model2 model3, star stats (N r2 r2_a rmse)
```

Variable	model1	model2	model3
dlnsedu	5.3419315**	3.9888864	3.1351876
drypc	.14896039***	.1483643***	.14913026***
dcapy	.11877809**	.11111492*	.08349176
pree	.18009619	.17244579	
pcee	-.22521168	-.19044182	
ptee			.0425068
_cons	-.28986953	-.24215517	-.116356
N	39	38	38
r2	.9827183	.98245132	.97924791
r2_a	.98009986	.97970933	.97673251
rmse	1.0799869	1.0141012	1.1027827

legend: * p<0.05; ** p<0.01; *** p<0.001

```
. regress grypc drypc dcapy pree pcee  dlnsedu,  robust

Linear regression                               Number of obs =      39
                                                F(  5,    33) =  141.69
                                                Prob > F      =  0.0000
                                                R-squared     =  0.9827
                                                Root MSE      =    1.08
```

grypc	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
drypc	.1489604	.0062108	23.98	0.000	.1363245	.1615963
dcapy	.1187781	.0392594	3.03	0.005	.0389041	.198652
pree	.1800962	.0897068	2.01	0.053	-.0024136	.362606
pcee	-.2252117	.1130955	-1.99	0.055	-.4553061	.0048828
dlnsedu	5.341931	1.771413	3.02	0.005	1.737965	8.945898
_cons	-.2898695	.4370195	-0.66	0.512	-1.178992	.5992534

```
. ivregress 2sls grypc drypc dcapy pree pcee  (dlnsedu = dddepr ddleb ddpupt  ),first robust

First-stage regressions
```

Number of obs	= 38
F(7, 30)	= 11.90
Prob > F	= 0.0000
R-squared	= 0.5422
Adj R-squared	= 0.4354
Root MSE	= 0.0827

dlnsedu	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
drypc	-.0004915	.0002255	-2.18	0.037	-.000952	-.000031
dcapy	-.0008717	.0031511	-0.28	0.784	-.0073071	.0055638
pree	-.0090953	.0070223	-1.30	0.205	-.0234367	.0052462
pcee	.0125618	.0090637	1.39	0.176	-.0059488	.0310723
dddepr	.4504659	.1119121	4.03	0.000	.2219108	.679021
ddleb	-1.151508	.4609496	-2.50	0.018	-2.092893	-.2101234
ddpupt	-1.786576	.9721817	-1.84	0.076	-3.772036	.1988839
_cons	.083465	.0382574	2.18	0.037	.005333	.161597

Instrumental variables (2SLS) regression

Number of obs	= 38
Wald chi2(5)	= 773.37
Prob > chi2	= 0.0000
R-squared	= 0.9825
Root MSE	= 1.0141

grypc	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
dlnsedu	3.988886	2.390497	1.67	0.095	-.6964019	8.674175
drypc	.1483643	.0060318	24.60	0.000	.1365422	.1601864
dcapy	.1111149	.0461221	2.41	0.016	.0207173	.2015125
pree	.1724458	.0880936	1.96	0.050	-.0002144	.345106
pcee	-.1904418	.1314616	-1.45	0.147	-.4481018	.0672182
_cons	-.2421552	.4505714	-0.54	0.591	-1.125259	.6409485

```
Instrumented:  dlnsedu
Instruments:   drypc dcapy pree pcee dddepr ddleb ddpupt
```

```
. estat endogenous

  Tests of endogeneity
  Ho: variables are exogenous

  Robust score chi2(1)          =  .536226  (p = 0.4640)
  Robust regression F(1,31)     =  .528072  (p = 0.4729)
```

```
. estat firststage, forcenonrobust all
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(3,30)	Prob > F
dlnsedu	0.5422	0.4354	0.4131	9.34458	0.0002

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
dlnsedu	0.4131	0.2995

Minimum eigenvalue statistic = 7.03792

Critical Values # of endogenous regressors: 1
Ho: Instruments are weak # of excluded instruments: 3

	5%	10%	20%	30%
2SLS relative bias	13.91	9.08	6.46	5.39
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	22.30	12.83	9.54	7.80
LIML Size of nominal 5% Wald test	6.46	4.36	3.69	3.32

```
.
```

```
. ivregress 2sls grypc drypc dcapy ptee  (dlnsedu = dddepr ddleb ddpupt  ),first robust

First-stage regressions
-----------------------

                                                Number of obs   =         38
                                                F(   6,     31) =      13.58
                                                Prob > F        =     0.0000
                                                R-squared       =     0.4920
                                                Adj R-squared   =     0.3937
                                                Root MSE        =     0.0857

------------------------------------------------------------------------------
             |               Robust
     dlnsedu |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       drypc |  -.0005393   .0002131    -2.53   0.017    -.0009739   -.0001047
       dcapy |   .0008269   .0038717     0.21   0.832    -.0070696    .0087233
        ptee |  -.0022963   .0067925    -0.34   0.738    -.0161498    .0115572
      dddepr |   .4852873   .1224273     3.96   0.000     .2355953    .7349793
      ddleb |  -1.288565   .4293549    -3.00   0.005     -2.16424   -.4128895
      ddpupt |   -1.45468   1.018862    -1.43   0.163    -3.532662    .6233021
       _cons |    .083707   .0395452     2.12   0.042      .003054    .1643601
------------------------------------------------------------------------------

Instrumental variables (2SLS) regression        Number of obs =         38
                                                Wald chi2(4)  =     610.72
                                                Prob > chi2   =     0.0000
                                                R-squared     =     0.9792
                                                Root MSE      =     1.1028

------------------------------------------------------------------------------
             |               Robust
       grypc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     dlnsedu |   3.135188   2.700394     1.16   0.246    -2.157488    8.427863
       drypc |   .1491303   .0067695    22.03   0.000     .1358624    .1623982
       dcapy |   .0834918   .0434794     1.92   0.055    -.0017262    .1687097
        ptee |   .0425068   .0782862     0.54   0.587    -.1109313    .1959449
       _cons |   -.116356   .4860874    -0.24   0.811     -1.06907    .8363578
------------------------------------------------------------------------------
Instrumented:  dlnsedu
Instruments:   drypc dcapy ptee dddepr ddleb ddpupt


. estat endogenous

  Tests of endogeneity
  Ho: variables are exogenous

  Robust score chi2(1)          =  .219797  (p = 0.6392)
  Robust regression F(1,32)     =  .202135  (p = 0.6560)
```

```
. estat firststage, forcenonrobust all
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(3,31)	Prob > F
dlnsedu	0.4920	0.3937	0.4105	9.387	0.0001

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
dlnsedu	0.4105	0.3184

Minimum eigenvalue statistic = 7.19597

Critical Values # of endogenous regressors: 1
Ho: Instruments are weak # of excluded instruments: 3

	5%	10%	20%	30%
2SLS relative bias	13.91	9.08	6.46	5.39
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	22.30	12.83	9.54	7.80
LIML Size of nominal 5% Wald test	6.46	4.36	3.69	3.32

```
.
```