AN EVALUATION OF THE IMPACT OF HUMAN CAPITAL FORMATION AND UTILIZATION ON ECONOMIC GROWTH IN NIGERIA (1981-2007)

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PhD/SOC-SCIE/01554/06-07

A DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES

AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A DOCTOR OF PHILOSOPHY (PHD) DEGREE IN ECONOMICS

DEPARTMENT OF ECONOMICS

FACULTY OF SOCIAL SCIENCES

AHMADU BELLO UNIVERSITY, ZARIA

NIGERIA

APRIL, 2013

DECLARATION

I declare that the work in this Dissertation entitled "An evaluation of the impact of human capital formation and utilization on economic growth in Nigeria (1981-2007)" has been carried out by me in the Department of Economics. The information derivedfrom literature has been duly acknowledged in the text and a list of references provided. No part of this Dissertation was previously presented for another degree or diploma at this or any other Institution.

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Name of Student	Signature	Date

CERTIFICATION

This dissertation entitled AN EVALUATION OF THE IMPACT OF HUMAN CAPITAL FORMATION AND UTILIZATION ON ECONOMIC GROWTH IN NIGERIA (1981-2007) by Ibrahim ALIYU meets the regulations governing the award of the degree of Doctor of Philosophy (PhD) degree of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to Almighty Allah the merciful and the magnificent all thanks belong to Allah for providing me with wisdom, good health, courage, determination and perseverance to complete this work.

ACKNOWLEDGEMENT

I wish to acknowledge the contributions of my supervisory team. They are Professor Mike Kwanashie for his invaluable contribution toward the completion of this dissertation. I thank him for making me believe that I can make it and unlocking the puzzles when I was lost. His fatherly guidance is well appreciated. He is a jewel of inestimable value to me. The contribution of my second supervisor Professor G.D. Olowononi is highly acknowledged. His knack for details and the numerous literatures he sourced for me has been of immense value to this work. I thank him for bringing the best out of me. I want to appreciate my third supervisor Dr. Peter Njiforti for his invaluable advice and encouragement. His invaluable contribution is highly acknowledged. My special thanks to Professor Abdulganiyu Garba for his scholarly lecture presentation. I will also like to thank Dr Abdulsalam, Dr Salamatu for their support and encouragement. Special recognition is given to the invaluable contributions of Dr Aliyu Sanusi Rafindadi in enhancing the quality of this dissertation. He is a great source of inspiration to me. My appreciation goes to Dr Muttaka Usman, Head of Economics Department. I wish to acknowledge the inestimable contributions of my beloved mother Hajiya Aishatu and my late father Alhaji Ali Ibrahim Biu. I want to specially thank the provost, FCE Zaria, Dr Mouktar Ibrahim Maccido and members of the management of Federal College of Education for the permission and sponsorship to undertake this programme. I also wish to thank my colleagues Deans and Staff of the student Affairs Division FCE Zaria. I want to recognize the special contribution of Professor Abdulrauf Adebisi of the French Department who has been my mentor. I want to say thank you to "a professor and yet a gentleman". My appreciation go to the following father figures: Professor Ibrahim

Naiya Sada , late Professor Muhammad Ben Yunus, Professor Musa Balarabe, Professor Ibrahim Ahmad Aliyu, and the following friends: Yunusa Isa, Usman Lawan Hassan, Dr Raymond Bako, Dr Sirajo Aminu, Hassan Buba, and M. S. Abubakar and my classmates Suleiman Dahiru, Emmanuel Aku and Damian. The staff of Federal College of Education Zaria will not be left out of my appreciation. My thanks go to Dr A.F. Muhammed, Dr Bulus Zamani, Dr Saeed Adewusi, Dr Musa Apemi, Nuhu Ramalan Jibril, A. A. Gital, L.M. Malumfashi, Asaolu Taiwo Moses, Hajiya Hauwa Usman, Hajiya Amina Sani, Hajiya R. Adebisi. Alhaji M.S Tijjani, Mal Kabiru Yusuf, Mariam Isiaka, Dayo, Hassan, Abduljalil and others. Please bear with me. Finally, I want to appreciate the love and the understanding of my beloved ones Khadija and Asiya who provided support and comforted me when I needed it most. I also want to appreciate my children Aisha, Maryam, Hassana, Salihu, Usman, Yunusa, Fatima, Adam, Ruquayya, Aliyu and Umar and my Grand Daughter halimat. However, I bear full responsibility for the errors and shortcomings in this Dissertation while individuals mentioned above deserve some of the credit for this Dissertation.

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Abstract

The broad objective of this dissertation is to empirically assess the channels through which human capital formation and utilization affects economic growth in Nigeria. This was done at both aggregate and disaggregated levels for various sub sectors of the economy using annual time series data from 1981 to 2007 by applying the Johansen co-integration technique and vector error correction methodology. There are two channels hypothesized: the first channel is when human capital is a direct input in the production function while the second is when human capital affects total factor productivity. Because of the inadequacies of the various existing measures of human capital, a multi-indicator latent measure of human capital was developed for the study using Factor Analysis. Having tested for the stochastic characteristics of the times series using Augmented Dickey Fuller (ADF) test, the study estimated a (cointegrated) Vector Autoregressive Model of the Nigeria's growth process at both aggregate and sectoral levels. The Impulse Response Functions (IRFs) were used to estimate the dynamic elasticities of the various measures of output with respect human capital. The findings confirmed the role of human capital as a source of economic growth in Nigeria through factor accumulation. The result of the study shows that human capital does not only have a positive impact on economic growth but such impact is strong and statistically significant. The long run co-integrating coefficients show that in the long run, a 1% increase in human capital will enhance economic growth by 0.3% and in the event of a one unit deviation from the long run GDP growth, there is a correction of approximately 4%. From the plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital is a

2.5% increase in output and the long run permanent impact is a 1% increase in output which implies that the interaction of human capital and technology did not lead to increasing returns to scale in the Nigerian economy as might be expected. The disaggregated results confirmed the role of human capital in the agricultural, manufacturing and service sectors of the economy. From the plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital increases output in the agricultural, manufacturing and service sectors by 5.5%, 3.9% and 0.2% respectively. In the long run, the permanent impact of a 1% increase shock to human capital is a 4.5% increase in agricultural output and a 0.28% and 4% decrease in manufacturing and service output respectively. A major policy implication of our findings is that in order to reduce the number of years it takes human capital effect to be optimal, government should provide public subsidies and company tax concessions for on the job training in the private sector. Government should direct its focus on linkages with employers of labor to generate demands for skills. In view of the growing proportion of people working in the informal economy, government should adopt strategies to train for self employment.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 Background to the Study

The Nigerian economy has remained under-developed for many years and has continued to remain so despite the country's abundance of human and natural resources. In the 1960s and early 1970s, Nigeria, Malaysia, Indonesia, Taiwan, Singapore and South Korea had similar incomes per capita, GDP growth rates, and under-developed political structures. Today, the "Asian Tigers" (as they are popularly known) have escaped under-development and poverty because of the way in which their economies have been managed and are now excelling economically and technologically due to heavy and sustained investments in human capital development. On the other hand, the growth performance of the Nigerian economy has been slow. Available data show that the economy grew at the rate of 7.5 per cent between 1970 and 1997. It decline to a rate of 0.5 per cent between 1980 and 1987. There was improvement to a rate of 5.6 per cent between 1988 and 1991. The economy again nose-dived and decline to a rate of 3 per cent between 1992 and 2001. From 2003 to 2007, the growth performance has improved with an average growth rate of 6 per cent. Similarly, there has been low response of human development to trends in economic development. Human development has remained unimpressive in Nigeria as shown by the human development indices which have consistently been among the lowest in the world since 1980. The World Bank 2006 Human Development Report placed Nigeria in the 154th position out of 179 countries. Nigeria's performance does not compare favorably to levels achieved in many other developing countries. For example, Malaysia is ranked 59, Thailand 76, Tunisia 92, South Africa 119, India 127 and Ghana 131. A basic interpretation of this is that, Nigeria is only better off than 27 countries in the measurable human development indices (HDI) and by implication in the quality of life of citizens. Some of the factors responsible for the low response of human development to economic growth may be found in the structure of production and nature of growth. The underlying structure of the economy has not been allowed to experience structural transformation. Subsistence agriculture is still widely practiced. According to UNDP (2009) more than 50 per cent of the labor force is still working in the agricultural sector, which means that Nigeria's labor force is largely unskilled. The growth of agricultural output has been disappointing. Available data indicate that growth in the agricultural sector remained at 5.8% between 1990 and 1993 but declined to 1.8%

during the period 1999 to 2001. During the period 1999-2001, agricultural GDP showed an average growth rate of 2.6%. The growth rate portrayed by this sector is disturbing, given the fact that it employs about 50% of the nation's labor force and the availability of vast and rich arable land all over the country. As Akingbade (2006) put it, the agricultural sector must grow between 7% and 10% in order to have any meaningful impact on poverty reduction. The performance of the industrial sector was also unsatisfactory. Available data show that between 1990 and 1992, growth in the sector stood at 2.1%. Between 1993 and 1995, growth was 1.3%. However, between 1999 and 2001 growth rose to 6.1%. The slow growth in industrial production was mirrored in the sluggish growth in the key sub-sectors. For the period 1993 to 2005, the growth of manufacturing stood at 8.4%, mining sub-sector grew by 7.4% during the period 1999 and 2010, perhaps as a result of increased activity in the solid minerals sub-sector. The disappointing performance of manufacturing is serious especially as manufacturing is expected to be an "engine of growth" of the economy. Manufacturing capacity utilization which averaged 75% in the mid-1970s, declined sharply to below 50% from 1983 and by 1995 it had reached a low of about 29%. In 1999, capacity utilization in manufacturing was about 30%, rising to about 40% in 2010. This marginal improvement, however, was not enough to contribute to increase real output in the economy. There is no doubt that expansion of manufacturing in Nigeria has been constrained by a series of factors, such as: high cost of domestic production due to the high cost of investible funds and power/energy etc. The oil sector generates more than 90 per cent of the foreign exchange earnings and funds at least 80 per cent of the federal budget, yet employs just 1 per cent of the labor force with low forward and backward linkages within the economy (UNDP, 2009). Therefore, the growth associated with the agricultural, manufacturing and oil sectors has not resulted in any significant restructuring or transformation of the economy as they were not seriously linked to the real sector. The result is that Nigeria was unable to maximize the benefits associated with its human capital potentials. It is generally believed that human capital plays a significant role in the functioning of an economy because human beings are the most-prized assets of a nation. Other factors of production such as land, unskilled labor, financial and physical capital are combined with skilled human resources to create wealth. Countries of the world such as Singapore and Malaysia etc that have realized the importance of human capital have invested heavily in it. No nation can achieve its full potentials without skilled human resources. Technical innovations that have occurred in the developed countries and a few developing countries are a product of human capital development. The key objective of human capital formation is the transformation of the social, political, economic and technological life of the society. It increases the capacity of people to do productive work and serve as agents of national growth and development. Governments desire to reverse the present situation and propel Nigeria as the 20^{th} largest economy requires sustained human capital development and utilization.

1.2 STATEMENT OF THE PROBLEM

In response to myriads of problems such as declining quality of education/relevance, under-employment, low absorptive capacity, shortage of professionals, and brain-drain, a number of policy and reforms initiatives were undertaken to improve human capital formation and utilization in Nigeria. These included the National Policy on Education 1977 revised in 1981, 1998 and 2004, the Universal Basic Education (2004), the Dakar framework for Action/Education for All (1990), the Millennium Development Declarations and Goals (2000) and the National Economic Empowerment and Development strategy (NEEDS, 2005). Public spending on education and health has also risen steadily between 1981 and 2007. CBN annual reports (1981-2007) revealed that public expenditure on education as a proportion of gross domestic product (GDP) rose from an average of 1.5 per cent between 1981 and 1991 to an average of 3.3 per cent between 2001 and 2007. Despite the rising trends of investment in education, Nigeria's share for education diverges sharply from regional and international norms. For instance UNESCO World Education Report 2000 indicates that for 19 other countries in Sub- Saharan Africa, education expenditure average 5.1% of GDP. This implies Nigeria's funding efforts and its budgetary priority for education is lower than that of Sub Saharan Africa. Similarly, between 1981 and 2007, health expenditure as a percentage of GDP, in Nigeria, grew by a mere 1 per cent. The impact of reforms in health sector is slow as indicated by major healthcare indicators in Nigeria. According to the midpoint assessment of the Millennium Development Goals (2008), infant mortality rate decline from 91 per 1000 in 1990 to 86 per 1000 in 2007. Maternal mortality ratio has worsened from 700 in 1990 to 800 in 2007. Access to basic sanitation remains static from 39 in 1990 to 42.9 in 2007. Access to safe drinking water has worsened from 54 in 1990 to 49 in 2007. From the foregoing, investment in human capital formation has remained inadequate and has slowdown attainments of the objectives of national development and those of the Dakar framework for Action/Education for All (1990), and the Millennium Development Declarations and Goals (2000). Therefore, the process of human capital formation has remained unimpressive because of the myriads of problems such as quality/relevance of education and the ability of increased investment in human capital to stimulate growth and development may be hindered because of the dysfunctional process of human capital formation and utilization in Nigeria. According to Garba (2003), the dysfunction has created and sustained great divides between theory and practice, between formal and informal skills and knowledge forming and using centre, and between local and foreign components which constitute formidable obstacles to Nigeria's development process. This may explain the sluggish growth of the non oil sectors of the economy. Similarly, human capital utilization in Nigeria has not been impressive. This is because employment growth rates failed to keep pace with expansion in economic activities. According to the National Bureau of Statistic's annual abstract of statistics (2006) growth rates of employment were 2.75%, 2.75%, 4.46% 2.55%, 3.11%, 5.74% and 3.25% for the years 2001, 20002, 2003, 2004, 2005, 2006 and 2007 respectively compared to growth rates of real GDP of 4.6%, 3.50%, 9.57%, 6.58%, 6.51%, 6.03%, and 6.22% for the same periods. The trend show that when the country experienced sustained growth rates, employment responded rather sluggishly. This is because the value addition in the real sector has been limited and so has been the employment effect. Also available data National Bureau of Statistics (2008) revealed that underemployment rate is significantly high. Underemployment rate was 20.2% in 2006. Similarly, growth during this period has not resulted in appreciable decline in unemployment. Unemployment figures continue to rise. Unemployment rose from 12.6% in 2002 to 19.7% in 2008. The presence of these problems in spite of the various policy formulation and response requires detail empirical analysis.

1.3 RESEARCH QUESTIONS

In attempting to address the research problems above, the following research questions have been answered:

1. To what extent has the trends in human capital formation and utilization impacted on economic growth in Nigeria?
2. Why has the growth performance in Nigeria been weak despite the various investment and policy measures undertaken?

1.4 OBJECTIVES OF THE STUDY

The broad objective of this study is to examine different channels through which human capital affect long run economic growth in Nigeria both at the aggregated and disaggregated levels for various sub-sectors of the economy.

The specific objectives are to:

a) To examine trends in human capital formation, utilization and economic growth in Nigeria

b) To examine the long run relationship between human capital and growth at the aggregate and disaggregated levels of the Nigerian economy.

c) To examine the extent to which shocks and variations in growth at the aggregate and disaggregated levels are explained by human capital innovations.

1.5 NULL HYPOTHESES

The following sets of null hypotheses were tested:

1. There is no significant relationship between human capital and economic growth in Nigeria.
2. There is no long run relationship between human capital and economic growth in Nigeria.
3. There is no long run relationship between human capital and growth in agricultural, manufacturing and service sectors of the economy.
4. There is no significant difference in the effects of shocks and variation in human capital innovations on economic growth in Nigeria at the aggregate and disaggregated levels.

1.6 SCOPE AND LIMITATIONS

This dissertation covers the period between 1981 and 2007. The period enables the researcher to assess the impact of the policy and subsequent human capital development on economic growth. But, due to the lack of published data on human capital and the inadequacies of the proxies used to measure human capital, we followed established practice for measuring an unobservable variable using the latent index variable approach to estimate a human capital index using a multi-variable approach. Another limitation is the problem of missing observations on some variables that were filled using linear- interpolation.

1.7 JUSTIFICATION FOR THE STUDY

Human capital is increasingly believed to play an important role in the growth process. However, adequately measuring its stock remains a major challenge. In Nigeria, measuring human capital remains a major challenge. Several studies in the country have investigated the relationship between human capital and economic growth using various human capital measures. For instance, Adamu (2003) used recurrent and capital expenditure for education, Chete and Adeoye (2003) used total expenditure on education and health, Uwatt (2003) used enrolments in education at primary, secondary and tertiary as measures for human capital while Otu and Adenuga (2006) used both capital and recurrent expenditure on education and enrolment rates in educational institutions to measure human capital. The measures of human capital used in the above studies are fraught with problems. School enrolment rate is a poor measure of the stock of human capital because enrolment is a flow measure rather than a stock measure of human capital. Hence, school enrolment only capture part of the continuous accumulation of the stock of human capital, also current enrolments are not indicators of the schooling level of current labor force but the future labor force. Therefore, school enrolment rates do not accurately reflects future flows of the human capital stock, let alone current flows or the current stock itself. In addition, measures such as literacy rates, capital and recurrent expenditure on education and health are also fraught with problems for several reasons: first, they are poor indicators of education quality, secondly, they ignore factors other formal education that impact on skill formation. Thirdly, they evolve in correlation with other macroeconomic variables that introduces endogeneity or reverse causality biases in estimation (Cohen and Soto 2007; Krueger and Lindahi, 2001). Based on the aforementioned gaps identified in these studies, this Dissertation makes a modest contribution to literature by developing a new multi-dimensional index of human capital as a latent factor using factor analysis. The choice of the human capital index is based on two factors. Human capital is too rich to be captured by a single variable. Secondly, given the scarcity of valid instruments, the unobserved latent factor approach provides a solution to endogeneity and measurement error problems (Flossmann, Piatek and Wichert 2006). To come up with a better measure that included more information and to determine whether indicators of human capital have a multidimensional character, we employ Factor Analysis to estimate the following measures as a human capital index: enrolment rates at primary, secondary and tertiary levels, public expenditure on education and health, per capital scientific publications in science (SciP), per capita capital equipment (Ke), and per capita high technology exports (Xm); and the labour force. The development of the instrument is a major contribution to growth empirics in the country given the scarcity of valid instruments.

Secondly, this Dissertation is important because it addresses other gaps identified in literature. Empirical evidence from the aforementioned studies on Nigeria suggests the researchers focus on analyzing the relationship between human capital and economic growth at the aggregated level. The Dissertation contributed to literature by extending the analysis to the disaggregated level in order to examine the impact of human capital on growth in the agricultural, manufacturing and service sectors of the economy. This has become necessary because of the disappointing growth trends recorded in agricultural and manufacturing sector of the economy.

1.8 ORGANISATION OF THE STUDY

This research dissertation is organized into five chapters. Chapter one is the general introduction and it includes: the background to the study, problem statement, research objectives, the hypothesis to be tested, scope and limitation as well as outline of chapters, and justification for the study, chapter two reviews the conceptual, theoretical and empirical literature on human capital and growth theories, chapter three presents the methodology of the study, while chapter four presents and discuss econometric results of the impact of human capital on economic growth at both the aggregated and disaggregated level. Finally chapter five contains the summary, conclusions and recommendation of the dissertation, as well as suggestion for further research. They are followed by the bibliography and list of tables.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 THE CONCEPT OF HUMAN CAPITAL

The concept of human capital is not easily amenable to a general definition because different authors have defined it in different ways since the concept is a complex and multifaceted one. Adam Smith (1776) was the first classical economist to have included human capital in his definition of capital. He included in the capital stock of a nation the inhabitants' acquired and useful talents, adding that human skills increase wealth for society as well as for the individual. In the recent literature, OECD (2001), defined human capital as the knowledge, skills, competencies and attributes embodied in individuals that facilitates the creation of personal, social and economic well-being. Human capital is also represented by the aggregation of investments in activities such as education, health, on-the-job training and migration that enhances an individual's productivity in the labor market (kiker 1966, Becker 1964, Schultz 1961, 1962). Similarly, Yesufu (2000) quoting Okojie (1995) indicated that human capital is formed through investment in education, training, health promotion, and investments in social services that influence man's productive capacities and that human capital formation is the process of acquiring and increasing the number of persons who have skills, education and experience which are critical for economic and political development of a country. It is generally believed that human capital is the most important factor of production because it is human capital that coordinates other factors of production to produce goods and services meant for human consumption. Human capital is the most active catalyst of economic growth and development. He concluded that human capital is more than educational attainment of a population. It is the total stock of human resources that a country has from which it can pool skills, knowledge, entrepreneurial and innovative capacities required to produce, distribute and utilize ideas, goods and services to generate growth and development. More recently, Loroche et al (1999) extended the concept to include an aggregation of the innate abilities and the knowledge and skills that individuals acquire and develop throughout their lifetime through intergenerational transfer of knowledge, personal contacts, work experience, on-the-job training, education and socialization. According to him

i) Human capital is a non-tradable good

ii) Individuals do not always control the channels and pace by which they acquire human capital because human capital decisions are not made by its owners, but by their parents, teachers, government, and by society as a whole through its educational and social institutions.

iii) Human capital has qualitative as well as quantitative aspects.

iv) Human capital can either be general or specific depending on weather it is used in a variety of activities or it is only used in limited activities.

v) Human capital has spillover effects and social externalities

From the foregoing, it was submitted that anything that contributes to the improvement of human productivity, stimulate resourcefulness and enhance human dignity and overall quality of human life while refining attitudes, is an integral part of the human capital of any nation. These include four cardinal aspects namely the education system, health and social services as well as good governance. The human capital status of a nation directly influences and positively correlates with economic and social indicators such as gross domestic product, income per capita, balance of trade, life expectancy, literacy rate, level of industrialization and the quality of infrastructural provisions has great impact on political stability, national peace and harmony. The more a nation has knowledgeable, skilled and resourceful individuals contributing to national growth and development, the higher the value of the human capital of that nation (Akingbade, 2006). High population does not necessarily translate to high human capital value. A country of high population can only have a higher potential for human capital development and no more. Substantial inputs and efforts are required to elevate that potential to active human capital to meet desired objectives. Among the inputs is a sound and dynamic education system, motivational operating environment and support services. According to him there has to be adequate number and balance of professionals, skilled and semi-skilled workers engaged in the different fields and sectors. He emphasized that the prevailing environment must be inclusive and stimulating; such that everyone can perform optimally and contribute their best to nation building and development. He observed that Nigeria is far more endowed in mineral resources and human population than Japan, Sweden or Singapore; yet it comes nowhere near these countries in technological advancement and in economic and social development. What makes the difference is human capital, its development, effective engagement and utilization he concluded.

2.1.1 Human capital development

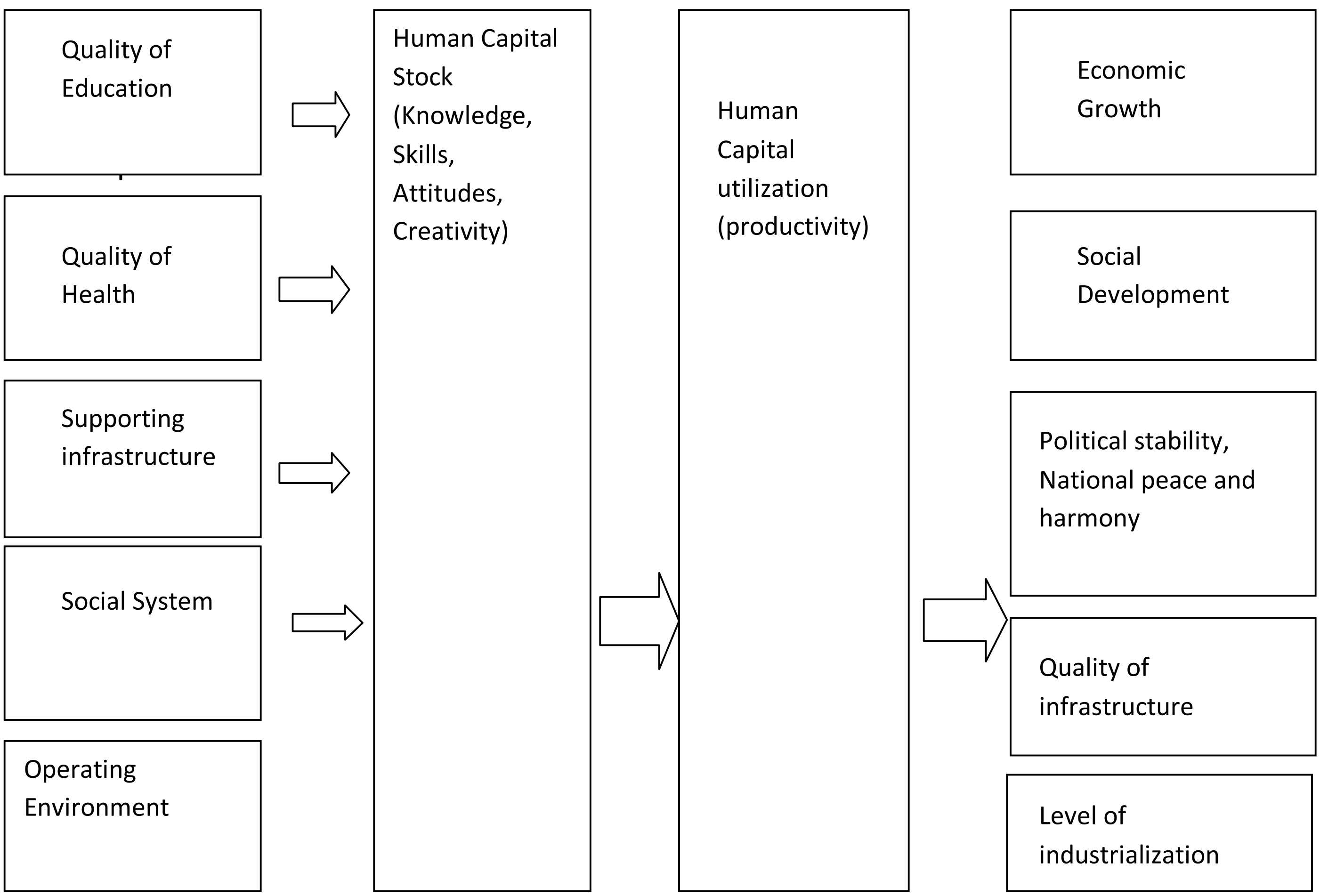
As Akingbade (2006) put it human capital development implies building an appropriate balance and critical mass of human resource base and providing an enabling environment for all individuals to be fully engaged and contribute, to national development efforts. It involves providing opportunities for all citizens to develop to their fullest potentials through education, training and motivation as well as creating the enabling environment for everyone to participate fully in national development. According to him any effort to increase human knowledge, enhance skills and productivity and stimulate resourcefulness of citizens is an effort in human capital development. Investments to entrench good governance, provide supporting infrastructure and develop then education, health and social systems are investments in human capital development. These will include expenditures in educational and training institutions, health facilities, adult functional literacy, vocational and skills acquisition programmes, information and communication technologies (ICT) as well as in research and development. He stated that human capital development as a process should be systematic, sustainable and strategic. The process should be systematic to the extent that there should be a plan for- which previous activities will provide support for upcoming activities while facilitating the attainment of set goals. The process should be sustainable since the product (human capital) must make desired and enduring impact on the society and human life. The process should be strategic to the extent that there are well defined goals and targets whose attainments are time-bound. It should be dynamic, responsive and result oriented; continually evolving to address emerging challenges as well as proactive. There should therefore be an effective monitoring system to inform further necessary improvements in the process.

2.1.2 Relationships between human Capital development, utilization and economic growth

According to Akingbade (2006) Skills development, and by extension skills formation systems, are important because of their contributions to national productivity. Enhanced skills enable national economies raise production and create wealth. When people acquire skills they make themselves more productive, able to produce more output and income for a given amount of time and effort. He found human capital to be a significant determinant of the amount of physical capital investment in an economy. He suggests that a more educated labor force can raise the returns to investment in physical capital—-i.e. that skills and capital are complementary. The variation in investment rates in physical capital across countries is partly a function of absorptive capacity, which in turn depends on availability of human capital and other institutional factors. The rate of return on investment in physical capital would appear to be a positive function of the supply of human capital; where the latter is scarce, the former is low, and so too is the incentive to invest. If so, raising levels of educational attainment should, *ceteris paribus*, increase returns to physical capital and thereby boost investment rates. Investment in physical capital, particularly capital equipment, is an important determinant of growth. Capital-skill complementarities largely reflect the skills required to master technologies in newly acquired capital equipment, specifically, more educated people are needed to operate higher-cost capital equipment incorporating sophisticated technology. He argued that globalization raises capital flows from developed to developing countries. This means that, even without technology imports, capital output ratios in developing countries rises and, given the complementarities between capital and skill, this would raise the relative demand for skilled labor. The acceleration of technical change in recent decades has been complemented by greater numbers of workers with higher skills. Without a workforce that is continuously acquiring new skills, it would be difficult to reap most of the returns from technological progress he said. The advancement of knowledge and innovation, and the diffusion of new methods of production are aided by higher levels of education and training. As with capital-skill complementarity, complementarities also exist between technology and skills. According to him the stock of human capital appears to be positively correlated with technological dynamism. The introduction of new technologies in lower income countries implies a reallocation of labor from low to high productivity activities, the latter being generally both more capital and skill intensive. This means that increased technology imports are likely to be accompanied by a rising ratio of capital to labor, and by demand for skilled labor.

Endogenous growth theory considers that the main reasons for poverty are gaps in the endowment of knowledge, and in the limited capability of developing countries to absorb new knowledge. Fig 2.1 shows the framework for human capital formation and utilization and economic growth.

Fig 2.1 **FRAMEWORKS FOR HUMAN CAPITAL FORMATION AND UTILIZATION AND ECONOMIC GROWTH**



Source: Adopted from Akingbade (2006)

2.2 MEASUREMENT OF HUMAN CAPITAL

Available literature reveals that there are three major approaches to estimating human capital. They are the cost based approach, the income based approach, and the education based approach.

2.2.1 The cost-based approach

The cost based method takes the costs of forming human capital into account. Engel (1883) was the first to apply a cost-based method when he estimated human capital based on child rearing costs to their parents. He argued that since it is difficult to anticipate future earnings, the production cost of human capital can be better sources of the estimation. According to him, the cost of rearing a person was equal to the summation of costs required to raise him from conception to the age of 25, since the author considered a person to be fully produced by the age of 26. Engel's approach has been supported to what is now commonly known as the cost-based method to human capital measurement. Schultz (1961) and Machlup (1962) estimated human capital based on the assumption that the depreciated value of the dollar amount spent on those items defined as investments in human capital was equal to the stock of human capital. Also Kendrick (1976) used a cost-based approach to divide human capital investments into tangible and intangible components. The tangible component consists of child rearing costs to the age of 14 while the Intangible investments are the costs to enhance the quality or productivity of labor such as expenditures on health and safety, mobility, education and training, plus the opportunity costs of students attending school. This approach provides an estimate of the resources invested in the education and other human capital related sectors, which can be very useful for cost-benefit analyses. Eisner (1985) departed from Kendrick's approach by allowing for the value of non-market household contribution to investment in child rearing. Investment in research and development counted as human capital investment in Eisner's estimates. Unlike Kendrick who divided human capital into tangibles and intangibles, Eisner classified all human capital as intangibles. There are several limitations of the cost-based method: The method excludes social costs and the depreciation (or appreciation) of the human capital investment. Cost-based estimates of investment in education fail to account for the crucial time dimension of educational investment (Jorgenson and Fraumeni, 1989). Indeed, there is a long lag between the current outlays of educational institutions and the emergence of human capital embodied in their graduates Another limitation, as pointed out by Jorgenson and Fraumeni (1989), is that by evaluating human capital based on costs of education and rearing rather than lifetime labor incomes, the cost-based approach disregards the value of non-market activities.

2.2.2The income-based approach

The basic idea behind the income-based approach is that human capital embodied in individuals is valued as the total income that could be generated in the labor market over a life time. The income-based approach to human capital measurement predates the cost-of-production method. Petty (1690) was the first to use this framework to estimate a country's stock of human capital. He calculated the human capital stock of England. The first truly scientific model to estimating the money value of a human being, according to Kiker (1966), was that developed by Farr (1853). Farr estimated the earning capacity by calculating the present value of an individual's future earnings net of personal living expenses, adjusted for deaths in accordance with a life table. Using a discount rate of 5 percent Farr's procedure laid a sound basis for the income approach to human capital measurement. The underlying principle of this model is to value the human capital embodied in individuals as the total income that could be generated in the labor market over their lifetime. Wittstein (1867) combined Engel's cost-of-production approach with Farr's method and developed an interesting procedure to evaluate the human capital of an individual at different ages. However, he was criticized for unjustifiably assuming that lifetime earnings and lifetime maintenance costs of an individual to be equal.

The income-based approach measures the stock of human capital by summing the total discounted values of all the future income streams that all individuals belonging to the population in question expect to earn throughout their lifetime. This method is said to be 'forward-looking' (prospective) because it focuses on expected returns to investment, as opposed to the 'backward-looking' (retrospective) method whose focus is on the historical costs of production. While the retrospective method includes expenditures on the individual in addition to those that improve his capabilities, the prospective method seeks to value his earning power. Indeed, the income-based method values human capital at market prices, since the labor market to a certain extent accounts for many factors including ability, effort, productivity, and education, as well as the institutional and technological structures of the economy from the interaction of supply and demand of human capital in the market (Dagum and Slottje, 2000). Also, the income-based approach does not assume an arbitrary rate of depreciation because depreciation is already implicitly accounted for. Therefore, this method provides the most meaningful results if the necessary data are available. But this approach is not free from drawbacks. Most notably, the model rests crucially on the assumption that differences in wages truly reflect differences in productivity. If this assumption fails, the model will collapse. In fact, wages may vary for reasons other than change in productivity. For example, trade unions may be able to command a premium wage for their members, or real wages may fall in economic downturns. In such circumstances, income-based measures of human capital will be biased. Besides, income-based measures of human capital are quite sensitive to the discount rate and the retirement age. Another shortcoming of the income-based method is that data on earnings are not as widely available as data on investment. This is especially the case for developing countries, where the wage rate is often not observable

Jorgenson and Fraumeni (1989, 1992) supported Graham and Webb's (1979) method in a very comprehensive study of human capital measurement using the income-based approach. These authors proposed a new system of national accounts for the US economy that included both market and non-market economic activities. The model was applied to estimate (along with nonhuman capital) the human capital of all individuals in the US population classified by the two sexes, 61 age groups, and 18 education groups (0-17+ years of schooling) for a total of 2,196 cohorts. Wei (2003) adopts Jorgenson and Fraumeni's framework to estimate the stock of human capital in Australia. Since his focus is on the working population (ages 25-65), Wei only distinguishes two life cycle stages: work and study (ages 25-34) and work only. He identified four education levels, based on qualifications, rather than 18 levels based on years of formal schooling as in Jorgenson and Fraumeni. Like Graham and Webb (1979), Wei found that education and human capital were positively related and that lifetime labor income initially rose then fell for all education levels. Also using the income-based approach to human capital measurement, some authors sought to obtain an index value rather than a monetary measure. Some prominent members of the stream of researchers were Mulligan and Sala-i-Martin (1997). They measured human capital for a given state in a given year as the total labor income per capita divided by the wage of the uneducated. The rationale for this method was that labor income incorporates not only the worker's skills (human capital) but also the physical capital available to him, such that for a given level of human capital workers in regions with higher physical capital would tend to earn higher wages. Since the human and physical content of education may vary across time and space, a given level of education may attract different wage levels and thus would incorrectly reflect different amounts of human capital. Therefore, the effect of aggregate physical capital on labor income should be netted out by dividing labor income by the wage of a zero-schooling worker. Mulligan and Sala-i-Martin's method clearly has some advantages. First, by netting out the effect of aggregate physical capital on labor income, this measure captures the variation in quality and relevance of schooling across time and space. Second, the elasticity of substitution across workers is allowed to vary in the model. Third, this method does not unrealistically impose equal amounts of skill on workers with equal amounts of schooling. Finally, it does not demand much data. Also income-based, Macklem's (1997) measure of human wealth takes a more macro approach by calculating the expected present value of aggregate labor income net of government expenditures, based on an estimated bivariate vector autoregressive model. According to the author, this method has at least two important merits. First, it is simpler. The macro focus is less data demanding, making it easily applicable to other countries. Second, this approach permits greater recognition of the joint statistical properties of innovations in income and interest rates. These advantages are, however, counteracted by the less disaggregated information. However, Dagum and Slottje (2000) criticized Macklem's estimation method for containing large, unacceptable and unsubstantiated fluctuations, in a period when Canada experienced steady economic growth.

2.2.3 The education-based approach

Unlike the 'conventional' approaches which measure capital by cost or by yield, the education based approach estimates human capital by measuring such education output indicators as literacy rates, enrolment rates, dropout rates, repetition rates, average years of schooling in the population, and test scores. The rationale for this method According to Le, Gibson and Oxley (2005) is that these indicators are closely related to investment in education and that (investment in) education is a key element in human capital formation. Educational measures are therefore proxies for, not direct measures of, human capital. Of course, they argued that human capital encompasses more dimensions, but education is arguably the most important component.

The followings are their main proxies of the education based approach:

2.2.4 Adult literacy rates

Typically defined as the proportion of the population aged 15 and older who are able to "read and write a simple statement on his or her everyday life" (UNESCO, 1993, p24), adult literacy rates convey meaningful information about a country's general educational status. This indicator was used in early empirical studies that control for human capital in growth equations, including Romer (1989) and Azariadis and Drazen (1990). The use of adult literacy as a proxy for human capital ignored the contribution of the more advanced skills and knowledge to productivity.

2.2.5 School enrolment rates

School enrolment rates measure the number of students enrolled at a given level relative to the population of the age group who, according to national regulation or custom, should be attending school at that level. Net and gross enrolment rates are distinguished by the numerator of the ratio. Specifically, gross enrolment rates take as the numerator the total number of students, regardless of age, enrolled at the given level, whereas net enrolment rates only count those students belonging to the designated age group. Studies that regarded school enrolment rates as proxies for human capital include Barro (1991), Mankiw et al (1992), Levine and Renelt (1992) and Gemmell (1996). According to Le, Gibson and Oxley (2005) enrolment rates prove poor proxies for the present stock of human capital. First, being measures of flows of investments in human capital rather than its stock, school enrolment rates only capture part of the continuous accumulation of the stock of human capital. Second, as Psacharopoulos and Arriagada (1986) noted, there is a long time lag between investment in education and additions to the human capital stock; hence, current enrolment rates are not indicators of the schooling level of the current labour force but of the future labor force. Third, Le, Gibson and Oxley (2005) also showed that the education of current students may not be fully added to the (future) productive human capital stock because graduates may not partake in the labor force and because investment may partially be wasted through grade repetition and dropouts. Indeed, the measurement error due to repetition and dropouts arises because gross enrolment ratios are typically used, due to data unavailability, even though net enrolment ratios should be more appropriate. Fourth, change in the stock of (productive) human capital is the difference between the human capital embodied in those who enter and those who withdraw from the labor force, but school enrolment rates take no account of the human capital of the latter. Therefore, school enrolment rates do not accurately reflect future flows of the human capital stock, let alone current flows or the current stock itself.

2.2.6 Average years of schooling

Le, Gibson and Oxley (2005) has identified the numerous deficiencies of adult literacy rates and enrolment ratios as proxies for human capital stocks. This motivated researchers such as Barro and Lee (2001) to look for a more reliable indicator, namely the average years of schooling of the labor force. This measure quantifies the accumulated educational investment in the current labor force and assumes that the human capital embodied in the workers are proportional to the years of schooling that they have attained. Le, Gibson and Oxley (2005) claimed that the number of average years of schooling has several advantages over adult literacy rates and school enrolment ratios. First, it is a valid stock measure. Second, by taking into account the total amount of formal education acquired by the labor force, years of schooling captures the effective human capital available for economic production. Since primary data on years of schooling are not typically available at the country aggregate level, researchers have to construct the data set they want using several techniques. Typically, UNESCO data on enrolment and attainment levels are used to obtain years of schooling through a perpetual inventory method or some other procedure.

The studies that have attempted to develop data series on years of schooling includes:

2.2.7 The Barro and Lee studies

Barro and Lee (1993) used some combination of all the three methods to develop a data set on educational attainment for 129 countries over five-year periods from 1960 to 1985. These authors applied essentially the same approach as Psacharopoulos and Arriagada's (1986; 1992); the departure in Barro and Lee's study is on how missing data are filled. Since census and survey data on educational attainment levels are available for only 40 percent of the observations, data gaps needed to be closed using information from other sources. The sound theoretical basis and the availability of data were major reasons why years of schooling have been so widely used in human capital studies, at both micro and macro levels. Years of schooling has become the most common proxy for human capital stocks in cross country growth studies, which can be found in studies by Benhabib and Spiegel (1994), Barro and Sala-i-Martin (1995), Islam (1995), Barro (1997, 1999), Temple (1999), Wolff (2000) and Krueger and Lindahl (2001). Many authors, including De la Fuente and Dom´enech (2000), Krueger and Lindahl (2001) and Cohen and Soto (2001), argue that it is the lack of good data on years of schooling, rather than the characteristics of the variable itself, that has rendered years of schooling a poor proxy for human capital in growth models. According to Krueger and Lindahl (2001), until recently, the available literature had not paid adequate attention to potential problems caused by measurement error in education, perhaps because average years of schooling has been poorly measured across countries. Additional estimates of the reliability of country-level schooling data further confirm their belief that measurement error in education severely distorts results from growth equations that control for human capital (Krueger and Lindahl, 2001).

2.2.8 The integrated approach

Recognizing that no single approach to human capital measurement is free from limitations led Tao and Stinson (1997) to combine different methods to exploit their strengths and to overcome the existing weakness. They developed an integrated approach which resolved the problems inherent in the cost- and income-based methods. The cost-, income- and education-based approaches to human capital measurement are not independent of each other. Simply put, the inputs in the human capital production process, including the costs of rearing and educating people, form the basis for the cost method. While the income method builds on individuals' earnings, literacy rates, school enrolment rates, and mean years of schooling have been widely used as education-based measures of human capital. Each approach is however subject to measurement errors. Similarly, the measures do not adequately reflect key elements of human capital, such as education, health, on-the-job training and migration that enhances an individual's productivity in the labor market. Therefore, how to properly measure human capital remains a challenge, they concluded.

2.2.9 New directions

In order to obtain a multi-faceted measure of human capital, Hanushek and Kimko (2000) introduced school quality indicators in growth equations to complement quantity measures. Coulombe, Tremblay, and Marchand (2004) and Hanushek and Wößmann (2007) also confirmed the link between test scores and economic performance. According to Hanushek and Wößmann (2007), the cognitive skills deficit is greater in developing countries and quality indicators are less susceptible to estimation problems such as endogeneity, although recent evidence suggests that selection and endogeneity biases remain (Glewwe 2002; Galiani and Schargrodsky 2002; Paxson and Schady 2007). The search for improved multi-dimensional measures of human capital has moved to new directions. One involves the relaxation of the Nelson and Phelps (1966) assumption of education as the means to understanding and adopting new technologies. Thus, several papers explore the role of skill decomposition where primary or secondary education is more suitable for adoption and higher education is more appropriate for innovation (Acemoglu, Aghion and Zilibotti 2002; Ciccone and Papaioannou 2005; Vandenbussche, Aghion and Meghir 2006). Jones and Schneider (2006) and Jones (2008), on the other hand, propose IQ test scores as a better measure of cognitive skills and abilities. An alternative methodology invokes the Mincerian approach to human capital and seeks to decipher key insights. So far, the review of literature has highlighted two principal ideas. One is that human capital is a composite index of skills acquired at school and skills learnt at work. Moreover, it is the current market value of these skills that counts as human capital. Although this micro approach focuses on *private* returns to education, the general methodology is employed here at the macro-level to account for both the quality and value of human capital.

From the review of conceptual literature, it appears that there is no clear cut consensus on the conceptualization of human capital.

2.3 GROWTH THEORIES

2.3.1 EXOGENOUS (NEOCLASSICAL) GROWTH MODEL

The Neo-classical growth model was an extension to the Harrod –Domar model. Solow extended the Harrod-Domar Model By:

- Adding labor as a factor of production;
- Requiring diminishing returns to labor and capital separately, and constant returns to scale
- Introducing a time varying technology variable distinct from capital and labor.

The key assumption of the Neo-classical growth model is that capital is subject to diminishing returns. Solow's model maintains that sustained positive growth is achieved whenever a non-declining marginal productivity of capital is attained. The model demonstrate that, with labor constant, technological progress can overcome the effects of diminishing returns to capital and thus deliver sustained positive per-capital growth in the long run, with per-capital output growing at the same rate as the rate of technological progress. The following are the implications of the Neoclassical growth models, in the short run, policy measures like tax cuts or investment subsidies can affect the steady state level of output but not the long run growth rate. Growth is affected only in the short run as the economy converges to the new steady state output level. The rate of growth as the economy converges to the steady state is determined by the rate of capital accumulation. Capital accumulation is in turn determined by the saving rate and the rate of capital depreciation. A key prediction of Neoclassical growth models is that income levels of poor countries will tend to catch up with or converge towards the income levels of rich countries however, this prediction has not been supported by empirical evidence. Only countries like Japan have been able to converge with and exceed rich countries. In the model, the long run rate of growth is exogenously determined. In other words, it is determined outside of the model, which means that the neoclassical model fails to explain how the key parameter of a growth model-the economic growth rate is generated. Consequently, neither tastes nor policies are able to influence the long run per capital growth rate of the economy.

2.3.2 ENDOGENOUS GROWTH THEORIES

The limitation of Solow's neoclassical model has led to further investigation into the fundamental question of growth .In particular, growth theorist have tried to indigenize the engine of growth, that is, to have the engine of growth determined within the model.

2.3.3 HUMAN CAPITAL-BASED GROWTH MODELS

Human capital-based growth models have human capital accumulation, rather than technological progress, as the source of endogenous growth.

2.3.4 THE LUCAS MODEL

Lucas (1988) built his model on Solow's model (1956) and considered human capital accumulation as the engine of growth. He introduced a specification for human capital accumulation, which allows for endogenous growth. In the model, sustained per-capital growth is obtained through sustained human capital accumulation. That is, Lucas's model was to overcome diminishing returns to physical capital through the accumulation of human capital. Hence, physical capital can be accumulated without decreasing its marginal productivity since human capital is also growing at the same rate as physical capital. This endogenous growth model predicts that economic growth increases with effectiveness of investment in human capital.

2.3.5 THE MAKIW-ROMER-WEIL MODEL

One of the most important and most widely used human capital models is the Mankiw-Romer-Weil model of 1992. The model is a augmented Solow-Swan model. The key feature of the model is the introduction of human capital as an additional factor in the production function. The dynamics of the Makiw-Romer-Weil Model economy is analogous to the dynamics in the Swan-Solow model except for the fact that there are two types of capital. The way of modeling these two types of capital is essentially the same. The introduction of human capital leads to a much better agreement between the model and empirical data. Thus the Makiw-Romer-Weil model is the basis for much of empirical research about the role of human capital in economic growth and about economic growth itself.

2.3.6 RESEARCH & DEVELOPMENT-BASED GROWTH MODELS

In the R&D-Based models, technological progress arises as a result of research and development (R&D) activities.

2.3.7 ROMER RESEARCH & DEVELOMENT MODEL

Romer(1990) formulated an explicit growth model with technical progress resulting from deliberate actions taken by private agents who respond to market incentives. A key feature of Romer's model is the introduction of imperfect competition in the capital goods sector, which makes it possible to model a firm's behaviour as engaging in deliberate research activities and thereby being compensated with monopoly rents for a successful innovation. By introducing profit-seeking research behaviour in the growth model, Romer generates an explanation for technological progress inside the model.

Romer's analysis is based on three assumptions:

1) Economic growth is driven by technological progress as well as capital accumulation;
2) Technological progress results from deliberate actions taken by private agents who respond to market incentives;
3) Technological knowledge is a non-rivalrous input (modeled as positive knowledge spill-over)

The analytical framework of the model is as follows:

There are three sectors in the economy. They are a final output sector, an intermediate goods sector and a research sector. The research sector uses human capital and existing knowledge to "produce" new knowledge in the form of technologies of production of intermediate goods. The intermediate goods sector, in turn, uses technology and physical capital and supplies its product to the final goods sector, which uses also labour and human capital. Firms in the final output sector produce a homogenous final output good that can be used for consumption or as an input for differentiated capital goods. The market for the final output is perfectly competitive. The capital goods sector produces differentiated capital goods. A capital goods producer must at first purchase the required blueprint (patent). The production function of the final output producers implies that the market for capital goods is monopolistically competitive. Firms in the research sector conduct research and development (R&D). i.e they search for new and economically valuable ideas. Specifically, R&D firms produce blueprints for the production of new types of capital goods (Designs). The market for designs is perfectly competitive (R&D) producers do not set the price for designs. In this model, economic growth is a function of research and development, the latter depending on the share of human capital allocated to the research sector. Accumulation of knowledge (innovations) forms the engine of growth and this accumulation can be unlimited because of the very nature of knowledge, which is a non-rival good with partially exclusive use. Nevertheless, self-maintained growth is based on the hypothesis of linear increase in knowledge stock. The key property of the research process in the Romer model is a twofold influence of knowledge on the economy. First, the limits of knowledge determine the range of intermediate goods, which in turn influences the efficiency of final goods production. Secondly, knowledge determines also the productivity of human capital in the research sector, allowing for faster technological progress. In this way, knowledge is the essential factor of economic growth.

2.3.8 MODELS OF HUMAN CAPITAL AND TECHNOLOGY DIFFUSSION

The link between human capital and technology adoption was highlighted by Nelson and Phelps (1966), who contended that educated workers were better at executing tasks that require adaptation to a changing environment and, thus, adopt new technologies faster than non-educated workers. Among others, this technological view of the benefits of human capital receives empirical support by Benhabib and Spiegel (1994, 2005) who showed that human capital was an important vehicle for growth through technology diffusion.

2.3.9 THE NELSON-PHELPS AND BENHABIB-SPIEGEL MODELS

In the model, technical progress can be understood as a process of new product development, and thus, greater understanding of the role knowledge and skills play can shed light on the process of technology growth. The model also highlights the importance of knowledge externalities as the source of spillovers from technology leaders to less developed countries. However, the adoption of foreign technology depends on the 'absorptive capacity' or 'social capability' of the imitator. Human capital is a key determinant of absorptive capacity since it enables workers to understand and assimilate new technology; a particular formulation of the convergence process whereby less developed economies catch-up with the developed. Nelson and Phelps (1966) see education as a catalyst in the diffusion of new technologies. Their model rests on two key assumptions: the further an economy is from the technology frontier, the stronger is the incentive to exploit externalities; and the bigger the human capital the greater is the capability to learn and adopt the new technology. Benhabib and Spiegel (1994) integrate the two ideas in a generalised model of human capital that aims to explain both innovation and technology diffusion. They build on the intuition that the two views of human capital are complementary rather than competing, for they explain different stages of economic development; i.e., nations closer to the technology frontier have accumulated high levels of human capital that could support innovation while countries far from the frontier focus on technology diffusion. Although intuitively appealing, the original Nelson-Phelps hypothesis, suggests that the imitation of foreign technology is always beneficial provided that educated workers 'follow and understand new technological developments' (Nelson and Phelps 1966, p.69). Moreover, the hypothesis implies that a backward economy could overtake the technology leader by simply relying on investment in human capital.

2. 4 EMPIRICAL LITERATURE

2.4.1 Cross-country studies

There is considerable cross country studies on the relationship between human capital and economic growth. For example, in a cross sectional study, Mankiw and Romer and Weil (1992) tested the impact of human capital formation by using the Solow-Swan model. In their test, they assumed a steady state and used a proxy for the rate of human capital accumulation that measured approximately the percentage of the working age population that is in secondary school. In the test that examined GDP per working age person in 1985 for 98 non-oil countries, they found that the coefficient on human capital accumulation was significant, that is, human capital accumulation, along with physical capital accumulation, explained for the growth of per capita GDP.

Benhabib and Spiegel (1994) estimated the stock of human capital and tested the augmented Solow-Swan model without the assumption of a steady state using data from 78 countries during the period of 1965-85, they found that the log difference in human capital in their specification was insignificant, and almost always had negative coefficients. In other words, human capital accumulation was found to lead to a negative growth of the economy although this impact was statistically not significant. They also undertook some tests using different models that included the stock of human capital instead of the accumulation of human capital. In the new model that included an average of human capital stock over the period understudy, human capital stock was insignificant and had a negative sign. However, when initial income levels are introduced in the model, human capital stock became significant with the predicted positive sign. They suggested that catch-up remains a significant element in growth, and countries with higher education tend to close the technology gap faster than others. In the second model that incorporated both endogenous growth and catch-up terms, the catch-up term enters positively and significantly for the entire sample of 78 countries. However, the coefficient estimate on country-specific technological progress is negative and insignificant. These authors tested the same model for subgroups of their sample, assuming that the relatively strong impact of the catch-up term could change with the relative position of the country. They found that (a) for the poorest third of their sample, the catch-up term is positive and significant, whereas the endogenous growth term is negative and insignificant; (b) for the middle group, both terms are insignificant; (c) for the richest third of the sample, the endogenous growth term enters positively and significantly with a 6 % level of confidence while the catch-up term enters insignificantly with a coefficient estimate that is positive but close to zero. From these results, they argued that human capital stocks in levels, rather than their growth rates, played a positive role in determining the growth of per capita income.

Hansson and Henrekson (1994) studied the combined importance of human capital and integration in the world economy for technology diffusion. In a cross-country study of 81 countries they found a significant effect of initial technology on labor productivity growth, and the effect was strengthened when the capability to absorb foreign technology was taken into account. Both higher level of human capital and more interaction with the rest of the world stimulated technological catch-up.

In a cross country study of per capita GDP growth during two periods (from 1965 to 1975) with 87 countries and (from 1975 to 1985 with 97 countries), Barro and Sala-i-Martín (1995) obtained the following results:

(a) educational attainment (measured by average years of schooling) was significantly correlated with subsequent growth (with a correlation coefficient at around 0.05), although the aggregate measure of educational attainment was decomposed by level of education and the impact of primary education remain largely insignificant;

(b) Public spending on education also had a significantly positive effect on growth as a 1.5 % increase of the ratio of public education spending to GDP during the period 1965-75 raised the average growth rate during the same period by .3 % per year.

Coe and Hapman, (1997) applied a dataset for 77 countries during 1971-1990, and found a substantial spillover effect of foreign R&D and that spillover were linked to trade. *Edwards (1998) investigated the effect of alternative measures of openness on TFP growth in a dataset of 93 countries and concluded open economies experienced* faster productivity growth.

Mayer (2001) employs growth accounting exercise for a sample of 53 countries to analyze the impact of machinery imports, in association with human capital stocks, on economic growth. The findings were that machinery imports by developing countries were higher over the recent years than during the 1970s and 1980s, and that such imports from technologically more advanced developing countries had gained considerable importance. The growth-accounting results show that machinery imports combined with human capital stocks had a positive and statistically strongly significant impact on cross-country growth differences in the transition to the steady state. This gives support to earlier findings in the literature which suggest that the main role of human capital in economic growth is to facilitate the adoption of technology from abroad, rather than to act as an independent factor of production.

Aiyar and Feyrer (2002) analyzed the causal links between human capital accumulation and growth in total factor productivity (TFP). In particular, they tested the Nelson- Phelps hypothesis. To this end the authors calculated TFP for a sample of 86 heterogeneous countries over the period 1960-1990 and investigated whether there has been (conditional) convergence in TFP. They also employed regressions with a variety of GMM estimators in a dynamic panel framework with fixed effects. Human capital was found to have a positive and significant effect on the long run growth path of TFP. Countries were found to be converging to these growth paths at a rate of about 3% a year. Their work were some way in resolving the debate over whether factor accumulation or TFP increases are more important for economic growth; while TFP differences explain most of the static variation in GDP across countries, human capital accumulation was found to be a crucial determinant of the dynamic path of TFP

Podrecca and Carmeci (2002) investigated the causality links, in Granger sense, between education and economic growth. Granger causality was tested applying the GMM estimator to a VAR model in a panel data framework, using data for a set of 86 countries over the period 1960-1990. The analysis shows that both education investment and the educational stock Granger-cause growth rates, both individually and jointly with physical capital investment. However the reverse causality runs from growth to investment in education. Causality also runs from physical capital investment to investment in education, and from education levels to physical capital investment (and back). The results are in line with the predictions of all different theories on the effects of human capital on growth, especially those who consider human capital as an input in the production function, together with physical capital, and those stressing its role as a vehicle for technical progress.

Using a sample of 80 countries, Papageorgiou (2003) examines the effect of human capital accumulation on economic growth and found that human capital affected growth as an input of final output and as a catalyst of technological innovation and imitation. The study disaggregated human capital and assigned different roles to primary and post-primary education. Results obtained from his study indicated that the structural specifications that allow human capital to operate as a facilitator of technological progress were better in explaining growth than the standard growth accounting specification. When the sample of countries was divided into three subsamples based on their initial per capita income, estimates from the proposed specifications suggested that for the wealthiest group of countries the role of human capital was a facilitator of innovation and imitation of technology. In addition, regression estimates show that the relative contribution of human capital to technology adoption increased with country wealth. This finding suggests that a country needs to reach a certain threshold before the returns to engaging in R&D activities become significant. The most important finding of the author was that primary education contributes mainly to production of final output, whereas post-primary education contributes mainly to adoption and innovation of technology.

Söderbom and Teals (2003) examined whether openness to trade and higher levels of human capital promoted faster productivity growth? To answer the question the authors used panel data on 93 countries spanning the 1970-2000 period. Controlling for fixed effects as well as endogeneity, the results showed a significant positive effect of openness on productivity growth. If the level of openness of an economy is doubled the underlying rate of technical progress will increase by 0.8 per cent per annum. They found positive effect, significant at the ten per cent level, of the level of human capital on the level of income but no such effect on productivity growth. Their preferred estimator combined high and low frequency differences of the data.

Benhabib and Spiegel (2005) undertook extensive sensitivity analysis and accounted for alternative production functions, capital-skill complementarity (CSC), skill-unskilled labour complementarity (CNC), and skill-biased-technical-change (SBTC). The result shows that (i) the new index performed better than existing indicators; (ii) the index also facilitated innovation and technology diffusion, and was consistent with the theoretical expectation; (iii) the valuable skills-education gap has widened in Africa and advanced OECD countries, and (iv) the CSC, SNC and SBTC hypotheses are confirmed but the effects are nonlinear.

Datta and Muhtadi (2006) Considered the transfer of technology from the North to the South which occurred through trade in high-technology goods and explicitly models the 'reverse-engineering' process that allows the South to assimilate new technologies. A key finding of this study was that the South's rate of growth was dictated by the size of the country's human capital, which determined its absorptive capacity and its ability to assimilate knowledge from the North. They found that while a Southern country that is poor in human capital could only imitate, Southern countries that possess sufficiently large human capital endowments, beyond a certain threshold, signal the onset of innovation. They also found that the North enjoyed a higher rate of innovation and growth with trade than without. North's gains are the highest when it trades with a human-capital 'poor' South, because imitation increases South's demand for Northern intermediates. But trade with the Southern countries that are human capital rich (and therefore involved in innovation), dampens their demand for Northern imports, adversely affecting North's growth. The model predicts growth convergence between the North and a South that is well passed the threshold for innovation.

Maksymenko and Rabbani (2008) employed a multivariate time series model, to study the role of economic reforms and human capital accumulation in the post-reform period. The authors constructed two indexes – a human capital index and a composite economic reform index – to perform a cointegration analysis of a long-run equilibrium growth path in India and South Korea twelve years after the implementation of reform. The significant positive effect of human capital accumulation was revealed in both India and South Korea. The impact of economic reforms was found to be heterogeneous across countries: The effect was positive, significant, and sizable in South Korea, while it was negative and relatively small in India. This result was suggestive of different degrees of efficiency of reform measures implementation in the two countries.

Amin and Mattoo (2008) used panel data for the fourteen major states of India over the 1980-2000 period, the estimated the effect of human capital endowment on the performance of the state economies and found that greater availability of skilled workers had a positive and significant impact on output in the service sectors. They could not find any such effect for the manufacturing sectors. They showed that the differential effect on services and manufacturing arose because service sectors were more skill intensive

Islam (2009) attempted to investigate whether differences in research intensity as well as absorptive capacity help to explain cross-country differences in productivity growth in a panel of 55 sample countries including 23 developed and 32 developing economies over the period 1970 to 2004. Using several indicators of innovative activity and product variety empirical results from system GMM estimator confirmed that research intensity had significant positive effect on productivity growth in both the developed and developing countries. TFP growth was also found to be enhanced by the distance to technology frontier in both the group of countries. R&D based absorptive capacity had significant positive impact on productivity growth in both the groups though stronger in developed countries. Human capital based technology transfer is found significant and robust in both the developed and developing countries. Absorptive capacity was sensitive to the model specification and measurement of innovative activity as well as product variety.

Messinis and Ahmed (2009) developed a new latent index of human capital identified as *valuable skills* for seventy countries for the period 1970-2003. The index is compared to existing measures of human capital in assessing the Benhabib and Spiegel (2005) model of logistic technology diffusion. The study undertakes extensive sensitivity analysis and accounts for alternative production functions, capital-skill complementarity (CSC), skill-unskilled labour complementarity (CNC), and skill-biased-technical-change (SBTC). The evidence shows that (i) the new index outperforms existing indicators; (ii) the index also facilitates innovation and technology diffusion, and is consistent with the theoretical model; (iii) the valuable skills-education gap has widened in Africa and advanced OECD countries, and (iv) the CSC, SNC and SBTC hypotheses are confirmed but the effects are nonlinear.

2.4.2 Single country studies

Lodde (1999) examined the relationship between education and growth by examines a sample of Italian regions. It considered two divergent views: The neoclassical and Schumpeterian approaches which emphasize education growth and stock respectively as determinants of output growth were tested against each other using disaggregate data on education and capital stock. The main results were that productivity growth was influenced by the stock of education rather than its rate of growth. Focusing on the manufacturing sector, where innovation was presumably a crucial input to output growth, the role of education was found to be important. In this case, TFP growth was mainly influenced by the endogenous innovation component rather than by the absorption of external technologies. Thus education behaves not as a factor of production but as an important requirement for enhancing the rate of technical progress and output growth. In the specific Italian case its role appears more important in developing endogenous technology and much less clear as regards external technology absorption. Contrary to other studies the study shows that higher education promotes growth once allocation effects are taken into account.

In a study on Guatemala, Loening (2002) investigated the impact of human capital on economic growth through the application of an error-correction methodology. Two channels by which human capital were expected to influence growth were analyzed. The results show that a better-educated labor force appears to have a positive and significant impact on economic growth both via factor accumulation as well as on the evolution of total factor productivity. However, it is empirically difficult to separate both approaches. The empirical results in this study have some policy implications. In particular, they underscore the need for further efforts in Guatemala to increase the level of human capital.

Monteils (2002) undertook a critical analysis of the theoretical contribution of new growth theories and presented an empirical testing for France in the 19th and 20th centuries to justify or invalidate the probable endogenous nature of economic growth induced by education. It was an empirical test of Lucas' model (1988). The results are surprising as they contradicted the hypothesis of new growth theories that human capital returns are decreasing and thus knowledge produced by education cannot be the engine of self-maintained economic growth. The importance of trade and openness for technology transfer and spillovers was documented in a wide range of studies.

Teixeira and Fortuna (2003a) investigated the effects of human capital on economic growth, measured by growth of total factor productivity, and they estimated structural (long run) relationship between total factor productivity (proxy of technological progress), human capital stock (average number of years of schooling), internal innovation capability (internal stock of knowledge – measured by the real accumulated expenditures on firms R&D), and absorption capability (composite variable involving human capital stock and the internal stock of knowledge). The estimation was carried out by using co-integration techniques, using the Johansen methodology. The estimated results showed that human capital stock was more important than internal innovation capability (internal stock of knowledge) in explaining the Portuguese productivity (1960-1991). More precisely, the estimate of elasticity of total factor productivity with respect to human capital stock was 0.42 percentage points, against 0.30 percentage points of the analogous estimate for internal stock of knowledge. Moreover, elasticity of total factor productivity with respect to innovation absorption capability was 0.40 percentage points. These values, in addition to confirming a stable long run relationship between productivity, human capital and internal innovation capability, also indicate that human capital is extremely important to the Portuguese economic growth, directly, through its impact on productivity and, indirectly, via its relation with innovation efforts.

Rattso and Stokke (2003) applied the method and the disaggregated data for agriculture and industry in Thailand to investigate more closely the dynamics of productivity and foreign spillover (for the period 1975-1996). Foreign spillovers were assumed to be channeled through foreign trade and foreign direct investment. They observed a strong and fair robust long-run relationship between openness and productivity in both domestic sectors during a period of an increasing trade share of GDP and an increasing foreign investment share of investment.

Lin (2003) examined the impact of education and the role of technical progress on economic growth in Taiwan by using a structural earnings function, average schooling years as a measure of education, and a transcendental production function to examine the effectiveness of education on economic growth. The findings revealed that education has a positive and significant effect on economic growth.

Teixeira and Fortuna (2003b) studied the effects of human capital on economic growth of Portugal from 1960 to 2001. By using VAR and cointegration analyses, they obtained 0.42 long-run estimates for human capital elasticity, 0.30 long-run estimates for internal knowledge elasticity, and 0.40 long-run estimates for the elasticity related with the composite variable that measured the interaction between human capital and innovation capability. These estimates seem to confirm that human capital and indigenous innovation efforts are enormously important to the process of Portuguese economic growth during the period 1960-2001, though the relevance of the former overpasses that involving the creation of an internal basis of R&D. In addition, the indirect effect of human capital, through innovation, emerged as critical, showing that a reasonably higher stock of human capital is important to enable a country to reap the benefits of its innovative indigenous efforts.

Another study on Guatemala by Loening (2004) investigated the impact of education on economic growth for the 1951 to 2002 period. An error correction model was used and the result show that a better educated labor force had a positive and significant impact on economic growth. The growth accounting framework demonstrated that human capital explained about 50% of output growth.

Self and Grabowski (2004) studied the impact of education on economic growth in India. They categorized education into primary, secondary, and tertiary with a view to examining whether each category had a causal impact on growth. In addition, the education variables were also broken down by gender and analysis was carried out to determine whether the causal results vary by gender. The result showed that primary education had a strong causal impact on growth than the impact of secondary education. Moreover, it was evident that female education at all levels had impact on economic growth while male education had a causal impact on growth only at the primary level.

Qian and Smyth (2005) examined the linkage between aggregate real output, capital, labour, education, and productivity within a growth accounting framework for 27 Chinese provinces between 1990 and 2000. Their main findings were that: first, economic growth in China's provinces depended heavily on the accumulation of physical capital stock, which accounted for around 55 per cent of GDP growth at the national level. Second, human capital stock played an important role in facilitating growth in all the provinces, contributing to 13 per cent of output growth on average between 1990 and 2000.

Mattrawy and Semmler (2006) studied the contribution of education on human capital formation to growth by using a very detailed data base on the educational system of Egypt from 1959 to 2002. The results show that education was a key component in the creation of human capital and an important factor for growth.

Teixeira and Fortuna (2006) employed co-integration techniques to demonstrate the relevance of the technological absorption hypothesis. They show that the interaction between human capital and (lagged) machinery imports – that is, the technological absorption capability - was the most critical determinant of Portuguese long-run total factor productivity.

Wirza (2008) investigated the extent that productivity increased in China was as explained by technology-adoption theory. He constructed a hybrid of some prominent technology-adoption models and calibrated it to reasonable parameter values. The calibrated version of the model was then combined with Chinese economic data. For the period 1978-2005, the analysis showed that technology adoption was a major driver for China's recent growth performance. Surprisingly, the simulation exercise showed that the technology-adoption framework

Hu and Lai (2008) examine the drivers behind China's economic growth. In particular, three channels of knowledge spillovers are identified including human capital, openness to trade and openness to growth. The specific features of the study include using the most recent comprehensive panel data consisting of 29 provinces during the period 1994–2006 and performing unit root and cointegration tests in the panel data framework. The paper finds that human capital, trade and FDI are the significant determinants of total factor productivity, but their importance varies with technological levels of provinces

2.4.3 Studies in Nigeria

Adamu (2003) examined the impact of human capital formation on economic growth of Nigeria from 1970- 2000. He used co-integration and error corrections mechanisms to determine the relationship between human capital formation and economic growth. The results show that investment in human capital in the form of education and training led to economic growth because of its impact on labour productivity. The author attributed the negative sign of growth rate of enrolment of graduates in tertiary institution to the time lag required for the impact of graduates to be felt on economic growth in terms of their contribution to national productivity. In addition, he attributed the negative sign to the non-utilization of graduates in productive activities. Notwithstanding the above anomaly, the results clearly vindicate the proposition that investment in human capital accelerates economic growth.

Chete and Adewoye (2003) explored the human capital-economic growth nexus using a number of methodological approaches. Granger causality was used to determine the direction of causality. The results were inconclusive because direction of causality alternated between bi-causality, no causality and mono-causality depending on the lag length allowed. The authors also employed VAR model in which variance decomposition analysis show that "own shocks" constituted the predominant source of variation in employment growth's forecast errors and in income growth forecast errors. They also used impulse response analysis to show that there were considerable oscillations in the response patterns of income and employment to unanticipated shocks in each other. The results also confirm the main stream view of the positive impact of human capital on growth. The results have far reaching policy implication as they suggest that the development of skills and knowledge, coupled with their effective utilization is important for the country's growth and development.

Uwatt (2003) employed the augmented Solow growth model and co-integration/error correction methodology to study the relationship between human capital and economic growth in Nigeria. He used enrolment in educational institutions as proxy for human capital. Human capital was disaggregated into primary education enrolment, secondary education enrolment and tertiary education enrolment. The author used five models at both the aggregate and disaggregated levels to examine the contribution of human capital to economic growth. The results of his study show that human capital at the aggregate and disaggregated level did not only have positive impact on economic growth but such impact was strong and statistically significant. The results also show that growth in total factor productivity was not only negative but also statistically insignificant.

Using Nigerian data, Garba (2003) developed a system analysis framework as an alternative to empirical studies for elucidating the relations between human capital formation, utilization and development through the network of relations between the formal, informal and the foreign sectors of the Nigerian economy. The method enabled the author to use the triad processes in the context of the duality and openness of the processes in Nigeria. The result shows a dysfunctional process and a triad of failures of institutions, state and market in Nigeria. The dysfunctional process created great divides between the components, which constitute formidable obstacles to Nigeria's developmental process.

Babatunde and Adefabi (2005) investigated the long run relationship between education and economic growth in Nigeria between 1970 and 2003 through the application of Johansen Cointegration technique and Vector Error Correction Methodology. It examines two different channels through which human capital can affect long run economic growth in Nigeria. The first channel is when human capital is a direct input in the production function and the second channel is when the human capital affects the technology parameter. The Johansen Cointegration result establishes a long run relationship between education and economic growth. A well educated labour force appears to significantly influence economic growth both as a factor in the production function and through total factor productivity.

Otu and Adenuga (2006) empirically examine the relationship between economic growth and human capital development using annual data from 1970 to 2003. Capital and recurrent expenditure on education and enrolments into primary, secondary and tertiary education were used as proxy for human capital. Cointegration and error correction mechanism technique was used for analysis. It was found that investment in human capital, through the availability of infrastructural requirements in the education sector accelerates economic growth. Physical capital formation was correctly signed and statistically significant at 1 per cent level of significance.

Awe and Ajayi (2010) examines the nexus between human capital investment and economic growth in Nigeria. Specifically the study investigated the causality between human capital investment and economic growth during the period 1975 and 2005 using cointegration and error correction mechanism technique. The findings of the study revealed that there exists a directional causality between human capital investment and economic growth in Nigeria.

From the review of empirical literature, it appears there is no general agreement in literature on the impact of human capital on economic growth. Some researchers have found that the accumulation of human capital stock is an important factor in achieving growth (Mankiw, Romer and Weil 1992, Barro 1991, while others provided evidence of a negative or insignificant relationship between human capital and growth (Islam 1995). Empirical studies in Nigeria (Adamu 2003, chete et al 2003, Uwatt 2003, Awe 2010 etc) used various variables such as capital and recurrent expenditure on education, secondary or total school enrolment ratio, and literacy rate. The proxies are highly problematic because they are poor indicators of education quality. Secondly they ignore factors other than formal education that impact on skill formation. Thirdly, they are often used with macroeconomic variables that introduce endogeneity or reverse causality biases in estimation. Lastly, they fail to measure the value of education.(Messini and Ahmed(2009). There is therefore the need to address these methodological weaknesses.

2.5 Theoretical Framework

The theoretical framework for the first Model is based on the work of Robert Lucas (1998) who model the link between human capital and economic activity by splitting the economy into two sectors: the education sector produces new human capital with the help of existing human capital (teachers), while the final goods sector uses both human and physical capital as inputs. In this model, a rise in human capital leads to a rise in national income, while a high level of human capital explains a high level of income. This Economic policy that raises the rate of growth of human capital will lead to higher growth rates of GDP. The second model is based on Nelson and Phelps (1966) framework in which human capital impact on the evolution of total factor productivity through innovations and diffusions.

2.6 Development of latent human capital index

This dissertation adopted a multiple-indicator model with one latent common factor based on a Factor analysis approach:

$$I_{k,t} = \mu_k + \lambda_k h_t^s + e_{k,t} \quad \text{.......... 3.2}$$

$I_{k,t}$ is the log of indicator *k=1,…,n* at time *t*, h_t^s is the common factor,

λ_k is the factor loading, and $e_{k,t}$ is an idiosyncratic error term. Factor analysis is a statistical data reduction technique used to explain variability among observed random variables in terms of fewer unobserved random variables called factors. The observed variables are modelled as linear combinations of the factors plus an error term. The eigen-value for a given factor measures the variance of all the variables that is accounted for by that particular factor. If a factor has a low eigen-value, it may be ignored because other factors are more important in explaining variance. The common factor is the unobserved characteristic of education quality that drives the *n* indicators. In search for appropriate indicators, we seek to include variables that measure quantitative as well as qualitative aspects of human capital. The following variables were included in the human capital index: enrolment rates, literacy rates, public expenditure on education and health, infant mortality rates, per capital scientific publications in science (SciP), per capita capital equipment (Ke), and per capita high technology exports (Xm); and labour force. The approach was used by Messini and Ahmed (2009) to obtain estimates of human capital for seventy countries for the period 1970-2003. We adopted the approach because the human capital indicators outperformed existing indicators in a sensitivity test. Similarly, the index is consistent with the theoretical model. The latent variable approach was also used by other researchers such as Dagun and Slottje (2000) who used indicators from household survey data and by Hanushek and Kimko (2000). The approach rests on three insights: (a) human capital is too rich to be captured by a single variable such as years of education (Le, Gibson and Oxley 2003; Dagum and Slottje 2000); (b) rather than skills, it is the *value* of skills that counts in economics (Schultz 1961: Becker 1964; Nelson 2005), and (c) given the scarcity of valid instruments, the unobserved latent factor approach provides a solution to the endogeneity and measurement error problems (Heckman, Stixrud and Urzua 2006; Flossmann, Piatek and Wichert 2006).

Table 3.1 Human capital indicators and sources

Human capital indicators	Source
Public expenditure on education (pee)	CBN & NBS 2009
Public expenditure on health (peh)	CBN & NBS 2009
Enrolment rate primary education (Erp)	World Bank 2009
Enrolment rate secondary education (Ers)	World Bank 2009
Enrolment rate tertiary education (Ert)	World Bank 2009
Literacy rate (Lr)	World Bank 2009
Per capita scientific publications in science (Scip)	World Bank 2009
Infant mortality rate (Mor)	World Bank 2009
Per capita Capital equipment stock (Ke)	World Bank 2009
High technology export as % of GDP (ht-Xm)	World Bank 2009
Labour force	World Bank 2009

3.1 MODEL SPECIFICATION

Two models through which human capital affects long run economic growth in Nigeria were used. The first model is when human capital is a direct input in the production function.

3.2 MODEL 1-Human capital accumulation approach

This model is presented in Cobb-Douglas production function with constant returns to scale as:

$$\mathbf{Y = A.\ K^{\gamma}\ .\ H^{\theta}.\ L^{(1-\gamma-\theta)}} \quad \ldots\ldots 3.3$$

Where

Y is defined as output:

A is the total factor productivity;

K is physical capital,

H is human capital and

L is labour.

The logarithmic conversion of equation 3.3 above yields the structural form of the production function as:

$$\mathbf{Ln\ y_t = Ln\ A + H.Ln\ k_t + \theta.Ln\ h_t + u_t} \quad \ldots\ldots 3.4$$

Where **y = Y/L** = output per worker

k = K/L= capital per worker

h = H/L= average human capital

In its error correction form equation 3.4 can be represented as:

$$Ln\ y_t = \beta_0 + \beta_1 \Delta Lnk_t + \beta_2.\Delta Ln\ h_t..\beta_3.(Ln\ y_{t-1+}\ \gamma.Ln\ k_{t-1} + \theta.Ln\ h_{t-1} - Ln\ A) + u_t \ldots\ldots 3.5$$

The final structural form of the model in the vector error correction form is given in equation 3.6 as follows:

$$Ln\ y_t = Ln\ A + \beta_1 Ln\ k_t + \beta_2 Ln\ h_t \ldots \beta_3.\ Ln\ y_{t-1} + \beta_4.Ln\ k_{t-1} + \beta_5.Ln\ h_{t-1} + u_t \ldots\ldots 3.6$$

The coefficient $\boldsymbol{\beta_3}$ represents the measure of the speed of adjustment through which the system moves towards its equilibrium on the average.

3.3 MODEL 2-Stock or Level of Human capital approach

In the second model, human capital is taken to affect the technology parameter directly rather than as a factor of production. The Cobb-Douglas production function with constant returns to scale is given in equation 3.7 as:

$$Y = A.\, K^{\alpha}\, .\, L^{(1-\alpha)} \quad \text{.........} \quad 3.7$$

Expressed as a logarithmic expression after standardizing by labour units, equations 3.7 becomes:

$$\text{Ln } Y = \text{Ln } A + \alpha.\text{Ln } K \quad \text{.........} \quad 3.8$$

The vector error-correction model combines the long-run aspect of the model and the short-run adjustment mechanism as shown in equation 3.9:

$$\text{Ln } y_t = \beta_1.\ \text{Ln } kt + \beta_2.\ (\text{Ln } y_{t-1} - \alpha.\text{Ln } k_{t-1} - \text{Ln } A) + u_t \quad \text{.........} \quad 3.9$$

Total factor productivity in this model is taken to be a function of exogenous variables, such as level of human capital, government expenditure on education and foreign inputs. The argument is that an educated labour force performs a major role in the determination of productivity level instead of entering the production function as a factor. The expenditure on education was assumed to influence the level of human capital which is expected to cause improvements in total factor productivity. In addition, higher level of human capital speeds up the adoption of foreign technology that is expected to balance the knowledge gap between the developed and the developing countries. (Nelson and Phelps, 1966; Lee; 1995; Benhabib and Spiegel, 1994; Loening, 2002) Consequently, the technology parameter in the second model is taken as a non-constant which is then allowed to be dynamic with time. The technology parameter is presented in 3.10 as follows:

$Ln\ A = b + \beta_4.Lnh_t + \beta_5\ .IMPGCF_t + \beta_6.GEXEDU_t +$……………..............................3.10

Where

b is the exogenous technological progress,

h is the level of human capital proxy by human capital index,

IMPGCFt is the ratio of total imports to gross capital formation,

GEXEDU as government expenditure on education.

A Prior Expectation **$\beta_4, \beta_5, \beta_6$** > 0

We expect human capital, the measure of foreign inputs and government expenditure on education to have positive effect on total factor productivity. The vector error correction model is at given in equation 3.11 as follows:

$Lnyt = b + \beta_1.Ln\ k_t + \beta_2.Ln\ y_{t-1} + \beta_3.Ln\ k_{t-1} + \beta_4.Ln\ h_t + \beta_5\ .IMPGCF_t + \beta_6.GEXEDU_t + u_t$……………………………………………………………………………………………………3.11

We assumed that the level of human capital instead of the growth rates perform a basic role in the determination of the growth of output per worker in the second model whereby human capital affects the productivity parameter than the first model whereby the human capital enters as a production function factor.

3.4 MODEL 3-Disaggregated Model

Cobb-Douglas Production function was employed for the sectoral specification. The sectors were disaggregated into five sectors as follows: Agriculture (Y_{AGR}), Manufacturing (Y_{MNF}), Service (Y_{SER}), Others (Y_{OTH}). The disaggregation is shown as:

$$\mathbf{Y = Y_{AGR} + Y_{MNF} + Y_{SER} + Y_{OTH}} \quad \textbf{……3.12}$$

The log sector specification is as follows:

$$\mathbf{lnY_{AGR} = b + \alpha 1 lnkt + \alpha 2 ln\ ht + \alpha 3 lnIMPGCF + \alpha 4 lnGEXEDU + u_t} \quad \textbf{……3.13}$$

$$\mathbf{lnY_{MNF} = b + \alpha 6 lnkt + \alpha 7 ln\ ht + \alpha 8 lnIMPGCF + \alpha 9 lnGEXEDU + u_t} \quad \textbf{……3.14}$$

$$\mathbf{lnY_{SER} = b + \alpha 10 lnkt + \alpha 11 ln\ ht + \alpha 12 lnIMPGCF + \alpha 13 lnGEXEDU + u_t} \quad \textbf{……3.15}$$

where **α1……………. αN** are coefficients and are expected to have positive signs. We expect the effect of human capital on total factor productivity should be stronger in those sectors where innovation is the most important engine of growth.

3.5 ESTIMATION TECHNIQUES

3.5.1 UNIT ROOT

Unit root test was performed on the time series macro-variables. This was because most macroeconomic time-series do have unit roots and regressing non-stationary series on each other is bound to yield spurious regression results. Also, the determination of whether a variable exhibits a unit root is to know if the variables exhibit certain characteristics such as mean reversion characteristics and finite variance, transitory shocks with the autocorrelations dying out with the increase in the number of lags under the alternative hypothesis of stationarity. Thus, we first tested the nature of the time series to determine whether they were stationary or non stationary and also their order of integration. The order of integration could assist researchers in determining the subsequent long-run relationship among the variables. The Augmented Dickey-Fuller (ADF) and Phillip Perron tests were adopted for this purpose.

3.5.2 COINTEGRATION

Thereafter, the test for cointegration among the series was done. Cointegration indicates the presence of a linear combination of non-stationary variables that are stationary. In a case where cointegration did not exist, it means the linear combination was not stationary and the variable did not have a mean to which it returns. The presence of cointegration however implies that a stationary long-run relationship among the series is present. The procedure adopted in this study was a representation of the approach of analyzing multivariate cointegrated systems developed and expanded by Johansen and Juselius (1990, 1992, and 1994) Unlike the Engle Granger static procedure, the Johansen Vector Autoregressive (VAR) procedure allows the simultaneous evaluation of multiple relationships and imposes no prior restrictions on the cointegration space. The Johansen cointegration approach tests for the cointegration rank for a VAR process, estimates the TRACE and LMAX stats, the eigen values, and the eigenvectors. It computes the long-run equilibrium coefficients, the adjustment coefficients, the covariance matrix of the errors, and the R-squares for each of the equations in the VECM. In addition, it also tests for linear restriction on the long-run equilibrium coefficients. Thus, the approach consists of information maximum likelihood estimation (FI|ML) of a system characterized by r cointegrating vectors. If for instance, it was assumed that qt such that t=1…T, whereby (px1) denotes a vector of random variables and follows a p-dimensional Vector Autoregressive (VAR) model with Gaussian errors (whereby p is the number of jointly endogenous variables). We then wrote the conditional model which is conditional on the observations Z_{k+1}, ---,z_0 which are fixed as:

$q_t = B_1 q_{t-1} + \ldots + B_k q_{t-k} + \mu + \psi C_t + \varepsilon_t$ … …………………………………………………………….3.16

where B_1, B_2, …,B_k are p by p matrices, μ is the vector of constants and C_t is a vector of nonstochastic variables such as a dummy variable. If there exists cointegration between the variables in qt, the model can be written in error correction form as ;

$\Delta qt = \Gamma_1 \Delta q_{t-1} + \ldots + \Gamma_{t-1} \Delta q_{t-k-+1} + \Pi q_{t-k} + \mu + \psi C_t + \varepsilon_t$. t=1,…, T. … ………………………3.17

Where $\Gamma_i = -(I-A_1 \ldots -A_i)$, for i=1… k-1; and $W = -(I-A_1-\ldots-A_k)$

The model in equation 3.17 is the vector error correction model for the cointegrated series. In this case, the short-run dynamics of the variables in the system are represented by the series in differences and the long-run relationships by the variables in levels. A shock to the i-th variable not only directly affects the i-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. The accumulated response is the accumulated sum of the impulse responses. It can be interpreted as the response to step impulse where the same shock occurs in every period from the first. If the estimated ARMA model is stationary, the impulse responses will asymptote to zero, while the accumulated responses will asymptote to its long-run value. If the innovations are contemporaneously uncorrelated, interpretation of the impulse response is straightforward. Innovations, however, are usually correlated, and may be viewed as having a common component that cannot be associated with a specific variable. While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR.

3.6 DATA TYPES AND SOURCES

Secondary data were used. Data for the study were sourced from the World Bank World Development Indicators (WDI, 2009), National bureau of statistics

(NBS), Federal Ministry of labour and productivity, Central Bank of Nigeria (CBN) Statistical Bulletin and Annual Report and Statement of Account, among others.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.0 PRESENTATION AND INTERPRETATION OF EMPIRICAL RESULTS

The purpose of this chapter is to present and discuss the results or findings of this dissertation. The chapter is organized into sections as shown below.

A. DESCRIPTIVE ANALYSIS

4.1 OBJECTIVE 1: To examine trends in human capital formation and utilization in Nigeria between 1981 and 2007

In order to achieve this objective, the major sources of human capital formation and utilization using a descriptive framework were examined. The major tool of human capital formation in the country is the formal educational and training institutions (Primary, Secondary, and Tertiary-Universities, Polytechnics and Colleges of Education). In addition, there are also other specialized training institutions which were set up mainly by the government to build capacity of those already in employment through specialized short term courses. Examples include: Administrative Staff College of Nigeria (ASCON), National Institute for Policy and Strategic Studies (NIPSS). Investment in education and health are critical components of human capital formation.

Trends in Gross Domestic Product (GDP), Public investment in education and health in Nigeria between 1981 and 2007 were examined in table 4.0, 4.1 and 4.2 as follows.

TABLE 4.1-PUBLIC EXPENDITURE ON EDUCATION IN NIGERIA (1981-2007)

Year	Recurrent expenditure (millions)	Capital expenditure (millions)	Total Expenditure (millions)	Gross Domestic Product(GDP) (millions)	Total Expenditure on Education as % of GDP
1981	543.70	440.90	984.6	202,222.06	2.1
1982	646.70	488.00	1134.7	199,685.25	2.3
1983	620.80	346.60	967.4	185,598.14	1.8
1984	716.30	144.90	861.2	183,562.95	1.4
1985	669.50	180.70	850.2	201,036.27	1.25
1986	652.80	442.00	1094.8	205,971.44	2
1987	574.40	139.10	713.5	204,806.54	1
1988	802.30	281.80	1084.1	219,875.63	1
1989	1719.90	221.90	1941.8	236,729.58	1
1990	1962.60	331.70	2294.3	267,549.99	0.85
1991	1205.60	289.10	1494.7	265,379.14	0.47
1992	1676.30	384.10	2060.4	271,365.52	0.38
1993	6436.10	1563.00	7999.1	274,833.29	1.10
1994	7878.10	2405.70	10283.8	275,450.56	1.10
1995	9421.30	3307.40	12728.7	281,407.40	0.65
1996	12136.00	3215.80	15351.8	293,745.38	0.56
1997	12136.00	3808.00	15944	302,022.48	0.56
1998	13928.30	12793.00	26721.3	310,890.05	1
1999	23047.20	8516.60	31563.8	312,183.48	1
2000	44,225.50	23342.60	67568.1	329,178.74	1.50
2001	39884.60	19860.00	59744.6	356,994.26	1.25
2002	100240.20	9215.00	109455.2	433,203.51	1.60
2003	164,755.90	14680.20	179436.1	477,532.98	2
2004	72217.90	21550.00	93767.9	527,576.04	1
2005	92594.70	27440.80	120035.5	561,931.39	1
2006	129421.90	35791.80	165213.7	596,821.61	9
2007	1347478.26	48293.51	1395771.77	634,251.14	7

Source: CBN annual reports, own computation

Table 4.1 shows public investment in education in Nigeria between 1981 and 2007. The table showed an average growth of 16% in public expenditure on education during the period under review. The expansion in public expenditure on education was accompanied by increased enrolment at the three levels of education. Enrolment grew on the average by 4%, 6% and 19% at the primary, secondary and tertiary levels respectively (see Table 4.3). Similarly, the upward trend in spending on education particularly between 2004 and 2007 is attributed to the reforms in the education sector and the array of ambitious goals such as the:

- National policy on education 2004
- Action plan for implementation of UBE act 2004
- Dakar framework for Action/Education for All
- Millennium Development Goals
- National Economic Empowerment and Development Strategy

As a percentage of GDP, total expenditure on education grew by 8% between 2005 and 2010. However the figure is a far cry from the recommended level of 26% by UNESCO. This implied inadequate funding of education which portends grave consequences on the process of human capital formation and utilization.

TABLE 4.2-PUBLIC EXPENDITURE ON HEALTH IN NIGERIA 1981-2007

Year	Recurrent expenditure (millions)	Capital expenditure (millions)	Total Expenditure (millions)	Gross Domestic Product(GDP) (millions)	Total Expenditure on Health as % of GDP
1981	119.80	128.40	248.2	202,222.06	0.122736362
1982	155.80	130.20	286.0	199,685.25	0.143225401
1983	143.60	136.00	279.6	185,598.14	0.150648061
1984	139.10	51.10	190.2	183,562.95	0.103615681
1985	167.70	56.20	223.9	201,036.27	0.111372938
1986	279.20	81.20	360.4	205,971.44	0.174975715
1987	166.90	69.50	236.4	204,806.54	0.115426002
1988	260.00	183.20	443.2	219,875.63	0.201568496
1989	326.60	126.00	452.6	236,729.58	0.191188613
1990	401.10	257.00	658.1	267,549.99	0.245972725
1991	619.40	137.60	757.0	265,379.14	0.285252262
1992	837.40	188.00	1025.4	271,365.52	0.377866724
1993	2331.60	352.90	2684.5	274,833.29	0.976773956
1994	2066.80	961.00	3027.8	275,450.56	1.099217224
1995	3335.70	1725.20	5060.9	281,407.40	1.798424633
1996	3192.00	1659.50	4851.5	293,745.38	1.651600444
1997	3179.20	2623.80	5803.0	302,022.48	1.921380157
1998	4860.50	7123.80	11984.3	310,890.05	3.854835496
1999	8793.20	7386.80	16180.0	312,183.48	5.182849522
2000	11612.60	6569.20	18181.8	329,178.74	5.523382221
2001	24523.50	20128.00	44651.5	356,994.26	12.50762407
2002	50563.20	12608.00	63171.2	433,203.51	14.58233799
2003	33254.50	6431.00	39685.8	477,532.98	8.310588307
2004	33377.40	26410.00	59787.4	527,576.04	11.33247067
2005	50032.80	21652.60	71685.4	561,931.39	12.75696665
2006	67550.20	38039.80	105590.0	596,821.61	17.69205374
2007	71278.99	51171.01	122450.0	634,251.14	19.30623254

Source: CBN annual reports, own computation

On the other hand, table 4.2 shows public expenditure on health between 1981 and 2007. Investment in healthcare grew on the average by 35% over the period. Comparing the increases in health expenditure with the 2.4% annual average growth rate of the population during this period, it means that the effectiveness of the increases in health expenditure is seriously compromised. To support this assertion we review the following health indicators in Nigeria. As a percentage of GDP, total expenditure on health is 1% of gross domestic product. The following indicators depict the current status of healthcare in the country.

Table 4.3 HEALTH INDICATORS IN NIGERIA 2007-2008

S/N	Indicators	Percentage
1	Total Mortality	5.7 %
2	Infant Mortality Rate	75 per 1000
3	Maternal Mortality Rate	10 per 1000
4	Children protected against Neo NalTeTanus	85.6%
5	Birth weight 500g and above	83%
6	Percentage of under five malnourished	36%
7	Immunization coverage before 1st birth day(Urban area)	27%
8	Immunization coverage before 1st birth day(Rural area)	10%
9	Delivery by trained attendants	39%
10	Access to safe water (Urban)	75.7%
11	Access to safe water (Rural)	37%
12	Excreta disposal (Urban)	70%
13	Excreta disposal (Rural)	31%
14	Breast feed rate (Urban)	73%
15	Breast feed rate (Rural)	79%

Source: NBS: National demographic health survey 2008 & Multiple indicators cluster survey 2007

The table shows that healthcare delivery is in a deplorable condition considering the above indicators.

TABLE 4.4- ENROLMENT IN EDUCATIONAL INSTITUTIONS IN NIGERIA (1981-2007)

Year	Primary	Secondary	Tertiary
1981	14026819	2473673	74607
1982	14964143	2880280	87066
1983	15308384	3334644	104683
1984	14383487	3402665	116822
1985	13025287	2995578	126285
1986	2914870	3094349	135783
1987	11540178	2934349	150613
1988	12690798	2997464	219119
1989	12721087	2723791	307702
1990	13607249	2901993	326557
1991	13776854	3123277	368897
1992	14805937	3600620	376122
1993	15911888	4150917	383488
1994	1683560	4500000	202534.7
1995	17994620	5084546	391035
1996	19794082	5389619	689619
1997	21161852	5578255	862023
1998	22473886	5795807	941329
1999	23709949	6056618	983689
2000	24895446	6359449	1032873
2001	27384991	6995394	1136160
2002	29575790	7485072	1249776
2003	26292370	7091376	1274772
2004	28144967	7091376	6745186
REMARKS	An average growth rate of 4% during the period	An average growth rate of 6% during the period	An average growth rate of 19% during the period

Source: National Bureau of Statistics, own computation

Table 4.4 shows enrolment at the primary, secondary and tertiary levels between 1981 and 2004. There has been increase in enrolment at all levels. The observed wide disparity in enrolment between primary, secondary and tertiary levels is attributed to high dropout rates that cut across the three levels of education. Other factors are economic, demographic, socio-cultural and religion. The need for higher education is partly based on the fact that those with higher education qualifications have a better chance of securing a job in a tough market compared to those without higher education qualifications.

TABLE 4.5-NUMBER OF EDUCATIONAL INSTITUTION IN NIGERIA 1981-2007

Year	Primary	Secondary	Tertiary
1981	36683	4969	16
1982	37611	5603	19
1983	37888	5894	24
1984	38211	6190	27
1985	35281	5876	24
1986	35433	5730	24
1987	34266	6092	28
1988	33796	6044	104
1989	34904	5868	118
1990	35433	6001	122
1991	35446	5860	124
1992	36610	6009	130
1993	37812	6162	133
1994	38000	6300	133
1995	39677	6452	138
1996	41660	6646	138
1997	43951	7311	138
1998	45621	7801	138
1999	47902	8113	144
2000	48860	8275	144
2001	49343	8275	142
2002	47694	8351	178
2003	52815	11918	202
2004	60189	10913	215
2005	60189	10913	215
2006	54434	18238	215
2007	54434	18238	215
REMARKS	An average growth rate of 2% during the period	An average growth rate of 3% during the period	An average growth rate of 7% during the period

Source: National Bureau of Statistics, own computation

Table 4.5 shows the number of educational institution in Nigeria between 1981 and 2007. The table indicated a proliferation of educational institutions in Nigeria during the period. The number of primary schools grew from 36,683 in 1981 to 54,434 while secondary schools grew from 4,969 to 18,238 during the same period. The increase in the number of primary and secondary schools is attributable to the implementation of Universal Basic Education programme and international conventions such as Education for All and the Millennium Development Goals. At the tertiary level where high level manpower are produced, the number of institutions established grew from 16 in 1981 to 215 in 2007. The breakdown shows that there were 91 Universities, 63 Polytechnics and 61 Colleges of Education in 2007. 27 of the universities were federal, 34 were state and 31 were private. The following factors account for the expansion in the number of universities in the country. Rising social demand for education and the lift on the ban on establishment of state and private universities led to more private participation in education delivery.

Table 4.6– GRADUATE OUTPUT FROM TERTIARY INSTITUTIONS IN NIGERIA 2003-2007

Discipline	2004	2005	2006	2007
Non-Sciences				
Accts/Bus. Studies	14,890	15,988	20,898	22,509
Arts /Humanities	10,260	11,017	14,400	15,510
Education Arts	5,555	5,965	7,796	8,397
Educ Special	2,242	2,408	3,147	3,389
Law	3,999	4,293	4,020	6,045
Secretarial Studies	2,804	3,011	2,819	4,239
Social Science	5,358	5,357	5,014	7,542
Others	5,158	7,192	7,444	10,125
SUB-TOTAL	**50,026**	**54,715**	**65,201**	**77,756**
Science Related				
Agric Engineering	1,120	1,203	1,572	1,693
Agric Science	3,387	3,637	16,548	5,120
Voc Education	542	582	761	819
Educ Science	5,054	5,427	7,094	7,640
Engineering	8,688	8,072	10,551	11,364
Environmental Design	4,941	5,305	6,933	7,469
Food Scie & Tech	867	931	872	1,311
Human Medicine	361	388	363	546
Natural & Applied Science	8,974	9,635	9,020	13,565
Para-Medical	1,988	2,134	1,998	3,005
Phamacy	710	762	714	1,074
Vet. Medicine	240	258	337	363
SUB-TOTAL	**37,112**	**38,850**	**57,100**	**53,969**
Science-Non Science output ratio	**42.5 : 57.5**	**41.5 : 58.5**	**46.7 : 53.3**	**41 : 59**
Government approved ratio of Science-Non Science output of graduates	**60 : 40**	**60 : 40**	**60 : 40**	**60 : 40**
GRAND TOTAL	**87,138**	**93,565**	**122,301**	**187,744**

Source: National Youth Service Corps, Abuja

Table 4.6 shows distribution of youth corps members by discipline. The table depicts the output of graduates according to discipline. It provides an outlook for the areas of growth and needs in skilled manpower production. The table showed low production of skilled manpower in critical areas such as human medicine, paramedical, pharmacy, food science and technology, vocational & technical education and agric engineering.

Table 4.7 Unemployment rate in Nigeria (1981-2007)

Year	Unemployment rate in %
1981	3.9
1982	4.3
1983	4.6
1984	6.2
1985	6.1
1986	5.3
1987	7.0
1988	5.3
1989	4.5
1990	3.5
1991	3.1
1992	3.4
1993	2.7
1994	2.0
1995	1.8
1996	3.4
1997	3.2
1998	3.2
1999	3.1
2000	4.7
2001	4.2
2002	12.6
2003	14.8
2004	13.4
2005	11.9
2006	13.7
2007	14.6

Source: CBN major economic, financial and banking indicators 2004 & NBS Social statistics 2008

Table 4.7 shows unemployment rate in Nigeria between 1981 and 2007. From the table, unemployment increase from 3.9 per cent in 1981 to 5.3 in 1986. This development was as a result of the economic downturn during the period which discourages new investment and forced government to implement stabilization measure including restriction on importation. Given the high import dependency of the manufacturing sector, the restriction forced many firms to operate below installed capacity causing most of them to close down or retrench a significant proportion of their workforce. This development made placement of fresh graduates exceedingly difficult. In addition, government placed embargo on employment and was implemented pari-passu with public sector retrenchment. Unemployment also increases from 5.3 per cent in 1986 to 7.0 per cent in 1987 due to rationalization policies which accompanied the introduction of structural adjustment policies especially in the private sector. Unemployment fell consistently from 7.0 per cent in 1987 to 1.8 per cent in 1995 before rising to 4.5 per cent in 1997. The declining trends in unemployment may be partly attributed to implementation of government programmes such as Agricultural Development programmes (ADPs), Directorate of Food, Roads and Rural Infrastructure (DFRRI), National Directorate of Employment (NDE), People's Bank, and Better Life for Rural Women. Unemployment consistently increases from 4.2 per cent in 2001 to

14.6 per cent in 2007. The sharp increases in unemployment during this period may be attributed to the dramatic increases in the number of graduates from tertiary institutions, the ban on employment in the public service, non compliance to civil service regulation on employment and retirement and low capacity utilization in the manufacturing sector.

TABLE 4.8 GROWTH RATE OF REAL GROSS DOMESTIC PRODUCT IN NIGERIA (1981 – 2007)

YEAR	REAL GROSS DOMESTIC PRODUCT (GDP)	GROWTH RATE OF GDP IN %
1981	202,222.06	-
1982	199,685.25	-1.2
1983	185,598.14	-7.1
1984	183,562.95	-1.1
1985	201,036.27	9.5
1986	205,971.44	2.50
1987	204,806.54	0.60
1988	219,875.63	7.4
1989	236,729.58	7.7
1990	267,549.99	13.0
1991	265,379.14	-0.8
1992	271,365.52	2.3
1993	274,833.29	1.3
1994	275,450.56	0.22
1995	281,407.40	2.1
1996	293,745.38	4.4
1997	302,022.48	2.8
1998	310,890.05	2.9
1999	312,183.48	0.4
2000	329,178.74	5.4
2001	356,994.26	8.4
2002	433,203.51	10.2
2003	477,532.98	10.0
2004	527,576.04	10.0
2005	561,931.39	6.5
2006	596,821.61	6.0
2007	634,251.14	6.4

Source: CBN annual reports, own computation

Table 4.8 Show the growth rate of real Gross Domestic Product (GDP) between 1981 and 2007. From the table, there was improvement in the growth rate of Gross Domestic Product (GDP) between the year 2000 and 2007 which shows an average growth rate of 8% of GDP. At this present rate, Nigeria's economy is growing faster than the global and regional average of 3 to 5.2 percent. However there is a paradox. In spite of the growth in GDP, unemployment had risen from 4.7% in 2000 to 14.6% in 2007 which shows that there is a wide gap between economic growth and job creation. This trend contradicted the neoclassical and Keynesian views of the nexus between economic growth and employment. The gap between economic growth and job creation is due to closure of major industries in the country. The gap has been widened by the perennial decay in infrastructure and the total neglect of manufacturing industries in the country. For instance, the textile industry, in the 80s dominated the Nigeria industrial sector. It was the largest employer of labour after government whilst its contribution to Gross Domestic Product (GDP) was second to Food, Beverages and Tobacco sector. The industry controlled close to 80 percent of the total market for textile. The sector employed more than 2 million people. But, today, the industry controlled a mere 15 percent of local market and its current employment level hover around 17,500. Beyond the textile subsector, the entire manufacturing sector is experiencing negative growth with dire consequence for job and employment. For instance available data indicates that manufacturing output declined from 7.03 percent in 2009 to 6.43 percent in 2010 with about one million job losses. In 2009, the Manufacturers Association of Nigeria (MAN) in her annual report disclosed that about eight hundred and thirty four factories (834) was closed across all the geo political zones with over 100,000 job losses just that year alone. The challenges of the sector has been that of power, smuggling, unrestrained importation of fake and sub-standard textile materials, absence of clear industrial policy, high cost of LPFO otherwise known as black oil, interest rate instability others are multiple taxation, low demand for made in Nigeria goods, low level of technology, poor water supply and transportation, and high cost of raw materials.

TABLE 4.9-GROWTH RATE OF GDP IN AGRICULTURAL, MANUFACTURING AND SERVICE SECTORS

Year	Agricultural sector	Manufacturing sector	Service sector
1981	-2.2%	-4.7%	-0.4%
1982	2.5%	13%	-3.2%
1983	-0.7%	-30.9%	-1.3%
1984	-5.2%	-11.7%	-7.7%
1985	17.6%	26%	11.2%
1986	9.7%	-3.7%	-0.9%
1987	-3.5%	4.0%	2.1%
1988	10.3%	13.9%	6.3%
1989	5.4%	2.2%	-16.5%
1990	4.3%	4.9%	18.0%
1991	3.7%	9.4%	0.2%
1992	2.1%	-4.5%	6.8%
1993	1.4%	-3.7%	-1.9%
1994	2.5%	-1.3%	0.5%
1995	3.6%	-5.2%	-4.1%
1996	4.2%	0.8%	1.3%
1997	4.3%	0.4%	4.3%
1998	4.1%	-6.9%	4.9%
1999	5.3%	3.4%	4.1%
2000	2.9%	3.4%	3.9%
2001	3.9%	7.0%	36.9%
2002	4.4%	10.1%	18.8%
2003	6.6%	5.6%	0.4%
2004	6.5%	10.0%	8.8%
2005	7.1%	9.6%	7.9%
2006	7.4%	9.4%	9.2%
2007	7.4%	9.2%	9.8%

Source: CBN stastistical Bulletin Golden Jubilee Edition

Table 4.9 shows the growth rate of GDP in the agricultural, manufacturing and service sectors of the Nigerian economy between 1981 and 2007. The agricultural sector experienced growth in the period while the manufacturing sector experienced growth in real output in some years and decline in others. The reasons for the decline in the output of the manufacturing sector could be trace to government policies of the time. For instance, government policy of import licensing, and those of interest and exchange rates controls resulted in severe shortages of industrial inputs with adverse consequences on manufacturing output and capacity utilization. Several firms were closed down leading to massive retrenchments. Also macroeconomic indicators such exchange rate and foreign reserves posted negative trends in their movements. These led to the introduction of rationing of foreign exchange among manufacturers. The introduction of Structural Adjustment Programme (SAP) in 1986 and trade liberalization as a major policy option of SAP led to adverse consequences such as the deterioration in the exchange rate, high costs of domestic production and scarcity of manufacturing raw materials, decline in manufacturing capacity utilization, production, and employment. For instance, capacity utilization was 70.1 per cent in 1980 but declined rapidly to 29.3 per cent in 1995 before rising gradually (with fluctuating trends) to 52.8 per cent in 2005. The share of manufacturing in the aggregate GDP declined from 5.3 per cent in 1981 to 4.1 per cent in 1993, 3.4 per cent in 2005. The trends above are the consequences of the problems confronting the manufacturing sector, among which are the near collapse of critical social and economic infrastructure, high bank lending rates, lack of long-term investible funds for manufacturing activities, massive influx and dumping of all kinds of imported finished goods, and multiplicity of taxes and levies among others. In order for the manufacturing sector to perform its role as the engine of growth and development, there is the need for government to move away from being the exclusive provider of infrastructure to being a provider and facilitator of infrastructure in partnership with the private sector (particularly on power, roads and ports). Government should strengthen financial sector intermediation, promote human capital development and develop a forward and backward linkages policy that will add value to the real sector of the economy.

Based on the analysis in this section, trends in human capital formation, utilization, and economic growth in the economy were reviewed, justifications were provided for the observed trends, constraint were identified and solutions were proffer. The analysis showed that the existing process of human capital formation and human capital utilization process in Nigeria is dysfunctional and is not compatible with development, it also show why the relationship between human capital formation and human capital utilization processes foster or constrain development. Possible ways forward out were proffered.

4.2 OBJECTIVE 2: To examine the long run relationship between human capital and growth at the aggregate and disaggregated levels of the Nigerian economy.

The second objective of the study is to examine the long run relationships between human capital and growth at the aggregated and disaggregated levels of the Nigerian economy. In order to achieve this objective, the time series data on Real Gross Domestic Product, Labor, Capital, Human Capital, ratio of gross capital formation to total imports and public expenditure on education were examined to determine whether the series has unit root, the order of integration and whether the series is co integrated.

AGGREGATED ANALYSIS

4.2.1 UNIT ROOT TEST

Unit root tests were conducted using Augmented Dickey-Fuller (ADF) test. The essence of the test is to determine whether the time series data is stationary i.e. whether the time series has unit root and the order of integration. The results of the stationary test are presented in Table 4.10 below.

Table 4.10 Results of unit root test for stationarity at level and first difference

	Level		Difference	
Variable	ADF statistics	Critical value (5%)	ADF statistics	Critical value (5%)
Lgdp	-1.4423870	-3.5943	-2.035225	-1.9552
Lhci	-2.721801	-3.5943	-4.602692	-3.6118
Limgcf	-1.959698	-2.9798	-4.362628	-1.9559
Lk	-3.859494	-3.6027	-3.859494	-3.6027
LL	-3.025934	-3.5943	-4.3735597	-3.6118
Lpexedu	-2.510480	-3.6027	-3.862574	-3.6219

Source: own computation

The stationarity test results in table 4.10 revealed that all the variables are non – stationary. Lhci, Limgcf and Lpexedu Lgdp,Lk and Ll are integrated of order of one at 5 percent level.

4.2.2 COINTEGRATION TEST

Given that the variables are non-stationary, it was decided to find out whether these variables are cointegrated. In doing so, Johanson and Juselious (1988, 1992) procedure for multivariate cointegration test which regarded all the variables in the series as endogenous was used. The test assumed linear deterministic trend in the series. Two separate models were tested. The first model tested human capital as a factor input in the production function while the second model considered the model of human capital as a factor affecting the Technology parameter

4.2.3 Model of human capital as a factor input in the production function

Table 4.11 Results of cointegration test for the Model of human capital as a factor input in the Production Function (Series: Lgdp, Lhci, Lk, LL)

Ho	Eigenvalue	Trace test	5% critical value	1%critical value
r=0*	0.864437	84.62301	47.21	54.46
r=1*	0.711783	40.65996	29.68	35.65
r=2	0.448934	13.29108	15.41	20.04
r=3	0.008205	0.181252	3.76	6.65

Trace test indicates 2 cointegrating equation(s) at both 5% level.

Table 4.12 Results of cointegration test for the Model of human capital as a factor input in the Production Function (Series: Lgdp, Lhci, Lk, LL)

Ho	Eigenvalue	Max-Eigen statistics	5% critical value	1% critical value
r=0*	0.864437	43.96304	27.07	32.24
r=1*	0.711783	27.36888	20.97	25.52
r=2	0.448934	13.10983	14.07	18.63
r=3	0.008205	0.181252	3.76	6.65

Max-Eigen value indicates 2 cointegrating equation(s) at the 5% level

The results of trace and Max-Eigen value tests for the model of human capital as a factor input in the production function are summarized in Tables 4.11 and 4.12 above. There is a clear agreement between the test results based on the trace statistic and the Max-Eigen statistic. The calculated value of trace statistics of 84.62301 and 40.65996 are greater than the critical values at both the 5 and 1 percent levels. This means that the trace statistic does not reject r = 1. Therefore the null hypothesis is accepted that there is stationary linear combination of the variables, hence the existence of long-run equilibrium relationship among the variables in the cointegration model. Similarly, the Max-Eigen statistic does not equally reject r = 1 and this is reflected in table 4.12, as the Max-Eigen values of 43.96304 and 27.36888 are greater than the critical values at 5% level. This means that the structure of the variables is cointegrated. The result of the cointegration test shows that there are two cointegrating equation. The result means that there is a stationary linear combination of the variables. The result also confirmed the existence of long-run equilibrium relationship among the variables in the cointegration model.

4.2.4 Model of human capital as a factor affecting the Technology parameter

Table 4.13 Results of Trace test for the Model of human capital as a factor affecting the Technology parameter (Series: Lgdp, Lhci, Limgcf, Lk, LL, Lpexedu)

Ho	Eigenvalue	Trace test	5% critical value	1% critical value
r=0*	0.943883	163.6556	94.15	103.18
r=1*	0.716773	88.76759	68.52	76.07
r=2*	0.660640	55.96843	47.21	54.46
r=3	0.510162	27.87035	29.68	35.65
r=4	0.296818	9.314659	15.41	20.04
r=5	0.006098	0.159043	3.76	6.65

*Trace test indicates 3 cointegrating equation(s) at 5% level.

Table 4.14 Results of Max-Eigen value test for the Model of human capital as a factor affecting the Technology parameter (Series: Lgdp, Lhci, Limgcf, Lk, LL, Lpexedu)

Ho	Eigenvalue	Max-Eigen value	5% critical value	1% critical value
r=0*	0.943883	74.88800	39.37	45.10
r=1	0.716773	32.79916	33.46	38.77
r=2	0.660640	28.09808	27.07	32.24
r=3	0.510162	18.55569	20.97	25.52
r=4	0.296818	9.155616	14.07	18.63
r=5	0.006098	0.159043	3.76	6.65

*Max-Eigen value indicates 1 cointegrating equation(s) at 5% level.

The results of trace and Max-Eigen value tests for the model of human capital as a factor affecting the Technology parameter are summarized in Tables 4.13 and 4.14 respectively. The result indicated agreement between the trace statistic and the max-Eigen value at 5% level. The calculated value of trace statistics of 163.6556, 88.76759, and 55.96843 are greater than the critical values at the 5% level. It means that the trace statistic does not reject r = 2. Similarly, the Max-Eigen statistic does not equally reject r = 0 and this is reflected in table 4.14, as the Max-Eigen value of 74.88800 is greater than the critical values at the 5% level. The result of the cointegration test shows that there is one cointegrating equations at 5% level. This means that the structure of the variables is cointegrated. The result confirmed the existence of long-run equilibrium relationship between human capital and economic growth through total factor productivity.

LONG RUN CO-INTEGRATING AND ADJUSTMENTS COEFFICIENTS

Table 15 johansen cointegrating vector for human capital as factor input
Normalized cointegrating coefficients: 1 cointegrating equation

Lgdp	Lhci	Lk	Ll
1.0000	-0.151547 (0.03086)	-0.449970 (0.02745)	5.252785 (4.14179)

Table 15 shows the long run co-integrating vectors for the model in which human capital is a factor input in the production function. From the table, the signs for human capital, private investment were positive and significant and were consistent with a-priori expectations while the sign for labor was negative and significant.

Table 16 johansen cointegrating vector for human capital affecting the technology parameter

Normalized cointegrating coefficients: 1 cointegrating equation

Lgdp	Lhci	Limgcf	Lk	Ll	Lpexedu
1.0000	-0.283483 (0.05313)	0.208155 (0.03949)	-0.359872 (0.03674)	-0.029446 (0.31686)	0.228050 (0.03610)

<u>Adjustment coefficients</u>

D(Lgdp)	-	-0.044341
		(0.04889)
D(Lhci)	-	-0.2708017
		(0.27131)
D(Limgcf)	-	-0.2865589
		(0.37707)
D(Lk)	-	-0.036939
		(0.24262)
D(Ll)	-	-0.013512
		(0.00192)
D(Lpexedu)	-	-1.606407
		(0.46556)

Table 16 shows the long run co-integrating vectors for the model in which human capital affected the technology parameter. From the table, the coefficients for human capital innovations, private investment, and labor were positive, significant and consistent with a-priori expectations while public expenditure on education and the measure of foreign input were negatively signed. The nature and content of import in Nigeria is mainly consumer goods which may explain the negative sign. The negative sign for Public expenditure on education may be explained by mismanagement and corruption in the use of public resources. In the presence of co-integration, in the long run a 1% increase in human capital will enhance economic growth by approximately 0.3%. The speed in which real GDP adjust in the absence of any shock is approximately 4%.

DIAGNOSTIC TESTS

In order to achieve this objective, Johansen (1988) and johansen and juselious (1990,1992) methods was adopted. Residuals from the unrestricted models were examined in order to decide whether the models are acceptable or not. Stability test, LM test for the residuals' autocorrelation, and Jarque-Bera normality test were adopted to ensure that none of the variables violated the standard assumptions of the models. This is because if the VAR model was fitted and all of the standard assumptions were violated then any inference made using the model may be erroneous.

4.3.1 Diagnostic tests for model in which human capital is a factor input

Table 4.17 VEC Stability condition check for model in which human capital is a factor input

Roots of Characteristic Polynomial
Endogenous variables: LGDP LHCI LK LL
Exogenous variables:
Lag specification: 1 1
Date: 10/07/11 Time: 18:00

Root	Modulus
1.000000	1.000000
1.000000	1.000000
0.707492	0.707492
0.241511 - 0.615546i	0.661229
0.241511 + 0.615546i	0.661229
0.490734 - 0.332353i	0.592688
0.490734 + 0.332353i	0.592688
0.030115	0.030115

VEC specification imposes 2 unit root(s).

Figure 2 Stability condition check for model in which human capital is a factor

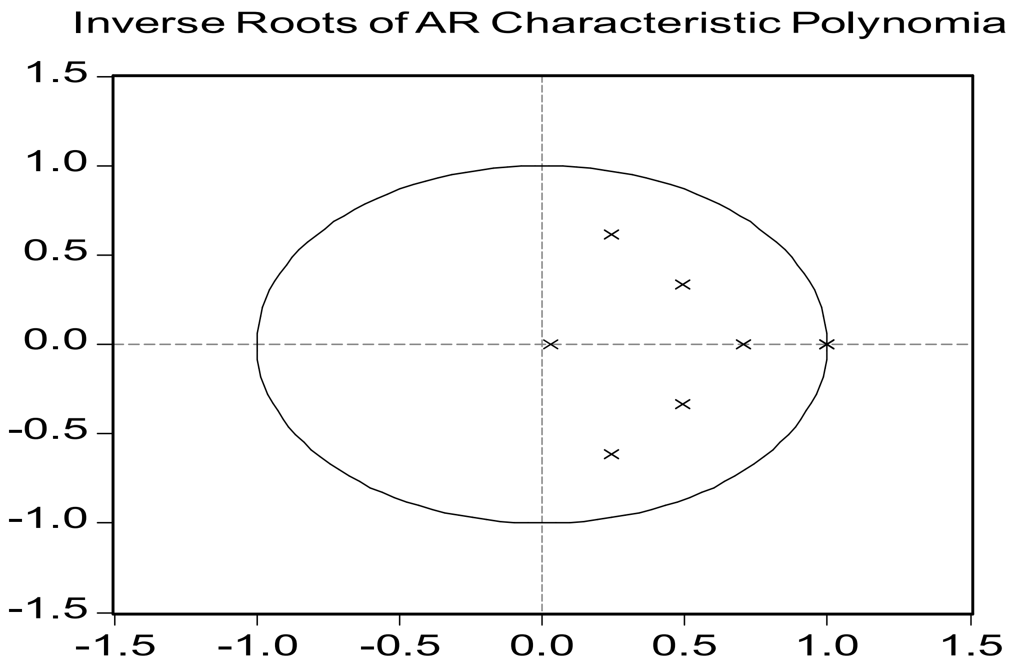


Table 4.17 shows the AR polynomial and Figure 2 shows the Inverse roots of AR polynomial. To determine the stability of the model, we examined the location of eigen values within the unit circle as displayed in figure 2 Since all the eigen values of the model lay within the unit circle. The VAR model has satisfied the stability condition. Next the model for no serial correlation using lagrange multiplier (LM) test for autocorrelation was examined.

Table 4.18 LM Test for model in which human capital is a factor input

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 10/07/11 Time: 18:06
Sample: 1981 2007
Included observations: 24

Lags	LM-Stat	Prob
1	20.81811	0.1856
2	17.50425	0.3537
3	28.28157	0.0293
4	18.70966	0.2840
5	20.24944	0.2092
6	15.69637	0.4743
7	10.98802	0.8102
8	10.36847	0.8467
9	8.141184	0.9446
10	10.15204	0.8586

Probs from chi-square with 16 df.

Table 4.18 shows the results of lagrange multiplier (LM) autocorrelation tests with the null hypotheses of no autocorrelation. From the probability values of the LM test, it did not reject the null hypothesis of no autocorrelation for lags between 1 and 10. Our result shows that there was not a serial correlation in our model. To test for normality, we checked the Skewness and the Kurtosis of the residuals of the model using cholesky factorization (litkepohl 1991) and Jarque-Bera normality test. The result is presented in the table 4.17 below:

Table 4.19 Normality Test for model in which human capital is a factor input

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Date: 10/07/11 Time: 18:07
Sample: 1981 2007
Included observations: 24

Component	Skewness	Chi-sq	Df	Prob.
1	0.215188	0.185224	1	0.6669
2	0.149386	0.089264	1	0.7651
3	-0.025615	0.002625	1	0.9591
4	0.156248	0.097653	1	0.7547
Joint		0.374766	4	0.9845

Component	Kurtosis	Chi-sq	Df	Prob.
1	0.909392	4.370642	1	0.0366
2	0.611022	5.707215	1	0.0169
3	0.539521	6.053959	1	0.0139
4	0.813592	4.780381	1	0.0288
Joint		20.91220	4	0.0003

Component	Jarque-Bera	Df	Prob.
1	4.555866	2	0.1025
2	5.796480	2	0.0551
3	6.056584	2	0.0484
4	4.878034	2	0.0872
Joint	21.28696	8	0.0064

Table 4.19 shows the results of the Vec residuals of normality tests. From the table, the residuals of the variables were characterized by skewness of 0.2, 0.1, 0.0 kurtosis of 0.9, 0.6, 0.5, the Jarque-Bera test of 0.006, therefore normality conditions of the estimated VAR model were not satisfied and it reject the null hypothesis of normality. Therefore the outcome of the normality test is not satisfactory because the Jaque-Bera test for residual normality assumptions is violated and the values of the kurtosis also violated the residual normality

assumptions. From the forgoing, inferences from the model have to be interpreted with caution.

4.3.2 Diagnostic tests for model in which human capital affected the technology parameter

Table 4.20 VEC Stability condition check for model in which human capital affected the technology parameter

Roots of Characteristic Polynomial
Endogenous variables: LGDP LHCI LIMGCF LK LL LPEXEDU
Exogenous variables:
Lag specification: 0 0
Date: 10/07/11 Time: 17:37

Root	Modulus
1.000000	1.000000
0.864641	0.864641
0.559463	0.559463
0.368315 - 0.225906i	0.432076
0.368315 + 0.225906i	0.432076
-0.180802	0.180802

VEC specification imposes 1 unit root(s).

Figure 3 Stability condition check for model in which human capital the technology parameter.

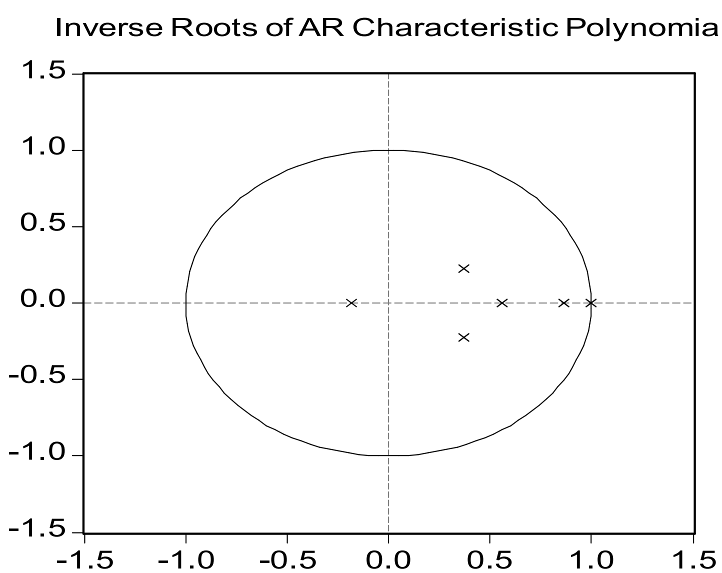


Table 4.20 shows the AR polynomial and Figure 2 shows the Inverse roots of AR polynomial. To determine the stability of the model, we examined the location of eigen values within the unit circle as displayed in figure 2. Since all the eigen values of the model lay within the unit circle. The VAR model has satisfied the stability condition. Next we examine the model for no serial correlation using lagrange multiplier (LM) test for autocorrelation.

Table 4.21 LM Test for model in which human capital affects the technology parameter

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 10/07/11 Time: 17:17
Sample: 1981 2007
Included observations: 26

Lags	LM-Stat	Prob
1	41.34517	0.2486
2	56.93366	0.0146
3	33.56402	0.5850
4	66.23513	0.0016
5	35.97056	0.4700
6	34.59691	0.5353
7	51.08773	0.0491
8	37.13122	0.4167
9	57.52869	0.0128
10	18.15303	0.9942

Probs from chi-square with 36 df.

Table 4.21 shows the results of lagrange multiplier (LM) autocorrelation test with the null hypotheses of no autocorrelation. From the probability values of the LM test, it did not reject the null hypothesis of no autocorrelation for lags between 1 and 10. Our result shows that there was no serial correlation in our model. To test for normality, we checked the Skewness and the Kurtosis of the residuals of the model using cholesky factorization (litkepohl 1991) and Jarque-

Bera normality test. The normality test relies usually on the Skewness and the Kurtosis of the residuals. The result is presented in the table below:

Table 4.22 Normality Test for model in which human capital affected the technology parameter

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Date: 10/07/11 Time: 17:21
Sample: 1981 2007
Included observations: 26

Component	Skewness	Chi-sq	Df	Prob.
1	0.786203	2.678502	1	0.1017
2	-0.568017	1.398120	1	0.2370
3	0.369643	0.592088	1	0.4416
4	-0.110077	0.052506	1	0.8188
5	-0.069691	0.021046	1	0.8847
6	0.198531	0.170797	1	0.6794
Joint		4.913060	6	0.5550

Component	Kurtosis	Chi-sq	Df	Prob.
1	2.381602	0.414284	1	0.5198
2	2.675601	0.114004	1	0.7356
3	2.614616	0.160898	1	0.6883
4	1.307519	3.103201	1	0.0781
5	1.372751	2.868602	1	0.0903
6	1.423399	2.692810	1	0.1008
Joint		9.353799	6	0.1546

Component	Jarque-Bera	Df	Prob.
1	3.092786	2	0.2130
2	1.512125	2	0.4695
3	0.752986	2	0.6863
4	3.155707	2	0.2064
5	2.889648	2	0.2358
6	2.863607	2	0.2389
Joint	14.26686	12	0.2840

Table 4.22 shows the results of the VEC residuals of normality tests. From the table, the residuals of the variables were characterized by skewness of 0.7, -0.5, 0.3 and kurtosis of 2.3, 2.6, 2.6, the Jarque-Bera test of 0.284, therefore

normality conditions of the estimated VAR model were satisfied and it did not reject the null hypothesis of normality. Therefore the inference is valid. From the foregoing, the outcome of the diagnostic test for the model in which human capital affected the technology parameter is satisfactory. The results of the test suggest that the model is well specified and robust for policy analysis when compared with the model in which human capital is a factor input.

The outcome of the diagnostic test for the two models indicated that the two models were robust concerning data issues. The parameter stability conditions were satisfied. The LM test confirmed the absence of serial correlation in the data. In the model in which human capital affected the technology parameter the normality conditions of the estimated VAR model were satisfactory suggesting that the model is well specified and robust for policy analysis.

DISAGGREGATED ANALYSIS

4.5.1 Unit Root Test for Agricultural Sector

Table 4.23 Results of unit root test for stationarity and order of integration for the Agricultural sector

Variable	ADF statistics	Critical value(5%)	ADF statistics	Critical value(5%)
Lgdp	-2.607855	-3.6027	-3.626893	-2.9850
Lhci	-2.721801	-3.5943	-3.547875	-1.9552
Limgcf	-2.653958	-3.5943	-7.601425	-3.6027
Lk	-2.402110	-3.6027	-4.843990	-2.9907
LL	-3.147620	-3.0521	-6.042950	-1.9559
Lpexedu	-2.454776	-3.6118	-3.862574	-3.6219

Source: own computation

The stationarity test results revealed that all the variables (Lgdp,Lhci,Limgcf,Lk,Ll and Lpexedu) are non -stationary and Lgdp, Lhci, Limgcf, Lk and Lpexedu Ll are integrated of order of one at the 5 percent level.

4.5.2 Cointegration Test for Agricultural Sector

Table 4.24 Results of Trace test for the Agricultural Sector

Ho	Eigenvalue	Trace test	5% critical value	1%critical value
r=0	0.926260	164.3764	94.15	103.18
r=1	0.811943	101.8033	68.52	76.07
r=2	0.679442	61.69906	47.21	54.46
r=3	0.549822	34.39445	29.68	35.65
r=4	0.411400	15.23974	15.41	20.04
r=5	0.099659	2.519554	3.76	6.65

Trace test indicates 4 cointegrating equation(s) at 5% level.

Table 4.25 Results of the Max-Eigen value test for the Agricultural Sector

Ho	Eigenvalue	Max-Eigen value	5% critical value	1% critical value
r=0	0.926260	62.57311	39.37	45.10
r=1	0.811943	40.10422	33.46	38.77
r=2	0.679442	27.30461	27.07	32.24
r=3	0.549822	19.15470	20.97	25.52
r=4	0.411400	12.72019	14.07	18.63
r=5	0.099659	2.519554	3.76	6.65

Max-Eigen value test indicates 3 cointegrating equation(s) at 5 level.

The results of trace and Max-Eigen value tests for the agricultural sector are summarized in tables 4.24 and 4.25 respectively. The trace test indicated the presence of 3 cointegrating equations at 5% level. This is seen in table 4.24 where the calculated value of trace statistics of 164.3764, 101.8033, 61.69445, and

34.39445 are greater than the critical values at the 5% level. It means that the trace statistic does not reject r = 3 therefore the null hypothesis is accepted. Similarly, the Max-Eigen statistic does not equally reject r =2 and this is reflected in table 4.25, as the Max-Eigen values of 62.57311, 40.10422, and 27.30461, are greater than the critical values at the 5% level. This means that the structure of the variables for the agricultural sector is cointegrated.

4.5.3 Unit Root Test for the Manufacturing Sector

Table 4.26 Results of unit root test for stationarity and order of integration for the manufacturing sector

Variable	ADF statistics	Critical value(5%)	ADF statistics	Critical value(5%)
Lgdp	-2.708565	-3.5943	-4.738015	-2.9970
Lhci	-2.530187	-3.6027	-4.623224	-3.6027
Limgcf	-1.959698	-2.9798	-7.440747	-2.9850
Lk	-1.453406	-3.6118	-2.251010	-1.9552
LL	-3.025936	-3.5943	-3.143151	-3.0521
Lpexedu	-2.124515	-3.5943	-3.862574	-3.6219

Source: own computation

The stationarity test results revealed that all the variables (Lgdp,Lhci,Limgcf,Lk,Ll and Lpexedu) are non -stationary and Lhci, Limgcf, and Lpexedu Lgdp,Lk and Ll are integrated of order of one at the 5 percent level.

4.5.4 Cointegration Test for Manufacturing Sector

Table 4.27 Results of Trace test for the Manufacturing Sector

Ho	Eigenvalue	Trace test	5% critical value	1% critical value
r=0	0.950789	138.4295	68.52	76.07
r=1	0.775079	69.16182	47.21	54.46
r=2	0.586453	34.84569	29.68	35.65
r=3	0.441125	14.53705	15.41	20.04
r=4	0.048977	1.154981	3.76	6.65

Trace test indicates 3 cointegrating equation(s) at 5% level.

Table 4.28 Results of the Max-Eigen value test for the Manufacturing Sector

Ho	Eigenvalue	Max-Eigen value	5% critical value	1% critical value
r=0	0.950789	69.26771	33.46	38.77
r=1	0.775079	34.31613	27.07	32.24
r=2	0.586453	20.30864	20.97	25.52
r=3	0.441125	13.38207	14.07	18.63
r=4	0.048977	1.154981	3.76	6.65

Max-Eigen value test indicates 2 cointegrating equation(s) at 5% level.

The results of trace and Max-Eigen value tests for the agricultural sector are summarized in tables 4.27 and 4.28 respectively. The trace test indicated the presence of 3 cointegrating equations at 5% level. This is seen in table 4.27 where the calculated value of trace statistics of 138.4295, 69.16182, and 34.84569 are greater than the critical values at the 5% level. It means that the trace statistic does not reject r = 2 therefore the null hypothesis is accepted. Similarly, the Max-Eigen statistic does not equally reject r =1 and this is reflected in table 4.28, as the Max-Eigen values of 69.26771, and 34.31613 are greater than the critical values at the 5% level. This means that the structure of the variables for the manufacturing sector is cointegrated.

4.5.5 Unit Root Test for the Service Sector

Table 4.29 Results of unit root test for stationarity and order of integration for the Service sector

Variable	ADF statistics	Critical value(5 %)	ADF statistics	Critical value(5 %)
Lgdp	-3.029924	-3.5943	-3.719407	-3.0659
Lhci	-2.530187	-3.6027	-4.754781	-2.9850
Limgcf	-2.653958	-3.5943	-7.601425	-3.6027
Lk	-2.173931	-3.6027	-3.143153	-3.0521
LL	-4.373594	-3.6118	-3.143153	-3.0521
Lpexedu	-2.577748	-3.6219	-3.044742	-2.9907

Source: own computation

The stationarity test results revealed that the following variables (Lgdp,Lhci,Limgcf,Ll and Lpexedu) are non -stationary and Lhci, Limgcf, Lgdp, Ll and Lpexedu are integrated of order of one at the 5 percent level.

4.5.6 Cointegration Test for Service Sector

Table 4.30 Results of Trace test for the Service Sector

Ho	Eigenvalue	Trace test	5% critical value	1% critical value
r=0	0.964663	210.2423	94.15	103.18
r=1	0.881142	130.0146	68.52	76.07
r=2	0.699029	78.89877	47.21	54.46
r=3	0.609496	50.08098	29.68	35.65
r=4	0.500385	27.51339	15.41	20.04
r=5	0.363947	10.85937	3.76	6.65

Trace test indicates 6 cointegrating equation(s) at both 5% level.

Table 4.31 Results of the Max-Eigen value test for the Service Sector

Ho	Eigenvalue	Max-Eigen value	5% critical value	1% critical value
r=0	0.964663	80.22767	39.37	45.10
r=1	0.881142	51.11587	33.46	38.77
r=2	0.699029	28.81779	27.07	32.24
r=3	0.609496	22.56759	20.97	25.52
r=4	0.500385	16.65402	14.07	18.63
r=5	0.363947	10.85937	3.76	6.65

Max-Eigen value test indicates 6 cointegrating equation(s) at 5% level.

The results of trace and Max-Eigen value tests for the service sector are summarized in tables 4.30 and 4.31 respectively. The trace test indicated the presence of 6 cointegrating equations at both 5% level. This is seen in table 4.30 where the calculated value of trace statistics of210.2423, 130.0146, 78.89877, 50.08098, 27.51339 and 10.85937 are greater than the critical values at both 5% level. It means that the trace statistic does not reject r = 5 therefore the null hypothesis is accepted. Similarly, the Max-Eigen statistic does not equally reject r =5 and this is reflected in table 4.31, as the Max-Eigen values of 80.22767, 51.11587, 28.81779, 22.56759, 16.65402 and 10.85937 are greater than the critical values at the 5% level. This means that the structure of the variables for the service sector is not cointegrated. It means that human capital does not effect technology in the service sector.

4.4 OBJECTIVE 3: To examine the extent to which shocks and variations in growth at the aggregate and disaggregated levels are explained by human capital innovations.

AGGREGATED ANALYSIS

4.4.1 To achieve this objective the Variance Decomposition for relation between human capital and economic growth was calculated.

Table 4.32 variance decomposition of Lgdp

Period	S.E.	Lgdp	Lhci	Limgcf	Lk	Ll	Lpexedu
Short Run							
1	0.045501	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.075290	88.55564	6.296510	4.728018	0.084058	0.278793	0.056985
3	0.097512	77.74788	14.55323	6.834468	0.658294	0.169223	0.036911
Medium Run							
4	0.119067	68.23856	23.91861	5.990825	1.506401	0.320495	0.025109
5	0.134007	63.10598	29.16075	4.752492	1.489844	1.370645	0.120288
6	0.143477	59.95666	30.85902	4.273728	1.304688	3.282420	0.323475
Long Run							
7	0.149057	58.42044	31.96904	3.960462	1.218023	4.051285	0.380743
8	0.153893	56.95457	33.16026	4.555650	1.145315	3.826980	0.357218
9	0.160700	54.22826	33.69228	6.811019	1.051012	3.828767	0.388661
10	0.168227	51.37312	33.74546	9.291690	0.975197	4.177186	0.436349

Variance decomposition provides information about the relative importance of each random innovation affecting the variables in a model. This is important so as to separate the variation in an endogenous variable into the component shocks to the VAR. The forecast error for the study is defined as the difference between the actual values of GDP, human capital, foreign input, gross fixed capital formation, labor force, and Public expenditure on education and their forecast values. This forecast error is due to shocks of the variable in each period. The variance decomposition gives the percentage of the forecast variance due to each innovation, with each row adding up to 100. While the second column labeled S.E contains the forecast error of the variable for each forecast period. The forecast error variance decomposition results for variations in GDP are presented in table 4.32. From the table, innovation in GDP is the predominant source of variation. GDP ranged between 51.4 percent and 100 percent over ten year period. The short run and medium impact of human capital innovations on GDP was sharp. It increases from 0% to 14.5% over the 1-3 year short run horizon and 14.5% to 30% over the 3-6 year medium run horizon. The long run impact was however slower. It increases from 30% to 33.7% over the 6-10 year long run horizon. In sum, the short, medium and long run horizon, human capital innovation is a major source of variation in GDP as it account for a total of 33.7 percent of the variation in GDP

4.4.2 Impulse Response Functions

Impulse response functions expose the dynamic response of each endogenous variable to a shock in the other variables. This dynamic tracing shows the effect of a unit shock in one variable on current and future values of itself and another variable(s). Hence variables in the VAR system were affected through one standard deviation shock which occurred in innovations of any variable in the system. In impulse response analysis, ordering the variables in VAR system is important and analysis is subject to change under different ordering, if one works with Choleski factorization. Then one should make decision on which variable behaves more exogenously, then that variable can come first (Doan, 1992: 8.14). Based on the above, choleski factorization was used for the impulse response function on the basis of a-priori expectations. The following ordering based on economic theory was applied to the choleski factorization: Gross domestic product was assumed to be most exogenous and is a function of total factor productivity, gross fixed capital formation and the labor force. It is expected that human capital, the measure of foreign inputs and government expenditure on education have positive effect on total factor productivity which in turn has positive effect on economic growth.

FIGURE 3 IMPULSE RSPONSE FUNCTION FOR GROSS DOMESTIC PRODUCT IN NIGERIA

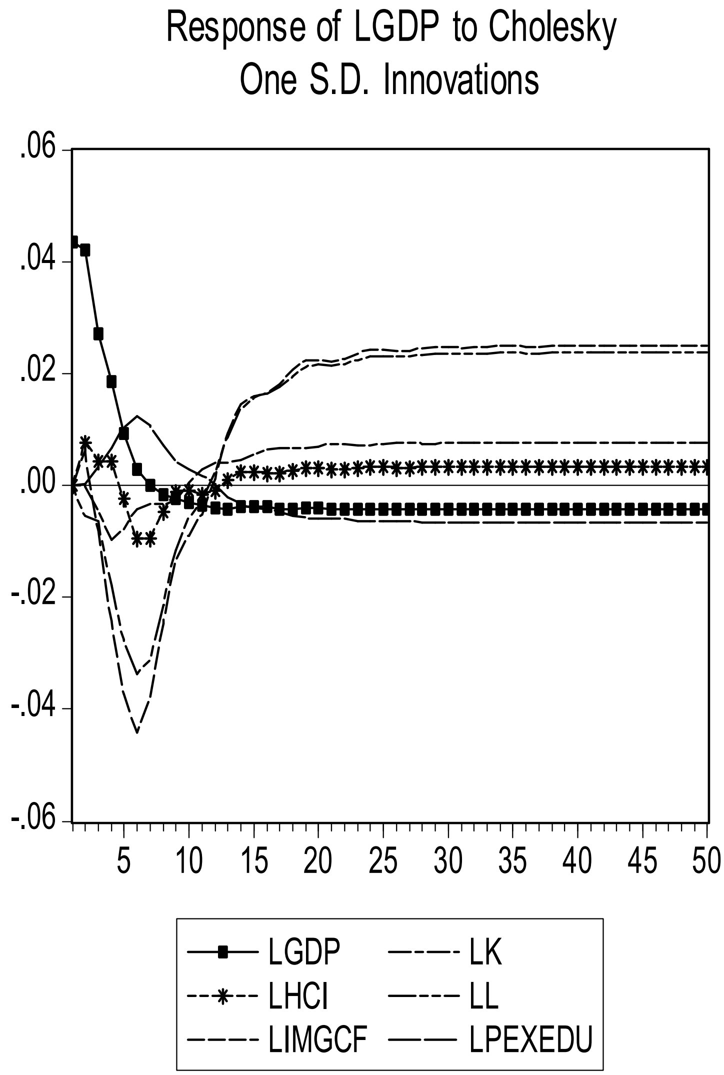
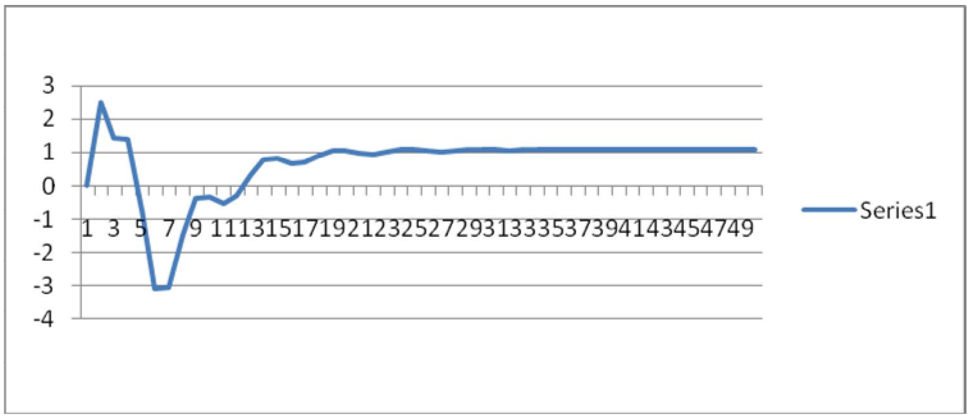


Fig 3 shows the results of the impulse response function (IRF). The first row panel represents IRF of GDP due to itself and other variables and IRF of human capital due to itself and other variables. The impulse response function with respect to GDP showed strong dynamic interaction between human capital and economic growth in Nigeria. The result showed that Gross Domestic Product is sensitive to unexpected changes in the level of human capital and Gross Fixed capital formation. The finding Support the endogenous growth theories Lucas (1988), Nelson and Phelps (1966).

FIGURE 4 DYNAMIC ELASTICITY OF OUTPUT WITH RESPECT TO HUMAN CAPITAL



The dynamic elasticity of output with respect to shocks in human capital is plotted in Figure 4. As the figure shows, on impact a 1% shock to human capital will raise output by 2.5%. Indeed over the 5-9 years horizon, the impact appears to be negative. While this may appear to be contradictory, it may be reflecting the number of years it takes for increases in those elements of our human capital index to translate into higher output. For instance, a rise in expenditure on education and health or an increase in enrolment will on the average take up to 12 years to yield positive output. Below 12 years however, output may even fall because resources are taken away for other project. In the long run, the permanent impact of a 1% increase to shock to human capital is a 1% increase in output. The findings revealed that there is a constant return to scale to human capital in Nigeria which is consistent with Uzawa (1965). It also means that the interaction between human capital and technology could not lead to increasing returns to scale in the Nigerian economy as might be expected. Hence the optimal economic effect of human capital is yet to be fully realized. This may be because increased levels of human capital are frequently directed towards socially-wasteful or directly-unproductive activities or may come up against greater incidence of unemployment, a point noted by Pritchett (1996). Also there is a large body of literature describing university graduates in developing countries devoting their talents to rent-seeking activities or frequently becoming unemployed (or underemployed in work that is not commensurate with their level of education) upon graduation and are forced to enter the unofficial economy (Pritchett,1996,Knowles,2001, Krueger and Lindahl, 2000). Furthermore, from the plot of the dynamic elasticity of output with respect to human capital, it took 19 years for the full impact of human capital to materialize. This is because it takes so many years to acquire knowledge and skills in school, and many more years before jobs are secured and for workers to acquire experience that will impact on productivity growth in the economy.

DISAGGREGATED ANALYSIS

4.7.1 Variance Decomposition for the agricultural sector

Variance decomposition provides information about the relative importance of each random innovation affecting the variables in a model. This section examines the extent to which variations in growth in the agricultural sector is explained by "own shocks" and by shocks from other variables. The forecast error variance decomposition results are presented in table 4.33. Own shocks in respect of growth in the agricultural sector ranged between 89.2 percent and 100 percent over the ten year period. From this result, own shocks constitute the greatest source of variation in growth for the agricultural sector; while variations in human capital and public expenditure on education are not much felt as they affected the agricultural sector by a small margin of just 4.33 percent and 4.0 percent respectively.

Table 4.33 variance decomposition of Agric Lgdp

Period	S.E.	Lgdp(A)	Lhci	Limgcf	Lk	Ll	Lpexedu
Short Run							
1	0.172482	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.318479	91.88612	0.031156	1.930706	0.064536	0.084580	6.002903
3	0.408548	90.79178	1.648620	1.256561	0.048226	0.084548	6.170263
Medium Run							
4	0.485374	89.36515	3.784138	0.890734	0.059674	0.146266	5.754035
5	0.544147	89.12704	4.341846	0.958337	0.081946	0.448692	5.042139
6	0.598131	89.37767	3.932074	1.137985	0.069568	0.652114	4.830592
Long Run							
7	0.642152	89.61774	3.853143	1.110428	0.079882	0.763973	4.574839
8	0.688196	89.59691	3.983724	1.029776	0.159098	0.829730	4.400763
9	0.733360	89.39592	4.216073	1.002911	0.223591	0.983296	4.178205
10	0.776620	89.24427	4.331185	0.997231	0.255092	1.153236	4.018987

4.7.2 Impulse Response Functions for the agricultural sector

FIGURE 5 IMPULSE RESPONSE FOR AGRICULTURAL GDP

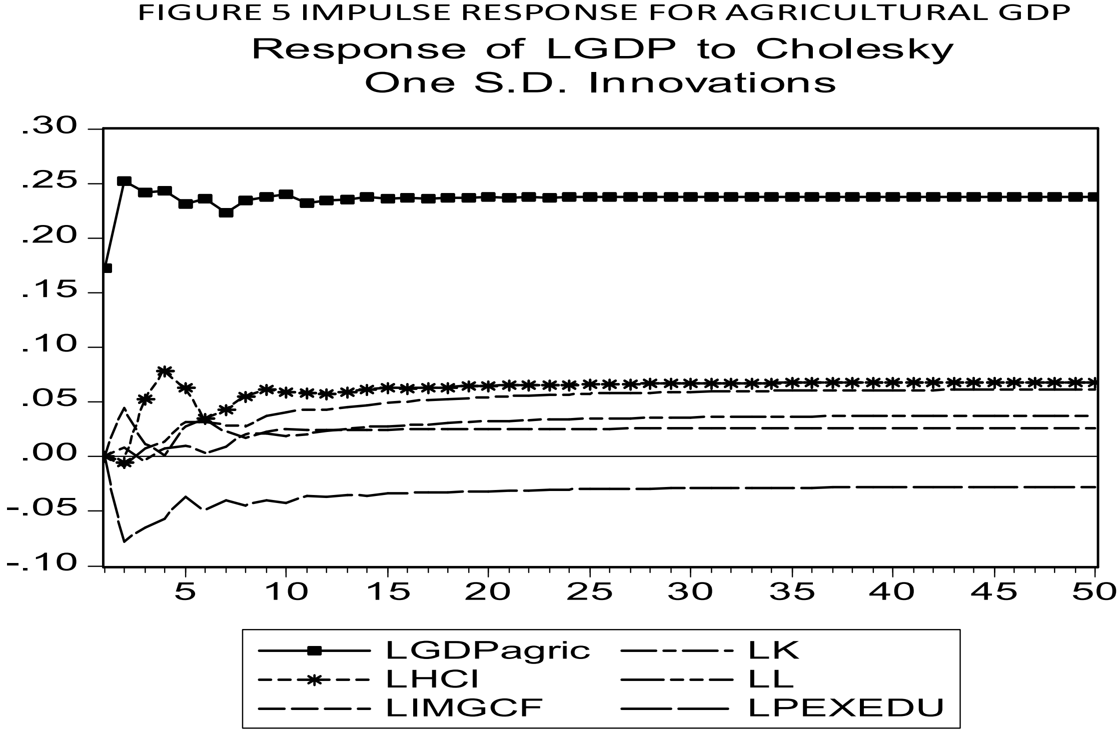
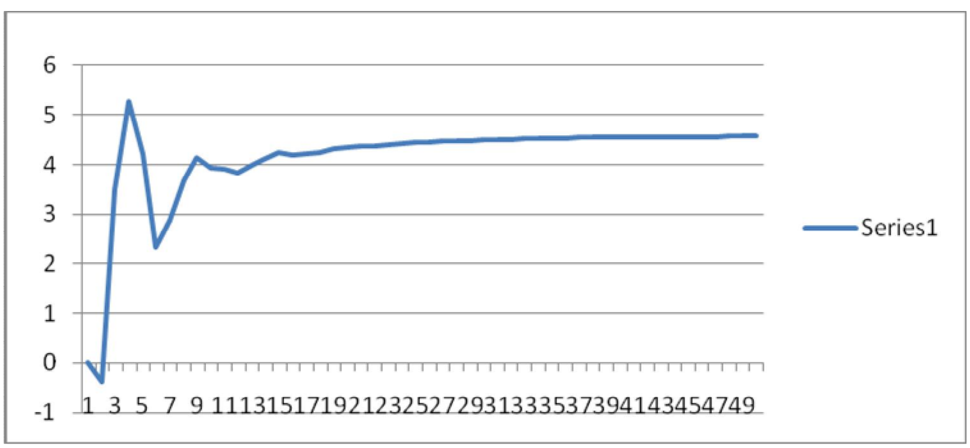


Figure 5 shows the results of the impulse response function (IRF) for the agricultural sector. The first row panel represents IRF for growth in the agricultural sector due to itself and other variables. Own shock raises growth in the agricultural sector in the first two periods by a wide margin after which it approaches neutralization. The impulse response function for growth in the agricultural sector seems to suggest that human capital, gross fixed capital formation, foreign input , and labor impacted positively on growth in the short and medium run while in the long run they seems to neutralized out. While public expenditure on education impacted negatively before it approaches neutralization.

FIGURE 6 DYNAMIC ELASTICITY OF AGRICULTURAL OUTPUT WITH RESPECT TO HUMAN CAPITAL



The dynamic elasticity of agricultural output with respect to shocks in human capital is plotted in Figure 6. As the figure shows, on impact, a 1% shock to human capital raises agricultural output by 5.5%. Indeed over the 3-7 years horizon, the impact appears to be negative. However, In the long run, the permanent impact of a 1% increase shock to human capital is a 4.5% increase in agricultural output. This implies there is increasing returns to scale to human capital which is consistent with Lucas (1988). It means that the optimal effect of the impact of human capital is fully realized in the agricultural sector. This is because of the establishment of specialized agricultural research institutes in the country in the early 60s which had enhanced agricultural research output, extension services and adoption of agricultural technology. Furthermore, from the plot of dynamic elasticity of agricultural output, it takes 15 years for the full impact of human capital to materialize in the sector. This is because it takes many years of schooling, research and dissemination of research findings before the full impact of human capital is attained. Research and development is a time consuming process. It takes time before new insights can be applied to processes and services. For applied research it can take a long time to further develop a prototype product, and to bring the product to the market. It takes time for farmers to accept new innovations.

4.7.3 Variance Decomposition for the manufacturing sector

Table 4.34 shows the extent to which "own shocks" and shocks by other variables impact on growth in the manufacturing sector. The forecast error variance decomposition results for the manufacturing sector are presented in table 4.34. Own shocks variable for the growth in the manufacturing sector ranged between 50.9 percent and 100 percent over the ten year period. Own shocks constitute the greatest source of variation in growth in the manufacturing sector, followed by variation in gross fixed capital formation, and public expenditure on education with 24.6 percent and 14.6 percent variation respectively. From the Table, gross fixed capital formation, and public expenditure on education have significant impact on the manufacturing sector.

Table 4.34 variance decomposition of Manufacturing Lgdp

Period	S.E.	Lgdp(A)	Lhci	Limgcf	Lk	Ll	Lpexedu
Short Run							
1	0.328792	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.425845	83.06306	0.409258	0.445939	8.271576	0.008674	7.801488
3	0.469423	71.00739	1.397838	2.343545	15.84538	0.688604	8.717240
Medium Run							
4	0.508655	66.18092	1.223557	1.999123	17.58282	1.188139	11.82544
5	0.558443	63.47450	1.344819	2.231690	18.19303	1.166774	13.58919
6	0.599107	60.04350	1.734779	2.013644	20.34819	1.293014	14.56687
Long Run							
7	0.638712	55.80696	1.544565	2.621187	22.86050	2.380627	14.78616
8	0.674788	53.74514	1.384875	2.654140	23.53902	3.384962	15.29186
9	0.702630	52.68781	1.336823	2.788460	24.04177	3.974519	15.17061
10	0.729475	50.93296	1.422965	3.722336	24.62225	4.651894	14.64760

4.7.4 Impulse Response Functions for the manufacturing sector

FIGURE 7 IMPULSE RESPONSE FOR MANUFACTURING SECTOR GDP

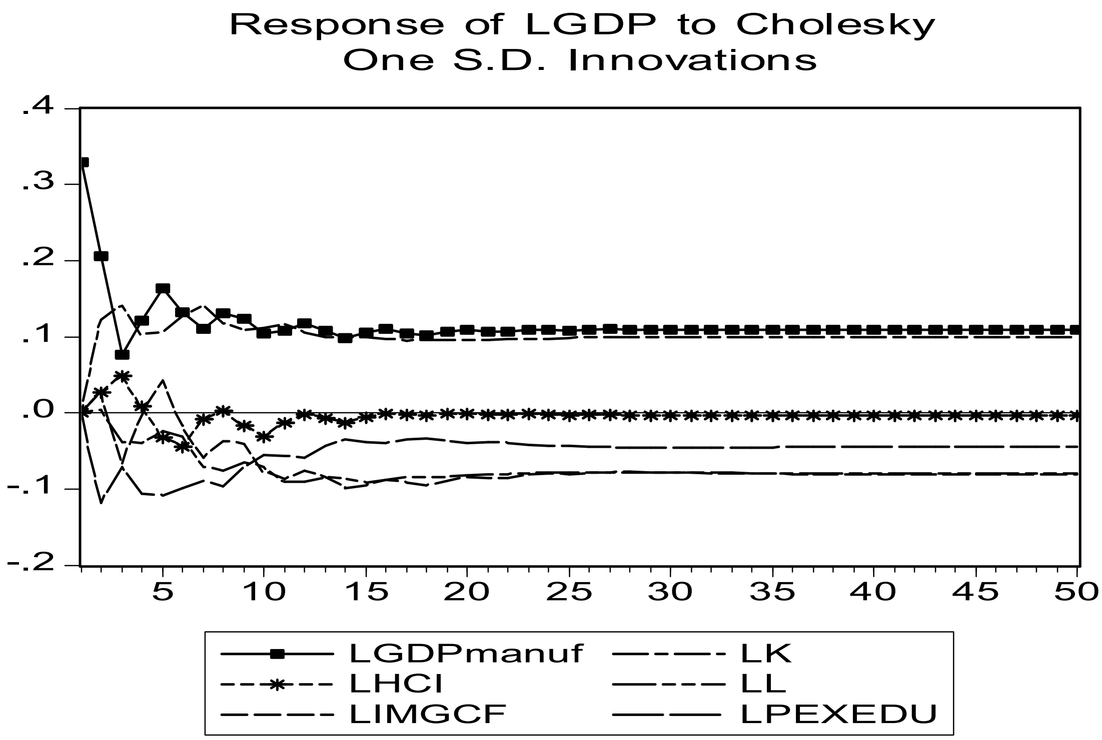
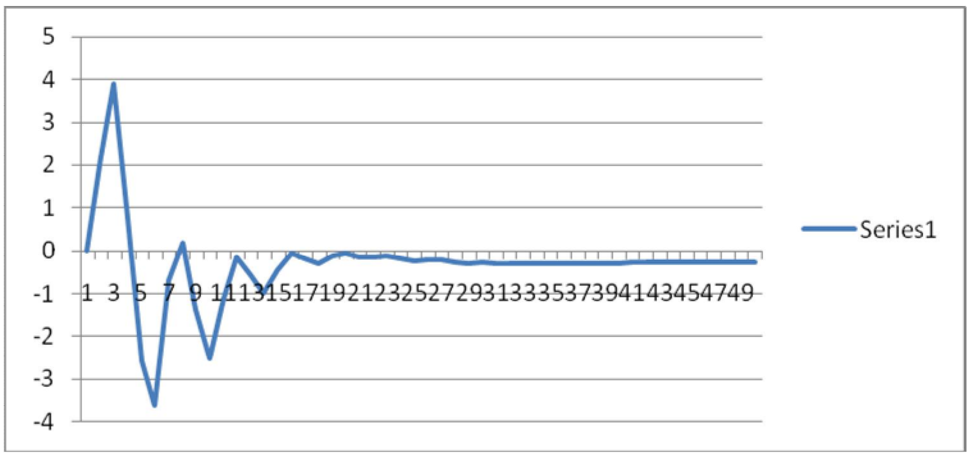


Figure 7 shows the results of the impulse response function (IRF) for the manufacturing sector. The first row panel represents IRF of growth in the manufacturing due to itself and other variables. Own shock lowered the growth in the manufacturing sector in the first three periods after which it approaches neutralization. The impulse response function for growth in the manufacturing sector seems to suggest that private investment and public expenditure on education impacted positively on growth in manufacturing sector in the short and medium run while in the long run they seems to neutralized out . Main while human capital, labor and the ratio of total imports to private investment impacted negatively on growth in the manufacturing sector before it approaches neutralization.

FIGURE 8 DYNAMIC ELASTICITY OF MANUFACTURING OUTPUT WITH RESPECT TO HUMAN CAPITAL



The dynamic elasticity of manufacturing output with respect to shocks to human capital is plotted in Figure 8. As the figure shows, on impact a 1% shock to human capital will raise output by 3.9%. Indeed over the 3-15 year horizon, there was negative and positive oscillations in output before it reach permanent impact at a constant negative value. The permanent impact of a 1% shock to human capital is a 0.28% decrease in output in the manufacturing output. This is because manufacturing in Nigeria use more of physical capital and unskilled and semi-skilled labor and little or no use for human capital. Also to the extent that there is a trade-off between labor (unskilled and semi-skilled) and supply/use of human capital, we should expect increase in human capital to lead to decrease in manufacturing output. Furthermore, from the dynamic elasticity of manufacturing output, it takes 15 years for the full impact of human capital to materialize in the sector. This is due to the lag in human capital arising from years of schooling, job search and on the job training. Building human capital for manufacturing industries takes time. Account should be taken of the time lag between investment in human capital and the time when human capital can be used for productive purposes. The time lag depends on the schooling level. For instance, while an increase in tertiary education enrolment will lead to a higher inflow of skilled workers on the labor market after, say, four to six years, early childhood interventions will only materialize after ten to fifteen years. Second, due to cohort effects, an extension of the schooling period only gradually changes the average educational attainment of the labor force.

4.7.5 Variance Decomposition for the service sector

Table 4.35 shows the extent to which "own shocks" and shocks by other variables impact on the growth in the service sector. The forecast error variance decomposition results for the service sector are presented in table 4.35 Own shocks constitute the greatest source of variation in growth in the service sector; followed by variation in foreign inputs, public expenditure on education and human capital with 78%, 14%, 5% and 2% variation respectively. From the foregoing, foreign inputs, public expenditure on education, and human capital have significant impact on the service sector.

Table 4.35 variance decomposition of Service Lgdp

Perio	S.E.	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
Short Run							
1	0.091427	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.173703	93.69615	0.012124	2.434725	0.700102	0.210918	2.945976
3	0.261279	90.88229	0.012910	4.617742	0.826188	0.102281	3.558591
	Medium R						
4	0.340015	86.72220	0.608743	8.256941	0.867296	0.152413	3.392408
5	0.423862	83.07364	1.428704	10.36036	0.869657	0.126541	4.141096
6	0.498428	81.09026	1.615951	11.75647	1.060626	0.112615	4.364076
	Long Run						
7	0.567287	80.43155	1.684152	12.39768	0.973647	0.108861	4.404107
8	0.632796	79.35962	1.771913	13.28730	0.992132	0.130424	4.458605
9	0.694033	78.73921	1.846044	13.80112	0.976464	0.148885	4.488279
10	0.753132	78.04746	1.935429	14.35600	0.972905	0.159693	4.528517

4.7.6 Impulse Response Functions for the service sector

FIGURE 9 IMPULSE RESPONSE FOR SERVICE SECTOR GDP

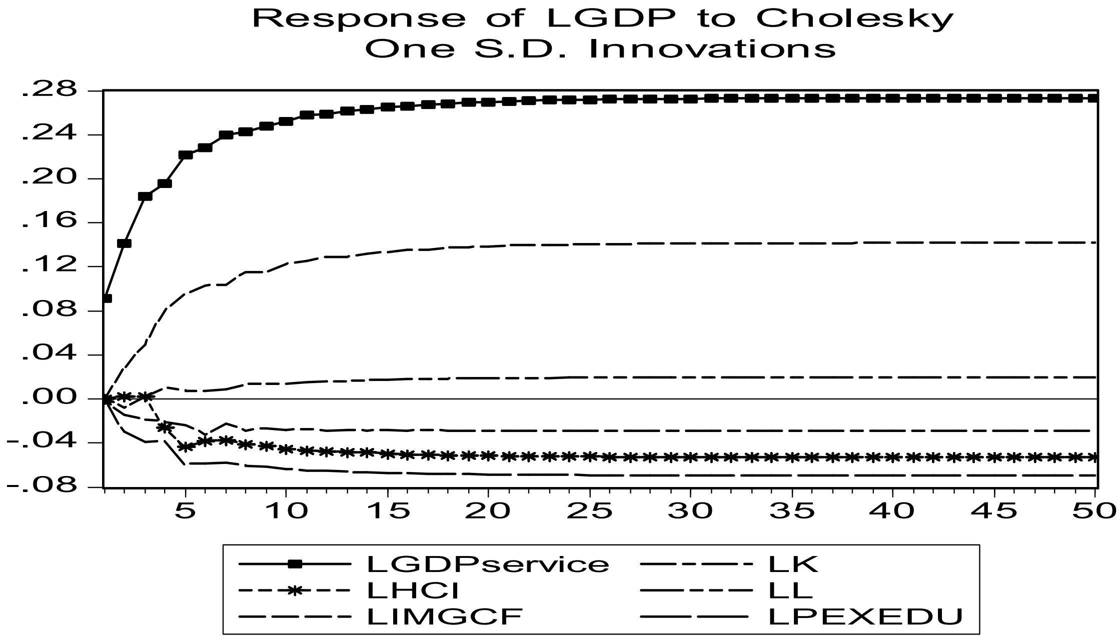
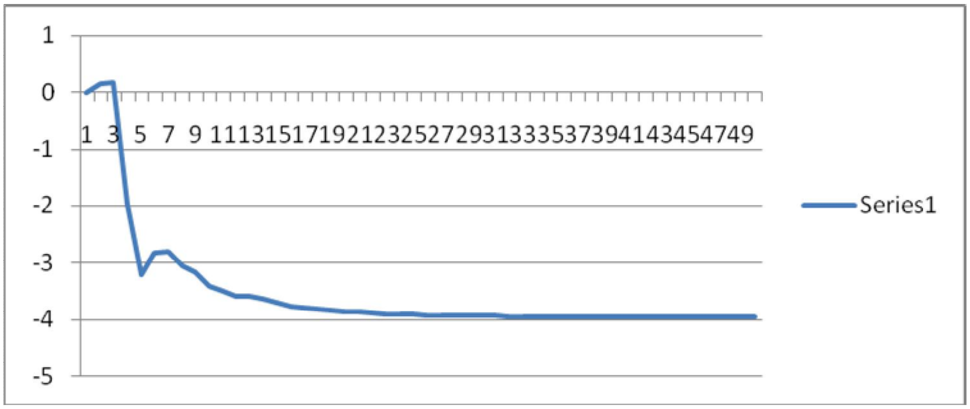


Figure 9 shows the results of the impulse response function (IRF) for the service sector. The impulse response function for growth in the service sector seems to suggest that human capital, foreign input and labor impacted positively on growth in the short and medium run while in the long run they seems to neutralized out. On the other hand, gross fixed capital formation, and public expenditure on education impacted negatively in the short and medium term until it approaches neutralization in long run.

FIGURE 10 DYNAMIC ELASTICITY OF SERVICE OUTPUT WITH RESPECT TO HUMAN CAPITAL



The dynamic elasticity of output in the service sector with respect to shock to human capital is plotted in Figure 10. As the figure shows, on impact, a 1% shock to human capital raises output by 0.2%. Indeed over the 3-6 years horizon, the impact appears to be negative before a small rise gave way to gradual decline over the 8-15 years horizon. In the long run, the permanent impact of a 1% shock to human capital is a 4% decrease in output. The decrease in output in the sector is due to “fat-cat effect” in which increases in income lead to decline in output. Furthermore, from the dynamic elasticity of service sector output, it takes 15 years for the full impact of human capital to materialize in the sector. This is due to the lag in human capital arising from years of schooling, job search and on the job training mentioned earlier.

4.8 SUMMARY OF MAJOR FINDINGS

1. The findings in this study confirmed the existence of long run equilibrium relationhips between human capital and economic growth in Nigeria. The findings support the human capital as a source of economic growth hypothesis. The result of the study shows that human capital does not only have a positive impact on economic growth but such impact is strong and statistically significant. The finding is broadly in line with those of Adamu (2003), Chete and Adeoye (2003), and Babatunde (2005) on Nigeria. The long run co-integrating coefficients show that in the long run, a 1% increase in human capital will enhance economic growth by 0.3%. The magnitude is smaller than 0.86% found by Babatunde (2005) for Nigeria. The coefficient of the error correction term is negative and statistically significant. It shows that in the event of a one unit deviation from the long run GDP growth, there is a correction of approximately 4%. The adjustment coefficient is of similar magnitudes to those of Babatunde (2005) who found 3% and 4% adjustment coefficients for the two models used in his study.

2. The diagonistic test showed that model in which human capital affects the evolution of total factor productivity was found to be satisfactory suggesting that the model was well specified and robust for policy analysis.

3. The findings from the variance decomposition analysis showed that GDP is the predominant source of variation in it own innovation as it accounts for between 51.3% and 100% of the variation. Human capital is a major source of variation in GDP as it accounts for a total of 33.7% of the variations in GDP. Babatunde (2005) also found that human capital and GDP are the most exogenous variables. He found that human capital and GDP innovations were 44.5% and 88.2%.

4. The impulse response function with respect to GDP showed strong dynamic interaction between human capital and economic growth in Nigeria. The findings revealed that Gross Domestic Product is sensitive to unexpected changes in the level of human capital.

5. From the plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital is a 2.5% increase in output and the long run permanent impact is a 1% increase in output which implies the interaction between human capital and technology could not lead to increasing returns to scale in the Nigerian economy as might be expected.

6. The disaggregated results confirmed the role of human capital in the agricultural, manufacturing and service sectors of the economy. From the

plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital increases output in the agricultural, manufacturing and service sectors by 5.5%, 3.9% and 0.2% respectively. In the long run, the permanent impact of a 1% increase shock to human capital is a 4.5% increase in agricultural output and a 0.28% and 4% decrease in manufacturing and service output respectively.

8. From impulse response analysis, the impulse response functions for growth in the three sectors suggest dynamic interaction between changes in human capital and growth in the sector. This means that growth in the sectors were sensitive to changes in human capital.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

This study has shown that economic performance in Nigeria has not been encouraging. This dissertation examined the effect of human capital development and utilization on economic growth in Nigeria. Most of the previous studies were from developed countries. This study was undertaken because of the dearth of empirical studies on this issue. In other words attempt to empirically examine the relationship between human capital and economic growth in Nigeria is not well documented in the literature. The study employs a vector autoregressive (VAR) model. The adoption of a reduced form of VAR was informed by several factors. The VAR methodology avoids the imposition of potentially spurious a priori constraints that are employed in the specification of structural models. Also, since few restrictions are placed on the way in which the system variables interact, VARs are well suited to an examination of the channels through which a variable operates. To avoid a spurious regression result, attempt was made to render the data stationary prior to specification and estimation of the VAR. Also, in order to bring out long-run policy implications of this short-run phenomenon (arising from data differencing); a vector error correction technique was employed, instead of the standard VAR (which was purely a short-run approach). This allows the long-run behavior of the endogenous variables to converge to their cointegrating (i.e long-run equilibrium) relationships while allowing a wide range of short-run dynamics. When the variables are expressed at levels, all the variables are non-stationary. Differentiating once, however, induced stationarity in all cases. Two channels through which human capital can affect long run economic growth in Nigeria at both the aggregated and disaggregated levels for three sub-sectors of the economy were analyzed. The sub sectors were agriculture, manufacturing and service sector. The estimated VAR models were found to be satisfactory suggesting that the model was well specified and robust for policy analysis. The result of the study shows that human capital does not only have a positive impact on economic growth but such impact is strong and statistically significant. The long run co-integrating coefficients show that in the long run, a 1% increase in human capital will enhance economic growth by 0.3% and in the event of a one unit deviation from the long run GDP growth, there is a correction of approximately 4%. From the plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital is a 2.5% increase in output and the long run permanent impact is a 1% increase in output which implies the interaction between human capital and technology could not lead to increasing returns to scale in the Nigerian economy as might be expected. The disaggregated results confirmed the role of human capital in the agricultural, manufacturing and service sectors of the economy. From the plot of the dynamic elasticity of output with respect to human capital, it was found that the immediate impact of a 1% increase shock to human capital increases output in the agricultural, manufacturing and service sectors by 5.5%, 3.9% and 0.2% respectively. In the long run, the permanent impact of a 1% increase shock to human capital is a 4.5% increase in agricultural output and a 0.28% and 4% decrease in manufacturing and service output respectively. From the descriptive analysis, it was found that: as a percentage of GDP, total expenditure on education grew by 4.6% between 1981 and 2010. Also total expenditure on health grew by 0.8%. On the other hand, enrolment into primary, secondary and tertiary institutions grew by 4%, 6% and 19% respectively between 1981 and 2007. Between 1981 and 1999 the Nigerian economy experienced growth in real output in some years and decline in others. The overall picture is that of low performance. However, there were improvements in the economy between 2000 and 2010. The economy grew on the average by 8% during the period. At this rate, Nigeria's economy is growing faster than the global and regional average of 3 to 5.2 percent. In spite of the growth in the economy, NBS data indicated that unemployment rose from 3.9% in1981 to 14.6% in 2007.

5.2 CONCLUSION

The Dissertation has confirmed the existence of long run equilibrium relationships between human capital and economic growth in Nigeria. The findings support the human capital as a source of economic growth hypothesis. The study empirically validated human capital as an engine of growth through factor accumulation and the evolution of total factor productivity. The finding empirically validated the endogenous growth theories of Lucas (1988) and Nelson and Phelps (1966). The finding is broadly in line with that of other empirical studies on Nigeria such as those of Adamu (2003), Chete and Adeoye (2003) and Babatunde (2005). The findings from our disaggregated analysis suggest the existence of long run equilibrium relationships between human capital and growth in the sectors which implies that human capital affects growth in the three sectors over time.

5.3 RECOMMENDATIONS

A major policy implication of our findings is that concerted efforts should be made by policy makers to increase the level of human capital in Nigeria. Based on the findings in this study, the following specific recommendations are made:

1. There are a number of options to consider in reducing the number of years it takes human capital effect to be optimal: The number of years in the job-market can be reduced or on the job training can be enhanced. The number of years in the job market can be reduced by reducing the job search period through the evolution of job centers whose role will be to compile, sieve and match skills. This will reduce job search duration. On the other hand, on the job training can be enhanced through subsidies and tax incentives. This is necessary because enterprises may under-train staff for a variety of reasons, including fear of poaching, an uncompetitive production environment, and lack of company foresight. Yet enterprise training is highly important in raising the skills and Productivity of the workforce. How can on the job training be stimulated? The two most widely used methods are direct public subsidies, and company tax concessions. Some observations on each of these methods are provided below: General training subsidies, e.g. subsidizing wages of apprentices, may result in more on the job training. However, the burden of cost falls on public budgets. Company tax concessions have not been favored worldwide. Tax concessions require a well developed and broadly based system of

corporate taxation. The cost burden falls largely on public budgets in the form of reduced revenues. Firms often respond to the tax incentives.

The following general recommendations are also proffered:

2. The challenges of human capital development should best be addressed through a qualitative education system. Nigeria can reposition herself as a potent force through the quality of the products of her education system, and by making manpower relevant in highly competitive and globalised economy through a structured, well funded and strategic planning of her educational institutions. Human capital development alone is a necessary but not sufficient condition for economic growth and development. Government should provide the enabling environment by ensuring macroeconomic stability that will encourage increased private sector investment, focus on non-oil growth, improve domestic business climate, increase and maintain infrastructure investments, strengthen domestic institutions, and increase social spending. It is only when such an environment exist that increased human capital investment will generate the desired economic growth that will stimulate employment.
3. Education and health care delivery system should be given priority attention through increased budgetary provisions at all levels of

government. The challenge, therefore, is to find an efficient and equitable cost sharing formula based on benefit principles by which all stakeholders shall contribute equitably to the funding of education. Government should mobilize additional resources for education by cutting down on enormous waste characteristic of government expenditure in other areas. Government must be more alert to its responsibility to ensure that resources meant for human capital development projects are judiciously applied. There is an urgent need for reforms, transparency, accountability and probity in the management of public resources.

4. The education system must guarantee unhindered access for all citizens at all levels; it should' ensure quality and relevance in curriculum content; it must provide a conducive and stimulating learning environment. The system must be dynamic; continually evolving and upgrading itself to keep abreast with global trends and to competently address emerging challenges. Only through this can a nation develop sufficient human capital required for national growth, development and sustenance.

5. Education reform policies and programmes must target attaining increased stake-holding, extended partnerships and collaboration in educational development. Education policy formulation, implementation, funding and

quality assurance should as much as possible involve all key stakeholders including the private sector, the communities and the civil society.

6. Government should continue to provide the enabling environment by ensuring Macroeconomic stability that will encourage increased investment in human capital by the private sector in order to address perennial problem of unemployment, underemployment and poverty.
7. The role of government should not only be in stimulating the supply of skills, but also in anticipating and generating demand for skills. This requires extraordinary foresight and collaboration between economic planners and skills providers. In this regard, government should direct its focus on linkages with employers to enable employers be actually involved in advising and directing skills development. Employer advice is important, but the degree of their authority over decisions and direction in the training system is even more important. The most effective forms of employer participation confer some authority on employers to direct training systems.
8. In the past, medium to long-term projections were made of skills demand as a basis for decisions about training supply. There was inadequate appreciation of how economic uncertainty, technological change, and the

nature of business cycles made it hazardous to forecast future labor and skills requirements. The forecasts proved unreliable. Therefore, the following methods can be used :

(i) Participation by employers in articulating which skills are in demand;

(ii) Establishment of capacity to analyze market trends in terms of job creation and absorption.

(iii) Tracer studies on the labor market outcomes of graduates over time, so that adjustments can be made in training supply; and

(iv) Efficient dissemination of information to the public about employment trends.

It is hoped that if all these recommendations are implemented then human capital will enhance growth better.

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APPENDIX I

ENDOGENOUS VARIABLES FOR THE GROWTH MODEL

YEAR	GDP	L	K	IMGCF	PEXEDU	HCI
1981	205222.1	24093173.13	12215	1.05113	984.6	2439
1982	199685.3	24638732.84	10922	0.9861	1134.7	1874
1983	185598.1	25221730.07	8135	1.0944	967.4	2087
1984	183563	25695336.09	5417	1.3251	861.2	2485
1985	201036.3	26165397.22	5573	1.2672	850.2	2104
1986	205971.4	26681764.38	7323	0.817	1094.8	2329
1987	204806.5	27384102.98	10661.1	1.6754	713.5	2581
1988	219875.6	27980149.68	12383.7	1.7317	1084.1	4002
1989	236729.6	28655146.67	18414.1	1.6759	1941.8	6158
1990	267550	29354373.06	30626.8	1.4927	2294.3	5702
1991	265379.1	30131657.67	35423.9	2.5262	1494.7	4621
1992	271365.5	30993563.54	58423.9	2.4502	2060.4	9889
1993	274833.3	31886386.39	58640.3	2.8244	7999.1	27879
1994	275450.6	32868259.25	80948.1	2.011	10283.8	31209
1995	281407.4	33821533.37	85021.9	8.8815	12728.7	34777
1996	293745.4	34803279	114476.3	4.9147	15351.8	40438
1997	302022.5	35876604.55	172105.7	4.9139	15944	46409
1998	310890.1	36977666.39	205553.2	4.0739	26721.3	45977
1999	312183.5	38102685.51	192984.4	4.4693	31563.8	86172
2000	329178.7	39248921.04	175735.8	5.6051	67568.1	103562
2001	356994.3	40415526.34	268894.5	5.0509	59744.6	92937
2002	433203.5	41603119.16	371897.9	4.0675	109455.2	150218
2003	477533	42660302.1	438114.9	4.7481	179436.1	129069
2004	527576	43732314.08	429230	4.6293	93767.9	146072
2005	561931.4	44900539.04	456970	6.1291	120035.5	178125
2006	595821.6	46089291.6	804400.8	3.9205	165213.7	197472
2007	634251.1	47299417.67	1546525.7	2.5766	1395771.77	236420

APPENDIX II

ENDOGENOUS VARIABLES FOR THE AGRICULTURAL SECTOR GDP

	GDP Agric	L	K	IMGCF	PEXEDU	HCI
1981	13580.3	16865221	21.39	1.05113	984.6	2439
1982	15905.5	17247113	6.83	0.9861	1134.7	1874
1983	18837.2	17655211	38.41	1.0944	967.4	2087
1984	23799.4	17986235	38.54	1.3251	861.2	2485
1985	26625.2	18315778	40.09	1.2672	850.2	2104
1986	27887.5	18677235	22.55	0.817	1094.8	2329
1987	39204.2	19168872	22.55	1.6754	713.5	2581
1988	57924.4	19586105	92.19	1.7317	1084.1	4002
1989	69713	20058603	128.7	1.6759	1941.8	6158
1990	84344.6	20548061	108.95	1.4927	2294.3	5702
1991	97464.1	21092161	111.2	2.5262	1494.7	4621
1992	145225.3	21695495	312.48	2.4502	2060.4	9889
1993	231832.7	22320470	609.09	2.8244	7999.1	27879
1994	349244.9	23007781	596.94	2.011	10283.8	31209
1995	619806.8	23675073	598.65	8.8815	12728.7	34777
1996	841457.1	24362295	598.65	4.9147	15351.8	40438
1997	953549.4	25113624	610.9	4.9139	15944	46409
1998	1057584	25884366	695	4.0739	26721.3	45977
1999	1127693	26671880	694.96	4.4693	31563.8	86172
2000	1192910	27474245	701.78	5.6051	67568.1	103562
2001	1594896	28290868	704.91	5.0509	59744.6	92937
2002	3357063	29122183	704.91	4.0675	109455	150218
2003	3624580	29862211	704.91	4.7481	179436	129069
2004	3903757	30612620	704.91	4.6293	93767.9	146072
2005	4773198	31430377	704.91	6.1291	120036	178125
2006	5940237	32262504	1344.53	3.9205	165214	197472
2007	6757868	33109593	1555.68	2.5766	1395772	236420

APPENDIX III

ENDOGENOUS VARIABLES FOR THE MANUFACTURING SECTOR GDP

YEAR	GDP MANUF	L	K	IMGCF	PEXEDU	HCI
1981	15802.6	2409317	1310.2	1.05113	984.6	2439
1982	14424.7	2463873	1720.06	0.9861	1134.7	1874
1983	13596.8	2522173	1724.07	1.0944	967.4	2087
1984	14470.8	2569534	1905.87	1.3251	861.2	2485
1985	18226.4	2616540	2106.61	1.2672	850.2	2104
1986	16392.9	2668176	2391.72	0.817	1094.8	2329
1987	34477.3	2738410	2777.53	1.6754	713.5	2581
1988	41200.3	2798015	3256.05	1.7317	1084.1	4002
1989	89596.7	2865515	5015.82	1.6759	1941.8	6158
1990	115591.4	2935437	8701.06	1.4927	2294.3	5702
1991	136627.7	3013166	10362.23	2.5262	1494.7	4621
1992	274755.3	3099356	12758.08	2.4502	2060.4	9889
1993	282305.9	3188639	23162.94	2.8244	7999.1	27879
1994	283563.1	3286826	28938.64	2.011	10283.8	31209
1995	873884.7	3382153	54425.47	8.8815	12728.7	34777
1996	1293226	3480328	68181.01	4.9147	15351.8	40438
1997	1215912	3587661	70553.62	4.9139	15944	46409
1998	882034	3697767	70627.84	4.0739	26721.3	45977
1999	1179551	3810269	69357.29	4.4693	31563.8	86172
2000	2359313	3924892	74012.77	5.6051	67568.1	103562
2001	1874083	4041553	75444.53	5.0509	59744.6	92937
2002	2042716	4160312	75643.18	4.0675	109455	150218
2003	3037706	4266030	78506.9	4.7481	179436	129069
2004	4610084	4373231	85925.06	4.6293	93767.9	146072
2005	6094891	4490054	93343.23	6.1291	120036	178125
2006	7488744	4608929	107837.7	3.9205	165214	197472
2007	8085380	4729942	118626.1	2.5766	1395772	236420

APPENDIX IV

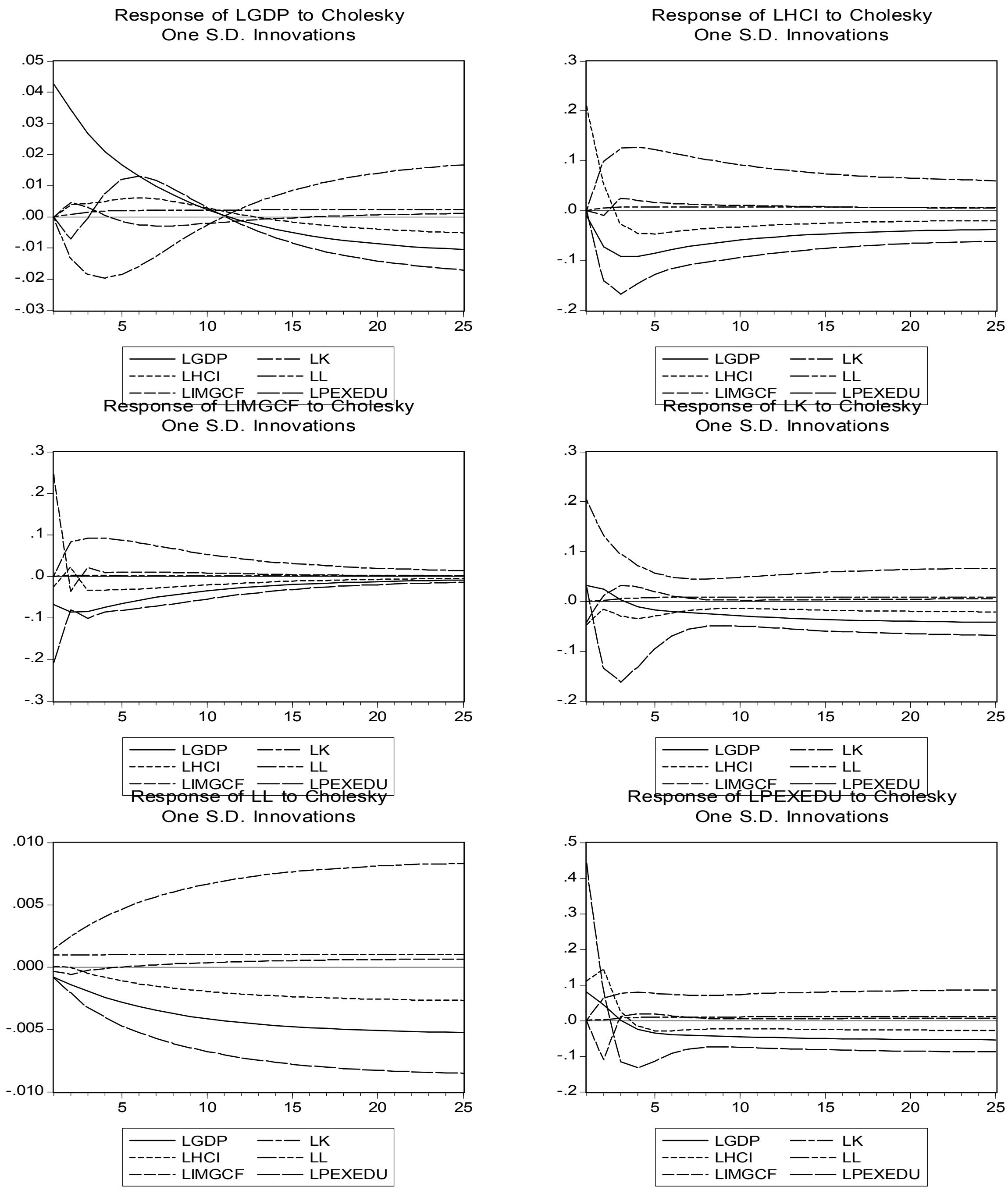
ENDOGENOUS VARIABLES FOR SERVICE SECTOR

	GDP SER	L	K	IMGCF	PEXEDU	HCI
1981	9005	4818635	719.45	1.05113	984.6	2439
1982	9633.2	4927747	673.68	0.9861	1134.7	1874
1983	10109.2	5044346	780.73	1.0944	967.4	2087
1984	10849.5	5139067	1081.2	1.3251	861.2	2485
1985	12338.3	5233079	1188.04	1.2672	850.2	2104
1986	13455.9	5336353	629.36	0.817	1094.8	2329
1987	14550.5	5476821	850.45	1.6754	713.5	2581
1988	16745.3	5596030	2115.26	1.7317	1084.1	4002
1989	21265.5	5731029	2287.57	1.6759	1941.8	6158
1990	27425.6	5870875	3553.1	1.4927	2294.3	5702
1991	31355.5	6026332	4327.32	2.5262	1494.7	4621
1992	44227.3	6198713	45550.18	2.4502	2060.4	9889
1993	60863.3	6377277	5302.21	2.8244	7999.1	27879
1994	98336.2	6573652	5663.66	2.011	10283.8	31209
1995	151822.9	6764307	7881.47	8.8815	12728.7	34777
1996	194941.2	6960656	11654.21	4.9147	15351.8	40438
1997	221391.9	7175321	11913.58	4.9139	15944	46409
1998	299450.1	7395533	12478.57	4.0739	26721.3	45977
1999	373576.2	7620537	12668.42	4.4693	31563.8	86172
2000	471814.6	7849784	12497.68	5.6051	67568.1	103562
2001	572666.2	8083105	12580.78	5.0509	59744.6	92937
2002	692179.5	8320624	12588.87	4.0675	109455	150218
2003	843690.5	8532060	13123.93	4.7481	179436	129069
2004	1246724	8746463	15063.96	4.6293	93767.9	146072
2005	1620112	8980108	17003.98	6.1291	120036	178125
2006	2143487	9217858	18872.95	3.9205	165214	197472
2007	2502832	9459884	20762.25	2.5766	1395772	236420

APPENDIX V

IMPLUSE RESPONSE WITH RESPECT TO GROSS DOMESTIC PRODUCT

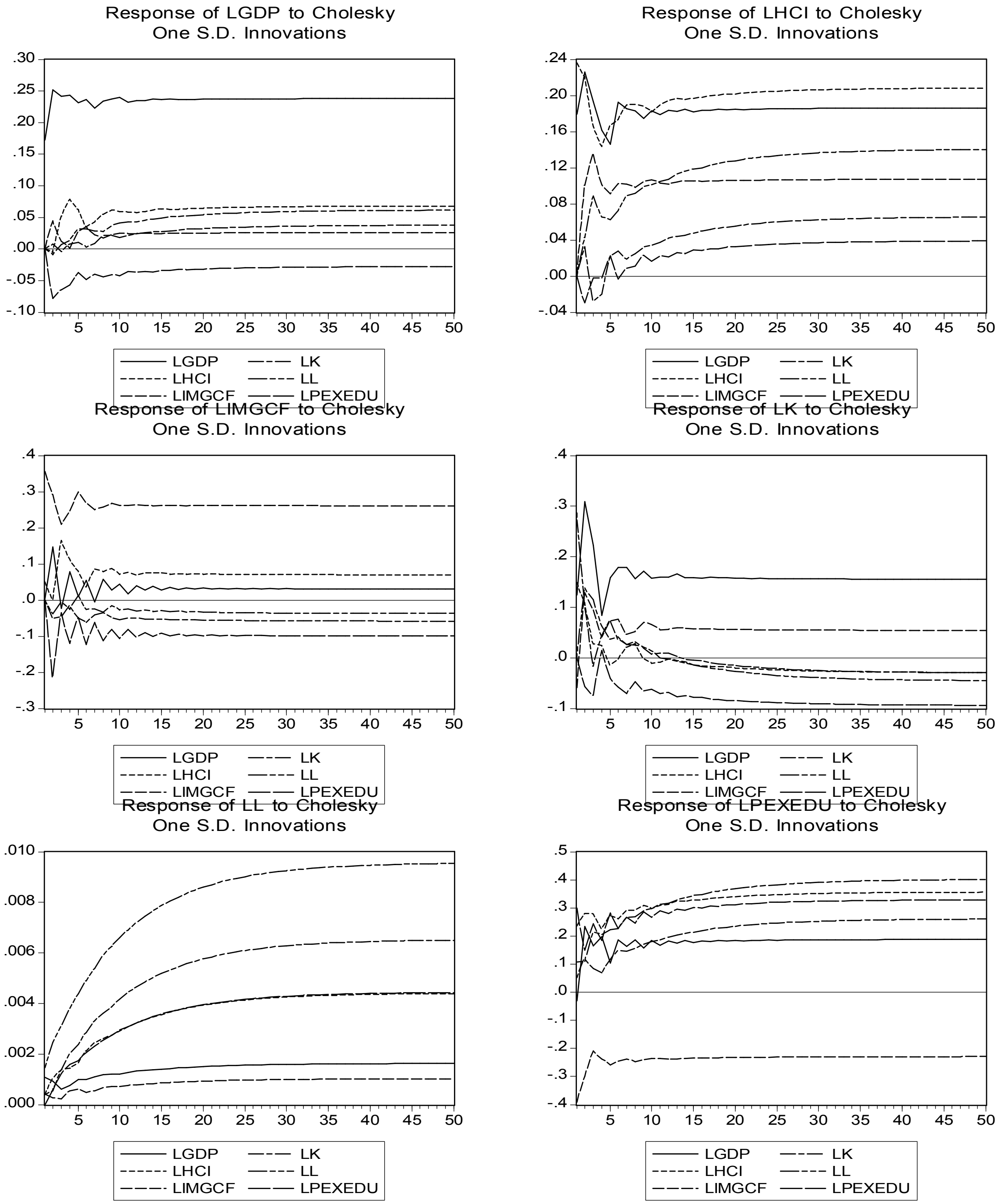
IMPULSE RESPONSE WITH RESPECT TO GDP



APPENDIX VI

IMPULSE RESPONSE WITH RESPECT TO AGRICULTURAL GDP

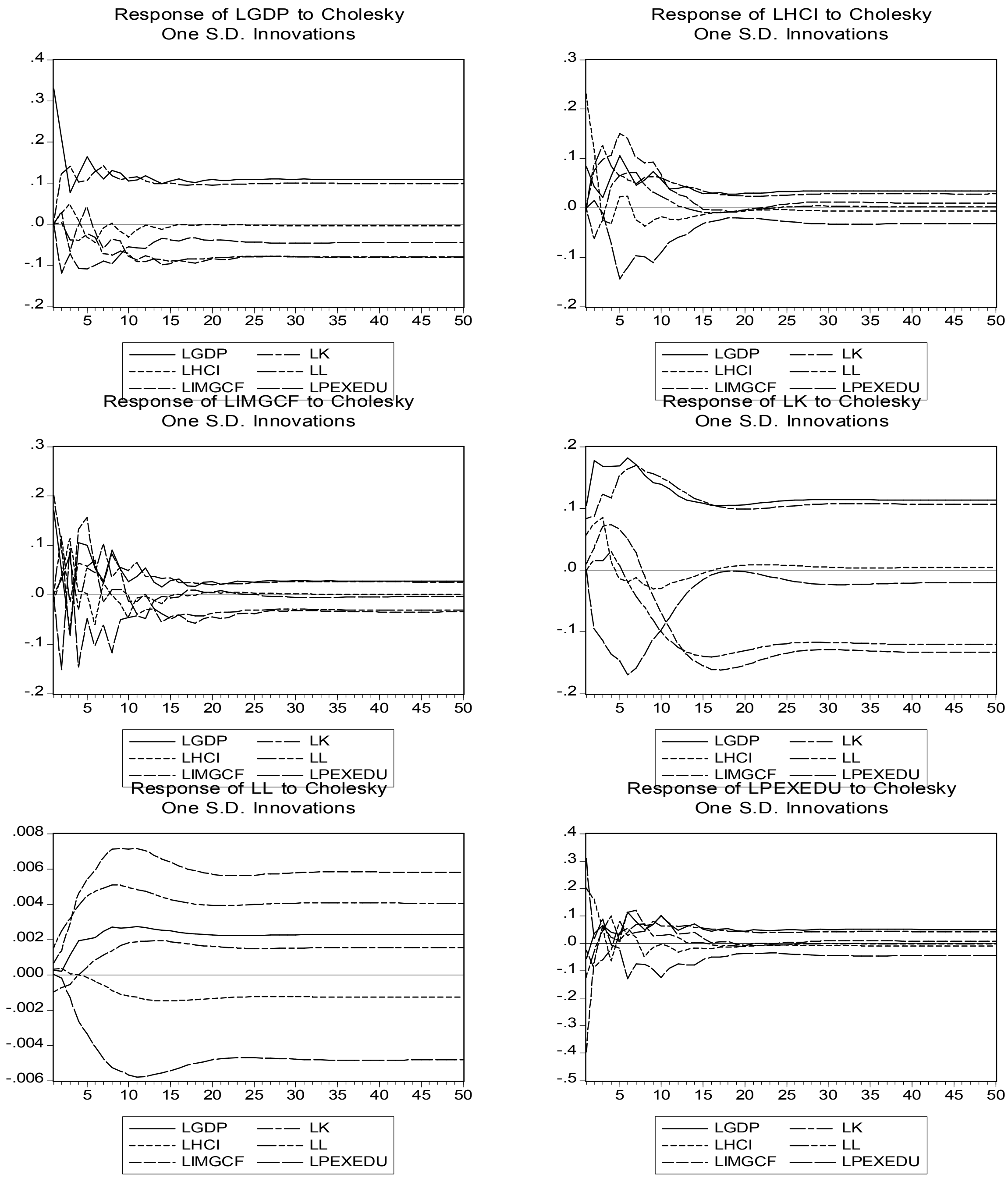
IMPULSE RESPONSE WITH RESPECT TO AGRICULTURAL SECTOR GDP



APPENDIX VII

IMPULSE RESPONSE WITH RESPECT TO MANUFACTURING GDP

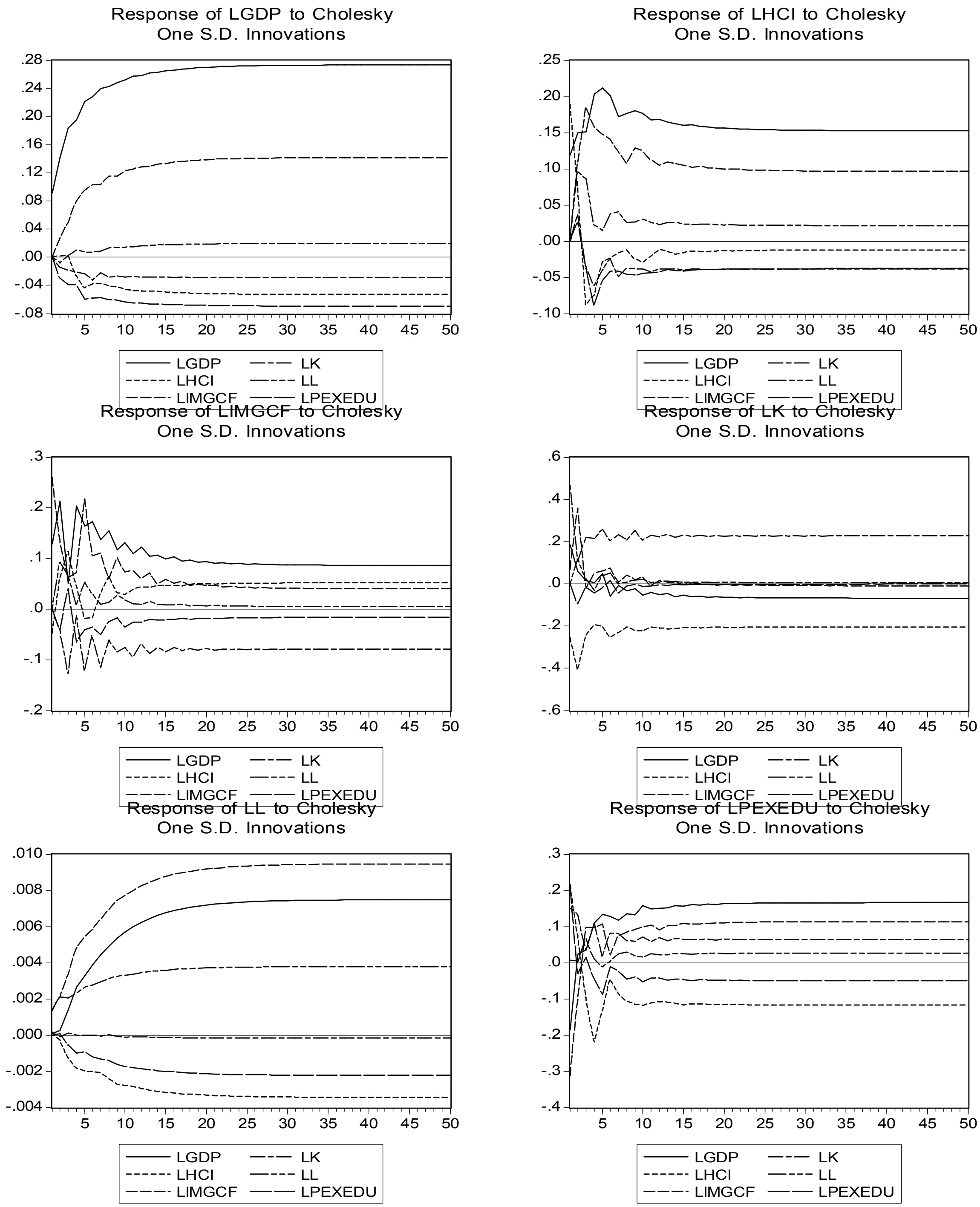
IMPULSE RESPONSE FOR MANUFACTURING SECTOR GDP



APPENDIX VIII

IMPULSE RESPONSE WITH RESPECT TO SERVICE SECTOR GDP

IMPLUSE RESPONSE FOR SERVICE SECTOR GDP



APPENDIX IX

HUMAN CAPITAL INDICATORS

YEAR	KE	LEB	PEH	PEE	SCHP	SCHS	SCHT	MR	SCIP	LR	THE	HCI
1980	24	45	53	156	94	13	2	126	555	782	-43697525	1850
1981	33	45	84	165	102	17	2	126	555	1310	6372747	2439
1982	114	45	96	12088	111	21	3	126	555	615	27030961	1874
1983	112	45	83	16222	112	25	3	126	555	864	8079223	2087
1984	150	45	102	19924	110	28	3	126	555	1167	3041135	2485
1985	198	45	132	25925	104	29	3	126	757	451	46356920	2104
1986	80	45	134	26327	91	27	4	126	976	583	38943637	2329
1987	81	45	41	22530	88	27	3	126	872	1073	27377996	2581
1988	337	45	423	1459	83	24	4	126	886	615	14489314	4002
1989	452	45	575	3012	81	24	4	126	864	975	39005187	6158
1990	612	45	501	2403	84	35	6	126	815	1075	-4298698	5702
1991	824	45	618	1256	83	45	8	125	719	898	11379605	4621
1992	7215	45	150	291	87	55	10	125	666	1245	10808145	9889
1993	12965	45	3878	8882	91	66	12	125	604	1211	6007493	27879
1994	18294	45	3871	7383	91	76	14	125	470	839	2703261	31209
1995	20129	45	3321	9740	254	87	16	125	450	610	3512781	34777
1996	24281	45	3024	11496	312	76	18	123	435	628	1504224	40438
1997	26011	45	3891	14853	312	81	20	121	437	638	418458	46409
1998	26054	45	4742	13589	270	86	22	118	402	649	30709	45977
1999	24883	46	16639	43011	285	91	24	116	417	660	13035583	86172
2000	28668	46	15218	57956	368	95	25	114	401	671	223377	103562
2001	26893	46	24523	39883	375	93	27	111	304	682	204540	92937
2002	27239	46	40621	80531	451	95	30	107	363	735	1261707	150218
2003	29089	47	33268	64782	504	97	33	104	358	787	8569633	129069
2004	33176	47	34197	76525	639	98	35	101	381	873	-4578585	146072
2005	37263	47	55662	82796	797	99	35	97	364	965	-7309786	178125
2006	48732	47	58687	87295	1018	101	34	94	406	1058	61665444	197472
2007	53605	47	72290	107529	1123	93	30	91	427	1184	11054430	236420
2008	47413	48	98200	164000	1370	93	30	89	555	1311	14517544	313109

APPENDIX X

Date: 04/12/13 Time: 07:10
Sample(adjusted): 1982 2007
Included observations: 26 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: LGDP LHCI LIMGCF LK LL LPEXEDU
Lags interval (in first differences): No lags

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.943883	163.6556	94.15	103.18
At most 1 **	0.716773	88.76759	68.52	76.07
At most 2 **	0.660640	55.96843	47.21	54.46
At most 3	0.510162	27.87035	29.68	35.65
At most 4	0.296818	9.314659	15.41	20.04
At most 5	0.006098	0.159043	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 3 cointegrating equation(s) at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.943883	74.88800	39.37	45.10
At most 1	0.716773	32.79916	33.46	38.77
At most 2 *	0.660640	28.09808	27.07	32.24
At most 3	0.510162	18.55569	20.97	25.52
At most 4	0.296818	9.155616	14.07	18.63
At most 5	0.006098	0.159043	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
4.571090	-1.295827	0.951039	-1.645005	-0.134600	1.042439
1.464417	-0.891910	2.588028	-0.531376	-19.62191	2.323343
-0.151815	-1.857692	2.199867	-0.668117	19.46142	-0.368695
2.444140	2.508959	-1.085628	-2.900666	5.223128	-0.254124
-12.36694	-2.706658	-1.274420	0.593631	27.10219	1.462128
1.647794	-2.909746	-0.373150	1.219063	0.386640	1.582442

Unrestricted Adjustment Coefficients (alpha):

D(LGDP)	-0.009700	0.002165	0.023616	0.026282	0.009754
D(LHCI)	-0.060821	-0.118482	0.140671	-0.125350	0.029174
D(LIMGCF)	-0.062696	-0.173697	-0.194678	0.000683	0.108627
D(LK)	-0.008081	-0.038439	0.128811	0.093891	-0.066524

D(LL)	-0.002956	0.000221	0.000686	-0.000300	-0.000250
D(LPEXEDU)	-0.220168	-0.226567	0.107528	0.014871	-0.143332

1 Cointegrating Equation(s): Log likelihood 156.3126

Normalized cointegrating coefficients (std.err. in parentheses)

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1.000000	-0.283483	0.208055	-0.359872	-0.029446	0.228050
	(0.05313)	(0.03949)	(0.03674)	(0.31688)	(0.03610)

Adjustment coefficients (std.err. in parentheses)

D(LGDP)	-0.044341
	(0.04889)
D(LHCI)	-0.278017
	(0.27131)
D(LIMGCF)	-0.286589
	(0.37707)
D(LK)	-0.036939
	(0.24262)
D(LL)	-0.013512
	(0.00192)
D(LPEXEDU)	-1.006407
	(0.46556)

2 Cointegrating Equation(s): Log likelihood 172.7121

Normalized cointegrating coefficients (std.err. in parentheses)

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1.000000	0.000000	-1.149596	-0.357271	11.61186	-0.954812
		(0.24775)	(0.25129)	(2.25792)	(0.19564)
0.000000	1.000000	-4.789178	0.009174	41.06526	-4.172602
		(0.85086)	(0.86302)	(7.75456)	(0.67189)

Adjustment coefficients (std.err. in parentheses)

D(LGDP)	-0.041171	0.010639
	(0.05130)	(0.01681)
D(LHCI)	-0.451524	0.184488
	(0.26016)	(0.08527)
D(LIMGCF)	-0.540954	0.236165
	(0.35750)	(0.11717)
D(LK)	-0.093229	0.044756
	(0.25197)	(0.08258)
D(LL)	-0.013188	0.003633
	(0.00200)	(0.00066)
D(LPEXEDU)	-1.338195	0.487377
	(0.43556)	(0.14275)

3 Cointegrating Equation(s): Log likelihood 186.7612

Normalized cointegrating coefficients (std.err. in parentheses)

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1.000000	0.000000	0.000000	-0.239272	-4.701681	0.427930
			(0.08630)	(0.77706)	(0.06852)
0.000000	1.000000	0.000000	0.500753	-26.89640	1.587854
			(0.41806)	(3.76409)	(0.33193)
0.000000	0.000000	1.000000	0.102644	-14.19067	1.202807
			(0.24187)	(2.17776)	(0.19204)

Adjustment coefficients (std.err. in parentheses)

D(LGDP)	-0.044756	-0.033232	0.048329
	(0.04581)	(0.02322)	(0.03364)
D(LHCI)	-0.472880	-0.076835	-0.055020
	(0.22077)	(0.11191)	(0.16215)
D(LIMGCF)	-0.511399	0.597817	-0.937425
	(0.30252)	(0.15334)	(0.22220)
D(LK)	-0.112785	-0.194536	0.176201
	(0.21819)	(0.11060)	(0.16026)
D(LL)	-0.013292	0.002358	-0.000728
	(0.00189)	(0.00096)	(0.00139)
D(LPEXEDU)	-1.354520	0.287624	-0.559204
	(0.42284)	(0.21433)	(0.31057)

4 Cointegrating Equation(s): Log likelihood 196.0390

Normalized cointegrating coefficients (std.err. in parentheses)

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1.000000	0.000000	0.000000	0.000000	-9.457745	0.702969
				(1.17244)	(0.12188)
0.000000	1.000000	0.000000	0.000000	-16.94282	1.012249
				(2.09908)	(0.21821)
0.000000	0.000000	1.000000	0.000000	-12.15040	1.084820
				(1.61741)	(0.16814)
0.000000	0.000000	0.000000	1.000000	-19.87723	1.149480
				(2.53799)	(0.26383)

Adjustment coefficients (std.err. in parentheses)

D(LGDP)	0.019481	0.032709	0.019797	-0.077208
	(0.04250)	(0.02757)	(0.02911)	(0.02715)
D(LHCI)	-0.779254	-0.391334	0.081064	0.432624
	(0.20580)	(0.13351)	(0.14095)	(0.13146)
D(LIMGCF)	-0.509729	0.599531	-0.938166	0.323520
	(0.33944)	(0.22021)	(0.23248)	(0.21684)
D(LK)	0.116698	0.041033	0.074270	-0.324689
	(0.22197)	(0.14400)	(0.15203)	(0.14180)
D(LL)	-0.014025	0.001605	-0.000403	0.005157
	(0.00209)	(0.00136)	(0.00143)	(0.00134)
D(LPEXEDU)	-1.318173	0.324935	-0.575348	0.367592
	(0.47417)	(0.30762)	(0.32476)	(0.30290)

5 Cointegrating Equation(s): Log likelihood 200.6168

Normalized cointegrating coefficients (std.err. in parentheses)

LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1.000000	0.000000	0.000000	0.000000	0.000000	-0.219414
					(0.01415)
0.000000	1.000000	0.000000	0.000000	0.000000	-0.640127
					(0.03152)
0.000000	0.000000	1.000000	0.000000	0.000000	-0.100168
					(0.03289)
0.000000	0.000000	0.000000	1.000000	0.000000	-0.789079
					(0.03783)
0.000000	0.000000	0.000000	0.000000	1.000000	-0.097527
					(0.00334)

Adjustment coefficients (std.err. in parentheses)

D(LGDP)	-0.101145	0.006308	0.007366	-0.071417	0.820064
	(0.10294)	(0.03374)	(0.02979)	(0.02666)	(0.29806)
D(LHCI)	-1.140049	-0.470299	0.043884	0.449943	5.206647
	(0.50890)	(0.16679)	(0.14729)	(0.13177)	(1.47348)
D(LIMGCF)	-1.853108	0.305516	-1.076602	0.388004	2.575575
	(0.79540)	(0.26068)	(0.23021)	(0.20596)	(2.30300)
D(LK)	0.939401	0.221092	0.159051	-0.364180	1.949638
	(0.52464)	(0.17194)	(0.15185)	(0.13585)	(1.51904)
D(LL)	-0.010929	0.002283	-8.36E-05	0.005008	0.001057
	(0.00520)	(0.00170)	(0.00150)	(0.00135)	(0.01504)
D(LPEXEDU)	0.454410	0.712887	-0.392683	0.282506	2.761003
	(1.11952)	(0.36691)	(0.32403)	(0.28988)	(3.24148)

APPENDIX XI

Vector Autoregression Estimates
Date: 04/12/13 Time: 09:07
Sample(adjusted): 1983 2007
Included observations: 25 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
LGDP(-1)	0.889287	-2.338946	0.747027	0.533857	-0.011468	-5.409479
	(0.33528)	(1.74625)	(2.49248)	(1.14736)	(0.01709)	(3.90817)
	[2.65236]	[-1.33941]	[0.29971]	[0.46529]	[-0.67110]	[-1.38415]
LGDP(-2)	-0.156459	1.312547	-1.625613	1.163087	0.004859	4.090611
	(0.26967)	(1.40452)	(2.00472)	(0.92283)	(0.01374)	(3.14337)
	[-0.58019]	[0.93452]	[-0.81089]	[1.26035]	[0.35351]	[1.30135]
LHCI(-1)	0.035910	0.413654	0.595031	-0.135646	0.000136	0.949239
	(0.06293)	(0.32775)	(0.46781)	(0.21535)	(0.00321)	(0.73352)
	[0.57066]	[1.26210]	[1.27195]	[-0.62990]	[0.04244]	[1.29410]
LHCI(-2)	-0.059942	-0.304102	0.673451	0.476309	0.004557	-0.666005
	(0.06943)	(0.36164)	(0.51617)	(0.23761)	(0.00354)	(0.80935)
	[-0.86329]	[-0.84091]	[1.30470]	[2.00458]	[1.28778]	[-0.82289]
LIMGCF(-1)	0.031514	0.107866	-0.346969	0.227937	-0.000364	-0.121775
	(0.04332)	(0.22563)	(0.32204)	(0.14825)	(0.00221)	(0.50496)
	[0.72746]	[0.47807]	[-1.07740]	[1.53756]	[-0.16508]	[-0.24116]
LIMGCF(-2)	-0.033274	0.070328	-0.193184	0.224480	0.001234	-0.110905
	(0.04506)	(0.23470)	(0.33499)	(0.15421)	(0.00230)	(0.52527)
	[-0.73839]	[0.29965]	[-0.57668]	[1.45570]	[0.53745]	[-0.21114]
LK(-1)	0.034222	0.368073	-0.033564	0.521038	0.003417	1.503973
	(0.09637)	(0.50193)	(0.71642)	(0.32979)	(0.00491)	(1.12333)
	[0.35511]	[0.73332]	[-0.04685]	[1.57992]	[0.69576]	[1.33885]
LK(-2)	-0.092395	0.114516	0.261334	-0.361689	0.000287	-0.883500
	(0.06987)	(0.36393)	(0.51945)	(0.23912)	(0.00356)	(0.81448)
	[-1.32230]	[0.31467]	[0.50310]	[-1.51261]	[0.08059]	[-1.08474]
LL(-1)	-3.431644	8.887195	41.98628	24.99134	1.034257	-112.2452
	(10.2811)	(53.5472)	(76.4297)	(35.1828)	(0.52400)	(119.840)
	[-0.33378]	[0.16597]	[0.54935]	[0.71033]	[1.97378]	[-0.93662]
LL(-2)	4.252586	-2.667449	-43.12453	-21.35299	-0.026309	116.3041
	(10.2340)	(53.3019)	(76.0796)	(35.0216)	(0.52160)	(119.292)
	[0.41553]	[-0.05004]	[-0.56683]	[-0.60971]	[-0.05044]	[0.97496]
LPEXEDU(-1)	0.003971	-0.072678	-0.816236	0.002932	-0.002262	0.263957
	(0.05547)	(0.28888)	(0.41233)	(0.18981)	(0.00283)	(0.64653)
	[0.07159]	[-0.25159]	[-1.97957]	[0.01545]	[-0.80023]	[0.40827]
LPEXEDU(-2)	0.039256	-0.060728	0.171060	-0.412650	-0.003732	0.131874

	(0.04019)	(0.20932)	(0.29877)	(0.13753)	(0.00205)	(0.46846)
	[0.97677]	[-0.29012]	[0.57255]	[-3.00040]	[-1.82176]	[0.28150]
C	-10.23372	-90.16935	22.16653	-75.53256	-0.062540	-54.40342
	(8.02169)	(41.7794)	(59.6332)	(27.4509)	(0.40884)	(93.5038)
	[-1.27576]	[-2.15822]	[0.37171]	[-2.75155]	[-0.15297]	[-0.58183]
R-squared	0.992457	0.990232	0.856143	0.995672	0.999934	0.970199
Adj. R-squared	0.984914	0.980463	0.712287	0.991344	0.999868	0.940398
Sum sq. resids	0.024551	0.665978	1.356786	0.287506	6.38E-05	3.335755
S.E. equation	0.045232	0.235580	0.336252	0.154787	0.002305	0.527238
F-statistic	131.5758	101.3706	5.951368	230.0449	15167.21	32.55565
Log likelihood	51.10009	9.843720	0.948500	20.34386	125.5144	-10.29625
Akaike AIC	-3.048007	0.252502	0.964120	-0.587509	-9.001155	1.863700
Schwarz SC	-2.414192	0.886318	1.597935	0.046307	-8.367340	2.497516
Mean dependent	12.63296	10.06985	1.047222	11.25646	17.34409	9.354352
S.D. dependent	0.368264	1.685435	0.626881	1.663667	0.200764	2.159605

Determinant Residual Covariance	1.44E-14
Log Likelihood (d.f. adjusted)	185.5944
Akaike Information Criteria	-8.607552
Schwarz Criteria	-4.804659

APPENDIX XII

Vector Error Correction Estimates
Date: 10/09/11 Time: 21:46
Sample(adjusted): 1983 2007
Included observations: 25 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5
LGDP(-1)	1.000000	0.000000	0.000000	0.000000	0.000000
LHCI(-1)	0.000000	1.000000	0.000000	0.000000	0.000000
LIMGCF(-1)	0.000000	0.000000	1.000000	0.000000	0.000000
LK(-1)	0.000000	0.000000	0.000000	1.000000	0.000000
LL(-1)	0.000000	0.000000	0.000000	0.000000	1.000000
LPEXEDU(-1)	-0.230066	-0.707992	-0.113574	-0.753141	-0.098335
	(0.02019)	(0.03718)	(0.04921)	(0.05741)	(0.00542)
	[-11.3923]	[-19.0427]	[-2.30813]	[-13.1187]	[-18.1538]
C	-10.50009	-3.455037	0.021281	-4.227529	-16.42612

Error Correction:	D(LGDP)	D(LHCI)	D(LIMGCF)	D(LK)	D(LL)	D(LPEXEDU)
CointEq1	-0.276116	-0.997857	-0.483383	1.709751	-0.003419	-2.132904
	(0.20395)	(1.06174)	(1.55619)	(0.69750)	(0.01078)	(2.48590)
	[-1.35382]	[-0.93983]	[-0.31062]	[2.45126]	[-0.31723]	[-0.85800]
CointEq2	-0.020613	-0.901357	1.117429	0.335768	0.003474	0.594372
	(0.08246)	(0.42929)	(0.62921)	(0.28202)	(0.00436)	(1.00512)
	[-0.24996]	[-2.09964]	[1.77591]	[1.19058]	[0.79727]	[0.59134]
CointEq3	-0.001878	0.178568	-1.534965	0.452585	0.000912	-0.243367
	(0.06561)	(0.34156)	(0.50062)	(0.22438)	(0.00347)	(0.79970)
	[-0.02862]	[0.52281]	[-3.06613]	[2.01703]	[0.26301]	[-0.30432]
CointEq4	-0.056995	0.478831	0.175738	-0.842337	0.003284	0.727651
	(0.07125)	(0.37092)	(0.54365)	(0.24367)	(0.00376)	(0.86844)
	[-0.79992]	[1.29094]	[0.32325]	[-3.45688]	[0.87240]	[0.83788]
CointEq5	0.832155	6.183964	-1.633689	3.622298	0.003949	5.079408
	(0.50419)	(2.62469)	(3.84702)	(1.72427)	(0.02664)	(6.14531)
	[1.65048]	[2.35607]	[-0.42466]	[2.10077]	[0.14823]	[0.82655]
D(LGDP(-1))	0.171831	-1.361599	0.946427	-1.185096	-0.010342	-2.691627
	(0.23572)	(1.22708)	(1.79854)	(0.80612)	(0.01245)	(2.87302)
	[0.72898]	[-1.10962]	[0.52622]	[-1.47013]	[-0.83038]	[-0.93686]
D(LHCI(-1))	0.056658	0.314582	-0.528352	-0.471607	-0.003386	0.367131
	(0.06265)	(0.32612)	(0.47800)	(0.21424)	(0.00331)	(0.76357)

	[0.90441]	[0.96461]	[-1.10534]	[-2.20127]	[-1.02289]	[0.48081]
D(LIMGCF(-1))	0.032730	-0.068591	0.217227	-0.223701	-0.001040	0.061382
	(0.04316)	(0.22468)	(0.32931)	(0.14760)	(0.00228)	(0.52605)
	[0.75835]	[-0.30529]	[0.65964]	[-1.51559]	[-0.45617]	[0.11669]
D(LK(-1))	0.090220	-0.107578	-0.165267	0.364802	0.000489	0.685620
	(0.06542)	(0.34059)	(0.49920)	(0.22374)	(0.00346)	(0.79743)
	[1.37899]	[-0.31586]	[-0.33106]	[1.63044]	[0.14134]	[0.85979]
D(LL(-1))	-4.352617	2.986644	47.54417	21.49621	0.061990	-125.4077
	(9.81505)	(51.0949)	(74.8900)	(33.5663)	(0.51860)	(119.631)
	[-0.44346]	[0.05845]	[0.63485]	[0.64041]	[0.11953]	[-1.04829]
D(LPEXEDU(-1))	-0.038218	0.057416	-0.216915	0.411164	0.003361	-0.037423
	(0.03795)	(0.19755)	(0.28955)	(0.12978)	(0.00201)	(0.46253)
	[-1.00711]	[0.29064]	[-0.74914]	[3.16819]	[1.67643]	[-0.08091]
C	0.132874	0.128634	-1.081961	-0.359784	0.024799	3.478256
	(0.25332)	(1.31873)	(1.93286)	(0.86632)	(0.01338)	(3.08759)
	[0.52453]	[0.09754]	[-0.55977]	[-0.41530]	[1.85277]	[1.12653]
R-squared	0.641735	0.681702	0.670009	0.827503	0.788201	0.526423
Adj. R-squared	0.338587	0.412373	0.390786	0.681544	0.608986	0.125705
Sum sq. resids	0.024589	0.666368	1.431550	0.287585	6.86E-05	3.652958
S.E. equation	0.043491	0.226405	0.331842	0.148734	0.002298	0.530091
F-statistic	2.116907	2.531111	2.399547	5.669418	4.398074	1.313698
Log likelihood	51.08061	9.836403	0.278016	20.34045	124.5940	-11.43173
Akaike AIC	-3.126448	0.173088	0.937759	-0.667236	-9.007524	1.874538
Schwarz SC	-2.541388	0.758148	1.522819	-0.082175	-8.422463	2.459599
Mean dependent	0.046228	0.193501	0.038419	0.198119	0.026087	0.284593
S.D. dependent	0.053477	0.295348	0.425154	0.263564	0.003675	0.566920

Determinant Residual Covariance	9.94E-15
Log Likelihood	239.2319
Log Likelihood (d.f. adjusted)	190.1874
Akaike Information Criteria	-7.054992
Schwarz Criteria	-2.081979

APPENDIX XIII

RESPONSE OF LGDP

Period	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1	0.043491	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.042028	0.007700	0.006127	-0.000254	-0.005515	0.000201
3	0.027136	0.004386	-0.008126	-0.004204	-0.006387	0.003379
4	0.018549	0.004225	-0.024154	-0.009674	-0.017862	0.006613
5	0.009338	-0.002260	-0.037382	-0.007886	-0.027581	0.010193
6	0.002893	-0.009588	-0.044286	-0.004328	-0.033753	0.012424
7	-4.39E-05	-0.009459	-0.038248	-0.003429	-0.031105	0.010742
8	-0.001617	-0.004660	-0.024634	-0.003662	-0.021447	0.007201
9	-0.002403	-0.001194	-0.013598	-0.002516	-0.011573	0.004063
10	-0.002993	-0.001018	-0.008926	0.000439	-0.006022	0.002809
11	-0.003562	-0.001611	-0.005299	0.002959	-0.002665	0.001766
12	-0.004155	-0.000917	0.001292	0.003951	0.002234	2.12E-05
13	-0.004201	0.000968	0.009266	0.003977	0.008585	-0.002221
14	-0.003901	0.002345	0.014377	0.004454	0.013540	-0.003664
15	-0.003700	0.002479	0.015864	0.005526	0.015628	-0.004133
16	-0.003903	0.002043	0.016351	0.006467	0.016311	-0.004263
17	-0.004193	0.002086	0.018169	0.006690	0.017562	-0.004767
18	-0.004272	0.002673	0.020750	0.006536	0.019573	-0.005482
19	-0.004141	0.003168	0.022332	0.006575	0.021132	-0.005945
20	-0.004072	0.003155	0.022437	0.006941	0.021569	-0.005988
21	-0.004171	0.002906	0.022215	0.007279	0.021473	-0.005929
22	-0.004322	0.002861	0.022678	0.007337	0.021722	-0.006050
23	-0.004365	0.003085	0.023612	0.007227	0.022404	-0.006310
24	-0.004310	0.003291	0.024192	0.007212	0.022972	-0.006477
25	-0.004270	0.003285	0.024159	0.007348	0.023086	-0.006475

APPENDIX XIV-RESPONSE OF AGRICULTURE LGDP

Period	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1	0.172482	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.251891	-0.005621	0.044253	0.008091	-0.009262	-0.078030
3	0.241542	0.052155	0.011792	-0.003878	0.007438	-0.064886
4	0.242882	0.078506	0.001059	0.007752	0.014264	-0.057070
5	0.231016	0.062778	0.027187	0.010102	0.031368	-0.037065
6	0.236340	0.034805	0.035124	0.002500	0.031693	-0.048501
7	0.223134	0.042678	0.022532	0.008973	0.028589	-0.039785
8	0.234086	0.054577	0.017269	0.020594	0.027918	-0.044473
9	0.237576	0.061703	0.022730	0.021190	0.036859	-0.040354
10	0.239752	0.058722	0.024917	0.018332	0.040832	-0.042059
11	0.232393	0.058305	0.024317	0.020291	0.042858	-0.035623
12	0.234744	0.056957	0.024351	0.023940	0.042984	-0.037006
13	0.235101	0.059336	0.024601	0.025544	0.045283	-0.035431
14	0.237337	0.061201	0.023979	0.026582	0.046742	-0.036363
15	0.236063	0.063056	0.024230	0.027787	0.048953	-0.033854
16	0.236965	0.062489	0.024962	0.028700	0.050242	-0.033950
17	0.236153	0.062721	0.025230	0.029448	0.051554	-0.032609
18	0.236808	0.063121	0.024952	0.030492	0.052193	-0.032740
19	0.236666	0.064199	0.024956	0.031446	0.053285	-0.031792
20	0.237340	0.064577	0.025138	0.032067	0.054168	-0.031792
21	0.237056	0.065007	0.025297	0.032548	0.055103	-0.031028
22	0.237266	0.065130	0.025343	0.033106	0.055684	-0.030877
23	0.237151	0.065486	0.025407	0.033640	0.056324	-0.030364
24	0.237435	0.065728	0.025439	0.034092	0.056821	-0.030281
25	0.237395	0.066084	0.025480	0.034475	0.057367	-0.029900
26	0.237547	0.066268	0.025527	0.034823	0.057792	-0.029766
27	0.237508	0.066473	0.025589	0.035127	0.058219	-0.029471
28	0.237611	0.066601	0.025621	0.035407	0.058548	-0.029358
29	0.237602	0.066786	0.025646	0.035663	0.058874	-0.029144
30	0.237688	0.066921	0.025669	0.035893	0.059146	-0.029044
31	0.237693	0.067065	0.025700	0.036090	0.059414	-0.028880
32	0.237746	0.067163	0.025723	0.036267	0.059635	-0.028790
33	0.237749	0.067269	0.025745	0.036427	0.059843	-0.028662
34	0.237790	0.067351	0.025761	0.036573	0.060019	-0.028587
35	0.237799	0.067439	0.025778	0.036701	0.060185	-0.028491
36	0.237830	0.067508	0.025791	0.036816	0.060328	-0.028428
37	0.237838	0.067576	0.025805	0.036919	0.060461	-0.028352
38	0.237860	0.067630	0.025817	0.037010	0.060575	-0.028299
39	0.237868	0.067684	0.025828	0.037093	0.060681	-0.028240
40	0.237885	0.067728	0.025837	0.037166	0.060773	-0.028197
41	0.237893	0.067771	0.025845	0.037232	0.060857	-0.028151
42	0.237906	0.067807	0.025852	0.037291	0.060931	-0.028116
43	0.237912	0.067841	0.025859	0.037344	0.060998	-0.028079
44	0.237922	0.067870	0.025865	0.037391	0.061057	-0.028050
45	0.237927	0.067897	0.025871	0.037433	0.061111	-0.028022
46	0.237935	0.067920	0.025875	0.037471	0.061158	-0.027998
47	0.237940	0.067942	0.025880	0.037504	0.061201	-0.027976
48	0.237945	0.067960	0.025883	0.037534	0.061239	-0.027957
49	0.237949	0.067977	0.025887	0.037561	0.061274	-0.027939
50	0.237954	0.067992	0.025890	0.037586	0.061304	-0.027924

APPENDIX XV-RESPONSE OF MANUFACTURING LGDP

Period	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1	0.328792	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.206218	0.027243	0.028437	0.122475	0.003966	-0.118943
3	0.076424	0.048354	-0.065996	0.141126	-0.038751	-0.071145
4	0.121487	0.009244	-0.002851	0.102837	-0.039455	-0.106709
5	0.163465	-0.032066	0.042277	0.106040	-0.023762	-0.108550
6	0.132525	-0.045085	-0.016366	0.127668	-0.031659	-0.099527
7	0.110238	-0.008630	-0.058870	0.142213	-0.071210	-0.089643
8	0.130601	0.002186	-0.037311	0.117993	-0.075506	-0.096485
9	0.124062	-0.017143	-0.041000	0.107282	-0.064875	-0.072566
10	0.104486	-0.031182	-0.077727	0.111048	-0.071642	-0.055219
11	0.107656	-0.013702	-0.087162	0.115729	-0.090206	-0.056718
12	0.118026	-0.001798	-0.076053	0.105470	-0.090265	-0.058662
13	0.107517	-0.007234	-0.084457	0.099130	-0.083921	-0.043094
14	0.098395	-0.012505	-0.099331	0.099046	-0.086363	-0.034289
15	0.105070	-0.005734	-0.095688	0.099617	-0.091254	-0.038286
16	0.110232	-0.000864	-0.088103	0.096400	-0.088269	-0.040274
17	0.104362	-0.002456	-0.091917	0.095098	-0.084519	-0.034756
18	0.101879	-0.003584	-0.094910	0.095549	-0.084833	-0.033534
19	0.106754	-0.001448	-0.089018	0.095705	-0.084761	-0.037575
20	0.108824	-0.000806	-0.084560	0.095356	-0.081951	-0.039398
21	0.106342	-0.001817	-0.085724	0.096083	-0.080263	-0.038551
22	0.106438	-0.001929	-0.085110	0.096905	-0.080347	-0.039908
23	0.109003	-0.001512	-0.081299	0.097153	-0.079670	-0.042515
24	0.109403	-0.002129	-0.079687	0.097482	-0.078283	-0.043391
25	0.108383	-0.002840	-0.080372	0.098287	-0.078000	-0.043508
26	0.108891	-0.002787	-0.079724	0.098807	-0.078343	-0.044612
27	0.109871	-0.002806	-0.078279	0.098901	-0.078116	-0.045617
28	0.109600	-0.003356	-0.078333	0.099096	-0.077796	-0.045610
29	0.109124	-0.003677	-0.079035	0.099448	-0.078091	-0.045535
30	0.109437	-0.003563	-0.078905	0.099563	-0.078481	-0.045890
31	0.109650	-0.003586	-0.078708	0.099482	-0.078520	-0.045962
32	0.109287	-0.003821	-0.079232	0.099479	-0.078589	-0.045607
33	0.109068	-0.003864	-0.079747	0.099520	-0.078898	-0.045396
34	0.109207	-0.003734	-0.079795	0.099444	-0.079126	-0.045381
35	0.109181	-0.003712	-0.079916	0.099321	-0.079168	-0.045197
36	0.108949	-0.003759	-0.080295	0.099261	-0.079247	-0.044905
37	0.108884	-0.003703	-0.080513	0.099216	-0.079392	-0.044767
38	0.108953	-0.003609	-0.080508	0.099132	-0.079448	-0.044716
39	0.108908	-0.003586	-0.080578	0.099060	-0.079428	-0.044593
40	0.108814	-0.003579	-0.080715	0.099029	-0.079439	-0.044474
41	0.108826	-0.003530	-0.080727	0.099003	-0.079463	-0.044453
42	0.108871	-0.003489	-0.080664	0.098969	-0.079437	-0.044458
43	0.108853	-0.003486	-0.080658	0.098953	-0.079393	-0.044431
44	0.108833	-0.003482	-0.080664	0.098957	-0.079376	-0.044424
45	0.108865	-0.003463	-0.080610	0.098959	-0.079360	-0.044459
46	0.108891	-0.003457	-0.080549	0.098959	-0.079326	-0.044489
47	0.108887	-0.003468	-0.080527	0.098968	-0.079298	-0.044502
48	0.108890	-0.003472	-0.080507	0.098983	-0.079286	-0.044526
49	0.108912	-0.003470	-0.080466	0.098992	-0.079275	-0.044559
50	0.108922	-0.003477	-0.080437	0.099000	-0.079259	-0.044580

APPENDIX XVI-RESPONSE OF SERVICE LGDP

Period	LGDP	LHCI	LIMGCF	LK	LL	LPEXEDU
1	0.091427	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.141110	0.001913	0.027104	-0.014534	-0.007977	-0.029814
3	0.183771	0.002271	0.049171	-0.018782	0.002487	-0.039249
4	0.195493	-0.026362	0.079959	-0.020945	0.010314	-0.038635
5	0.221335	-0.043163	0.095223	-0.023659	0.007151	-0.059312
6	0.228482	-0.038049	0.102924	-0.032749	0.007241	-0.058325
7	0.239556	-0.037488	0.103396	-0.022325	0.008400	-0.057718
8	0.242777	-0.040932	0.115365	-0.028974	0.013112	-0.060668
9	0.247976	-0.042388	0.115200	-0.027031	0.013961	-0.061365
10	0.251830	-0.045671	0.122273	-0.028547	0.013734	-0.063772
11	0.257605	-0.047049	0.125510	-0.027491	0.014950	-0.065277
12	0.258363	-0.048072	0.128689	-0.028922	0.016207	-0.064856
13	0.261710	-0.048276	0.129209	-0.027847	0.016213	-0.066375
14	0.262963	-0.048693	0.132158	-0.029063	0.016994	-0.066519
15	0.265208	-0.049820	0.133296	-0.027922	0.017504	-0.066968
16	0.266104	-0.050698	0.135477	-0.029023	0.017930	-0.067613
17	0.267649	-0.050738	0.135739	-0.028525	0.018020	-0.067940
18	0.268313	-0.051096	0.137122	-0.028854	0.018329	-0.068080
19	0.269386	-0.051427	0.137674	-0.028576	0.018611	-0.068393
20	0.269746	-0.051727	0.138529	-0.028955	0.018819	-0.068515
21	0.270550	-0.051903	0.138834	-0.028699	0.018868	-0.068777
22	0.270887	-0.052104	0.139540	-0.028936	0.019049	-0.068860
23	0.271381	-0.052253	0.139751	-0.028770	0.019151	-0.068981
24	0.271601	-0.052379	0.140181	-0.028947	0.019241	-0.069079
25	0.271968	-0.052449	0.140335	-0.028837	0.019294	-0.069168
26	0.272130	-0.052566	0.140665	-0.028931	0.019377	-0.069215
27	0.272378	-0.052639	0.140786	-0.028874	0.019421	-0.069292
28	0.272489	-0.052696	0.140987	-0.028947	0.019466	-0.069327
29	0.272666	-0.052739	0.141072	-0.028894	0.019494	-0.069374
30	0.272747	-0.052790	0.141227	-0.028944	0.019535	-0.069399
31	0.272864	-0.052823	0.141284	-0.028915	0.019555	-0.069432
32	0.272923	-0.052854	0.141385	-0.028947	0.019577	-0.069452
33	0.273008	-0.052876	0.141430	-0.028926	0.019592	-0.069474
34	0.273048	-0.052901	0.141502	-0.028947	0.019611	-0.069487
35	0.273105	-0.052916	0.141532	-0.028935	0.019621	-0.069504
36	0.273135	-0.052931	0.141580	-0.028949	0.019632	-0.069513
37	0.273175	-0.052943	0.141603	-0.028940	0.019640	-0.069524
38	0.273196	-0.052954	0.141638	-0.028950	0.019648	-0.069530
39	0.273223	-0.052962	0.141653	-0.028944	0.019653	-0.069538
40	0.273238	-0.052970	0.141676	-0.028951	0.019659	-0.069543
41	0.273257	-0.052975	0.141688	-0.028947	0.019663	-0.069548
42	0.273268	-0.052981	0.141704	-0.028951	0.019667	-0.069551
43	0.273281	-0.052984	0.141712	-0.028949	0.019669	-0.069555
44	0.273289	-0.052988	0.141723	-0.028952	0.019672	-0.069557
45	0.273298	-0.052991	0.141729	-0.028950	0.019674	-0.069560
46	0.273303	-0.052994	0.141737	-0.028952	0.019676	-0.069562
47	0.273310	-0.052996	0.141741	-0.028951	0.019677	-0.069563
48	0.273313	-0.052997	0.141746	-0.028952	0.019679	-0.069564
49	0.273318	-0.052999	0.141749	-0.028951	0.019680	-0.069566
50	0.273320	-0.053000	0.141753	-0.028952	0.019680	-0.069567