

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**THE FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH:
(GRANGER CAUSALITY TEST)**

BY: TEMESGEN GOSHANA

JUNE 3, 2016
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**A project submitted to the School of Graduate Studies of Addis Ababa University in Partial
fulfillment of the requirement for the Degree in Masters of Art in Applied Economic Modeling and
Forecasting**

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This is to certify that the paper prepared by Temesgen Goshana entitled: Financial development and Economic growth in Ethiopia: A granger causality test, and submitted in partial fulfillment of the requirement of the Degree of Masters of Art in Applied Economic Modeling and Forecasting complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Approved by

Signature

Assefa Admasie (PhD)

.....

JUNE 3, 2016
ADDIS ABABA

DECLARATION

I, the undersigned, declare that this is my original work and has not been presented for a degree in any other university and that all sources of materials used for the project have been duly acknowledged.

Declared by

Name: Temesgen Goshana

Signature:

Date:

Confirmed by Advisor

Name: Assefa Admasie (PhD)

Signature:

Date:

ABSTRACT

The study determines the causal relationship between financial development and economic growth in Ethiopia. In order to test for existence of long run relationship between the variables, the study employs a co integration and vector error correction model (VECM) technique. Granger causality test was applied to the variables to test for the direction of causation between variables.

The study uses annual data for the period of 1980 to 2014. Economic growth is proxied by gross domestic product, and financial development is proxied by bank deposit, domestic credit, broadly defined money supply (M2); and credit to the private sector. The result shows that there is a stable long-run relationship between financial development and economic growth.

The Granger causality test indicates that the causality runs from both directions which is economic growths to financial development and from financial development to economic growth. The results suggest that the real sector of the economy should be developed further in order to stimulate further development in the economy

The results indicate that the causal effect of financial development for the economic growth is more than the economic effects to the financial development.

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Acronyms

GDP	Gross Domestic Product
ADF	Augmented Dicker-Fuller
M2	Broad Money Supply
NBE	National bank of Ethiopia
FD	Financial development
DC	Domestic Credit
PC	Credit to Private Sectors
BD	Bank deposit
MoFEC	Ministry of finance and Economic cooperation
AIC	Akaike Information Criteria
MFs	Micro Finance Institutions
VECM	Vector Error Correction Model

Chapter One

1. Introduction

1.1 Background

A variety of economic growth theories ranging from the Harrod-Domar growth Model and Rostow take off model (1960) have one in common: that is availability of saving is precondition for continuing growth. Financial development is usually defined as a process that makes improvement in quantity, quality, and efficiency of financial intermediary services. The relationship between financial development and economic growth has been broadly treated in theoretical and empirical literature, but economists hold different perspectives. The theoretical relationship between financial development and economic growth goes back to the study of Schumpeter (1911) who focuses on the services provided by financial intermediaries and argues that these are essential for innovation and development.

A theoretical view claims that financial development follows economic growth as a result of increased demand for financial services. This explanation was originally advanced by Robinson (1952). All these views are based on the observation that the ratio of the broad money stock to nominal GDP.

The Mckinnon – Shaw school examines the impact of government intervention on the development of the financial system. Their main proposition is that government restrictions on the banking system such as interest rate ceilings and direct credit programs have negative effects on the development of the financial sector and, consequently, reduce economic growth (Mckinnon 1973, Shaw 1973).

The endogenous growth theory has reached equivalent conclusions by explicitly modeling the services provided by financial intermediaries such as risk-sharing and liquidity provision. This theory also suggests that financial intermediation has a positive effect on steady-state growth and that government intervention in the financial system has a negative effect on economic growth (Ghali 1999).

There are views which contend that both financial development and economic growth are positively interdependent and their relationship could lead to feedback causality. The work of (Luintel & Khan, 1999), among others, is supportive of this argument.

Shan, Morris, and Sun (2001) use a Granger causality procedure to investigate the relationship between financial development and economic growth for nine OECD countries and China by estimating a vector auto regression (VAR) model. The results of their study show that five out of ten countries have a bilateral Granger causality; three of them have reverse causality with economic growth leading to financial development while two countries do not have a causal effect at all.

Deidda and Fattouh (2002) present a simple model, which establishes a non-linear relationship between financial development and economic growth, based on a threshold regression model of King and Levine's study (1993a). The results of their paper suggest that in low-income countries there is no significant relationship.

1.2. Statement of the problem

It is evident from the background to the study of this thesis that the issue of causality between financial development and economic growth has remained questionable. This is both at the theoretical and empirical levels. Several cross-country investigation using OLS regressions,

causality tests and panel regressions including country case studies employing time series data predominantly has ended with different results so far as some supports the theoretical arguments while the other totally rejects and the opposite holds factual (Loayza and Bek(2000) they argued that the financial development does not have significant effect on the economic growth which contradictory to the growth model that support the theory of saving to the economic growth. Some of the studies suggest that in the early stages of development, financial development leads to growth, while in later stages growth may determine the speed of financial development (Rousseau and Sylla, 2000 and Odhiabo, 2007) in US and Sub-Saharan African countries respectively. When an economy starts to grow it creates immediate additional demand for financial services and helps grow a better financial system. At this stage the positive impact of financial system on economic growth could be modest. As development proceeds, a better and well functioning financial system is established.

Studies such as those of King and Levine (1993), Levine and Zervos (1998) and Beck and Loayza (2000) have been conducted to highlight the importance of financial development to economic growth and the correlation between the two.

In the case Ethiopian, currently economy continued to register a notable growth. In FY 2014/15, the real GDP grew by 10.2 percent relative to 11.2 percent growth target set in the first GTP for the fiscal year (NBE, 2015). The growth of the economy has also been remarkable compared to the 4.4 percent growth estimated for Sub - Saharan Africa in 2015 (World Economic Outlook Update, July 2015). While Banks, insurance companies and micro-finance institutions are the major financial institutions operating in Ethiopia. The number of banks stood at 19 of which 16 were private and the remaining three state-owned (NBE, 2015)

Moreover Ethiopia's financial sector is characterized by dominance of state ownership and low level of development with the Commercial Bank of Ethiopia accounting for 90 per cent of total deposit (Alemayehu, 2006). Still Ethiopia's financial sector remains a highly under-banked country in the world however; the supply of the banking service is growing from year to year.

Ethiopia's financial sector development, as measured by the financial indicators such as private credit to GDP, the ratio of narrow to broad money and the ratio of broad money to GDP, is well below that of other African countries, and is even more undeveloped when compared to the financial systems of the industrial countries (Abdi, 2000).

The researcher wants to identify that whether above mentioned economic growth and financial development in Ethiopia have causal effect or not and to show the current results until 2014. Another objective of this study fill the gap that identified from other studies else that is the direction of causal relationship between FD and EG.

1.3. Objective of the Study

1.3.1. General Objective

The objective of this study is to determine the causal relationship between financial development and economic growth in Ethiopia, and provided that the relationship is found the study also seeks to establish the nature and extent of that relationship.

1.3.2. Specific Objective

- ✓ To determine long-run relationship between financial development and economic Growth in Ethiopia
- ✓ To examine the direction of causality between financial development and economic Growth

1.4. Significant of the study

The study is important in that policymakers may use this information in formulating efficient resource allocation. The study may yield results that will assist in deciding on how resource allocation should be achieved between financial development and the real sector development.

An empirical study of this nature is essential in ascertaining whether financial development causes economic growth or vice versa, as the result may assist policy makers in setting up optimal macroeconomics policies to institute competitive growth.

The fact that in the cross-country the type of studies do not properly account for time dimension, and can give a wrong impression of the impact of financial development on economic growth. Since they assume that the different countries in the model are homogeneous entities. Moreover, since countries may differ greatly with respect to institutions and economic policies used, results may be country specific. Knowing the direct relationship between financial development and growth is not sufficient by itself, however if proper policy is to be formulated, this information is going to play a vital role for designing proper policy and fill the knowledge gap

Thus, an analysis of causal relationship between financial development and economic growth in Ethiopia is essential for policy makers. The study contributes to the existing debate by assessing econometrically the causal relationship between financial development and economic growth nexus, by analyzing the time series data for Ethiopia.

1.5 Scope of the Study

The study is limited in scope with regard to the issue of examining the causal relationship between financial development and growth. The study covers the period between the years 1980-2014 G.C in Ethiopia due to the unavailability of data. To test causality between financial intermediation and economic growth, it is common to apply Granger causality test.

Furthermore, the co-integration technique initiated by Engle and Granger (1987) has an important role in testing causality.

1.6 Organization of the Paper

This paper is organized into five chapters. Following the introduction part, chapter two presents the review of related theoretical and empirical literature regarding financial development and economic growth. Chapter three gives insight on the model specification, methodology employed and data. Chapter four provide the data analysis and Presentation, and finally chapter five discusses the conclusion and recommendation.

Chapter two

2. Literature Review

2.1. Theoretical framework

Traditionally, the focus of the economic growth theory was on labor usage and capital accumulation as the cause for long run growth, thus growth is exogenously determined. However, this approach excluded any specific role for the financial sector. During the past twenty years, new theories has been developed that moved away from the view that growth is exogenously determined and therefore government cannot influence it. New theories states that growth is endogenously determined, thus institutions and policies matters for economic growth.

The Exogenous growth model was an extension to the Harrod-Domar model which included the new term, ‘productivity growth’. The most important contributor to this model, Robert Solow; in 1956 developed a relatively simple growth model which fit available data on US economic growth with some success. The key assumption of the Solow growth model is that capital is subjected to diminishing returns. Given a fixed stock of labor, the impact on output of the last unit of capital accumulated will always be less than the one before. Assuming for simplicity no technological progress or labor force growth, diminishing returns implies that at some point the amount of new capital produced is only just enough to make up for the amount of existing capital lost due to depreciation.

According to (Sorensen & Jacobsen, 2005) beyond some point, the marginal returns to new capital will be smaller than the marginal cost of adding new capital. At this point because of the assumptions of no technological progress of labor force growth, the economy ceases to grow.

Thus, in the exogenous growth models financial markets have no role in promoting the long run economic growth. Limitations of the model include its failure to take account of

entrepreneurship (which may be catalyst behind economic growth) and strength of institutions (which facilitate economic growth). In addition, it does not explain how or why technological progress occurs.

Endogenous growth models are based on two broad approaches, the first one sees all inputs as reproducible, and the second one is based on externalities (in the form of human capital). In both approaches, the savings rate plays a key role in the growth of capital and output per worker.

The first approach assumes that all inputs are reproducible, in particular the state of knowledge through research and development. The diminishing marginal productivity of capital which in the neo-classical model leads to constant steady state values of capital and output per worker is compensated by an increasing quality of machinery. In this approach an increase in the saving rate permanently raises the rate of growth of capital and output per worker.

The second approach is based on the assumption that externalities in the production process such as increase in the output level by one firm positively affects factor of productivity in another firm. In this approach, labor is endogenously determined and it is not just the quantity of labor which is relevant, but the quality of such labor. Households can save by investing in human capital in addition to physical capital investments. Therefore, households will produce labor with skills that will create ideas needed to handle new technologies. In this approach savings occurs in two ways: a fraction is saved for capital accumulation and a fraction is saved to increase human capital quality. With this approach both savings rates have effects on the growth rates. As a result, growth is no longer determined by the arbitrary technological changes, but it is endogenously determined by decision to invest in physical or human capital.

Without introducing financial market clearly, there are grounds to believe that incentives for the

population to save and more efficient channeling of saving can affect growth.

The growth models discussed so far do not have the financial sector intermediation explicitly modeled. The models only state that the share of aggregate output saved by the economy is available for investment. The problem inherent with this assumption is that it does not take into account the leakages and costs associated with financial intermediation process.

However financial development contributes to growth in various ways. For instance, financial institutions are better suited than individuals to identify potentially successful projects, because these institutions are big enough to pay high costs of collecting information about individual projects and to analyze this information more efficiently. To ensure that the saver's resources are used productively, the institutions also do supervise these projects.

Financial markets can also enhance growth, firstly, by mobilizing resources from the savers necessary to invest in large projects. Secondly, they facilitate the pooling and hedging of risk inherent in individual projects and industries. Thus, well developed financial markets can generate growth by increasing the pool of funds and by reducing the risk and enhancing the productivity of fund transfers from savers to investment projects. The relationship between financial development and economic growth has established a great deal of attention in the modern history of economics. This theoretical relationship dates back to the work of (Schumpeter, 1911), who emphasized that financial services are dominant in promoting economic growth.

Several studies have addressed the potential links between financial development and economic growth (Levine, 1997). Alternative views on the links between financial intermediation and economic growth focus on the key functions of the financial systems.

These include firstly, acting as an effective instrument for channeling funds from surplus

to deficit units by mobilizing resources and ensuring an efficient transformation of funds into real productive capital. Secondly, financial intermediation transforms the maturity of the portfolios of savers and investors, while providing sufficient liquidity to the system as the need arises. The third function is risk reduction from the system through diversification and the technique of risk sharing and pooling. By so doing, a modern financial system may spur economic growth. However, despite the rapidly growing literature, the debate concerning the role played by the development of financial intermediaries in economic growth is far from settled.

The early models on financial intermediation and economic growth lacked solid modeling of the exact mechanisms of the relationship between the two variables. In the 1990's many new theoretical contributions on how financial intermediation may affect economic growth emerged (Greenwood & Jovanovic, 1990). The wave of new theoretical models on the relationship between financial development and economic growth has prompted new empirical interest into the relationship between finance and growth (King & Levine, 1993), which extended the cross country framework introduced in Barro (1991), by adding a financial variable to the standard growth regression.

2.2 Empirical Reviews

Most empirical investigations on finance and growth have been conducted in three major ways: (I) in the form of cross-country, (II) in the form of panel studies and (III) as time-series investigation. Temporarily, results from these empirical studies are still conflicting and inconclusive. While the focus of this chapter is on time-series, attempts are made briefly to review some of the important cross-country and panel studies.

King and Levine (1993a) carry out a cross-country study with an endogenous growth model on eighty countries with data covering the period 1960-1989. The results show that financial development has a positive impact on economic growth. Meanwhile, the issue of causality could not be resolved due to the cross-country technique employed in their analysis. Khan and Senhadji (2003) use both panel and cross-sectional methodologies on 159 countries for the period 1960-1999. They conclude that financial development does have positive impact on economic growth. Beck, Levine and Loayza (2000) however use the Generalized-Method-of-Moments (GMM) technique and the overall results of their findings reveal that financial development is positively related to both per capita GDP growth and total factor productivity growth. The same results are obtained also by Levine, Loayza and Beck (2000) and Beck and Levine (2004). Favara (2003) however finds a result that contrasts with the findings of Levine, Loayza and Beck (2000) using both the instrumental-variables regression and the GMM panel estimation. His results indicate that financial development does not have significant effect on economic growth.

Christopoulos and Tsionas (2004) use panel unit root and panel co integration techniques to examine the relationship between financial development and economic growth and results suggest that long-run causality runs from financial development to economic growth and there is no evidence of bi-directional causality. Zang and Chul Kim (2007) also carry out a panel data test to establish the direction of causality between financial development and economic growth. Their results however contradict the findings of Levine et al. (2000) by showing that economic growth leads financial development. Using a sample of fourteen countries, Luintel et al. (2008) apply time-series and dynamic heterogeneous panel methods to examine the relationship between financial structure and economic growth. The results indicate that for most countries in

the sample, financial structure and financial development tend to have a strong impact on economic growth. Meanwhile, on the time-series, there is a long-run relationship between the level of output, capital stock, financial structure and financial development. Akimov et al. (2009) have established strong and vigorous evidence between financial development and economic growth in 27 transition economies. Through unbalanced panel data analysis, all the four measures of financial development indicate a robust and positive relationship between financial development and economic growth. This chapter focuses on time series and some of the empirical time-series works that relate to this study are briefly reviewed below:

Earlier empirical works include: Patrick (1966), Gupta (1984), Jung (1986), McKinnon (1988) and Demetriades and Hussein (1996). Arestis and Demetriades (1997) highlight the importance of time-series over the cross-section data. They argue that cross-section regressions do not always reflect individual countries' circumstances especially in the cases of financial institutions, policy regimes and effectiveness of governance.

Through time-series data and VAR methodology Demetriades and Hussein (1996) obtain results that contrast with most of the cross-sectional studies. Most of their findings on the 16 countries studied indicate bidirectional causality between financial development and economic growth. Others even show unidirectional causality from economic growth to financial development. Calderon and Liu (2003) establish bidirectional causality between financial development and economic growth. However, in the case of developing countries, financial development contributes more to the causal relationship, while in the case of developed countries; economic growth contributes more than financial development to the causal relationship. Shan (2005) uses a VAR framework through variance decomposition and impulse

response function analysis. The results show very little or weak evidence that financial development leads economic growth. Singh (2008) utilizes time-series data for India and through bivariate reduced VAR model, the results obtained suggest the existence of bidirectional causality between financial development and economic growth.

Luintel and Khan (1999) argue that bivariate VAR tests “*suffer from omitted variable problems and lead to erroneous causal inferences*” (p.383) and after using the multivariate VAR tests and theoretical over-identifying restrictions on 10 countries, the results reveal a bidirectional causality between financial development and economic growth in all the sample countries studied. Moreover, Liang and Teng (2006) use similar methods for China for the period 1952-2001 but the results reveal a unidirectional causal relationship from economic growth to financial development. Ang and Mckibbin (2007) also obtain similar results for Malaysia using multivariate VAR framework. Their findings reveal that in the long-run, it is economic growth that causes financial development while in the short-run there is no causality between financial development and economic growth in all the models analyzed. Chang and Caudill (2005) analyze the relationship between financial development and economic growth in Taiwan based on a multivariate VAR model. The results of their findings suggest a unidirectional causality running from financial development to economic growth. Ang (2008), through Autoregressive Distributed Lag (ARDL), examines mechanisms that provide the linkage between financial development and economic growth for Malaysia.

These are: financial development, private saving, foreign direct investment, saving-investment correlation, private investment and aggregate output. The results indicate that financial development has a strong link with economic growth through qualitative and

quantitative channels. Through the use of vector error correction model and variance decomposition technique, Masih et al. (2009) obtain results that contrast that of Ang (2007) for Saudi Arabia. After examining the direction of causality between financial development and economic growth in a multivariate VAR framework, their findings show a unidirectional causality from financial development to economic growth. Handa and Khan (2008) also use time series data on 13 countries. After applying VEC model the results show the existence of unidirectional causality from economic growth to financial development for Bangladesh, Sri Lanka, Brazil, Malaysia, Thailand and Turkey. Meanwhile, for Germany, Japan, India, Argentina, the UK and the USA they establish bidirectional; and no causality exists for Pakistan.

In the case of Africa, Ghirmay (2004) examines the causal relationship between financial development and economic growth in 13 sub-Saharan African countries. He uses bivariate VAR model and the result reveals that financial development leads economic growth in eight countries while six countries depict a bidirectional causal relationship. Atindehou et al. (2005) find weak causal relationship between financial development and economic growth for all the 12 sample countries in West Africa with the exception of Mauritania which exhibits unidirectional causality from finance to growth. The paper uses time-series data for the period 1960-1997 and the estimation is based on VAR methods. Odhiambo (2007) examines the causal relationship between financial development and economic growth in three Sub-Saharan African countries. The findings reveal that in both Kenya and South Africa, the direction of causality is from economic growth to financial development while Tanzania also exhibits unidirectional causality; but this is from finance to economic growth. Abu-Badr and Abu-Qarn (2008) also obtain similar results for Egypt using annual data from 1960 to 2001 and applies a multivariate VAR method. Their results reveal bidirectional causality for all the four measures of financial development

employed. Wolde-Rafael (2009) applies multivariate VAR and Modified Wald test (MWALD) for Kenya. He establishes bidirectional causality between financial development and economic growth in three out of four measures of financial development used. His study uses annual data and covers the period 1966 to 2005. Gries et al. (2009) also carry out a similar multivariate VAR studies but on a wider scope covering 16 sub-Saharan African countries. Using finance, trade openness and economic growth, they establish weak causal relationship between finance and growth in most countries in the sample. However stronger evidence is established between finance and trade openness and also between trade openness and economic growth.

Empirical work on financial development and economic growth in Botswana shows evidence that supports Schumpeter's view that financial development leads to economic growth (Eita & Jordaan, 2007). These empirical results illustrate that the development of the financial sector in Botswana is important for its economic growth and development. This suggests that financial deepening and institutional reforms should be enhanced to promote Botswana's economic growth.

The empirical results of the study on the causal relationship between financial development and economic growth which used data for South Africa, Kenya, and Tanzania show that the direction of the causality between financial development and economic growth is sensitive to the choice of measurement for financial development (Odhiambo, 2007). A demand-leading view was found to be stronger in South Africa and Kenya.

Whilst in Tanzania a supply leading response was found to be strong. These findings are also consistent with Patrick's hypothesis (Patrick, 1966), which postulates that the direction of causality between financial development and economic growth changes over the course of development.

Findings of the study into the relationship between development of the financial sector and economic growth for Egypt over the time period 1967-1996 confirm the importance of the development of the financial sector and economic growth, with a rise in the ratio of private credit to total credit of 1% leading to an increase of 0.17 % in the real GDP per capita in the long run (Hussein, 1999).

A study examining the causal relationship between financial development and economic growth in Lesotho concluded that there exists no causality between finance and growth in either direction (Mohapi & Motelle, 2007). This is consistent with the findings of Chang, Shan & Morris; and Dawson (as cited in Mohapi & Motelle, 2007) that exhibit no link between finance and growth.

A study done in five MENA countries (Algeria, Egypt, Morocco, Syria, and Tunisia) for the past five decades found no evidence of causality between financial development and economic growth in the short-run, whereas long-run causality tests showed that finance follows rather than leads economic growth (Abu-Bader & Abu-Qarn, 2006). Based on these results, they concluded that the financial reforms that most of the countries have undertaken in the past two decades were not successful in achieving the desired results of enhancing economic growth, either by improving efficiency or through increasing resources for capital accumulation.

It appears that in some countries finance affects growth, while in other countries growth determines finance or the causality is twofold. Most importantly, these studies argue that generalizations based on multi-country results may lead to incorrect policy advice at the country level. Moreover, there is still a theoretical debate on the relative importance of stock market development (Singh, 1997).

Chapter Three

3. Data and Methodology

3.1 Data

In finance and growth relationship issue, economic growth can be measured by rate of change in real GDP, and rate of change in real per capita GDP but real change in per capita growth is used for this study. Financial sector development/deepening on the other hand can be measured by various quantitative 1 proxies. Though the traditional proxy used in the literature to measure financial deepening is a ratio of some broadly measured money supply, generally M_2 ratio to the level of nominal GDP, the following alternative financial intermediation measures are used in this study to avoid measurement presumption.

3.1.1. The Ratio of Private Credit to Total Domestic Credit (PC/DC): A financial system that simply channels credit to the government or state owned enterprises may not be evaluating managers, selecting investment projects, pooling risks and providing financial services to the same degree as a financial system that allocates credit to the private sector. (Powell and Sephooko 2006) argues that government credit from banks in countries with a highly regulated financial system is regularly captive and that lending banks have no or less control over its use.

3.1.2. The Ratio of Domestic Credit to GDP (DC/GDP): as loan is the major item in the asset side of the consolidated balance sheet of the financial sector, it measures the asset size of the financial sector (Odedokum, 1989 in Kar and Pentecost 2000).

3.1.3. The Ratio of Bank Deposit Liabilities to GDP (BD/GDP): the degree to which banks collect cash and generate deposits stand for the degree of financial intermediation. As a huge component of broad money stock is currency held outside banks in developing countries where a rising ratio of broad money to GDP may reveal the more extensive use of currency rather than an increase in the amount of bank deposits, it is better to get more representative measure of financial development. In this case, currency outside banks should be excluded from broad money supply (Kar and Pentecost, 2000).

3.1.4. The Ratio of Private Credit to GDP (PC/ GDP): so as to obtain the more direct measure of financial intermediation, credit extended to the private sector is also used as an indicator of

financial intermediation. It is assumed to contribute more to increase investment and productivity to a much larger extent than credit channeled to the public sector. On the other hand, loans to the private sector are given more stringently and that the improved quality of investment emanating from financial intermediaries evaluation of projects viability is more significant for private sector credit (Wachlet 2002)

3.1.5. The Ratio of Broad Money to GDP (M2/GDP): Broad money consists of both narrow money and quasi-money, where narrow money contains currency outside the bank and net demand deposits and quasi-money includes both saving and time deposits. It is the broadest measure of financial development and it measures the depth of the financial system. It also indicates the degree of monetization with respect to the real economy.

The benefits of using alternative proxies to measure financial development is subject to the conclusiveness of assumption made, provided that all indicators tell more or less the same story.

3.2 Methodology

The study uses econometric techniques to determine the causal relationships between the variables of financial development and economic growth in Ethiopia for the period 1980-2014. Since the study uses time series data that is subject to non-stationary, we employ unit root tests to test for stationary of the different variables used. The study also employs a co integration test on the different variables used to establish a long run and short run relationships. The last test is the Granger causality test to determine the direction of the relationship between variables used.

The conventional Granger causality test involves the testing of financial development (FD) does not cause economic growth (Y) and vice versa by simply running the following two regressions.

$$Y_t = \alpha_0 + \sum \alpha_{1i} \Delta y_{t-i} + \sum \alpha_{2j} \Delta FD_{t-j} + \mu_t \quad \dots\dots\dots 1$$

$$FD_t = \beta_0 + \sum \beta_{1i} \Delta y_{t-i} + \sum \beta_{2j} \Delta FD_{t-j} + \varpi_t$$

Where μ_t and ϖ_t is the white noise error term for the two functions respectively. Y_t is the economic growth variable, and FD_t financial development proxies (the ratio of credit extended to private sector to nominal GDP; the ratio of private credit to domestic credit, the ratio Private credit to GDP, the ratio of bank deposit to GDP and the ratio of broad money to nominal GDP).

If the variables involved have a unit root, there are different options to test for causality based on whether such variables are co-integrated or not. If the non-stationary variables are not co-integrated, they enter equation (1) in differenced form. If non-stationary variables are co-integrated, Vector Error Correction Model (VECM), representations of VAR used in the conventional test. Several researchers used this approach in the finance-growth nexus among others is Kar and Pentecost (2000) and Boulila and Trabelsi (2004). Kouassi, Iyoha and Kymn (2005) as indicated in Kar and Pentecost (2000) on the other hand presented mathematical equation for causality test as follow

$$\Delta Y_t = \phi_1 + \lambda_1(\Delta \chi_{t-i}) + \lambda_2(\Delta y_{t-i}) + \theta_1 E\Omega M_{t-i} + \varepsilon_{1t} \dots\dots\dots 2$$

$$\Delta \chi_t = \Phi_2 + \lambda_2(\Delta \chi_{t-i}) + \lambda_1(\Delta y_{t-i}) + \theta_2 E\Omega M + \varepsilon_{2t}$$

In this specification, EΩM is the error term obtained from equation (1) while Δ refers to difference. θ 1 and θ 2 are elements of the adjustment vector. Under this specification, there are two sources of causality. Equation (2) demonstrates unidirectional causality from FD to GDP if λ 2 ≠ 0 and θ 2 ≠ 0. No causality in either direction occurs if λ 1 = 0, λ 2 = 0 and θ 1 = 0 θ 2 = 0 (Powell and Sephooke 2006). The inclusion of EΩM in (2) is to differentiate non-stationary, non-co-integrated variables from non-stationary, co-integrated variables where the later takes in to account the equilibrium relationship of the variables revealed by the existence of co-integrations.

Chapter Four

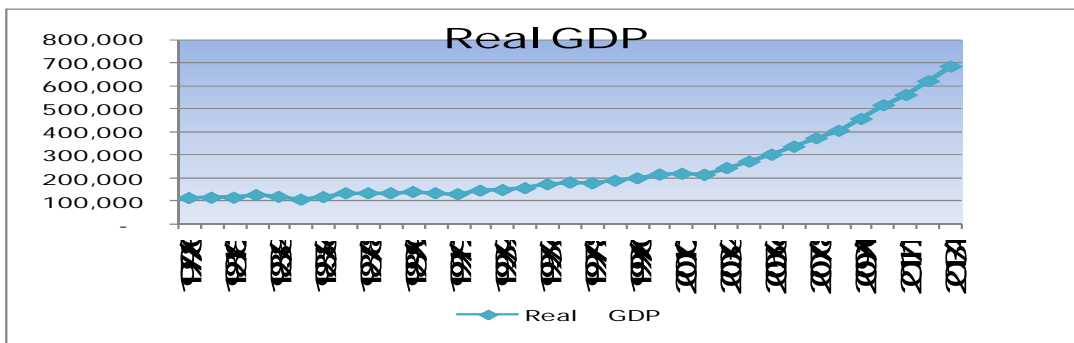
4. Data Analysis and presentation

4.1 Descriptive Analysis

4.1.1 The trends of gross domestic product

Ethiopia's economy is highly vulnerable to exogenous shocks due to its dependence on primary commodities and rain-fed agriculture. Agricultural productivity remains low even though agricultural production has increased considerably. In recent years, Ethiopia has experienced strong economic growth. This is mainly due to the increasing contribution of the service sector and industrial sector to GDP. Real GDP growth is 10.28 percent during the 2013/14(NBE, 2014).

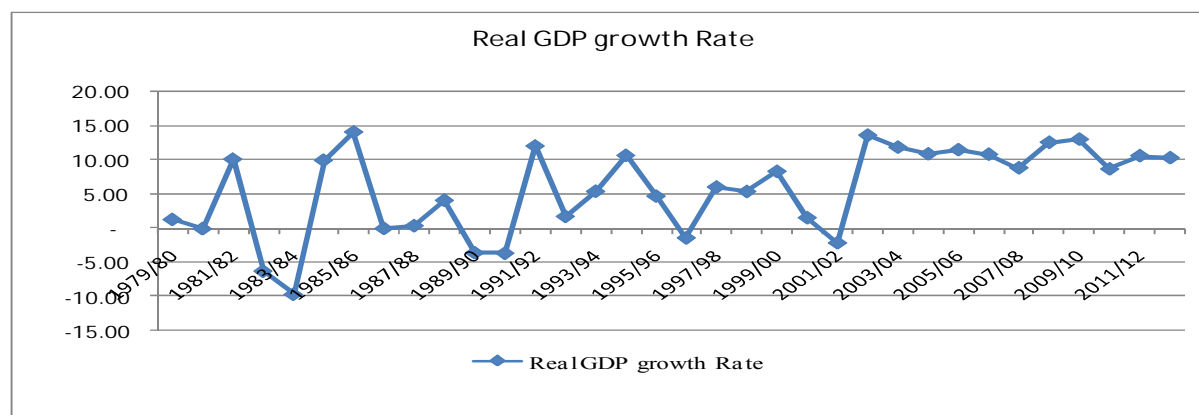
Fig 4.1. The trend of Real GDP



Source: MoFEC

The above figure implies that there is an increasing of real GDP trend in Ethiopia.

Figure 4.2, the real GDP growth rate



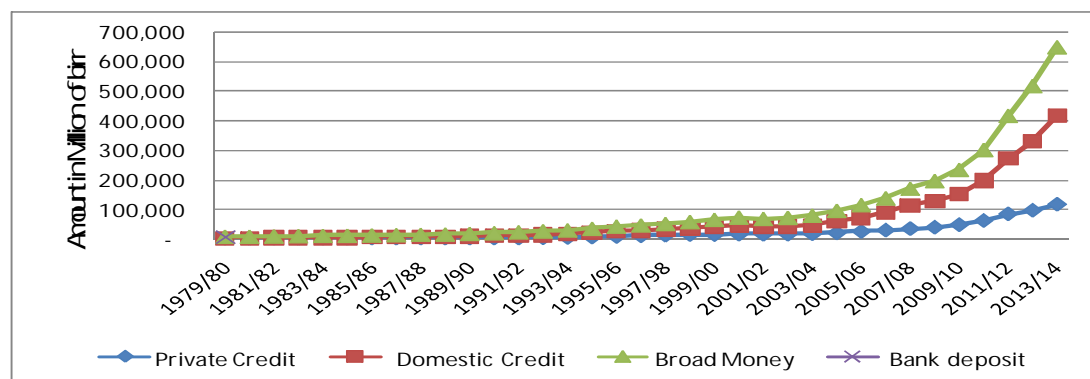
Source MoFEC

Even though the real GDP show increasing in trends, the real GDP growth rate fluctuates though out the year. For example during the 2003, the country was under fire due to the wide spread drought that led to food insecurity for over more than 14 million persons (United States Agency for International Development, 2003). As the country’s economy is highly dependent on agriculture, the real GDP growth rate at that time has fallen to 2.1%. It is worth mentioning in this regard that much of the fluctuations in real GDP growth which is not the problem of inadequate of financial sector development in the Ethiopia. But due to variation in rainfall and climatic condition that affects agricultural production as the economy is highly dependent on agriculture. From 2004 onwards, the economy has continued to grow with an average growth rate of 11%. The reorientation in financial development and government expenditure towards the provision of basic infrastructures like road, telecommunication, education and health together with the improvements in the private sector involvement in the economy has contributed to the achievement of this high growth rate.

4.1.2. The Financial development indicators

A good measurement of financial development is crucial in evaluating the progress of financial sector development and understanding the corresponding impact on economic growth and poverty reduction. The financial sector is the set of institutions, instruments, and the regulatory framework that permit transactions to be made by incurring and settling debts; that is, by extending credit. However, in practice, it is difficult to measure financial development given the complexity and dimensions it encompasses.

Figure 4.3 The trends of Bank deposit, Domestic credit, M2 and Private credit



Source: NBE

The well- structured financial system is important to boot economy but the main question is how to measure the financial development. In the above, the figure shows that the trend of financial development in Ethiopia. But the indicator of financial development is not only this one. The researcher focuses on those proxy variables that can cause the economic development. As indicated in the above the Private credit, bank deposit, domestic credit and broad money are increasing at increasing rate. There are other variable like number of bank, bank branch, number account holder and etc are good measures of financial development.

Table 4.1. Summary statistics

	GDP	DC_GDP	BD_GDP	M2_GDP	PC_DC	PC_GDP
Mean	5.580736	0.350961	0.235851	0.261396	0.306205	0.107585
Median	5.99483	0.368915	0.240266	0.272331	0.382298	0.109327
Maximum	14.03877	0.505339	0.363212	0.375804	0.534196	0.211252
Minimum	-9.69256	0.215567	0.106995	0.150994	0.078192	0.034321
Std. Dev.	6.293928	0.073659	0.069532	0.058034	0.15639	0.063006
Skewness	-0.58328	-0.10455	0.19995	0.04189	-0.23078	0.259752
Kurtosis	2.350335	2.127833	2.189035	2.239124	1.393692	1.574306
Jarque-Bera	2.600069	1.173079	1.192309	0.854512	4.0735	3.357795
Probability	0.272522	0.556249	0.550926	0.652297	0.130452	0.18658
Sum	195.3258	12.28363	8.25479	9.148849	10.71719	3.765461
Sum Sq. Dev.	1346.86	0.184472	0.164381	0.11451	0.831569	0.134971
Observations	35	35	35	35	35	35

Table 1 show the summary statistics contains different characteristics of data used in the causality analysis. The standard deviation shows how much dispersion exists from the average

value. A low standard deviation indicates that the data point tend to be very close to the mean, whereas high standard deviation indicates that the data point are spread out over a large range of values. As shown in the summary statistics, all have low standard deviation. This shows stability in the long run relationship between financial development and economic growth.

4.2. Econometric analysis

4.2.1. Unit root test

Unit root test is the starting point of the analysis of time series variables. Accordingly, ADF unit root test is used to see if the variables have unit root or not. All variables under this study passed the test and found to have unit root at level both without trend and with trend. As all variables have unit root they should be taken through the test machine in first difference in order to establish the order of integration of such variables and all found to be stationary at first difference without trend and with trend. Tables 1&2 below are summary of the unit root results.

Table 4.2 Unit root test results of Variables in Level

Variables in level		Augmented Dickey Fuller Statistics (ADF) Without Trends	Critical value at 5%	Augmented Dickey Fuller Statistics (ADF) With Trends	Critical value at 5%
	GDP	-1.808389	-2.957110	-4.356822	-3.562882
	PC/DC	-1.096231	-2.954021	-1.535610	-3.552973
	DC/GDP	-1.824368	-2.951125	-1.672029	-3.548490
	BD/GDP	-1.846000	-2.951125	-1.306041	-3.548490
	M2/GDP	-2.051143	-2.957110	-1.316475	-3.548490
	PC/GDP	-1.456629	-2.954021	-1.194476	-3.552973

Table 2 Unit root test results in First difference

Variables in First difference		Augmented Dickey Fuller Statistics (ADF) Without Trends	Critical value at 5%	Augmented Dickey Fuller Statistics (ADF) With Trends	Critical value at 5%
	dGDP	-9.488819	-2.957110	-9.323114	-3.557759
	dPC/DC	-5.015607	-2.954021	-4.919208	-3.552973
	dDC/GDP	-4.929371	-2.954021	-4.412083	-3.562882
	dBD/GDP	-4.677706	-2.954021	-4.725562	-3.552973
	dM2/GDP	-4.687525	-2.954021	-5.170019	-3.552973
	dPC/GDP	-3.389709	-2.954021	-3.661920	-3.552973

Where **d** stands for first difference

4.2.2 Co integration test

Under unit root test section, it has been tested that all variables have a unit root and before employing the co integration test the optimal lag length is chosen. As a result there are five bivariate VARs to work with in testing for co integration between each of the five financial sector development proxies and real per capita GDP growth. In a bivariate system consisting in this case of FDs and GDP representing financial sector development and real per capita GDP growth rate, respectively, the maximum number of co integrating vector is one so that the null hypothesis is that there is no co integrating vector and the alternative is that there is one co integrating vector. As conventional Granger causality test works only if the variables are stationary at level, the Johansen approach is used in this analysis to test for co integration between growth and financial sector development. In performing the test, each of the five VARs was first estimated in levels to select appropriate order². Schwarz information Criterion (SIC) is selected as it favors more prudent models relative to other familiar information criteria and then was used in this study.

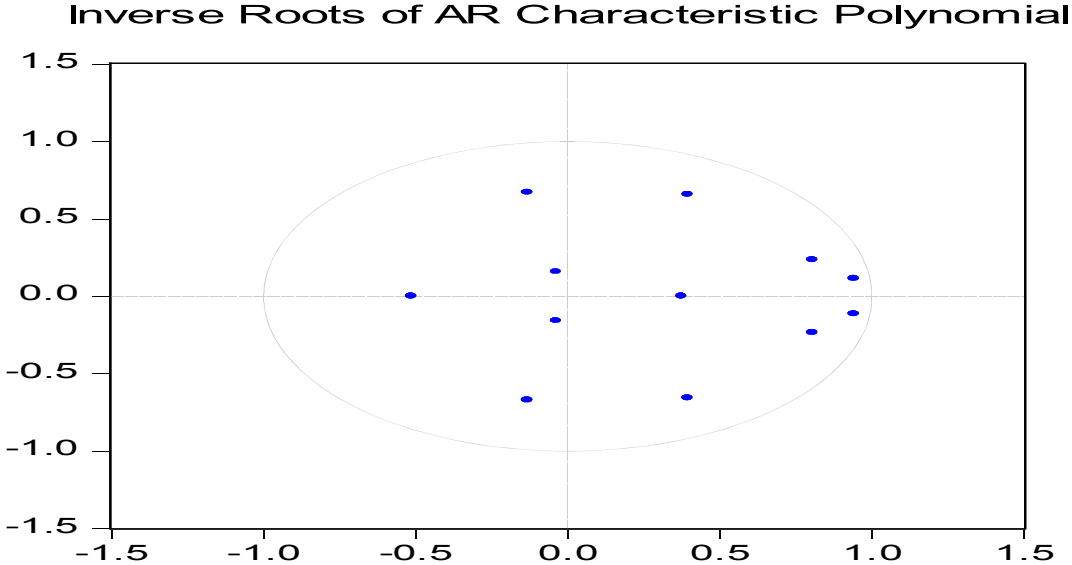
Table 3 Bivariate Unrestricted Co integration Test Result (Trace and Maximal Eigen value)

VAR Elements	Null	Alternative	Test			
			Trace Statistic	Critical Value at 5%	Maximal Eigen value Test	Critical Value at 5%
GDP and PC/DC	r=0	r=1	22.57453	15.49471	21.36995	14.26460
GDP and DC/GDP	r=0	r=1	23.38863	15.49471	20.30096	14.26460
PGP and BD/GDP	r=0	r=1	22.64122	15.49471	19.77436	14.26460
GDP and M2/GDP	r=0	r=1	21.45266	25.87211	16.28584	19.38704
GDP and PC/GDP	r=0	r=1	18.86309	25.87211	13.10932	19.38704

As revealed by both Trace test and Max-Eigen value tests, there is no co integration between growth and financial sector development measured by Private credit to GDP ratio (PC/GDP) and broad money supply to GDP ratio (M2/GDP). However, Johansen co integration test evidence revealed the existence of long run relationship between economic growth and financial sector development proxied by the ratio of the private sector credit to the total domestic credit (PC/DC), the ratio of domestic credit to GDP (DC/ GDP) and the ratio of bank deposit liability to GDP (BD/GDP). In two out of the five financial sector development proxies, there is no co integration between growth and financial development that leads one not to expect the causality

between growth and financial sector development. However, the long-run relationship between economic growth and financial development is found to be positive in each co-integrating vector between growth and finance measured by all three credit ratios suggesting one to expect causality in at least one direction. The long-run or equilibrium relationship between financial development and economic growth does hold for Ethiopia in the case of financial development measured by the three credit ratios. As observed from the use of several alternative quantitative proxies for financial development, this seems reasonably vigorous finding and overall three out of the five proxies indicate long-run relationship between growth and financial development in Ethiopia. This finding also revealed that one should be proxy sensitive to investigate finance-growth relationship in the Ethiopian case.

Figure 4.4 Stability test



All diagnostic tests have been done including stability test. So; the stability conditions of the model is shown below in figure 4.4. As the modulus of each Eigen value lies within a unit circle, the estimates of the model satisfy the stability condition.

4.2.3 Granger Causality Test

Table 4 Summary of Finance and Growth Granger Causality Test

Null hypothesis	obs	F-Statistic	Prob.
GDP does not Granger Causes PC/DC	33	0.88489	0.4240
PC/DC does not Granger Causes GDP		3.32068	0.0508
GDP does not Granger Causes DC/GDP	33	2.82353	0.0764
DC/GDP does not Granger Causes GDP		0.87279	0.4288
GDP does not Granger Causes BD/GDP	33	0.11734	0.8897
BD/GDP not Granger Causes GDP		2.95174	0.0687
GDP does not Granger Causes M2/GDP	33	1.00197	0.3799
M2/GDP does not Granger Causes GDP		2.01270	0.1525
GDP does not Granger Causes PC/GDP	33	0.16537	0.8484
PC/GDP does not Granger Causes GDP		1.54467	0.2310

As shown in the above, the presence of co-integration leads to the existence of at least unidirectional causality between the variables. In the case of financial accessibility which is measured by number of bank branch to total population of the time series data is not available. Therefore the researcher did not incorporate it. Since the scope this study includes the data from 1980 to 2014. The obtained evidence as summarized in table 4 above did not indicate causality between financial sector development measured by Private credit to GDP ratio (PC/GDP) and broad money supply to GDP ratio (M2/GDP) as neither causes GDP growth nor caused by GDP. On the other hand, the existence of co integration between growth and financial intermediation using proxies such as private credit to total domestic credit ratio (PC/DC), domestic credit to GDP ratio (DC/GDP) and private credit to GDP ratio (BD/GDP) is supported by the Granger Causality test revealing a unidirectional causality but direction of causality is different for those

proxies who support Granger causality test. Among these proxies that the financial sector development Granger cause economic growth are the ratio BD/GDP and DC/GDP. The result reveal that one proxies support ‘demand-following’ hypothesis in the case of GDP and DC/GDP ratio. The remaining two are support ‘supply-leading’ hypotheses in the case of BD/GDP ratio and GDP. The next one is PC/DC ratio and GDP.

In this case, three important conclusions can be drawn from the finding. 1) Mixed result obtained indicates that financial sector development is a proxy sensitive in case of Ethiopia 2) two proxies out of five neither supports ‘demand-following’ nor ‘supply-leading hypothesis’ and 3) one ‘demand-following hypothesis’ evidence from growth to financial development in case of domestic credit to GDP ratio.

Chapter Five

5 Conclusion and recommendation

5.1 Conclusion

This study has endeavored to evaluate the standing of the Ethiopian economy in the long-lasting debate of the role of financial development in economic growth. It is obvious that there is theoretical consensus that financial development facilitates economic growth. However, this theoretical consensus seems unable to hold up empirical investigation with robustness.

These findings point up that, the role of finance in a given economy cannot be a finished theoretical recommendation but quite an empirical issue. Hence, this investigation examined the existence of long run relationship between financial development and economic growth in Ethiopia and then the direction of causality between them was not the same. The study uses time series techniques of co integration and causality test employing bivariate VAR structure for a sample of periods ranging from 1980 to 2014. Five proxies of financial development were paired with the per capita GDP growth datum in the co integration and causality tests. Co integration was found between three out of five proxies (the ratios of private credit to total domestic credit, total domestic credit to GDP and bank deposit liability to GDP) and economic growth captured by real per capita GDP growth while no co integration was found between financial development measured by broadly defined money supply to GDP ratio and Private credit to GDP ratio. Causality also exists between that co integrated proxies with growth where demand-following

hypothesis prevails in the case of domestic credit to GDP ratio. In the case of other two co integrated proxies of financial development, private credit to total domestic credit and bank deposit liability to GDP ratios, supply-leading hypothesis in case of Ethiopia.

5.2 Recommendation

- The finding of this study sets three important results. These are demand-following hypothesis, supply-leading hypothesis and neither demand-following nor Supply-leading hypothesis. It is one of finding but supply-leading hypothesis greater than demand-following hypothesis. In general in the overall causality from to financial sectors to growth sector seems stronger in the case of Ethiopia and well-structured or well-developed financial sector is essential for economic growth.
- The emergence of ‘demand-following hypothesis’ in the case of domestic credit to GDP ratio can lead one to recommend that aggressive growth enhancing policy should be directed towards increasing individual income so as to create surplus that in turn increases the demand for financial services like deposit and investment in financial market securities. That is growth should be enhanced to scale up the demand for financial services.
- The finding of this study shows that there are three financial development indicators which are positive affecting the real GDP growth. These are 1) the ratio bank deposit to GDP 2) the ratio of private credit to domestic credit 3) the ratio of domestic credit to GDP. So they are important for economic growth and it is better to focus on these proxies variable to handle better performance in economic growth.
- Finally, the direction causality is both from supply-leading hypothesis (from proxy’s variable like PC/DC and BD/GDP) and demand-following hypothesis (from DC/GDP) which reveal that there is inconsistency on the issue of direction of causality that needs further investigation on this area. This study show the debatable of causal relationship between financial development and economic growth in the Ethiopia so that it calls all for identifying the point at which the valid direction of causation through further investigation.

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Appendices

UNIT ROOT TEST

Null Hypothesis: GDP has a unit root
 Exogenous: Constant
 Lag Length: 2 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.808389	0.3699
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 09:54
 Sample (adjusted): 4 35
 Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.447995	0.247731	-1.808389	0.0813
D(GDP(-1))	-0.174860	0.202006	-0.865620	0.3941
D(GDP(-2))	-0.476873	0.166377	-2.866216	0.0078
C	2.937042	1.668498	1.760290	0.0893
R-squared	0.530700	Mean dependent var		0.324304
Adjusted R-squared	0.480418	S.D. dependent var		7.902434
S.E. of regression	5.696238	Akaike info criterion		6.433958
Sum squared resid	908.5195	Schwarz criterion		6.617175
Log likelihood	-98.94332	Hannan-Quinn criter.		6.494689
F-statistic	10.55443	Durbin-Watson stat		1.898063
Prob(F-statistic)	0.000082			

Null Hypothesis: GDP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 3 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.356822	0.0084
Test critical values:		
1% level	-4.284580	
5% level	-3.562882	
10% level	-3.215267	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 09:55
 Sample (adjusted): 5 35
 Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-1.722439	0.395343	-4.356822	0.0002
D(GDP(-1))	0.811729	0.334246	2.428542	0.0227
D(GDP(-2))	0.175705	0.234178	0.750307	0.4601
D(GDP(-3))	0.306685	0.172911	1.773656	0.0883
C	-3.017739	2.038177	-1.480607	0.1512
@TREND(1)	0.661584	0.168032	3.937254	0.0006
R-squared	0.704659	Mean dependent var		0.006614
Adjusted R-squared	0.645591	S.D. dependent var		7.822581
S.E. of regression	4.656957	Akaike info criterion		6.086587
Sum squared resid	542.1813	Schwarz criterion		6.364133
Log likelihood	-88.34210	Hannan-Quinn criter.		6.177060
F-statistic	11.92961	Durbin-Watson stat		1.818495
Prob(F-statistic)	0.000006			

Null Hypothesis: D(GDP) has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.488819	0.0000
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 09:58
 Sample (adjusted): 4 35
 Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-2.103295	0.221660	-9.488819	0.0000
D(GDP(-1),2)	0.655510	0.139020	4.715224	0.0001
C	0.532634	1.046725	0.508858	0.6147
R-squared	0.794133	Mean dependent var		0.032848
Adjusted R-squared	0.779935	S.D. dependent var		12.60898
S.E. of regression	5.915003	Akaike info criterion		6.481921
Sum squared resid	1014.630	Schwarz criterion		6.619334

Log likelihood	-100.7107	Hannan-Quinn criter.	6.527469
F-statistic	55.93385	Durbin-Watson stat	2.037537
Prob(F-statistic)	0.000000		

Null Hypothesis: D(GDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.323114	0.0000
Test critical values:		
1% level	-4.273277	
5% level	-3.557759	
10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:01
 Sample (adjusted): 4 35
 Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-2.103575	0.225630	-9.323114	0.0000
D(GDP(-1),2)	0.655692	0.141512	4.633461	0.0001
C	0.416317	2.383100	0.174695	0.8626
@TREND(1)	0.006290	0.115281	0.054563	0.9569
R-squared	0.794155	Mean dependent var		0.032848
Adjusted R-squared	0.772100	S.D. dependent var		12.60898
S.E. of regression	6.019381	Akaike info criterion		6.544315
Sum squared resid	1014.523	Schwarz criterion		6.727532
Log likelihood	-100.7090	Hannan-Quinn criter.		6.605046
F-statistic	36.00822	Durbin-Watson stat		2.037715
Prob(F-statistic)	0.000000			

Null Hypothesis: PC_DC has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.096231	0.7055
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(PC_DC)
 Method: Least Squares
 Date: 05/19/16 Time: 10:02
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PC_DC(-1)	-0.063777	0.058179	-1.096231	0.2817
D(PC_DC(-1))	0.150840	0.178532	0.844887	0.4049
C	0.024170	0.019827	1.219070	0.2323
R-squared	0.051763	Mean dependent var		0.005384
Adjusted R-squared	-0.011452	S.D. dependent var		0.051640
S.E. of regression	0.051935	Akaike info criterion		-2.991136
Sum squared resid	0.080918	Schwarz criterion		-2.855090
Log likelihood	52.35375	Hannan-Quinn criter.		-2.945361
F-statistic	0.818836	Durbin-Watson stat		1.851874
Prob(F-statistic)	0.450558			

Null Hypothesis: PC_DC has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.535610	0.7963
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_DC)
 Method: Least Squares
 Date: 05/19/16 Time: 10:04
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PC_DC(-1)	-0.146282	0.095260	-1.535610	0.1355
D(PC_DC(-1))	0.178895	0.179810	0.994913	0.3280
C	0.018650	0.020400	0.914240	0.3681
@TREND(1)	0.001700	0.001557	1.091731	0.2839
R-squared	0.089197	Mean dependent var		0.005384
Adjusted R-squared	-0.005024	S.D. dependent var		0.051640
S.E. of regression	0.051770	Akaike info criterion		-2.970807
Sum squared resid	0.077723	Schwarz criterion		-2.789412
Log likelihood	53.01832	Hannan-Quinn criter.		-2.909773
F-statistic	0.946675	Durbin-Watson stat		1.841625
Prob(F-statistic)	0.430943			

Null Hypothesis: D(PC_DC) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.015607	0.0003
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_DC,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:05
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PC_DC(-1))	-0.884005	0.176251	-5.015607	0.0000
C	0.004847	0.009107	0.532261	0.5983
R-squared	0.447970	Mean dependent var		0.000756
Adjusted R-squared	0.430162	S.D. dependent var		0.069023
S.E. of regression	0.052104	Akaike info criterion		-3.012466
Sum squared resid	0.084159	Schwarz criterion		-2.921769
Log likelihood	51.70569	Hannan-Quinn criter.		-2.981949
F-statistic	25.15632	Durbin-Watson stat		1.822484
Prob(F-statistic)	0.000021			

Null Hypothesis: D(PC_DC) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.919208	0.0020
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_DC,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:06
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PC_DC(-1))	-0.882032	0.179304	-4.919208	0.0000
C	0.008384	0.019705	0.425461	0.6735
@TREND(1)	-0.000197	0.000969	-0.203263	0.8403
R-squared	0.448729	Mean dependent var		0.000756
Adjusted R-squared	0.411977	S.D. dependent var		0.069023
S.E. of regression	0.052929	Akaike info criterion		-2.953236
Sum squared resid	0.084043	Schwarz criterion		-2.817190
Log likelihood	51.72840	Hannan-Quinn criter.		-2.907461
F-statistic	12.20983	Durbin-Watson stat		1.828790
Prob(F-statistic)	0.000132			

Null Hypothesis: BD_GDP has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.846000	0.3528
Test critical values:		
1% level	-3.639407	
5% level	-2.951125	
10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(BD_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:08
 Sample (adjusted): 2 35
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD_GDP(-1)	-0.098805	0.053524	-1.846000	0.0742
C	0.028077	0.013100	2.143285	0.0398
R-squared	0.096242	Mean dependent var		0.004882
Adjusted R-squared	0.068000	S.D. dependent var		0.022381
S.E. of regression	0.021607	Akaike info criterion		-4.774601

Sum squared resid	0.014939	Schwarz criterion	-4.684815
Log likelihood	83.16822	Hannan-Quinn criter.	-4.743982
F-statistic	3.407715	Durbin-Watson stat	1.618352
Prob(F-statistic)	0.074161		

Null Hypothesis: BD_GDP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.306041	0.8694
Test critical values:		
1% level	-4.252879	
5% level	-3.548490	
10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(BD_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:08
 Sample (adjusted): 2 35
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD_GDP(-1)	-0.111302	0.085221	-1.306041	0.2011
C	0.029008	0.014171	2.046979	0.0492
@TREND(1)	0.000114	0.000601	0.190390	0.8502
R-squared	0.097298	Mean dependent var		0.004882
Adjusted R-squared	0.039059	S.D. dependent var		0.022381
S.E. of regression	0.021940	Akaike info criterion		-4.716946
Sum squared resid	0.014922	Schwarz criterion		-4.582268
Log likelihood	83.18809	Hannan-Quinn criter.		-4.671017
F-statistic	1.670666	Durbin-Watson stat		1.600559
Prob(F-statistic)	0.204616			

Null Hypothesis: D(BD_GDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.677706	0.0007
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(BD_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:08
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BD_GDP(-1))	-0.817391	0.174742	-4.677706	0.0001
C	0.003432	0.004005	0.857036	0.3980
R-squared	0.413777	Mean dependent var		-0.000608
Adjusted R-squared	0.394867	S.D. dependent var		0.028877
S.E. of regression	0.022464	Akaike info criterion		-4.695148
Sum squared resid	0.015643	Schwarz criterion		-4.604451
Log likelihood	79.46995	Hannan-Quinn criter.		-4.664631
F-statistic	21.88093	Durbin-Watson stat		2.002765
Prob(F-statistic)	0.000054			

Null Hypothesis: D(BD_GDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.725562	0.0032
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(BD_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:08
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BD_GDP(-1))	-0.851204	0.180128	-4.725562	0.0001
C	0.010003	0.008794	1.137506	0.2643
@TREND(1)	-0.000356	0.000423	-0.840341	0.4074
R-squared	0.427259	Mean dependent var		-0.000608
Adjusted R-squared	0.389076	S.D. dependent var		0.028877
S.E. of regression	0.022571	Akaike info criterion		-4.657808
Sum squared resid	0.015283	Schwarz criterion		-4.521762
Log likelihood	79.85384	Hannan-Quinn criter.		-4.612033
F-statistic	11.18986	Durbin-Watson stat		1.980203
Prob(F-statistic)	0.000234			

Null Hypothesis: DC_GDP has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.824368	0.3628
Test critical values:		
1% level	-3.639407	
5% level	-2.951125	
10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(DC_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:09
 Sample (adjusted): 2 35
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DC_GDP(-1)	-0.133027	0.072917	-1.824368	0.0774
C	0.048925	0.026278	1.861836	0.0718
R-squared	0.094211	Mean dependent var		0.001970
Adjusted R-squared	0.065905	S.D. dependent var		0.031978
S.E. of regression	0.030906	Akaike info criterion		-4.058693
Sum squared resid	0.030566	Schwarz criterion		-3.968907
Log likelihood	70.99777	Hannan-Quinn criter.		-4.028073
F-statistic	3.328319	Durbin-Watson stat		1.688940
Prob(F-statistic)	0.077446			

Null Hypothesis: DC_GDP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.672029	0.7417
Test critical values:		
1% level	-4.252879	
5% level	-3.548490	
10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(DC_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:09
 Sample (adjusted): 2 35

Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DC_GDP(-1)	-0.118000	0.070573	-1.672029	0.1046
C	0.060976	0.026059	2.339942	0.0259
@TREND(1)	-0.000992	0.000523	-1.896613	0.0672
R-squared	0.188388	Mean dependent var		0.001970
Adjusted R-squared	0.136026	S.D. dependent var		0.031978
S.E. of regression	0.029724	Akaike info criterion		-4.109653
Sum squared resid	0.027388	Schwarz criterion		-3.974974
Log likelihood	72.86410	Hannan-Quinn criter.		-4.063724
F-statistic	3.597795	Durbin-Watson stat		1.914017
Prob(F-statistic)	0.039346			

Null Hypothesis: D(DC_GDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.929371	0.0003
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(DC_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:10
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DC_GDP(-1))	-0.877296	0.177973	-4.929371	0.0000
C	0.001313	0.005687	0.230892	0.8189
R-squared	0.439408	Mean dependent var		-0.000114
Adjusted R-squared	0.421325	S.D. dependent var		0.042893
S.E. of regression	0.032629	Akaike info criterion		-3.948518
Sum squared resid	0.033005	Schwarz criterion		-3.857820
Log likelihood	67.15054	Hannan-Quinn criter.		-3.918001
F-statistic	24.29870	Durbin-Watson stat		2.000158
Prob(F-statistic)	0.000026			

Null Hypothesis: D(DC_GDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.412083	0.0074
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(DC_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:10
 Sample (adjusted): 5 35
 Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DC_GDP(-1))	-1.584275	0.359076	-4.412083	0.0002
D(DC_GDP(-1),2)	0.524181	0.279123	1.877960	0.0716
D(DC_GDP(-2),2)	0.357816	0.192191	1.861774	0.0740
C	0.039647	0.016884	2.348237	0.0267
@TREND(1)	-0.002021	0.000824	-2.452336	0.0212
R-squared	0.560254	Mean dependent var		-0.000524
Adjusted R-squared	0.492601	S.D. dependent var		0.043993
S.E. of regression	0.031337	Akaike info criterion		-3.941340
Sum squared resid	0.025532	Schwarz criterion		-3.710051
Log likelihood	66.09076	Hannan-Quinn criter.		-3.865945
F-statistic	8.281273	Durbin-Watson stat		1.971496
Prob(F-statistic)	0.000190			

Null Hypothesis: M2_GDP has a unit root
 Exogenous: Constant
 Lag Length: 2 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.051143	0.2648
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(M2_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:10
 Sample (adjusted): 4 35
 Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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M2_GDP(-1)	-0.149475	0.072874	-2.051143	0.0497
D(M2_GDP(-1))	0.151791	0.171186	0.886702	0.3828
D(M2_GDP(-2))	0.288054	0.174971	1.646296	0.1109
C	0.040878	0.019917	2.052443	0.0496
R-squared	0.198917	Mean dependent var		0.001301
Adjusted R-squared	0.113087	S.D. dependent var		0.022711
S.E. of regression	0.021388	Akaike info criterion		-4.735475
Sum squared resid	0.012809	Schwarz criterion		-4.552258
Log likelihood	79.76760	Hannan-Quinn criter.		-4.674744
F-statistic	2.317564	Durbin-Watson stat		2.047740
Prob(F-statistic)	0.097150			

Null Hypothesis: M2_GDP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.316475	0.8666
Test critical values:		
1% level	-4.252879	
5% level	-3.548490	
10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(M2_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:11
 Sample (adjusted): 2 35
 Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2_GDP(-1)	-0.086107	0.065407	-1.316475	0.1977
C	0.035921	0.016725	2.147810	0.0397
@TREND(1)	-0.000642	0.000384	-1.670335	0.1049
R-squared	0.175046	Mean dependent var		0.002083
Adjusted R-squared	0.121823	S.D. dependent var		0.022243
S.E. of regression	0.020844	Akaike info criterion		-4.819420
Sum squared resid	0.013468	Schwarz criterion		-4.684741
Log likelihood	84.93014	Hannan-Quinn criter.		-4.773490
F-statistic	3.288929	Durbin-Watson stat		1.829582
Prob(F-statistic)	0.050659			

Null Hypothesis: D(M2_GDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.687525	0.0007
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(M2_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:11
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M2_GDP(-1))	-0.825715	0.176151	-4.687525	0.0001
C	0.001390	0.003934	0.353195	0.7263
R-squared	0.414795	Mean dependent var		-0.000299
Adjusted R-squared	0.395917	S.D. dependent var		0.028957
S.E. of regression	0.022506	Akaike info criterion		-4.691333
Sum squared resid	0.015703	Schwarz criterion		-4.600636
Log likelihood	79.40700	Hannan-Quinn criter.		-4.660816
F-statistic	21.97289	Durbin-Watson stat		2.086015
Prob(F-statistic)	0.000052			

Null Hypothesis: D(M2_GDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.170019	0.0010
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(M2_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:11
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M2_GDP(-1))	-0.950563	0.183861	-5.170019	0.0000
C	0.015509	0.008742	1.774045	0.0862

@TREND(1)	-0.000770	0.000429	-1.793467	0.0830
R-squared	0.471463	Mean dependent var	-0.000299	
Adjusted R-squared	0.436228	S.D. dependent var	0.028957	
S.E. of regression	0.021743	Akaike info criterion	-4.732577	
Sum squared resid	0.014182	Schwarz criterion	-4.596531	
Log likelihood	81.08753	Hannan-Quinn criter.	-4.686802	
F-statistic	13.38025	Durbin-Watson stat	1.998659	
Prob(F-statistic)	0.000070			

Null Hypothesis: PC_GDP has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.456629	0.5426
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:11
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PC_GDP(-1)	-0.058892	0.040431	-1.456629	0.1556
D(PC_GDP(-1))	0.482833	0.156226	3.090608	0.0043
C	0.007460	0.005084	1.467395	0.1527
R-squared	0.267794	Mean dependent var	0.001831	
Adjusted R-squared	0.218981	S.D. dependent var	0.016563	
S.E. of regression	0.014638	Akaike info criterion	-5.523921	
Sum squared resid	0.006428	Schwarz criterion	-5.387875	
Log likelihood	94.14469	Hannan-Quinn criter.	-5.478145	
F-statistic	5.486051	Durbin-Watson stat	2.149413	
Prob(F-statistic)	0.009322			

Null Hypothesis: PC_GDP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.194476	0.8953
Test critical values:		
1% level	-4.262735	

5% level -3.552973
 10% level -3.209642

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_GDP)
 Method: Least Squares
 Date: 05/19/16 Time: 10:12
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PC_GDP(-1)	-0.068085	0.057000	-1.194476	0.2420
D(PC_GDP(-1))	0.494694	0.166733	2.966989	0.0060
C	0.006841	0.005811	1.177215	0.2487
@TREND(1)	8.91E-05	0.000383	0.232664	0.8177
R-squared	0.269159	Mean dependent var		0.001831
Adjusted R-squared	0.193554	S.D. dependent var		0.016563
S.E. of regression	0.014874	Akaike info criterion		-5.465180
Sum squared resid	0.006416	Schwarz criterion		-5.283785
Log likelihood	94.17546	Hannan-Quinn criter.		-5.404146
F-statistic	3.560098	Durbin-Watson stat		2.166432
Prob(F-statistic)	0.026220			

Null Hypothesis: D(PC_GDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.389709	0.0186
Test critical values:		
1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PC_GDP,2)
 Method: Least Squares
 Date: 05/19/16 Time: 10:12
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PC_GDP(-1))	-0.537005	0.158422	-3.389709	0.0019
C	0.001063	0.002607	0.407780	0.6862
R-squared	0.270419	Mean dependent var		0.000173

Adjusted R-squared	0.246884	S.D. dependent var	0.017170
S.E. of regression	0.014900	Akaike info criterion	-5.516190
Sum squared resid	0.006883	Schwarz criterion	-5.425493
Log likelihood	93.01714	Hannan-Quinn criter.	-5.485673
F-statistic	11.49013	Durbin-Watson stat	2.071302
Prob(F-statistic)	0.001923		

Null Hypothesis: D(PC_GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.461920	0.0605
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PC_GDP,2)
Method: Least Squares
Date: 05/19/16 Time: 10:12
Sample (adjusted): 3 35
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PC_GDP(-1))	-0.559429	0.161595	-3.461920	0.0016
C	0.005202	0.005687	0.914802	0.3676
@TREND(1)	-0.000228	0.000278	-0.820158	0.4186

R-squared	0.286419	Mean dependent var	0.000173
Adjusted R-squared	0.238847	S.D. dependent var	0.017170
S.E. of regression	0.014980	Akaike info criterion	-5.477758
Sum squared resid	0.006732	Schwarz criterion	-5.341712
Log likelihood	93.38301	Hannan-Quinn criter.	-5.431983
F-statistic	6.020728	Durbin-Watson stat	2.061936
Prob(F-statistic)	0.006334		

COINTEGRATION TEST

Date: 05/19/16 Time: 10:18
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments
 Trend assumption: Linear deterministic trend
 Series: GDP DC_GDP
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.459457	23.38863	15.49471	0.0026
At most 1	0.089322	3.087664	3.841466	0.0789

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.459457	20.30096	14.26460	0.0049
At most 1	0.089322	3.087664	3.841466	0.0789

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

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

GDP	DC_GDP
-0.197579	-5.618867
0.048881	-13.55556

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	4.277896	-1.112539
D(DC_GDP)	0.010037	0.007849

1 Cointegrating Equation(s): Log likelihood -33.66375

Normalized cointegrating coefficients (standard error in parentheses)

GDP	DC_GDP
1.000000	28.43863
	(14.7900)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.845221
	(0.21826)

D(DC_GDP) -0.001983
 (0.00104)

Date: 05/19/16 Time: 10:25
 Sample (adjusted): 3 35
 Included observations: 33 after adjustments
 Trend assumption: Linear deterministic trend
 Series: GDP BD_GDP
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.450762	22.64122	15.49471	0.0035
At most 1	0.083208	2.866856	3.841466	0.0904

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.450762	19.77436	14.26460	0.0061
At most 1	0.083208	2.866856	3.841466	0.0904

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

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

GDP	BD_GDP
-0.221550	7.378187
-0.014862	-14.57098

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	4.954509	-0.068393
D(BD_GDP)	-0.001638	0.006229

1 Cointegrating Equation(s): Log likelihood -23.03661

Normalized cointegrating coefficients (standard error in parentheses)

GDP	BD_GDP
1.000000	-33.30252
	(13.9077)

Adjustment coefficients (standard error in parentheses)

D(GDP) -1.097674
(0.22521)
D(BD_GDP) 0.000363
(0.00089)

Date: 05/19/16 Time: 11:23
Sample (adjusted): 4 35
Included observations: 32 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: GDP M2_GDP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.398863	21.45266	25.87211	0.1610
At most 1	0.149102	5.166813	12.51798	0.5726

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.398863	16.28584	19.38704	0.1334
At most 1	0.149102	5.166813	12.51798	0.5726

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

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

GDP	M2_GDP	@TREND(2)
-0.442110	-5.060194	0.116603
0.020446	17.67755	0.024777

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	D(M2_GDP)
3.397910	0.000221
0.581982	-0.008130

1 Cointegrating Equation(s): Log likelihood -13.12663

Normalized cointegrating coefficients (standard error in parentheses)

GDP	M2_GDP	@TREND(2)
1.000000	11.44555	-0.263742
	(11.1938)	(0.07508)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-1.502251
	(0.38457)
D(M2_GDP)	-9.79E-05
	(0.00183)

Date: 05/19/16 Time: 11:27

Sample (adjusted): 4 35

Included observations: 32 after adjustments

Trend assumption: Linear deterministic trend (restricted)

Series: GDP PC_GDP

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.336128	18.86309	25.87211	0.2890
At most 1	0.164567	5.753770	12.51798	0.4922

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.336128	13.10932	19.38704	0.3193
At most 1	0.164567	5.753770	12.51798	0.4922

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

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

GDP	PC_GDP	@TREND(2)
-0.411203	-8.755393	0.182136
0.060122	-22.11862	0.077812

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	2.947005	-0.880223
D(PC_GDP)	0.004375	0.004377

1 Cointegrating Equation(s): Log likelihood 0.286263

Normalized cointegrating coefficients (standard error in parentheses)

GDP	PC_GDP	@TREND(2)
1.000000	21.29216	-0.442936
	(15.5951)	(0.10715)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-1.211816
	(0.37706)
D(PC_GDP)	-0.001799
	(0.00100)

Date: 05/19/16 Time: 11:28

Sample (adjusted): 3 35

Included observations: 33 after adjustments

Trend assumption: Linear deterministic trend

Series: GDP PC_DC

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.476686	22.57453	15.49471	0.0036
At most 1	0.035844	1.204583	3.841466	0.2724

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.476686	21.36995	14.26460	0.0032
At most 1	0.035844	1.204583	3.841466	0.2724

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

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

GDP	PC_DC
0.230932	-4.210696
0.017754	6.131689

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	-4.968206	-0.287658
D(PC_DC)	0.012181	-0.008927

1 Cointegrating Equation(s): Log likelihood -49.80383

Normalized cointegrating coefficients (standard error in parentheses)

GDP	PC_DC
1.000000	-18.23351
	(5.42283)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-1.147316
	(0.23254)
D(PC_DC)	0.002813
	(0.00209)

Granger causality

Pairwise Granger Causality Tests

Date: 05/19/16 Time: 10:48

Sample: 1 35

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
BD_GDP does not Granger Cause GDP	33	2.95174	0.0687
GDP does not Granger Cause BD_GDP		0.11734	0.8897

Pairwise Granger Causality Tests

Date: 05/19/16 Time: 10:59

Sample: 1 35

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
M2_GDP does not Granger Cause GDP	33	2.01270	0.1525
GDP does not Granger Cause M2_GDP		1.00197	0.3799

Pairwise Granger Causality Tests

Date: 05/19/16 Time: 11:01

Sample: 1 35

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
PC_DC does not Granger Cause GDP	33	3.32068	0.0508
GDP does not Granger Cause PC_DC		0.88489	0.4240

Pairwise Granger Causality Tests

Date: 05/19/16 Time: 11:02

Sample: 1 35

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
PC_GDP does not Granger Cause GDP	33	1.54467	0.2310
GDP does not Granger Cause PC_GDP		0.16537	0.8484

Pairwise Granger Causality Tests

Date: 05/19/16 Time: 11:04

Sample: 1 35

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DC_GDP does not Granger Cause GDP	33	0.87279	0.4288
GDP does not Granger Cause DC_GDP		2.82353	0.0764
