

Addis Ababa University

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ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

**AN INVESTIGATION OF THE MACROECONOMIC DETERMINANTS OF PRIVATE
INVESTMENT IN ETHIOPIA: COINTEGRATED VAR APPROACH**

BY

MAMO ESAYAS

June, 2016

Addis Ababa, Ethiopia

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MAMO ESAYAS

**A Thesis Submitted to the Department of Economics Presented in Partial Fulfillment of the
Requirement for the Degree of Masters of Science in Economics (Economic Policy Analysis)**

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ABSTRACT

AN INVESTIGATION OF MACROECONOMIC DETERMINANTS OF PRIVATE INVESTMENT IN ETHIOPIA: CO-INTEGRATED VAR APPROACH.

Mamo Esayas, Addis Ababa University, 2016

This study was conducted with the main objective of investigating and analyzing the macroeconomic determinants of private investment in Ethiopia over the period from 1974/75-2013/14.

The study employed Vector error Correction model to estimate the long run relationship of the variables. The regression results shows that real physical infrastructure investment, real social infrastructure investment, trade openness and bank credit have significant positive long run effect on private investment, where as inflation has significant negative long-run effect. In the short run economic growth have significant positive impact on the real private investment. The result of the regression suggests the crowding in effect of the real physical infrastructure investment and real social infrastructure investment on real private investment in Ethiopia in the long run.

Moreover, the result of the regression confirm the validity of accelerator model which states investment is the linear proportion of output in the context of Ethiopia. Thus require the need to extend the growth of national output to raise the growth of private investment.

Hence, as policy implication the study recommends government provision of fertile macroeconomic and investment climate. Moreover, investment in physical and social infrastructure in line with other supplementary reforms to enable the private investment to contribute more to the gross domestic product should need to be extended.

Key words : private investment, vector error correction model, economic growth

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Acronyms

ADF: Augmented Dickey-Fuller

AIC: Akaike Information Criteria

AR: Auto Regressive

ARDL: Autoregressive-Distributed Lag

BOP: Balance Of Payments

FPE: Final Prediction Error

GDP: Gross Domestic Product

GNP: Gross National Product

HQ: Hannan-Quinn Information Criteria

IGE: Imperial Government of Ethiopia

IMF: International Monetary Fund

IRF: Impulse Response Functions

IS: Import Substitution

JB: Jarque-Berra

LM: Lagrange Multiplier

LDCs: Less Developing Countries

NBE: National Bank of Ethiopia

NTB: Non Tariff Barriers

OLS: Ordinary Least Square

OPE: Trade Openness

PP: Phillips-Perron

PPP: Purchasing Power Parity

R&D: Research and Development

RGDP: Real gross domestic product

RPI: Real public Investment

RPRI: Real private Investment

RPII: Real Physical Infrastructure Investment

RSII: Real Social Infrastructure Investment

RGDS: Real Gross Domestic Saving

RDBC: Real Domestic Bank Credit

SIC: Schwarz (Bayesian) Information Criteria

SSA: Sub-Saharan Africa countries

TGE: Transitional Government of Ethiopia

VAR: Vector Auto Regression

VDC: Variance Decompositions

VECM: Vector Error Correction Model

WB: World Bank

WDR: World Development Report

WTO: World Trade Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The role of investment in the economic growth of nations has been one of the most crucial issues for development related discussion among policy makers, researcher, donors, scholars as well as various economic and financial institutions in developing as well as developed nations. This view emanates mainly from the fact that investment plays a central role in economic development in every country. According to Khan (2008), investment is taken as one of crucial determinants of the rate of physical accumulation and productive capacity of an economy by raising the productivity of factors of production through the use of new techniques of production and promotion of technological progress.

It is argued that investment is the major foundation of enhancement in the level of literacy, improvement in technology and increase in the capital stock (Hashmi et al 2012). Levine and Renelt (1992) argued that investment in capital goods is the most robust and vital determinant of economic growth. Gross domestic investment boosts economic growth by increasing physical capital directly and indirectly through technological spillovers (De Long and Summers, 1995).

The investment sector has the significant contribution to the economic growth through creating an employment opportunities, enhancing technical progress and introducing new techniques of production. In the investigation of Greene and Villanueva (1991) in developing countries during the year 1980s, decline in economic progress of countries was directly linked with the decline in gross capital formation.

According to Maida and Sofia (2010), in the process of investigating the economic performance or growth of a country, one of the key determinants that need to be considered is investment. Countries

that are developed are those that have invested much in their economies whereas countries that are investing slowly, are not only developing slowly but also still remaining poor (Solow, 1956). A number of cross-country studies also confirmed that difference in growth rate performance among countries is caused by the difference in investment rate (Collier and Gunning, 1999; Ghana and Hadjmicheal, 1995).

There exists a close connection between the level of investment and the rate of economic growth (Durham, 2004). Empirically, countries that were able to accumulate high levels of investment achieved faster rates of economic growth. It is in this respect that investment culture needs to be given a top priority by individuals in their country through their daily activities, the government in its policy planning and implementation

As evidenced in many studies, it is rather private investment that plays greater role than public investment in determining growth in most developing (Serven and Salimano ,1990 , Khan and Rein hart 1990: and Badawi ,2003 and 2005). The tendency to boost private sector participation in economic growth has prominently shaped the policy-making process in developing countries, giving rise to a wave of privatization program and other related policies 2002; Badawi ,2003 and 2005).

Alemayehu and Befekadu (2005) have explored the role of investment as one of the long-run determinants of Ethiopia's growth rate. With regard to the relative contribution of public investment and private investment to economic growth, they confirmed that private investment is a greater contributor than public investment to the country's economic growth; a 10% increase in private investment leads to an approximately 1.5% increase in output, while a similar increase in government investment leads to a 0.95% increase.

Recently, economists have developed a common opinion about the constructive effect of sustainable investment on economic growth. Moreover, the sustainability of investment depends on the investment

climate (World Bank (WB), 2004). In general, the investment climate refers to the totality of macroeconomic, political, policy, and institutional conditions in a country that, together with structural forces, determines the performance of private investment and economic growth (WB, 2004a). According to the United Nation (UN, 2005), investment climate can be explained further as access to basic physical infrastructure such as electricity, telephone, water and roads; access to information and advisory services; higher labor productivity; efficient tax administration and tax rates; access to finance; availability and affordability of urban land; business regulations and trade facilitation services, among other elements, Tadesse (2011).

A good investment climate provides opportunities and incentives for investors to invest profitably, create jobs, and expand national output thereby increasing private investment and economic growth (World Bank, 2004). In the 2005 World Development Report (WDR), Bernal *et al.* (2004) note that improvements in the investment climate in developing countries are key to increasing the flow of investments and, consequently, a higher level of economic growth and development. However, in the poorest developing countries, such as Ethiopia, businesses frequently operate in investment climates that undermine their incentive to invest and grow, thus undermining the performance of trade (UN, 2005). In line with this environment, Ethiopian investors complain about poor infrastructure, particularly power shortages; poor transport; poor telecom connectivity of business locations and lack of efficient tax administration (Mima and David, 2012; World Bank, 2004). Ethiopia ranked 124th out of 148 countries in terms of the infrastructure in the 2013/14 global competitiveness report, WEF, (2013).

The Ethiopian government recognized the role of private investment in particular and private sector growth in general for faster and sustainable economic growth and it has been taking various measures to that effect including formulating various development policies and plan so as to enable the private investment sector to take the lead in contributing for sustainable growth. Due to the policies and

strategies formulated by the EPRDF government the private sector began to revive in contributing for economic growth which was the result of policies and strategies. The objectives of the different policy measures have been for the creation of a conducive and free market friendly environment for the private sector invest and operate in the economy. Following the shift of policy, the participation of private sector in the economy has shown an improvement as compared to the previous regime during which there was extremely limited room for the private sector operation.

1.2. Statement of the problem

Being one of the least developing countries, Ethiopia has been characterized by low and fluctuating private investment performance which partly contributed for the very low advancement in the economy. The private investment has shown different trends of growth and performance in the case of Ethiopia due to shifts in the regimes and political processes. During the imperial era (1960/61-1973/74), private investment as a percent of GDP at market price was about 10.5 percent and growing by about 6 percent per annum on average. The reasons for a relatively good performance of private investment in this period include the existence of import substitution strategy, market-oriented financial sector policies, a developing share market, the free market where prices were determined purely by supply and demand, Alemayehu and Befekadu, (2002)

However, this promising trend was reversed due to the socialist ideology persuaded by the military government that replaced the monarchy in 1974. Thus, the period 1974/75-1990/91 witnessed centralized economic system, where the state was given a significant role in all sphere of the economy. The private investment was given little rooms due to the ideology. During this period (1974-1991), the ratio of private investment as a percent of GDP declined to 4.5 percent. This ratio is far below the SSA countries where the average rate of private investment to GDP was 10.6 percent (IMF, 1995).

After the down fall of the Derge regime in 1991, the country adopted the market-oriented economic policy, placing due emphasis on the role of the private sector in its development efforts. In line with this policy, new investment policy and decree was promulgate and successively amended with the aim of expanding private investment. As a result, the share of private investments in the GDP has registered an encouraging improvement.

Between the periods 1992/3-2004/05, the share of private investment rose to around 8 percent of GDP at Market Price. Despite this achievement, the performance the private sector has not been considered adequate in light of twelve years of adjustment efforts and policy incentives directed toward making the private investment take the lead in initiating economic growth. As indication of this inadequate performance could be seen vis-à-vis the average shares of private investment of SSA countries (12.5 %), IMF (2006).

It has also been argued that despite the incentives taken by the government, the sector's contribution towards the economy of the country has remained very poor by international standards, even when compared with Sub-Saharan countries (WB, 2004).

The private sector investment share in total investment in Ethiopia during 2008-09 was 46.1 percent where as the public investment account for 53.9 percent during 2008-09: however the public investment has fallen from 66.3 percent of share in 2006-07. The average real private capital stock formation as a share of real gross capital formation in Ethiopia over 2004/05- 2013/14 was 4.21 percent whereas real public capital stock formation account for 3.43 percent. This is an indication of the low share of private sector investment from the total investment which requires efforts to extend its share from the current stage, Addis Ababa Commerce Report (2013).

The private investment has very low performance interims of the implementation of licensed projects¹ which can serve as bottleneck in the growth endeavor of investment in the country. During 2010/11 and 2011 /12 fiscal year 4734 and 3341 projects owned by domestic and foreign investors have got investment license to invest in different sectors respectively. However only a total of 433 projects have become operational in 2010/11 and 2011/ 12. Only 5 % became operational indicating the lowest percentage of implementation even after securing license to invest which require unreserved effort to investigate what determine private investment in Ethiopia, MOFED (2011/12).

The resource gap between saving and investment is very high despite the low share of private investment to the country's GDP. For instance, the resource gap between 2009/10 was 19.4 % which could be considered very high in compression to the international average share (FDRE, 2010). The low private investment performance as compared to Sub-Saharan African countries and also the global average particularly in terms of its share from the GDP in the one hand and the efforts of the government to attract private investment on the other require researchers, what could be the underlying factors that determine the growth or expansion of private investment, Ambaye et al (2013).

Due to massive and collaborated effort to increase saving through strengthening saving for housing program², selling government bonds and improving social security schemes the share of gross domestic saving increase from 9.5 percent in 2009/10 – 22. 5 percent in 2013/14. Despite the increase in saving mobilization the gap between investment required and the level of domestic saving required is widened The share of gross domestic investment in gross domestic product increased from 24.7 percent in 2009/10 to 40.3 percent by the end of 2013/14 . It has become one of the key macroeconomic challenges to Ethiopia.

¹ Only 433 projects started implementation out of 8075 and account only 5 % of the total project during 2011/12.

² Housing saving program refers to the saving made to condominium housing program.

The real private investment has not shown substantial progress in terms of its share from the total Gross Domestic Product with in 2006/07- 2013/14 which was only 0.68 % and 0.76 % respectively which indicate the progress of the real private investment sector share from the total GDP as compared to the Sub Saharan standard of the rate of growth of real private investment as a share from total gross domestic product.

Many studies on the determinants of the private investment in developing countries have been undertaken based on the cross-country regression analysis. Since cross country regression analysis is an approach in which each country is treated as a sample point assuming the impact of each variable is constant across countries, it is hardly possible to conclude about investment behavior in specific country based on such studies because cross country studies is not informative of the individual country scenarios . Moreover, the inconsistency between the findings of individual country regression and the cross country regression suggest that studies may need to be undertaken on individual case (Oshikoya, 1993).

The rationale behind undertaking this study currently is based on the argument that private investment in Ethiopia has low share from the gross domestic product and the saving investment gap is wide so as to enable the private investment to have capital and credit. This require accomplishments of studies so as to enable the private investment to grow fast to sustain the sustainable growth of the economy. Ethiopia require fast growing private sector to ensure structural transformation of the economy and its sustainability which require identification of determinants of private investment to address their respective roles and take policy tools and measures. The other rationale behind undertaking this study currently is to evaluate the investment endeavor of the government in different social and physical infrastructure components of public investment in the short run and long run growth of private investment sector.

Moreover the rationale behind undertaking this study is mainly to have closer look on the impacts of saving efforts made by the government and public to the housing program and selling government bonds in the endeavor to promote private investment in the long run and short run.

In the case of Ethiopia, some studies have been undertaken. Abdush Hussein (2000) studied factors determining private investment in Ethiopia using time series data for the period between 1975 and 1998 and applied OLS models. In his study real gross domestic product and public expenditure are found to have statistically significant effect to promote private investment

Adugna (2013) studied determinants of private investment using time series data over the period from 1981-2010 employing OLS methods and came up with a positive and statistically significant impact of public investment, economic growth and interest rate upon the performance of private investment.

Hailu and Debele (2015) studied the effects of monetary policy on the private investment on in the case of Ethiopia using the time series data from 1975-2011 and applied autoregressive distributed lag models and co integration based on ECM. The main findings of their study were that economic growth, exchange rate and public investment has significant long run impacts on the private investment in Ethiopia. Not only the existence of limited empirical evidence in the determinants of private investment but also none of the study from the aforementioned scholars take the disaggregated form of public investment in social and physical infrastructure category than taking into account the aggregated form .

This study had filled the gaps of previous research through the following ways. First Vector Error Correction Model was used to estimate long-run relationship and short run. Secondly, the paper used disaggregated form of public investment into social and physical infrastructure investment that help to evaluate the role of different components of public investment in the growth of private investment.

1.3. Main Research Questions

The study is aimed to answer the following core research questions:

- What are the macroeconomic determinants of private investment?
- What kind of relationships exists between determinants and private investment both in the short run and long run?

1.4 Hypothesis of the study

The dependent variable is real domestic private investment and the explanatory variables that are expected to determine private investment are Real Gross Domestic Product, inflation, real gross domestic saving, real domestic bank credit, trade openness and real public investment in social and physical infrastructure. The explanatory variable that may affect the decision to invest in the literature are very wide and only variables having sound theoretical explanations and empirical evidences are selected for these study.

Economic growth (RGDP) is one of the most commonly used variables to measure its effect on the private investment. According to some literature such as Fielding (1997), Serven and Solimano (1992) explained that private investment is positively related with real GDP growth of one country. This is because countries with higher income level inclined to allocate more of their wealth to domestic savings which could be then used to help in financing private investment. Empirical results from Lawanson (2012) from Nigeria, Ouattara (2004) from Senegal and Asante (2000) from Ghana evidenced the contribution of GDP to private investment. Thus economic growth is expected to have positive sign.

Inflation: as measured by Consumer price index is one of the explanatory variables used as a measure of macroeconomic stability in the country. There is no uniformity on the theoretical explanation of the variable and its effect on domestic private investment. Some models such as the cash-in-advance models Stockman (1981) forwarded that inflation raises the cost of acquiring capital which

then lowers capital accumulation. Others Tobin -Mundell model argues that higher anticipated inflation lowers the real interest rate which then causes to be made portfolio adjustments away from real money balance to real capital which then expected higher inflation to raise real private investment (Ghura and Goodwin, 2000). Empirical evidence by Bakare (2011), Ndikumana (2000) and Asante (2000) reported that inflation has a negative effect on private investment. Thus the sign of inflation is ambiguous.

Real domestic saving: is another important explanatory variable included to see its effect on domestic private investment. Empirical evidence from Giannone and Lenza (2008) reported the existence of higher correlation between saving and investment in members of organization for economic co-operation and development (OECD) countries where as Vamvakidis (1998) evidenced the existence of negative relation in non -OECD countries. Thus expected sign of saving is positive.

Real domestic bank credit is another explanatory variable included in the study to measure the relation between financial development and private investment in Ethiopia .As Serven and Solimano (1992) evidenced private investors source of income for investment in developing countries is credit and thus the existence of low financial services in such countries may affect the private sector negatively . However empirical evidence by Jongwanch and Kohpaiboon (2008), Outarra (2004) evidenced the negative relation the variable. Thus the expected sign of the bank credit is positive.

Government expenditure on real physical infrastructure investment is another explanatory variable included in the study to whether it has crowding in /out effect on the private investment. Theoretically there are ambiguous and divided arguments on the effect of public expenditure on private investment. literatures such as Villanueva (1991) and khan (1984) described that if government expenditure is spent in provision of infrastructure like communication , energy , transport , health and education services it complements the private investment .but there is a situation o crowding out by the

government expenditure if the latter competes with the private sector or if the government expenditure is financed by a deficit (Rossister ,2002) empirical evidence by Lawson (2012) revealed the crowding out of public expenditure in Nigeria. Thus the sign of government expenditure is ambiguous.

Trade openness³ is one of the explanatory variables included in the study to measure external openness and the impacts of trade liberalization on the private investment. empirical evidence by argue the role of trade through promoting growth according to orthodox trade theory which argue the contribution of trade to growth through specialization , increase in productivity , division of labor and expansion of production capacity . This will lead to economic growth and in turn pave the way to private investment growth. Thus trade openness is expected to have positive sign.

Based on the empirical literature on the determinants of private investment in developing countries the study proposes the following working hypotheses to hold true in my analysis.

- Real physical infrastructure investment crowds in private investment in the long run.
- Real social infrastructure crowds in private investment in the long run.
- Trade openness influence private investment positively in the long run.
- Economic growth and credit affect private investment positively in the long run.
- Inflation influence private investment negatively in the long run.
- Saving promote private investment positively in the long run.

1.5 Objective of the study

1.5.1 General Objective

The main objective of this study is to examine the macroeconomic determinants of private investment in Ethiopia over the period between 1974/75 and2013/14.

³ Trade openness can serve as a measure of the extent of trade liberalization.

1.5.2 Specific objective

The specific objectives of this study include:

- To investigate the impacts of each determinants on the real private investment in the short run and long run.
- To provide policy recommendation to promote private investment growth in Ethiopia in the long run.

1.6 Scope of the study

This study was delimited to assess the determinants of private investment in Ethiopia over the period between 1974/75 and 2013/4. The study period was selected based on the availability of data about the private investment and all the variables that are included in the study. In the analysis, the relationship between private investment and trade openness, macroeconomic stability, public investment in physical infrastructure and social infrastructure was analyzed. Moreover, the trend, roles as well as the contribution of private investment in Ethiopia was investigated.

1.7 Significance of the study

A number of studies on the investment especially in developing countries have been carried out. Nevertheless, empirical evidence on the determinants of private investment growth has been limited (Khan and Kumar, 1997 and Siraj, 2014). In Ethiopia, the presence of little empirical analysis in this context makes this study vital to show the determinants of the private investment in the economy and to help design informed and prudent policy in the endeavor to promote private sector development.

This study provides relevant information on the relevance of economic and social infrastructure investment on the private investment than only investigating the aggregate impacts of public investment.

This study will be useful for Ethiopian policy makers in designing and formulating policies that would create an enabling environment for the flourishing of private sectors investment so as to boost growth of the economy.

Moreover, the study may also help to initiate other researchers to carry on further and deep rooted studies in the endeavor to remove bottlenecks for private investment flow and thereby enhance their contribution for economic growth process. Finally it enhances other scholars to carry on further study through providing relevant evidence on the determinants of private investment in Ethiopia.

1.8 Limitations of the study

This study is mainly intended to investigate the macroeconomic determinants of private investment in Ethiopia from 1974 – 2014. Owing mainly to lack of time series data and financial constraint to conduct surveys so as to obtain primary data, some macro and microeconomic factors that have the potential to determine private investment, such as corruption, taxation, law and order, research and development and property right have not been considered. Thus, carrying on the further study by taking into account those Macro, Meso and micro factors is open to research for future researchers by employing ARDL model.

1.9 Methodology of the study

1.9.1 Data type and sources

The study used secondary data that was collected from MOFED for the period 1974/75 - 2013/14.

The period of study was selected based on the availability of data for most variables included in this study as explanatory variables .

1.9.2 Data analysis and estimation technique

The collected data was analyzed using descriptive and econometric technique. Appropriate tests of variables behavior was checked like stationarity, post diagnostic tests, and co integration of the variables.

The model was estimated using Vector error correction model (VECM) to estimate the long-run and short run equilibrium relation.

1.10 Organization of the Thesis

The remaining part of the study was organized as follows. Chapter two reviews the related theoretical and empirical literature in the area of study. In chapter three model specifications and variable definitions and source and estimation technique have been discussed. The analysis of data using descriptive method was presented in the fourth chapter. Chapter five presents empirical analysis and findings of the study. The last chapter presented conclusions and policy implications

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical review

2.1.1 Basic theories of Investment

There are various theories on the factors that determine private investment activities having implication for the economies of developed as well as in developing countries.

2.1.1.1. Marginal Efficiency of Capital

The first and oldest theories of investment were developed by Keynes. Keynes (1936) was the first to call attention to the existence of an independent investment decision in the economy. The study formulated the oldest and the most familiar explanation of the theory of user cost of capital. The neo-classical theory of stated that the firm maximizes its market value by adjusting its capital stock to appoint where the marginal value product of capital equals the market interest rate.

This theory is underpinned by diminishing the marginal value of capital in a convex production function which postulates demand for investment goods to decline with an increase in interest rate⁴. Incorporating fiscal incentives like taxes on profits and investment tax credits to make it more realistic easily made extensions to the user cost, Mulubrihan (2006).

According to Keynes (1936), the idea of the marginal efficiency of capital could be interpreted as the internal rate of return that is used to equate the projected cash receipts and payments to their present values. Investment takes place if the marginal efficiency of the capital of a project is greater or equal to its financing costs. Keynes further acknowledges the presence of uncertainties by varying the marginal efficiency of capital. On the other hand, the liquidity preference is concerned with the rate of interest as illustrated by Keynes (1936) theory. Once the willingness of a community to hold money balances is known and the supply of money is also known then interest rate can be determined, Mohammed (2007)

Keynes (1936) identified three basic motives for holding money, namely; transaction motive, precautionary motive and speculative motive. The speculative motive is concerned with changes in interest rate, for example, if security prices are expected to decline then the demand for liquidity will increase and vice versa.

⁴ Interest rate is the cost of capital.

The study pointed out that investment was intrinsically volatile since any rational assessment of the return on investment was bound to be uncertain. On a more formal basis, shifts in investors' expectations are supposed to be found on economic fundamentals including observed shifts in technology, consumer demand, opinion surveys and the like.

User cost theory, however, says little or nothing about what determines the marginal value of the product of capital. The theory of user cost of capital developed by Keynes was criticized on the basis of expectation hypothesis and the internal rate of return used for discounting (Otto, 1975).

Keynes did not take explicit account of such an expectation hypothesis, which could not reflect the investor's concern about the outcome of the possible return streams. To overcome this problem, it was suggested that investors worry only about the mathematically expected return of each given data or the stream of returns represents "creativity equivalents" to the probability distribution, thus requiring that the stream of returns to be statistically independent, an assumption which might not be realistic, Mulubrihan (2006).

The Keynesians approaches were further complicated by the difficulty in computing the present value of an investment project as a result of the ambiguity about the proper rate to be used for discounting. By considering a perfect market, the market real interest will be used which must be considered as one prevailing for comparable risk.

2.1.1.2 The Accelerator Principle.

After Keynes, the evolution of investment theory was linked to simple growth models. These models gave rise to the accelerator⁵ principle popular in the 1950s and early 1960s and widely used in empirical studies even today in practical growth exercises (Akpokodje, 1997). The accelerator principle is based on a number of assumptions like, full utilization capacity, permanent character for sales charge; constant sales- out put rates etc. (Dornbusch and Fisher put will require a proportional

⁵ Accelerator model of investment is the most widely used model in developing countries.

increase in its stock of capital equipment (ibid). The implications of accelerator theory are that, the level of output or the changes in aggregated demand determines investment or the change in capital stock. Or its extreme simplicity explains its popularity given an incremental capital output ratio [ICOR]. It is easy to compute the investment requirements associated with a given target for output growth (Akpokodje, 1997). In the accelerator model, expectations, profitability and capital cost, play no significant role. In the model, a relatively modest increase in the rate of growth of demand for the final good can lead to a large increase in the demand for investment increase.

The accelerator model assumes that firms' desired capital-output ratio is roughly constant. This theory is not commonly used due to the fact that it assumes firms respond to changes in demand such that investment is always sufficient to keep the desired capital stock equal to the actual capital stock. To account for the weaknesses of the accelerator model, a general form model known as the flexible accelerator model was developed. This model assumes that the larger the gap between the desired and existing capital stock of a firm, the more is the firm's rate of investments. In other words, in this theory, net investment is seen as a fraction of the gap between the existing level of investment of a firm and its desired level of investment. Within this framework, output, internal funds, the cost of external financing and other variables are treated as the determinants of desired capital (Ghura et al., 2000).

A more general form of the accelerator model is flexible accelerator model. The basic notion behind this model is that the larger the gap between the existing capital stock and the desired capital stock, the greater a firm's rate of investment. The hypothesis is that firms plan to close a fraction of the gap between desired capital stock and the actual capital stock in each period. This gives rise to a net investment equation. Within the framework of flexible accelerator model, output, internal funds cost of external financing and other variables may be included as determinants of desired capital stock. The flexible accelerator mechanism may be transferred into a theory of investment behavior by

adding a specification of desired capital stock and a theory of replacement investment. In flexible accelerator model, desired capital stock is proportional to output, but in alternative models, it depends on capacity utilization, internal funds, the cost of external finance and other variables, Mulubrihan (2006).

Neoclassical accelerator model has been criticized for its shortcomings in estimating investment function for developing countries. These criticisms are related to lack of readily available methods of measuring capital stock⁶ and returns to capital. In that regard, the study will consider the accelerator investment model for the same reason, Mohammed (2007).

Despite the drawbacks of the accelerator principle, these theories, as well as the flexible accelerator principle of investment, are popular as evident in most of the empirical studies done to date.

2.1.1.3 Neoclassical Investment Theory

The restrictive assumptions behind the accelerator theory led Jorgenson et al (1967), Jorgenson, to formulate the neoclassical approach. In this approach, which is a version of flexible accelerator model, the desired (or optimal) capital stock depends on the level of output and the user cost of capital (which in turn depends on the price of capital goods, the real interest rate, and depreciation rate). Lags in decision making and delivery creates a gap between current and desired capital stocks, giving rise to an investment equation, that is , an equation for the change in the capital stock.

The foundation of this approach has been criticized on the ground that: the assumptions of perfect competition and exogenously given output are inconsistent, the assumption of static expectations about future prices, output, and the interest rate is inappropriate since investment is essentially forward-looking, and the lags in delivery are introduced(Birahanu ,2004)

⁶ In developing countries measuring the return to the capital stock and return to the capital is difficult.

2.1.1.4 The Q Theory of Investment

An alternative formulation of investment function is the $-Q$ ⁷ theory of investment associated with Tobin (1969). This theory emphasizes that what matters is the relation between the increase in the value of the firm as a result of the installation of an additional unit of capital and its replacement cost. When an increase in the firm's market value exceeds an (or less than) replacement cost, firms will want to increase (or decrease) their capital stock. This ratio, known in the literature as the marginal Q, may differ from unity because marginal Q and the ratio of the market value of the entire existing capital stock to its replacement cost (the average Q ratio) is used instead.

This theory has been criticized on the grounds that if firms enjoy economies of scale or market power or if they sell all they want, marginal and average Q will systematically differ (Abel, 1980). Moreover, the assumption of increasing marginal installation costs underlying the Q theory is dubious; the argument is that the costs of additions to an individual firm's capital stock are likely to be proportional or even less than proportional to the volume of investment because of the lumpy nature of many investment projects. More important, disinvestment, if feasible, is more costly than positive investment: capital goods often are firm specific and have a low resale value.

2.2 Models of private investment in developing Countries

From the above mentioned theories and models of private investment, Accelerator Model of investment has been widely applied in developing countries. The other model of private investment has not been widely applied due to the assumption underlining their application. The direct application of those models except simple accelerator model to understand investment behavior in developing countries is difficult due to the following two reasons.

The first one is related with technical aspects and is related to scarcity of data on key variables such as wage rates, capital stock, real interest rates and stock market prices. The second one is related with

⁷ Q refers to the Tobin Q theory of investment

incompatibility of the institutional and structural peculiarities of developing countries with the underlying assumptions of the basic models such as in the perfectly competitive markets, little or no government intervention and absence of liquidity constraints. These assumptions are hardly tenable in the context of developing countries making the models less relevant to apply (Shiferaw, 2002).

Due to difficulties with the measurement of key variables in developing countries and the expected influence of public investment, the application of flexible accelerator model require the identification of variables included as determinants of private investment in developing countries. As Blejir and khan (1984) stated variable that are taken as determinants of private investment should be based on the specific realities of the country. That means the theory and variables that are found to be valid in developed country may not yield the same results in developing countries due to difference in the economic environment and institutional setup of the countries.

In the investigation of variables that are considered as a determinants of private investment Blejir and khan (1984) identified variable as financial, non financial and macroeconomic uncertainty indicators. Monetary policy indicators include, rate of interest, real exchange rate and the level of financial development measured by bank credit.

2.2.1 Monetary policy and private investment

The investigation of the growth of private investment in developing countries considered the role of financial development as potential ingredient to carry on deep rooted study of private investment topic .Many scholars, who studied private investment in developing countries, opted to move away from the traditional theories and give emphasis on the role of financial sector development. The rationale behind the shift in the attention of the scholars was that financial markets in developing countries are typically repressed and firms are credit rationed constraining their ability to adjust capital to the desired level. More specifically, limited access to credit compels firms in developing countries to accumulate enough real balance before initiating investment projects. That is an increase

in current consumption at the cost of future consumption or increase in current consumption as a substitute of financial assets. McKinnon (1973) and Shaw (1973) provided the theoretical and empirical frame work for such analysis and they argued that the level and quality of private investment in developing countries is positively associated with the real interest rate on deposits.

Since early (1990), many developing countries have embraced policies of financial reform and liberalization intended to promote capital markets and ensure positive real interest rate. Though the standard economic theory states a negative relation between investment and the rate of interest, the effects of changes in the real rate of interest on private investment in developing countries may depend on the level of the financial system. In a financially repressed economy, the rise in interest rate may stimulate an increased flow of deposits that enable increased investment to be undertaken (Fry, 1998). However this proposition was in contradiction with the neoclassical model where interest rate is treated as user cost of capital.⁸

McKinnon (1993) and Shaw (1973) further explained a higher positive interest rate would generate greater rates in saving and investment, which are important in accelerating the rate of economic growth. In developing countries, government intervention in the capital market, such as a fixed interest rate at a low level, the imposition of a high reserve ratio, and widespread selective credit policy leads to a reduced saving rate and causes important sectors to use inferior technologies.

Nonetheless, banking sector credit and depth or size of financial intermediation came out as important factors and they are incorporated in investment equation to reflect information and moral hazard which often low capital markets in developing countries, (Blejer and Khan, 1984; Greene and Villanueva, 1991; Cardoso, 1993; and Oshikoyo 1994) with in this context interest rates are screening devices to sort out ‘good’ borrowers from ‘bad’ ones. The equilibrium interest rate is below

⁸ Interest rate is the measure of the user cost of capital.

the equilibrium market interest rate that is the demand for credit is more than the supply of credit which is termed as credit rationing. It is an equilibrium outcome of the unfiltered rational behavior of lenders when information costs are significant. Even if there is excess demand or loans at a certain level of interest rates, a lender may find it more profitable to ration credit than to raise the interest rate. In this case, the expected returns of the excluded groups may be higher than the expected returns of investments of the group that obtains the loans where capital is allocated under such circumstance (Stieglitz and Weiss, 1981). As a result, the availability of credit to the private sector is thought to be the other key variable in determining private investment equation in developing countries instead of using only interest rates which are administratively controlled.

2.2.2 Fiscal policy and private investment

Since public investment in developing countries assumes a relatively large role than in industrial countries it became important to take account of its complementarities and substitutability with private investment and appeared in empirical investment equation (Badawi, 2003 and 2005; Shiferaw, 2002; Blejar and Khan, 1994; Carson, 1993; Oshikoya, 1994; Quattara, 2005; Agenor, et al, 2005; Eden and Holcombe, 2005; Atukeren, 2005).

In theory, crowding in and crowding out effects of public investment could take place at the same time and, hence, the net effect on private investment is indeterminate. The effect of government activity on private sector activity may take two broad sets: complementarities' (crowding-in) and substitutability (crowding out) effects.

The complementarities effect asserts that public capital, infrastructure investment, is likely to be related in a rather different way to private capital profitability (formation), because the provision of public services that reduce the cost of production of the private sector would have a positive impact on the profitability of private investment. Public investment as such is expected to be a direct complement to the output produced by the private sector. Moreover, the crowding in effect of public

capital on the marginal productivity of private investment is high when more public capital spending is on education and health, which may enhance the productivity of labor, other components of current public spending such as on the enforcement of property rights and legal aspects improve the productivity of private investment. Agenor, et al, (2005) suggested that expenditure on infrastructure have a large effect in the countries where internal stocks are low and basic infrastructure services (electricity, communication, etc) are lacking.

However, to the extent that public investment displaces or crowds out private investment its positive impact on private capital formation can be highly mitigated (Badawi, 2003 and 2005 in Sudan). The crowding out effect on public investment in developing countries may not be felt through an increase in distortion taxes which may increase incentives for private agents to evade tax, or increases interest rates as in industrial countries (Shiferaw , 2002) Shiferaw discussed the main reasons for crowding out effect of public investment on private capital formation in developing countries. The study stated firstly, many developing countries are characterized by limited market size which indicates that public investment in productive sectors may displace private ventures. Second, financial crowding out effect may occur if the increase in public investment is paid by borrowing on the domestic financial markets, which leads to greater incidence of rationing of credit to the private sector for there is limited credit pool in most developing countries. And finally, the study notes that financing public investment through foreign borrowing could crowd out private investment through its effect on inflation and debt accumulation, which may result in the uncertain business environment.

2.2.3 Foreign trade policy and private Investment

The terms of trade are one of the most important indicators of external shocks to the economy and the changes in the economy's terms of trade will influence private investment demand. The permanent TOT⁹ changes will affect the profitability of private investment through two mechanisms. The first

⁹ Permanent change in Terms of trade leads to uncertainty to the private investment.

mechanisms operate through the impacts of a change in the terms of trade on the real income and the profitability of the export sector, but also through the extent multiplied if profits are positively correlated across sectors, Deterioration in terms of trade reduces real income and has at least a transitory negative effect on investment. A term of trade deterioration also reduces investment in the export sector because it directly affects the profitability effects of investment in that sector. If profits are positively correlated across the sector, bad news for the export sector is bad news for the economy as the whole. Conversely, positive terms of trade shock will spread in the benefit throughout the economy.

The deterioration in the terms of trade also affects the budget adversely-either indirectly, by reducing the tax base, or directly, if the government owns the export sector. Budget deterioration will require corrective measures and its deflationary effects will reduce investment. When the government spends what it earns, reduction in taxes automatically will reduce spending, profits, and investment, even in the absence of corrective action Cardoso (1993) called this effect Manaus Opera House Effects. The second mechanism operates when deterioration in terms of trade has an impact on the current account and thus induces concretionary measures.

Deterioration in the terms of trade will worsen the current account balance, if the deterioration is perceived as permanent, it will require corrective measures. A transitory deterioration that cannot be financed will also require correctives measures. These measures may include expenditure reducing fiscal and monetary policies that will affect investment adversely. They may also include a devaluation of the exchange rate that can only be transmitted into a real devaluation in the context of tight money; Carson called this effect IMF effect.

The adverse effect in the terms of trade will increase the cost of imports relative to income and also reduce the purchasing power of exports. Severely terms of trade, therefore may worsen the ratio of

current deficit to GDP ratio-an indicator of external balance and macroeconomic instability, with adverse consequence on private investment, Cardoso (1993).

World price fluctuation will not only induce macroeconomic uncertainty but will also exert an impact on inflation, the real exchange rate, resource allocation, and the overall investment outlook. An increase in the price of an imported good with the large weight in the cost of living index will have a direct impact on consumer prices. Depressed export prices, in the agricultural export sub-sector, will draw resources away from the export sector reducing export and discouraging investment in the sector (Oshikoya, 1994).

2.2.3 Macroeconomic Uncertainty, Instability, and Private Investment

Developing economies suffer from a high degree of macroeconomic uncertainty. Growth, inflation, real exchange rate and other key macroeconomic variables are much more volatile in developing countries than industrial economies, and the consequences of this excess volatility for aggregate performance in several dimensions growth, investment and trade have attracted some attention in the empirical literature (Dixit and Pindyck, 1994). In the case of investment, this concern has been received by recent theoretical work identifying several channels through which uncertainty can impact on investment such as exchange rate volatility, policy uncertainty, inflation variability (Serven, 1996; Dixit and Pindyck, 1994; Dehn, 2000; and Shiferaw, 2002). But the effect of uncertainty on investment relation is indeterminate on the theoretical grounds and at the same time, some of these effects of uncertainty operate in mutually opposing directions. To get determinate relationship among uncertainties and private investment within the typical country and specified the period of time, they need to be incorporated as key determinants of investment.

Many economists and theoretical arguments in this line of research focus on the detrimental effects of macroeconomic instability on private investment, productivity, capital accumulation and economic growth. A rise in macroeconomic instability means a rise in one or more policy-induced

macroeconomic instability indicators such as inflation rate, and public deficit to GNP ratio, moreover macroeconomic instability adversely affects the rates of productivity and investment mainly by creating uncertainty about current and future macroeconomic environment (Dhan, 2000 and Shiferaw, 2002).

2.2.4 Inflation and private investment

Inflation rates also constitute a source of uncertainty in the macroeconomic environment. But the direction of the effects of inflation on investment is ambiguous in both the theoretical and empirical literature. The traditional view on the role of inflation in economic growth articulated in the works of Tobin (1965) held that inflation is positively correlated with capital formation. According to Tobin, the substitutability hypothesis views money and capital as substitutes. Since inflation the cost of holding money; this will encourage a portfolio shift into capital. The line of reasoning here is that inflation by encouraging saving reduces the interest rate and therefore leads to an increased investment and economic growth (De-Gregorro, 1995).

The studies conducted by Stockman,(1981), De-Gregor on, (1993) and: Shiferaw, (2002) and Oshikoya, (1994), however, shown that inflation can be considered to be a tax on investment and therefore a can slow down the wheel of economic growth.

Another mechanism that inflation could affect growth is by distorting the optional choice between consumption and leisure. An increase in the rate of inflation will increase the price of consumption with respect to the price of leisure inducing substitution from consumption to leisure, thereby reducing the labor supply (De, Gregorro, 1993).

2.2.5 Public investment and Private Investment: crowding out approach

With regard to the relationship between private and public investment, the general observation is that an increase in public investment leads to competition between private and public sectors for limited domestic savings and, hence, the dominant public sector might crowd out the private sector

(Jayaraman, 1996). In contrast, as long as public investment measures are in terms of services such as transportation, communications, and other services used by the public, increases in public investment should contribute to an increase in private investment.

2.2.6 Public investment and private investment: Crowding-in private investment

According to Barro (1991, 1996 and 2003); Artadi and Sala-i-Martin (2003) public and private investment are related, and their relationship can be explained as follows. Private investment is often seen as the engine that drives a country's economy while public investment provides the necessary infrastructure. The two investment type are tied, as a public investment may crowd in (if it provides the infrastructure to support the private sector) or crowd out (by increasing costs of borrowing) private investment. Public investment itself affects growth either directly, via its productivity, or indirectly via its effect on private investment. Public investment in human capital (health and education), law and order, research and development, and social and economic infrastructure leads to the creation of positive externalities which in turn improve the productivity of private investment.

When public and private capital are complements of one another, public investment raises the marginal productivity of private capital, which raises the returns to private investment and the amount of private investment. In turn, this crowding-in of private investment increases the economic growth rate. However, although public investment is almost certain to crowd in private investment when starting from a low level, it likely does not do so at all levels. Increases in public investment have a successively smaller positive effect on returns to private investment, whereas the taxes required to finance this public investment have a constant negative effect. Therefore, at some point, it is inevitable that increased public investment will crowd-out¹⁰ private investment (cited in Edward, Paolo and Stephanie, 2006).

¹⁰ Crowding out refers to the negative effect.

In the model of Barro (1990), three stages are distinguished. Initial levels of public investment increase the returns to private investment, which represents the crowding-in phase. After a certain point, the (negative) effects of higher taxes offset the (positive) effects of greater public capital on the returns to private investment, and further increases in public investment lower the private savings rate. Nevertheless, increases in public investment still increase the growth rate because public investment remains highly productive. Therefore, this concept is described as the efficient crowding-out phase. However, after these levels, public investment is less productive and further increases lower both the savings rate and the growth rate, which represents the inefficient crowding-out phase.

According to Fujita et al., (2001), in “new economic geography” models improvements in the domestic transport and communications infrastructure can have significant effects on growth, for two reasons. First, by lowering transport costs, firms’ profits increase. Second, driving a cumulative process that moves labor and other resources to a small number of core regions and/or cities in which (because of increasing returns) labor productivity levels are higher accelerates a country’s growth rate.

In Keynesian models of the economy, public investment affects the level of national income through aggregate demand. Such models assume that, because of inflexible wages and/or prices, economies sometimes operate at less than full employment. In such cases, an increase in public investment has an immediate and positive effect on the level of national income (cited in Haussmann et al., 2004).

Through changes in output and relative prices, public investment and capital in infrastructure may also affect private capital formation indirectly. As noted earlier, Easterly and Rebelo (1993) and Ramirez (1994) have argued that public capital in infrastructure may increase the marginal productivity of existing factor inputs (both capital and labor), thereby lowering marginal production costs and increasing the level of private production. In turn, as postulated by Chirinko (1993), this

scale effect on output may lead, through the standard accelerator effect, to higher private investment. Public infrastructure can also affect private investment indirectly through its flow effect on the price of domestic consumption goods relative to the price of imported goods, that is, the real exchange rate. An increase in public investment in infrastructure, for instance, will raise aggregate demand and domestic prices (in addition to stimulating output). In the eventuality that nominal exchange rate does not depreciate fully to offset the increase in domestic prices it is likely that the domestic-currency price of imported consumption goods will fall in relative terms (real exchange rate appreciation), thereby stimulating demand for these goods and dampening domestic activity (Boopen & Khadaroo, 2009).

On the supply side, the real appreciation¹¹ may lead to a shift in resource allocation toward the non-tradable goods sector, thereby stimulating investment in that sector and depressing capital formation in the tradable goods sector. So, the net effect may thus be uncertain. There may be an increase in private investment if the nominal exchange rate does not depreciate fully in response to the increase in domestic prices which implies a fall in the real cost of imported intermediate inputs. (Agenor et al, 2005).

The above theoretical linkages of public infrastructure and private investment implied that the net effect of public investment on private investment is an empirical question since public infrastructure investments play many competing and offsetting roles in its effect on the investment activities of the private sector. The net effect on output may be positive or negative, depending on the intra-temporal elasticity of substitution between domestic and imported goods. If this elasticity is low (as one would expect in the short run), the net effect on output may be positive, so that private investment may indeed increase (Agenor et al, 2005).

¹¹ Real Appreciation leads to the increase in the import and reduction of export capacity.

In addition, public investment in infrastructure may affect private investment through both demand- and supply-side effects on output. On the demand side, the increase in domestic prices may lower private sector real wealth and thus expenditure; if this effect is sufficiently large (relative to the increase in public spending) to entail a fall in domestic absorption, firms may revise their expectations of future demand and lower investment outlays, through a —reverse|| accelerator effect (Boopen & Khadaroo, 2009)

2.3 Performances of physical Infrastructure in Ethiopia

2.3.1 Energy infrastructure

Ethiopia's investment in infrastructure is quite significant. This is clearly seen in the energy sector. Big investment projects have been initiated to meet the growing demand and support the on-going efforts to build rapid and sustainable development in Ethiopia. The Great Renaissance Hydro Electric Power Project (with 6000MW), Gilgel-gibe III (1,870MW) and Genale- Dawa III (254MW) and other Wind Power Projects (Adama and Ashegoda), were mega projects that are under way in Ethiopia recently .some of the projects are well in progress and the wind power projects such as Ashegoda, Adama No. I and II have already started generating electricity. Generally, the initiated projects, when completed are expected to transform the energy sector of Ethiopia. It is not enough to increase generation capacity. Complementary investment in sub-stations, power transmission and distribution is also required to carry power to users. Accordingly, many projects have been initiated and are under construction including 400 and 500 KV lines. Overall, Electricity service coverage at national level has increased from 41% in 2009/10 to 54% in 2013/14 (MOFED , 2015/16).

2.3 .2 Railway Infrastructure

Transport cost was and is one of the challenges affecting competitiveness. Thus, Railway infrastructure development has been one of the priority development programs of the first GTP. Obviously, the Addis Ababa-Djibouti corridor was given priority. The project is nearing completion to some parts and will be accomplished for the remaining areas. Contract was also awarded to start

the construction of Mekele-Hara-Gebeya (Waldya) (268k.m) and Hara-Gebeya-Semera-Assayita (229 k.m) railway projects. The Awash-Kombolcha-Hara Gbeya (Woldiya) has begun construction. Preparatory works are underway for projects in other corridors.

The construction of 34km Addis Ababa Light Rail Transit (LRT) project is nearly completed and is going to start operation. The rail way academy has already started the training of staff to ensure that the country has skilled human resource for effective management and operation of the railway industry. Overall, the railway industry is expected to play a key role in Ethiopia's endeavor to integrate both locally and regionally. It is also important to render Ethiopia's exports competitive in the regional and global market via using the rail way infrastructure.

2.3.3 Road Infrastructure

The road (sector) has continued to witness increased investment during the 2010/11 -2015/16 . This has helped to increase road network from 48,800 km in 2009/10 to 60,466 km in 2013/14. Under Universal Rural Road Access Program (URR AP), 39,070 Km all-weather woreda roads were constructed. As a result, the proportion of kebeles connected by all-weather roads increased from 39% in 2009/10 to 68% in 2013/14. On the other hand, road density increased from 44.5 km/1000 km to 90.5 km/1000 km in the same year. Thus, the average time taken to reach the nearest all weather roads was reduced from 3.7 hours in 2009/10 to 1.8 hours by 2013/14. This is an indication of massive government infrastructure investment in Ethiopia. (MOFED, 2015/16)

2.3.4 Telecommunication

In Ethiopia telecommunication is another area that has seen major investment for improving service quality, expansion of service coverage and enhancing institutional capacity. During 2010/11-2013/15 the number of subscribers in the overall telecom services has increased from 7.7 million in 2009/10 to 29.63 million in 2013/14 and number of mobile subscribers increased from 6.25 million and in 2009/10 to 28.3 million in 2013/14. Similarly, the percentage of the rural population with access

(within 5 kilometers radius) to telephone service is increased from 62.1 percent in 2009/10 to 96 percent in 2013/14. (MOFED, 2015/16)

2.4 Performances of Social Services

2.4.1 Education Sector Development

During 2010/11-2013/14 Ethiopia has continued to make remarkable progress in basic service delivery as in education and health in a way that promotes equitable access to services. Investing in human development is key to long term growth and transformation. This rapid expansion of basic services has helped Ethiopia in achieving the MDGs as related to gender parity in primary education, reducing child mortality, fighting HIV/AIDS, malaria and access to primary education.

The primary education net enrolment rate (NER) increased from 82.9 percent in 2009/10 to 92 percent in 2014/15. Secondary education first cycle (grade 9-10) gross enrolment rate (GER) stood at 39.7 percent, which fell short of expectation. The major factors for the low performance were limited investment in new secondary school construction and expansion that limited accommodating the students promoted from primary education to secondary level, lack of follow-up in teaching learning processes at the primary education level, and the long travelling distance between residence and schools particularly for female students have been identified as challenges for participation of female students in particular. (MOFED, 2015/16)

The preparatory education (grade 11-12) GER increased from 7 percent (male 8.9 percent, female 5 percent) in 2009/10 to 10 percent (male 10.7 percent, female 9.1 percent) in 2013/14 and estimated to reach 19.8 percent in 2014/15. The achievement is higher than the targets set for the end of the GTP period. Increased investment in the preparatory school construction and upgrading the first cycle secondary schools through the construction of additional class rooms contributed to the remarkable GER achievement at preparatory level.

During 2010/11-2013/14, huge public resource has been allocated to expand higher education. The GER of higher education increased from 5.3% in 2009/10 to 9 percent in 2014/15. The share of female students in undergraduate and postgraduate reached 32 and 19 percent, respectively. (MOFED, 2015/16)

2.4.2 Health Sector Development

To provide basic health services in an equitable manner to the rural and urban population, Health Extension Program (HEP) has been designed and is being implemented throughout the country. Regarding maternal and children health care, under five child mortality rate (U5CMR) was reduced from 204/1000 in 1990 to 64/1000 in 2013/14. Improvements in nutrition, effective implementation of the disease prevention programs and first stage medical treatment and changes in economic and social development have resulted in improvements in child health and the reduction in U5CMR. In addition to this, the implementation of the integrated treatment of infants at health post and health centers, malaria control and prevention, improvements in vaccination coverage, implementation of community based nutrition program have contributed to improvements in child health. In addition, the maternal mortality rate (MMR) in 1990 has declined by 69 percent and during the last four year from 2011/11 -2014/15, it has been declining by 11 percent per annum. In some districts, all child deliveries are being conducted at health facilities as a result of the implementation of the community based health development army and the close follow-up by health teams that contributed to improved maternal health. Thus, encouraging results have been registered towards achieving the millennium development goals such as reducing under 5 child mortality rate and maternal mortality rate, combat HIV/AIDS, malaria and tuberculosis. The U5CMR was reduced from 204/1000 in 1989/90 to 64 in 2013/14. Therefore, Ethiopia has achieved the goal in advance and become one of the countries that achieved MGD¹² 4. It was targeted to reduce the MMR from 1400/100,000 in 1989/90 by three-fourth at the end of 2014/15. Until 2013/14, the MMR was reduced by 69 percent. The performance

¹² MDG refers to millennium development goal.

indicated that, it is likely that Ethiopia would achieve the planned target (75 percent reduction in MMR) by 2014/15. On the other hand, the number of newly HIV/AIDS infected persons was reduced significantly. The death rate caused by malaria has declined to zero percent and no malaria epidemic has been witnessed for the last six years. With regard to preventing tuberculosis, encouraging result has been registered that indicates to the achievement of the millennium development goals in the health sector, GTP I(2015/16)

2.5 Empirical Literature on the determinants of private investment

The purpose of this section is to review related studies in Ethiopia and elsewhere to have a deeper understanding of the factors contributing for private sector investment growth. Sakr (1993) carried on studies on the private investment behavior in Kenya and found a positive influence of savings, GDP growth and public investment on the behavior of private investors. The study's findings also indicated that output growth did not affect private investment while monetary policy played a less significant role.

Further, the paper found that credit provided to the private sector, public investment and GDP growth had a significant impact on private investment. Restrictions on investment financing are a problem broadly documented in the literature on the determinants of investment. Loungani and Rush (1995) suggested that some agents, typically small and medium enterprises (SMEs), are unable to get financing directly from open market debt. Hence, these agents are strongly dependent on bank credit, a market that is usually characterized by imperfections due to asymmetric information between lenders and borrowers. In developing countries, this problem of access to credit is critical, due to the absence of markets and poor access to long-term financing. The evolution of the credit amounts destined for the private sector would be a good indicator of the restrictions operating in the domestic financing of investment.

Ronge and Kimuyu (1997) examined the determinants of private sector investment for Kenya using data over the period 1964-1996. A double-logarithmic form of the investment equation was estimated using ordinary least squares (OLS). The results indicated that both the availability of credit and foreign exchange exerts significant positive effects on private investment confirming the results in most empirical studies. Private investment, however, was adversely affected by the stock of debt. Specifically, a one percent increase in the lagged debt to GDP ratio reduced private investment by 0.3 percent. The study also establishes a negative effect of exchange rate depreciation on investment while public investment crowded in private investment, contrasting the results of Were (2001) where crowding-out was found. The interest rate was also found to be less important in determining the level of private investment in Kenya.

Asante (2000) investigated the determinants of private investment in Ghana using time series and cross-section data. The survey data comprised of 116 manufacturing firms in Ghana sought to capture the determinants of private investment that are not captured in time series analysis, for example, political instability and policy uncertainties. The study had nine variables in total which included GDP growth rate, Balance of Payment, Credit to the private sector, Public investment as a percentage of GDP, Private investment as a percentage of GDP, Inflation rate, Budget Deficits as a percentage of GDP, Real Exchange Rate and Foreign Direct Investment which is also a percentage of GDP. The study found that public investment had a crowd in effect on private investment while credit to the private sector has a positive influence on private investment. Further, the study found coefficients of the proxies for macroeconomic instability, that is, the real exchange rate, the debt burden, the black market premium, and the inflation rate to be statistically insignificant in explaining private investment. However, the overall indicator of instability was found negative in private investment in Ghana.

Kazeem et al (2012) in the study which covered the period 1970 to 2010 used an advanced econometric technique of ARDL bounds testing approach in modeling long run determinants of domestic private investment. Findings from the study showed clearly that difference exists between long and short run determinants. The interest rate, real GDP, exchange rate, terms of trade, external debts, public investments, credit to the private investment and reforms dummy are the key long-run determinants of domestic private investment while real GDP, public investment and terms of trade are statistically significant in the short run. Kazeem et al (2012) recommended that necessary infrastructures to complement domestic private investment should be put in place and that external debts reduced to the barest minimum and negative effects of external shocks endangered by foreign direct investment uncertainty and deficit terms of trade should be prevented all together.

Frimpong et al (2010) carried out a study seeking to present an empirical assessment of factors that have either stimulated or dampened private sector investment in Ghana using ARDL framework covering the period 1970 to 2002. From the results it emerges that private investment is determined in the short-run by public investment, inflation, real interest rate, openness, real exchange rate and a regime of constitutional rule, while real GDP, inflation, external debt, real interest rate, real exchange rate and openness significantly influenced private investment response in the long-run. On the policy front, the study indicates that improving the productivity of sectors such as agriculture and manufacturing by providing more efficient advanced technologies as input subsidies could go a long way to increasing private investment levels and growth in output.

In Fiji, Seruvatu et al. (2001) investigated the determinants of the private investment using time series technique. Specifically, the study employed unrestricted error correction model for the period 1966 to 1998 to analyze the long run and short run determinants of private investment. The study found real GDP growth, real lending rate, real private sector investment, real effective exchange rate index, terms of trade index and real unit labor cost to weakly explain private investment with only 35

percent of the variations in private investment being explained by the independent variables. The paper justifies this poor fit of the model by highlighting factors such as perceived inadequacies in the legal system, failure to enforce contractual obligations and property rights, and land effects on private investment.

Badawi (2004) investigated the impact of macroeconomic policies on private investment in Sudan employing annual data over the period 1969-1998. The results suggested the significant crowding-out effect of public investment on private investment in Sudan, devaluation policies also contributed to discouraging private sector capital expansion.

Quattara (2004) employed the ARDL modeling for the period 1970 to 2000 to analyze the determinants of private investment in Senegal. Further, the paper employed Johansen co integration and ARDL bounds approach to estimate the long run relationship between private investment, public sector investment, real GDP, credit to the private sector, foreign aid and terms of trade. The paper found that private investment was positively influenced by public investment, real income and foreign aid flows, but negatively influenced by credit to private sector and terms of trade.

Acosta et al. (2005) investigated the short run and long run determinants of private investment in Argentina for the period 1970 to 2000. The results from the ARDL model revealed that exchange rate, inflation, trade liberalization and shocks in the aggregate demand were the main determinants of private investment in the short run. Further, public investment was found to have a crowding-out effect on private investment in Argentina. In the case of the long run, external debt and domestic credit markets were found to determine private investment.

Esubalew (2014) carried on studies on the macroeconomic determinants of private investment in east Africa region with panel data set from the period of 2000-2012. According to his studies macroeconomic factors such as variation in the output and real per capita growth fiscal and monetary

policy as well as exchange rate are the most determinant factors for the variation of private investment in eastern African countries over the study period. His study confirmed that domestic private investment is positively influenced by real GDP growth, financial availability as measured by credit to the private sector as the percentage of GDP and the development of human capital as measured by school enrollment has significant positive influence on the private investment of the region. On the other hand variable such as unstable macroeconomic environment, as measured by the inflationary situation, high external debt, fluctuation in the terms of trade, real exchange movement, public investment and real interest rate are found to hinder private investment significantly in east Africa.

Osmond (2014) studied the determinants of private investment in Nigeria for the period from 1970-2012 by estimating the investment rate function derived from life cycle hypothesis while taking into account the structural distinctiveness of developing country. The study employed error correction model to avoid for the problem of spurious relations. The results of the study confirmed that investment rate is positively influenced by the growth rate of disposable income and the real interest rate on bank deposits .investment rate in Nigeria is found to be influenced negatively due low public infrastructure, high lending rate, low saving rate and political insatiability.

Sisay(2010) carried on the study of the determinants of private investment in Ethiopia over the period ranging from 1950-2003 motivated by modified flexible accelerator model by applying multivariate single equation ECM estimation methodology. According to his study private investment in Ethiopia is influenced by the domestic market, infrastructural facilities and FDI and negatively by macroeconomic uncertainty.

Adugna (2013) studied the determinants of private investment in Ethiopia by using multiple regression OLS models for the period from 1981-2010 by using Engle granger two step error

correction model .According to his study variables such as public investment real GDP and external debt had the significant positive long run effect on private investment where as lagged private investment(a proxy for investment climate) had significant negative long-run effect .in the short run external debt and real GDP had the significant contribution to private investment growth .

Siraj (2014) tried to evaluate the inter-relationship between private investment and economic growth both in the long and short run. He argued that there is evidence of unia-directional causality between economic growth and private investment. The findings showed that both private and public sector investment have a positive significant impact on real output/economic growth while in the short run public investment has a negative impact on growth and private investment has a positive impact on growth.

2.6 Conceptual Framework

The conceptual framework of the study include real private investment as a dependent variable and the explanatory variables such as Real Physical Infrastructure investment, Real Social Infrastructure investment, inflation, Real Gross Domestic Saving, Real Domestic Bank Credit, Economic Growth and Trade Openness as respectively .

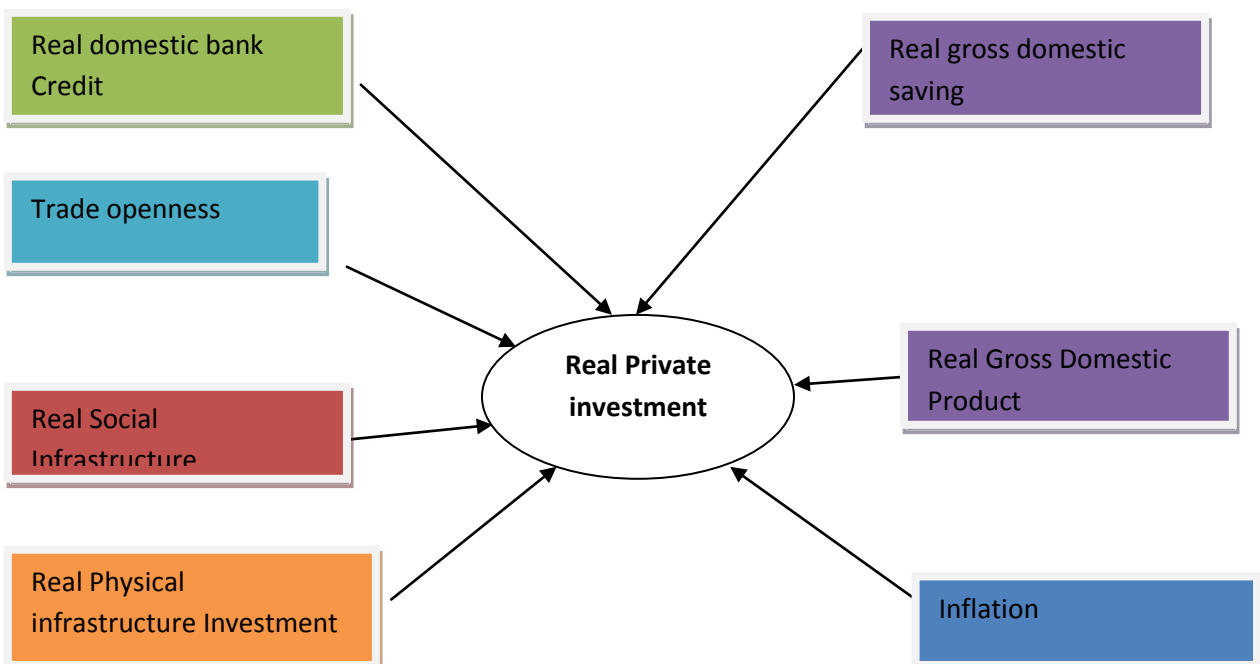


Figure 2. Conceptual framework

Source: literatures

CHAPTER THREE

MODEL SPECIFICATION, VARIABLE DEFINITION AND ESTIMATION TECHNIQUE

3.1 Theoretical framework

The empirical frame work of this study is to model the macroeconomic determinants of private investment in Ethiopia. A variant of the flexible accelerator model was used to evaluate the determinants of private investment. The idea in the formulation of private investment model is that, investment in the private sector follows the flexible accelerator hypothesis. This model is built based on the assumption that if the larger the gap between the existing capital stock and the desired level of capital stock, there will be greater firm rate of investment. Firms will plan to close the gap between the desired capital sock, K^* and the actual capital stock, K in each period, Mbaye (2014).

The flexible accelerator model has been the most popular, however in the context of developing countries due to the data limitations and structural constraints, a variant of the flexible accelerator model has often been used in empirical research Ouattara(2004), and Seruvatu and Jayaraman (2001)).

3. 2 Model Specifications

The model adopted for this study is developed from the neoclassical flexible accelerator model formulated by Jorgensen (1967). The reason for the adoption of this model is that it ranks the most popular amongst all investment theories and the assumption of the theory is relevant in the context of developing countries in general. The benchmark model to be tested here is the modification of

flexible accelerator model of investment for a developing economy and focuses on the hypothesized determinants of private investment in Ethiopia.

There is no general consensus on the determinants of private investment; therefore, to formulate the investment equation, we have to first estimate the standard accelerator investment model and thereafter incorporate other variables until a more robust model is formulated.

According to the accelerator theory, investment is a function of economic growth. In the long-run, the desired capital stock (K) is assumed to be directly related to levels of income (Y).

$$K_t \sim Y_t$$

$$K_t = \alpha Y_t \dots \dots \dots (1)$$

Where α is a constant, and t is time-operator. Differentiating the equation with respect to time, t ;

$$\Delta k_t = \alpha \Delta y_t \dots \dots \dots (2)$$

Where the Δ is the difference operator.

To obtain an equation for the relationship between investment and desired capital stock, the conventional capital accumulation identity is used to identify investment, I ;

$$k_t = (1 - \delta)k_{t-1} + I_t \dots \dots \dots (3)$$

Where δ refers to the depreciation of capital. From equation (3) we can obtain the following equation;

$$k_t - k_{t-1} = I_t - \delta k_{t-1} \dots \dots \dots (4)$$

Rearranging the expression and assuming $\delta = 0$, we can solve for I_t to yield the following equation;

$$\Delta k_t = I_t \dots \dots \dots (5)$$

Equation (5) can be substituted in equation (2) to obtain;

$$I_t = \alpha \Delta y_t \dots \dots \dots (6)$$

This equation represents the basic investment function. But we need to account for the slow adjustment of the actual capital stock to the desired capital stock, lagged values of the dependent variable can be introduced into the expression to yield the following investment equation denoted by ;

$$I_t = \rho I_{t-1} + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + \varepsilon_t \dots \dots \dots (7)$$

Where the first two terms on the right-hand side are lagged investment and income growth rates respectively. β represents coefficients while Δy_{t-1} represents lagged growth rate of output. ε is the disturbance (error) term which captures the effects of omitted variables, Mbaye (2014).

The final equation can thus be estimated;

$$I_t = \rho I_{t-1} + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + X_t + \varepsilon_t \dots \dots \dots (8)$$

Where X_t represents some of the variables that are applicable in the developing countries such as financial factors, policy-related factors, neoclassical factors, open economy factors and general macroeconomic related variables. The variables are chosen based on the availability of data and existence of wide literature that support the variable.

Our model for private investments can now take the following form;

$$RPRI = f(RGDP, RPII, RSII, OPEN, RDBC, RGDS, CPI) \dots \dots \dots (9)$$

Therefore, to estimate the parameters β , the equation can take the following form;

$$RPRI = \beta_0 + \beta_1 RGDP + \beta_2 RPII + \beta_3 RGDS + \beta_4 OPEN + \beta_5 RDBC + \beta_6 RSII + \beta_7 CPI + \varepsilon_t \dots \dots \dots (10)$$

where RPRI is the dependent (endogenous) variable being real private Investments where as the independent variables are RGDP, RPII ,RGDS, RGDC, OPEN, and RSII are real gross domestic product , real physical infrastructure investment and real social infrastructure investment, real gross domestic credit ,real gross domestic saving , trade openness , and consumer price index respectively .

ε is white noise error term.

3.3 Description of the variable

The real gross domestic product (RGDP), which is the gross domestic product deflated by GDP deflator, is used as a proxy for economic growth. The real GDP is expected to have a positive impact on private and public investment.

The theoretical relationship can be readily derived from a flexible-accelerator model with the assumption that there is a fixed relationship between the desired capital stock and the level of real output in the underlying production function (Blejer and Khan, 1984). Greene and Villanueva (1991) assert that countries with higher per capita income could devote more resources to domestic savings, which could be used to finance investment projects.

Real physical public infrastructure investment (RPII) is proxied by government energy, transportation, airport and communication infrastructure capital formation deflated by the GDP deflator. At the theoretical level, the impact of physical public infrastructure investment is ambiguous. It may have a positive or negative effect on private investment depending on which one outweighs i.e. the crowding in/out the effect of it. However, it is expected to have a positive impact on private investment.

Real social public infrastructure investment (RSII) is proxied by government education and health infrastructure capital formation deflated by the GDP deflator. Similarly, its impact is ambiguous like

RPII. However, we expect the positive sign of real social infrastructure investment on the real private investment.

Real private investment (RPRI) is proxied by private capital formation deflated by GDP deflator. It is expected to have a positive impact on economic growth and thus a source of simultaneity bias if I would have used OLS.

The change in consumer price index (CPI) is used as a measure of inflation. Inflation makes nominal values uncertain, so investment planning becomes difficult. Therefore, individuals may be reluctant to enter into contracts and over time will inhibit investment which will affect economic growth. The sign of the effects of inflation on private investment is thus to be negative.

Real Gross Domestic savings are important as far as investments are concerned. Investment can be financed either through loans or savings. Even borrowed funds are those saved by individuals in financial institutions. Savings, therefore, impact positively on investment. The higher the savings, the more likely we shall have higher investments. The coefficient for this variable is expected to have a positive sign. It implies that growth in saving promotes private investment.

Gross domestic bank credit is one of the explanatory variables which are expected to have a positive influence in the growth of private investment. Since credit is relevant to avail access to working capital for investors where there is capital shortage, the prevalence of good and efficient credit facilities has a positive role to promote private investment.

Trade openness (OPE): There are many ways to measure the degree of liberalization, which is also referred to as openness. The most commonly used standard measure of liberalization in the new growth theory literature is the ratio of total trade (export + import) to GDP (Thirwall, 2004). Raju (2011); Alicia and Carles (2002) and Markus and Daniel (2012) referred to trade openness as the average of exports and imports expressed as a share of the GDP. This study also uses the same

standard to measure the openness of the country. Trade openness is one of the vital elements to determine the growth of private investment due to the fact that the existence of trade liberalization can promote the import as well as the export of goods and service as well as machinery and equipment required o the private sector operation. Thus, trade openness as measured by the sum of export plus import divided by gross domestic product is taken as the measure of openness. Thus, the expected sign of openness with private investment is positive.

3.4 Source of Data

The data that was used for this study was collected from the Ministry of Finance and Economic Development of Ethiopia. Time-series data on real gross domestic product, real private investment, real physical infrastructure investment, real social infrastructure investment, gross domestic saving, gross domestic bank credit, consumer price index and trade openness were collected from the ministry of finance and economic cooperation of Ethiopia. In order to avoid the complication of data that are obtained from the different source the researcher prefers to collect from only one source.

3.5 Estimation Technique

3.5.1 Stationarity Test

A definition of a stationary series is a series whose data generating processes such as the mean, variance, and auto-covariance do not depend upon time.

More formally, a stochastic process said to be weakly stationary if its mean and variance are constant over time and the value of the covariance between the two-time periods depends only on the distance or gap between the two-time and not the actual time at which the covariance is computed. In addition, a time series is strictly stationary if all of the moments of its probability distribution are invariant over time, however, the normal stochastic process fully specified by two moments; the mean and variance.

The stationarity of each series was verified with the standard Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. Since the majority of economic theory built upon the assumption of

stationarity, it is typically required to check that the various variables are stationary before applying standard estimation or testing procedures in a dynamic time series model. Otherwise, regression of a non-stationary variable upon a non-stationary variable may lead to the so-called spurious regression (correlated time trend rather than a meaningful economic relationship), in which estimators and test statistics are misleading. According to Davidson and Mackinnon (1999), to overcome this problem, it is necessary to identify whether the variables in the model are stationary and identify their orders of integration.

A time series is said to be integrated of order d , denoted $I(d)$, if it becomes stationary after being differenced a minimum of d times (Dickey and Fuller, 1981). The stationarity test results may be sensitive to whether a constant and/or a time trend are/is included in the regression. The appropriateness of including a constant and/or a trend were checked by formally testing whether they are statistically significant in the respective stationarity test of regression equations.

A widely popular approach to test for stationarity is the unit root test. Among different ways of testing for the presence of a unit root: this study employed ADF and Phillips-Peron tests to determine the existence of a unit root.

3.5.2 Augmented Dickey-Fuller (ADF) Test

Dickey (1976), and Dickey and Fuller (1981) developed a method for testing the stationarity of a time series variable by directly testing the null of the unit root (non-stationarity). The original Dickey-Fuller (DF) test is based on a simple autoregressive of order one, AR (1) process with a white-noise disturbance. However, because the DF test regression does not include values of variables beyond one lag, there may be the serial correlation among error terms. Results based on such tests may be biased and are not valid (Kirchgassner and Wolters, 2007). The ADF test avoids this problem because it corrects for serial correlation by adding lagged-difference terms (Greene, 2003).

The general form of the ADF Equation with

No constant and no trend Model ----- $\Delta Y_t = \beta Y_{t-1} + \sum_{i=1}^p \theta_i \Delta Y_{t-i+1} + \varepsilon_t \dots \dots \dots \text{eq (1)}$

Constant and no trend model $\Delta Y_t = \alpha_0 + \beta Y_{t-1} + \sum_{i=1}^p \theta_i \Delta Y_{t-i+1} + \varepsilon_t \dots \dots \dots \text{eq (2)}$

Constant and trend model----- $\Delta Y_t = \alpha_0 + \alpha_{2t} + \beta Y_{t-1} + \sum_{i=1}^p \theta_i \Delta Y_{t-i+1} + \varepsilon_t \dots \dots \dots \text{eq (3)}$

Where

$\Delta y_t = Y_t - Y_{t-1} \dots \dots \dots$ First difference of series Y_t .

$\Delta Y_{t-1} = Y_{t-1} - Y_{t-2} \dots \dots \dots$ First difference of series Y_{t-1} .

$\varepsilon_t \dots \dots \dots$ stochastic disturbance term.

$\beta, \alpha, \theta \dots \dots \dots$ parameters to be estimated.

Where Y_t is variable to be tested station ary and in the above three equation the Δ is the difference operator and the null hypothesis of $\beta=0$ will be tested against the alternative $\beta<0$ will be tested where a rejection of this hypothesis indicates that the time series is stationary and it does not contain a unit root (Enders 1995).

After estimating the equations, the appropriate critical value was used to test for the Presence of a unit root by using Dickey-Fuller test, in which the critical values are different for three regressions. After estimating the equations with OLS, the resulting ‘ statistics was compared with the respective critical values given in the Dickey-Fuller tables. However, MacKinnon (1991) has implemented a much larger set of simulations than those tabulated by Dickey and Fuller. In addition, MacKinnon estimates the response surface using the simulation results, permitting the calculation of Dickey-Fuller critical values for any sample size and for any number of right-hand variables. Therefore, in this study, MacKinnon critical values were used for the unit root test. If the t-calculated value is less than the MacKinnon critical value, the null hypothesis of the presence of the unit root will not be rejected.

3.5.3 Phillips-Perron Test

According to Nandwa and Mohan (2007), the other test of stationarity with the same null as ADF is the Phillips-Perron (PP) test, which is argued to be more robust to serial correlation and time-dependent heteroscedasticity and is an improvement over the ADF test with respect to finite sample properties.

In contrast to the ADF, the PP test does not add lagged difference terms to account for a potential serial correlation in the error terms; rather, it uses non-parametric statistical methods. This test statistic follows the same asymptotic distribution as the ADF test statistic (Gujarati, 2004). However, Kirchgassner and Wolters (2007) argued that both tests have low power if, under the alternative hypothesis, the first-order autocorrelation coefficient is close to one.

3.6 Estimation of VAR Model

3.6.1 Lag Length Selection Criteria

Before estimating the VAR, we have to decide the maximum lag length, to generate the white noise error terms. To determine the optimal lag length different information criteria can be used. The objective of the information criteria (IC) method is to select the number of parameters, which minimize the value of the information criteria. The most popular information criteria's are the Akaike information criterion (AIC), Schwarz's Bayesian information criterion (SBIC) and the Hannan-Quinn information criterion (HQIC). The model having said low AIC is better.

3.6.2 Lag Exclusion Test

After testing and deciding the optimal lag length of endogenous variables one thing will remain is that testing that weather the chosen optimal lag of independent variables is the significant contribution to dependant variable or not. Therefore, to know the stability of the optimal lag length of endogenous and exogenous variables chosen by the appropriate the researcher applied Wald's lag exclusion (which is asymptotically chi-square distributed) test both individually and jointly.

3.6.3 VECM Diagnostic Tests

After the Vector error Correction Model models were estimated the researcher would make some diagnostic tests which are important in order to make sure that the results obtained from VECM estimation can be used for forecasting or policy purposes. Under the considered VECM model, the errors must be white noise (the absence of autocorrelation, the distribution normality, and Homoscedasticity).

These post-estimation tests mostly performed on the residual of the VECM and they include the LM test for residual autocorrelation, Jarque-Bera test for residual multivariate normality, test for VECM stability, and White test for the presence of heteroscedasticity in the VECM's residuals.

3.6.4 Residual Vector Normality Test

The Jarque-Bera normality test was used to determine whether the regression errors are normally distributed. It is a joint asymptotic test whose statistic is calculated from the skewness and kurtosis of the residuals.

3.6.5 Stability Test

The Vector Error Correction Model stability is confirmed when the inverses of estimated coefficients matrix characteristic roots have modules less than one or alternatively, they lie within the circle of radius one. The researcher would test the model stability with the help of AR roots test as stable.

The test for stability checks whether the roots of the characteristic polynomial lies inside the unit circle or not. If all roots lie inside the unit circle then the VECM considered as stable and can be used for policy analysis, Taddesse (2012).

3.6.6 Residual Vector Autocorrelation Test

Testing for autocorrelation helps to identify any relationships that may exist between the current values of the regression residuals and any of its lagged values. The null hypothesis of the LM test for autocorrelation is there is no serial correlation on residuals. If the P-value is less than 0.05 then we reject the null hypothesis (Harris, 1995). The test

Statistic is given by:

$$LM = (T-q) R^2 \text{ ----- (7)}$$

Where q=degree of freedom

R^2 coefficient of determination that will be obtained from auxiliary regression and the LM test statistics is chi-square distribution.

3.6.7 Heteroscedasticity Test

The test for heteroscedasticity investigates whether the variance of the errors in the model is constant or not. White's test used to check whether the residuals are homoscedasticity. It tests the null hypothesis that the residuals are both homoscedasticity and that there is no problem of misspecification. The test regression runs by regressing each cross product of the residuals on the cross products of the regression and testing the joint significance of the regression. If the White test statistic is significant, that is, P value is less than 0.05; the null hypothesis of homoscedasticity and no misspecification will be rejected (Brooks, 2002).

3.7 Granger-Causality Test

When two or more totally unrelated variables are trending over time, they will appear as correlated simply because of the shared directionality. Correlation does not necessarily imply causation.

Therefore, traditional linear regression or correlation methods cannot use to establish casual relations among a group of variables. Two methods for testing for causality among time-series variables are

Granger causality tests (Granger, C.W.J. 1969) and co integration analysis (Engle, R.E. & C.W.J. Granger. 1987).

The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. Y is said to be Granger-caused by x if x helps in the prediction of y , or equivalently if the coefficients on the lagged x 's are statistically significant. Note that two-way causation is frequently the case; x Granger causes y and y Granger causes x .

Following Granger (1969), the concept of causality assumes a different meaning with respect to the more common use of the term. The statement " y_t Granger causes x_t " (or vice versa), in fact, does not imply that y_t (x_t) is the effect or the result of x_t (y_t), but represents how much of the current y_t (x_t) can be explained by the past values of x_t (y_t) and whether adding lagged values of x_t (y_t) can improve the explanation.

VAR model can use to test Granger causality among the variables and that an endogenous variable can be treated as exogenous. The Granger causality test will be applied to investigate the direction of causality between the variables. This concept involves the effect of past values of one or more of the variables on the current value of the other. A chi-square (Wald) statistic was used to test for the joint significance of all other lagged endogenous variables in each equation of the model. The null hypothesis being tested is that for X and Y in the vector of endogenous variables of the VAR, X does not Granger-cause Y ; or Y does not Granger-cause X . This was checked by testing whether lagged values of the variables in the unrestricted VAR are statistically significant or not.

3.8 Vector Autoregressive (VAR) Modeling and Co-Integration Analysis

Recently, long run linear relationships among variables in the presence of short-run deviations from the long-run equilibrium are checked, using co-integration test. In the face of non-stationary series

with a unit root, first differencing appears to provide the appropriate solutions to ensuring series are weakly stationary. First differencing, however, does possess a major limitation in that it tends to ignore the long-run properties of the data.

If two-time series y_t and x_t are both integrated of order d (i.e. $I(d)$), then, in general, any linear combination of the two series will also be $I(d)$; that is, the residuals obtained on regressing Y_t on x_t are $I(d)$. If, however, there exists a vector b , such that the disturbance term from the regression ($\epsilon_t = y_t - bx_t$) is of a lower order of integration $I(d-b)$, where $b > 0$, then Engle and Granger (1987) define y_t and x_t as co integrated of order (d, b) .

The procedure that was used for co-integration testing and estimation of the VAR in this study follows the methodology developed and used by Johansen (1988, 1991), and Johansen and Juselius (1990). This method is preferred to the single equation based Engle-Granger two-step procedure due to the following reasons. The Johansen (1988) procedure allows testing for the presence of more than one co integration vector. Moreover, it permits to estimate the model without priority restricting the variables as endogenous and exogenous. It is used to determine how each endogenous variable responds over time to a shock in that variable and in every other endogenous variable

Johansen (1988, 1991) has shown that the test for co-integration can be expressed as a test of reduced rank of a regression coefficient matrix. The coefficient matrix can be estimated consistently using linear regression techniques and the test statistic can be computed from the solution to an Eigen value problem. Moreover, linear restrictions on the co-integrating parameters can be tested by computing the shortcomings of the Engle-Granger method likelihood ratio test statistic which follows a χ^2 distribution (Walls, 1993).

The starting point in this procedure is the formulation of VAR model in the following form. Considering K-lags of Y_t , a general path-order VAR representing the interrelationships among the n variables in the model; as given in Johansen and Juselius (1990) is of the form.

$$Y_t = \Omega + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_p Y_{t-p} + \varepsilon_t$$

$$Y_t = \Omega + \sum_{i=1}^p \beta_i Y_{t-i} + \Psi D_t + \varepsilon_t$$

Where, Y_t is an $(n \times 1)$ vector containing the n -variables (including RGDP, RPII, RSII, RGDS, RDBC, CPI, OPN); β_i is $(n \times n)$ matrix of coefficients; Ψ is a vector of deterministic terms like trends, dummy or intercepts; and ε_t are iid $(0, \Sigma)$ vector of error terms. With Σ representing the contemporaneous covariance matrix, Tadesse (2012).

3.9 Co-integration Test

3.9.1 The Johansen's co-integration Test

Co-integration analysis was employed to determine the long run relationship between the variables. By definition, two or more series are said to be co-integrated if they exhibit a well-established long-term relationship. This normally implies that the variables must have a long-term co-movement. For times series variables that exhibit Co-integration, even though they may be non-stationary in levels, these variables do have a valid long-run relationship. In this vain, therefore, testing for Co-integration becomes very important when dealing with time series data.

The Johansen co-integration test estimates and tests for the presence of multiple co-integration vectors. It also allows the researcher to test restricted versions of co-integration vectors and speed of adjustment. The Johansen's procedure relies very much on the relationship between the rank of the matrix and its characteristics roots, Aragie (2014).

When variables are found to be non-stationary at the level, one option in order to get the short run dynamic is to estimate the equation by differencing variables if their differences are stationary. However, this method will result in a considerable loss of long-run properties of the data. Alternatively, economic variables may be combined in levels if they are co-integrated.

3.10 Vector Error Correction Model (VECM)

According to Mukhopadhyay and Pradhan (2010), it is widely noted that time series variables are non-stationary at level; therefore, the results that are obtained from the level VAR are spurious and misleading. Moreover, utilizing properly differenced variables in the VAR may lead to model misspecification if the level variables share the long run relationship. In this case, the VAR should be investigated further in a vector error correction form.

An important exception arises when two or more I (1) variables are co-integrated, that is, if there exists a particular linear combination of these non-stationary variables that is stationary. In such cases, a long-run relationship exists between these variables. Often economic theory suggests the existence of such long run or equilibrium relationships. The existence of a long-run relationship between stationary variable will also has its implications for the short-run behavior of the I(1) variables, because there also has to be some mechanism that derives the variables to their long-run equilibrium relationship. This mechanism is modeled by an error correction mechanism, in which the ‘equilibrium error’ also derives the short-run dynamics of the series.

Moreover, the formation of the VECM treats all variables as potentially endogenous. Each variable, expressed in its first difference specified to respond to changes in other variables as well as to the deviation of the variables under consideration from the long-run equilibrium path.

The relationship among the co-integrated variables was tested using the VECM, which avoids arbitrary selection of dependent and independent variables. The VECM describes how variables are

adjusted towards the long-run equilibrium state. The coefficients of the error-correction terms indicate the proportion by which the long-run disequilibrium in the dependent variables is corrected in the short-term period.

Following the Granger representation theorem, if some variables are co-integrated, the vector error correction model (VECM) representation can be written as follows: In order to capture both the short and long-run relationships in the model the study would use VECM which can be specified as:

$$\Delta Y_t = \Psi\Omega + \Pi Y_{t-1} + \beta_1 \Delta Y_{t-1} + \beta_p \Delta Y_{t-p-1} + \varepsilon_t$$

$$\Delta Y_t = \Psi\Omega + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta Y_{t-i} + \varepsilon_t$$

Where, ΔY_t represents the first differences of the variables $\beta_i = -\sum_{j=i+1}^p \alpha_j$ is (nxn) Coefficient matrix in the error correction term (which contains short-run parameters); and $\Pi = \sum_{i=1}^p \alpha_{i-1}$ is (nxn) matrix of long-run responses, which contains information about the long-run relationships. Further, error terms are assumed to be Gaussian or well behaved.

3.10.1 Impulse Response Function and Variance Decomposition

There are two approaches, impulse response function and variance (forecast error) decomposition, for characterizing the dynamic behavior of the VAR model. The impulse response functions and variance decomposition technique suggested by Sims (1980) are useful devices in the VAR framework for testing the sources of variability.

3.10 .2 Impulse Response Function

The impulse response function can trace the response of the endogenous variables to a shock in itself and another variable due to a random shock or innovation in other variables. A shock to the i^{th} variable directly affects the i^{th} variable and transmitted to all of the endogenous variables through the dynamic structure of the VAR (Stock and Watson, 2001). Thus, for each variable from each equation, a unit

shock to the error would be analyzed in order to determine the effects upon the VAR system over time.

Two approaches were commonly used to estimate impulse responses. These are the generalized impulse response and the Cholesky decomposition. The main advantage of the generalized impulse response is that it does not require orthogonalization of innovations and is invariant of the ordering of the variables in VAR (Pesaran and Shin, 1998). However, the Cholesky decomposition in the base line model incorporates a small sample degrees of freedom adjustment when estimating the residual covariance matrix used to derive the Cholesky factor (Lutkepohl, 1991). As a result, the Cholesky decomposition was used in this study. However, we should note that in this approach the ordering of the variables in the VAR matters.

3.10 .3 Variance Decomposition

The variance decomposition breaks down the variance of the forecast error for each variable into components that can attribute to each of the endogenous variables. That is, it helps us to measure the proportion of forecast error variance in a variable that explained by innovations in itself and the other variables. In other words, variance decompositions show the portion (or relative importance) of the variance in the prediction for each variable in the system that is attributable to its own innovations and to shocks to other variables in the system, Aragie (2014). Enders in Shan et al. (2006) proposed that the forecast-error variance decomposition permits inferences to draw concerning the proportion of the movements in a particular time-series due to its own earlier shocks vis-a-vis shocks arising from other variables in a VAR model. The technique breaks down the variance of the forecast error for each variance following a shock to a particular variable, and in this way, it identifies which variables are strongly affected. Shan et al.(2006)

CHAPTER FOUR

THE PERFORMANCE OF PRIVATE INVESTMENT, PUBLIC INVESTMENT AND ECONOMIC GROWTH IN ETHIOPIA

4.1 Economic Policy and Trends of Public and Private Investment

4.1.1 Imperial Regime (1955/56-1973/74).

The development plan at this period targeted the bulk of public investment in the productive sector and laid the foundation for the basic infrastructure development that began to occur. Among others, a network of roads, the generation of electric power and the development of Ethiopian Air Lines were in motion, offering a favorable environment for the success of the five-year plan. During the five-year development plan, legislation was introduced in 1950 as a notice (notice No. 10, 1950) with the objective of encouraging private investment growth, particularly the absorption of private foreign capital (Ethiopia, 1950, cited in Mohammed, 2006).

Furthermore, to attract local and foreign investors, a series of proclamations were enacted by the imperial regime. These statements include the 1954 new investment proclamation, an improvement over the 1950s notice that differs greatly in terms of conceptual framework and coverage. The new proclamation was meant to attract domestic and foreign investors to participate both in the agricultural and industrial sector. In 1963, the government consolidated both the notice and legislation as the investment decree that culminated in the 1966 investment proclamation (Imperial Government of Ethiopia, proclamation No. 242/1966).

The private sector was expected to play a significant role, until the Derge regime reversed the policy. In the last period of the regime, 1970/71-1973/74, private investment as a share of RGDP was 14.07% while that of public investment as a share of RGDP was 4.05 %, Tadesse (2011)

4.2 Derge Regime (1974/75 - 1990/91)

A command economic system in which the state played a considerable role in all aspects of economic activity was characteristic of the period 1974–1991. Throughout its ruling period, with the exception of the late 1980s, the military government (Derge) followed socialist policy, emphasizing the expansion of medium- and large-scale manufacturing owned by the state. In other words, the economy was guided by central planning, and economic policies were devised in such a way that the public sector was favored at the cost of the private sector (Brahanu, 2001).

The Derge regime froze the private sector by issuing nationalization proclamations at various periods. Soon after the revolution, the military government came to power and nationalized all private large- and medium-scale manufacturing enterprises owned by nationals and foreigners (MEDAC, 1999). With proclamation No. 26/1975, the government nationalized a large number of domestic and foreign producers, distributors, and service-providing establishments (Berhanu, 2001). Furthermore, the government, through another proclamation (Proclamation No. 76/1975), allowed only the operation of individual businesses; if businesses wished to organize themselves, their membership was limited to five persons. To increase the freezing effect further, the government set the maximum ceiling for private-sector investment to Birr 500,000.00; it also prohibited the issuance of licenses to investors for more than one line of business, and investors could not possess other jobs, Alemenew (2015)

The government levied progressive taxes on the income and profit of individual business that completely discouraged the participation of the private sector. However, the government made policy changes in the 1980s after an unsuccessful attempt to lead the country in a socialist direction. In light of this new perspective, the government raised the level of the capital ceiling and exempted the import duty on vital goods. The government has also issued a proclamation

(proclamation No.235/1983) inviting the participation of foreign investors in joint ventures with the objective of bringing technology and technical skills into the country. The government also invoked the Ten-Year Perspective Plan from 1984/85 to 1993/94, which recognized the role of savings in improving the economy, although the government also relied on the public sector at this time, Alemenew et al (2015).

In addition, by decree, the government allowed domestic private investment participation (special decree No. 11 of 1989) in the form of joint-venture agreements, although the state retained the majority of the share. In contrast to the preceding four decades of the Imperial period, private investment during the military government followed a poor trend. During the early period of the military government, from 1974 to 1979, private investment as a share of real GDP fell to 7.81%, whereas public investment as a share of real GDP was approximately 3.9%. From 1974 to 1990, private investment as a share of real GDP averaged 6.5 percent. The low rate of private-sector development in the period of the Derge was a result of the restrictive policies pursued by the state.

However, due to policy reforms, private investment as a share of real GDP improved. These policy reforms helped boost the share of private investment (11.1% of real GDP) in the later periods of the military government, particularly in 1988, which may be considered the peak of investment during the military period. In the last days of its political dominance, the Derge pursued a mixed economic development approach. Most of the restrictions imposed on both domestic and foreign investments were removed by Proclamation No. 17/1990. This last proclamation offered various privileges and incentives, namely, that both domestic and foreign investors were exempted from income tax and customs duty; leased land was also given to those engaged in agricultural endeavors.

4.3 Post-Derge Period (Mid-1991-to today)

Since 1991, the country has witnessed a transition of the economic system from a socialist, planned economic system to a more market-oriented economic system, particularly in terms of macroeconomic policy. Unlike the military government, which made itself a crucial player in the economy, the Transitional Government of Ethiopia (TGE) attempted to reduce its role in the economy and promoted the active participation of the private sector through various economic reforms (Ethiopian Investment Commission, 2008).

At the center of the new economic policy lay the notion of market liberalization guidelines geared toward creating a favorable environment for both domestic and foreign private investment. The reform measures included a public enterprise reform program (meant to improve efficiency, productivity, and competitiveness), price decontrol, and the removal of subsidies and preferential treatment (on the supply of credit, labor and foreign exchange) to public enterprises (MEDaC, 1999). The TGE introduced a private investment policy, the first in the country's history, under-investment proclamation No. 15/1992. The stipulation made by the private investment policy includes, among others, entry and ownership requirements, investment incentives, labor laws, immigration rules, settlement of disputes, guarantees, and protection, Taddesse (2012).

The proclamation was introduced to support, expand, and coordinate investment in the country. The objectives of the proclamation were to expand the domestic market, increase employment opportunities, strengthen private-sector investment, and encourage the use of domestic raw materials and the absorption of foreign production know-how. The proclamation enabled the private sector to invest in most sectors, except in those areas reserved for the government such as defense industries, the production and supply of electricity, telecommunication and postal

services, large-scale air and marine transport services and the import of petroleum and weaponry for the government. Furthermore, the government reserved investments in the following areas for itself or in partnership with private investors. These additional areas of investment include investment in large-scale engineering and metallic industries, capital-intensive and technology-intensive investment, large-scale mining and energy production, large-scale pharmaceutical and fertilizer production and industries that supply strategic raw materials for chemical industries, Tadesse (2011) and Alemenew (2015).

To overcome the shortcomings of the first proclamation, the government enacted a second investment proclamation in June 1996 (Investment Proclamation No. 37/1996). The second investment proclamation guaranteed incentives for private investors who invest in priority sectors with an investment capital of less than Birr 250,000. This proclamation also lowered the capital requirements of foreign investors to USD 100,000 or its equivalent, provided that they reinvest profits or dividends drawn from the existing investment; service sectors, such as tourism, health, and education, enjoyed duty-free exemptions as a result of the second investment proclamation. Between the two proclamations (1991/92-1995/96), the share of private investment averaged 5.8% of real GDP, and public investment averaged 7.3% of real GDP. In particular, the former reached 7.5% of real GDP in 1993. To redefine domestic investors to include foreign nationals who were Ethiopian by birth and to allow investors to invest jointly with the government in defense industries and telecommunication services, the second proclamation (proclamation No. 37/1996) was amended in June 1998 by proclamation No. 116/1998. The proclamation also enabled the Federal Investment Board to grant, after securing approval from the Council of Ministers, additional incentives other than what is provided under the Investment Incentive Regulations, Alemenew (2015).

Investment areas included under the additional incentive package include education, health, defense, telecommunication, and industry. The government also legislated two proclamations (proclamation No 280/2002 and its reenactment proclamation No. 373/2003) that provided more opportunity for private-sector participation and permitted the improvement of transparency and efficiency in service delivery. Because of the revised investment proclamation in 1996 and subsequent amendments, private-sector participation has increased. The share of private investment to real GDP reached an average of 13.96% for the period 1996/97-2009/10. In general, except for the two-year-period of war with Eritrea, investment has continued to increase after the reforms in 1991/92 and subsequent proclamations. In 2000/01, total investment equaled 16% of GDP, 2 percentage points higher than in the two preceding years of conflict; both private and public investment has recovered, with the former exceeding pre-war levels, Alemenew *et al* (2015)

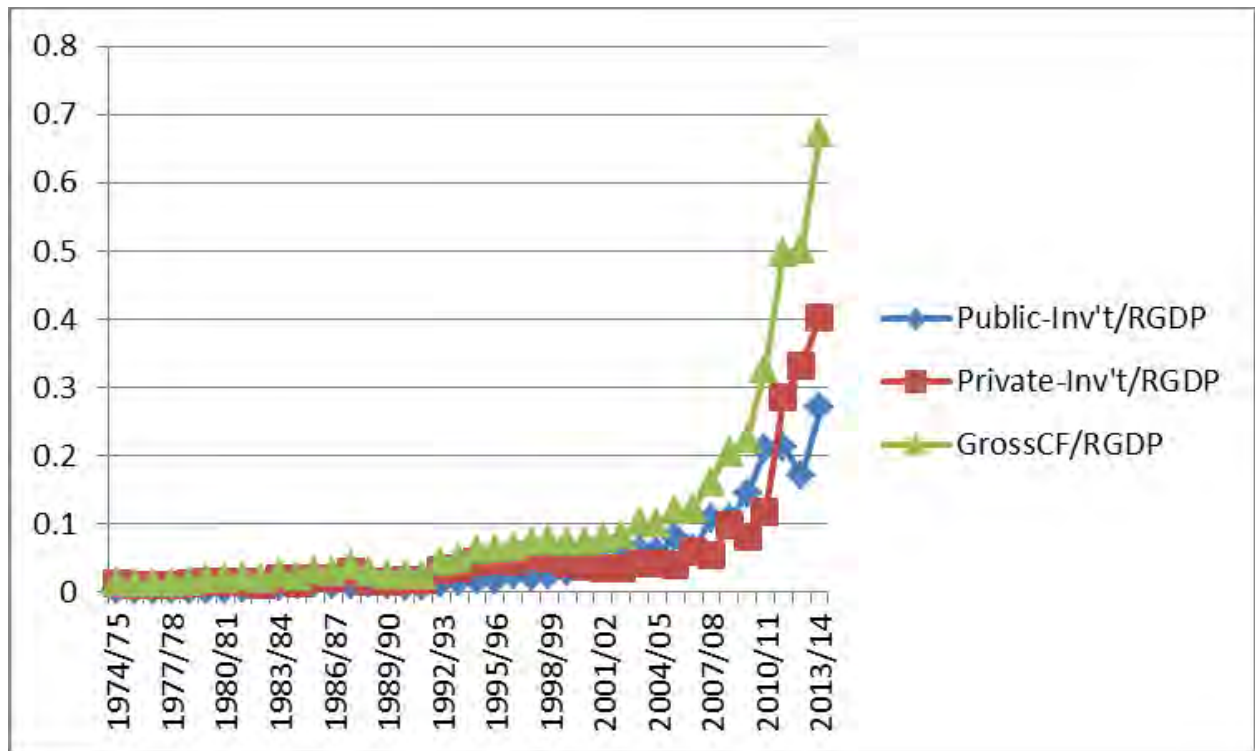


Figure 4.1 Trends of private and public capital formation

Source: own computation using data from MOFED

Three important conclusions emerge from Figure 4.1. Primarily, the pre-reform period exhibited a declining trend in gross capital formation, indicating the worsening state of the economy in the last period of the Derge regime. This downward trend, however, did not improve in the early periods of the TGE until 1992, primarily due to the violent political change. The second conclusion is the rising importance of private investment during the post-Derge period, which was brought about by the liberalization policies pursued by the incumbent with the support of the WB and IMF stabilization policy. The third conclusion is the expansion of public investment from 2001 onward due to the shift in paradigm from a neoliberal paradigm to a pro-poor growth policy and state-led development program, Taddesse (2012).

4.4 Economic Policy and Trends of Economic Growth

4.4.1 The Imperial Regime (1955/56-1973/74)

During the Imperial era, economic and population growth increased at a rate of 4.2% and 2.1% per year, respectively, while the growth in per capita income was 1.8. Over the ten-year period of the imperial regime, from 1962/63 to 1973/74, the average growth rate of the GDP registered by the country was 3.7%. Nonetheless, this figure is comparatively lower than the one envisaged in both the First and Second “Five-Year Development Plan”, which were 4.3% and 6%, respectively. Over these periods, the service sector accounted for 46% of the growth in the real GDP, exceeding that of the agricultural sector, Alemenew (2015).

4.4.2 The Derge Regime (1974/75-1990/91)

The inappropriate economic policy and mismanagement, together with prolonged internal and external social and political unrest (such as the war with Somalia and drought) and high population growth are at least partially responsible for the poor performance of the economy and the erratic nature of growth (whenever it occurs) over this time period.

The period can best be illustrative of acute economic failure. For example, real GDP exhibited growth of 2.7% on average (which is almost 27% lower than the growth in real GDP during the Imperial era), while the population grew at 2.5% per year. The rate of growth of population over the real GDP dropped the per capita real GDP below zero to 0.19, reflecting deterioration in the standard of living compared to the previous regime. Disaggregation of the periods would yield greater insight into the dismal economic performance, as well as the irregular nature of growth. This irregularity of growth is strongly connected to the growth of agriculture, which, in turn, is vulnerable to the vagaries of nature, Alemeyehu (2001).

The more favorable the weather, the greater the growth of agriculture and consequently the greater the growth of the economy (Alemayehu, 2001). For instance, the average growth rate over the period 1974/75–77/78 was 3.9%, while per capita growth was 1.5%. The economy, on average, has increased to 4% growth over the period 1978/79 to 1982/83, a period characterized by relative stability and good weather conditions, while the per capita growth for the same period was 1.3 percent. Other periods ensued, including periods of severe drought (1983/84 and 1984/85) that decelerated growth by 6.9 percent and 8.7 percent, respectively. However, the growth rate increased, showing remarkable recovery from the previous years, and reached 7.8 percent during 1985/86 and 1987/88, only to fall to 1.3% during the next two years (1988 to 1989). The collapse of manufacturing (-8.3%) and construction (-14.7%) that was responsible for the sharp drop in the industry's added value to -8.3% chiefly accounted for the decline in GDP for the year 1982/83.

4.4.3 Post-1991 Period

The post-1991 period witnessed the economy's revival and increasing impetus to reverse the poor performance trend of the economy that characterized the previous regime. Under the auspices of the Breton Woods Institutions (IMF and WB), the new regime embraced structural adjustment policies, and the country witnessed a shift in the economic system, allowing more room for the private sector to play a significant role in the economy. As a result, overall economic performance has shown a relative improvement in spite of fluctuations (due to recurrent drought, population pressure, war, and land degradation) over the period, and the country experienced broad-based growth across sectors, Tadesse (2012).

4.5 Economic Policy and Trends of Foreign Trade

4.5.1 Pre-1991/92

Both the imperial and military government pursued inward-looking development strategies that entailed import substitution as the center of trade policy. However, a comparison of the two regimes reveals that the imperial period's inward-looking strategy is much looser than that of the military régime. Both periods were characterized by the prolonged overvaluation of the domestic currency, high tariff rates, extensive foreign exchange control, non-tariff barriers and heavy taxation on exports. Despite the fact that both regimes pursued an import substitution strategy and exports were considered secondary, the regimes made efforts to promote and diversify the country's exports. During the last years of the imperial regime (1970 to 1973), exports as a share of GDP averaged approximately 8.6 percent, while imports as a share of GDP averaged 8.8 percent. By contrast, the exports and imports as a share of GDP during the Derge regime (1974 to 1990) averaged approximately 11 and 12.7 percent, respectively. The value of goods and services exported and imported increased at an average annual rate of 11.2 and 13.3 percent, respectively, for the period 1970 to 1973 and 7.1 and respectively, for the period 1974 to 1990, Taddesse (2012).

4.5.2 Post-1991 (EPDRF Regime)

Transitional Government of Ethiopia (TGE) adopted a policy of trade liberalization and devised new foreign trade policies. The reforms in trade regime and deregulation were motivated by the belief that free markets facilitate the improvement and expansion of exports, enhance the efficiency and competitiveness of the domestic economy, and result in strong and sustainable growth. To achieve these objectives, such steps as exchange-rate liberalization, simplified licensing and exchange retention procedures, and modified tariff structures, among others, have been taken by the government. As a result of the above reforms, average exports as a share of

GDP between 1991/92-2009/10 reached 11.1, while that of imports reached 23.4 percent. The average values of exports and imports for the same period were 24.2 and 26.9 percent, respectively, which is mainly the result of the outward-looking policy pursued by the current government. In general, the assessment of the trend in external trade over the three regimes indicates that there is a shift in policy perspectives from an inward-looking trade policy to an outward-oriented policy.

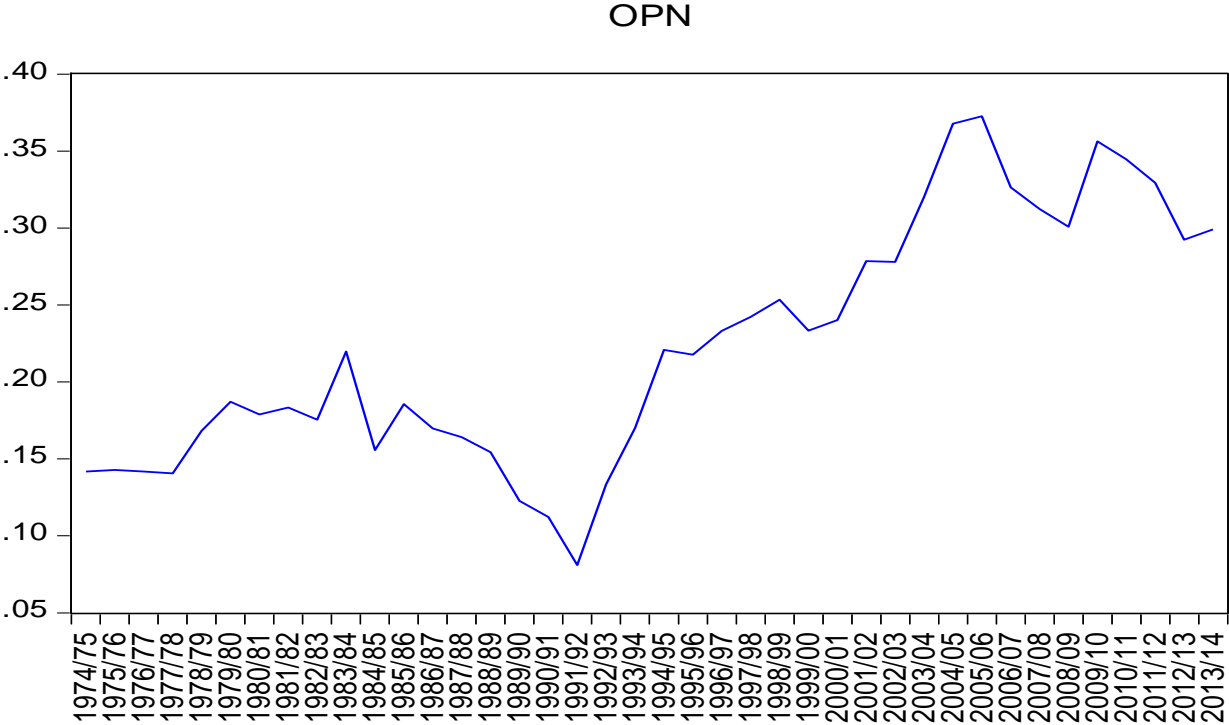


Figure 4.2 Trends of Trade Openness

Source: own computation based on MOFED data

Figure 4.2 shows that trade openness remained stable before mainly due to restrictive trade policy. From the period 1984 to 1991, trade openness continually fell, which can be attributed to recurrent drought and civil war. However, after the reform period (1991/92), trade openness has increased with the exception of the period during 1998, which saw a reduction due to the Ethio-

Eritrean conflict. The sharp increase in openness is due to the policy reform following the stabilization policy of the WB and IMF, as well as the liberalization of the trade regime.

4.6 Policy Environment and Growth Performance in Ethiopia

In 1991, the EPRDF removed the military regime through military action and issued New Economic Policy in November 1991 by openly adopting a market-oriented economic policy. The new regime began to carry out liberalization under the World Bank (WB) and International Monetary Fund (IMF) policy prescriptions in a typical Structural Adjustment Program (SAP) packages. This policy promoted the domestic private sector and opened the door to foreign investors, except in the financial industry (Alemayehu, 2001). The Ethiopian Privatization Agency (EPA) was also established and privatization program started in 1994 so as to give the private sector a room to play a significant role in the country's development than the Derge regime did, Alemayehu (2001)

The core objective of the EPRDF regime is poverty reduction. To accelerate the reduction of poverty in the most effective way, the government chosen growth strategy, named Agricultural Development Led Industrialization (ADLI) (SDPR, 2002). The primary objective of ADLI is to make a strong interdependence between agriculture and industry by increasing farmer's productivity, expanding private commercial farms, and reconstructing the manufacturing sector. ADLI is seen as a long-term strategy to achieve faster growth and economic development by making use of technologies that are labor intensive, but land augmenting, such as fertilizer and improved seeds and other cultural practices, Tadesse (2011).

In the first decade of the EPRDF regime, from the period 1991/92 to 2000/01, the economy bounced back to the good growth track, except the year 1998- primarily due to the severe drought and conflict with Eritrea. In this decade, the real GDP and per capita GDP grew at an

average annual rate of 4.8 percent and 1.9 percent, respectively. The economy would have registered above this growth rate if the country did not have war with Eritrean in 1998, where the real GDP and per capita GDP grew at a rate of 1.4 percent and 4.3 percent below zero, respectively, Tadesse, (2011).

The next two consecutive years (year 2001/02 and 2002/03) again the Ethiopia economy has deteriorated. In the period 2001/02 the real GDP grew at a rate of 1.6 percent, but in the year 2002/03, the real GDP increased at a rate of 2.1 percent below zero. The actual reason for this slothful economic growth is that the economy has been adversely affected by the drought that severely hit Ethiopia in 2001/02 and 2002/03. –The worst since 1984/85. This was accompanied by a sharp decline in agriculture production, Getahun (2004).

From the period 2003/04 to 2009/10, with no doubt, the economic growth was quite impressive. Real GDP and per capita GDP grew nimbly at an average annual rate of 11.3 percent and 8.3 percent respectively for the last seven consecutive years, which is the highest among the non-oil producing economies of Africa. However, following the recovery commencing in 2003/04, growth has been very much sustained and complemented by strong performance in the construction, manufacturing, trade and tourism, banking and insurance, and real estate sectors/sub-sectors. The construction sector has been spurred by the much needed public sector investment in infrastructure (roads, rural infrastructure development including food security, telecom, power, irrigation, etc.) and private sector expansion as well, Alemenew ,(2015).

The Government of Ethiopia_s current five-year development plan (2010/11-2014/15), Growth and Transformation Plan (GTP), is geared towards fostering broad-based development in a sustainable manner to achieve the Millennium Development Goals (MDGs). The GTP envisions

a major leap in terms of not only economic structure and income levels but also the levels of social indicators. During the first year of GTP implementation (2010/11), the country has registered 11.4 percent real GDP growth rate surpassing the GTP target of 11 percent. Particularly, the agriculture and industry sectors have registered growth rates above their targets set for the year. Clearly, more effective implementation of prudent macroeconomic and sectoral policies has contributed to this faster and broad-based growth (MOFED, 2012).

During the second year (2011/12) of GTP implementation, real GDP grew by 8.8 percent. In 2012/13, the GDP grew by 9.7 percent in real terms. Though the 9.7 percent growth performance registered in 2012/13 is below the 11.3 percent target set for the fiscal year under review, it was achieved under difficult domestic and global environment. Furthermore, the 2012/13 low real GDP growth was achieved due to the fall in prices of Ethiopia's major export commodities such coffee and gold while prices of its major import items such as fuel continued to be high. On the other hand, the 2012/13 economic growth was high compared to the sub-Saharan average performance of around 5 percent. The performance was also above the 7 percent growth requirement set to achieve the Millennium Development Goals (MDGs). In general, Ethiopia's economic performance in 2012/13 was widely regarded as one of the fastest growth rates in the world by different international financial institutions (MOFED, 2014). Moreover, the country's Real GDP expanded by 10.3 percent in 2013/14, IMF(2014).

CHAPTER FIVE

EMPIRICAL ANALYSIS AND FINDINGS

5.1 Time series property of the data

5.1.1 Stationarity Tests

The first important step in the estimation of vector auto regression model is to test the stationarity of variables. Non-Stationarity of time series data has often been regarded as a problem in empirical analysis. Therefore working with non-stationary variables lead to spurious regression results, from which further inference is meaningless (misleading regression). A unit root test is a common practice and a first step that are to be undertaken in macro-level data analysis to address the non-stationarity problem of variables. The test examines whether the data series is stationary or not.

In order to obtain a consistent and reliable result, we must transform the non-stationary data into stationary data by differencing if the test happens to reveal the non-stationarity of variables. In contrast to the non-stationary process that has a variable variance and a mean that does not remain near, or returns to a long-run mean over time, the stationary process reverts around a constant long-term mean and has a constant variance independent of time. All the variables are stationary after first differencing and indicating that the variables are $I(1)$ at 5 % significance level .The tests of stationarity based on augmented ducky fuller test and Phillips person test have been conducted and presented as below. Both tests revealed the same conclusion about the variables. All the variables are stationary at first differencing at 5 % significant level using ADF test at intercept and trend and for PP also at intercept and none. Both augmented dickey fuller and Phillips Pearson test suggest the entire variable as cointegarted of order (1) at intercpt and trend and at interecpt and none for ADF and PP test respectively .

Table 5.1.1 ADF Test for Stationarity

| Variables | ADF test | | | Order of Intigrat. |
|-----------|----------------|-------------------|------------|--------------------|
| | With Intercept | Intercept & trend | None | |
| lnRPRI | 0.627953 | -2.468750 | 2.645970 | |
| D(lnRPRI) | -4.470996* | -4.550032* | -3.958479* | I(1) |
| lnRGDP | 4.306919 | 1.028333 | 5.368499 | |
| D(lnRGP) | -1.967908 | -6.545504* | 0.3907 | I(1) |
| lnOPN | -1.34601 | -2.104574 | -1.052708 | |
| D(lnOPN) | -6.404535* | -6.316295* | -6.388806* | I(1) |
| lnRPII | 0.761459 | -2.023578 | 5.054065 | |
| D(lnRPII) | -4.531162* | -4.578452* | -3.214647 | I(1) |
| Ln(RSII) | 1.339825 | -1.619488 | 5.368263 | |
| D(lnRSII) | -4.779982* | -5.046573* | -3.309905* | I(1) |
| ln(CPI) | 0.476286 | -1.439497 | 5.57718 | |
| D(lnCPI) | -4.202155* | -2.259797* | -1.276625* | I(1) |
| lnRDBC | -2.056454 | -4.030074 | 2.886821 | |
| D(lnRDBC) | -7.386843* | -7.205590* | -6.084147* | I(1) |
| lnRGDS | -0.085447 | -3.328826 | 1.091212 | |
| D(lnRGDS) | -8.504979* | -8.744557* | -8.410212* | I(1) |

Table 5.1.2 Phillips Pearson Test for Stationarty

| Variables | Phillips Pearson Test for Stationarty | | | Order of Intigrat. |
|------------|---------------------------------------|------------------|------------|--------------------|
| | Intercept | Trend& intercept | None | |
| lnRGDP | 4.528201 | -0.231176 | 4.420046 | |
| D(lngdp) | -4.604471* | -5.828687* | -3.324962* | I(1) |
| lnrpri | 0.277565 | -1.928220 | 4.420046 | |
| D(lnrpri) | -4.466503* | -4.5521118 | -4.031302* | I(1) |
| lnrprii | 0.548370 | -1.879821 | 4.136275 | |
| D(lnprij) | -4.508626* | -4.5774328 | -3.187303* | I(1) |
| lnrgds | -0.570479 | -3.294569 | 0.725006 | |
| D(lngds) | -8.727787* | -9.937306* | -8.482322* | I(1) |
| lnrgdbc | 0.303038 | -2.712711 | 2.695243 | |
| D(lnrgdbc) | -6.966624* | -6.815196* | -5.914435* | I(1) |
| lnpci | 0.103618 | -1.494792 | 4.065115 | |
| D(lnpci) | -4.183113* | -4.173716* | -2.858963* | I(1) |
| lnopn | -1.379681 | -2.141405 | 4.065115 | |
| D(lnopn) | -6.384704* | -6.319519* | -6.384704* | I(1) |

Note: D shows the variable is differenced once. In addition * shows rejection of null hypothesis at 5 %.(Source: Own computation using Eviews.

The ADF test shows the stationary of the all variable at with intercept and trend where as PP test revealed the stationarity at intercept and none and thus indicating as Coin grated of order I (1).

5.2 Estimation of VAR Model

5.2.1 Lag Length Selection Criteria

Deciding on the optimal lag length is the most necessary step to generate the white noise error terms. Optimal lag length selection can be done by using different information criteria to select the number of parameters that minimize the value of the information. The model having the low value of given information criteria can be considered as best as compared to the model with the largest value of the information criteria. Alemayehuet'al (2012) also states that the first step in estimating a VAR model is to determine the optimal lag length of the VAR¹³.

This is important because the Johansen co-integration test results could be highly sensitive to the number of lags included for the endogenous variables in the estimation of the VAR, Tadesse (2012) which necessitates the determination of an optimal lag order prior to the test of co-integration. The optimal lag order determined by using sequential modified Likelihood Ratio test statistics [LR], final prediction error (FPE), Akaike Information Criterion [AIC], Schwarz Information Criterion (SIC) and Hannan –Quinn information criteria (HQ).

According to Baum, (2013) introducing too many lags wastes degrees of freedom, while too few lags leave the equations potentially mis-specified and are likely to cause autocorrelation in the residuals.

¹³ VAR model require the stationarity of the variable .

As shown in Table 5.2.1, the optimal lag length selected is two based on the result of various information criteria such as FPE, HQ, and AIC results suggestion. Here the rationale for choosing this lag length is that most of the information criteria verified the lag number two as optimal lag length for this analysis.

Table 5.2.1 Optimal Lag Order Selection Criteria

| VAR Lag Order Selection Criteria | | | | | | |
|----------------------------------|----------|-----------|-----------|------------|------------|------------|
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | 43.69791 | NA | 2.11e-11 | -1.878837 | -1.534082 | -1.756176 |
| 1 | 377.9636 | 510.1951 | 1.51e-17 | -16.10335 | -13.00056* | -14.99940* |
| 2 | 459.1387 | 89.71980* | 9.78e-18* | -17.00730* | -11.14647 | -14.92206 |

Source: own computation using Eviews

As it can be seen from Table 5.2,1 three tests of information criteria out of six confirmed lag number two as optimal for each variable of interest. Since the lowest the value of the information criteria, it became the better. Thus the likelihood ratio, final prediction error and Akaike Information criteria.

5.2.2 Lag Exclusion Test

A number of the lags (of some endogenous variables) that are chosen as optimal may have insignificant contributions to movement's independent variable, individually as well as jointly. Therefore, whether the first and second lags (chosen as optimal) of all variables are individually and jointly important and should be included in the testing for co-integration and estimation of the VECM should be evaluated. This approach was taken with the Wald form of the lag-exclusion test (which is asymptotically chi-square distributed).

Table 5.2.2 shows that the chosen lags of all of the endogenous variables are significant both individually and jointly. This suggests that the use of the second lags of the variables means the model is valid and robust.

Table 5.2 .2 VAR lag exclusion Wald Test

| VAR lag exclusion Wald Test | | | | | | | | | |
|------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| DLag | D(RPRI) | D(OPN) | D(RDBC) | D(RGDP) | D(RGDS) | D(RPII) | D(RSII) | D(CPI) | Joint |
| 1 | 36.30347 | 6.719809 | 23.70223 | 25.30876 | 53.30955 | 6.921548 | 12.26590 | 12.65431 | 412.5047 |
| | [1.55e-05] | [0.567143] | [0.002570] | [0.001378] | [9.39e-09] | [0.545120] | [0.139728] | [0.124310] | [0.000000] |
| DLag | 13.97098 | 10.12937 | 8.335708 | 7.192209 | 36.21527 | 4.704729 | 6.255167 | 10.90508 | 342.0487 |
| 2 | [0.082525] | [0.256063] | [0.401383] | [0.516044] | [1.60e-05] | [0.788618] | [0.618673] | [0.207136] | [0.000000] |
| df | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 64 |

Numbers within bracket [] represent p – value of respective variable and number outside the bracket represents the value of the first and second lags of the variable.

Source: Own computation based on Eviews.

5.2.3 Granger Causality¹⁴ / Block Exogeneity Test

In addition to the lag-exclusion test, the Granger causality test was performed to examine the presence of bidirectional causality as described in the table. As the table 5.2 3. Below indicate that real gross domestic product and real private investment granger cause inflation as measured by consumer price index. Real gross domestic saving granger causes real private investment and real social infrastructure investment. This finding implies that the lagged values of the variables have statistically significant roles in explaining the current and future values of some other variables, and this effect occurs in one direction in some of the cases such as for instance real

¹⁴ Granger causality test were undertaken on unrestricted VAR model.

gross domestic product and inflation. This, in turn confirms the legitimacy of using the VAR model and the Johansen Procedure, as opposed to the single-equation approach of Engel and Granger.

Table 5.2.3 Granger Causality/ Block Exogeneity Test

| Equation | RPRI | RPII | RGDP | RGDS | RDBC | RSII | CPI | OPN |
|----------|---------------------|---------------------|----------------------|----------------------|---------------------|-----------------------|----------------------|----------------------|
| RPRI | | 0.03455 (0.9829) | 5.721788 (0.0572) | 0.343943 (0.8420) | 1.13460 (0.5670) | 1.6206242 (0.4447) | 11.78036 (0.0028) | 0.561294 (0.7553) |
| RPII | 2.09130 (0.3514) | | 1.566656 (0.4569) | 0.252895 (0.8812) | 0.53826 (0.7640) | 1.808910 (0.4048) | 1.322998 (0.5161) | 0.267961 (0.8746) |
| RGDP | 5.97377 (0.0504) | 2.12608 (0.3454) | | 0.872481 (0.6465) | 0.17963 (0.9141) | 4.001757 (0.1357) | 8.857751 (0.0119) | 0.395086 (0.8207) |
| RGDS | 26.1721 (0.0000) | 2.82711 (0.2432) | 3.622847 (0.1634) | | 1.41766 (0.4922) | 10.65539 (0.00049) | 0.564225 (0.7542) | 4.584807 (0.1010) |
| RDBC | 0.04449 (0.5720) | 0.07121 (0.9650) | 0.958721 (0.6192) | 2.357366 (0.3077) | | 0.493092 (0.7815) | 2.184866 (0.3354) | 5.943158 (0.0512) |
| RSII | 1.46375 (0.4810) | 1.74389 (0.4182) | 2.350780 (0.3087) | 0.951550 (0.6214) | 2.07740 (0.3539) | | 3.403592 (0.1824) | 1.531191 (0.4651) |
| CPI | 2.70822 (0.2582) | 0.39903 (0.8191) | 5.369612 (0.0682) | 0.077055 (0.9622) | 0.85067 (0.6536) | 0.567771 (0.75290) | | 0.376653 (0.8283) |
| OPN | 1.95137 (0.3769) | 0.90520 (0.6360) | 0.675055 (0.7135) | 5.206290 (0.0740) | 1.04761 (0.5923) | 1.920169 (0.38290) | 0.772084 (0.6497) | |

Number in the parenthesis refers to the p- value of the respective

Source: Own computation using eviews

As it can be inferred from the table 5.2.3 above the variables when the p- value of the variable is significant at 5% and 10 % we can decide it as significant implying that there is causation among variable. Since the p- value of the real private investment is less than 10 % (0.0572) it is significant and implies that real private investment cause real gross domestic product . Moreover the p –value of the real private investment is less than 5% (0.0028) it implies that inflation cause

variation in the level of real private investment. The p –value of the real economic growth is less than 10 % (0.0504) implies that it is significant meaning it cause the real private investment .Thus there is bi - directional causality between real private investment and economic growth . The p value of the real gross domestic product is significant at 5 %(0.0119) thus implies that economic growth cause inflation. The value of the p- value of real gross domestic saving is significant at 5% (0.0000) implies that saving promote real private investment. The p- value of real gross domestic saving is significant at 5% implies that saving cause the raise in real social infrastructure investment. The p- value of the real gross domestic credit is significant at 10 % (0.0572) implies that domestic bank credit cause trade openness. The p- value of inflation is significant at 10 % (0.0682) implies that inflation can cause economic growth. Thus we can say that there is bi directional causality between inflation and economic growth. The p –values of trade openness is significant at 10 % (0.0740) implies that it cause real gross domestic saving. From the results of granger causality we can conclude that real private investment is endogenous variable.

5.3 Johnson co integration test

The ADF and Philips-Perron stationarity test results demonstrate that all of the variables are stationary at first difference, and this result can be further strengthened by the Johansen Co-integration test. Thus, the presence and the number of such co-integrating relationships are evaluated with the trace and the maximum Eigen value. It may also be possible to use the Engle-Granger two-step procedure to test for co integration. However, the Engle-Granger method tests the presence of only one co-integrating relationship and does not reveal whether there may be

other such relationships (more than one co integrated equation).The results from the Johansen method of co integration rank test may also be sensitive to the deterministic trend assumption (in addition to the number of lags of the endogenous variables) in the underlying VAR structure. Because the results may vary with the alternatives, a decision must be made as to which one to choose for the purpose of further analysis, Taddesse(2011).

Table 5.3.1 Johnson co integration test using Trace and maximal Eigen valueTrace Static Test

| Null hypothesis | Alternative hypothesis | Eigen value | Trace static | 0.05 critical value | Prob** |
|-----------------|------------------------|-------------|--------------|---------------------|--------|
| $H_0: r \leq 0$ | $H_A: r > 0$ | 0.925720 | 328.0036* | 52.36261 | 0.0000 |
| $H_0: r \leq 1$ | $H_A: r > 1$ | 0.862107 | 231.8069* | 46.23142 | 0.0000 |
| $H_0: r \leq 2$ | $H_A: r > 2$ | 0.710622 | 158.4997* | 40.07757 | 0.0000 |
| $H_0: r \leq 3$ | $H_A: r > 3$ | 0.675383 | 112.6189* | 33.87687 | 0.0000 |
| $H_0: r \leq 4$ | $H_A: r > 4$ | 0.565559 | 70.98987* | 27.58434 | 0.0001 |
| $H_0: r \leq 5$ | $H_A: r > 5$ | 0.473969 | 40.14317* | 21.13162 | 0.0023 |
| $H_0: r \leq 6$ | $H_A: r > 6$ | 0.292468 | 16.73452* | 14.26460 | 0.0368 |
| $H_0: r \leq 7$ | $H_A: r > 7$ | 0.092064 | 3.573521 | 3.841466 | 0.0587 |

Maximal Eigen static test

| Null hypothesis | Alternative hypothesis | Eigen value | Max-Eigen static | 0.05 critical value | Prob** |
|-----------------|------------------------|-------------|------------------|---------------------|--------|
| $H_0: r=0$ | $H_A: r=1$ | 0.925720 | 96.19677* | 52.36261 | 0.0000 |
| $H_0: r=1$ | $H_A: r=2$ | 0.862107 | 73.30721* | 46.23142 | 0.0000 |
| $H_0: r=2$ | $H_A: r=3$ | 0.710622 | 45.88074* | 40.07757 | 0.0100 |
| $H_0: r=3$ | $H_A: r=4$ | 0.675383 | 41.62904* | 33.87687 | 0.0049 |
| $H_0: r=4$ | $H_A: r=5$ | 0.565559 | 30.84670* | 27.58434 | 0.0184 |
| $H_0: r=5$ | $H_A: r=6$ | 0.473969 | 23.76865* | 21.13162 | 0.0208 |
| $H_0: r=6$ | $H_A: r=7$ | 0.292468 | 12.80100 | 14.26460 | 0.0840 |

| | | | | | |
|--------|--------|----------|----------|----------|--------|
| H0:r=7 | HA:r=8 | 0.092064 | 3.573521 | 3.841466 | 0.0587 |
|--------|--------|----------|----------|----------|--------|

Source: own computation using eviews. The co integrating equations are significant at 5%

The trace statics indicate that the existence of seven co integrating relationships and whereas the maximal Eigen value test indicates the existence of six co integrating relationships. This result is an indication of the existance of significant long- run relationship between the real private investment with real physical infrastructure investment, real gross domestic product, gross domestic saving, trade openness and real social infrastructure investment and consumer price index. The existence of more co integrating vector indicate the more the stable the model is.

5.4 Vector Error Correction Model

VECM captures both the long run and the short run dynamics relationship. While the change in the given variable from its short run effect represents a variation in the short run, the coefficient of the error correction term captures the speed of adjustment towards the long-run relationship of variables, Tadesse (2011)

5.4.1 Long Run dynamics of real private investment

As discussed in the co integration test, the Johansen trace and maximal statistics indicated that there are cointegrating vectors. Since the objective of this section is examining the impact of real public investment, real gross domestic credit, real gross domestic saving, trade openness, real effective exchange rate and economic growth on the real private investment long run equilibrium relation should be estimated.

Table 5.4.1: Long run relationship when real private investment is a dependent variable

| Variable | Coefficient | t-statics |
|----------|-------------|------------|
| LRPII | 2.004179 * | [1.765449] |
| LOPN | 0.126432* | [-2.55123] |

| | | |
|--------|------------|------------|
| LRGDS | 0.058905 | [-1.82323] |
| LRGDBC | 0.069881* | [-2.15562] |
| LRGDP | -1.455331* | [14.2198] |
| LRSII | 0.420696* | [-6.76843] |
| LCPI | 0.372054* | [-11.1179] |
| C | 20.78778 | |

Parenthesis refers to t-statics and * refers to significance at 5%

Source: own computation based on Eviews

The result of the single long-run relationship after estimating the unrestricted co integrating vector with ad-hoc normalization on LRPIV is (with t-value in parenthesis)

$$\mathbf{LRPRI = 20.78778 + 2.004179LRPII + 0.126432LOPN + 0.058905LGRDS - 1.455331LRGDP + 0.420696LRSII + 0.372054LCPI}$$

After following the Johnson normalization procedure, the estimated coefficient of the long run relationship for each determinant are explained as follows.

The long-run impact of real physical infrastructure investment on real private investment is found to be positive and statically significant at 5% .The value of real physical infrastructure investment indicate thatit has crowding in effect in the long run on the real private investment and thus, have complementary than competitive role. This finding asserts that public investment in the form of physical infrastructures such as power sector, communication sector, airport activities, and electricity has a positive and significant impact on the growth of private investment in Ethiopia. For 1 percentage increase in real physical infrastructure investment will lead to 2.004 percentage increases in the real private investment in the long run.

The long-run impact of real social infrastructure investment on real private investment is found to be positive and statically significant at 5% .The value of real social infrastructure investment

indicate that it has crowding in effect in the long run on the real private investment and thus have complementary than crowding out effect. This finding asserts that public investment in the form of social infrastructures such as education and health sector has a positive and significant impact on the growth of private investment in Ethiopia. For 1 percentage increase in real social infrastructure investment will lead to 0.4206 percentage increases in the real private investment in the long run. This finding confirms the hypothesized argument about the positive effect of real social infrastructure on the real private investment.

The long-run impact of economic growth (real GDP) on private investment is found to be positive and statistically significant at 5% which means that a 1-percentage-point increase in real economic growth (real GDP) increase private investment by 0.73 percentage points in the short run. Theoretically, the result can be supported by accelerator model which assumes that investment as a linear proportion of changes in output. However the finding of Adugna (2013) , Augustine (2014) , Hailu and Debele (2015) , Jalloh (2002) , Kaputo (2011) and Quattra (2004) about the positive and significant impact of real gross domestic product (economic growth) in the growth of real private investment in the long run .Economic growth can serve as source of increase in aggregate and effective demand thus motivate firms to invest more due to higher sales volume and profitability .The result supports the hypothesis of the study .

The long run impacts of real gross domestic credit on the growth of real private investment is positive and significant implies that for 1 percentage increase in real domestic bank credit to the private investor will raise real private investment by 0.0698 percentage which implies that credit has a positive and significant 5% level. This finding is consistent with the finding of Kaputo (2011), Ogunbayo (2014), Mbaye (2014) and Ouattara (2004) which revealed the significant and

positive impact of real gross domestic credit to promote the growth of real private investment in the long run. moreover the result supports the hypothesized sign.

The long-run impact of trade openness on private investment is found to be positive and statistically significant, which means that a 1-percentage-point increase in trade openness increases private investment by 0.1264 percentage points in the long run. This finding is in line with the sound theoretical argument that trade openness promotes the growth of private investment by enhancing the efficiency of investments (either through the capacity to more fully employ an investment or by enriching the competitiveness of the market place), restraints on the potential capacity of an economy are relaxed so as to diversify export capacity and promote international competition by fostering competition in the market for inputs (both in acquiring low-cost or more appropriate inputs from a broader market and by permitting international competition for the most efficient or most appropriate form of domestic governance structures), investments are freed to realize their greatest potential. This result is consistent with studies Sisay (2010), Tadesse (2011) and Aysan et al. (2006) in which it was found that trade openness affects private investment positively. This finding indicates that international integration is a beneficial strategy for growth in the long-term. According to the World Bank (1993), the positive contribution of trade openness to growth stemmed from the notion that liberalization increases specialization and the division of labor, thus improving productivity and export capability, as well as economic performance. According to the World Bank (1993), the economies of countries with greater relative trade openness outperformed those of less-opened countries. In addition, studies by Lloyd and MacLaren (2000) and Jonson and Subramanian (2001) on Asian countries support a similar opinion that the rapid growth of Asian countries was largely caused by the openness of their economy. This result is also consistent with the finding of Ouattrra (2004) and

Narr- Idar et al (2012) which revealed the significant long- run impact of trade openness on the growth of real private investment. Moreover the result supports the hypothesis of the study.

The long run impact of inflation as measured by consumer price index has a positive and significant impact on the real private investment. A 1 percentage change in the inflation as measured by consumer price index will lead to 0.372 percentage change in the real private investment. This result is against the negative role of inflation in promoting private investment in the economy. However the existence of severe inflation leads to the instability of macroeconomic environment and thus reduces motivation to invest and leads to uncertainty in the investment decision by the firms. The findings of Getechew, (1997), Adugna (2013) and Alamenew (2015), Worke (2013) and Zerfu (2013) asserts the negative role of inflation n the private investment fortune. However this result is in contradiction with the hypothesized sign of the variable.

5.4.2 Short-run dynamics of real private investment model

Once the existence of long-run relationship was checked and the appropriate parameters are determined, the next step is estimating the coefficients of the short- term dynamics of the private investment model. In order to capture the short-run dynamics of the model, error correction mechanism was applied. The estimated VECM provides the correction terms that reflect influences of deviation of the relationship among the variables from long-run equilibrium and short-run parameters. In this study, we have one error correction terms in the real private investment model due to the existence of co integrating vectors in the Johansen co- integration test and the interrelationship of the variables in the VECM.

The coefficients of ECM1 (-1) showed the speed of adjustment of disequilibrium in the period of study. This implied that all the eight variables are adjusted to the one error correction terms in the VECM.

Table 5.4.2 shows the results of the D (RPRI) equation in the error-correction model, from which the short-run influence of real gross domestic product, real physical infrastructure investment, real social infrastructure investment, inflation, real gross domestic saving, real gross domestic credit, and trade openness on real private investment is estimated.

The coefficients of the two periods lagged differences in the table can be interpreted as the short-run parameters representing the short-run impact of the explanatory variable upon the dependent variable real gross domestic private investment

Table 5.4.2: Short run coefficient when dependent variable is RPRI

| Variable | Coefficient | t-static |
|--------------|-------------|-------------|
| ECM1(-1) | -0.534885* | [-2.05316]* |
| D(RSII) (-1) | 0.420696* | [-6.76843]* |
| D(RSII) (-2) | -0.234521 | [-0.743330] |
| D(RPII) (-2) | 2.004179 * | [1.765449] |
| D(RPII)(-2) | -0.014716 | [-0.053153] |
| D(OPN(-1) | 0.126432* | [-2.55123]* |
| D(OPN(-2) | 0.082461 | [0.696728] |
| D(CPI(-1) | 0.372054* | [-11.1179]* |
| D(CPI(-2) | 0.036115 | [0.144992] |
| D(RGDS(-1) | 0.058905 | [-1.82323] |
| D(RGDS(-2) | 0.629369 | [0.577471] |
| D(RDBC(-1) | 0.069881* | [-2.15562]* |
| D(RDBC(-2) | 0.027364 | [0.492313] |

| | | | |
|----------------------------|----------------------|--------------------------|--------------------------|
| D(RGDP(-1)) | -1.455331* | [14.2198]* | |
| D(RGDP(-2)) | 0.730958 | [-2.327194]* | |
| R-squared (R^2) | 0.750125 | Mean dependent variable | 0.045257 |
| Adjusted R-squared | 0.526553 | S.D. dependent variable | 0.104339 |
| S.E. of regression | 0.071793 | Akaike info criterion | -2.123557 |
| Sum squared residual | 0.097931 | Schwarz criterion | -1.339867 |
| Log likelihood | 57.28581 | Hannan-Quinn | -1.847270 |
| F-statistic | 3.355183 | Durbin-Watson stat | 2.063517 |
| Prob (F-statistic) | 0.006339 | | |
| Serial correlation LM test | Prob.F(2,17)= 0.3718 | Heteroskedasticity Test: | Prob.F(24,12)=0.937 5 |

* refers to significance at 5 % and

Source: own computation using Eviews

The coefficient of the error correcting term of the real private investment has the expected negative sign and magnitude implying it is error correcting. The result indicates that 53 % of adjustment will take place at each period to the long-run equilibrium, which requires a period of 1.5 years to have full adjustment towards long-run equilibrium. The error correction term is also significant at 10 % level.

The short-run coefficient of the real gross domestic product is positive and significant at 5% implying that economic growth has the significant role in promoting real private investment in the short run in Ethiopia. For 1 percentage increase in economic growth, real private investment will raise by 0.739 percentage in the short run .Finally, the short-run coefficient of real gross domestic credit has positive sign implies that real domestic bank credit has the positive effect

and insignificant on the real private investment in the short run in Ethiopia .via reducing the shortage of working capital to the private investor.

The coefficient of determination (R-squared) is high explaining that about 75.125 % of variation in the real private investment is attributed to variations in the explanatory variables in the model. In addition, the DW statistic does not suggest autocorrelation and the F-statistic is quite robust

The value of the overall significance test of the model is significant since the p-value of F-statics is less than 5 % i.e. $0.006339 < 0.05$

In the study, different post-estimation diagnostic tests were performed to guarantee that the residuals from the model are Gaussian that the assumptions are not violated and the estimation results and inferences are trustworthy. The diagnostic test results could also be used as indicators of the validity of employing impulse-response functions and variance decomposition analyses.

In order to make the results of VECM acceptable and ensure that the models satisfy stability conditions, the autocorrelation and heteroscedasticity tests on the disturbance term (error term) show no evidence of autocorrelation and heteroscedasticity.

5.5.1 Residual vector normality test

Normality is checked mainly by using the Jarque-Bera test. The result shows that the residual vector of the model is found to be individually and jointly normal. This may suggest that the results from this regression have strong power. The null hypothesis for normality of the residual states that the residual of the model is normally distributed and the alternative hypothesis is the residual is not normally distributed.

Table 5.5.1 Residual Normality Test

Residual Normality Test

| Component | Jarque-Bera | df | Prob. |
|-----------|-------------|----|--------|
| 1 | 2.112582 | 2 | 0.3477 |
| 2 | 0.159925 | 2 | 0.9232 |
| 3 | 1.122516 | 2 | 0.5705 |
| 4 | 0.327649 | 2 | 0.8489 |
| 5 | 0.974533 | 2 | 0.6143 |
| 6 | 1.095272 | 2 | 0.5783 |
| 7 | 0.420914 | 2 | 0.8102 |
| Joint | 6.213390 | 14 | 0.9608 |

Source: own computation based on eviews the p-value became significant at 10 %

Since the p- value of residual is significant both individually and jointly at 10 % there is no reason to reject the null hypothesis that means it is normal. As the result of the Jarque- Bera test statics indicate that there is no reason to reject the null hypothesis which says that the residuals are normally distributed for the reason that the p-value associated with the Jarque –Bera normality test is larger than the standard significance level i.e. $0.9608 > 0.05$.

5.5.2 Model Stability Test

The stability of the VECM model and the results of the post-estimation diagnostics could affect the validity and robustness of the results of the impulse response functions and other diagnostics and thus model stability should be tested prior to further analysis. The companion matrix showing the roots of the characteristic polynomial and the corresponding modulus presented below. Hence, the results suggest that the VECM model satisfies the stability condition. Since all the value of the roots of characteristic polynomial lie inside the unit circle and the characteristic root for entire model is less than one, it confirmed the stability of the model.

Inverse Roots of AR Characteristic Polynomial

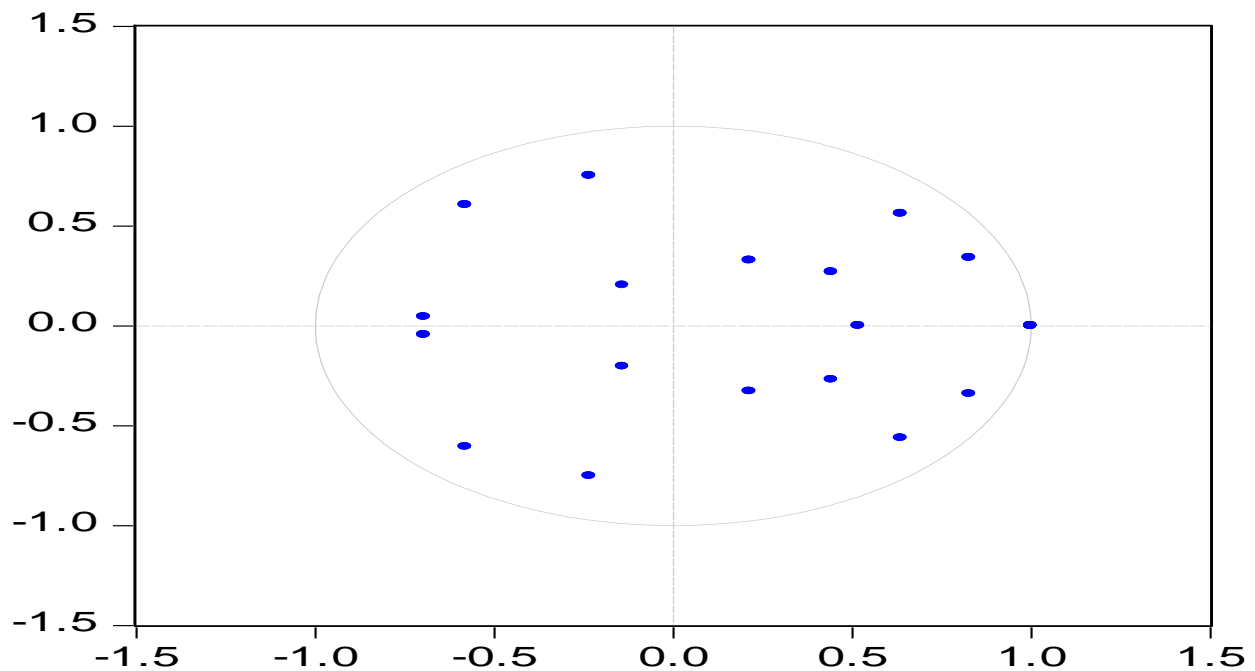


Figure 5.5.2 Inverse Roots of Characteristic Polynomial

Source: own computation using Eviews

5.5.3 Residual Vector Serial Correlation LM Test

Table 5.5.3 shows that there is no evidence that reveals the presence of autocorrelation from the first through the second lags. The large p-values imply that the chi-squared statistics at all lags are not large enough to help reject the null of no autocorrelation at any of the usual critical values. Thus, the study could not find any evidence of autocorrelation problem in the residual since the p-value of the residual is greater than 0.05 i.e. $(0.3718 > 0.05)$

Table 5.5.3: Test for Auto-Correlation

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---------------|----------|---------------------|--------|
| F-statistic | 1.049379 | Prob. F(2,17) | 0.3718 |
| Obs*R-squared | 4.065921 | Prob. Chi-Square(2) | 0.1309 |

Source: own computation using Eviews software.

5.5.4 Residual Heteroskedasticity Test

The test for residual heteroskedasticity involves testing whether the residual variance is homoscedastic or not according to the result of the test statistics there is no enough evidence to help reject the null of no heteroskedasticity. Since the p-value of the residual is greater than the 5% ($0.9375 > 0.05$) we accept the null hypothesis which state the homoscedasticity, Therefore, the residuals of the model are found to be homoscedastic. This, together with the results of the other pre and post estimation diagnostic tests, suggests the validity and robustness of the estimated results.

Table 5.5.4 Test for Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey

| | | | |
|---------------------|----------|----------------------|--------|
| F-statistic | 0.483159 | Prob. F(24,12) | 0.9375 |
| Obs*R-squared | 18.18310 | Prob. Chi-Square(24) | 0.7940 |
| Scaled explained SS | 5.533718 | Prob. Chi-Square(24) | 1.0000 |

Source: own computation using Eviews software.

As the above table indicate that the p-value of the residual is greater than 5 % implies the residual of the model is homoscedastic. Since the p-value associated with the test statistics is greater than the significance level i.e. $0.7940 > 0.05$.

5.5.6 Structural Break test

As can be seen from appendix (5) the structural break test indicates that only inflation has break in 1991 implying the unsmooth path of macroeconomic instability measured by inflation. Moreover the policy change brought significant change on openness, economic growth, investment in social and physical infrastructure, saving and credit to the private investor. The result of structural break confirms the severity of macroeconomic instability post adoption of reform in 1991.

5.6 Impulse Response and Variance Decomposition

5.6.1 Impulse Response

Impulse response functions could tell us how the dependent variable at any point in time may respond to a one standard deviation innovation (impulse) generated from shocks of any of the variables earlier times and how that effect may be multiplied (lasts for long or is transitory), Tadesse (2012).

Impulse response function represents the time profile of the effect of a shock to one variable on the future values of all endogenous variables. Thus, in this study, to track the time path of real private investment to shock from real physical and social infrastructure investment, real gross domestic product, real gross domestic saving, real gross domestic credit, trade openness and inflation the response function was employed

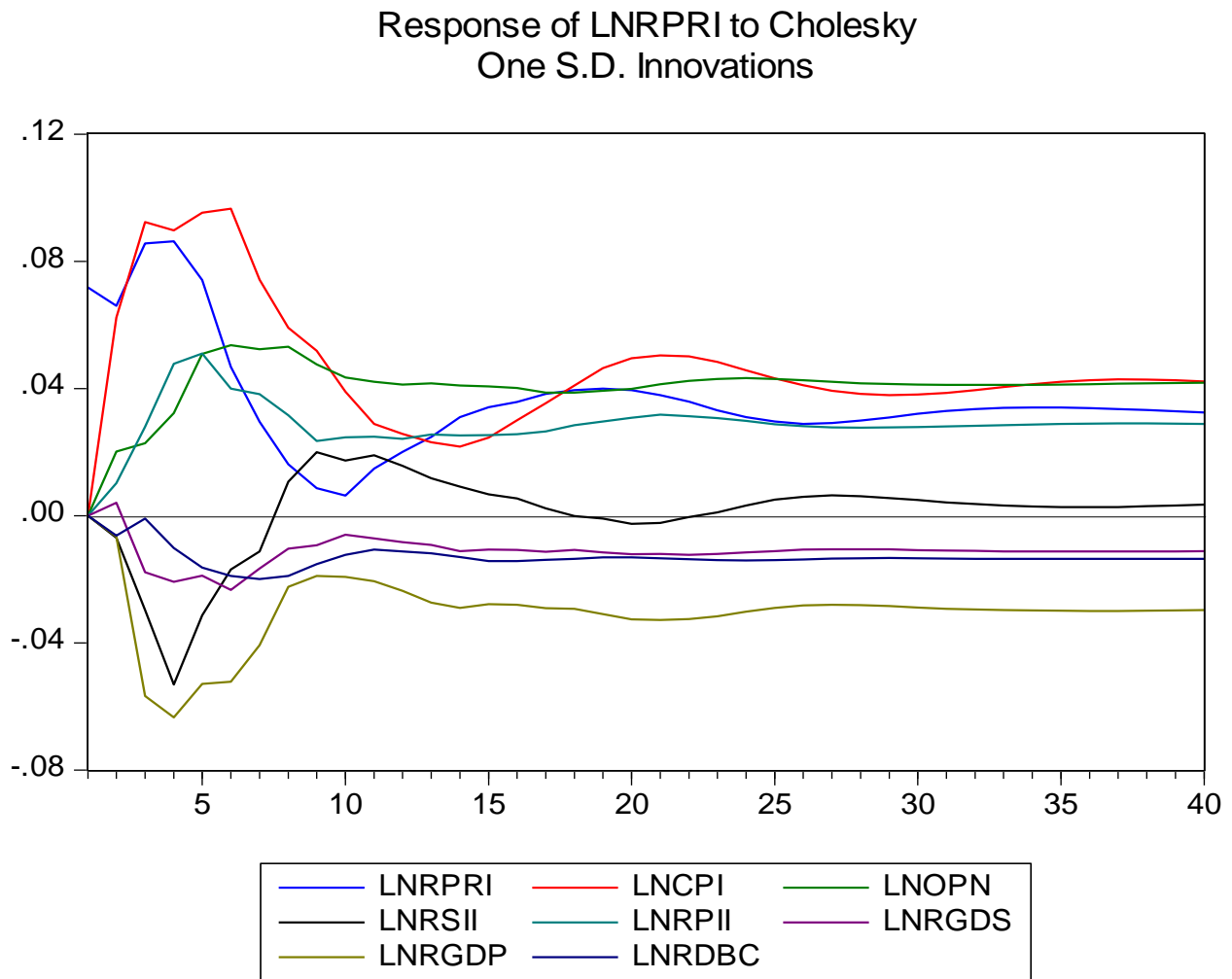


Figure 5.6.1 Impulse Responses of Real Private Investment to the shocks from the explanatory variable.

Source: own computation using Eviews software

This function can produce the time path of dependent variable (LRPRI), in the system of the equation developed within the VECM framework to shocks from the entire explanatory variable.

As it can be seen from figure 5.6.1 the shocks occurred in real gross domestic product will have permanent impact in the real private investment throughout the period. However shocks resulted from real gross domestic product and real gross domestic will have impact after 15 periods on the real private investment. The responses of real private investment from shocks resulted from real gross domestic product and inflation has permanent effect where as shocks resulted from real gross domestic saving and real domestic bank credit has transitory effect on the real private investment. Moreover shocks resulted from inflation leads to the fall of the real private investment throughout the whole period implying that macroeconomic instability measured by change in inflation will have permanent negative effect on the real private investment. where as shocks resulted from trade openness will leads to the fall of private investment after 25 periods.

As it can be seen from the figure 5.6.1 above shocks resulted from real economic growth will have permanent impact where as shocks resulted from real social infrastructure investment and real physical investment will have impact after 10 periods implying the crowding in effect of real public investment on the real private investment in the long run.

5.6.2 Variance Decomposition

Variance decomposition refers to the breakdown of the forecast error variance for a specific time horizon. Variance decomposition can indicate which variables have short-term and long-term impacts on another variable of interest. Variance decomposition can tell a researcher the percentage of the fluctuation in a time series attributable to other variables at selected time horizons. Mamatzakis (2001) states that the variance decomposition analysis indicates how much

of the uncertainty surrounding the predictions of dependant variable can be explained by the uncertainty surrounding the other variables.

Hence, the variance decomposition will give us information about the relative importance of each random innovation (shocks) to the variables in our model.

The variance decomposition provided further evidence of relationships among the variables under investigation. The variance decomposition showed the proportion of the forecast error of one variable due to the other variables. Therefore, the variance decomposition makes possible to determine the relative importance of each variable in creating fluctuations in other variables (Ratanapakorn and Sharma, 2007).

Table 5.6.2. Variance Decomposition of Real Private Investment.

| Per | S.E | RPRI | OPN | CPI | RSII | RPII | RGDS | RDBC | RGDP |
|-----|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1 | 0.07173 | 100.000 | 0.00000 | 0.00000 | 0.000000 | 0.000000 | 0.000000 | 0.00000 | 0.00000 |
| 4 | 0.2341 | 39.27367 | 0.314678 | 35.96434 | 6.072955 | 5.114853 | 1.243152 | 0.24154 | 11.7748 |
| 8 | 0.35710 | 25.9436 | 3.78445 | 43.89807 | 4.126843 | 7.689124 | 1.611328 | 1.220797 | 11.7257 |
| 12 | 0.384560 | 22.87698 | 6.536059 | 43.60837 | 4.44055 | 8.231854 | 1.55490 | 1.48032 | 11.2709 |
| 16 | 0.410194 | 22.48878 | 8.584345 | 40.93788 | 4.07908 | 8.771717 | 1.628024 | 1.73460 | 11.77557 |
| 20 | 0.443190 | 22.40592 | 9.066261 | 40.31020 | 3.500874 | 9.212306 | 1.661632 | 1.85859 | 11.9842 |
| 24 | 0.476577 | 21.48332 | 9.537548 | 40.51205 | 3.034905 | 9.648118 | 1.691600 | 1.94904 | 12.14339 |
| 28 | 0.502018 | 20.73075 | 10.28593 | 40.26335 | 2.78941 | 9.947286 | 1.708909 | 2.05707 | 12.2173 |
| 32 | 0.526053 | 20.39137 | 10.84854 | 39.78885 | 2.571110 | 10.19141 | 1.728000 | 2.13797 | 12.3447 |
| 36 | 0.550643 | 20.12942 | 11.19658 | 39.54490 | 2.357355 | 10.39064 | 1.744360 | 2.19900 | 12.43774 |
| 40 | 0.574440 | 19.81594 | 11.49344 | 39.4345 | 2.177656 | 10.56594 | 1.756715 | 2.248420 | 12.5074 |

Source: own computation using eveiws

The result of the variance decomposition indicate that 100 % of the forecast error variance of dependent variable is explained by it disturbance from itself. The result indicates that lagged value of dependent can explain total variation in the dependent variable.

As it can be seen from the table 5.6.2 39.4345 % of the forecast error variance of real private investment is explained by disturbance in inflation. This result implies macroeconomic instability measured by inflation has significant impact in real private investment.

Over 40 years 10.565 % of the forecast error variance of real private investment is explained by the disturbance in real physical infrastructure investment. Whereas real social infrastructure investment account 2.1776 %.

Moreover 11.493 % and 12.5074 % of the forecast error variance of real private investment is explained by disturbance in trade openness and real gross domestic product over forty periods. Whereas 1.7567 % and 2.2484 % of the forecast error variance of real private investment is explained by disturbance in saving and credit .the variation of real gross domestic product account for 19.815 % of the forecast error variance of real private investment .

Generally inflation¹⁵, economic growth, trade openness, and real physical infrastructure investment account for the lion share of variation of the forecast error variance of the real private investment in Ethiopia.

¹⁵ Inflation which is the measure of the macroeconomic instability has to be managed properly

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATION

6.1 Conclusion

This study investigated the macroeconomic determinants of private investment in Ethiopia over the period from 1974/75 -2013/14. The rationale behind undertaking these study was address the low contribution of private investment for the economy of Ethiopia and the existence of limited empirical evidence on what determines private investment in Ethiopia .

Vector Error Correction approaches have been applied for the investigation of the impacts of real physical infrastructure investment, real social infrastructure investment, real gross domestic saving, real domestic bank credit, trade openness and inflation as measured by consumer price index, real gross domestic product and trade openness in determining the growth of real private investment in the short run and long run.

The study also employed innovation accounting to analyze the response of the real private investment to the shocks from the explanatory variables. The study used time series data of 40 years collected from Ministry of Finance and Economic Development of Ethiopia.

The major contribution of this study is that, unlike other researchers who consider the public investment in an aggregate form ; these study took the disaggregate form of public investment in physical and social infrastructure investment sector to investigate the impacts of different components of public investment on real private investment in Ethiopia . Moreover ,this paper employed modern tools of analysis using VECM in opposition to the previous researcher that were employed OLS model to analyze time series which would lead to misleading. Based on the findings of the study, the following conclusions are derived.

The findings indicate that public investment made in real physical infrastructure investment and real social infrastructure investment is found to be significant at 5% in the long run implying the crowding in effect that means investment made on physical and social infrastructure has positive effect for the growth of private investment in Ethiopia in the long run.

Trade openness is found to have the positive and significant contribution in the growth endeavor of private investment in the long run due to the fact that openness promote technological progress, increase productivity and division of labor that can serve as potential source of entrepreneurship, productivity, increasing in keymarkets,and risingcompetition which require, increasing trade openness as a useful channel to boost private sector development and economic growth.

The impacts of economic growth in the private investment are found to be positive and significant in the short run which implies that economic growth is crucial to the growth of private investment which addresses the need to enhance further the growth of the economy. The result confirm the validity of the accelerator principle that suggest the quantity of domestic output should be expanded as it will increase the profitability of firms , especially those that produce

tradable goods. The rationale behind the positive and significant role in economic growth to the growth of private investment is because of the fact that economic growth boosts the demand for produced goods and services of private investment activities and with the increase in the purchasing power of the societies that resulted from the grown income and increase in the effective demand.

The impact of inflation as measured by consumer price index has a negative role in promoting private investment in the short run; which implies that a private investor engages in business when there is stable macroeconomic environment created by the stable level of price. Thus, macroeconomic instability has a negative and significant impact on the growth of private investment in Ethiopia. The impulse response analysis reveals that much of the fluctuation in private investment in the country is explained by real gross domestic product, inflation, domestic credit and physical and social infrastructure investment. Variance Decompositions (VDC) is also computed for private investment. From the VDCs, the forecast error variance of private investment explained by the economic growth (RGDP), trade openness, inflation and real private infrastructure investment is significant accounting 11.493 %, 12.5074%, 39.4345 % and 10.565 % of the forecast error variance of the real private investment respectively. The results of the variance decomposition test for private investment confirm the significant role of trade openness, economic growth and real physical infrastructure investment, and macroeconomic instability as measured by inflation as potential determinants of private investment in Ethiopia.

6.2. Policy implication

Based on the finding of the analysis, the following policy implication should need to be drawn to promote the sustainable growth of the private investment sector to boost the economic growth.

First, given the significant role of real physical infrastructure investment and real social infrastructure in promoting the private investment in Ethiopia in the long run the government should promote the well functioning and distribution of public sector investment in a manner that maintains complementarily than the competition. In addition to the existence of crowding in the effect of public investment in the growth of private investment, there should be significant expansion as well as the existence of improved public expenditure in infrastructure.

The government effort should need to be extended to ensure the distribution as well as the well functioning of the infrastructure. The long -run positive effect of the real public investment on growth and loss of sufficient statistical evidence of crowding out effect on private investment calls the responsible authority; first there is a need to identify which sectors of public investment are crowding in and which sectors are crowding out private investment, before the expansion of state participation. The guiding principle for public investment should be complimentary rather than competition with private investment

Second ,trade openness is found to have the potential role to promote the growth of private investment in the long run which necessities the need to create a conducive environment that enables the performance of trade sector due to the fact that trade sector is not only one of determinants of private investment but also components of national income account. Thus, there is a need to design and implement informed trade policies that encourage the growth of domestic industry. Thus to realize the long -run positive effect of real private investment, the government of Ethiopia should take supplementary reforms that will improve the country's poor investment climate such as poor infrastructure, particularly, power shortage; poor transport; poor telecom connectivity of business locations and lack of efficient tax administration.

Thus, the study calls for the government intervention in improving the investment climate in a way that promotes private sector development, in supportive of entrepreneurial endeavor and with a bias towards exportable products and the expansion of business activities. In particular, the government has roles to play at different levels of the economy to encourage the private sector and to attain sustainable development. These include the supply of efficient infrastructure facilities such as electricity, telephone, water and road; improving the tax administration system, for example minimizing the random imposition of taxes and increasing access to information and advisory services. In the absence of some or all of these prerequisites, private investment expansion which is a means for accumulation of physical capital and increment of national output may not result at the projected level.

Third, massive and collaborated effort should be made to promote the saving capacity due to the existence of close links with investment and increasing demands of rising saving. There should be reduction in the lag between saving and investment to extend the role of saving to the investment. It is found that the level of saving in Ethiopia is not sufficient enough to avail funds to investment that necessity the need to raise the income of rural ¹⁶pours.

In order to raise the capacity to save and access to credit in the economy, there should need to expand as well as promote the performance of the financial institution in the country and there should be smooth effort to secure access to credit. There should be improvement in the saving and investment gap.

This calls the government to create fertile legal and institutional framework that encourage saving like the current beginning in terms of saving for housing program and government selling

¹⁶ The government of Ethiopia prepared bonds to the public to collect money to the construction of great dam.

of bonds¹ and creating conducive climate for the availability of capital for credit . Moreover ,provision of awareness creation o the society about the habits of promoting saving is necessary.

Generally, there should be appropriate policy tools and implementation to reduce the vulnerability of domestic industry from the external treats and extending efforts to augment the growth of the national output through investment in infrastructure, good governance and collaborated endeavor to develop that human capital if there is need to realize the contribution of private investment to the economy.

The government should create fertile macroeconomic environment having the stable price and exchange rate situation to enable the private investor to have the motive to invest and reduce uncertainty in the investment decision. The working capital requirements and the supplementary fund required by the private investors will have to be met efficiently and on sound conditions by financial institutions.

Finally, Access to credit for private investor is found to have positive and significant impact for private investment to grow thus address the need to extend the operation of financial institutions such as commercial banks even in remote areas the government should strive to expand and distribute financial institutions such as banks and micro finance institution towards rural and remote areas to promote saving mobilization and credit availability to the growth of private investor.

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APPENDIX

Appendix 1. Johnson cointegration test

Date: 05/30/16 Time: 16:52
 Sample (adjusted): 1977 2013
 Included observations: 37 after adjustments
 Trend assumption: Linear deterministic trend
 Series: LNCPI LNOPN LNRDBC LNRGDP LNRGDS LNRPII LNRPRI
 LNRSII
 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 * | 0.925720 | 328.0036 | 159.5297 | 0.0000 |
| At most 1 * | 0.862107 | 231.8069 | 125.6154 | 0.0000 |
| At most 2 * | 0.710622 | 158.4997 | 95.75366 | 0.0000 |
| At most 3 * | 0.675383 | 112.6189 | 69.81889 | 0.0000 |
| At most 4 * | 0.565559 | 70.98987 | 47.85613 | 0.0001 |
| At most 5 * | 0.473969 | 40.14317 | 29.79707 | 0.0023 |
| At most 6 * | 0.292468 | 16.37452 | 15.49471 | 0.0368 |
| At most 7 | 0.092064 | 3.573521 | 3.841466 | 0.0587 |

Trace test indicates 7 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 * | 0.925720 | 96.19677 | 52.36261 | 0.0000 |
| At most 1 * | 0.862107 | 73.30721 | 46.23142 | 0.0000 |
| At most 2 * | 0.710622 | 45.88074 | 40.07757 | 0.0100 |
| At most 3 * | 0.675383 | 41.62904 | 33.87687 | 0.0049 |
| At most 4 * | 0.565559 | 30.84670 | 27.58434 | 0.0184 |
| At most 5 * | 0.473969 | 23.76865 | 21.13162 | 0.0208 |
| At most 6 | 0.292468 | 12.80100 | 14.26460 | 0.0840 |
| At most 7 | 0.092064 | 3.573521 | 3.841466 | 0.0587 |

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Appendix 2 VEC Granger Causality/Block Exogeneity Wald Test

VEC Granger Causality/Block Exogeneity Wald Tests

Date: 05/30/16 Time: 16:55

Sample: 1974 2014

Included observations: 37

Dependent variable: D(LNRPRI)

| Excluded | Chi-sq | df | Prob. |
|-----------|----------|----|--------|
| D(LNOPN) | 0.561294 | 2 | 0.7553 |
| D(LNCPI) | 11.78036 | 2 | 0.0028 |
| D(LNRGDP) | 5.721788 | 2 | 0.0572 |
| D(LNRGDS) | 0.343943 | 2 | 0.8420 |
| D(LNRDBC) | 1.134634 | 2 | 0.5670 |
| D(LNRSII) | 1.620642 | 2 | 0.4447 |
| D(LNRPRI) | 0.034585 | 2 | 0.9829 |
| All | 46.63212 | 14 | 0.0000 |

Dependent variable: D(LNOPN)

| Excluded | Chi-sq | df | Prob. |
|-----------|----------|----|--------|
| D(LNRPRI) | 1.951387 | 2 | 0.3769 |
| D(LNCPI) | 0.772084 | 2 | 0.6797 |
| D(LNRGDP) | 0.675055 | 2 | 0.7135 |
| D(LNRGDS) | 5.206290 | 2 | 0.0740 |
| D(LNRDBC) | 1.047631 | 2 | 0.5923 |
| D(LNRSII) | 1.920169 | 2 | 0.3829 |
| D(LNRPRI) | 0.905240 | 2 | 0.6360 |
| All | 20.90924 | 14 | 0.1040 |

Dependent variable: D(LNCPI)

| Excluded | Chi-sq | df | Prob. |
|-----------|----------|----|--------|
| D(LNRPRI) | 2.708232 | 2 | 0.2582 |
| D(LNOPN) | 0.376653 | 2 | 0.8283 |
| D(LNRGDP) | 5.369612 | 2 | 0.0682 |
| D(LNRGDS) | 0.077055 | 2 | 0.9622 |
| D(LNRDBC) | 0.850667 | 2 | 0.6536 |
| D(LNRSII) | 0.567771 | 2 | 0.7529 |
| D(LNRPRI) | 0.399083 | 2 | 0.8191 |
| All | 22.07469 | 14 | 0.0771 |

Dependent variable: D(LNRGDP)

| Excluded | Chi-sq | df | Prob. |
|------------|----------|----|--------|
| D(LNRPRI) | 5.973727 | 2 | 0.0504 |
| D(LNOPN) | 0.395086 | 2 | 0.8207 |
| D(LNCPI) | 8.857751 | 2 | 0.0119 |
| D(LNRGDS) | 0.872481 | 2 | 0.6465 |
| D(LNRDBC) | 0.179603 | 2 | 0.9141 |
| D(LNRSII) | 4.001757 | 2 | 0.1352 |
| D(LNRPPII) | 2.126098 | 2 | 0.3454 |
| All | 27.50803 | 14 | 0.0165 |

Dependent variable: D(LNRGDS)

| Excluded | Chi-sq | df | Prob. |
|------------|----------|----|--------|
| D(LNRPRI) | 26.17271 | 2 | 0.0000 |
| D(LNOPN) | 4.584807 | 2 | 0.1010 |
| D(LNCPI) | 0.564225 | 2 | 0.7542 |
| D(LNRGDP) | 3.622847 | 2 | 0.1634 |
| D(LNRDBC) | 1.417676 | 2 | 0.4922 |
| D(LNRSII) | 10.65539 | 2 | 0.0049 |
| D(LNRPPII) | 2.827979 | 2 | 0.2432 |
| All | 52.91886 | 14 | 0.0000 |

Dependent variable: D(LNRDBC)

| Excluded | Chi-sq | df | Prob. |
|------------|----------|----|--------|
| D(LNRPRI) | 0.044459 | 2 | 0.9780 |
| D(LNOPN) | 5.943158 | 2 | 0.0512 |
| D(LNCPI) | 2.184866 | 2 | 0.3354 |
| D(LNRGDP) | 0.958721 | 2 | 0.6192 |
| D(LNRGDS) | 2.357366 | 2 | 0.3077 |
| D(LNRSII) | 0.493092 | 2 | 0.7815 |
| D(LNRPPII) | 0.071219 | 2 | 0.9650 |
| All | 24.92826 | 14 | 0.0353 |

Dependent variable: D(LNRSII)

| Excluded | Chi-sq | df | Prob. |
|-----------|----------|----|--------|
| D(LNRPRI) | 1.463795 | 2 | 0.4810 |
| D(LNOPN) | 1.531199 | 2 | 0.4651 |
| D(LNCPI) | 3.403592 | 2 | 0.1824 |
| D(LNRGDP) | 2.350786 | 2 | 0.3087 |
| D(LNRGDS) | 0.951530 | 2 | 0.6214 |
| D(LNRDBC) | 2.077410 | 2 | 0.3539 |

| | | | |
|------------|----------|----|--------|
| D(LNRPPII) | 1.743809 | 2 | 0.4182 |
| All | 15.82901 | 14 | 0.3239 |

Dependent variable: D(LNRPPII)

| Excluded | Chi-sq | df | Prob. |
|-----------|----------|----|--------|
| D(LNRPRI) | 2.091388 | 2 | 0.3514 |
| D(LNOPN) | 0.267961 | 2 | 0.8746 |
| D(LNCPI) | 1.322998 | 2 | 0.5161 |
| D(LNRGDP) | 1.566655 | 2 | 0.4569 |
| D(LNRGDS) | 0.252895 | 2 | 0.8812 |
| D(LNRDBC) | 0.538286 | 2 | 0.7640 |
| D(LNRSII) | 1.808910 | 2 | 0.4048 |
| All | 11.63146 | 14 | 0.6359 |

Appendix 3 Vector Error Correction Estimates

Vector Error Correction Estimates

Date: 05/30/16 Time: 06:19

Sample (adjusted): 1977 2013

Included observations: 37 after adjustments

Standard errors in () & t-statistics in []

| CointegratingEq: | CointEq1 |
|------------------|---------------------------------------|
| LNRPRI(-1) | 1.000000 |
| LNCPPI(-1) | 0.372054 (0.03346) [-11.1179] |
| LNOPN(-1) | 0.126432 (0.04956) [-2.55123] |
| LNRPDB(-1) | 0.069881 (0.03242) [-2.15562] |
| LNRPDP(-1) | - 1.455331 (0.10235) [14.2198] |
| LNRPDS(-1) | 0.058905 (0.03231) [-1.82323] |
| LNRPPII(-1) | 0.272620 (0.04267) |

| | | |
|------------|-----------------------|------------|
| | | [-6.38927] |
| LNRSII(-1) | 0.420696 (0.06216) | [-6.76843] |
| C | 20.78778 | |

| Error Correction: | D(LNRPRI) | D(LNCPI) | D(LNOPN) | D(LNRDBC) | D(LNRGDP) | D(LNRGDS) | D(LNRPPI) | D(LNRSII) |
|-------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| CointEq1 | -0.534885 (0.26037) [-2.05432] | 0.098881 (0.30650) [0.32261] | 0.445507 (0.53822) [0.82775] | 0.058098 (0.47949) [0.12116] | -0.577178 (0.13990) [-4.12578] | -6.217144 (1.00602) [-6.17992] | -0.640268 (0.38317) [-1.67098] | -0.431800 (0.34463) [-1.25294] |
| D(LNRPRI(-1)) | 0.801222 (0.35925) [2.23023] | -0.551423 (0.42290) [-1.30391] | -0.408177 (0.74262) [-0.54965] | -0.099438 (0.66159) [-0.15030] | 0.284477 (0.19302) [1.47379] | 6.089158 (1.38809) [4.38672] | 0.401371 (0.52869) [0.75918] | 0.163386 (0.47551) [0.34360] |
| D(LNRPRI(-2)) | 1.026524 (0.36675) [2.79895] | 0.227101 (0.43173) [0.52603] | -1.056166 (0.75812) [-1.39314] | 0.061487 (0.67540) [0.09104] | 0.457713 (0.19705) [2.32279] | 5.547169 (1.41706) [3.91456] | 0.761401 (0.53972) [1.41072] | 0.586777 (0.48544) [1.20876] |
| D(LNCPI(-1)) | 0.730893 (0.22039) [3.31640] | 0.179511 (0.25943) [0.69194] | -0.114908 (0.45556) [-0.25223] | 0.401800 (0.40586) [0.99000] | 0.350076 (0.11841) [2.95641] | 0.547921 (0.85153) [0.64345] | 0.343691 (0.32433) [1.05970] | 0.483646 (0.29171) [1.65799] |
| D(LNCPI(-2)) | 0.036115 (0.24908) [0.14499] | 0.218542 (0.29321) [0.74535] | 0.451211 (0.51487) [0.87635] | 0.393179 (0.45870) [0.85717] | -0.130447 (0.13383) [-0.97473] | 0.230009 (0.96239) [0.23900] | 0.075925 (0.36655) [0.20713] | 0.142039 (0.32968) [0.43083] |
| D(LNOPN(-1)) | 0.050806 (0.10548) [0.48166] | 0.029855 (0.12417) [0.24044] | -0.074044 (0.21804) [-0.33959] | 0.419023 (0.19425) [2.15714] | -0.034605 (0.05667) [-0.61059] | 0.871640 (0.40755) [2.13871] | 0.080221 (0.15523) [0.51680] | 0.171462 (0.13961) [1.22812] |
| D(LNOPN(-2)) | 0.082461 (0.11835) [0.69673] | -0.064036 (0.13932) [-0.45962] | 0.428633 (0.24465) [1.75202] | 0.383540 (0.21796) [1.75970] | -0.021281 (0.06359) [-0.33466] | 0.354252 (0.45730) [0.77466] | 0.023570 (0.17417) [0.13532] | 0.083353 (0.15665) [0.53208] |
| D(LNRDBC(-1)) | -0.091985 (0.08998) [-1.02225] | 0.064071 (0.10592) [0.60487] | -0.188342 (0.18600) [-1.01257] | 0.402912 (0.16571) [2.43144] | 0.015415 (0.04835) [0.31883] | -0.329730 (0.34768) [-0.94839] | -0.092685 (0.13242) [-0.69993] | -0.157380 (0.11910) [-1.32140] |
| D(LNRDBC(-2)) | 0.027364 (0.05558) [0.49231] | -0.052379 (0.06543) [-0.80053] | 0.005761 (0.11490) [0.05014] | -0.149306 (0.10236) [-1.45863] | -0.010029 (0.02986) [-0.33582] | -0.112083 (0.21476) [-0.52189] | 0.028775 (0.08180) [0.35178] | 0.060429 (0.07357) [0.82138] |
| D(LNRGDP(-1)) | 0.536383 (0.47207) [1.13624] | 0.046627 (0.55570) [0.08391] | -0.656893 (0.97581) [-0.67317] | 0.257737 (0.86934) [0.29647] | 0.473093 (0.25364) [1.86523] | 2.002943 (1.82397) [1.09812] | 0.080050 (0.69471) [0.11523] | 0.200988 (0.62483) [0.32167] |
| D(LNRGDP(-2)) | -0.730958 (0.31409) [-2.32719] | 0.819055 (0.36974) [2.21522] | -0.182382 (0.64927) [-0.28091] | -0.565763 (0.57843) [-0.97811] | -0.140114 (0.16876) [-0.83026] | 1.477832 (1.21360) [1.21773] | -0.570270 (0.46223) [-1.23374] | -0.636614 (0.41574) [-1.53129] |
| D(LNRGDS(-1)) | 0.024115 (0.05561) | -0.015935 (0.06546) | 0.166314 (0.11494) | 0.142188 (0.10240) | -0.027843 (0.02988) | -1.072601 (0.21485) | 0.033964 (0.08183) | 0.034286 (0.07360) |

| | | | | | | | | |
|----------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | [0.43367] | [-0.24343] | [1.44690] | [1.38851] | [-0.93193] | [-4.99226] | [0.41505] | [0.46584] |
| D(LNRGDS(-2)) | 0.029369 (0.05086) [0.57747] | -0.015224 (0.05987) [-0.25429] | -0.053986 (0.10513) [-0.51352] | 0.030816 (0.09366) [0.32903] | -0.016918 (0.02733) [-0.61912] | -0.691971 (0.19650) [-3.52140] | 0.035799 (0.07484) [0.47832] | 0.064835 (0.06732) [0.96315] |
| D(LNRPII(-1)) | 0.048371 (0.26010) [0.18597] | 0.178970 (0.30618) [0.58452] | -0.452451 (0.53766) [-0.84152] | 0.112029 (0.47900) [0.23388] | -0.203726 (0.13975) [-1.45778] | -1.648719 (1.00498) [-1.64054] | -0.057579 (0.38277) [-0.15043] | -0.352744 (0.34427) [-1.02460] |
| D(LNRPII(-2)) | -0.014716 (0.27687) [-0.05315] | -0.129788 (0.32592) [-0.39822] | 0.382339 (0.57231) [0.66806] | 0.028298 (0.50987) [0.05550] | 0.058167 (0.14876) [0.39102] | 0.128300 (1.06976) [0.11993] | 0.393347 (0.40745) [0.96540] | 0.400717 (0.36646) [1.09347] |
| D(LNRSII(-1)) | -0.286789 (0.34281) [-0.83659] | -0.268268 (0.40354) [-0.66478] | 0.979910 (0.70862) [1.38284] | -0.433903 (0.63130) [-0.68731] | 0.185314 (0.18419) [1.00611] | -1.370067 (1.32454) [-1.03437] | 0.269443 (0.50449) [0.53410] | 0.565014 (0.45374) [1.24523] |
| D(LNRSII(-2)) | -0.234521 (0.31550) [-0.74333] | 0.184610 (0.37139) [0.49707] | -0.262321 (0.65217) [-0.40223] | 0.172507 (0.58101) [0.29691] | -0.324281 (0.16951) [-1.91299] | -3.386819 (1.21902) [-2.77830] | -0.614577 (0.46430) [-1.32367] | -0.449071 (0.41760) [-1.07537] |
| C | -0.036098 (0.03773) [-0.95677] | 0.026608 (0.04441) [0.59911] | 0.031276 (0.07799) [0.40103] | 0.001170 (0.06948) [0.01684] | 0.012753 (0.02027) [0.62909] | 0.049908 (0.14578) [0.34235] | 0.033852 (0.05552) [0.60970] | 0.012967 (0.04994) [0.25967] |
| R-squared | 0.750125 | 0.592542 | 0.551740 | 0.729107 | 0.777074 | 0.796628 | 0.484895 | 0.539971 |
| Adj. R-squared | 0.526553 | 0.227974 | 0.150665 | 0.486730 | 0.577614 | 0.614663 | 0.024011 | 0.128366 |
| Sum sq. resids | 0.097931 | 0.135705 | 0.418454 | 0.332122 | 0.028271 | 1.462013 | 0.212089 | 0.171569 |
| S.E. equation | 0.071793 | 0.084512 | 0.148405 | 0.132212 | 0.038574 | 0.277395 | 0.105653 | 0.095026 |
| F-statistic | 3.355183 | 1.625325 | 1.375654 | 3.008147 | 3.895893 | 4.377923 | 1.052098 | 1.311866 |
| Log likelihood | 57.28581 | 51.25084 | 30.41822 | 34.69292 | 80.27069 | 7.274691 | 42.99016 | 46.91251 |
| Akaike AIC | -2.123557 | -1.797343 | -0.671255 | -0.902320 | -3.365983 | 0.579746 | -1.350819 | -1.562838 |
| Schwarz SC | -1.339867 | -1.013653 | 0.112434 | -0.118630 | -2.582293 | 1.363436 | -0.567130 | -0.779149 |
| Mean dependent | 0.045257 | 0.082964 | 0.020162 | 0.103366 | 0.048496 | 0.068467 | 0.087837 | 0.086201 |
| S.D. dependent | 0.104339 | 0.096184 | 0.161030 | 0.184544 | 0.059353 | 0.446867 | 0.106945 | 0.101783 |

| | |
|---|-----------|
| Determinant resid covariance (dof adj.) | 1.67E-18 |
| Determinant resid covariance | 8.07E-21 |
| Log likelihood | 435.9115 |
| Akaike information criterion | -15.34657 |
| Schwarz criterion | -8.728741 |

Appendix 4 Short run coefficients

Dependent Variable: D(LNRPRI)

Method: Least Squares

Date: 05/30/16 Time: 06:20

Sample (adjusted): 1977 2013

Included observations: 37 after adjustments

$$\begin{aligned}
 D(LNRPRI) = & C(1)*(LNRPRI(-1) - 0.37205367836*LNCPI(-1) - \\
 & 0.126432019417*LNOPN(-1) - 0.069880664972*LNRDBC(-1) + \\
 & 1.45533081893*LNRGDP(-1) - 0.0589048938633*LNRGDS(-1) - \\
 & 0.272620271823*LNRPII(-1) - 0.420696488034*LNRSII(-1) - \\
 & 20.7877797986) + C(2)*D(LNRPRI(-1)) + C(3)*D(LNRPRI(-2)) + C(4) \\
 & *D(LNCPI(-1)) + C(5)*D(LNCPI(-2)) + C(6)*D(LNOPN(-1)) + C(7)
 \end{aligned}$$

$$\begin{aligned}
& *D(LNOPN(-2)) + C(8)*D(LNRDBC(-1)) + C(9)*D(LNRDBC(-2)) + C(10) \\
& *D(LNRGDP(-1)) + C(11)*D(LNRGDP(-2)) + C(12)*D(LNRGDS(-1)) + \\
& C(13)*D(LNRGDS(-2)) + C(14)*D(LNRPPII(-1)) + C(15)*D(LNRPPII(-2)) + \\
& C(16)*D(LNRSII(-1)) + C(17)*D(LNRSII(-2)) + C(18)
\end{aligned}$$

| | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|-----------|
| C(1) | -0.534885 | 0.260371 | -2.054316 | 0.0540 |
| C(2) | 0.801222 | 0.359254 | 2.230235 | 0.0380 |
| C(3) | 1.026524 | 0.366753 | 2.798953 | 0.0114 |
| C(4) | 0.730893 | 0.220387 | 3.316404 | 0.0036 |
| C(5) | 0.036115 | 0.249079 | 0.144992 | 0.8862 |
| C(6) | 0.050806 | 0.105480 | 0.481660 | 0.6355 |
| C(7) | 0.082461 | 0.118354 | 0.696728 | 0.4944 |
| C(8) | -0.091985 | 0.089983 | -1.022251 | 0.3195 |
| C(9) | 0.027364 | 0.055583 | 0.492313 | 0.6281 |
| C(10) | 0.536383 | 0.472067 | 1.136243 | 0.2700 |
| C(11) | -0.730958 | 0.314094 | -2.327194 | 0.0312 |
| C(12) | 0.024115 | 0.055607 | 0.433674 | 0.6694 |
| C(13) | 0.029369 | 0.050858 | 0.577471 | 0.5704 |
| C(14) | 0.048371 | 0.260103 | 0.185969 | 0.8544 |
| C(15) | -0.014716 | 0.276867 | -0.053153 | 0.9582 |
| C(16) | -0.286789 | 0.342808 | -0.836588 | 0.4132 |
| C(17) | -0.234521 | 0.315499 | -0.743334 | 0.4664 |
| C(18) | -0.036098 | 0.037729 | -0.956767 | 0.3507 |
| R-squared | 0.750125 | Mean dependent var | | 0.045257 |
| Adjusted R-squared | 0.526553 | S.D. dependent var | | 0.104339 |
| S.E. of regression | 0.071793 | Akaike info criterion | | -2.123557 |
| Sum squared resid | 0.097931 | Schwarz criterion | | -1.339867 |
| Log likelihood | 57.28581 | Hannan-Quinn criter. | | -1.847270 |
| F-statistic | 3.355183 | Durbin-Watson stat | | 2.063517 |
| Prob(F-statistic) | 0.006339 | | | |

Appendix 5. Structural break Test (chow test)

Chow Breakpoint Test: 1991

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: LNOPN

Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 6.645030 | Prob. F(1,32) | 0.0148 |
| Log likelihood ratio | 7.547291 | Prob. Chi-Square(1) | 0.0060 |
| Wald Statistic | 6.645030 | Prob. Chi-Square(1) | 0.0099 |

Chow Breakpoint Test: 1991

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: LNCPI

Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 2.575343 | Prob. F(1,32) | 0.1184 |
| Log likelihood ratio | 3.096196 | Prob. Chi-Square(1) | 0.0785 |
| Wald Statistic | 2.575343 | Prob. Chi-Square(1) | 0.1085 |

Chow Breakpoint Test: 1991
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: LNRGDP
Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 5.425388 | Prob. F(1,32) | 0.0263 |
| Log likelihood ratio | 6.264535 | Prob. Chi-Square(1) | 0.0123 |
| Wald Statistic | 5.425388 | Prob. Chi-Square(1) | 0.0198 |

Chow Breakpoint Test: 1991
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: LNRDBC
Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 5.068820 | Prob. F(1,32) | 0.0314 |
| Log likelihood ratio | 5.881611 | Prob. Chi-Square(1) | 0.0153 |
| Wald Statistic | 5.068820 | Prob. Chi-Square(1) | 0.0244 |

Chow Breakpoint Test: 1991
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: LNRGDS
Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 5.976692 | Prob. F(1,32) | 0.0202 |
| Log likelihood ratio | 6.849468 | Prob. Chi-Square(1) | 0.0089 |
| Wald Statistic | 5.976692 | Prob. Chi-Square(1) | 0.0145 |

Chow Breakpoint Test: 1991
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: LNRSII
Equation Sample: 1974 2013

| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 4.909584 | Prob. F(1,32) | 0.0339 |
| Log likelihood ratio | 5.709414 | Prob. Chi-Square(1) | 0.0169 |
| Wald Statistic | 4.909584 | Prob. Chi-Square(1) | 0.0267 |

Chow Breakpoint Test: 1991
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: LNRPII
Equation Sample: 1974 2013

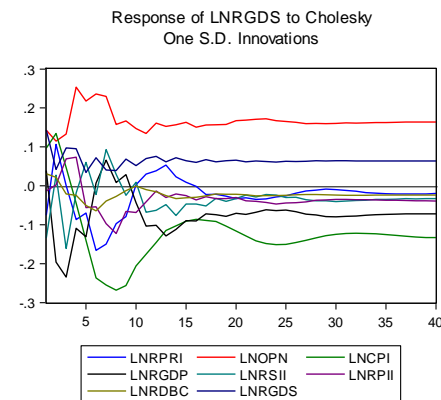
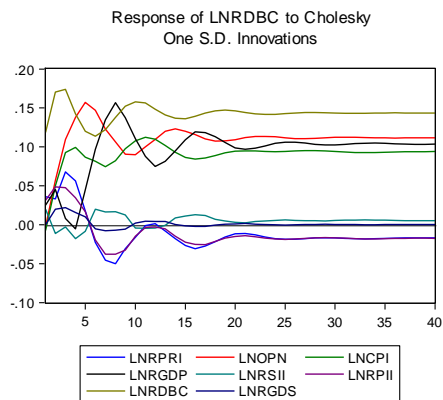
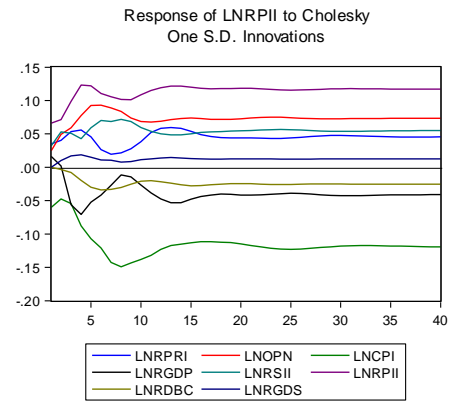
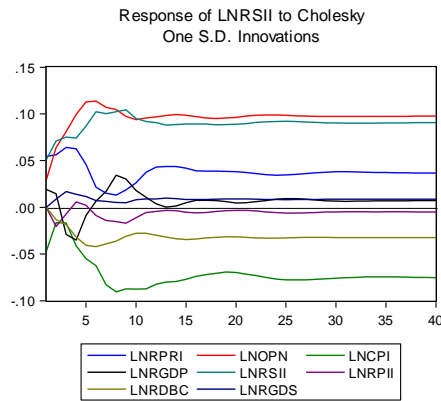
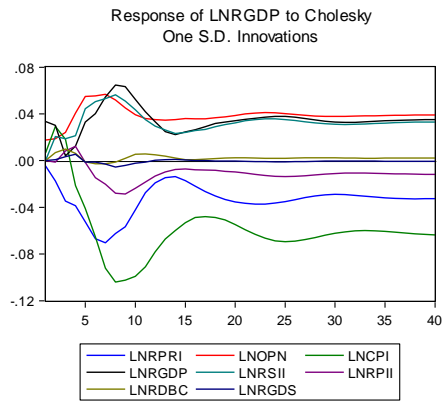
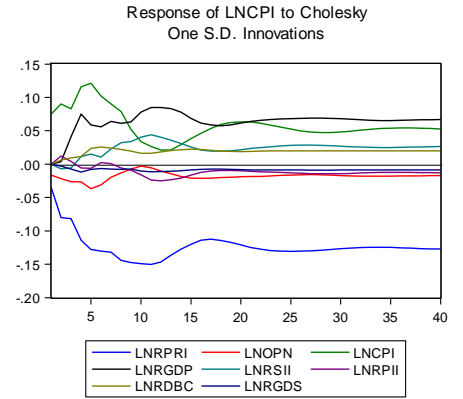
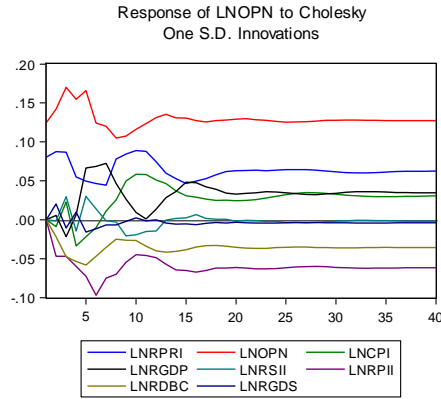
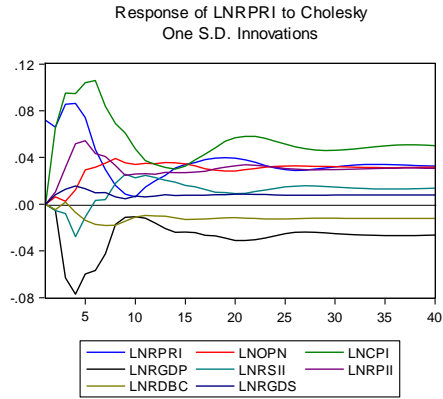
| | | | |
|----------------------|----------|---------------------|--------|
| F-statistic | 4.772873 | Prob. F(1,32) | 0.0363 |
| Log likelihood ratio | 5.560981 | Prob. Chi-Square(1) | 0.0184 |
| Wald Statistic | 4.772873 | Prob. Chi-Square(1) | 0.0289 |

Appendix.5 Roots of Characteristic Polynomial .

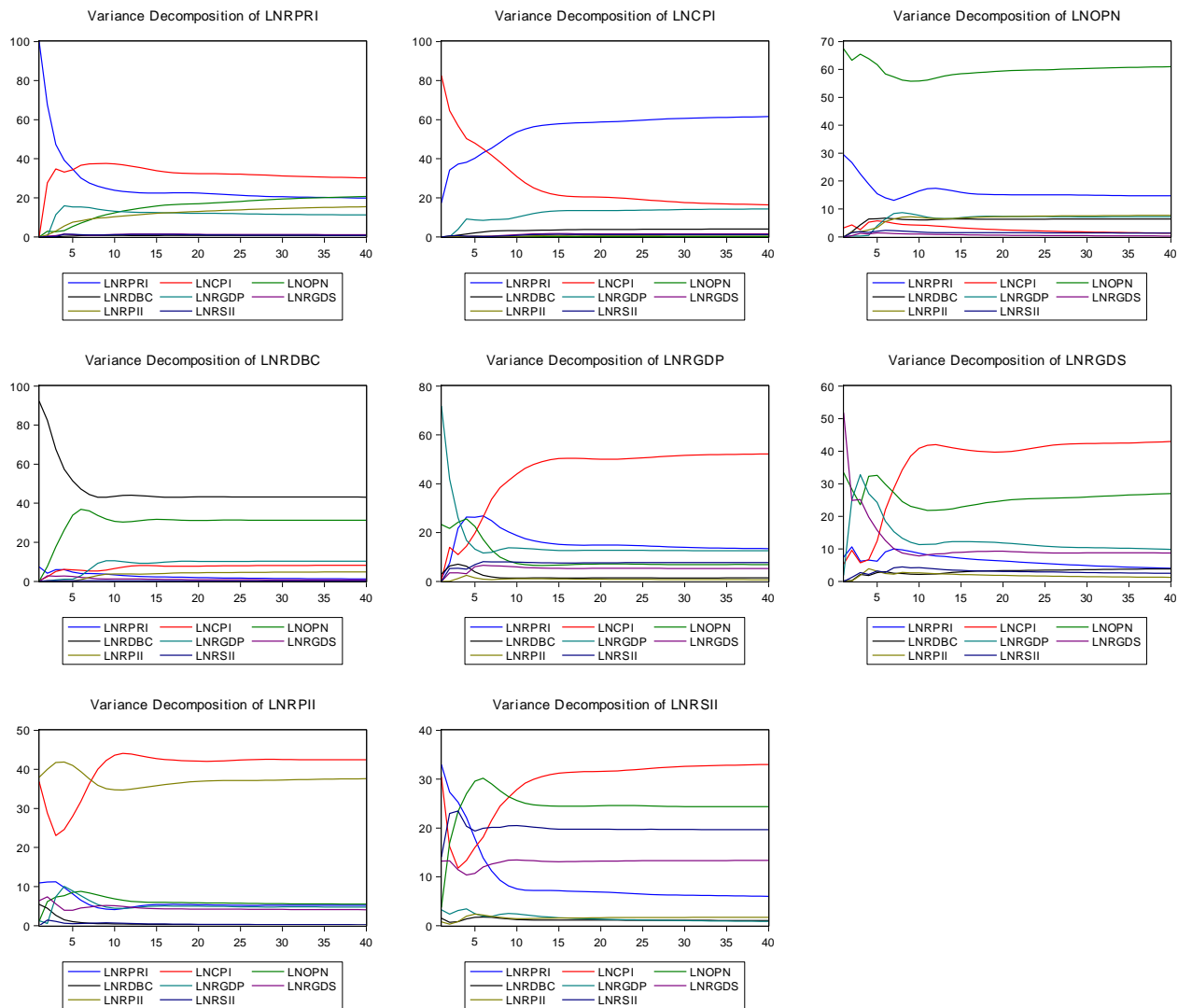
Roots of Characteristic Polynomial
 Endogenous variables: LNRPRI LNCPI LNOPN LNRDBC LNRGDP
 LNRGDS LNRPII LNRSII
 Exogenous variables:
 Lag specification: 1 2
 Date: 05/30/16 Time: 06:24

| Root | Modulus |
|-----------------------|----------|
| 1.000000 | 1.000000 |
| 1.000000 | 1.000000 |
| 1.000000 - 9.63e-16i | 1.000000 |
| 1.000000 + 9.63e-16i | 1.000000 |
| 1.000000 | 1.000000 |
| 1.000000 - 6.93e-16i | 1.000000 |
| 1.000000 + 6.93e-16i | 1.000000 |
| 0.828311 + 0.340876i | 0.895710 |
| 0.828311 - 0.340876i | 0.895710 |
| 0.636381 - 0.562068i | 0.849059 |
| 0.636381 + 0.562068i | 0.849059 |
| -0.579644 - 0.606613i | 0.839027 |
| -0.579644 + 0.606613i | 0.839027 |
| -0.233760 - 0.752380i | 0.787858 |
| -0.233760 + 0.752380i | 0.787858 |
| -0.695897 - 0.043988i | 0.697286 |

Appendix 6 Impulse Responses of each variable



Appendix 7 .Variance decomposition for each variables



Appendix 8.Data used for regression log form

| lnRPII | lnRSII | lnRPRI | lnRGDP | lnRDBC | lnCPI | lnOPN | lnRGDS |
|--------|--------|--------|--------|--------|--------|--------|----------|
| 9.0881 | 7.7674 | 11.4 | 11.537 | 8.8699 | 1.3863 | -1.953 | 9.591856 |
| 9.1363 | 7.8258 | 11.434 | 11.543 | 7.8395 | 1.5476 | -1.946 | 9.527785 |
| 9.1173 | 7.8161 | 11.402 | 11.554 | 8.1792 | 1.7579 | -1.953 | 9.24446 |
| 9.1245 | 7.8288 | 11.418 | 11.548 | 8.6438 | 1.9315 | -1.961 | 8.668146 |
| 9.1316 | 7.8659 | 11.456 | 11.595 | 9.0258 | 2.0541 | -1.782 | 9.088112 |
| 9.2438 | 7.9102 | 11.561 | 11.642 | 9.4631 | 2.1748 | -1.676 | 9.44659 |
| 9.3664 | 7.9911 | 11.663 | 11.655 | 9.6646 | 2.1972 | -1.721 | 9.200366 |
| 9.4426 | 8.112 | 11.7 | 11.654 | 9.7212 | 2.2721 | -1.696 | 9.216562 |
| 9.6106 | 8.2188 | 11.736 | 11.75 | 9.5585 | 2.3125 | -1.741 | 9.54389 |
| 9.7494 | 8.3142 | 11.844 | 11.685 | 9.6228 | 2.3026 | -1.516 | 8.388752 |
| 9.6341 | 8.1206 | 11.601 | 11.583 | 9.4098 | 2.4423 | -1.86 | 9.598695 |
| 9.8701 | 8.2467 | 11.748 | 11.677 | 9.5957 | 2.5337 | -1.684 | 9.602781 |
| 10.075 | 8.4047 | 11.909 | 11.808 | 9.7868 | 2.4248 | -1.773 | 9.602781 |
| 10.123 | 8.4443 | 12.009 | 11.808 | 9.8894 | 2.4423 | -1.807 | 10.0983 |
| 10.228 | 8.5018 | 12.003 | 11.811 | 9.929 | 2.5257 | -1.869 | 9.763246 |
| 10.245 | 8.5369 | 12.021 | 11.851 | 9.9646 | 2.5802 | -2.098 | 9.689346 |
| 10.113 | 8.4155 | 11.893 | 11.814 | 9.7966 | 2.7344 | -2.187 | 8.816633 |
| 10.007 | 8.342 | 11.818 | 11.777 | 9.6331 | 2.9653 | -2.513 | 8.644374 |
| 9.93 | 8.3341 | 11.806 | 11.89 | 9.3093 | 3.035 | -2.013 | 9.379889 |
| 10.026 | 8.548 | 11.873 | 11.907 | 9.5021 | 3.0681 | -1.771 | 9.289935 |
| 10.062 | 8.659 | 11.891 | 11.959 | 9.8873 | 3.1864 | -1.511 | 9.731305 |
| 10.197 | 8.9354 | 12.024 | 12.06 | 10.227 | 3.2149 | -1.525 | 9.771692 |
| 10.366 | 9.1317 | 12.097 | 12.106 | 10.306 | 3.1442 | -1.456 | 9.914471 |
| 10.412 | 9.218 | 12.133 | 12.091 | 10.341 | 3.1442 | -1.417 | 9.903187 |
| 10.565 | 9.3292 | 12.213 | 12.149 | 10.399 | 3.1781 | -1.373 | 10.18185 |
| 10.76 | 9.3667 | 12.255 | 12.2 | 10.452 | 3.2387 | -1.455 | 10.06252 |
| 11.044 | 9.5942 | 12.376 | 12.28 | 10.586 | 3.2465 | -1.426 | 10.24748 |
| 11.283 | 9.7932 | 12.468 | 12.295 | 10.555 | 3.1268 | -1.278 | 9.919811 |
| 11.341 | 9.9004 | 12.391 | 12.273 | 10.382 | 3.2149 | -1.28 | 9.696053 |
| 11.53 | 10.097 | 12.426 | 12.402 | 10.43 | 3.2958 | -1.139 | 10.51125 |
| 11.588 | 10.2 | 12.409 | 12.513 | 10.78 | 3.3499 | -1 | 10.12624 |
| 11.743 | 10.303 | 12.371 | 12.615 | 10.924 | 3.45 | -0.987 | 10.43951 |
| 11.752 | 10.312 | 12.349 | 12.723 | 11.036 | 3.5946 | -1.12 | 10.43952 |
| 11.771 | 10.308 | 12.199 | 12.825 | 11.169 | 3.791 | -1.164 | 10.43953 |
| 11.75 | 10.351 | 12.205 | 12.909 | 11.136 | 4.14 | -1.201 | 10.58609 |
| 12.028 | 10.629 | 12.353 | 13.029 | 11.359 | 4.1636 | -1.032 | 10.65349 |
| 12.23 | 10.759 | 12.399 | 13.134 | 11.58 | 4.3081 | -1.066 | 11.39463 |
| 12.208 | 10.74 | 12.576 | 13.229 | 11.734 | 4.6141 | -1.111 | 11.58053 |
| 12.288 | 10.941 | 12.921 | 13.33 | 11.921 | 4.7501 | -1.229 | 11.59379 |
| 12.367 | 11.006 | 13.077 | 13.348 | 12.004 | 4.8275 | -1.207 | 11.77773 |

