UNIVERSITY OF CAPE COAST

DOMESTIC SAVINGS AND ECONOMIC GROWTH IN GHANA

BY

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Thesis submitted to the Department of Economics of the Faculty of Social Sciences, University of Cape Coast in partial fulfillment of the requirements for the award of Master of Philosophy degree in Economics.

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Name: Augustine Mensah Owusu

Candidate's Signature:…… Date:…..……...

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Name: Prof. Isaac K. Acheampong

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ABSTRACT

This study investigates the relationship between domestic savings and economic growth in Ghana using quarterly time series data from 1983 to 2012. The study adopted the quantitative research design under the positivist philosophy to address the research objectives. Whereas domestic savings was measured by gross domestic savings to GDP ratio, economic growth was measured by real GDP per capita. Employing the Johansen's Cointegration within the vector autoregressive and vector error correction framework and Granger causality approaches, the results revealed a positive long run relationship between domestic savings and economic growth.

The results of the forecast error variance decomposition indicated that the most important variable for economic growth besides its own shock was money supply. The source of least forecast error variance of real GDP per capita is the innovations of consumer price index throughout the short-term, medium-term and long-term horizons. Also, there was unidirectional causality between domestic savings and economic growth.

It is therefore recommended that the government should encourage people to save in order to boost investment for increased economic growth.

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DEDICATION

To my parents, Elder G. A. Mensah and Deaconess Elizabeth Mensah.

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
BOG	Bank of Ghana
CPI	Consumer Price Index
CRS	Constant Returns to Scale
DF	Dickey Fuller
DOLS	Dynamic Ordinary Least Squares
DS	Domestic Savings
DW	Durbin Watson
ECM	Error Correction Model
ECT	Error Correction Term
EG	Engle Granger
ERP	Economic Reform Program
FDI	Foreign Direct Investment
FEVD	Forecast Error Variance Decomposition
FMOLS	Fully Modified Ordinary Least Squares
FPE	Final Prediction Error
GCC	Gulf Co-operation Council
GDP	Gross Domestic Product
GNP	Gross National Product
GOV	Government
GTS	General-to-Specific
HICs	Higher Income Countries
HIPC	Highly Indebted Poor Country

HMCs	Higher Middle Income Countries
HQ	Hannan-Quinn information criterion
K	Capital Stock
L	Labour Force
LDCs	Least Developed Countries
LICs	Lower Income Countries
LM	Lagrange Multiplier
LMCs	Lower Middle Income Countries
LR	sequential modified LR test statistic
MS	Money Supply
OLS	Ordinary Least Squares
PP	Phillip Perron
R	Interest Rate
RESET	Regression Specification Error Test
SAP	Structural Adjustment Program
SBC	Schwarz-Bayesian Criterion
SIC	Schwarz Information Criterion
SUR	Seemingly Unrelated Regression
TFP	Total Factor Productivity
TYDL	Toda and Yamamoto and Dolado and Lutkepohl
UMCs	Upper Middle Income Countries
VAR	Vector Autoregression
VEC	Vector Error Correction
VECM	Vector Error Correction Models
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

Background to the study

The relationship between savings and economic growth is an important issue for economists and policy makers as far as economic literature is concerned. Savings are critically essential in maintaining a higher level of investment which is a key determinant of economic growth. Thus, the position of savings in promoting growth has received more attention in growth theories (Budha, 2012).

The neo-classical Solow-Swan (1956) model highlights the relative importance of savings in promoting growth and relegates investment to a more passive equilibrating role. The new growth theories since the mid-1990s, typified by Romer (1986, 1990), Lucas (1988) and Barro (1990) reconfirm the view that the accumulation of physical capital are the drivers of long-run economic growth (Verma, 2007).

Similarly, development economists have been concerned for decades about the crucial role of domestic savings mobilisation in the sustenance and reinforcement of the savings-growth chain in developing economies. The unsatisfactory growth performance of several developing countries has therefore been attributed to poor savings and investment (Nwachukwu & Odigie, 2011). More so, poor growth performance has generally led to a remarkable decline in investment (Nwachukwu & Odigie, 2011). Lin (1992) argued that economic growth could only be sustained when resources such as savings were optimally mobilised and easily transformed into capital. In this regard, savings would not

necessarily generate economic growth if the resources were channelled into non-productive sectors.

The financial system also play a key role in the saving- growth nexus by acting as an effective vessel for: channelling funds from surplus to deficit units by mobilising resources and ensuring an efficient transformation of funds into real productive capital; creating sufficient liquidity in the economy by borrowing short-term and lending long-term; reducing information costs, providing risk management services and reducing risks from the system through diversification and techniques of risk sharing and risk pooling; mobilising savings from atomised individuals for investment, thereby solving the problem of indivisibility in financial transactions and mobilising savings that are invested in the most productive ventures irrespective of the source of the savings. This can be achieved either by direct market based financing or by indirect bank-based finance (Levine, 2004; Emenuga, 2004; Nowbutsing, Ramsohok & Ramsohok, 2010).

In low income countries, there is a vicious cycle of low income leading to low savings, low investment and back to low income. Failure to break the vicious cycle by raising the savings proportion of income results in perpetual stagnation and poverty (Nurkse, 1953 & Myint, 1967). The dismal growth record in most African countries relative to other countries of the world has been of great concern to economists. This is because the growth rate registered in most African countries is often not proportionate to the level of investment. Over the past three decades, saving rates have stagnated in sub-Saharan Africa (Loayza & Shankar, 2000).

The examination of the causal relationship between savings and economic growth is very important because it provides useful information on which economic variable(s) that the government and relevant authorities need to regulate in order to attain the desired level of the targeted variable(s) (Sajid & Sarfraz, 2008). If savings positively affect growth, policy makers can apply policies that increase the mobilisation of savings to provide a higher level of economic growth.

In Ghana, savings naturally play an important role in the economic growth and development process. Savings determine the national capacity to invest and thus to produce, which in turn, affect economic growth potential of the country (Ogoe, 2009). Domestic savings in Ghana result in economic growth through investment which has been observed to be perhaps the most robust explanatory variable in the growth equation of developing countries (Renelt & Levine, 1993).

Projections in the first medium-term development plan of Ghana (Vision 2020) indicated that, domestic savings were expected to equal foreign savings by the year 2000, contributing 11 percent each to GDP (Ayeetey, Fosu & Bawumia, 2001). Gross domestic savings as a percentage of GDP has been low at about 5.7 percent since 2001 to 2010 where as average annual growth rate has improved to about 5.8 percent during that same period (Ministry of Environment Science and Technology-MEST, 2012). Gross capital formation on the other hand has been higher of about 21.1 percent compared to gross domestic savings between 2001 and 2010. Figure 1 below shows the trend of gross domestic savings and real GDP since 1983.

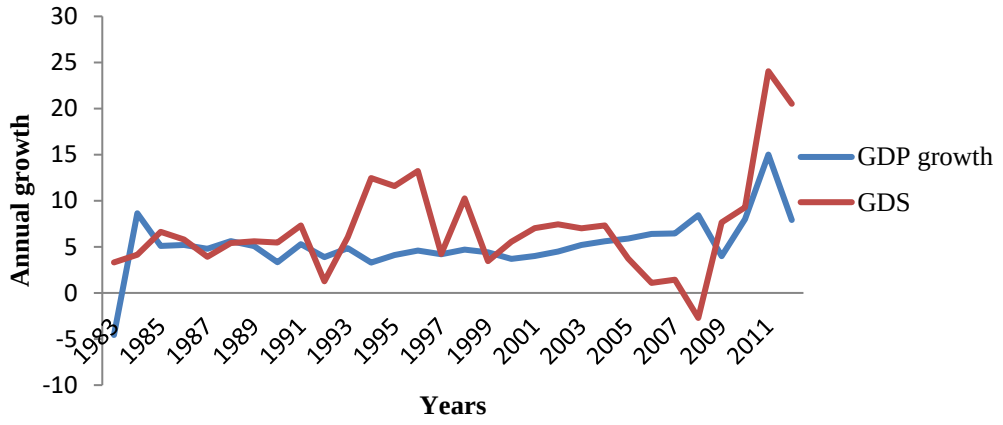


Figure 1: Ghana's gross domestic savings and real gross domestic product
Source: World Bank's World Development Indicators (2012)

Figure 1 shows that, real GDP reached its lowest point ever in the history of Ghana's post independence during the early 1980's. The years that recorded negative GDP growths were 1981, 1982 and 1983. Specifically, 1983 saw the most significant decline in GDP growth, with the fall in total factor production being the most significant contributory factor. GDP per capita declined by more than 3 percent a year, 4.2 percent a year in industrial output and 0.2 percent a year in agricultural output (Aryeetey & Fosu, 2005).

However, real GDP recorded positive values for all the years after the introduction of economic reforms even though the rate of growth has been fluctuating. The highest growth rate of GDP of 15.01 percent was recorded in 2011.

Gross domestic savings on the other hand has been positive since 1983 until 2008 where it recorded a negative value of 2.71 percent. Nevertheless, gross domestic savings of periods after 2008 were positive. The year 2011 recorded the highest figure of 24.05 percent for gross domestic savings. Comparatively, gross domestic savings in Ghana over the past two decades has on the average

reduced which has had significant impact on investment. Even though increase in gross domestic savings is expected to improve economic growth through investment, real GDP improved (5.8%) for the past decade even after a decline in gross domestic savings (5.7%) in the same period (MEST, 2012). This can however be attributed to some other factors that influence real GDP growth in Ghana.

Statement of the problem

It is an undeniable fact that economists have long been interested in the factors that cause different economies to grow in order to attain different levels of wealth. However, many believe that savings play a significant role in an economy because it serves as a source of capital which leads to increase investment portfolio. Growth models developed by Romer (1986) and Lucas (1988) predict that higher saving rates and the related increase in capital accumulation can result in a permanent increase in growth rates. Empirical work by Barro (1990) has provided support to the notion that capital accumulation and savings are central for understanding growth differentials across countries.

Growth rates in Ghana have remained positive since the start of the economic reforms in contrast to some periods in the earlier years where negative growth rates were recorded. Average annual growth rate has improved from about 2.2 percent in the decade 1981 to 1990 to about 4.3 percent between 1991 and 2000 and further to about 5.8 percent between 2001 and 2010. This has contributed in moving Ghana into the Lower Middle Income Status (MEST, 2012). However, the question that needs to be answered is whether the economy's growth rate is enough compared to that of some other lower middle

income countries, for example, Sudan, Cape Verde and Nigeria whose annual growth rates averaged 6.3 percent, 6.4 percent and 9.2 percent respectively between 2001 and 2010. The growth record of Ghana is deemed inadequate for the desired transformation of the economy given that the country in 1993 set itself to become an upper middle income country by 2020 (Aryeetey & Fosu, 2008). In the quest of achieving this objective, it has been estimated using a Harrod-Domar model that the economy needs to grow, on average, at 8 percent to achieve this goal (Institute of Economic Affairs, 1992).

The most robust explanatory variable in the growth equation of developing countries is investment which occurs through savings (Renelt & Levine, 1993). Therefore, considering the theoretically positive relationship between savings and growth, it is believed that domestic savings will be critical in determining the variations in economic growth. However, the argument that is being raised is whether this has been the case for a country like Ghana.

The numerous researches conducted on the relationship between domestic savings and economic growth has employed bivariate approaches. However, bivariate tests suffer from omitted variables problem and lead to erroneous causal inferences (Loizides & Vamvoukas, 2005). A review of existing literature revealed only one study on Ghana by Ogoe (2009). Ogoe (2009) conducted a bivariate study on the causal relationship between gross domestic savings and economic growth in Ghana. The study did not however control for other variables which can influence real GDP per capita such as capital stock, consumer price index, money supply, government expenditure, interest rate and labour force. The introduction of an additional variable in the

causality framework may not only alter the direction of causality but also the magnitude of the estimates (Loizides & Vamvoukas, 2005).

It is against this background that this study seeks to employ the Johansen (1988) and Johansen and Juselius (1992) multivariate approach to examine the cointegration and causal relationship between domestic savings and economic growth in Ghana by including other variables that might be vital in examining the variations in economic growth.

Objectives of the study

The main objective of the study is to examine the relationship between domestic savings and economic growth in Ghana.

The specific objectives of this study are to;

1. determine the long run relationship between domestic savings and economic growth in Ghana.
2. investigate the short run relationship between domestic savings and economic growth in Ghana.
3. examine the direction of causality between domestic savings and economic growth in Ghana.

Hypotheses

1. H_o: there is no long-run relationship between domestic savings and economic growth in Ghana.

   H_1: there is long-run relationship between domestic savings and economic growth in Ghana.

2. H_o: there is no short-run relationship between domestic savings and economic growth in Ghana.

   H_1: there is short-run relationship between domestic savings and economic growth in Ghana.

3. H_o: there is no causal relationship between domestic savings and economic growth in Ghana.

   H_1: there is causal relationship between domestic savings and economic growth in Ghana.

Significance of the study

In view of the opposing theories surrounding the direction of causality between domestic savings and economic growth, this study will contribute to the existing literature on the angle of causality between these two variables in Ghana. Also, the results of the study will serve as a planning tool to Ghanaian policy makers and other stakeholders in the formulation of policies concerning the subject matter. That is, whether domestic savings should be given that crucial role in our national development policy. In addition, there exist few studies using time-series analysis on domestic savings and economic growth relationship in Ghana. In so doing, this study adds to existing literature by addressing some of the methodological issues inherent in existing literature, especially in the case of Ghana.

Scope of the study

This study examines the relationship between domestic savings and economic growth in Ghana using quarterly time series data set for the period

1983 to 2012. This study period was choosen due to the focus of the study which is to investigate the relationship between domestic savings and economic growth after the introduction of economic reforms in Ghana. It includes theoretical and empirical discussions of savings, domestic savings and economic growth. It also gives a background discussion on domestic savings in Ghana as well as the growth process of the Ghanaian economy. The study employed the Johansen's Cointegration and Granger causality techniques. The following variables were employed for the study: economic growth, domestic savings, consumer price index, government expenditure, interest rate, money supply, gross fixed capital formation and labour force. Economic growth is proxied by real gross domestic product (GDP) per capita, domestic savings is proxied by gross domestic savings, gross fixed capital formation is used as a proxy for capital stock, the proportion of the total population aged between fifteen (15) and sixty-five (65) years is used as a proxy for labour force, the Bank of Ghana's prime rate is used as a proxy for interest rate and money and quasi money (M2) is used as a proxy for money supply. The extent of the analysis will only be on the effect of domestic savings on real GDP per capita in Ghana as well as controlling for other macroeconomic determinants of economic growth and their relative importance to real GDP per capita. Domestic savings is expected to be statistically significant and also exert a positive impact on economic growth.

Organisation of the study

This study is organised into five chapters. Chapter one is the introduction and presents a background to the study, problem statement, objectives of the study, hypotheses, significance, the scope and organisation of the study. Chapter

two presents review of relevant literature, both theoretical and empirical that underpins domestic savings and economic growth. Chapter three presents the methodological framework and techniques employed in conducting the study. Chapter four examines and discusses the results and main findings with reference to the literature. The final chapter presents the summary, conclusions and recommendations of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

The aim of this chapter is to present the review of related literature on the relationship between domestic savings and economic growth. This chapter is organized into three sections. The first section looks at the Ghanaian economy with specific focus on Ghana's economic growth experience. The second section presents and discusses the theoretical literature on economic growth as well as the linkage between domestic savings and economic growth. The final section in this chapter presents a review of empirical literature on the relationship between domestic savings and economic growth.

Ghana's growth experience

The growth rate of Ghana has been unstable since independence. Ghana experienced a high rate of economic growth at the early stages of independence. However, the economy began to experience a decline in the growth of GDP by 1964. Growth was turbulent during much of the period after mid-1960 and only began to stabilize after 1984 (Aryeetey & Fosu, 2005). Ghana recorded negative growth rates for the following years; 1966, 1972, 1975, 1976, 1979, 1981, 1982 and 1983 (World Bank, 2012). The negative GDP growth has been attributed mainly to the political instability between these years. However, the years 1974, 1977 and 1978 recorded some positive growth in GDP. In 1975, Ghana recorded the lowest growth rate of -12.4 percent. This decline in growth rate was attributed to the decline in the production of cocoa, minerals, and timber which happened to drive the economy's export after Ghana gained her independence. Cocoa

exports, for example, reduced from 382,000 metric tonnes in 1974 to 159,000 metric tonnes by 1983 (World Bank, 1987).

The implementation of the Economic Reform Program (ERP) and Structural Adjustment Program (SAP) in the 1980s put the economy back on track in terms of economic growth. The first phase of the reforms was instituted in April 1983 and was marked by the adoption of a stabilization programme, the Economic Recovery Programme with a major support from World Bank and the IMF. This programme was intended to halt the downward economic spiral. The full implementation of the programme spread over 1983-6. The second phase of the reform was when the Structural Adjustment Programme (SAP) was introduced to supplement the ERP. The SAP was geared towards correcting a number of structural imbalances in order to engender sustained economic growth. The gains were fragile because the SAP and ERP were mainly that of stabilization and did not contribute to addressing the obstacles to the real sectors of the economy. Aryeetey and Kanbur (2008) noted that, the economy responded positively to the economic reforms as it recovered from its negative growth rate of 5 percent in 1983 to an immense positive economic growth rate of about 8 percent in the following year. Ghana has since the implementation of the ERP and SAP seen consistent, stable, and positive economic growth, with annual growth rates averaging 5.4 percent (World Bank, 2012).

However, with the country's high average rate of economic growth of 5.4 percent, the growth record is deemed inadequate for the desired transformation of the economy given that the country in 1993 set itself to become an upper middle income country by 2020 (Aryeetey & Fosu, 2008). In pursuit of achieving this objective, it was estimated using a Harrod-Domar model that the

economy needed to grow, on average, at 8 percent to achieve this goal (Institute of Economic Affairs, 1992). The economy did not show any aptitude of achieving this goal in five years after the targets were set. The government used the apparent stability of the Ghanaian economy as a springboard for economic diversification and expansion and began the process of moving Ghana from a primarily agricultural economy to a mixed agricultural industrial one, (Aryeetey & Fosu, 2003). Unfortunately, the price of cocoa collapsed in the mid-1960s, destroying the fundamental stability of the economy (Aryeetey & Fosu, 2003). Since then, Ghana has been caught in a cycle of debt, weak commodity demand, and currency overvaluation, which has resulted in the decay of unproductive capacities and a crippling growth rate.

The economic and growth performance of the country had been characterized by the non-attainment of macroeconomic targets. Particularly, while GDP was expected to grow between 7.1 percent and 8.3 percent in the period 1996-2000, actual growth was between 4.2 percent and 5.0 percent (Fosu & Aryeetey, 2008). From 1984 to 2006, the GDP growth has averaged about 3.9 to 4.5 percent (Baafi, 2010).

The developments in 1999 reflect the condition of significant divergence between actual and targeted macroeconomic figures. This is better explained with the case in 1999 where real GDP growth of 4.4 percent was 1.1 percent less than the targeted growth. Also, end-of-period inflation was 4.3 percent higher than targeted, and budget deficit was 3 percent higher than what was targeted. This trend of non-attainment of macroeconomic targets persisted up to 2002 (Centre for Policy Analysis, 2003).

Ghana experienced a huge debt relief after joining the Highly Indebted Poor Country (HIPC) initiative. The country also saw progress in becoming an upper middle income country with the discovery of oil in commercial quantities. There was an increase in GDP growth from 4 percent in 2001 to 14.4 percent in 2011 while per capita GDP growth has increased from U.S. $270.43 in 2001 to U.S. $1570.13 in 2011 (World Bank, 2012). According to Fosu and Aryeetey (2008), the inability of the Ghanaian economy to grow beyond an average of 6.0 percent per annum is basically due to the absence of structural transformation of the economy. This is influenced by the fact that macroeconomic policies have not been ashore in a comprehensive and reliable long-term development framework. Figure 2 gives the trend in the growth of GDP and per capita GDP growth in Ghana from 1970 to 2011.

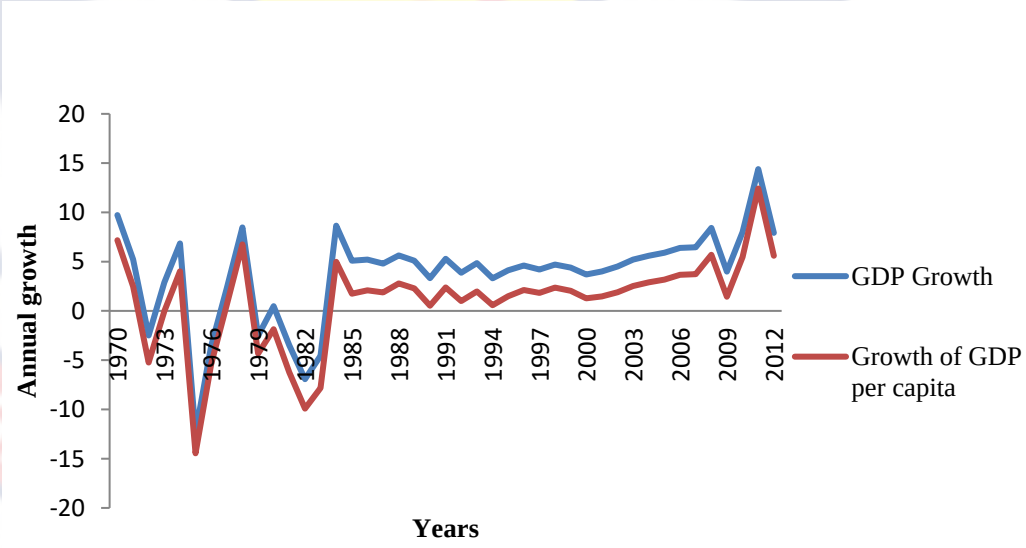


Figure 2: Trends in GDP and Per capita GDP growth
Source: Generated from WDI (2012) using Excel

Baafi, (2010) suggested that, Ghana's growth of GDP is closely tracked by growth of GDP per capita. The stable co-movement of growth of per capita GDP and real GDP growth shows a stable population growth rate over the period 1970 to 2012. The highest growth rates were recorded in 1970 with per capita

GDP of 7.2 percent and real GDP increasing to 9.7 percent. In 1975, the lowest growth rate in per capita GDP and real GDP were recorded. Growth rate of GDP per capita decreased to -14.5 percent where as real GDP growth rate reduced to -12.4 percent. The slow rate of per capita income growth in the economy, averaging 2.8 percent since 1990 has largely been attributed to low productivity in the economy (O'Connel & Ndulu, 2000).

To achieve sustained economic growth, increased production and productivity must be at the centre of an economic recovery strategy. In order to formulate strategies for rapid economic growth necessary for poverty reduction and the attainment of upper middle income by 2020, all relevant information is important. Hence, it is very imperative to decompose the structure of Ghana's economic growth rate in order to get a better understanding of the factors that have produced differences in growth rates in the various periods.

Trend of other macroeconomic variables used for the study (1983-2012)

The growth in government expenditure has been oscillating and does not show a consistent pattern. From Figure 3, government expenditure began to rise from 1983 to 1986 and later fell between 1987 and 1988. Government expenditure rose again between 1988 and 1989 then fell thereafter, but rose between 1991 and 1993. It fell again after 1993 and rose from 2002 to 2005. However, from the graph, government expenditure was highest in 2011 and the lowest was recorded in 1983.

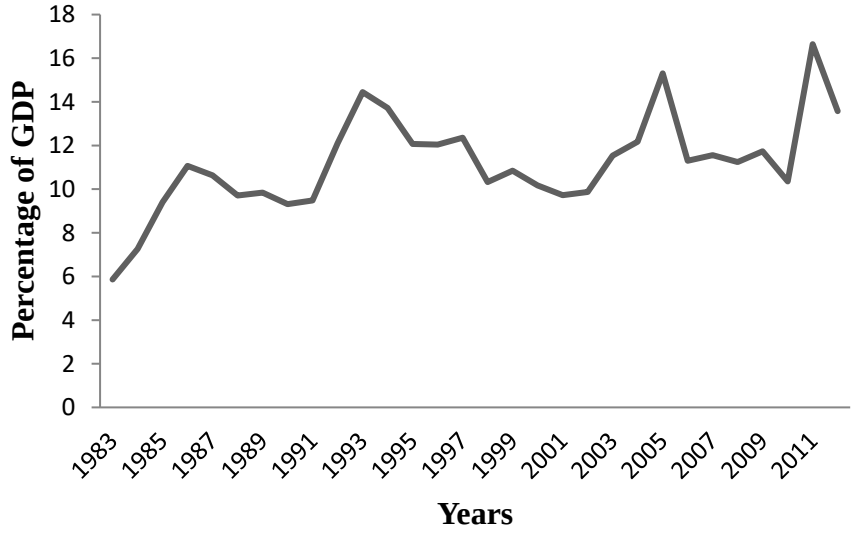


Figure 3: Trend in the level of government expenditure in Ghana since 1983
Source: Generated from WDI (2012) using Excel

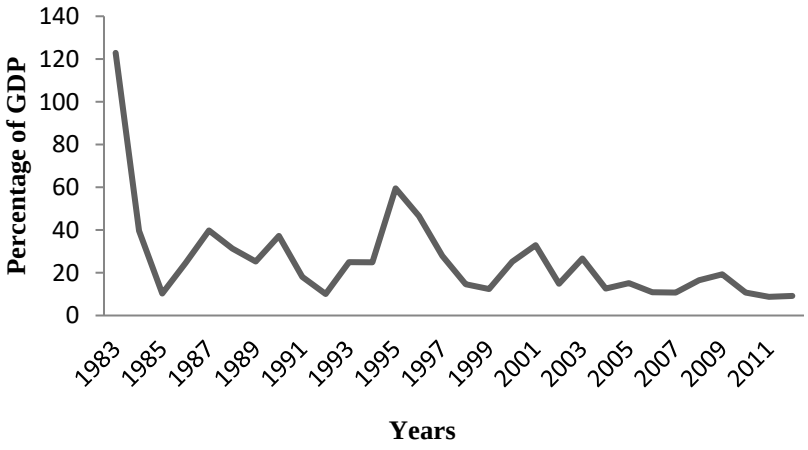


Figure 4: Trend in the level of inflation in Ghana (1983-2012)
Source: Generated from WDI (2012) using Excel

From Figure 4, the rate of inflation has been inconsistent since 1983. Inflation rate fell between 1983 and 1985 and increased in 1986 and 1987. Inflation rate decreased again in 1988 and 1989 after which it increased in 1990. The highest rate of inflation was recorded in 1983 whereas the least growth in the rate of inflation occurred in 2011.

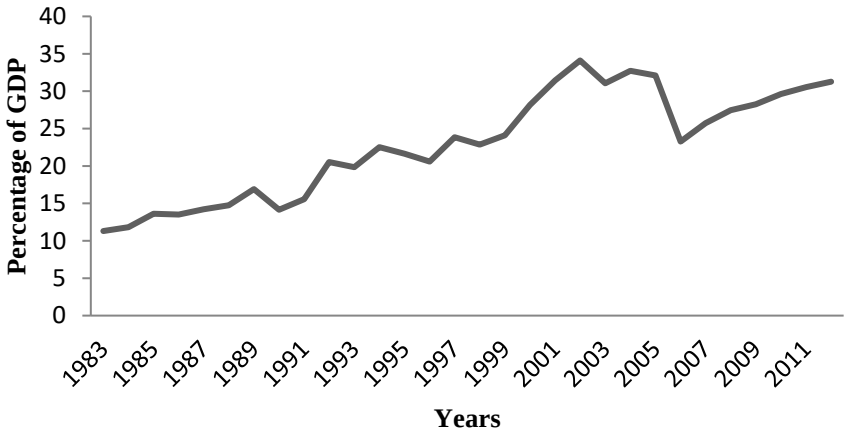


Figure 5: Trend in the level of money supply in Ghana (1983-2012)
Source: Generated from WDI (2012) using Excel

Figure 5 indicates that, money supply increased between 1983 and 1985 and fell in 1986. Money supply rose again between 1987 and1989 but fell in 1990. The highest growth in money supply was recorded in 2002 whereas the least growth of money supply was recorded in 1983.

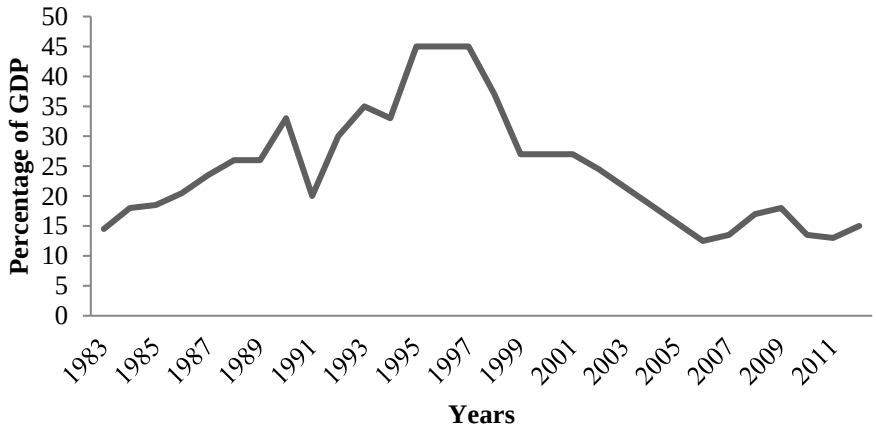
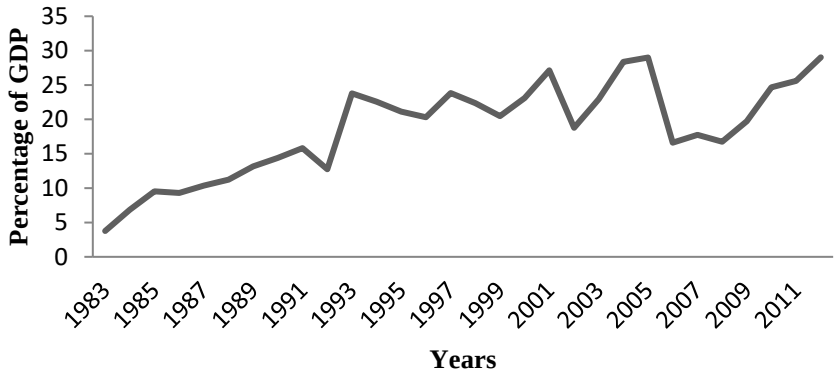


Figure 6: Trend in the level of interest rate in Ghana (1983-2012)
Source: Generated from WDI (2012) using Excel

The rate of interest from Figure 6 shows an increase from 1983 to 1990. Also, interest rate fell in 1991 but rose from 1992 to 1993. In 1995, interest rate was stable between 1995 and 1997 as well as between 1999 and 2001 after which

it has been inconsistent. The years that recorded the highest interest rate were 1995, 1996 and 1997. However, 2006 recorded the least rate of interest.



;Figure 7: Trend in the level of gross fixed capital formation in Ghana (1983-2012)
Source: Generated from WDI (2012) using Excel

From Figure 7 above, gross fixed capital formation increased from 1983 to 1985, fell in 1986 and further increased between 1987 and 1991. Gross fixed capital formation has increased since 2008. The year 2012 recorded the highest level of gross fixed capital formation and the least value of gross fixed capital formation was recorded in 1983.

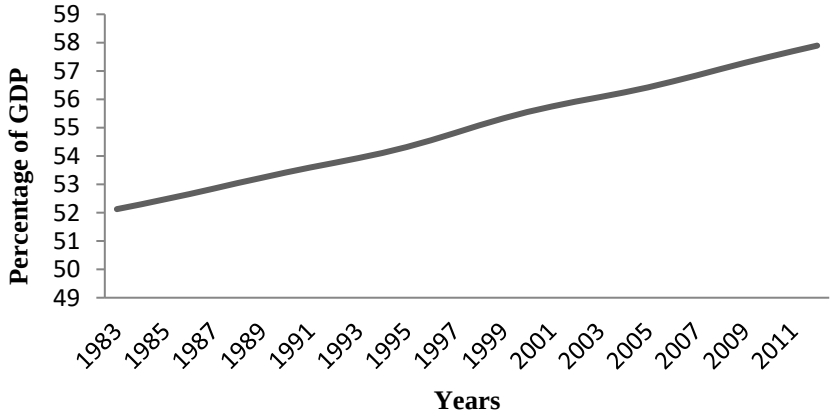


Figure 8: Trend in the level of population ages 15-64 in Ghana (1983-2012)
Source: Generated from WDI (2012) using Excel

The diagram from Figure 8 shows that, the level of population of Ghana ages 15 to 64 has been increasing since 1983. The year that recorded the highest population ages 15 to 64 was 2012 whiles the lowest was recorded in 1983.

Review of theoretical literature

The theoretical framework for the study is presented in this section. This section, therefore, provides an account of the theoretical developments in the area of domestic savings and economic growth. The study reviewed theoretical literature on economic growth as well as savings.

Neoclassical theory of economic growth

Theoretical work on economic growth can be traced back to the works of classical economists like Adam Smith, Rev Thomas Malthus, and David Ricardo. Though these early economists did not consciously study economic growth or talk about it, they outlined the fundamental elements of economic growth in their publications. Some of the main proponents of the neoclassical growth theory include: Ramsey (1928); Solow (1956); Swan (1956); Koopmans (1965); Romer (1986) and Lucas (1988).

A great deal of modern theoretical and empirical work on economic growth is based on the neoclassical growth model. The extensive use of the neoclassical model centres on the important role it plays in coordinating and integrating various works in macroeconomics, international economics and public finance. The neoclassical model therefore enjoys a wide usage in aggregate economic analysis.

The starting point of neoclassical theory of growth can be traced to the Harrod-Domar model that tends to explain the relationship between investment, growth rate and employment in an economy with stationary growth. For these two economists, production capacity was proportional to the stock of capital (Sueyoshi , 2010).

One basis of the neoclassical free-market argument is the assertion that liberalization of national markets draws additional domestic and foreign investment and thus increases the rate of capital accumulation. This is equivalent to increasing domestic savings rates in terms of GDP growth which enhances capital-labour ratios and per capita incomes in capital-poor developing countries.

Ramsey (1928) model is an important neoclassical growth theory which is an enhancement of the Solow model. In the literature, Ramsey model is usually put after the Solow model even though the Ramsey's growth theory was formulated before the Solow model. One of the vital characteristics in the Ramsey model is the assumption that households maximize their satisfaction (utility) over time. This all-important assumption makes the model a dynamic one.

The Solow (1956) neoclassical growth model in particular represented the determining contribution to the neoclassical theory of growth. It expanded on the Harrod-Domar formulation by adding a second factor, labour and introducing a third independent variable, technology to the growth equation.

Solow (1956) contributed to the development of the theory of economic growth by improving the severity of the assumptions. Solow (1956) basically argued that if production activity takes place under neoclassical production conditions of variable proportions and constant returns to scale, there would be

no resistance between natural and unwarranted growth rates. The system is self-adjusting to any given rate of growth of labour force and ultimately approaches a state of steady proportional expansion.

In order to differentiate his model from the Harrod-Domar model and its fixed capital-output ratio, Solow defined a production function that permits factors to be continuously substituted for each other. Such continuous substitution means that the marginal product of each factor are variable, depending on how much of the factor is already used in production and how many other factors it is combined with. The continuous substitutability of the factors of production is what makes Solow's model neoclassical in nature (Van den Berg, 2001).

One very important assumption of the Solow model is that, it exhibits diminishing returns to labour and capital separately and constant returns to both factors jointly. The model exhibited diminishing returns in the sense that as equal increments of one factor are added to a fixed amount of the other factors of production, output increases, but it increases by very smaller amounts. This is not a radical assumption: recall that, Thomas had assumed that labour was subject to diminishing returns when it was combined with a fixed stock of agricultural land. Solow's aim was to show that the Harrod-Domar model was wrong in concluding that a constant rate of savings and investment could bring everlasting economic growth. Solow showed that, with diminishing returns, continuous investment could not, by itself, generate permanent economic growth because diminishing returns would eventually cause the gains in output from investment to approach zero. Solow's model thus clashed with what many development economists were advising policy makers to do in order to increase

economic growth, which was to increase savings and investment any way possible (Van den Berg, 2001). The residual factor explaining long-term growth was technological progress and its level was assumed by Solow and other neoclassical growth theorists to be determined exogenously, that is independent of all other factors.

The neoclassical Solow model explains economic growth as resulting from the combination of two elements, namely capital and labour. This gives rise to the question: how much of output growth can be attributed to other factors of production apart from labour and capital. To answer this question, Solow disintegrates the growth in output into three components, each identifiable as contribution of one factor of production, that is labour, capital, and total factor productivity. This implied that in the Solow model, long term economic growth is explained by labour augmenting technological change and by the increase of capital per labour.

The total factor productivity is often referred to as the Solow residual. The term residual is suitable, since the estimate represent the part of measured GDP growth that may not be accounted for by labour and capital. The residual refers to the difference between the rate of growth of output and the weighted average of the rates of growth of capital and labour, with factor income shares as weights. The total factor productivity is calculated under the assumption of perfect competition in the labour and capital market as well as the product and service markets.

The Solow-Swan (1956) model presents the view that a rise in the savings rate affects the stock of capital and the level of per-capita income, but does not affect the rate of economic growth. An increase in the savings rate

increases per capita output and per capital stock in steady-state. A higher savings rate will generate more investment per unit of output than it did before which in turn will lead to an expansion of capital per worker. The process, however, comes to a halt since for a given growth rate of labour, an increasing proportion of investment will be devoted to maintaining this higher capital-labour ratio. The savings rate thus influences the level of per capita capital stock and thus per capita output towards which the economy gravitates in equilibrium, rather than the rate at which either magnitude changes.

On the whole, the Solow-Swan model posits that a change in the savings rate changes the economy's balanced growth path and hence per capita output in steady state, but it does not affect the growth rate of output per worker on the balanced growth path. Only an exogenous technological change will result in a further increase in output per worker in steady state.

Using Ramsey's model as their basis, Cass and Koopmans (1965) recast the savings rate that is exogenous under the Solow model as endogenous. Despite the fact that Cass and Koopmans's work is believed to be an improvement of the neoclassical growth model, it does not do away with the dependence of the long-run growth rate on exogenous technological progress. The works of Cass and Koopmans (1965) essentially marked the end of the basic neoclassical growth era.

By contrast, the Romer (1986) growth model assumes technology to be endogenous. According to the model an increase in the savings rate not only increases per capita output in steady state but also increases the growth rate of per capita output. Thus, since the growth rate of the capital-labour ratio is not declining, it follows that the growth rate of per capita output is not declining in

the capital-labour ratio either. Thus, an increase in the savings rate, not only increases the growth rate of the capital-labour ratio, and per capita output, but also the increase in the growth rate would persist indefinitely.

The difference between the Solow-Swan (1956) model and the Romer (1986) model relates to the nature of the capital stock. Since, in the Romer model, the social returns to scale in capital are constant, the marginal product of capital is also constant. Unlike in the Solow-Swan model, there is no incentive in the Romer model to discontinue investing in capital as the capital-labour ratio increases. Thus, there is no incentive for the economy to stop expanding. The above discussion illustrates how an increase in the savings rate can indeed lead to growth and more so, when technological change is seen as being endogenous, the increase in the growth rate will persist indefinitely. Thus, while the Solow-Swan model shows the savings rate to have a temporary effect on the growth rate, the Romer model shows the effect to be permanent.

Endogenous growth theory

The Neoclassical growth model is concerned with the dynamic process through which capital-labour ratios approach long-run equilibrium levels. However, in the absence of technological change, which is not explained in the neoclassical model, the growth of all economies will converge to zero. Thus, an increase in per capita gross national income is considered a temporary phenomenon which occurs as a result of a change in technology or short-term equilibrating process in which an economy approaches its long-run equilibrium.

The neoclassical model simply assumes technological progress is exogenous or completely independent process to the mainstream of the

economy's growth. Given the empirical and policy problems associated with the Solow model, a number of new models which attempt to endogenise the growth process have been approved. The dependence of growth on exogenous technological progress in the neoclassical growth model and the apparent inconsistency of the "unconditional convergence" hypothesis led to the renewed search for alternative models that can generate economic growth endogenously. The major proponents are Lucas (1988), Grossman and Helpman (1991), and Jones (1995).

Research works of the mid 1980s therefore began by considering models that examined long-run growth through the accumulation of all sorts of capital. This includes human capital, spill over effects and the endogeneity of the technological process. The pioneering work on endogenous growth theory was by Romer (1986) and Lucas (1988). The numerous jarring behaviour of developing world capital flows helped provide the drive for the development of the concept of endogenous growth theory or, more simply the new growth theory.

The neoclassical growth model assumes a perfect competition for economic efficiency. According to the neoclassical model, capital receives a rate of return that is equivalent to its marginal product. This implies that, for entrepreneurs to yield profitable investment, the marginal product of capital should be above the discount rate. Nevertheless, in the long-term, the diminishing returns of production factors might impede economic growth. In the endogenous growth models, due to the spill over effects, marginal product of capital can remain permanently higher than the investment discount rate, even in the face of diminishing returns that is due to the lack of introduction of new

technologies and improvement in productivity (Grossman & Helpman, 1994). The endogenous growth theorists are concerned with explaining the factors that determine the rate of growth of gross domestic product that is left unexplained and exogenously determined in the Solow neoclassical growth equation.

The theoretical difference between the neoclassical and the endogenous growth model stem from discarding the neoclassical assumption of diminishing marginal returns to capital investments, permitting increasing returns to scale in aggregate production, and frequently focusing on the role of externalities in determining the rate of return on capital investments. By assuming that public and private investments in human capital generate external economies and productivity improvements that offset the natural tendency for diminishing returns, endogenous growth theory seeks to explain the existence of increasing returns to scale and the divergent long-term growth patterns among countries. Also, whereas technology still plays an important role in these models, exogenous changes in technology are no longer necessary to explain long-run growth (Todaro & Smith, 2009). There are beneficial spill over to the economy from the research and development process so that the social benefits of innovation exceed the private benefits to the original innovator. These externalities generate momentum in the growth process. As firms install new capital, this tends to be linked with process and product innovations. The motivation to devote resources to innovation comes from the prospect of temporary monopoly profits for successful innovations (Stern, 2003).

The Romer (1986) endogenous growth model addresses technological spillovers that may be present in the process of industrialization. The growth rate of per capita output will not decline since the growth rate of the capita-labour

ratio remains the same. Therefore, any rise in the rate of savings leads to an increase in the growth rate of the capita-labour ratio, per capita output as well as an indistinct persistence of the growth rate.

However, Romer (1990) stressed that endogenous growth does not just happen. He identified four basic pre – conditions for growth which are;

1. Capital – measured in units of consumption goods.
2. Labour – skills available from a healthy human body.
3. Human capital – activities such as formal education and on the job training which is person specific.
4. An index of the level of technology.

A glaring problem here is that the empirical implications of these models are less clear as technological progress and the factors influencing it are difficult to measure.

McKinnon-Shaw model

McKinnon (1973) and Shaw (1973) were the first to suggest theoretical arguments against the policies of financial repression. They pointed out the vital role of the financial sector in growing the volume of savings as a result of creating appropriate incentives.

In order to reach higher savings and hence investment rates, McKinnon (1973) and Shaw (1973) argue that governments should eliminate interest rate ceilings and allow real interest rates to be determined by the market. They argued that the elimination of interest rate ceilings will result to increasing savings and investment and thereby leading to economic growth as well as reducing inflation (Gibson & Tsakalotos, 1994).

Mckinnon (1973) argues that money holdings and capital accumulation are complementary in a development process. Because of the lumpiness of investment expenditure and the reliance on self-finance, agents need to accumulate money balances before investment takes place. Positive (and high) real interest rates are necessary to encourage agents to accumulate money balances, and complementarity with capital accumulation will exist as long as the real interest rate does not exceed the real rate of return on investment.

Shaw (1973) stresses the importance of financial liberalization for financial deepening, and the effect of high interest rates on the encouragement to save and the discouragement to invest in low-yielding projects. The increased liabilities of the banking system resulting from higher real interest rates, enables the banking system to lend more resources for productive investment in a more efficient way.

Advocates of financial liberalization theory, Levhari and Patinkin (1968), McKinnon (1973) and Shaw (1973) have, however, argued for financial liberalization on the basis that saving is complementary to investment in the development process, even with a money economy where saving can go either into the accumulation of money balances or the accumulation of physical capital. The McKinnon-Shaw Model postulates that, financial development affects economic growth positively. The McKinnon-Shaw Model extends the supply-side argument by emphasising that financial development implies not only higher productivity of capital but also a higher savings rate and therefore, a higher volume of investment leading to growth (DeGregorio & Guidotti, 1995). This model focuses on the effect of public policy regarding financial development as being characterised by financial restrictions.

McKinnon (1973) and Shaw (1973) stress the negative effects of financial repression on economic growth, characterising developing economies. The McKinnon-Shaw Model postulates economic development in which financial liberalization prevails rather than financial repression accelerating rate of growth.

By taking a neo-liberal position on the role of money in the development process, McKinnon (1973) and Shaw (1973) argued that financially repressive policies in the form of nominal interest rate ceilings, controlled credit allocation and high reserve requirements were not only inefficient but also the source of economic instability that reduced the volume of financial savings, the rate of real economic growth and the real size of the financial system relative to the non-financial sector in developing countries. Financial repression in this context is defined to entail artificially low deposit and loan rates that give rise to excess demand for loans and to non-price credit rationing (McKinnon, 1973; Shaw, 1973).

The McKinnon-Shaw Model suggests that liberalization of financial markets allows penetration of financial services among the rural population and therefore providing them with accessible tools of finance could be considered a very significant step towards achieving economic growth. McKinnon (1973) and Shaw (1973) argue that, liberalization of financial markets allows financial deepening which reflects an increasing use of financial intermediation by savers and investors and the monetisation of the economy, and allows efficient flow of resources among people and institutions over time. According to the McKinnon-Shaw Model, liberalization encourages savings and reduces constraint on capital accumulation and improves allocative efficiency. Also the low return on bank

deposits encourages savers to hold their savings in the form of unproductive assets such as land, rather than the potentially productive bank deposits. They assert that financial liberalisation would improve the rate of economic growth through increased efficiency in financial intermediation subject to financial discipline (Acheampong, 2007).

According to this model, interest rate ceilings distort the economy in four ways: Bias in favour of current consumption and against future consumption, hence reducing savings below the socially optimal level; engagement in relatively low-yielding investments; bank borrowers are able to obtain all the funds they want at low interest rates and will choose relatively capital-intensive projects and the pool of potential borrowers contains entrepreneurs with low yielding projects who would not want to borrow at the higher market clearing interest rates (Fry,1978).

The proposition by McKinnon (1973) and Shaw (1973) was supported by their complementarity and debt intermediation hypotheses. McKinnon (1973) on complementarity between money balances and physical capital, considers an outside model of money demand (money backed by loans to government). McKinnon (1973) postulates that, there are limited opportunities for external finance and all firms are confined to self-finance due to underdeveloped financial markets in most developing countries. Given that investment expenditures are lumpier than consumption expenditures; potential investors must first accumulate money balances prior to undertaking relatively expensive and indivisible investment projects. Shaw (1973) on the other hand based his 'debt-intermediation' hypothesis on an inside money model. He contends that high interest rates are vital in attracting more saving. With more supply of credit,

financial intermediaries promote investment and raise output growth through borrowing and lending.

However, both the theoretical underpinnings and the empirical validity of the McKinnon-Shaw thesis have been challenged by various scholars since 1980's. The neo-structuralist led by Wijnbergen (1983) and Taylor (1983) argued that given that financial sector reform leads to increased mobilised savings, it may not facilitate economic growth. Economic activities would be induced if more of the growth in savings is channelled to productive activities. On the contrary, the gains to economic growth through increased credit to the private sector would be sidelined if the increased savings is used to finance public sector deficits (Wijnbergen, 1983).

Again, the implicit assumption that seem to underlie financial liberalisation and for that matter the McKinnon-Shaw hypothesis is that markets will work reasonably well when left alone. A refutation from Keynesian economics is the fact that markets are not necessarily self-equilibrating because of, among other things, the role of expectations.

Emenuga (2004) argued that increased real interest rate may not necessarily lead to improved private savings. In developing countries, the level of income could be so low that all or more than half of households' earnings are spent on basic needs. In such a case, even with high real interest rates, very little if any proportion of income could be saved. This suggests that the McKinnon-Shaw proposition would therefore be more relevant in rich nations.

Review of empirical literature

Several studies have been carried out to examine the relationship between domestic savings and economic growth. However findings of these

studies tend to give conflicting results. Some studies have shown that, it is growth in domestic savings that leads to growth in real GDP and hence economic growth while others have opposing views that economic growth rather leads to growth in domestic savings. Some studies have also indicated a bidirectional relationship between growth of domestic savings and economic growth. The section is divided into three subsections. The study considers cross country studies, country specific studies as well as empirical works on Ghana.

Cross Country Studies

Using both the Vector Error Correction (VEC) and Vector Autoregression models (VAR), Saltz (1999) examined the causal relationship between savings and economic growth of seventeen third world countries. The author used VECM for nine countries whose variables were cointegrated. For other eight countries whose variables were not cointegrated, the author employed the Vector Autoregressive (VAR) model to find the causality. The results confirmed that in four countries (Colombia, Jamaica, Peru, and the Philippines) no causality was detected in either direction. For eight countries the empirical results indicated that the growth rate of real GDP positively granger causes the growth rate of gross domestic savings. For two countries (Argentina and Taiwan), it was the growth rate of gross domestic savings which granger causes the growth rate of real GDP. Finally, for two countries (Dominican Republic and Mexico), there was bi-directional causality. However, the author did not clearly state the reason for the detection of no causality in the four countries (Colombia, Jamaica, Peru, and the Philippines).

Agarwal (2001) investigated the causality between gross domestic product (GDP) and saving for seven Asian countries. Granger causality analysis was undertaken using the VECM (Engle and Granger) and VAR procedures. The results of the study showed that in most cases, the direction of causality runs primarily from growth (or income) to savings, although in some countries, there is also evidence of a feedback effect from savings to income and growth. The author thus suggested that, development policy should focus less on promoting high savings rates and more on promoting high growth rates. Estimation of the savings functions were presented using Engle and Granger's Static OLS and Stock and Watson's dynamic OLS (DOLS) procedures where appropriate. The high savings rates in Asia were found to be due to the high rate of growth of income per capita, declining shares of dependent population, and some special institutional features, such as the high central provident fund rates in Singapore. Interest rates were found to have little impact on savings. The author discovered that, in most economies causality runs from GDP to saving.

Anoruo and Ahmad (2001) explored the causal relationship between economic growth and the growth rates of domestic savings for the Congo, Coˆted'Ivoire, Ghana, Kenya, South Africa, and Zambia for the period 1960–1997. The authors employed the Johansen and Juselius's (1990) co-integration test and the Granger causality test. The results from the study showed a long-run relationship between economic growth and the growth rates of domestic savings. The results indicated a unidirectional causality whereby economic growth causes growth rate of domestic savings for most of the countries under consideration.

Using Granger causality analysis with bootstrapping, Konya (2004) investigated the relationship between savings and growth on panels of countries.

The paper examined the possibility of Granger causality between the saving ratio (the proportion of gross domestic saving in GDP) and the growth rate (annual percentage change of real per capita GDP) in eighty-four countries of the world from 1961 to 2000. For technical reason, the countries have been classified on the basis of their per capita GDP in 1995 as high-income (at least 10000 $US), medium-income (between 1000 and 10000 $US) and low income (less than 1000 $US) countries, and the three panels of twenty-six, thirty and twenty eight countries, respectively, are considered separately. Granger causality is tested for with a new panel-data approach based on SUR systems and Wald tests with country specific bootstrap critical values. The results indicated two-way Granger causality between the saving ratio and the growth rate in Austria, one-way causality from saving to growth in Ireland, Trinidad & Tobago and the Central African Republic, and one-way causality from growth to saving in Finland, France, Japan, Sweden, Switzerland and Niger. There was also some support to causality from saving to growth in Mauritania and from growth to saving in Saudi Arabia, but in all other cases there is no empirical evidence of Granger causality in either direction. However, the study did not conduct panel unit root test which is very important in panel analysis because of the problem of spurious regression.

Mohan (2006) examined the relationship between domestic savings and economic growth by taking into consideration the income levels of the different countries studied. He grouped the countries into various categories, namely low income countries (LICs), low middle income countries (LMCs), upper middle income countries (UMCs), and high income countries (HMCs). The study's results supported the claim that causality runs from economic growth rate to

growth rate of savings. The author submitted that the income level of a country plays an important role in determining the causal relationship between savings and economic growth. In addition, the author reported that empirical results were mixed in the LICs, while causality runs from growth rate to savings rate for most of LMCs. Finally, whereas in the HICs (except Singapore), causality runs from economic growth rate to growth rate of savings, a feedback causal relation was more prevalent in the UMCs.

Bassam (2010) employed a newly developed ARDL approach to cointegration by Pesaran et al. (2001) to investigate the long-run relationship between savings and economic growth in Morocco and Tunisia. The author used real gross domestic saving (S) and real gross domestic product (Y) as a measure for savings and economic growth respectively for Morocco and Tunisia. The study period for Morocco was from 1965 to 2007 and that for Tunisia was from 1961 to 2007, respectively. The ADF test results show that both variables *S* and *Y* are nonstationary in their levels and stationary in their first difference in both countries. In addition, the Phillips-Perron test results confirm the results that both variables *S* and *Y* are nonstationary in their levels and stationary in their first difference in both countries. The cointegration test results revealed that in the case of Morocco a long-run relationship existed between the variables, while no evidence of long-run relationship existed in the case of Tunisia. Also, the Granger causality test indicated the existence of a bidirectional causal relationship between gross domestic product growth and gross domestic saving growth in Morocco. Lastly, the author observed a unidirectional Granger causality between real gross domestic product and real gross domestic saving as causality runs from gross domestic saving growth to gross domestic product

growth in Tunisia. However, these results should be interpreted with caution since they may be affected if we could have a large data set and it may be useful to add other policy variables and see how this affects the economy.

Baafi (2010), using time series data, tested the validity of the hypothesis for Ghana and the Western European Countries (with the United Kingdom (UK), as a proxy). He determined how fast or slow this convergence process is by using the returns to scale concept on Ghana's economy and latter account for the factor that determines economic growth in sectors. The study supported the null hypothesis of convergence that is Ghana is catching up with the Western European countries and also showed that Ghana's growth accounting exhibits decreasing returns which is an implication of its relatively slow convergence and unbalanced growth path (this refers to the simultaneous, coordinated expansion of several sectors of the economy). The study showed a negative relationship between GDP and labour supply both in the long run and short run relationship. Again, the study showed a positive relationship between GDP and capital, agricultural and Industrial sector. Lastly, the study showed a negative relationship between GDP and AID and Service in the long run and positive relationship in the short run.

Misztal (2011) examined the relationship between savings and economic growth in advanced, emerging and developing countries. The study employed method based on studies in macroeconomics and international finance as well as econometric methods (co-integration models and Granger's causality test). The results confirmed the existence of one-way casual relationship between gross domestic savings and gross domestic product in the case of developed countries as well as in developing and transition countries. At the same time it revealed

the absence of causal relationship between gross domestic product and gross domestic savings both in developed economies, developing and transition countries.

Alomar (2013) investigated the relationship between domestic savings and economic growth of GCC (Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates, and Oman). The study used annual data from 1980 to 2010 for a panel of 6 Countries. The ADF unit root test indicated that both log of GDP and log of GDS series have unit roots in the level data. The Johansen Fisher Panel cointegration method was used to examine the nature of the relationship. The main finding is pointing to such a relationship between Domestic savings and economic growth in all of the GCC with different level of significant. The findings suggested that the economic growth rate Granger causes growth rate of savings in 4 countries. The opposite results prevailed in one country, which is Oman. In Bahrain only, a bi-directional causality was found. Based on the empirical results, the main conclusion of this study is that income source of a country does play an important role in determining the direction of causality. In those countries where most income came from natural resources, direction of the causality was from economic growth to domestic savings.

Country Specific Studies

Using the Granger non-causality test procedure developed by Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996), Alguacil, Cuadros, and Orts, (2004) analysed the saving-growth nexus in Mexico. Contrary to the reverse causation between national saving and domestic income found in other

empirical studies, evidence was presented in favour of Solow's model prediction that higher saving leads to higher economic growth. The confirmation of a saving-growth nexus in this country seems to be related to the inclusion of foreign direct investment (FDI) in the model, as the most relevant component of foreign saving. As this study tried to show, this last variable enhances economic growth and reinforces the connection between the two focus variables in the analysed country.

Sinha and Sinha (2007) examined the relationship between per capita saving and per capita GDP for India during the period 1950-2004. The authors employed the Toda and Yamamoto tests of Granger causality and distinguished between three types of saving: household saving, corporate saving and public saving. Ng-Perron unit root tests showed that all variables with the exception of per capita public saving were I(1). The results of Toda-Yamamoto tests of Granger causality showed that there was bidirectional causality between per capita household saving and per capita corporate saving. However, there was no evidence of causality in any direction between per capita GDP and per capita corporate saving/per capita household saving.

Sajid and Sarfraz (2008) investigated the causal relationship between savings and output in Pakistan by using quarterly data for the period of 1973 to 2003. The study employed the cointegration and the vector error correction techniques to explore the causal relationship between savings and economic growth. The results suggested bi-directional mutual long run relationship between savings and output level. However, there was unidirectional long run causality from public savings to output (GNP and GDP), and unidirectional long run causality from private savings to gross national product (GNP). The results

also indicated that the speed of adjustment in case of savings is stronger than that of level of output. The overall long run results of the study favour the capital fundamentalist's point of view that savings precede the level of output in case of Pakistan. The short run mutual relationship existed between gross domestic product (GDP) and domestic savings. The results also indicated unidirectional short run causality from gross national product (GNP) to national and domestic savings; and from gross domestic product (GDP) to public savings. The short run causality runs only from national savings to gross domestic product (GDP). So overall short run results favour Keynesian point of view that savings depend upon level of output.

Waithima (2008) examined the relationship between savings and growth in Kenya. The paper adopted the Hendry Model with a two-step method to model a saving function for Kenya. The Model used a complex dynamic specification that includes lagged dependent and the independent variables. The results showed that a 1% increase in GDP growth rate leads to a 0.5% increase in private saving in the long run which is consistent with the life cycle hypothesis. A striking result in the saving function is the positive effect that population growth rate seems to have on private savings which puts into question the notion of a smaller population as a mobilization tool for private saving. Even though consumption had a significant negative effect on private savings in the short run, in the long run, it did not have any significant effect. Results from the granger causality tests supported uni-directional causality from per capita GDP to private saving and a bi-directional causality between Gross Domestic Saving and Investment.

Lean and Song (2009) examined the relationship between the growth of domestic savings and economic growth in China. The Johansen and Juselius (1990) cointegration test was used to analyze the long-run relationship between savings growth and economic growth from 1955 to 2004. The Granger causality test was then used to determine the direction of causality. The data for the whole country and four of its component provinces, i.e. Beijing, Shanghai, Guizhou and Xinjiang were used as samples in this study. These four provinces were from different regions of China representing different prevailing economic, social and developmental models for study; Beijing and Shanghai stood for the developed cities while Guizhou and Xinjiang represented the developing ones. According to their results, all the variables were integrated of order one. Also, China's economic growth was found to have a long-running relationship with household savings and enterprise savings. Bilateral causality existed between the domestic savings growth and the economic growth in the short-run. In the long-run, a unidirectional causality existed running from the domestic savings growth to the economic growth. Finally, comparing the short-run and long-run results, we find that the economic growth could stimulate the household saving growth in the short-run and enterprise saving growth in the long run. Therefore, the results are consistent with the literature for developing countries (e.g. Pakistan, Mexico, Philippines and Indian) that the economic growth has positive effect on the domestic saving growth. However, the provinces showed a different statistical relationship between these two variables.

Olajide (2009) employed the Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) methodology to uncover the direction of causal relationship between savings and economic growth in Nigeria between 1970 and

2006. The empirical results suggested that savings and economic growth are positively cointegrated, indicating a stable long-run equilibrium relationship. Further, the findings revealed a unidirectional causality between savings and economic growth and the complementary role of FDI in growth.

Odhiambo (2009) examined the direction of causality between savings and economic growth in South Africa during the period 1950-2005. The study was motivated by the low and declining savings rate currently prevailing in South Africa as well as the dwindling level of economic growth experienced in the country during the 1990s. Given the weakness associated with the bivariate causality framework, the current study incorporated foreign capital inflow as an intermittent variable in the bivariate model between savings and economic growth thereby creating a simple trivariate causality framework. Using the cointegration-based error-correction mechanism, the study found a bi-directional causality between savings and economic growth to prevail in the short run and a distinct unidirectional causal flow from economic growth to savings to dominate in the long run. On balance, the study found growth-led savings to predominate in South Africa. The results also showed that foreign capital inflow and savings Granger-cause each other, while economic growth Granger causes foreign capital inflow. The study, therefore, recommends that in the short run, South African policies should be geared towards achieving both higher savings and economic growth in order to boost investors' confidence and to attract foreign capital inflow. However, in the long run, the country should shift its focus towards achieving higher economic growth, in order to boost the domestic savings and to sustain a steady flow of foreign capital investment.

Agrawal and Sahoo (2009) investigated the relationship between savings and growth in Bangladesh. The authors estimated the long-run total and private savings functions for Bangladesh using Granger-causality and co-integration techniques. The results showed that the total savings rate is mainly determined by the GDP growth rate, dependency ratio, interest rates and bank density. The private savings rate is also affected by the public savings rate. Further, using the Granger Causality tests, it was found that in Bangladesh, there is a bi-directional causality between savings and growth. The authors carried out the Forecast Error Variance Decomposition (FEVD) using the unrestricted VAR model consisting of all relevant variables namely, total savings rate (GDSY), GDP growth rate (GROWTH), dependency rate (DEPEND), access to banking (BOPM), foreign savings (FSY) and interest rate (RD). The VAR model consists of a system of equations in which each variable is treated as the dependent variable in turn. Since the individual coefficients of the VAR model are difficult to analyse in terms of economic theory, the authors used the Forecast Error Variance Decomposition (FEVD) at different horizons to examine dynamic relations among the variables. The FEVD measured the effects of a shock in each of the variables on it own as well as the rest of the variables in the system. Results from the Forecast Error Variance Decomposition (FEVD) analysis using the VAR framework confirmed the causality results obtained using the Granger causality tests as well as the estimated savings functions.

Tang and Chua (2009) re-examines the savings-growth nexus in Malaysia by using the nonparametric methodology. Using quarterly data from March 1991 to September 2006, the result of the Bierens (1997) nonparametric cointegration test showed that savings and economic growth are cointegrated.

Moreover, the multiple rank F-test (Holmes and Hutton, 1990) indicated a bilateral causality between savings and economic growth. In this study, Dynamic OLS was adopted and the estimated result implied that savings and economic growth were positively related in the long run. This result highlights that policies which encourage savings should be implemented as the causality test showed that savings is an engine to economic growth through its impact on capital formation. Thus, high savings carry the meaning of 'boosting economy', rather than 'freezing economy'.

Abu (2010) studied the savings-economic growth nexus in Nigeria from 1970 to 2007. The controversy surrounding the direction of causality between saving and economic growth motivated this study. The author employed the Granger-causality and co-integration techniques to analyze the relationship between saving and economic growth in Nigeria during the period 1970-2007. The Johansen co-integration test indicated that the variables (economic growth and saving) were co-integrated, and that a long-run equilibrium existed between them. In addition, the granger causality test revealed that causality runs from economic growth to saving, implying that economic growth precedes and granger causes saving. Thus, the author rejected the Solow's hypothesis that saving precedes economic growth, and accepted the Keynesian theory that it is economic growth that leads to higher saving. The author recommended that government and policy makers should employ policies that would accelerate economic growth so as to increase saving.

Singh (2010) investigated the effect of domestic saving on economic growth in India. The study examined the long-run effects of domestic saving on income and tested the null of non-causality between saving and growth. The

optimal single-equation and the maximum-likelihood system estimates of the model consistently supported the predictions of the neoclassical exogenous and the post-neoclassical endogenous models of economic growth, and suggested the significant long-run effects of saving on income. The innovation accounting showed the bidirectional causality between saving and growth. The stylized evidence for the steady-state effects of saving on income suggested the need to accelerate domestic saving to finance capital accumulation and foster higher income and growth. Results from the study showed that most of the saving comes from the surplus household sector, and the deficit private corporate and public sectors draw on household saving to meet their investment requirements and finance the resource gaps. A two-pronged approach with the incentive-based measures to induce the motivation to save and the productivity-based measures to increase income and strengthen the capacity to save, would be useful to generate higher saving and reinforce the acceleration of income and growth.

Mphuka (2010) investigated the effect of savings on Zambia's economic growth. The author employed the vector autoregression approach to cointegration. Results from the Augmented Dickey-Fuller and Phillip Perron unit root test showed that all the variables were integrated of order one and are thus non-stationary in levels. The results from the granger causality test revealed that economic growth 'Granger' causes domestic savings. This goes contrary to the neoclassical theory on the relationship between economic growth and savings. However, the article argues that a case of increasing domestic savings mobilization holds on the premise that doing so may influence growth indirectly by attracting partnerships with international capital thereby helping to inject new technology in the economy which is undoubtedly vital for growth. The argument

is strengthened further by observing that East Asian countries have grown faster than Latin American countries from the 1960s. The key distinguishing factor was that the saving rate in East Asian countries was higher than the rate in Latin American countries.

Tang (2010) empirically investigated the vindication of savings-led growth hypothesis for the Malaysian economy with the long run Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) version of Granger causality. This study used the quarterly sample from 1970 to 2008. The recursive regression procedure was also incorporated into the TYDL causality test to measure the stability of the savings-led growth hypothesis in the long run. The empirical results supported that the savings-led growth hypothesis is long run phenomenon and stable over time. Therefore, the Malaysian dataset supports the endogenous growth theory.

Adelakun (2011) examined the nexus of private savings and economic growth in Nigeria. The study employed the Johansen's cointegration test as well as the dynamic error correction model to examine the long run and short run properties of the variables. The author discussed the trend in Nigerian saving behaviour and reviewed policy options to increase domestic saving. The author also examined the determinants of private saving in Nigeria during the period covering 1970-2007. It made an important contribution to the literature by evaluating the magnitude and direction of the effects of the following key policy and non-policy variables on private saving: Income growth, interest rate, fiscal policy, and financial development. The framework for analysis involved the estimation of a saving rate function derived from the Life Cycle Hypothesis while taking into cognizance the structural characteristics of a developing

economy. The Augmented Dickey-Fuller and Phillip-Perron tests indicated that while the private saving rate (PSR), growth rate of real per capita GNDI (GRCY) and fiscal balance (FB) are I(0) variables (stationary before differencing), real interest rate (RIR) and the degree of financial depth (DFD) are I(1) variables (stationary after first differencing). The results of the analysis showed that the saving rate rises with both the growth rate of disposable income and the real interest rate on bank deposits. Public saving seems not to crowd out private saving; suggesting that government policies aimed at improving the fiscal balance has the potential of bringing about a substantial increase in the national saving rate. Finally, the degree of financial depth has a negative but insignificant impact on saving behaviour in Nigeria.

Mehrara, Musai and Nasibparast (2012) examined the causal relationship between gross domestic savings (GDS) and GDP for Iran using annual data over the period 1970-2008. The Gregory-Hansen (1996) cointegration technique, allowing for the presence of potential structural breaks in data was applied to empirically examine the long-run co-movement between GDS and GDP. The results suggested that there is a long-run relationship between these variables. The evidence also indicated that the value of the income elasticity of saving before the regime shift was 1.32, amounting to 0.51, much less than unity, after the regime shift happening with Islamic revolution (1979-2008). It means that savings rate decreases when income increases during the second regime. The Granger Causality test indicates strong unidirectional effects from GDP to GDS. But there is no evidence that GDS promotes long-term economic growth. Moreover, the main results confirmed that there is an instantaneous as well as unidirectional causal link running from GDP to GDS. So the findings of this

paper supported the consumption theories such as Keynesian point of view that it is higher economic growth that leads to higher saving growth. According to the results, it seems that oil revenues have mostly contributed to investment and economic growth during the sample period.

Hevia and Loayza (2012) determined the relationship between savings and growth in Egypt. The study illustrated the mechanisms linking national saving and economic growth, with the purpose of understanding the possibilities and limits of a saving-based growth agenda in the context of the Egyptian economy. The study adopted a simple theoretical model, calibrated to fit the Egyptian economy, and simulated to explore different potential scenarios. The results from the study showed that, if the Egyptian economy does not experience progress in productivity stemming from technological innovation, improved public management, and private sector reforms, then a high rate of economic growth is not feasible at current rates of national saving and would require a saving effort that is highly unrealistic. For instance, financing a constant 4% growth rate of GDP per capita with no total factor productivity improvement would require a national saving rate of around 50% in the first decade and 80% in 25 years. However, if productivity rises, sustaining and improving high rates of economic growth becomes viable.

Zeren and Akbas (2013) investigated the causal relationship between savings and economic growth in Turkey from 1961 to 2012. The study employed the bootstrap, process-based, Toda-Yamamoto, linear Granger causality test. The study used the proportion of gross domestic savings in the GDP and the annual percentage change of real per capita GDP (the growth). The Phillip Perron unit root test indicated that the variables gross domestic savings and real

per capita GDP were I(0) and I(1) respectively. The results from the study indicated bidirectional causality between savings and economic growth in Turkey. This means that the feedback hypothesis is valid in the case of Turkey. That is, both the Keynes and the Solow models are relevant for Turkey.

Ghana

Ogoe (2009) examined the direction of causality between gross domestic savings and economic growth (using real per capita GDP as a measure of growth) of Ghana using annual time series data over 1961-2008. In this study, Ogoe carried out three analyses. First, the time series properties of growth rate of gross domestic savings and the growth rate of real per capita GDP were ascertained using the ADF unit root test procedure. The estimated results indicated one order of integration or I(1) for the series. Second, the long-run relationship between the series was determined using Engel–Granger Cointegration Test procedure. The result of the test indicated that the series were not cointegrated. Finally, the causal relationship between growth rate of gross domestic savings and the growth rate of real per capita GDP was performed using the Vector Autoregressive (VAR) model and Pairwise Granger Causality Test. The results showed that there was bi-directional causal relationship between growth rate of gross domestic savings and growth rate of real per capita GDP in Ghana. Based on the findings of the study, certain monetary and fiscal policies as well as legislation and other measures have been recommended to boost gross domestic savings mobilisation and to increase growth. However, the study did not control for other variables which can influence real GDP per capita such as capital stock,

labour, money supply, government expenditure, interest rate and consumer price index in the growth equation.

Antwi, Mills and Zhao (2013) examined the long-run macroeconomic factors of economic growth in Ghana using Johansen approach to cointegration. The study period spanned from 1980 to 2010. The time series properties of the data were, first, analyzed using the Augmented Dickey Fuller (ADF) test. The empirical results derived indicated that all the variables of interest were stationary after their first differencing. The study found cointegration relationship between real GDP per capita (economic growth) and its macroeconomic factors. The coefficients of physical capital and labour force were positive and statistically significant. However the coefficients of foreign direct investment and foreign aid were statistically significant and exerted positive impact on economic growth. The author recommended that the government should generate more revenue domestically than relying on foreign aid.

Havi, Enu, Osei-Gyimah, Attah-Obeng and Opoku (2013) investigated the macroeconomic determinants of economic growth in Ghana between the periods 1970 and 2011 applying the Johansen method of cointegration. All the variables used in the study were stationary at first difference. As a result the Johansen's cointegration approach was employed. The study revealed that physical capital and foreign aid had a positive effect on growth in real gross domestic product per capita. In the long run, physical capital, labour force, foreign direct investment, foreign aid, consumer price index, government expenditure and military rule were the significant determinants of growth in real gross domestic product per capita in Ghana. Also, in the short run, foreign direct

investment and government expenditure were significant determinants of growth in real gross domestic product per capita. The result showed a unidirectional causality between labour force and physical capital, physical capital and foreign direct investment, foreign aid and physical capital, physical capital and consumer price index, physical capital and military rule, labour force and foreign direct investment, consumer price index and labour force, foreign direct investment and foreign aid. Also, there is bidirectional causality between consumer price index and foreign direct investment. The author recommended that policies should be put in place to increase physical capital and foreign aid. Educational institutions should link up with the corporate organizations to train productive larbour force. Military rule had negative impact on growth in real GDP per capita, therefore, the Government must put in place strategies to protect and sustain democratic rule in Ghana.

Conclusion

This chapter reviewed relevant literature on Ghana's economic growth as well as theoretical and empirical works on the savings-growth nexus. It was observed that, Ghana's economy experienced a high rate of economic growth at the early stages of independence but later began to decline by 1964. However, the growth of the Ghanaian economy has been relatively stable over the past two decades. The theoretical literature focused on the various channels through which domestic savings may affect growth of the economy. The empirical literature focused on the review of cross country studies, country specific studies as well as studies conducted in Ghana on the subject matter. The empirical

literature revealed that, most of the studies have largely focused on bivariate analysis. In addition, the related study conducted in Ghana did not capture the possible influence of other determinants of economic growth such as government expenditure, consumer price index, money supply, interest rate, capital stock and labour force in the model while examining the relationship between domestic savings and economic growth.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter presents the methodological framework employed in the study. It explores the research hypotheses in detail, and discusses what methods are appropriate for the study, given the objectives and the nature of the study. Specifically, it presents the research design, theoretical and empirical specification of the model, definition and measurement of variables, sources of data for the study, estimation technique, and tools for data analysis.

Research Design

The study employed quarterly time series data from 1983 to 2012. In line with the objectives of the study, the positivist philosophy within the framework of neoclassical economics was adopted. The positivist believes that reality is stable and can be observed and described from an impartial viewpoint without interfering with the phenomena being studied (Levin, 1988). Thus, positivist philosophy allows the researcher to study social processes in an objective manner as well as explain relationships between variables. More importantly, the positivist philosophy favours the use of quantitative approach to research as used in this study. Positivist philosophy is suitable for the development of mathematical models to investigate the relationship between quantitative measurements. Therefore, the quantitative approach is the appropriate research design for this study.

The quantitative approach was adopted because of the objective of the study which is to explain the causal relationship between domestic savings and economic growth. The major strength of this research design is that, it maximises objectivity, replicability and generalisability of findings. Thus, this design ensures that the researcher set aside his or her personal experiences, perceptions, and biases to ensure objectivity in the conduct of the study and the conclusions that are drawn. Quantitative research designs are either descriptive (subjects usually measured once) or experimental (subjects measured before and after a treatment). The present study is a descriptive study that attempts to identify the relationship between economic growth and domestic savings in Ghana. This will provide an accurate and valid representation of the variables that are relevant to the objectives of the study. Also, the quantitative approach enables the researcher

to put the social world into a structure of causality and nullifies the role of human effect through the use of a quantitative instrument such as multivariate statistical analysis in analyzing data as used in this study. More specifically, since the objective of the study is explanatory in nature (i.e. establish the causal relationship between domestic savings and economic growth), the study adopted the explanatory research under the quantitative approach.

Theoretical Model Specification

Following Abu (2010) and Misztal (2011), the study adopted the neoclassical growth model of Solow (1956) to examine the relationship between domestic savings and economic growth. Solow argued that higher savings preceded economic growth. Therefore, the growth model specifies economic growth as a function of saving. The Solow growth model starts by explaining economic growth as resulting from the combination of capital (K) and labour (L).

$$Y = F(K, L,) \quad (1)$$

Solow made an assumption that this production function exhibits a constant return to scale. This means that an increase in input by some amount will yield an equal increase in output. Thus for any positive constant λ the following condition must hold:

$$\lambda Y = f(\lambda K, \lambda L) \quad (2)$$

Assuming that λ is 1/L gives equation 4:

$$\frac{Y}{L} = f\left(\frac{K}{L}, \frac{L}{L}\right) = f\left(\frac{K}{L}, 1\right) \quad (3)$$

Equation 4 can be appropriately rewritten as:

$$y = f(k) \tag{4}$$

Where y and k are defined as Y/L and K/L respectively.

Equation (4) describes output per labour as a function of capital per labour. This representation of the production function in per-worker terms is quite appropriate given that we define economic growth as the change in per capita output. In judging whether welfare in society increases, output per person must increase. In terms of the variables defined above, economic growth requires an increase in *y*, not just *Y*.

In addition to assuming constant returns to scale, Solow further assumed positive but diminishing marginal returns to any single inputs. That is the slope of output continuously decreases because each additional increase in *K* relative to *L* causes smaller and smaller output (Van den Berg, 2001). This is the inherent characteristics of the Solow model that brings convergence to light. The model assumes that a constant fraction of output, δ , is invested, that is, $S = \delta Y$. Further assuming the existing capital depreciates at rate, ρ the competitive equilibrium of the Solow model can be written as the following:

$$k_{t+1} - k_t = \frac{1}{1+n}[\delta f(k_t) - (\rho + n)k_t] \tag{5}$$

Where n is defined as growth rate.

The left hand-side of equation (5) states that the change in capital stock per unit of labour, is determined by two terms on the right-hand side of the equation, where the first term $\delta f(k_t)$, is the actual investment per unit of labour, and the second term $(\rho + n)k_t$, is called breakeven investment, the amount of

capital stock must be invested to keep the capital per unit of labour at its existing level. In steady state:

$$k_{t+1} = k_t \Rightarrow \delta f(k_t) = (\rho + n)k_t \quad (6)$$

When the actual investment per unit of labour exceeds the breakeven investment, $k_{t+1} - k_t > 0, k$ increases until it reaches the steady state level, and vice versa. Eventually, k will converge to its steady state level regardless of where it starts (Romer, 1994).

In the long run, when the economy converges to its steady state level of capital stock per unit of labour, real output grows at the same rate as population growth rate n. Given the assumption of constant growth of saving rate, population growth rate, and the CRS; Solow growth model states that growths in key macroeconomic variables are determined by the population growth rate.

Solow argued that long-run growth is basically determined by technological change and not by savings or investment. Saving only affects temporal growth, since the economy will run into diminishing returns as the ratio of capital per labour increases. Thus, the absence of constant improvement in technology, per capita growth will eventually cease (Stern, 2003).

However, the question one needs to ask is how much of the output growth can be attributed to other factors other than capital and labour. It is as a result of this that Solow (1956) decomposes the growth in output into three components, that is, physical capital accumulation, labour force growth, and total factor productivity (TFP) growth with each identifiable as contribution of one factor of production. The TFP growth is considered as the effect of exogenous technological progress, which can also be reflected in increasing productive

efficiency. To account for this, Solow used the Cobb-Douglas production function and started from this simple growth equation which is stated as:

$$Y_t = f(K, L, A) \tag{7}$$

More specifically, the production function in equation (7) is further expressed as

$$Y_t = F(K_t, A_t, L_t, \ell) \tag{8}$$

Where: Y is output at time t

A : total factor productivity which grows over time at an exogenous rate

L : labour stock

K : capital stock and

ℓ: the naperian "e" which represents natural logarithm in the production function.

The equation Solow specified applying the Cobb-Douglas production function is,

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \ell^{\varepsilon} \tag{9}$$

From this, Solow defined his TFP to be technology. According to Solow it is expedient to use the Cobb-Douglas production function because it exhibits constant returns to scale. The key point to note here is that the variable A is not constant but varies with different production functions based on the factors being studied. This production function is widely used in literature including Feder, 1983; Fosu, 1990; Mansouri, 2005; Fosu & Magnus, 2006. Aside the traditional input of production-labour and capital, the model assumes other conventional inputs.

Empirical Model Specification

In order to explain the possible relationship between domestic savings and economic growth, this study adopted the neoclassical growth model of Solow, which is specified in equation (9) above. A review of the literature indicates that a number of variables affect total factor productivity. However, due to data availability, the following variables were used to examine the variations in total factor productivity.

$$A_t = f(DS_t, CPI_t, MS_t, GOV_t, R_t,) \quad (10)$$

Given the above functional form, the TFP function can be specified as:

$$A_t = DS_t^{\beta_1} CPI_t^{\beta_2} MS_t^{\beta_3}, GOV_t^{\beta_4}, R_t^{\beta_5} \quad (11)$$

Where DS is domestic savings, CPI is consumer price index, MS is money supply, GOV is government expenditure and R is interest rate.

By substituting equation (11) into the Cobb-Douglas production function gives equation (12)

$$Y_t = \psi K_t^{\alpha} DS_t^{\beta_1} CPI_t^{\beta_2} MS_t^{\beta_3} GOV_t^{\beta_4} R_t^{\beta_5} L_t^{\beta_6} \ell^{\varepsilon_t} \quad (12)$$

Taking natural logs of equation (12) for linearity gives equation (13)

$$\ln Y_t = \ln\psi + \alpha \ln K_t + \beta_1 \ln DS_t + \beta_2 \ln CPI_t + \beta_3 \ln MS_t + \beta_4 \ln GOV_t + \beta_5(R_t) + \beta_6 \ln L_t + \varepsilon_t \ln \ell \quad (13)$$

Let $\ln\psi = \beta_0$ and $\ln \ell = 1$, rewriting equation (13) gives

$$\ln Y_t = \beta_0 + \alpha \ln K_t + \beta_1 \ln DS_t + \beta_2 \ln CPI_t + \beta_3 \ln MS_t + \beta_4 \ln GOV_t + \beta_5(R_t) + \beta_6 \ln L_t + \varepsilon_t \quad (14)$$

Differencing equation (14) gives the growth equation as shown in equation (15):

$$\ln Y_t - \ln Y_{t-1} = \beta_0 + \alpha(\ln K_t - \ln K_{t-1}) + \beta_1(\ln DS_t - \ln DS_{t-1}) + \beta_2(\ln CPI_t - \ln CPI_{t-1}) + \beta_3(\ln MS_t - \ln MS_{t-1}) + \beta_4(\ln GOV_t - \ln GOV_{t-1}) + \beta_5(R_t - R_{t-1}) + \beta_6(\ln L_t - \ln L_{t-1}) + \varepsilon_t \quad (15)$$

Based on the above derivation, the growth equation is finally given as;

$$\Delta \ln Y_t = \beta_0 + \alpha \Delta \ln K_t + \beta_1 \Delta \ln DS_t + \beta_2 \Delta \ln CPI_t + \beta_3 \Delta \ln MS_t + \beta_4 \Delta \ln GOV_t + \beta_5 \Delta (R_t) + \beta_6 \Delta \ln L_t + \nu_t \quad (16)$$

Where ln is the natural logarithmic operator and Δ is the difference operator. The coefficients $\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are the elasticities of the respective variables, β_0 is the drift component, *t* denotes time and ν_t is the error term.

The following signs of the coefficients are expected based on economic theory;

$\alpha > 0, \beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 > 0, \beta_5 < 0, \beta_6 > 0$.

The short run model for this study is given as:

$$\Delta \ln Y_t = \beta_0 + \sum_{i=1}^{p} \theta \Delta \ln Y_{t-i} + \sum_{i=1}^{q} \alpha \Delta \ln K_{t-i} + \sum_{i=1}^{r} \beta_1 \Delta \ln DS_{t-i} + \sum_{i=1}^{s} \beta_2 \Delta \ln CPI_{t-i} + \sum_{i=1}^{t} \beta_3 \Delta \ln MS_{t-i} + \sum_{i=1}^{t} \beta_4 \ln \Delta G_{t-i} + \sum_{i=1}^{v} \beta_5 \Delta (R_{t-i}) + \sum_{i=1}^{u} \beta_6 \Delta \ln L_{t-i} + \psi ECT_{t-1} + \nu_t \quad (17)$$

Justification, Measurement of Variables and Sign Expectations

Economic growth is defined as the sustained increases in a country's real gross domestic product or real gross national product over time. It refers to the market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product. Following standard practice, we use real per capita GDP (Y) as the measure for economic growth (Roubini & Sala-i-Martin, 1992; King & Levine, 1993a; Demetriades & Hussein, 1996; Levine et al, 2000). Real GDP per capita is real gross domestic product divided by population.

Domestic savings (DS): Gross domestic savings is used as a proxy for domestic savings. Gross domestic savings is calculated as GDP less final consumption expenditure (total consumption). It can also be perceived as a choice between consumption today and consumption tomorrow as it is a way to

accumulate wealth over time and raise living standards in the future. Domestic savings helps in maintaining high growth rates through its impact on investment (Solow, 1956). The higher the domestic savings rate, the higher the growth rate of the economy, all things being equal, hence the variable (GDS) is expected to be positive, $\beta_1 > 0$.

Capital stock (K): Gross fixed capital formation (GFCF) is used as a proxy for capital stock. Gross fixed capital formation as a proxy for capital has been used in several other studies such as Aryeetey and Fosu (2003) and Mansouri (2005). Gross fixed capital formation is defined as the total value of additions to fixed assets by domestic enterprises, *less disposals* of fixed assets during the year, *Plus* additions to the value of non-produced assets such as discoveries of mineral deposits, plants, machinery, and equipment purchases; and the construction of infrastructure, commercial and industrial buildings (Baafi, 2010). According to Sinha and Sinha (1998), rising saving increases the level of investment, thereby accelerating economic growth. It is important to note however that high rate of investment result in high economic growth (Barro & Sala-Martin, 1992). Therefore, empirical evidence has shown that high rate of investment results in high economic growth; hence, all things being equal, the variable (K) is expected to be positive, $\alpha > 0$. This is in line with both the neoclassical and endogenous growth predictions.

Consumer Price Index (CPI): Consumer price index is an index of prices used to measure the change in the cost of basic goods and services in comparison with a fixed base period. CPI is used to measure the average change over time in the prices paid by consumers for a market of consumer goods and services. It is constructed using the prices of a sample of representative items whose prices

are collected periodically. The annual percentage change in the CPI is used as a measure of inflation. Inflation rate is a reflection of macroeconomic instability. A high rate of inflation is generally harmful to growth because it raises the cost of borrowing and thus lowers the rate of capital investment. However, at low levels of inflation, the likelihood of such a trade-off between inflation and growth is minimal. Inflation is therefore used as an indicator to capture macroeconomic instability (Asiedu & Lien, 2004) and (Asiedu, 2006). It is expected that $\beta_2 < 0$.

Money Supply (MS) is the total amount of monetary assets available in an economy at a specific time. These comprise the sum of currency outside banks, demand deposits other than those of the central government, as well as savings and other time deposits (World Bank, 2012). Money and quasi money (M2) as a percentage of GDP is used as a proxy for money supply. This enters the model as a policy variable and is to capture the influence of the monetary sector. In this study, it is expected that $\beta_3 > 0$. This is because the increase in money supply is likely to result in a reduction in interest rates, that is, a decrease in the cost of borrowing which turns to increase investment and hence lead to economic growth.

Government expenditure (GOV): Government expenditure refers to the overall government spending at any particular point in time. This includes real goods and services purchased from outside suppliers; spending on employment in state services such as administration, defense, and education; spending on road maintenance, health, subsidies, grants, and debt servicing (Black, Hashimzade, & Myles, 2009). Government expenditure is included in the model as a policy variable and also to complete the components of GDP. Following the works of

Easterly and Rebelo (1993), Doh-Nani (2011) and Ayibor (2012), the ratio of government expenditure to GDP is used in the study. The Keynesian proposition suggests that government expenditure will result in a rise in economic growth. It could, however, reduce economic growth because of the crowding out effect on private investment and the inflationary pressures (Allen & Ndikumana, 2000). However, following Keynesian proposition and given that all things remain constant, we expect $\beta_4 > 0$.

Interest rate (INT) refers to the rate that financial institutions charge on borrowings (loans). The Bank of Ghana's (BOG) prime rate is used as a proxy for interest rate. The prime rate is the annualized interest rate that the central bank charges commercial, depository banks for loans to meet temporary shortages of funds. Interest rates are normally expressed as a percentage of the principal for a period of one year. High prime rate restricts the supply of bank lending because the banks are unable to borrow large sums of money to lend to the private sector so as to enhance investment activities. Moreover, because the prime rate is the leader of all the other interest rate in the commercial banks, a high level of it will widen the intermediation margin (the difference between lending rate and deposit rate) which deter borrowing and hence growth in investment. Interest rate in this study is expected to have a negative effect on economic growth, that is, $\beta_5 < 0$.

Labour Force (L): Labour force consists of the proportion of the population that is economically active. In this study, the proportion of the total population aged between fifteen (15) years and sixty-four (64) years who are active and productive is used as a proxy for the labour force. Jayaraman and Singh (2007) argued that, there can be no growth without the involvement of

labour. Solow (1956) and Swan (1956) also recommended that labour force should be incorporated in the growth model because of its impact on the work force, hence the inclusion of labour force in the study. Total labour force comprises people ages 15 and older who meet the International Labour Organization definition of the economically active population: all people who supply labour for the production of goods and services during a specified period. It includes both the employed and the unemployed. While national practices vary in the treatment of such groups as the armed forces and seasonal or part-time workers, in general the labour force includes the armed forces, the unemployed and first-time job-seekers, but excludes homemakers and other unpaid caregivers and workers in the informal sector. All things being equal, the higher the labour force the higher the supply of labour and hence output. It is expected that $\beta_6 > 0$.

Table 1: Summary of definition and measurement of variables

Variable	Definition	Expected sign
LY	Natural logarithm of Real GDP per capita	
LDS	Natural logarithm of gross domestic savings	+
LK	Natural logarithm of capital stock	+
LCPI	Natural logarithm of consumer price index	-
LMS	Natural logarithm of ratio of money supply to GDP	+
LGOV	Natural logarithm of ratio of government expenditure to GDP	+
R	Interest rate	-

LL	Natural logarithm of labour force	+

Source: Estimated from WDI (2012) and Bank of Ghana data

Data description and source

The study employed secondary data. Quarterly time series data were generated from the annual time series collected from 1983 to 2012 using Gandolfo (1981) algorithm. Data on real per capita GDP(Y), domestic savings (DS), gross fixed capital formation (K), consumer price index (CPI), money supply (MS) and labour force (L) were drawn from World Development Indicators (world Bank, 2012). Data on interest rate was drawn from the Bank of Ghana.

Estimation Techniques

To test the direction of causality between domestic savings, money supply, interest rate, CPI, capital stock, government expenditure, labour force and real GDP per capita, the study applied Granger causality test within the framework of cointegration and error-correction models. The empirical procedure involves the following steps. In the first step, the study investigated the time series properties of the data by using the Augmented Dickey–Fuller (ADF) and the Phillip-Perron (PP) tests. The unit root test was used to check the stationarity position of the data. In the second step, the cointegration test was conducted using Johansen's multivariate approach. In the third step, the study employed granger-causality to test for causality. The causality test is followed by cointegration testing because the presence of cointegrated relationships has implications for the way in which causality testing is carried out. Finally, variance decomposition analysis was conducted.

Unit Root Tests

It is very important to test for the statistical properties of variables when dealing with time series data. Time series data are rarely stationary in level forms. Regression involving non-stationary time series often lead to the problem of spurious regression. This occurs when the regression results reveal a high and significant relationship among variables when in fact, no relationship exist. Moreover, Stock and Watson (1988) have also shown that the usual test statistics (t, F, DW, and R^2) will not possess standard distributions if some of the variables in the model have unit roots. A time series is stationary if its mean, variance and auto-covariance are independent of time.

The study employed the two common unit root tests. This was done to ensure reliable results of the test for stationarity due to the inherent individual weaknesses of the various techniques. The study used both the PP and the ADF tests. These tests are similar except that they differ with respect to the way they correct for autocorrelation in the residuals. The PP nonparametric test generalizes the ADF procedure, allowing for less restrictive assumptions for the time series in question. The null hypothesis to be tested is that the variable under investigation has a unit root against the stationarity alternative. In each case, the lag-length is chosen using the Akaike Information Criteria (AIC) and Schwarz Information Criterion (SIC) for both the ADF and PP test. The sensitivity of ADF tests to lag selection renders the PP test an important additional tool for making inferences about unit roots. The basic formulation of the ADF is specified as follows:

$$X_t = \mu + \alpha X_{t-1} + \gamma t + \varepsilon_t \qquad (17)$$

Subtracting X_{t-1} from both sides gives:

$$\Delta X_t = \mu + (1-\alpha)X_{t-1} + \gamma t + \varepsilon_t \quad (18)$$

The t-test on the estimated coefficient of X_{t-1} provides the Dickey Fuller test for the presence of a unit-root. The Augmented Dickey Fuller (ADF) test is a modification of the Dickey Fuller test and involves augmenting the above equation by lagged values of the dependent variables. It is made to ensure that the error process in the estimating equation is residually uncorrelated, and also captures the possibility that X_t is characterized by a higher order autoregressive process. Although the DF methodology is often used for unit root tests, it suffers from a restrictive assumption that the errors are *i.i.d*. Therefore, representing $(1-\alpha)$ by ρ and controlling for serial correlation by adding lagged first differenced to equation (18) gives the ADF test of the form:

$$\Delta X_t = \mu + \rho X_{t-1} + \gamma t + \sum_{i=1}^{p} \phi_i \Delta X_{t-i} + \varepsilon_t \quad (19)$$

Where X_t denotes the series at time t, Δ is the first difference operator, μ, γ, ϕ are the parameters to be estimated and ε_t is the stochastic random disturbance term. The ADF and the PP test the null hypothesis that a series contains unit root (non-stationary) against the alternative hypothesis of no unit root (stationary), that is:

$H_0 : \rho = 0$ (X_t is non-stationary)

$H_1 : \rho \neq 0$ (X_t is stationary)

If the "tau" value or t-statistic is more negative than the critical values, the null hypothesis is rejected and the conclusion is that the series is stationary. Conversely, if the tau statistic is less negative than the critical values, we fail to

reject the null hypothesis and conclude that the series is non-stationary. The critical values for this t-statistic are given in Mackinnon (1991).

Cointegration Tests

In the face of non-stationary series with a unit roots, first differencing appears to provide the appropriate solution to the problems. However, first differencing results in eliminating all the long-run information which are invariably the interest of economists. Later, Granger (1986) identified a link between non-stationary processes and preserved the concept of a long-run equilibrium. Two or more variables are said to be cointegrated (there is a long-run equilibrium relationship), if they share common trend. Cointegration exists when a linear combination of two or more non-stationary variables is stationary.

Johansen and Juselius Approach to Cointegration

A number of techniques for testing the presence of equilibrium long-run relationship among time series variables have been advocated and used by researchers. However, when the variables are integrated of the same order, OLS is used to estimate the parameters of a cointegrating relationship. It has been shown that the application of OLS to $I(1)$ series yields super-consistent estimates (Johansen, 1988). That is estimates converge on to their true values at a faster rate than the case if I (0) or stationary variables are used in estimation. These parameter values are used to compute the residuals. Cointegration tests are the test for stationarity of the residuals by using DF and ADF tests. If the residuals are stationary, there exists one cointegrating relationship among variables and it will rule out the possibility of the estimated relationship being "spurious". Since

the residuals are estimated by OLS, by construction the residual variance is made as small as possible, the test is biased towards finding a stationary error process. The test is also sensitive to how the equation is presented (i.e. whether *x* is regressed on *y* or vice versa). Finally, if there are more than two variables, the Engle Granger (EG) procedure will not allow discernment between different cointegrating vectors.

As a result of the above limitations of the Engle Granger (EG) procedure, several methods have been developed for testing cointegration. One of the most popular is the Johansen and Juselius procedure. They include the Fully Modified Ordinary Least Squares (FMOLS) procedures of Phillips and Hansen (1990), the Johansen (1988, 1991) or the Johansen and Juselius (1990, 1992) and the Autoregressive Distributed Lag (ARDL) approach by Pesaran and Shin (1998) and Pesaran, and Smith (1995) to determine the long-run relationship in bivariate and multivariate frameworks.

Johansen (1988) and Johansen and Juselius (1992) developed multivariate method that explicitly used the Vector Autoregressive (VAR) and the Vector Error Correction (VECM) framework for the testing of the presence of cointegration and estimation of long-run and short-run relationships among non-stationary macroeconomic time series. The VAR and VECM provide a useful framework to study the impact of unanticipated shocks (individual and system) on the endogenous variables (impulse response functions). Additionally, we can identify the relative importance of each variable in explaining the variations of endogenous variables (variance decomposition analysis). Moreover, both long-run (cointegration) relationships and short-run dynamics of the variables in the system can be established. The relationship between VAR

and VECM is expressed as follows. Assume an unrestricted reduced form VAR (p):

$$[X]_t = [\delta] + [\varphi_1][X]_{t-1} + \ldots + [\varphi_p][X]_{t-k} + [\varepsilon]_t \quad (20)$$

Where $[X]_t, [X]_{t-1}$ ... $[X]_{t-k}$ are 8x1 vector of integrated series of order one (economic growth, gross domestic savings, capital stock, labour force, consumer price index, government expenditure, money supply and interest rate), $[\varphi_1]$ ... $[\varphi_p]$ are a vector of coefficients to be estimated, $[\delta]$ is a vector intercepts while $[\varepsilon]_t$ is a vector of error terms and denotes the lag length of the series. Since there are only lagged values of the endogenous appearing on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates. Estimation of equation (14) requires that $[\varepsilon]_t$ □ $IID(0,\Omega)$ where Ω is non-diagonal covariance matrix that remains constant overtime. Following Johansen (1991) and provided that the variables are integrated of order one and cointegrated, further assuming Δ represent the first differences, equation 16 is transformed into an equilibrium error correction model of the form:

$$\Delta X_t = \delta + \sum_{i=1}^{k-1} \Phi_i \Delta X_{t-i} + \Pi X_{t-k} + \varepsilon_t \quad (21)$$

Where $\Phi_i = -(\varphi_{i+1} + \ldots + \varphi_k),\ i = 1, \ldots, k-1,$ and $\Pi_i = -(I - \varphi_1 - \ldots - \varphi_k)$

Φ_i represents a 8x8 matrix of coefficients of the first difference variables that capture the short-run dynamics. The coefficients of the lagged dependent variable indicate inertia as well as the formation of expectations. The coefficients of the other lagged endogenous variables provide estimates impact assessment. The coefficient matrix Π contains information about the long-run relationships among the variables involved in the model. That if the rank of Π is $0 < r < n$, then

Π can be decomposed into $\Pi = \theta\beta'$. The error correction representation of equation 17 is:

$$\Delta X_t = \delta + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \ldots + \Phi_{p-1}\Delta X_{t-p+1} + \theta(\beta' X_{t-p}) + \varepsilon_t \quad (22)$$

where the columns of β are interpreted as distinct cointegration vectors providing the long-run relationships $(\beta' X_t)$ among the variables, and the $\theta's$ are the adjustment or error correction coefficients, indicating the adjustment to long-run equilibrium. In this case, β contains the coefficients of the r distinct cointegrating vectors giving $\beta' X_t$ stationary (X_t may not be stationary). A major problem in the estimation of VAR and VEC models is the selection of an appropriate lag length. Thus strictly speaking, in an m-variable VAR model, all the m variables should be stationary. The lag length plays a crucial role in diagnostic tests as well as in the estimation of VECM and VAR models (Bhasin, 2004). As a result, appropriate lag length (p) will be chosen using standard model selection criteria (AIC and SBC) that ensure normally distributed white noise errors with no serial correlation.

Johansen (1988) cointegration techniques allow us to test and determine the number of cointegrating relationships between the non-stationary variables in the system using a maximum likelihood procedure. There are two tests to determine the number of cointegrating vectors namely, the trace test and the maximum Eigen value test. These tests are defined as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\lambda_i) \quad (23)$$

$$\lambda_{max}(r, r+1) = -T\ln(1-\lambda_{r+1}) \quad (24)$$

Where λ_i the estimated value of the characteristic roots, T is the number of usable observations, and r is the number of distinct cointegrating vectors. In the

trace test, the null hypothesis (H_0) is there at most *r* cointegrating vectors (*r* =0, 1, 2...) is tested against a general alternative. Alternatively, in the maximum Eigen value test, the null hypothesis (H_0 :*r*= 0) is tested against an alternative (H_1 : *r* = 1) . This is followed by (H_0 :*r*= 1) against (H_1 : *r* = 2), and so on. The trace and maximum Eigen value statistics are compared with the critical values tabulated. The distribution of the statistics depends on the number of non-stationary components under the null hypothesis and whether or not a constant is included in the cointegrating vector.

Diagnostic tests

In order to test for goodness of fit, stability and the robustness of the model, post estimation test were conducted. These post estimation test takes care of autocorrelation, heteroscedasticity, normality and the functional form that are linked with the model selected.

The study employed the Lagrange Multiplier (LM) Test of Breusch (1978) and Godfrey (1978). The LM test the null hypothesis of no serial correlation up to the selected maximum lag length. Heteroscedasticity of the variables was tested using the ARCH test. The ARCH test the null hypothesis of no ARCH element in the residual as against the alternative of the presence of ARCH element in the residual. The Regression Specification Error Test (RESET) proposed by Ramsey (1969) was employed to check for correct specification of the functional form of the model. The RESET test the null hypothesis that the equation is correctly specified as against the alternative that the equation is not correctly specified. The study employed the Jackque-Bera test of normality to test for normality properties of the error term. Finally, to

check the stability of the coefficients of the model, the study employed the VAR stability condition check. The null hypothesis that no root lies outside the unit circle was tested against the alternative hypothesis of some root lies outside the unit circle.

Granger Causality Test

One of the main objectives of empirical research has been the study of the causal relationships among economic variables. According to Engle and Granger (1991), cointegrated variables must have an error correction representation. One of the implications of Granger representation theorem is that if non-stationary series are cointegrated, then one of the series must granger cause the other (Gujarati, 2001). To examine the direction of causality in the presence of cointegrating vectors, Granger causality is conducted based on the following:

$$\Delta Y_t = \delta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{p} \phi_{1i} \Delta X_{t-i} + \omega_{1i} ECT_{t-1} + v_t \quad (25)$$

$$\Delta X_t = \delta_0 + \sum_{i=1}^{p} \beta_{2i} \Delta X_{t-i} + \sum_{i=0}^{p} \phi_{2i} \Delta Y_{t-i} + \omega_{2i} ECT_{t-1} + u_t \quad (26)$$

Where ΔY and ΔX are our non-stationary dependent and independent variables, ECT is the error correction term, ω_{1i} and ω_{2i} are the speed of adjustments. P is the optimal lag order while the subscripts t and t-i denote the current and lagged values. If the series are not cointegrated, the error correction terms will not appear in equations 25 and 26. To find out whether the independent variable (X) granger-causes the dependent variable (Y) in equation

25, we examine the joint significance of the lagged dynamic terms by testing the null hypothesis:

$H_0 : \phi_{1i} = 0,$ implying that the independent variable (X) does not granger-cause the dependent variable (Y), against the alternative hypothesis that

$H_1 : \phi_{1i} \neq 0,$ implying that the independent variable (X) granger-cause the dependent variable (Y).

Similarly, to find out whether the independent variable (Y) granger-cause the dependent variable (X) in equation 26, we examine the significance of the lagged dynamic term by testing the null hypothesis

$H_0 : \phi_{2i} = 0,$ implying that the independent variable (Y) does not granger-cause the dependent variable (X), against the alterative hypothesis that

$H_1 : \phi_{2i} \neq 0,$ implying that the independent variable (Y) granger-cause the dependent variable (X).

Using the standard F-test or Wald statistic, four possibilities exist: First, rejection of the null hypothesis in equation (25) but failing to reject the null in equation (26) at the same time implies unidirectional causality running from X to Y. Second, a rejection of the null hypothesis in equation (26) but at the same time failing to reject the null in equation (25) implies unidirectional causality running from Y to X. Third, simultaneous rejection of the two null hypotheses indicates bi-directional causality. Fourth, simultaneous failure to reject the two null hypotheses indicates independence or no causality between the variables of interest.

Variance Decomposition

Variance decomposition or the forecast error variance decomposition helps in the interpretation of a VAR model once it has been fitted. The variance decomposition indicates the amount of information each variable contributes to the other variables in the VAR models. It tells us the proportion of the movements in a sequence due to its own shock, and other identified shocks (Enders, 2004). Therefore variance decomposition provides information about the relative importance of each variable in explaining the variations in the endogenous variables in the VAR. To assign variance shares to the different variables, the residuals in the equations must be orthogonalised. Therefore, the study will apply the Cholesky decomposition method.

Data Analysis

The study employed both descriptive and quantitative analysis. Charts such as graphs and tables were employed to aid in the descriptive analysis. Unit root tests were carried out on all variables to ascertain their order of integration. Furthermore, the study adopted the Johansen's maximum likelihood econometric methodology for cointegration introduced and popularized by Johansen (1988), Johansen and Juselius (1990) and Johansen (1991) to obtain both the short and long-run estimates of the variables involved. All estimations were carried out using Econometric views (Eviews) 6.0 package.

Conclusion

This chapter presented the methodological frame work of the study. The theoretical model adopted in the study is the Solow growth model within the framework of neoclassical economics. The study employed quarterly time series

data from 1983 to 2012. The variables for the study included: real gross domestic product per capita, gross domestic savings to GDP ratio, capital stock, consumer price index, labour force, interest rate, and broad money supply to GDP ratio. In order to smoothen the data series, the empirical model was formulated by taking natural logarithms of the variables. This chapter provided a thorough description and measurement of the variables used as well as the source of the data. Stationarity test was conducted using ADF and PP tests. Also, Johansen cointegration test, VAR and VECM were used to examine the long-run and short-run dynamics among the variables. Variance decomposition analysis was employed to determine the relative contributions of each endogenous variable to the forecast error variance of a targeted variable. Finally, the chapter used the Granger-causality technique to determine the direction of causality among the variables.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The objective of this chapter is to present a detailed discussion of the results of the study. The rational is to verify empirically the relationship between domestic savings and economic growth in Ghana. This chapter is divided into six main sections. The first section examines the descriptive statistics of the variables in the study. The second section examines the time series properties of the variables where the results of both ADF and PP unit root tests are presented. The granger causality test results are presented in the third section. The results of Johansen's approach to co-integration are presented in the fourth section. Section five presents and discusses the results of the estimated long-run growth equation using VAR approach. The final section presents and discusses variance decomposition analysis. These results are discussed in relation to the hypotheses of the study.

Descriptive statistics

The study computed the descriptive statistics of the variables used in the study. This presents the distributive properties of the variables used for the study.

The descriptive statistics include the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, sum, sum squared deviation and number of observations. Table 2 illustrates clearly these statistics.

From Table 2, the total number of observations used was 120. It can be observed that all the variables in the table have positive average values (means). The variables real GDP per capita (LY), labour force (LL) and interest rate (R) are positively skewed. Capital stock (LK), consumer price index (LCPI), government expenditure (LGOV) and money supply (LMS) on the other hand are negatively skewed.

Table 2: Summary Statistics

	LY	LDS	LK	LCPI	LMS	LGOV	LL	R
Mean	5.20	5.79	4.82	1.53	5.44	5.27	13.74	6.11
Median	5.16	5.71	4.93	1.90	5.45	5.27	13.74	5.68
Maximum	5.70	6.63	5.96	4.04	5.75	5.58	14.48	11.25
Minimum	4.87	4.36	3.31	-1.87	5.09	4.92	13.02	2.99
Std. Dev.	0.21	0.47	0.71	1.83	0.18	0.14	0.44	2.43
Skewness	0.67	-0.40	-0.30	-0.28	-0.21	-0.12	0.04	0.77
Kurtosis	2.75	3.52	2.07	1.73	1.88	2.97	1.75	2.64
Jarque-Bera	9.23	4.53	6.13	9.66	7.14	0.27	7.88	12.42
Probability	0.01	0.10	0.05	0.01	0.03	0.87	0.02	0.00
Sum	623.81	694.45	579	183.00	652.38	631.86	1648.44	733.50
SSq. Dev.	5.13	26.11	6010	400.36	4.05	2.44	22.92	702.03
Observations	120	120	120	120	120	120	120	120

Source: Estimated from WDI (2012) and Bank of Ghana data using Eviews 6.0 package Note: Std. Dev. represents Standard Deviation while SSq. Dev. represents Sum of Squared Deviation

The minimal deviations of the variables from their means as indicated by the standard deviations demonstrate that taking the logs of variables minimises their variances. The Jarque-Bera statistic which shows the null hypothesis that all the series are drawn from a normally distributed random process cannot be rejected for domestic savings (LDS) and government expenditure (LGOV) implying that they are normally distributed. However, real GDP per capita (LY), capital stock (LK), consumer price index (LCPI), money supply (LMS), labour force (LL) and interest rate (R) are not normally distributed.

Unit roots test results

Before applying the Johansen's multivariate approach to co-integration and Granger-causality test, unit root test was conducted in order to investigate the stationarity properties of the variables. All the variables were examined by first inspecting their trends graphically **(Appendix A)**. From the graphs in **Appendix A**, it can be seen that, all the variables appear to be non-stationary. However, the plots of all the variables in their first differences exhibit some stationary behaviour as presented in **Appendix B.** This implies that the series may be stationary at first difference.

Furthermore, the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests were applied to all variables in levels and in first difference in order to formally establish their order of integration. The optimal lag length was selected based on automatic selection by Schwarz-Bayesian Criterion (SBC) and the Akaike Information Criterion (AIC). The study presented and used the P-values for making the unit root decision which arrived at similar conclusion with the

critical values. The results of both tests for unit root for all the variables at their levels with intercept and their first difference are presented in Tables 3 and 4.

Table 3: Unit Root Test Results for the Order of Integration (ADF and Philips Perron): At levels with (intercept)

VARIABLES	ADF STATS	P-VALUE	[LAG]	PP STATS	P-VALUE	[BW]
LY	3.5758	(1.000)	[2]	-2.9221	(1.000)	[1]
LDS	-1.8096	(0.374)	[2]	-1.8154	(0.372)	[2]
LK	-2.4255	(0.137)	[1]	-2.7057	(0.176)	[1]
LCPI	-3.3503	(0.148)	[1]	-2.8061	(0.604)	[2]
LMS	-0.9515	(0.769)	[1]	-0.8829	(0.791)	[1]
LGOV	-1.8599	(0.350)	[1]	-1.7540	(0.402)	[1]
R	-1.6281	(0.465)	[1]	-1.4298	(0.566)	[1]
LL	-0.8494	(0.801)	[2]	0.8721	(0.995)	[2]

Source: Computed using Eviews 6.0 Package

From the results of unit root test in table 3, the null hypothesis of unit root for all the variables cannot be rejected at levels. This means that all the variables are not stationary at level since their p-values for both ADF and PP tests are not significant at all conventional level of significance.

Results from Table 4 shows that, at first difference all the variables are stationary and the null hypothesis of the existence of unit root is rejected. Therefore, the null hypothesis of the existence of unit root in D(LY), D(LK), D(LDS), D(LCPI), D(LMS) , D(LGOV), D(R) and D(LL) is rejected at 1 percent level of significance. From the above analysis, one can therefore conclude that all variables are integrated of order one *I*(1) and in order to avoid spurious

regression the first difference of all the variables must be employed in the estimation of the short run equation.

Table 4: Unit Root Test Results for Order of Integration: (ADF and Philips Perron) At first difference with (intercept)

VARS	ADF STATS	PVALUE	*OI* LAG	PP STATS	PVALUE	*OI* BW
DLY	0.6430	(0.005)***	*I*(1) [0]	-5.4192	(0.000)***	*I*(1) [5]
DLDS	-5.2143	(0.000)***	*I*(1) [3]	-4.1694	(0.001)***	*I*(1) [4]
DLK	-6.4673	(0.000)***	*I*(1) [0]	-6.2611	(0.000)***	*I*(1) [6]
DLCPI	-9.1890	(0.000)***	*I*(1) [0]	-9.6302	(0.000)***	*I*(1) [6]
DLMS	-8.3982	(0.000)***	*I*(1) [0]	-8.4225	(0.000)***	*I*(1) [4]
DLGOV	-6.2635	(0.000)***	*I*(1) [1]	-5.8284	(0.000)***	*I*(1) [5]
DR	-8.3116	(0.000)***	*I*(1) [0]	-8.3318	(0.000)***	*I*(1) [4]
DLL	-1.8981	(0.003)***	*I*(1) [2]	-14.193	(0.000)***	*I*(1) [5]

Note: *OI* represents order of integration and D denotes first difference. *** represents significance at 1% level.
Source: Computed using Eviews 6.0 Package.

VAR Lag Length Selection

The estimation of VAR models requires the selection of an appropriate lag length. The lag length plays a vital role in diagnostic tests as well as in the estimation of VAR models for co-integration, impulse response and variance decomposition (Bhasin, 2004). Appropriate lag length (p) is chosen using standard model selection criteria (AIC and SBC) that ensure normally distributed white noise errors with no serial correlation. The results of the VAR lag selection criteria are presented in Table 5.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	717.1484	NA	4.37e-16	-12.66336	-12.46919	-12.58458
1	2175.732	2682.751	6.71e-27	-37.56664	-35.81903	-36.85758
2	2422.895	419.2949*	2.59e-28*	-40.83741*	-37.53638*	-39.49807*
3	2460.408	58.27898	4.33e-28	-40.36443	-35.50996	-38.39482
4	2499.155	54.66124	7.39e-28	-39.91348	-33.50559	-37.31360
5	2554.776	70.51982	9.88e-28	-39.76386	-31.80254	-36.53370
6	2600.280	51.19220	1.71e-27	-39.43358	-29.91883	-35.57315
7	2636.204	35.28204	3.94e-27	-38.93221	-27.86404	-34.44150
8	2682.265	38.65874	8.82e-27	-38.61188	-25.99028	-33.49090

* indicates lag order selected by the criterion
Source: Conducted using Eviews 6.0 package
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appropriate lag length (p) is chosen using standard model selection criteria (AIC, LR, SC, FPE and HQ) that ensure normally distributed white noise errors with no serial correlation. It can be observed from the VAR lag selection criteria presented in Table 5 that there are asterisks attached to some statistics of the second lag selection criteria (AIC, LR, SC, FPE and HQ). Tracing these statistics against the first column labeled 'lag' shows that they coincide with lag 2. This implies that the appropriate lag length chosen is 2.

Tests for Cointegration

This section presents the results of the Johansen cointegration analysis. Considering non stationary series with a unit root, first differencing appears to provide the appropriate solution to the problems. But, first differencing will eliminate all the long-run information which economists are most interested in. According to Johansen (1991), cointegration can be used to establish whether there exists a linear long-term economic relationship among variables. In the same vein, Pesaran and Smith (1995) added that cointegration enable researchers to determine whether there exists disequilibrium in various markets. In this regard, Johansen (1991) asserts that cointegration allows us to specify a process of dynamic adjustment among the cointegrated variables and in disequilibrated markets. Given that the series are $I(1)$, the cointegration of the series is a necessary condition for the existence of a long run relationship. Under the assumption of no linear trend in the data, and an intercept in the co-integration

equation the results of both the trace and maximum-Eigen value statistic of the Johansen cointegration test are presented and displayed in Tables 6 and 7.

It can be seen from Tables 6 and 7 that the trace statistics indicates the presence of four cointegrating equations among the variables at one and five percent significance levels. The maximum-eigen value statistics on the other hand suggest one cointegrating equation among the variables at one percent level of significance.

Table 6: Johansen's Cointegration Test (Trace) Results

Hypothesized No. of CE(s)	Eigen value	Trace Statistics	5 Percent Critical Value	Probability
None***	0.439154	205.2856	159.5297	0.0000
At most 1***	0.285437	137.6233	125.6154	0.0075
At most 2**	0.215930	98.30148	95.75366	0.0330
At most 3**	0.193012	69.84045	69.81889	0.0498
At most 4	0.170462	44.75024	47.85613	0.1951
At most 5	0.108482	22.88460	29.79707	0.2518
At most 6	0.066665	9.449571	15.49471	0.3254
At most 7	0.011706	1.377673	3.841466	0.2405

Trace test indicates 4 cointegrating equation(s) at 1% and 5% level of significance.
Note: ** and *** denotes rejection of the hypothesis at 5% and 1% significance level.
Source: Computed Using Eviews 6.0 Package.

Table 7: Johansen's Cointegration Test (Maximum Eigen value) Results

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	5 Percent Critical Value	Probability
None***	0.439154	67.66223	52.36261	0.0007
At most 1	0.285437	39.32185	46.23142	0.2269
At most 2	0.215930	28.46103	40.07757	0.5291
At most 3	0.193012	25.09020	33.87687	0.3789
At most 4	0.170462	21.86564	27.58434	0.2274
At most 5	0.108482	13.43503	21.13162	0.4130
At most 6	0.066665	8.071898	14.26460	0.3715
At most 7	0.011706	1.377673	3.841466	0.2405

Max-eigen value test indicates 1 cointegrating equation(s) at 1% level of significance. Note: *** denotes rejection of the hypothesis at the 1% significance level. Source: Computed Using Eviews 6.0 Package.

The null hypothesis of no cointegrating relationship or vector (r = 0) is therefore rejected since the computed values of the trace and the maximum-eigen value statistics of 205.2856, 137.6233, 98.30148, 69.84045 and 67.66223 are greater than their respective critical values of 159.5297 (1%), 125.6154(%), 95.75366(5%), 69.81889(5%) and 52.36261 (1%) respectively. However, the analysis allows for one cointegrating vector at the one percent significance level based on the maximum-eigen value statistic test following the recommendation of both Enders (2004) and Banerjee et al. (1993) who prefer the maximum-eigen value test. Hence applying the Johansen test to the quarterly series spanning from 1983:Q1 to 2012:Q4 leads to the conclusion that there exist at most one cointegrating relationship. This confirms the existence of a stable long-run relationship among economic growth (Y) as measured by real GDP per capita, domestic savings, capital stock as measured by the share of gross fixed capital formation to GDP (K), consumer price index (CPI), money supply (MS) as measured by money and quasi money to GDP ratio, government expenditure

(GOV) as a share of GDP, labour(L) as measured by population ages 15-64 and interest rate (R) as measured by the Bank of Ghana's prime rate.

Model diagnostics

Since the estimation of a VAR is a means to analysing variance decompositions and impulse response functions, inappropriately estimated VAR will render the impulse response and variance decomposition invalid. Hansen (1992) cautioned that estimated parameters of a time series data could differ over time. Consequently, it is critical to conduct parameter tests in order to check for model misspecification that may arise as a result of unstable parameters and subsequently lead to bias estimates. Table 8 below shows the results for the model diagnostics and goodness of fit.

Table 8: Diagnostic Test for LY Model

R-Square (R^2)	0.72745	R-Bar-Squared	0.70726
S.E. of Regression	0.03819	F-statistic=3.6032	Prob=0.0001
Mean of Dependent Variable	0.07003	S.D. of Dependent Variable	0.07059
Residual Sum Squares	0.02575	Equation log-Likelihood	490.0829
Akaike Info. Criterion	-8.223639	Schwarz Bayesian Criterion	-8.011164
DW-statistic	2.04723		
Specification	Ramsey Reset Test	F-statistic=2.1078 (0.1495)	Log likelihood ratio=

			2.282 (0.1308)
Heteroskedasticity	ARCH Test	F-statistic	Obs*R-squared
		1.7814(0.1378)	6.9942 (0.1362)
Serial Correlation LM	Breusch-	F-statistic	Obs*R-squared
Test	Godfrey	2.3193(0.1033)	4.9053 (0.1861)
Multivariate	Jackque-	1.4281(0.4352)	
Normality	Bera test		
Stability	Highest root	0.9897	

Source: Source: Estimated from WDI (2012) and Bank of Ghana data using Eviews 6.0 package.

Table 8 presents the diagnostic and goodness of fit of the model used in the study. The results in Table 8 shows an R-squared value of 0.72745, suggesting that about 73 percent of the total variations in economic growth is explained by variations in domestic savings and the other explanatory variables in the model. Table 8 also shows that the overall regression is significant at one percent with a p-value of 0.0001. This implies that the explanatory variables in the model properly determine the variations in economic growth.

Furthermore, the results in Table 8 show that there is no evidence of spurious regression. This is justified by the fact that the Durbin-Watson (DW) is greater than the adjusted R-squared. This result is confirmed by the test for serial correlation. The errors of the model are normally distributed and the model passes the Ramsey's RESET for correct specification of the model as well as the arch test for heteroskedasticity.

Finally, to check the stability of the coefficients of the model, the study conducted the VAR stability condition check. The highest root is 0.9897 which

implies that, no root lies outside the unit circle. This however concludes that the VAR satisfies the stability condition. Since the goodness of fit, diagnostics, and stability tests indicates that the model passes all necessary tests, the long and short run relationships are presented.

The results of the long-run relationship

In order to establish the long-run equation, Eviews automatically normalises the first variable in the VAR which is the growth variable. This variable is also of considerable interest to the study. The estimated long-run equilibrium relationship for economic growth (GDP per capita) derived from the normalised vectors, with standard errors in brackets and the t-statistics in parenthesis is expressed as follows:

$$\begin{aligned} LY = {} & 0.1567LDS + 0.2673LK - 0.1398LCPI + \\ & \underset{(0.0196)}{} \quad \underset{(0.0931)}{} \quad \underset{(0.0351)}{} \\ & \underset{[8.0006]}{} \quad \underset{[2.8711]}{} \quad \underset{[3.9824]}{} \\ & 0.3069LMS + 0.1076LGOV - 0.0060R + 0.6380LL \\ & \underset{(0.0372)}{} \quad \underset{(0.1386)}{} \quad \underset{(0.0026)}{} \quad \underset{(0.06545)}{} \\ & \underset{[8.2428]}{} \quad \underset{[0.7763]}{} \quad \underset{[2.2521]}{} \quad \underset{[9.7491]}{} \end{aligned} \qquad (27)$$

Where *LDS* is domestic savings, *LK* is capital stock, *LCPI* is consumer price index, *LMS* is money supply, *LGOV* is government expenditure, *R* is interest rate and *LL* is labour force.

The error correction term of equation (27) can be expressed as:

$$\begin{aligned} ECM = {} & LY - 0.1567LDS - 0.2673LK + 0.1398LCPI - \\ & \underset{(0.0196)}{} \quad \underset{(0.0931)}{} \quad \underset{(0.0351)}{} \\ & \underset{[8.0006]}{} \quad \underset{[2.8711]}{} \quad \underset{[3.9824]}{} \\ & 0.3069LMS - 0.1076LGOV + 0.0060R - 0.6380LL \\ & \underset{(0.0372)}{} \quad \underset{(0.1386)}{} \quad \underset{(0.0026)}{} \quad \underset{(0.06545)}{} \\ & \underset{[8.2428]}{} \quad \underset{[0.7763]}{} \quad \underset{[2.2521]}{} \quad \underset{[9.7491]}{} \end{aligned} \qquad (28)$$

Equation 28 represents the long run effects on output.

The results from equation 27 reveal that, domestic savings to GDP ratio is statistically significant and exerts a positive impact on output with a coefficient of 0.1567. This shows that a 1 percent increase in domestic savings in the long run would lead to a 0.16 percent increase in real GDP per capita, holding all other factors constant. The positive and statistically significant effect of domestic savings is consistent with the predictions of the Solow neoclassical growth theorists. The positive effect of domestic savings on economic growth is in conformity with the suggestions made by Ogoe (2009). Ogoe (2009) showed that the immediate past value of growth rate of gross domestic savings was positive and significantly affected the current growth rate of per capita real GDP.

The coefficient of capital stock of 0.2673 shows that, a percentage increase in capital input would result in a 0.27 percent increase in real GDP per capita, holding all other factors constant. The sign of the capital variable support the theoretical conclusion that capital contributes positively to growth of GDP since the coefficient of capital in this long-run growth equation is positive and significant. This positive relationship between capital stock and economic growth is consistent with the expectation of the classical economic theory. It is consistent with conclusions reached by Aryeetey and Fosu (2003), Fosu and Magnus (2006) and Baafi (2010) in the case of Ghana.

In addition, consumer price index with a coefficient of -0.1398 has a negative and significant impact on economic growth. Specifically, a percentage increase in CPI will decrease economic growth by 0.14 percent. A higher level of CPI represents distortion in an economy. If LDCs are streamlining their investment regulatory framework, implementing policies which promote macroeconomic stability and improve infrastructure, they can achieve a higher

level of economic growth (Asiedu, 2002; Asiedu, 2006). This variable is used to capture macroeconomic instability, (Asiedu, 2006). It shows that stability of a country is an important element for achieving economic growth.

According to Stockman (1981), individual's welfare falls whenever there is an increase in inflation. The negative effect of inflation on economic growth is an indication that inflation causes economic growth in the long-run which is consistent with the results by Bittencourt (2010) who for four Latin American Countries (Argentina, Bolivia, Brazil and Peru) found out that inflation has a negative but significant effect on economic growth. Ahmed and Mortaza (2005) found a statistically significant long-run negative relationship between inflation and economic growth for Bangladesh. Gokal and Hanif (2004) also found a statistically significant negative effect of inflation on economic growth for Fiji.

The results however contradict the findings by Erbaykal and Okuyan (2008) and Omoke (2010). Erbaykal and Okuyan (2008) showed no statistically significant long-run relationship between inflation and economic growth for Turkey. Omoke (2010) found no cointegrating relationship between inflation and economic growth for Nigeria implying no long-run relationship between the two variables. Also, Mallik and Chowdhury (2001) found a positive relationship between inflation and economic growth for four South Asian Countries (Bangladesh, India, Pakistan and Sri Lanka).

The ratio of money supply to GDP is positive and has a significant impact on economic growth. The coefficient of 0.3069 indicates that, a 1 percent increase in money supply will result in an increase in economic growth by 0.31 percent. This is consistent with the expectations of the study. The positive effect of money supply on output is in conformity with the monetarist view of direct

relationship between money supply and output. Chuku, Effiong, and Sam (2010) found a positive relationship between output and money supply for Nigeria. Similarly, Jiranyakul (2009) also found a positive relationship between money supply and output in Thailand.

The ratio of government expenditure to GDP which served as an exogenous variable exerts a positive impact on economic growth but is statistically insignificant with a t-statistic of 0.7763. The coefficient of government expenditure was 0.1076 and this implies that, a percentage increase in government expenditure in the long-run would lead to 0.11 percent increase in economic growth.

The result is consistent with the findings of Grossman (1988), Barro (1990), Dowrick (1996) and Nworji, Okwu, and Nworji (2012). Barro (1990) found that government investment has no statistically significant effect on economic growth. Current spending itself is likely to have no impact on productivity of private sector as a result of counterproductive impact of current expenditures (Volkov, 1998). Nworji, Okwu, and Nworji (2012) found insignificant positive effect of capital expenditure on transfers on economic growth.

Interest rate is significant and exerted a negative impact on real GDP per capita with a coefficient of 0.0060. The magnitude of the coefficient implies that an increase in interest rate by 1 percent will reduce real GDP per capita by 0.01 percent, holding all other factors constant. The result is consistent with that found by D'Adda and Scorcu (1997), Anaripour (2011) and Udoka and Anyingan (2012)

Labour force is positive and significant with a coefficient of 0.6380 indicating an increase in economic growth (LY) by this amount if there is a 1 percent increase in the labour force (L). This is consistent with the argument of Jayaraman and Singh (2007) who asserted that there can be no growth achievement without the involvement of labour as a factor input hence, the positive and significant coefficient. This result however contradicts the works of Aryeetey and Fosu (2003) who found a negative effect of labour on economic growth. Baafi (2010) also found negative long run relationship between labour force and GDP.

Short Run Dynamics

Engle and Granger (1991) argued that when variables are cointegrated, their dynamic relationship can be specified by an error correction representation in which an error correction term (ECT) computed from the long-run equation must be incorporated in order to capture both the short-run and long-run relationships. It is expected to be statistically significant with a negative sign. The negative sign implies that any shock that occurs in the short-run will be corrected in the long-run. If the error correction term is greater in absolute value, the rate of convergence to equilibrium will be faster.

Given that our variables are non-stationary but cointegrated, the estimation of the VECM, which included a first differenced VAR with one period lagged error correction term yielded an over-parameterized model as presented in **Appendix D**. As the values of the variables are stationary, the model was estimated using the ordinary least squares (OLS). The approach of general-to-specific (GTS) modelling was employed to arrive at a more parsimonious

model, where insignificant lagged variables were deleted using the t-ratios. Rutayisire (2010) argued that this process of moving from the general to the specific brings about a simplification of the model that makes estimations more reliable and increases the power of the tests.

The results from the vector error correction model as displayed in Table 10 suggests that the ultimate effect of previous period's values of real GDP per capita on current values of real GDP per capita in the short-run is positive and significant at lag 2.

Table 9: Results of Error-Correction Model (VECM)

Variable	Coefficient	Std error	t-statistics	Probability
ECT(-1)	-0.050184	0.010905	-4.602026	0.0000
D(LY(-1))	0.301742	0.123719	2.438930	0.0000
D(LY(-2))	0.235797	0.078079	3.019971	0.0032
D(LGDS(-2))	0.010679	0.005061	2.110235	0.0371
D(LK(-1))	0.043985	0.016341	2.691676	0.0082
D(LGOV(-1))	0.044350	0.025846	1.715937	0.0890
D(R(-1))	-0.001682	0.000702	-2.395514	0.0183
D(LL(-1))	0.288220	0.034529	8.347097	0.0000
CONSTANT	0.009417	0.000920	10.23442	0.0000

Source: Estimated from WDI (2012) and Bank of Ghana data using Eviews 6.0 package

The results from table 9 show that, the coefficient of the error correction term (ECT) is negative and highly significant at one percent significance level. This is an indication of the existence of a cointegrating relationship among the variables in the model. According to Kremers et al. (1992) and Bahmani-

Oskooee (2001), a relatively more efficient way of establishing cointegration is through the error correction term. The ECT represents the rate of adjustment to restore equilibrium in the dynamic model after a disturbance. The estimated coefficient of the error correction term is -0.050184 which implies that the speed of adjustment is approximately 5 percent per quarter. The size of the coefficient of the error correction term (ECT) denotes that about 5 percent of the disequilibrium in the product market caused by previous quarters' shocks converges back to the long-run equilibrium in the current quarter. The study indicates that the variables in the model show evidence of moderate response to equilibrium when shocked in the short-run. It is theoretically argued that a genuine error correction mechanism exists whenever there is a cointegrating relationship among two or more variables. Acheampong (2007) maintains that, the larger the error correction coefficient (in absolute term), the faster the variables equilibrate in the long-run when shocked. However, the magnitude of the coefficient in this study suggests that the speed of adjusting to long-run changes is slow.

From Table 9, the current value of real GDP per capita is affected by the past quarter values of real GDP per capita. Specifically, real GDP per capita at lag one and two are significant with coefficients of 0.301742 and 0.235797 respectively. It shows a positive effect on real GDP per capita in the first and second quarters. This is expected in that, previous growth and expansion of the economy serves as an indication of prosperity and may attract more investment leading to more growth.

Domestic savings is also significant at lag two in the short run where it exerts a positive effect on real GDP per capita with coefficient of 0.010679. Thus

in the second quarter a percentage increase in LDS would lead to 0.01 percentage increase in real GDP per capita. The positive effect is justified by the fact that domestic savings in Ghana result in economic growth through investment which has been observed to be perhaps the most robust explanatory variable in the growth equation of developing countries (Renelt & Levine, 1993).

Similarly, the short-run coefficient of capital is positive and significant just as the long run estimate. Thus in the short run a percent increase in capital would lead to approximately 0.04 percent increase in GDP per capita growth in the first quarter. The sign of the capital variable support the theoretical conclusion that capital contributes positively to growth of GDP both in the short and long-run since the coefficient of capital in these two periods is positive and significant.

Also, government expenditure is positive and significant at lag 1. Thus, one percent increase in government spending in the previous quarter will cause growth in real GDP per capita to rise by 0.04 percent in the first quarter. A short-run change in government expenditure exerts a positive and statistically significant impact on economic growth. This means that an increase in government expenditure in the short-run exerts a positive impact on economic growth. The positive impact is in conformity with the findings by Kouassy and Bohoun (1994) for Ivory Coast.

Furthermore, interest rate exerts a negative and significant effect on economic growth confirming the results from the long-run estimation. The results concur with the study by Udoka and Anyingan (2012).

Similarly, the growth in labour force is positive and significant at 1 percent significance level. One percent increase in the labour force in the short

run would increase real GDP per capita growth by 0.29 percent. This result contradicts the findings of Baafi (2010) who found a negative short run relationship between labour force and GDP. The result suggests that capital and labour force are integral part of the Ghanaian economy as postulated by the Neoclassical Growth Theory of Solow.

Granger-Causality Test

To find out the direction of causality between domestic savings and economic growth and selected macroeconomic variables, the study conducted a pair wise Granger causality test using lag 2 and the results are presented in Table 10.

Table 10: Granger Causality Test

Null Hypothesis	F Statistics	Probability
LDS does not Granger Cause LY	1.14234	0.3227
LY does not Granger Cause LDS	3.25228	0.0432**
LK does not Granger Cause LY	2.90899	0.0586*
LY does not Granger Cause LK	6.60410	0.0006***
LCPI does not Granger Cause LY	7.34305	0.0010***
LY does not Granger Cause LCPI	1.91708	0.1518
LMS does not Granger Cause LY	2.20480	0.0005***
LY does not Granger Cause LMS	2.16912	0.1190
LGOV does not Granger Cause LY	5.63915	0.0046***
LY does not Granger Cause LGOV	7.94181	0.0006***
R does not Granger Cause LY	1.24017	0.2932
LY does not Granger Cause R	1.22899	0.2965

LL does not Granger Cause LY	37.4941	0.0125**
LY does not Granger Cause LL	0.22017	0.008027***

Note: *, ** and *** denote rejection of null hypothesis at 10%, 5% and 1% level of significance. Source: Conducted using Eviews 6.0 package.

The results of the granger causality test in Table 10 show that domestic savings (DS) does not granger cause economic growth (Y). The results therefore fail to reject the null hypothesis that domestic saving does not granger causes economic growth. However, the results reject the null hypothesis that economic growth does not granger causes domestic savings at 5 percent level of significance. The results indicate unidirectional causality between domestic savings and economic growth. The implication is that real economic growth predicts future values of domestic savings which further confirms the position of the keynesian hypothesis. Keynes (1936) was of the view that it is economic growth that rather leads to higher savings.

In the empirical literature, the result is in consonance with the findings of Anoruo and Ahmed (2002), Abu (2010), Mphuka (2010) and Mehrara, Musai and Nasibparast (2012). Anoruo and Ahmed (2002) who found the direction of causality running from the growth rate of per capita real GDP to the growth rate of gross domestic savings. Abu (2010) rejected the Solow's hypothesis that saving precedes economic growth, and accepted the Keynesian theory that it is economic growth that leads to higher savings when he found a unidirectional causality between savings and economic growth running from economic growth to saving. Mphuka (2010) found that economic growth 'Granger' causes domestic savings. Mehrara, Musai and Nasibparast (2012) also found unidirectional causality between gross domestic savings and economic growth

in Iran with the direction of causality running from economic growth to gross domestic savings.

However, the findings of this study contrast that of Sajid and Sarfraz (2008), Agrawal and Sahoo (2009), Lean and Song (2009), Ogoe (2009) and Zeren and Akbas (2013) who found bidirectional causality between domestic savings and economic growth. Also, Alguacil, Cuadros, and Orts, (2004) found evidence in favour of Solow's model prediction that higher saving leads to higher economic growth in Mexico.

Similarly, the results indicate a bi-directional causality between gross fixed capital formation and economic growth. The null hypotheses that LK does not granger cause LY and LY does not granger cause LK are rejected at 10 percent and 1 percent significance levels respectively. It is important to note however that, causality from economic growth to investment is stronger than the causality from investment to economic growth. This is in line with the long-run findings. It also gives credibility to the fact that investment in productive capital is a real booster for every economy including that of the Ghanaian economy. Nevertheless, growth in the economy also creates income for reinvestment.

The Granger causality test results also suggests that the null hypothesis that CPI does not Granger cause real GDP per capita is rejected at 1 percent level of significance, implying that CPI granger causes real GDP per capita. However, the null hypothesis that real GDP per capita does not granger cause CPI is not rejected; implying that real GDP per capita does not granger cause CPI. Thus, a unidirectional causality has been identified from CPI to economic growth at the 1 percent significance level.

The unidirectional causality between CPI and economic growth is in line with the findings of Erbaykal and Okuyan (2008) for Turkey and Omoke (2010) for Nigeria. Erbaykal and Okuyan (2008) found a unidirectional causality between inflation and economic growth running from inflation to economic growth. Omoke (2010) identified a unidirectional causality between inflation and economic growth running from inflation to economic growth.

However, the study differs from the results obtained by Gokal and Hanif (2004) who found a unidirectional causality between inflation and economic growth for Fiji running from economic growth to inflation.

The null hypothesis that LMS does not granger cause LY is rejected at 1 percent significance level. This result suggests that money supply granger causes real GDP per capita. However, the null hypothesis that real GDP per capita does not granger cause money supply is not rejected. The implication is that real GDP per capita does not granger cause money supply. The results show that money supply predicts future values of real GDP per capita but real GDP per capita does not predict future values of money supply. This result supports the monetarist view of direct relationship between money supply and output.

The results indicate a bi-directional causality between government expenditure and economic growth at 1 percent significance level. The results indicate that, the null hypothesis of LGOV does not granger cause LY and LY does not granger cause LGOV is rejected. This implies that there exist a positive feedback effect between government expenditure and economic growth which further confirms the position of the Wagner's Law and the Keynesian hypothesis. This is an indication that government expenditure is a critical

variable in achieving economic growth. Also achieving economic growth is vital in determining the variations in government expenditure.

The result is consistent with the findings of Samudram et al. (2009) who found bi-directional causality between government expenditure and economic growth. The result however contradicts the findings of Al-Faris (2002), Tang (2008) and Amin (2011). Al-Faris (2002) found a uni-directional causality between government expenditure and economic growth with the angle of causality running from economic growth to government expenditure in Gulf Cooperation Council which confirmed the Wagner's Law. Tang (2008) found non-stable granger causality between government expenditure and economic growth. Amin (2011) also confirmed the Wagner's Law by finding uni-directional causality between government expenditure and economic growth in Bangladesh with the angle of causality running from economic growth to government expenditure.

The null hypothesis that LL does not granger cause LY is rejected at 5 percent significance level. Likewise, the null hypothesis of LY does not granger cause LL is rejected at 1 percent significance level. This implies that labour force granger causes real per capita GDP and vice versa. This means that economic growth predicts future values of labour force and labour force also predicts future values of economic growth.

Variance Decomposition Analysis

Following the VAR estimation, the study decomposed the forecast error variance by employing Sim's Recursive Cholesky decomposition method. The forecast error variance decomposition provides complementary information for

a better understanding of the relationships between the variables of a VAR model. It tells us the proportion of the movements in a sequence due to its own shock, and other identified shocks (Enders, 2004). Thus, the variance decomposition analysis will enable us identify the most effective instrument for each targeted variable based on the share of the variables to the forecast error variance of a targeted variable. The results of the forecast error variance decomposition of the endogenous variables, at various quarters are shown in Table 11.

Table 11: Result of Variance Decomposition of Real GDP Per capita

Qtr	LY	LDS	LK	LCPI	LMS	LGOV	R	LL
2	82.6712	0.1438	2.0716	0.8493	1.9742	6.1024	2.3382	3.8492
4	64.0046	0.2675	5.6908	0.4353	7.5206	9.7322	7.7921	4.5568
6	54.1533	2.6819	6.7042	0.4296	13.6208	7.0816	12.5276	2.8010
8	46.8575	6.6630	6.9600	0.4950	16.7951	4.3985	16.1528	1.6781
10	41.7367	9.3750	7.6217	0.5322	17.1939	2.9920	18.6842	1.8644
12	38.7920	9.8965	9.0030	0.5478	16.4429	2.3289	20.2260	2.7629
14	37.2873	9.1613	10.8977	0.5589	15.6401	1.9615	20.7314	3.7618
16	36.4620	8.2098	12.8504	0.5714	15.2498	1.7925	20.2863	4.5778
18	35.8622	7.4032	14.4749	0.5834	15.5011	1.7872	19.2090	5.1789
20	35.2547	6.7889	15.6279	0.5884	16.4407	1.8354	17.8381	5.6259
22	34.5690	6.3916	16.3853	0.5796	17.8277	1.8396	16.4217	5.985
24	33.8648	6.1457	16.9228	0.5562	19.2883	1.7852	15.1222	6.314
26	33.2194	5.9346	17.3826	0.5231	20.5710	1.7040	14.0098	6.655
28	32.6527	5.7009	17.8172	0.4876	21.6091	1.6251	13.0799	7.027

30	32.1455	5.4511	18.2171	0.4573	22.4387	1.5631	12.2980	7.429
32	31.6793	5.2075	18.5591	0.4384	23.1149	1.5243	11.6320	7.844
34	31.2508	4.9830	18.8301	0.4356	23.6765	1.5114	11.0618	8.250
36	30.8662	4.7818	19.0288	0.4517	24.1424	1.5243	10.5751	8.629
38	30.5308	4.6041	19.1599	0.4891	24.5195	1.5596	10.1631	8.973
40	30.2441	4.4493	19.2307	0.5503	24.8095	1.6117	9.8178	9.286

Source: Computed Using Eviews 6.0 Package

The results from table 11 above shows that, the largest source of variations in real GDP per capita forecast error is attributed to its own shocks. The innovations of domestic savings, capital stock, consumer price index, money supply, government expenditure, interest rate and labour force are important sources of the forecast error variance of real GDP per capita. Consumer price index contributes least to the forecast error variance of real GDP per capita. This suggests that all the variables play important part in real GDP per capita with the most effective variable being the ratio of money supply to GDP (LMS).

In explaining the forecast error variance of real GDP per capita above, it is observed that in the short term horizon (two years), medium-term and long-term horizon innovations of money supply, capital stock and interest rate are the most important sources of variations besides its own shock. The source of least forecast error variance of real GDP per capita is the innovations of consumer price index throughout the short-term, medium-term and long-term horizons. The most effective instrument for real GDP per capita seems to be money supply.

Conclusion

This chapter focused on the estimation of the models, presentation and discussion of the results of the study. The chapter began by looking at the descriptive statistics. This was followed by an examination of the time series properties of the variables in the model. The unit root test was conducted by employing both the ADF and the PP techniques which showed that all the series had to be differenced once to achieve stationarity. The implication is that all the series are integrated of order one, $I(1)$. Granger-causality test suggested bi-directional causality between domestic savings and economic growth. This indicates support for the Solow's neoclassical growth theorist as well as the Keynesian hypothesis.

The presence of non-stationary variables implied the possibility of the presence of a long-run relationship, which the study verified using Johansen's cointegration test. The results confirmed the presence of one cointegrating relationship between domestic savings and economic growth. After determining the existence of the long - run relationship between the variables of interest, the study proceeded to present the diagnostic and parameter stability test. This was to ensure that the presented results were robust. The diagnostic and parameter stability tests revealed that the model passes the test of serial correlation, functional form mispecification, normality and hetroskedasticity. The VAR stability condition check indicated that, no root lied outside the unit circle which implied that the VAR satisfies the stability condition.

Whereas domestic savings, capital stock, money supply and labour force exerted positive and statistically significant effect on economic growth in the

long run, a negative effect was realized from consumer price index and interest rate to growth. However, the ratio of government expenditure to GDP was not statistically significant but positive.

The results of the VECM showed that the error correction term for economic growth did carry the expected negative sign. The findings from variance decomposition showed that, the predominant source of variations in real GDP per capita forecast errors is attributable to its own shocks with the most effective variable being money supply and the least forecast error variance of real GDP per capita was the innovations to consumer price index.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This final chapter presents the summary, conclusions and recommendations of the study. Whereas the summary shows a brief overview of the research problem, objective, methodology and findings, the conclusions capture the overall outcomes regarding the findings of the study in light of the hypotheses. Recommendations also present specific remedies to be implemented by specific bodies. The chapter also presents the limitations and direction for future research in the area of domestic savings and economic growth.

Summary

Savings naturally play an important role in the economic growth and development process in Ghana. Savings determine the national capacity to invest and thus to produce, which in turn, affect economic growth potential of the country (Ogoe, 2009). Domestic savings in Ghana result in economic growth through investment which has been observed to be perhaps the most robust explanatory variable in the growth equation of developing countries (Levine &

Renelt, 1993). Thus, domestic savings in Ghana is a very critical and reliable factor in the capital formation process (MESTI, 2012).

Growth rates in Ghana have remained positive since the start of the economic reforms in contrast to some periods in the earlier years where negative growth rates were recorded. The growth record of Ghana is however deemed inadequate for the desired transformation of the economy given that the country in 1993 set itself to become an upper middle income country by 2020 (Aryeetey & Fosu, 2008).

The main objective of this study was to examine the effect of domestic savings on economic growth in Ghana using quarterly time series data from 1983 to 2012. More specifically, the study investigated the long-run, short-run and the causal relationship between domestic savings and economic growth in Ghana. This was done by employing the Johansen cointegration, vector error correction (VECM), vector autoregressive (VAR) and Granger causality approaches.

An empirical model was specified based on an extensive review of the literature on domestic savings and economic growth. The variables included in the model were real GDP per capita (*LY*), domestic savings (*LDS*), capital stock (*LK*), consumer price index (*LCPI*), money supply (*LMS*), government expenditure (*LGOV*), interest rate (*R*) and labour force (*LL*). In order to determine the long run and short run relationships between domestic savings and economic growth, the Johansen cointegration and error correction methodology was preferred to other techniques, because of its several advantages over those alternative techniques.

These variables were first tested for the existence of unit roots using the Augmented-Dickey Fuller (ADF) and Phillips-Perron (PP) tests. This was done

in order to determine their order of integration. The ADF and the PP test indicated that all the variables employed in this study were integrated of order one ($I(1)$).

The Johansen (1988) approach to cointegration and the VECM were employed to examine the long-run and short-run dynamics among the variables used in the estimation. The cointegration analysis revealed the presence of one economically interpretable long-run relationship among real GDP per capita, domestic savings, capital stock, consumer price index, money supply, government expenditure, interest rate and labour force based on the maximum-eigen value statistic.

The long-run model indicated that, domestic savings, capital stock, money supply and labour force were statistically significant and exerted a positive impact on economic growth (real GDP per capita) except for CPI and interest rate which were negatively related to real GDP per capita. However, government expenditure was not statistically significant even though it had the correct positive sign as expected. This is consistent with the predictions of the neoclassical growth literature.

The study went further to estimate the general to specific model which is much simplified than the VECM. The short-run results revealed that domestic savings has a positive effect on economic growth. This confirms the fact that domestic savings serve as a very critical and reliable factor in capital formation process which in turn promotes economic growth.

Also, capital stock, government expenditure and labour force were all positive and statistically significant in the short run. However, interest rate exerted a negative impact on economic growth. Furthermore, CPI and money

supply as a share of GDP were statistically insignificant in the short run. The coefficient of the error correction term (ECT) was negative and highly significant at one percent significance level. The estimated coefficient of the error correction term of -0.050184 implies that the speed of adjustment is approximately 5 percent per quarter. The size of the coefficient of the error correction term (ECT) denotes that about 5 percent of the disequilibrium in the product market caused by previous years' shocks converges back to the long-run equilibrium in the current year.

To identify the direction of causality between domestic savings and economic growth, the granger causality test was conducted. The results revealed unidirectional causality between domestic savings and economic growth with the direction of causality running from real GDP per capita to domestic saving. This result confirmed the Keynesian hypothesis. The study also found unidirectional causality between consumer price index and economic growth as well as money supply and economic growth. The result however found bidirectional causality between capital stock and economic growth, government expenditure and economic growth and labour force and economic growth in Ghana.

The forecast error variance decomposition suggested that the largest source of variations in real GDP per capita forecast error is attributed to its own shocks. However, the variable that influenced economic growth significantly aside its own shocks was money supply while the source of least forecast error variance of real GDP per capita was the innovations of consumer price index throughout the short-term, medium-term and long-term horizons.

Evidence from the diagnostic test statistics indicated that, the estimated model was satisfactory and in line with the Lagrange multiplier and F-statistic. The VAR stability condition check result showed that no root lied outside the unit circle. This was verified with a higher root of 0.9897which concluded that the VAR satisfied the stability condition.

Conclusions

The main objective of this study was to examine the relationship between domestic savings and economic growth in Ghana. The results obtained in this study clearly indicate that this objective was achieved. The following conclusions were reached based on the findings obtained from the study.

It can be concluded from the study that the neoclassical growth model which argues that savings influence economic growth is valid in both the long-run and short-run. The result implies that any increase in domestic savings is vital for sustained economic growth. The effect of domestic savings increase on output in the long-run is however greater than that of the short run.

The empirical evidence concludes that, capital stock, consumer price index, money supply, interest rate and labour force are important determinants of long-run growth of the country. Also, government expenditure only influences short-term growth of the economy. Capital stock, interest rate and labour force determine variations in economic growth in both the long run and the short run.

The study also concludes from the granger causality test results that increases in economic growth are essential for increasing domestic savings in Ghana. From the results of the forecast error variance decomposition, it can be

concluded that money supply is an important source of variation in economic growth.

Recommendations

The following recommendations are proposed from the study. The study revealed that domestic savings play an important role in the growth of the economy. In respect of this, measures should be put in place to boost domestic savings which would increase investment and hence accelerate growth. The government should therefore encourage people to save in order to increase capital formation for increased economic growth.

The unidirectional causality between domestic savings and economic growth implies that their policy orientation will run from growth of real GDP per capita to domestic savings. It is recommended that the government should embark on an expansionary fiscal policy by increasing government spending in order to increase economic growth. Keynesian economics suggests that increasing government spending is the best way to stimulate aggregate demand and hence economic growth. The increase in economic growth will therefore lead to increase in domestic savings.

The forecast variance decomposition analysis results indicated that the most effective variable influencing economic growth was money supply. This implies that in order to achieve higher economic growth, money supply needs to be shocked to stimulate economic growth. It is however recommended that the government increases money supply through an expansionary monetary policy. This rise in money supply will boost investment which will lead to increased economic growth.

Limitations of the study

The main limitation of the study was the limited availability of annual data on some key variables used for the study. Quarterly series were generated through interpolation. According to Hakkio and Rush (1991) and Campbell and Perron (1991) as cited in Bashiru (2011), there is no gain in the power of these tests by switching from low frequency to high frequency data and merely increasing the number of observations over a short time period. This did not however affect the quality of the results in any way because other authors including Sajid and Sarfraz (2008) have used similar approach and arrived at reliable results.

This study employed the Johansen approach to cointegration and one major limitation with the Johansen's approach to cointegration is that, it is based on VAR methodology which is inherently over parameterized and sensitive to both model specification and lag length selection. The selected lag length has implications for the outcome of the cointegration, variance decomposition and causality test. Nevertheless, the cointegration, variance decomposition and causality test produced consistent results.

Suggestions for future research

The main aim of this study was to examine the relationship between domestic savings and economic growth in Ghana. The areas for further research that emerge from this study include disaggregating the domestic savings data into private savings and public savings and analysing their relationship with economic growth.

Another interesting area for future research will be to investigate the contribution of domestic savings to the various sectors of the economy such as industrial, agricultural and service. This will aid in identifying the main channels (by sectors) through which domestic savings affect economic growth of Ghana.

Finally, two separate models could be estimated considering the possibility of bidirectional causality between domestic savings and economic growth. The argument that domestic savings can affect output growth indirectly through its impact on investment can also be explored.

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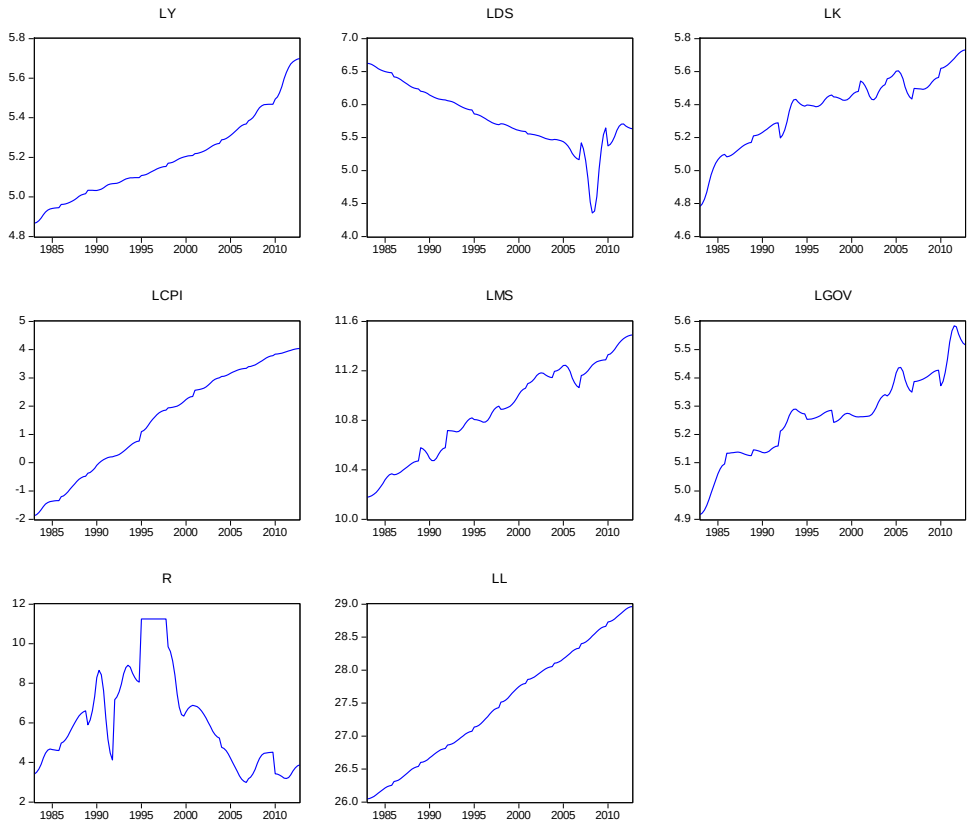
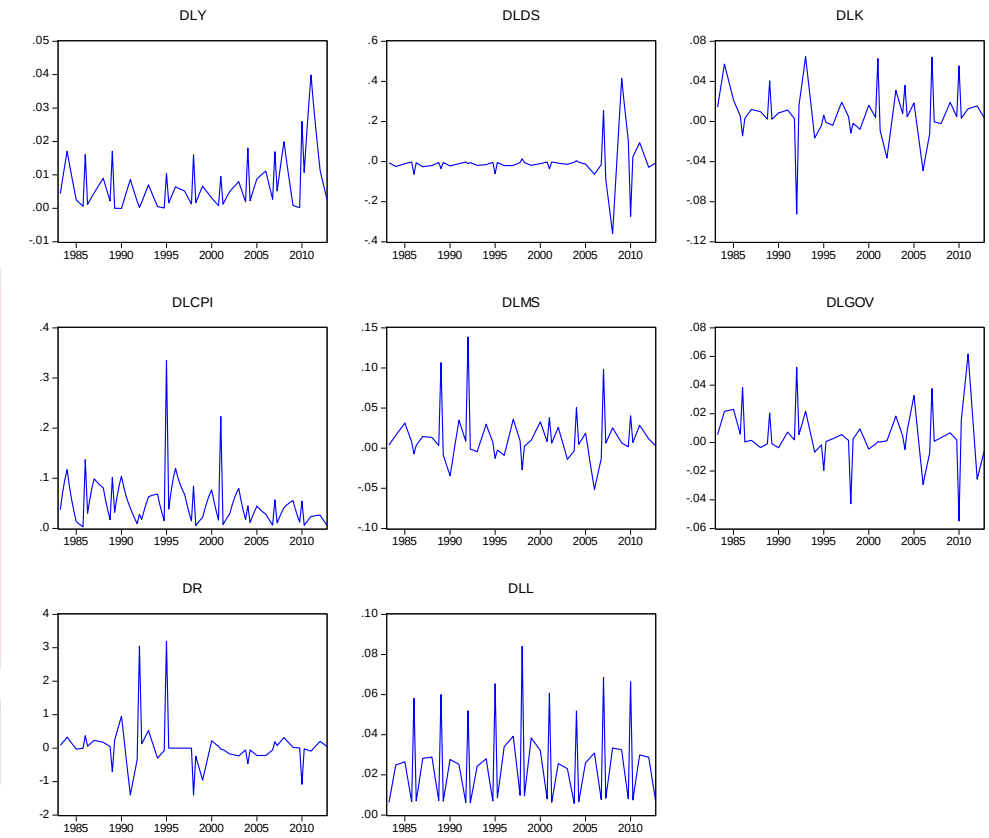
APPENDICES

A: Results of plots of variables in levels



Source: Generated by the author using Eviews 6.0

B: Results of plots of variables in first difference



Source: Generated by the author using Eviews 6.0

C: Un-normalised Cointegrating Coefficients

LY	LDS	LK	LCPI	LMS	LGOV	R	LL
-39.5978	6.2041	10.5863	-5.5356	12.1523	4.2616	-0.2377	25.2653
0.5154	0.0935	30.5083	-5.7958	2.8105	-35.4124	-0.5008	-9.7561
6.2427	-1.9648	7.0568	-1.6948	-3.0950	-23.6011	0.4558	1.9022
38.7963	1.9617	-9.5918	13.4958	2.3371	-10.8021	-0.5974	-29.3564
-36.2514	1.8267	5.9530	-10.9965	3.4202	-16.2860	0.4866	26.3334
8.6345	-1.4992	-2.1986	-2.2906	-1.2193	-7.2788	-0.1286	6.7841
6.01797	0.4812	-4.8434	1.2527	5.3161	-5.8263	0.0850	-2.1078
-40.2702	-1.2564	3.1331	-1.9057	-2.6537	10.7868	-0.1475	9.8585

D: Short run dynamic (VECM) results for real GDP per capita

Variables	Coefficients	Standard Errors	t value
ECT(-1)	-0.060008	0.014407	-4.165150
D(LY(-1))	0.939596	0.180065	5.218083
D(LY(-2))	0.166857	0.173542	0.961481
D(LDS(-1))	-0.003099	0.007214	-0.429559
D(LDS(-2))	0.015974	0.007905	2.020863
D(LK(-1))	0.063429	0.036151	1.754561
D(LK(-1))	0.000466	0.036766	0.012680
D(LCPI(-1))	0.025004	0.025865	0.966745
D(LCPI(-2))	-0.006281	0.027094	-0.231831
D(LMS(-1))	0.007434	0.026811	0.277260
D(LMS(-2))	0.006257	0.028544	0.219194
D(LGOV(-1))	0.029690	0.042307	0.701770
D(LGOV(-2))	0.032537	0.042967	0.757259
D(R(-1))	-0.000908	0.001291	-0.702910
D(R(-2))	0.000232	0.001318	0.175931
D(LL(-1))	0.313622	0.065855	4.762287
D(LL(-1))	-0.025847	0.072049	-0.358736
CONSTANT	0.009861	0.001172	8.415360