
# ST. MARRY'S UNIVERSITY

## SCHOOL OF GRADUATE STUDIES

# THE NEXUS BETWEEN PUBLIC INVESTMENT, PRIVATE INVESTMENT AND ECONOMIC GROWTH IN ETHIOPIA: TIME SERIES ANALYSIS

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**JULY, 2020**

**ADDIS ABABA, ETHIOPIA**

**THE NEXUS BETWEEN PUBLIC INVESTMENT, PRIVATE INVESTMENT AND ECONOMIC GROWTH IN ETHIOPIA: TIME SERIES ANALYSIS.**

**A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE DEGREE OF MASTERS OF ARTS I N DEVELOPMENT ECONOMICS**

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**JULY, 2020**

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# DECLARATION

I hereby declare that this thesis is my own work and has never been presented in any other university. All sources of materials used for this thesis has been appropriately acknowledged. Declared by:

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## ENDORSEMENT

This thesis has been submitted to St. Mary's University, School of Graduate Studies for examination with my approval as a university advisor.

_____ _____

Advisor Signature

St.Marry's University, Addis Ababa July, 2020

## APPROVAL OF BOARD OF EXAMINERS

As a member of the Board of Examiners of the Master Thesis open defense examination, we testify that we have read and evaluated the thesis prepared by AbuBeker Reda under the title "The Nexus between public investment, private investment and Economic Growth in Ethiopia". We recommended that this thesis to be accepted as fulfilling the thesis requirement for Degree of Master of Arts in Development Economics.

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# ABSTRACT

*Ethiopia has weak easy business doing environment, sever corruption, poor public expenditure management, high inflation rate, infant private investment and huge foreign official assistance in general there is macro economy imbalance. This paper tries to investigate the nexus between private investment, public investment and economic growth in Ethiopia. The study applied ARDL estimation technique and time series data for the period 1982-2017 to investigate the relationship of private investment, public investment and economic growth. To establish a link between theory and empirics Solow growth model used. The findings from the study show the short-run the result private investment, public investment, official development assistance, broad money supply and inflation have significantly explains 85 percent on real GDP. In addition, such variables as labor force and human capital are found to have no significant role in the short run. The short-run coefficient of private investment, public investment, broad money supplyand official development assistance indicates a positive significant causal effect on economic growth.The long-run impact of public investment on economic growth is found to be positive and significant. Other variables like private investment, official development assistance, broad money supply and inflation are found to be statistically not significant in the long run model.The long-run impact of real public investment on private investment is found to be negative and statistically significant and the long-run impact of economic growth on private investment is found to be positive but statistically insignificant.Money supply is found to have long run impact on private investment significantly. The long-run impact of official development assistance on private investment is found to be positive and statistically significant.Government should have to take the prior step to improve the status of private investors and mitigate the investment obstacles such as road, electric power, water supply, Internet and establish the transparent administration system to improve the existing poor investment climate.*



*Keywords: GDP,ODA,ARDL method of Co-integration, ECM model.*

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# LIST OF ACRONYMS

| | |
|---|---|
| ADBG | African Development Bank Group |
| ADF | Augmented Dickey-Fuller |
| ADLI | Agriculture Development Lead Industrialization |
| AEO | African Economic Outlook |
| AIC | Akaiki Information Criterion |
| ARDL | Auto Regressive Distributed Lag |
| CSA | Central Statistics Agency |
| ECM | Error Correction Model |
| FDI | Foreign Direct Investment |
| FPE | Final Prediction Error |
| GDP | Growth Domestic Product |
| GTP | Growth Transformation Plan |
| ILO | International Labor Organization |
| IMF | International Monitory Fund |
| LDC | Least Developing Country |
| MDG | Millennium Development Goal |
| NBE | National Bank of Ethiopia |
| ODA | Official Development Assistance |
| SIC | Schwarz Information Criterion |
| WB | World Bank |

# CHAPTER ONE

# 1. INTRODUCTION

## 1.1. Background of the study

Developing countries are experienced by resource-scarce economies, specifically financial capital. Capital to directly boost economic growth and welfare is largely inadequate domestically, which consequently warrants the need for additional capital (Keri Phillips, 2013). Developing countries face low-income levels, growing unemployment, widening current account deficits, high inflation, and high poverty levels. African countries should focus on building a good investment climate to enhance their prospects for achieving sustainable development. Since Africa has a shortage of financial capital, aid is assuming to fill the lack of financial resources (by augmenting domestic savings and providing additional foreign exchange) so as to support the recipient's effort in accelerating growth and reducing poverty.

Investment is the nucleus of an economy. It plays a crucial role in the models of economic growth. According to Maqbool*et al*, 2010 in the process of investigating the economic performance of a country, one of the key determinants of economic growth is investment. Moreover, most of the countries that grow rapidly invest a considerable fraction of their Gross Domestic Product (GDP).

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).

The two most important macroeconomic policies in the economics are monetary and fiscal policies of which the monetary policy is one of the most important macroeconomic policy which the monetary authority use as a way of achieving certain economic objective in the economy such macroeconomic objectives include; employment, economic growth and development, balance of payment equilibrium and relatively stable general price level (Mengesha, 2016).

According to IS-LM model, monetary policy can be used to influence national output through increasing money supply in order to lower interest rate which, in turn, encourages investors to increase the investment with low-cost funds available for lending. The model explained that an increase in money supply could lower local interest rate compared to global interest rate. As a result, firms could increase their production through available loan with low interest rate (Mankiw, 2010).

Furthermore, it also influences expectations about the future direction of economic activity and inflation, thereby affecting the prices of goods, asset prices, exchange rates, consumption and investment levels. Accordingly, monetary decision of lower interest rate may result in high investment activities and the purchase of durable consumer goods. The expectations that the tempo of economic activities might increase will equally trigger the commercial banks and other lending institutions to ease borrowing policies, hence allowing the household and business entities to increase spending (Mengesha, 2016).

Ethiopia is the second-largest populous country in Africa, with an estimated population of nearly 100 million (in 2017 projection) and a growth rate of 2.8 percent per year. Ethiopia is a predominantly rural and young society with 84 percent living mainly in densely populated highland settlements. Ethiopia is one of the poorest countries in the world (according to World Bank report the share of the population under the poverty decreased from 30 percent in 2011 to 24 percent in 2016). The Ethiopian economy is a subsistence one that is highly dependent on agriculture, which in turn depends on vagaries of nature. Over 85 percent of the population depends on this sector for earning the means of its livelihood. Agriculture accounts for almost half of the GDP and more than 90 percent of the export earnings. However, the share of agriculture is declining steadily whereas the share of the service sector in GDP is rising recently. The share of the manufacturing sector is relatively static which is between 13 and 14 percent.

According to the African Development Bank Group, The Ethiopian real GDP growth slowed to an estimated 7.4 percent in 2019 from 7.7 percent in 2018, caused by social unrest and fiscal consolidation to stabilize the public debt. On the supply side, the leading sectors in 2019 are industry and services. Construction has a major role in the industry sector through industrial parks and infrastructure investments. Structural transformation is underway but needs to

accelerate. While agriculture's share in GDP has fallen, the sector still employs more than 70 percent of Ethiopia's workforce. In 2019 manufacturing accounts for less than 10 percent of the national GDP. Private consumption and domestic investment were the primary growth drivers on the demand side, but the domestic investment is at a slower rate.

The other most important permanent feature of the Ethiopian economy is the presence of resource (financial) gap. The resource gap can be explained as the presence of the savings-investment gap, foreign exchange gap, and fiscal gap. In recent years the savings-investment gap has been widening from an average of 1.1 percent of GDP during the Imperial period (1960-74) to 6 percent of the GDP during the Derg period (1974-91) to 11.7 percent of the GDP in the EPRDF (1991/92 2007/08). The presence of resource gap (gross domestic investment-gross domestic savings) forces the country to rely on an inflow of foreign finance (specifically foreign aid) to bridge the gap (TadesseTasew, 2011).

### 1.2. Statement of the problem

Higher economic growth brought with it positive trends in poverty reduction in both urban and rural areas. The share of the population living below the national poverty line decreased from 30 percent in 2011 to 24 percent in 2016. The government is implementing the second phase of its Growth and Transformation Plan (GTP II) which will run to 2019/20. GTP II aims to continue expanding physical infrastructure through public investments and to transform the country into a manufacturing hub. GTP II targets an average of 11 percent GDP growth annually, and in line with the manufacturing strategy, the industrial sector is set to expand by 20 percent on average, creating more jobs (World Bank, 2016).

Economic growth of a country is largely related to the level of investment. Investment plays a very important and positive role for the progress and prosperity of any country. Many countries rely on investment to solve their economic problems such as poverty, unemployment etc. Here note that not getting increased level of capital formation is the only trick, but also designing an appropriate sectoral and regional investment pattern is important to benefit from its end results. To this end the effect of public spending on private sector expenditure has received considerable attention in the economic literature. This is because of the fact that mainly public expenditure has a crowding- out effect. But for an economic growth to come economists argue that there should

be a complimentary rather than a substitutability relationship between the two. This is because the "crowding-out" effect reduces the ability of the government to influence economic activity through fiscal measures.

On macroeconomic bases formal banks providing the big role on savings, mobilization, and financial resource allocation institutions. Consequently, these roles make them an important impact in economic growth and development through investment. In performing this role, it must be realized that banks have the potential, scope, and prospects for mobilizing financial resources and allocating them to productive investments (Olumuyiwa 2012).

Public and private investments play a crucial role in achieving the goals of economic and social envelopment. The nature of public and private investment gave rise to a strong argument in economic theory and policy for a complementary relationship between them. Besides to this, there are multi dimensions of variables which determine private investment in Ethiopia. Therefore it is important to identify those significant variables which determine private investment in the country. This helps to know where to focus and what policy measures to take so as to boost private investment in the country.

According to World Bank (2016)Ethiopia Growth and Competitiveness report, Ethiopia's growth has been driven by public investment and agricultural growth. The Government has sustained high levels of public investment which has driven strong growth in agriculture and services. Despite substantial investments in infrastructure to support future growth, Ethiopia's recent economic success has occurred in a context of modest structural economic transformation and private-sector development. There has been relatively slow progress in the development of a vibrant private sector especially in manufacturing and modern services, growing indebtedness including in major state owned enterprises and persistent inflation. As the GTP II nears its midpoint, the government is shifting its focus to expand private-sector participation in an effort to enhance economic dynamism.

Ethiopia is a public investment dominated country. For example, Ethiopians private investment is the sixth lowest in the world and its public investment is the third highest i.e., in terms of government involvement. This 'big push' of public investment – led development has delivered

positive returns but the development of a strong and vibrant private sector is needed to sustain the high growth (World Bank Report, 2013).

There are many researches on the determinants of private investment than its role in the economy, its trend and problems faced (Biruk, (2001), Getaneh, *et al.*, (2003), Bikila and Abera, (2006), Simon, (2009)). In addition, AlemneshTadesse, (2012) on their paper evaluates the nexus between private investment, public investment and economic growth including trade openness on explanatory variable. The purpose of this study is to identify the kind of relationship that existed between private investment, public investment and economic growth in Ethiopia and then to investigate the main explanatory variables which determine private investment such as broad money, foreign aid and inflation.

### 1.3. Research objectives

The general objective of this study is to investigate the nexuses between private investment, public investment and economic growth in Ethiopia.

**The specific objectives:**

1. To investigate the impact of private investment on economic growth in short run and long run.
2. To investigate the impact of public investment on economic growthin short run and long run.
3. To draw policy implications arising from the study findings.

### 1.4. Research questions

This study will try to answer the following questions:

1. What is the impact of private investment on economic growth in short run and long run?
2. What is the impact of public investment on economic growthin short run and long run?
3. What is the policy implication of the findings from the study?

### 1.5. The hypothesis of the study

In accordance with the objective of the study, the following hypothesis is formulated for investigation. Hypotheses of the study stand on the theories related to private investment and public investment in improving economic growth that has been developed over the years by different researchers and past empirical studies related. Hence, based on the objective, the present study seeks to test the following null hypothesis.

*H1:* Private investment has no significant impact on economic growth.

*H*2: Public investment has no significant impact on economic growth.

*H*3: There is no significant relationship between private investment, public investment and economic growth.

### 1.6. Significance of the study

The study focuses on Ethiopia rather than all the least developing countries and accounts for the limitations of the few country-specific studies. The statistical evidence on the relationship between private investment, public investment and economic growth remains debatable. The study will focus on Ethiopia for the period from 1981 to 2017, which constitutes the most up-to-date data.

The results from this study give insight especially to policy makers on whether private investment and public investment is an appropriate policy to promote sustainable economic growth and development. With the availability of more data and advanced econometric methods, the study forms the basis of further research on the relationship between private investment, public investment and economic growth and vise versa.

Therefore, this study will contribute to the existing literatures by analyzing the relationship between private investment and public investment on economic growth and looking its impact by incorporating other relevant macroeconomic variables such as broad money, foreign aid and inflationusing the recent data.

## 1.7. Scope and Limitation of the Study

The study explores the relationship between private investment and public investment on economic growth in Ethiopia. To achieve this objective, the period's 1981 to 2017 will chosen based on availability of data for variables used in the study. Unavailability of data is usually a challenge for researchers in most developing countries like Ethiopia, as expecting the case in this study. Due to the absence of longtime series data on some variables i.e. the shortage of disaggregated data for macroeconomic variables and economic growth based on activities (sector) and types, the study will be limit to assess the aggregate relationship between private investment and public investment on economic growth and vise versa. In addition, due to the absence of data, some variables that may affect will not included in the study such as total labor force.

## 1.8. Organization of the Thesis

The rest of the paper is organized as follows; the theoretical and empirical reviews will discuss in the second chapter. The third chapter presents the methodology of research including study design, data source and methods of analysis, and model specification. The fourth chapter will be devoted to empirical analysis and interpretation of the study. The last chapter provides conclusion and policy implications from empirical findings.

# CHAPTER TWO

# 2. LITERATURE REVIEW

The purpose of this chapter is to review the related literature on the area of theprivate investment and public investment on economic growth. This establishes a framework that guides the study. The main parts of the section will discuss under theoretical and empirical literature. The first part deals with theoretical literature and the second part reviews empirical study.

## 2.1. Overview of economic growth in Ethiopia

The Ethiopian economy is continually showing successive growth. This high growth measured by the growth rate in real GDP conformably translates to high per capita income which has a potential of reducing poverty with a significant margins and further leading to economic growth. However, the major issue is that this high economic growth rate is followed by low domestic saving which are seemingly paradoxical incidence and a contested debate among policy makers, researchers and other stakeholders. The saving rate shrank significantly widening the resource gap and witnessing heavy dependence on foreign resources to increase investment and bring economic growth.

### 2.1.1. Foreign aid in Ethiopia

After 1945, Ethiopia began to receive economic development aid from the more affluent Western countries, Originally the United Kingdom was the primary source of this aid, but they withdrew in 1952, to be replaced by the United States (Edmond J, 1991) Between 1950 and 1970, one source estimated that Ethiopia received almost US$600 million in aid, $211.9 million from the US, $100 million from the Soviet Union and $121 million from the World Bank (Keller). Sweden trained the Imperial Bodyguard and India at one point contributed the majority of foreign-born schoolteachers in the Ethiopian educational system (Keller).

While the Soviet Union provided extensive amounts of aid, either directly or through its allies like East Germany (Dagne Haile, 2006) and South Yemen, this was predominantly in the form of either military aid, or ideological education; these ended with the close of the Cold War. Large aid inflows resumed in the early 1990s aimed at reconstruction and political stabilization but declined during the war with Eritrea. The post-2000 period, however, has seen a resumption of

large disbursements of grants and loans from the United States, the European Union, individual European nations, Japan, the People's Republic of China, the World Bank, and the African Development Bank. These funds totaled US$1.6 billion in 2001.

In 2001 Ethiopia qualified for the World Bank-International Monetary Fund-sponsored Highly Indebted Poor Countries (HIPC) debt reduction program, which is designed to reduce or eliminate repayment of bilateral loans from wealthy countries and international lenders such as the World Bank. In Ethiopia's case, the program aims to help stabilize the country's balance of payments and to free up funds for economic development. A noteworthy advance toward these goals came in 1999, when the successor states to the former Soviet Union, including Russia, cancelled US$5 billion in debt contracted by the Derg, a step that cut Ethiopia's external debt in half.

### 2.1.2. General Overview of Ethiopian Economy

In Ethiopian economy the agricultural sector takes the lion share on export and employment opportunity. Subject to many factors affecting this dominant sector adversely, for the last three regimes the sector did not bring meaningful and expected structural transformation to the country. The backward production techniques coupled with dependence on the unpredictable weather condition and natural rainfall made the sector's contribution to the economy of Ethiopia weak. External trade performances like coffee, skin, hides and skins are from this sector. For many years, recurrent drought, famine, poor policies and war had been the characteristic feature of the Ethiopian affecting the agricultural sector at large (Hailemariam, 2010).

Real GDP growth slowed to an estimated 7.4 percent in 2019 from 7.7 percent in 2018, caused by social unrest and fiscal consolidation to stabilize the public debt. On the supply side, industry and services continued to lead growth in 2019. Industry was driven by construction, notably for industrial parks and infrastructure investments. Structural transformation is under way but needs to accelerate. While agriculture’s share in GDP has fallen, the sector still employs more than 70 percent of Ethiopia’s workforce. Manufacturing accounts for less than 10 percent of GDP. On the demand side, private consumption and domestic investment were the primary growth drivers in 2019, but domestic investment slowed, reflecting fiscal consolidation(African Economic Outlook, 2020).

Monetary policy was tight. But inflation remained in double digits in 2019 and above the 8 percent central bank target because of central bank advances to finance the fiscal deficit. Ethiopia's managed float exchange rate foresees a 5 percent–6 percent annual depreciation to adjust for inflation differentials with trading partners. High inflation has, however, contributed to overvaluation of the Ethiopian birr despite the 15 percent devaluation in 2017, necessitating a gradual shift to a more competitive exchange rate. Fiscal consolidation has ensured low and stable fiscal deficits, despite a low tax GDP ratio, averaging 11 percent during 2016–19. Tax reforms are under way to boost revenue mobilization, but deficit financing through central bank advances has fueled inflation and reduced monetary policy effectiveness (AEO, 2020).

Current account deficits have stabilized because of the phased reduction of import-intensive capital projects in line with the government's strategy of reducing external borrowing and been partly offset by official and private transfers. Ethiopia's debt sustainability rating deteriorated to high risk in 2018 because of worsening terms of trade and the subsequent weak export performance.

The economic outlook is positive, and real GDP growth is projected to stabilize at 7.1 percent 7.2 percent in 2020–21 due to ongoing political and economic reforms and normalizing relations with Ethiopia's neighbors. Growth should benefit from the Homegrown Economic Reform Program, which seeks to address macroeconomic imbalances and unlock structural and sectoral bottlenecks, improving governance of state-owned enterprises and strengthening institutional capacities. Measures to open key sectors to competition notably transport, logistics, manufacturing, and telecommunication will attract private investment, catalyze high value-added services, and boost competitiveness. Transport investments, such as the Addis Ababa Djibouti railway, and ongoing logistics reforms, including measures to improve first- and last-mile railway connectivity, will produce efficiency gains in trade and manufacturing.

Ethiopia's public private partnership framework will diversify the country's development finance sources, improve debt sustainability, and sustain growth-generating infrastructure investments. Ongoing financial reforms, particularly to develop a capital market, will enhance domestic resource mobilization.

Overdependence on unprocessed agricultural exports has contributed to persistent trade deficits. Foreign exchange shortages, unstable electricity supply, low access to credit, weaknesses in raw material supply chains, and shortages of skilled labor have hindered business growth and reduced production capacity utilization for manufacturing firms (57 percent in 2018 versus the targeted 68 percent). Inefficient trade logistics have also slowed the development of a competitive manufacturing sector. Weak export growth and high debt-service ratios are depressing the growth outlook. Intermittent interregional conflicts could impede socioeconomic progress. Youth unemployment is high, particularly in urban areas (at 25 percent), requiring improvements in education quality to enhance employability(African Economic Outlook, 2020).

### 2.1.3. The trends of employment in Ethiopia

According to the May 2007 Population and Housing Census of Ethiopia, the population of the country is estimated to be about 73.9 million (50.46 percent male and 49.54 percent female). The total population of the country was projected to reach 79.8 million by the year 2010 and 129.1 million by the year 2030 (WB, 2007).

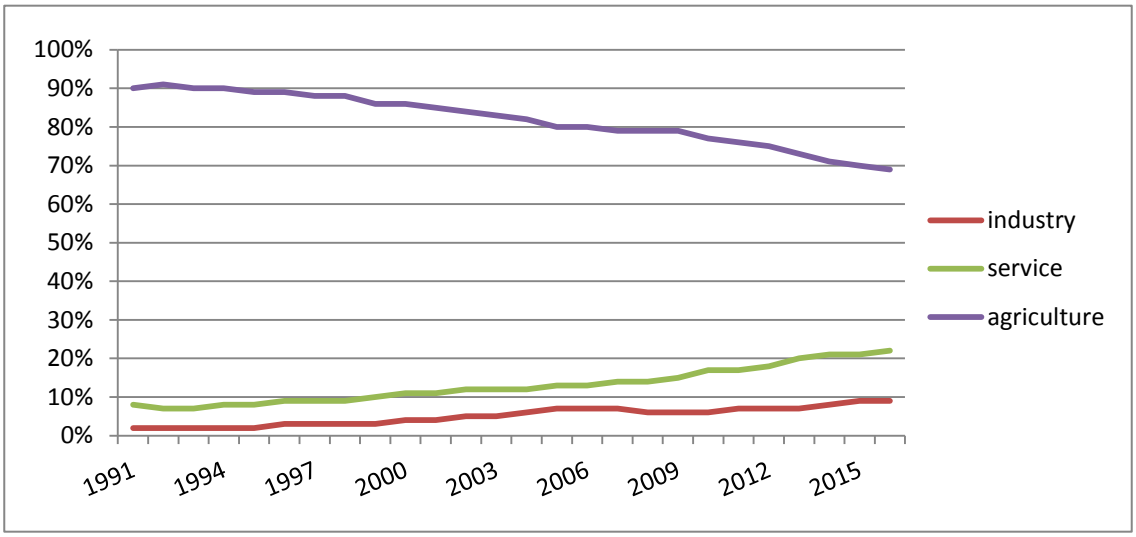
According to CSA (2007), the population of the country is estimated at about 73.9 percent million and in the last three decades, population growth experienced declining trend. However, the labor force is growing at higher rate than the population. The reason behind is that the pyramid structure of the population that dominated by youths at working age at the bottom which estimated about 45 percent. The past two decades labor force in Ethiopia has doubled and increased from 14.7 to 26.5 million within the period 1994-2005 and it increased further to 33 million in 2005, projected to reach about 26.5 by the year of 2030.it created huge pressure in employment creation in the economy. The trends of employment as showed in figure 5 that total employment increased from 15.32 million to 47.66 million in 1981 and 2016 respectively.

The literature on economic growth argues that when the given country experienced growth, location and structural transformation of labor transition from rural agricultural sector to urbanized industry and service sectors reduce poverty through higher wages in employment and increased agricultural productivity for those remain in rural by increasing land to labor ratio through innovation and capital accumulation.

The government adopted the Agricultural Development Led Industrialization (ADLI) strategy in the recent decades and it has aimed to increase agricultural productivity by encouraging labor diversification to industry and service sectors.

However, as shown in figure 6 there is still a wide disparity between agricultural and nonfarm employment. Although employment rate of agriculture sector showed declining trend in the past two decades, the growth of employment in the industrial sector is almost insignificant with the average growth of only 6 percent. On the other hand, the aggregate employment share in the service sector has increased 8 percent in 1991 to 22 percent in 2016 and has a significant contribution for labor diversification. The share of agriculture from overall employment has declined from 90 percent in 1990 to 69 percent in 2016. Although the government of Ethiopia has made a significant effort in promoting domestic and foreign investment in manufacturing sectors, the employment trends reflect slow growth in the labor demand and the figure suggest a pattern of development shifting to the service sector.

**Figure2. 1Employment rate by sector, 1991 - 2016**




Source: ILO Database

### 2.1.4. Foreign Direct Investment in Ethiopia

The trend of FDI inflow during the Derg regime was experienced a continuous decline. The command policy of the regime was not welcoming foreigninvestors and even net outflow experienced in some years due to political instability, nationalization, and unavailability of incentive policies.post-1991, FDI inflow to Ethiopia increased radically because of a policy shift from a command economy to a market-oriented economy. The inflow of FDI has increased from US$ 6 million in 1991 to $22 million in 1996 although there are fluctuations. The total FDI inflow into Ethiopia was highly increased from US$ 135 Million in 2000 up to US$ 545 Million in 2006.

Lucie Weissleder indicated 3 reasons for the heavy growth of FDI inflow since 2006, the first one was depreciation of the Ethiopian Birr compared with the currencies of the investors. The Second reason was the grabbing of natural resources to secure the food demand in the investor's country that was caused by world food crises. The existence of favorable investment climate in Ethiopia was the third reason (Lucie Weissleder, 2009).

Although FDI has shown an increasing trend over the last ten years, Ethiopia remains one of the least FDI recipients in the world. Ethiopia accounted for only 1 percent of Africa's inward FDI stock, while representing approximately 9 percent of continent's population, Solomon (2008). Due to a vast untapped resources and a wide range of investment opportunities in Ethiopia, the policymakers and the government to attract FDI inflows to the economy undertake considerable amount of effort.

## 2.2. Concepts and Definitions of investment and economic growth

Changes in national income are expected to move together with investment levels. As the Accelerator theory postulates (the Keynesian concept of multiplier which states that as the investment increase, income increases by a multiple amount, when income or consumption increases, investment will increase by a multiple amount) changes in investor's expectations about future economic conditions influence the levels of investment, the particular or main channel or variable to affect is the question of debate between the Keynesians and the Neo-Classical thinkers (Asante, 2000). Infrastructural public investment is the one that complements private investment (Bakare, 2011). For public investment, it is just a matter of whether it

competes or complements private investment. Private investment is an indication of good investment climate and therefore is expected to encourage present and future private investment. Therefore a positive correlation is expected with its present levels (Asante (2000).

Growth and development models indicate that the main factors that influence long-term growth and development are the availability of capital and labor as well as their productiveness (investment/savings) and technological progress. The low domestic savings in developing countries cannot meet the required investment, and the unsustainable current account deficit prevents these economies from importing capital goods for investment.

The success of the Marshall plan in the 1950s created a great deal of optimism that foreign aid flows to developing countries would spur economic growth and development in recipient nations. The classical economists considered capital accumulation as the engine of growth but in the absence of technological progress and foreign aid was assumed to increase physical capital stock. Schumpeter (1954) stresses that technological progress was an important determinant of growth and therefore; foreign aid only spur growth when combined with the transfer of entrepreneurship and new skills.

The contribution that monetary policies make to sustainable growth is the maintenance of price stability. Since sustained increase in price levels is adjudged substantially to be a monetary phenomenon, monetary policy uses its tools to effectively check money supply with a view to maintaining price stability in the medium to long term. Theory and empirical evidence in the literature suggest that sustainable long term growth is associated with lower price levels. In other words, high inflation is damaging to long-run economic performance and welfare. Monetary policy has far reaching impact on financing conditions in the economy, not just the costs, but also the availability of credit, banks' willingness to assume specific risks, etc. It also influences expectations about the future direction of economic activity and inflation, thus affecting the prices of goods, asset prices, exchange rates as well as consumption and investment.

A monetary policy decision that cuts interest rate, for example, lowers the cost of borrowing, resulting in higher investment activity and the purchase of consumer durables. The expectation that economic activity will strengthen may also prompt banks to ease lending policy, which in turn enables business and households to boost spending. In a low interest-rate regime, stocks

become more attractive to buy, raising households' financial assets. This may also contribute to higher consumer spending, and makes companies' investment projects more attractive. Low interest rates also tend to cause currency to depreciate because the demand for domestic goods rises when imported goods become more expensive. The combination of these factors raises output and employment as well as investment and consumer spending.

### 2.2.1. Typology of Foreign Investments

Portfolio investments can be characterized as short-term investment, highly unstable and volatile. Their purpose is to assess the deposited amount and profit from the interest rate differential. In this case, the investor interest is to control and manage the company. In Portfolio investments, the total amount of investments will be divided into individual share and each share is invested with a specific goal and risk. This investment is good to avoid losses by dividing risk among shareholder makes it possible to divide the risk that arises from the effects of future achievement. Due to the nature of portfolio investments, they are financial transactions with a speculative motive, because of their positive impact on economic growth is not provable. Therefore, portfolio investments will not be considered as part of foreign investments, which hypothetically have a positive effect on the economic growth of the country (Haddad, 1993).

In contrast, foreign direct investments are characterized by its long-term nature, non-debt and more stable than portfolio investments. Under direct foreign investments, it is not only incurring expenditure in the basic of a company capital and expands but also as reinvested its earnings and other forms of capital. Specifically, it can be a purchase of securities such as stocks or shares in a company to gain its profits, and share its management and control or as an acquisition, joint - ventures or to build a new plant. In the latter case, the investment is a physical investment or it is called "Greenfield investment or Brownfield". Under Greenfield investment, we can assume the building of new or expansion of an existing plant (Gorg, 2000). In the case of Brownfield investment, it does not involve constructing a new plant, but the investor may buy or rent an existing factory in the host country, which is not efficiently utilized. In both cases, it is establishing a new production, which is involved in the creation of domestic product and increase employment in the region. Investments through acquisitions include activities aimed at

obtaining sufficient proportion necessary to take control and ownership of the company. This is obvious that there is a change in the ownership of assets (UNCTAD, 2000).

Direct foreign investment can be realized through the improvement of existing production facilities and by increasing production efficiency. The entry of foreign capital in this form usually existed at the beginning of the transformation of the country and during the period of privatization,state own firms, when the foreign owner decides to restructure the plant itself. This form is usually associated with "lean-society," it is necessary for the context of streamlining production to accede to the dismissal of employees. A joint venture is a form of cross-border cooperation between domestic and foreign companies, who undertake to create a joint venture agreement that will enable them to maximize the mutual benefits. This cooperation will contribute to a better understanding of both companies and facilitates in export markets. (Gorg, 2000) in general, to be considered as FDI, the investor must have a certain ownership share of the company.

According to the IMF, there is a foreign direct investment if investor from foreign country obtains a share of ownership of at least 10 percent of the ordinary shares or voting rights. This criterion is known as the ten percent rule - "The 10 percent rule". From foreign direct investment is expected to result in new, expanding or acquiring existing companies that will create new jobs and new economic opportunities that will have a positive impact on the national economy.

## 2.3. Theoretical Literature

### 2.3.1. Harrod–Domar growth model

The Harrod–Domar model is used in development economics literature to explain the relationship between savings and the productivity of capital and aggregate growth theory (Mansour and Fatimah, 2011). Early Harrod-Domar growth model posits a homogenous output that can consume or invested. The model assumed that the main objective of capital is assisting investment by supporting saving that runs to investment. Thus, growth is solely falls behind and handicapped due to inefficient and inadequate level of investment arising from weak saving performances showing that the capital- labor ratio and the saving ratio consequently constrain growth.

However, capital can rise the growth rate (raising the availability of its output), and there by the resource available for investment. Based on this way that foreign aid contributes to economic growth and the Harrod-Domar growth model supported the flow of capital to encourage the low savings proportion.

The empirical finding of the 1960s as to how aid fills the resource gaps and leads to achieve a targeted growth rate prompted by the gap models. Gap model has a paramount importance in determining the amount of resource required by the aid recipient country to accomplish the level of investment demand and then to attain the targeted growth rate. Aid has a crucial role in narrating physical capital formation as a key factor that determines economic growth; it also show as that under the scenario of resource gap how much of aid is used to fill the gap (Tassew, 2009).

In addition to the above role of foreign aid in filling the saving-investment gap, a two-gap approach identified that an imported commodity not produced domestically is essential for the production of investment goods. The availability of foreign exchange rather than the supply of domestic savings, can then constrain the growth of the economy. In these circumstances foreign capital raises growth not by raising the resources available for saving, but by increasing the availability of foreign exchange to import capital goods. The model used to argue that the contribution of foreign capital to growth is greater in a situation where growth is constrained by the availability of foreign exchange (Chenery and Bruno, 1962; Chenery and Strout, 1966).

Most developing countries, however, assumed to fall into the second category, where the foreign-exchange gap is binding. The existence of complementary domestic resources would permit them to undertake new investment project if they had the external finance to import new capital goods and associated technical assistance. Foreign aid can therefore play a critical role in overcoming the foreign exchange constraints and raising the real rate of economic growth.

Bacha (1990) extended the two-gap model into a three-gap model, wherein the fiscal gap constraints the private sector investment at a level below what available national saving permit. For a government to finance its deficit must be the option of searching for finance in different ways. For example, the government may resort to borrow from central bank (CB) by printing money leading to a seingiorage (inflation tax) and this excess inflation debilitates the private

investment. In the other way the government borrowing from private sector to financing their capital and this is limited due to the shortage of financial capital in most LDCs.Aid can relax the financing constraints by supporting the budget (Brone, 1994).The gap model had the tradition of stressing physical capital formation as a central deriving force of economic growth and aid played a major role in filling the above three gaps, its effectiveness and welfare implications remain debatable Tassew (2009).

The big push theory, which was the first conceptualized by Professor Paul Rosenstein-Rodan in 1943 and later modified by Murphy, Shleifer and Robert wvishny in 1989, was the most used theory in aid-growth literature. The theory assumes that poverty traps- which arises from various factors such as weak savings, low production capacity, and high population- hampers growth and development and therefore; a big push (involving a temporary injection of capital in form of foreign aid) increases investment in many different sectors leading to a take-off into self-sustaining growth.

Collier (2007) identified internal conflict traps, bad governance traps, natural resources traps, and landlocked by bad neighbor traps as the four significant traps that affect the bottom billion of the world's population. Rostow (1990) sees ODA as a precondition for take-off into self-sustaining growth. Sachs *et al.*, (2004) claims that sub-Saharan-Africa require a temporary big push from capital formation to spur economic growth and reduce poverty.

The big push model lost credibility for a while but gained it again in 2005 and used as a rationale for large foreign aid programs. Sachs (2005) argues that it is feasible for aid to accelerate growth in Africa to meet the MDGs target of halving the poverty rate by 2015 if aid flows are increased. The big push theory assumes that once a country attains self-sustaining growth, it will stop receiving aid. Rostow (1960) argued that aid could be discontinued after 10-15 years while Sachs (2005) predicted the discontinuation of aid in 2025. Easterly (2006) found no evidence of poverty traps and also never found much data in support of take-offs induced with aid and investment and therefore; found very little evidence in support of the theory. To Easterly, some poor countries such as China, Botswana, India, and Lesotho advanced quite nicely and rapidly out of poverty without significant foreign assistance while other countries like Zaire and Chad had no growth or declined despite massive foreign assistance.

The Harrod-Domar growth model indicated that the saving rate and capital-output ratio jointly determine full capacity growth rate (g=s/v) of a closed economy (Harrod, 1939; Domar, 1946). Chenery and Strout (1966) extended the Harrod–Domar model into two-gap model by introducing foreign exchange shortage [g = (s/v) + (a/v)]. The smaller gap is considered binding and foreign aid is perceived to fill the gap. The dual gap models are used throughout the 1970s and 1980s to justify the effectiveness of the capital formation on economic growth. Bacha modified the two-gap model to the three-gap model by incorporating the fiscal gap (Bacha, 1990).

Foreign aid was expected to finance the most pressing gaps leading to an increase in investment and hence economic growth; initiating an upward path to economic development. Weisskopf (1972) argues that aid substitute's domestic savings. The gap models are oversimplified (assumes that aid converts entirely into an investment which in turn converts entirely into growth). The financial gap model still used by the World Bank in judging the extra resources that developing economies would need to finance investments and imports.

Due to its simplicity and flexibility, the neoclassical model forms the basis for various extensions and identifies the core determinants of long-term growth and development. Solow model together with subsequent extensions and refinements have been used in aid-growth literature since the late 1990s. The model predicts that the economy will converge to a steady-state growth determined by the rate of population growth and rate of technological change. The model attempts to explain that aid inflows are important in the short-run, but the steady-state growth rate will be reached at a higher level of GDP per capita.

However, without a change in any fundamental factors (e.g. technology), an increase in capital above steady-state will begin to depreciate and therefore; countries will be pushed back towards the steady-state level. Dalgaard and Erickson (2009) offer a basic framework in which to analyze progress towards halving poverty by 2015 and concluded that past and future expectations for capital in promoting growth and reducing poverty have been too high.

Endogenous growth models developed by Lucas (1988) and Romer (1986) are praise for incorporating human capital, institutions and policy factors as well as endogenous technological progress and growth in labor productivity. The argument is that low human capital, infrastructure

causes poverty, and hence capital is assumed to improve human capital and infrastructure necessary for sustained growth.

### 2.3.2. Neo-classical Theory

The Neo-classical theory argues that the rate of interest is the important determinant of investment. The neoclassical model assumes that the desired stock depends not only on planned output but also on the ratio of output price to the implicit rental price of the services of capital goods (Bischoff, 1971). Basically it is derives from a profit maximization process aimed at desired capital given a Cobb-Douglas production function. Bodie, Alex and Marcus (2009) note that Keynesian (demand-side) economists look at effects of taxes on consumption demand whereas supply-siders (Neoclassical) argue that lowering tax rates will elicit more investment and improve incentive to work. Accordingly, monetary policy works largely through its impact on interest rates. Increases in the money supply lower interest rates which in turn stimulate investment demand (Galbraith, 1987).

### 2.3.3. The Accelerator Theory

The main implication the accelerator theory of the model is that the investment expenditure of an investing firm is proportional to its output while its output is a function of demand (Chenery (1952), Koyck (1954), Leeuw (1962), Evans (1967), Carver (1903), Aftalion (1909), Bickerdick (1914) and Clark (1917).

Samuelson‘s accelerator theory suggests that investment is a function of past changes in income (Galbraith, 1987). It follows the Keynesian view that the levels of investment influence and changes by investor‘s expectations about future economic conditions. The desired investment definitely depends on planned total output. Neo-classical believed that investment is very sensitive to the interest rate while Keynes believe that changes in investor‘s expectations about future economic conditions are far important in explaining changes in levels of investment. Keynesian and Neo-classicals both are agreed that equilibrium investment occurs when the expected rate of return in investment equals to the interest (Byrns and Stone, 1981). The declines of government spending directly deflate the demand for goods and services. This also decreased investment activities (Bodie, *et al.,* 2009).

## 2.4. Empirical Literatures

WoldemariamFujaw, (2018) on their MSc thesis entitled "The Determinants of Private Investment in Ethiopia". They try to investigate and analyzing factors that determine private investment in Ethiopia from 1996 to 2016. The regression results show that real GDP, access to bank credit, external debt servicing and public investment have significant positive effect on private investment, while foreign direct investment and lending interest rate have significant but negative effect on performance of private investment. They suggested that strengthen financial institutions able to provide sufficient financial resource to private investors.

Aslam&Awan, (2018) on their research called "The effect of monetary policy on Pakistan's economic growth". They try to investigate the effect of monetary policy on economic growth. They found that monetary policyhad a significant impact on inflation rate, money supply, employment, gross capital formation, foreign direct investment, savings and other macroeconomic variables.

EyobeFeleke, (2015) on their MSc thesis entitled "The Role of Private Investment to the Economic Growth of Ethiopia". They try to investigate the private sector development in Ethiopia. They found that the increase in the net public investment, have a negative impact on growth and the increase in the active labor force has a positive impact on growth. They suggested that public policies should be supportive to the growth of private sector and foster external competitiveness and a prudent fiscal stance.

Tibebu (2014) on their MSc thesis entitled "Impact of foreign direct investment on domestic private invetment in Ethiopia". They try to investigate the relationship between FDI and domestic private investment using time series data over the period 1970-2012. The study shows that FDI crowds-out domestic private investment and foreign direct investment does not have a significant effect on economic growth. According to the study in the long run economic growth have a significant positive effect on both foreign direct investment and domestic private investment. Remal (2012) empirically analyze the relationship between foreign direct investment and poverty for the period 1970-2009. The study uses co-integrated VAR approach and the result showed there is the negative impact of FDI on economic growth.

AlemneshTadesse, (2012) on their MSc thesis entitled "The nexuses between public investment, private investment, trade openness and economic growth in Ethiopia: co-integrated var approach". They try to investigate about is there a nexus between public investment, private investment, trade openness and economic growth in Ethiopia during the period of 1970-2009. They found that public investment, trade openness and private investment have complementing effect on long run economic growth, economic growth and trade openness also complements private investment, but trade openness reduces public investment, while in Ethiopia economic growth and private investment encourages expansion of public investment, there is bi directional causality between private investment, real GDP and public investment and in Ethiopia economic growth is in quicker transitory pattern to the long run time path, while private investment and public investment exhibits relatively slower transitory pattern to the long run time path.

Yohannes B (2011) on his studies the title of "The impact of foreign aid on economic growth and the Transmission mechanisms (i.e. investment, import and government consumption expenditure) of Ethiopia using Johansson maximum likelihood approach over the period of 1970/1 to 2008/9". He found that in the long run foreign aid has a positive and significant impact on economic growth through its significant contribution to import and investment. However, in the short run aid has a significant impact on economic growth and government consumption expenditure.

Tasew T (2010) on his studies the title of "The impact of foreign aid on investment and economic growth in Ethiopia over the period 1970 to 2009 using multivariate co-integration analyses". The empirical result shows that aid has a significant positive impact on investment in the long run. And the volatility of aid has a negative influence on domestic capital formation activity. In general foreign aid is effective in enhancing growth. The aid-policy interaction term has a significant negative effect on economic growth.

Shonchoya (2010), on their research they try to show the recent pattern of government expenditure in developing countries using a panel data of 1984 to 2004 from 111 developing countries, this study finds that the expansion of public economy is influenced by the greater economic affluence of a nation.

Aka (2007) on their research used an autoregressive-distributed lag (ARDL) error correction model to explore the effect of public and private investment on the economic performance of

Cote d’Ivoire for the period 1969–2000. They try to show that the effect of private investment in the short run is greater than that of public investment, whereas the opposite is the case in the long run.

# CHAPTER THREE

# 3. RESEARCH METHODOLOGY

This section constitutes three parts. The first part of the chapter specifies an appropriate model use to analyze the relationship between private investment, public investment and economic growth in Ethiopia. In doing so after the growth model is specified, brief description of variables with their hypothesized sign is stated. Then, the second parts will presents the sources of data on the variables will be used in construction of the model. Finally, the chapter winds up by explaining the estimation methods use for the study at hand.

## 3.1. Data Type and Source

To investigate the relationship between private investment, public investment and economic growth, annual time series secondary data over the period of 1981-2017, have been used.This study was entirely dependent on secondary data. The major data sources are National Bank of Ethiopia (NBE) and World Bank (WB).

## 3.2. Research Design

The study used longitudinal research design since it fits the secondary data collected from various sources.

## 3.3. Methods of Analysis

The collected data analyze and interpret through the use of different techniques of data analysis and interpretation. In this study both simple descriptive and econometrical methods of data analysis are employed. To analyze the trends of private investment, public investment and economic growth during the study period, we used tools of descriptive statistical such as trend graphs andAutoregressive Distributed Lag (ARDL) approach and ECM-ARDL model to assess the long-run cointegrating relationship among variables in the model by using E-views 10 software.

### 3.4. Econometric Model Specification

To obtain an empirical estimate of the relationship between private investment, public investment and economic growth, the study examined the micro-foundations of the relationship, from which economic growth indicators were derived.

Few studies were undertaken in order to understand the relationship between private investment, public investment and economic growth in developing countries. And different variables and methods were used to analyze it. Some studies focused on the impact of private investment on economic growth while some others focused on the determinants of public investment on economic growth. As it is difficult to analyze the relationship between private investment, public investment and economic growth on all sectors and variables in a single study, the major objective of this study is to investigate the nexuses between private investment, public investment and economic growth in Ethiopia. The growth equation was specified on the basis of the theoretical propositions reviewed in the literature that helps to examine the impact both private and public investment on economic growth.

Although neoclassical growth model predicts that labor and capital inputs are able to explain the bulk of economic growth patterns in a given country, there is still scope to account for the role of other explanatory variables in deriving output changes. Such factors may be considered on the basis of further theoretical foundations as well as country-specific characteristics. Among such factors, the recent literature on economic growth has centered on as a percentage of GDP, total net private capital flows as percentage of GDP, trade as a percentage of GDP to account for the degree of openness of the economy, budget deficit, broad money, inflation, foreign direct investment, etc, as possible growth enhancing variables.

The empirical model specified in this paper is motivated by Solow's (1956) growth model and will use to establish a link between theory and empirics. The relative slowness in adjustment outside steady state justifies the use of Solow model.

Assume that we have the following Cobb-Douglus production function of a capital formed countries.

$$Yt = Kt^{\alpha} [At\ Lt]^{1-\alpha}$$

Where; At is labor augmenting technology which grow in time at g rate;

L t is labor force which grows in time at λ rate;

Kt is capital;

Yt is total production (GDP);

[At L t] = Et is effective labor force which grows (Ė/Et) in time at (g+λ) rate

$Et = L0\ e^{gl+\lambda,t} = Lt^{e\lambda,t}$ ; $Lt = L0\ e^{gl+\lambda,t}$ ,

Where: L0 is initial labor force.

α – output elasticity of capital

**GDP per capita**

**Assumption**

Effective units of labor = total population

$Y_t/E_t = Kt\alpha\ E_t\ (1-\alpha)/E_t$

$y_t = K_t^{\alpha}\ E_t^{-\alpha} = (Kt/E_t)^{\alpha} = k_t^{\alpha}$ …….(1)

**Capital accumulation**

$\dot{K} = I_t - \delta K_t$…….2)

Where:

$\dot{K} = (\Delta K_t/\Delta_t)$

It= Investment

Δ= Capital depreciation rate

$I_t$= Ig+Ip

$\dot{K} = Ig + Ip - \delta K_t$ …….. (3)

Where: g and p represents public and private sector respectively

Capital stimulates economic growth through investment. Suppose a fraction $\phi$ of capital is invested by the public sector and the remaining (1-$\phi$) consumed or wasted, we can rewrite equation three as;

$\dot{K} = \phi capital + Ip - \delta Kt$;

In per capita terms

$\dot{K}/E = \Phi oda/E + Ip/E - \delta K_{t/E} = \phi oda + i - \delta k$

But $\dot{k} = \Delta(Kt/Et)/E = Et\,\dot{K} - Kt\,\dot{E}/E = \dot{K}/E_t - Kt\dot{E}/EtEt$

Where: $\dot{K} = (\Delta Kt/\Delta t)$, $\dot{E} = (\Delta Et/\Delta t)$, $(\dot{E}/E) = (\lambda + g)$

Therefore;

$\dot{k} = \phi capital + i - \delta k - (\lambda + g)k = \phi oda + i - (\delta + \lambda + g)k$ …… (4)

Expressing the rate of growth of GDP per capita in terms of the rate of capital stock per capita and substituting equation 4 yields

$\dot{y}/y = \alpha\ \dot{k}/k = \alpha * \phi capital/k + i - (\delta + \lambda + g)k + = \alpha\ (\phi capital + i)/k - \alpha\ (\delta + \lambda + g)$ ……. (5)

Differentiating equation 5 with respect to capital/per capita we have

$\Delta(\dot{y}/y)/\Delta capital = \alpha\phi\ 1/k$ ……. (6)

Equation 6 implies that a 1percent point increase capital in investment should at most raise the long run economic growth rate by $(\alpha\phi)/k$ percent and therefore; the coefficient of investment in the regression should be related to the $\alpha$ (capital share in output), $\phi$ (fraction of capital invested), and k (capital per capita). Equation 5 justify the choice of the model

Therefore, the ultimate log linear empirical model is specified as follows:

Equation1: GDP = f (PRINV, PUBINV, ODA, M2, INF)

Equation2: PRINV = f (GDP, PUBINV, ODA, M2, INF)

Equation3: PUBINV = f (PRINV, ODA, ODA, M2, INF)

$$\text{Equation1:} \ln GDP_{t=} \theta_0 + \theta_1 \ln PRINV_t + \theta_2 \ln PUBINV_t + \theta_3 \ln ODA_t + \theta_4 \ln M2_t + \theta_5 \ln INF_t + \varepsilon_{it}$$

*for t = 1, 2 3,…, …,36* (7)

$$\text{Equation1:} \ln PRINV_{t=} \theta_0 + \theta_1 \ln GDP_t + \theta_2 \ln PUBINV_t + \theta_3 \ln ODA_t + \theta_4 \ln M2_t + \theta_5 \ln INF_t + \varepsilon_{it}$$

*for t = 1, 2 3,…, …,36*

$$\text{Equation1:} \ln PUBINV_{t=} \theta_0 + \theta_1 \ln GDP_t + \theta_2 \ln PRINV_t + \theta_3 \ln ODA_t + \theta_4 \ln M2_t + \theta_5 \ln INF_t + \varepsilon_{it}$$

*for t = 1, 2 3,…, …,36*

Where;

$RGDP_t$ = Real Gross Domestic product at time t

$PRINV_t$ = Private investment flows at time t

$PUBINV_t$ = Public investment flows at time t

$ODA_t$=Official Development Assistance at time t

$M2_t$ = Broad money at time t

$INF_t$ = Inflation at time t

### 3.4.1. Unit Root Test

Unit root test procedure is use to find out the order of time series variable stationarity to use the correct estimation procedures. A series is considered non-stationary when it has unit root. Such results will show spurious regression; this means $R^2$ squareand t statistics are no longer valid to make the hypothesis tests. The unit root tests were evaluated using the Augmented Dickey-Fuller (ADF) test to check stationarity and order of integration of the variables.

### 3.4.2. Augmented Dickey-Fuller Test (ADF)

The Augmented Dickey-Fuller test is use to check whether the variables in the time series are stationary or not. According to Fuller (1976), the optimal lag length should be chosen so that the variables are not serially correlated which is determined by using two options; Akaike Information Criterion (AIC) or Schwartz Information Criterion (SIC). The ADF test allows for two options while conducting the tests; i.e., constant without trend and constant with trend. The null hypothesis for the series claims that it has unit root or is non-stationary. On other hand, the alternative hypothesis claims that the series is stationary.

### 3.4.3. ARDL bound test for co-integration

The ARDL-Bounds Test procedure is preferable from the previous models, such as the two-step procedure of Engle and Granger (1987) and the Johansen (1995) technique. The drawback of Engle-granger procedure is that it does not allow the variable in the right hand side to be potentially endogenous. Furthermore, errors introduced in the first step may transfer to the next step and it reduces the result reliability (Enders, 1996). Johansen Maximum Likelihood Cointegration method can estimate more than one cointegration relationship .however, it require all variables to be integrated in the same order (Pesaran*et al.*, 2001).

The advantages of the ARDL model and the Bounds Test over the above methods includes ARDL model can be employed whether each of the time series variables is integrated of order zero I(0), order one I(1), or are mutually co-integrated. The ARDL model also has an option to include lagged differences of varying orders in the variables. In addition, The Error Correction Model (ECM) can be derived from ARDL model through a simple linear transformation, which integrates short-run adjustments with long-run equilibrium without losing long-run information. The associated ECM model takes a sufficient number of lags to capture the data generating process in general to specific modeling frameworks. This procedure provides an efficient estimate of the long-run model and avoids biases problem that arises from small sample size (Pesaran et al, 2001). Further, the model provides unbiased and valid estimates of the long run model with the endogenous variable among the regressors (Harris and Sollis, 2003). Therefore, due to the above advantages, the researcher has use ARDL model to examine the relathion ship of private investment, public investment and economic growth.

The ARDL model for the standard log-linear functional specification of a long-run relationship among Real Gross Domestic product (RGDP), Private Investment (PRINV),Public Investment (PUBINV), Official Development Assistance (ODA), Broad money (M2) and Inflation (INF) may follow as: for equation 1

$$\Delta \mathrm{LnRGDP_t} = \beta_0 + \beta_1 \mathrm{LnPRINV_{t-i}} + \beta_2 \mathrm{LnPUBINV_{t-i}} + \beta_3 \mathrm{LnODA_{t-i}} + \beta_4 \mathrm{LnM2_{t-i}} + \beta_5 \mathrm{LnINF_{t-i}} + \sum_{i=1}^{j} \alpha_{1i} \Delta \mathrm{LnPRINV_{t-i}} + \sum_{i=1}^{k} \alpha_{2i} \Delta \mathrm{LnPUBINV_{t-i}} + \sum_{i=1}^{l} \alpha_{3i} \Delta \mathrm{LnODA_{t-i}} + \sum_{i=1}^{m} \alpha_{4i} \Delta \mathrm{LnM2_{t-i}} + \sum_{i=1}^{n} \alpha_{5i} \Delta \mathrm{LnINF_{t-i}} + \varepsilon_t$$

*For t = 1, 2, 3…36* (8)

Where:

LnRGDP = Real Gross Domestic product at time t

$\mathrm{LnPRINV_t}$ = Private investment flows at time t

$\mathrm{LnPUBINV_t}$ = Public investment flows at time t

$\mathrm{LnODA_t}$=Official Development Assistance at time t

$\mathrm{LnM2_t}$ = Broad money at time t

LnINF = Inflation at time t

$\varepsilon_t$ = an error term and

$\Delta$ =First difference operator

(j, k, l, m & n) =denotes lag length of the autoregressive process by using the minimum Akaike Information Criterion (AIC).

The ARDL approach to cointegration involves three steps for estimating the long-run relationship (Pesaran*et al.*, 2001). After the empirical works of (Alimi*et al.*, 2013), (Gebrehiwot, 2016) and (Pinn*et al.*, 2011), The first step in the ARDL bounds testing approach is to estimate Equation (8) in order to test for the existence of a long-run relationship among the variables by

conducting an *F*-test for the joint significance of the coefficients, $\beta_i$'s ($i$ = 1, 2,…, The null hypothesis is:

$H_0=\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$ (no co-integration or no long-run relationship)

The ARDL bound test is based on the Wald-test (F-statistic). The asymptotic distribution of the Wald-test is non-standard under the null hypothesis of no co-integration among the variables. According to Pesaran*et al.* (2001), two critical values will be given for the co-integration test. The lower critical bound assumes all the variables are I(0) meaning that there is no co-integration relationship between the examined variables. The upper bound assumes that all the variables are I(1) meaning that there is co-integration among the variables. When the computed F-statistic is greater than the upper bound critical value, then the H0 is rejected (the variables are co-integrated). If the F-statistic is below the lower bound critical value, then the H0 cannot be rejected (there is no co-integration among the variables). When the computed F-statistics falls between the lower and upper bound, then the results are inconclusive.

When long-run co-integration confirmed from the bound test, the second step in the ARDL procedure is estimating the long-run model for LnRGDP (for Equation1) as follow:

$$\mathrm{LnRGDP_t} = \beta_0 + \sum_{i=1}^{j} \beta_{1i}\,\mathrm{PRINV_{t-i}} + \sum_{i=1}^{k} \beta_{2i}\,\mathrm{LnPUBINV_{t-i}} + \sum_{i=1}^{l} \beta_{3i}\,\mathrm{LnODA_{t-i}} + \sum_{i=1}^{m} \beta_{4i}\,\mathrm{LnM2_{t-i}} + \sum_{i=1}^{n} \alpha_{5i}\,\mathrm{LnINF_{t-i}} + \varepsilon_t$$

*For t = 1, 2, 3…36* (9)

The final step is to estimate the coefficient of error correction term as well as short-run effects of the variables, Error Correction Model (ECM) based on Akaike Information Criterion (AIC) is estimated as follow: for Equation1

$$\Delta\mathrm{LnRGDP_t} = \alpha_0 + \sum_{i=1}^{j} \alpha_{1i}\Delta\,\mathrm{LnPRINV_{t-i}} + \sum_{i=1}^{k} \alpha_{2i}\,\Delta\mathrm{LnPUBINV_{t-i}} + \sum_{i=1}^{l} \alpha_{3i}\,\Delta\mathrm{LnODA_{t-i}} + \sum_{i=1}^{m} \alpha_{4i}\,\Delta\mathrm{LnM2_{t-i}} + \sum_{i=1}^{n} \alpha_{5i}\,\Delta\mathrm{LnINF_{t-i}} + \delta\mathrm{ECM_{t-i}} + \varepsilon_t$$

*For t = 1, 2, 3…36* (10)

where, $\alpha_{ij}(i = 1, 2,\ldots,5)$ are the short-run dynamic coefficients of the model's convergence to equilibrium and $\delta$ is the speed of adjustment parameter and ECM is the error correction term that is derived from the estimated equilibrium relationship of Equation (8) in the following form,

$$\mathrm{ECM_{t-1}} = \mathrm{LnRGDP_{t-i}} - \eta_0 - \eta_1 \mathrm{LnPRINV_{t-i}} - \eta_2 \mathrm{LnPUBINV_{t-i}} - \eta_3 \mathrm{LnODA_{t-i}} - \eta_4 \mathrm{LnM2_{t-i}} - \eta_5 \mathrm{LnINF_{t-i}}$$

Where, $\eta_i(i = 1, 2\ldots5)$ are the estimated parameters. (11)

### 3.4.4. Diagnostic Checking

The diagnostic test is undertaken to check whether or not the model is affected by econometrics problem by applying misspecification test, serial correlation test, normality test and heteroscedasticity test. Finally, the stability of the long-run coefficient is tested by the short-run dynamics. Once the ECM model which is given by equation (11) has been estimated, the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests are applied to assess the parameter stability (Pesaran, 1997).

**Table3. 1Description and Measurement of Variables Studied**

| Type of Variable | Specification of variables | Sign | Unit |
|---|---|---|---|
| $RGDP_t$ | Real Gross Domestic product at time t | | Annual |
| $ODA_t$ | Official Development Assistance at time t | + | Annual |
| PRINV | Private investment flows at time t | + | Annual |
| PUBINV | Public investment flows at time t | + | Annual |
| $M2_t$ | Broad money at time t | + | Annual |
| $INF_t$ | Inflation at time t | - | Annual |

# CHAPTER FOUR

## 4. RESULT AND DISCUSSION

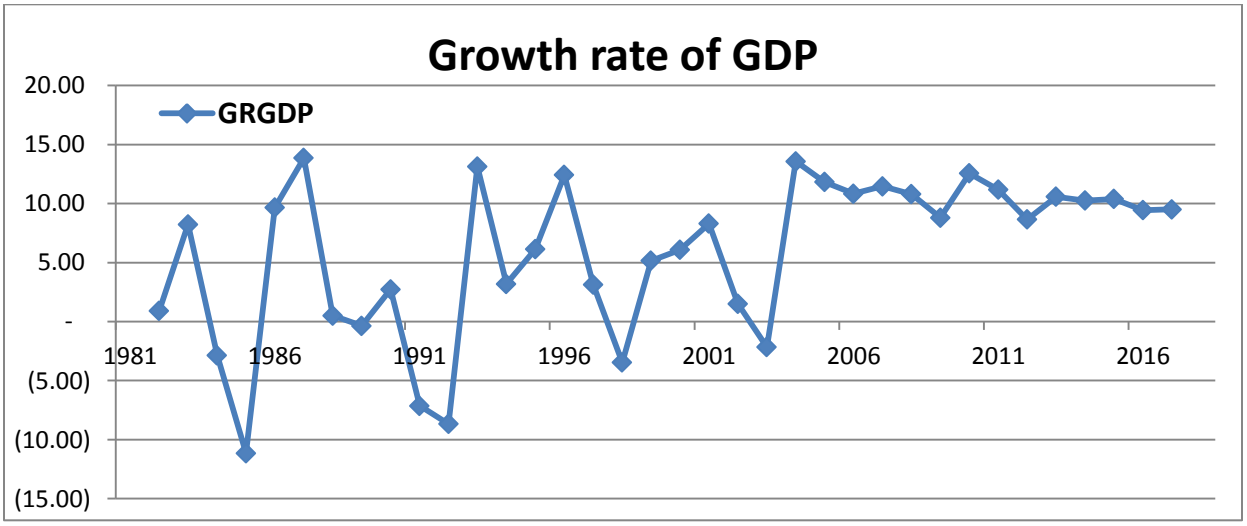
### 4.1. Descriptive statistics results

#### 4.1.1. Trends of economic growth in Ethiopia

Ethiopia's gross domestic product (GDP) growth in the study period from 1981 to 2017 performs several ups and downs but it was estimated to have rebounded to 10 percent in 2017. According to officialstatistics, Ethiopia's annual rate of economicgrowth, which averaged 10 percent over2006–2016, slowed to 9 percent inFY2016 due to drought-related lower agricultural production. With agricultural recovery, gross domestic product (GDP) growth rebounded in2017.

When we look back to the performance of Ethiopian economy in the post 1991 the good performance of the economy was seen in 1983 which is 8 percent but in the following subsequent years from 1984 to 1985 the growth of the economy was below zero percent. Following this recession period the economy was showed recovery till 1987 but again it starts to fall up to the change of the government in 1991.

**Figure4. 1: Trends of economic growth in Ethiopia**




In the post 1991 Ethiopia was in transition to form the new government and the economy was at the lower stage but following the year 1993 the economy starts to recover gradually. But when

the country falls in the war with Eritrea since 19998 again the economy starts to fall till it starts to recover in 1999.

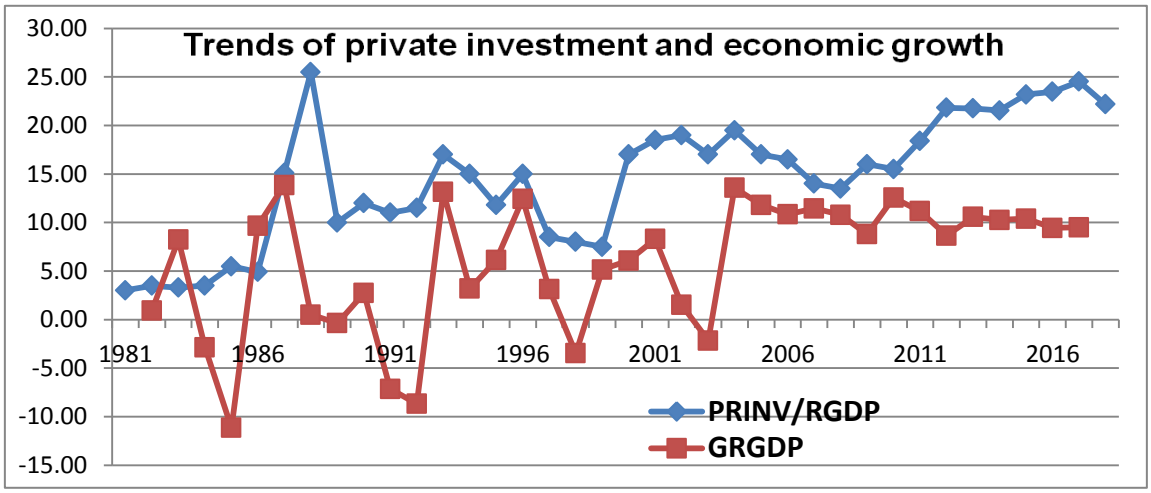
There is broad consensus that the rapid economic growth in Ethiopia was since 2000 till now with average growth rate of 8 to 9 percent and it is believed that it is largely driven by public investment in infrastructure (World Bank, 2016).

### 4.1.2. Private Investment Trend and Economic growth

The Ethiopian private investment performance has been weak for long time. It had been stagnantly low until the end of the socialist regime in 1991. Domestic private investment has started to rise since 1992 and also contracted during the 1998-2000 border war and few years following the 2005 national election. In this period investment is one of the volatile macroeconomic variables.

Investment is regarded as one of the engines of growth and prosperity of nations. Since it mobilizes idle resources, be it material or human, investment has special importance for developing countries. Ethiopia, as a developing country, needs a huge surge of investment from both public and private sources. More or less, various investment policies have been designed and implemented since long time ago. However, the private investment performance trend of Ethiopia has been very low for a long time since 1980's. Figure 4.2 below indicates the long term performance of private investment in Ethiopia. In per capita terms, private investment has never been above10 percent until 2000. It also shows that its performance has been below the full trend for continuous years (1981- 93). Below trend performances are mostly associated with either political chaos or natural disasters.

**Figure4. 2Trends of private investment and economic growth**




The share of private investment in GDP and its contribution to the development process of the country have been at their extreme low levels. Its contribution to GDP has never been above 6 percent. In the period considered, its highest contribution to GDP was recorded to be 5.75% in 1996 while its lowest was 2.82% (1991). Figure 2 displays the fluctuation of the percentage share of investment in GDP around its flat time-trend with a slight rise in its contribution since 1993.

Year 1991, marked the end of the socialist era and the beginning of the transition towards the liberal/market oriented system, is clearly identified as the starting point in time for the revival of private investment in Ethiopia. The relatively better investment performances of the post-1992 period, noting the severe declines in 1998-2000 and the post-2005 few years, might have some sensible reasons linked with the policy stances of the respective regimes, stability, increased openness/liberalization moves, improved investment climate and other macroeconomic and institutional factors.

Private investment has been very volatile and declining in recent years. It increased to about 15% of GDP right after the 1991-92 economic reforms but declined sharply in the second half of the 1990s. Although private investment bounced back to 18% of GDP during 2002-2004, it steadily declined to about 14% of GDP in 2011. It is only in 2012, half way into the first GTP that private investment for the first time rose above 20% of GDP. While some of the reasons behind the unimpressive and volatile private investment will be discussed shortly, it is clear that the steady

increase in public investment has not yet attracted commensurate private investment. The unsteady and limited expansion of productive capacity in the private sector is an important concern for sustained economic growth of Ethiopia.

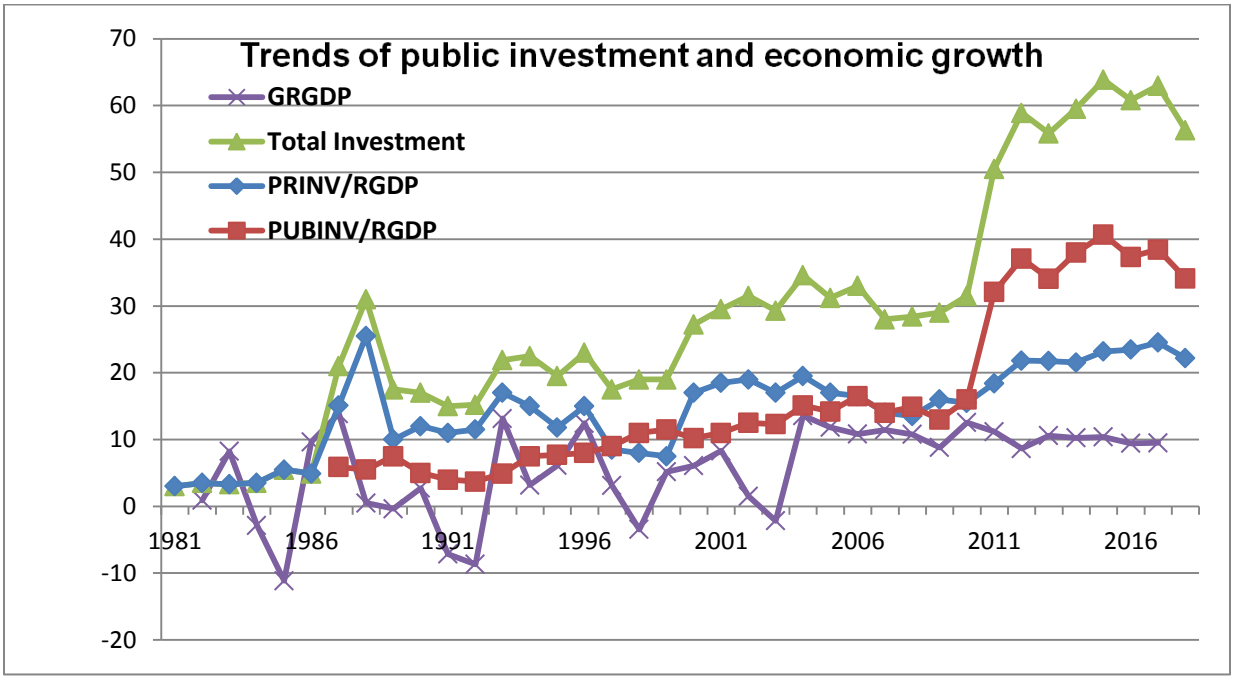
### 4.1.3. Trends of Public Investment and economic growth

The important things we understand from Figure 4.3below is 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 Derg regime. This downward trend, however, did not improve in the early periods of the transitional government until 1992, primarily due to the violent political change. Also we can observe that the rising importance of private investment during the post-Derg period, which was brought about by the liberalization policies pursued by the incumbent with the support of the WB and IMF stabilization policy. We can also see that the expansion ofpublic investmentfrom2001 onward due to the shift inparadigm from aneoliberalparadigm toapro-poorgrowthpolicyandstate-led development program.

When we look through the trends of investment and economic growth we can conclude that that the rapid economic growth in Ethiopia was since 2000 till now with average growth rate of 8 to 9 percent and it is believed that it is largely driven by public investment in infrastructure (World Bank, 2016). These would be associated with expansion of road networks, construction of hydroelectric power plants and transmission lines, airports, telecommunication systems, health and education facilities, and most recently railways. For instance, a series of Road Sector Development Programs have significantly improved road accessibility. Although evidence remains scant, Shiferaw et al., 2015 find that improvements in road infrastructure have allowed a growing number of new firms to locate outside the historical centers of manufacturing including the capital city Addis Ababa and increased average size of startup firms.

Figure 4.3 shows that the investment rate in Ethiopia doubled from about 20% of GDP in the second half of the 1990s to about 40% of GDP in 2014..Most of this increase is attributed to a steady increase in public investment from about 5% of GDP in 1992-93 to 16% of GDP in 2014.

**Figure4. 3Trends of public investment and economic growth**




Before the launch of the GTP in 2010, the Government of Ethiopia adhered to a development strategy dubbed Agricultural Development Led Industrialization (ADLI) that emphasized improving agricultural productivity. Major interventions under ADLI included provision of fertilizers, improved seeds and extension services to smallholder farmers.

These public sector investments unlike the recent empirical findings in developing were found to substitute the private sector in Ethiopia rather to complement it. This is not surprising because the majority of the year's estimated had fallen in the period where government capital budget, which is used as a proxy public investment, used to establish state-owned enterprises. On the other hand, the remaining years out of 24that expected to have the positive impact outweighed by seventeen years negative influence. Real exchange rate was also found to influence the sector negatively over the period. The result looks confirmed the existing situation of real exchange rate in both periods. The first, pre-reform period used to be with multiple and over valuation which acted as a tax on export while the post-1992 is the devaluation period with gradual adjustment to the parallel market having negative impact on the returns to investment as it increases the cost of capital goods imported in a short time period.

From the descriptive analyses, we have observed that Ethiopian investment has been

extremely weak as signified by its low values and share of investment to GDP. Gross private investment has been sluggish in the period 1981-1992 while it was reviving since 1993. Domestic investment is found to be the main component of total investment, while FDI had been negligibly low until its slight resurgence in 1994-1995 and considerable swing since 1996.

### 4.2. Econometric analysis

#### 4.2.1. Test for unit roots

The data set deployed for this study is a time series data. According to Harris (1995) when dealing with time series data it is important to test the stationary or non-stationary nature of the data set for the reason that non-stationary variables might lead to spurious regression. Thus, before checking the unit root the variables need to be checked whether they have trend graph or not. The E-view 10 software gives the following trend result.

The output showed that the variables exhibit trending which is prone to noise or other rapid phenomena resulting in unstable behavior. Therefore, once the graph is trending, we need to check the existence of unit root for all variables. A unit root is a feature of some stochastic processes that can cause problems in statistical inference involving time series models. Unit-root processes have a permanent impact on the mean (i.e. no convergence over time) (www.Wikipedia.com. Accessed on June 15 2020.).

To test the stationary nature of the variables, the Augmented Dickey-Fuller (ADF), the modified version of the Dickey-Fuller, test is used. According to Dickey and Fuller (1984) the ADF test, null hypothesis is that the variable is assumed to have/contain a unit root. The time series nature of the data was tested against the alternative, where a stationary process generates the variable. Hence, the result showed that all variables which are LnRGDP, LnPRINV, LnPUBINV, LnODA, LnM2 and INF have p-value 1.0000, 0.9411, 0.9989, 0.5749, 0.9998, 0.0001 respectively above 5% level of significance indicating existence of unit root in all explanatory variables except INF (Inflation) which led to do not reject decision (accept the null hypothesis).

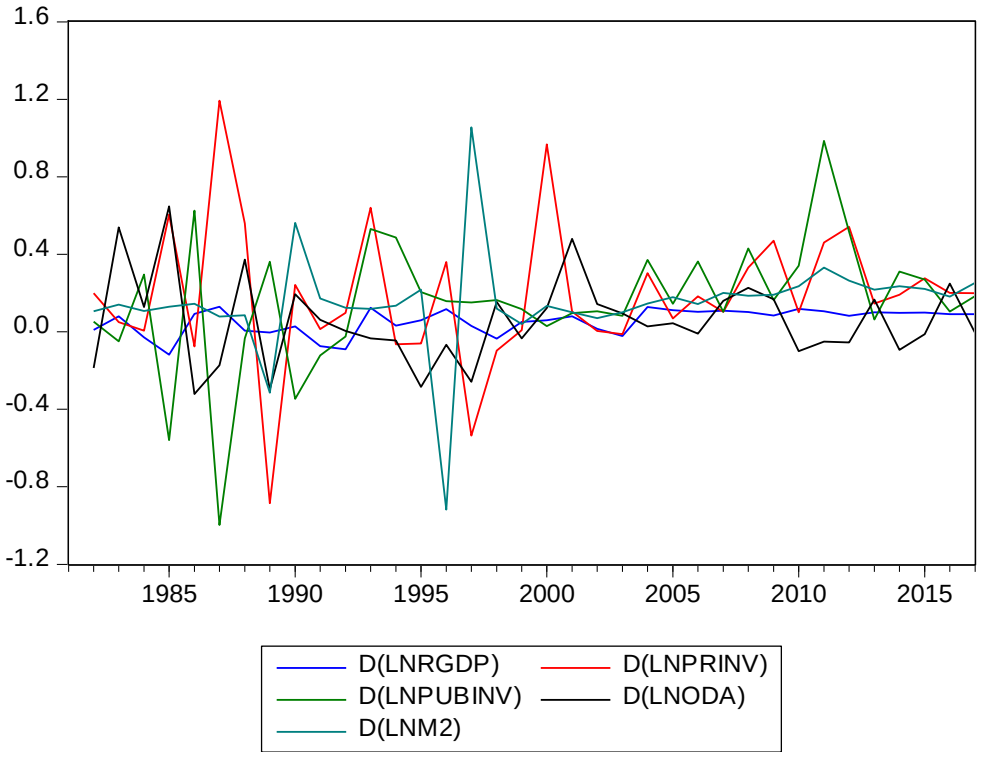
Having checked the existence of unit root, therefore, we needed to take the first differencing as a corrective measure for the above problems associated with the variables. Hence, the unit roots

are removed leading to rejection of the null hypothesis (below 5% significance level) for all variables in the model. Finally, all variables become stationary I (0) and I (1) the graph is smoothed.

**Table4. 1Unit root test summery**

| At Level | | | At First Difference | | | |
|---|---|---|---|---|---|---|
| **Variables** | **T-values** | **Probabilities** | **Variables** | **T-values** | **Probabilities** | **Decision** |
| LNRGDP | 2.965625 | 1.0000 | LNRGDP | -4.210848 | 0.0022 | I(1) |
| LNPRINV | -0.107387 | 0.9411 | LNPRINV | -6.580809 | 0.0000 | I(1) |
| LNPUBINV | 1.484982 | 0.9989 | LNPUBINV | -6.135566 | 0.0000 | I(1) |
| LNODA | -1.392870 | 0.5749 | LNODA | -6.790640 | 0.0000 | I(1) |
| LNM2 | 2.018858 | 0.9998 | LNM2 | -9.404375 | 0.0000 | I(2) |
| INF | -5.496153 | 0.0001 | INF | | | I(0) |

**Figure4. 4Trends of variables after first differencing**.



### 4.2.2. Optimal lag length Selection

Optimal lag length Selection is one of the most important criteria used to find best ARDL model. Therefore according to VAR Lag Order Selection Criteria the optimal lag order is determined with the sequential modified Likelihood Ratio test statistics [LR], the Final Prediction Error [FPE], the Akaiki Information Criterion [AIC], the Schwarz Information Criterion [SIC], and the Hannan-Quinn Information Criterion [HQ]). LR, FPE, SIC, and HQ our model maximum lag length isthree lags of all variables as shown below on Table 4.2.

**Table4. 2Optimal lag length Selection**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -98.94812 | NA | 2.33e-05* | 6.360492 | 6.632585* | 6.452043* |
| 1 | -76.39632 | 35.53618 | 5.48e-05 | 7.175534 | 9.080180 | 7.816390 |
| 2 | -45.73925 | 37.16008 | 9.54e-05 | 7.499349 | 11.03655 | 8.689509 |
| 3 | 21.58553 | 57.12406* | 2.86e-05 | 5.600877* | 10.77063 | 7.340342 |

Optimal model Selection is one of the most important criteria used to find best ARDL model. According to selected model combination for ARDL is (1, 1, 0, 3, 2, 3) for LNRGDP, LNODA, LNPERF, LNFGCE, LNGCF, TO, INF respectively.

### 4.2.3 ARDL bound test for co-integration

After confirming that all variables we used in ARDL model are stationary in first and second difference the next most important test that have been done was ARDL Bound test to confirm that variables have long run relationship and cointegration.

Therefore, as it was depicted in table 4.3 below the ARDL bound test that the value of F-statistics 5.87 more than the critical value of bounds 3.79 and this indicates the existence of log run relationship among variables.

**Table4. 3ARDL bound test**

| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| | | | Asymptotic: n=1000 | |
| F-statistic | 5.871254 | 10% | 2.26 | 3.35 |
| K | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |
| t-Bounds Test | | Null Hypothesis: No levels relationship | | |
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -2.758946 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

### 4.2.4 Diagnostic Checking

In the process of undertaking diagnostic checking the researcher tried to know whether or not the model is affected by econometrics problem by applying serial correlation test, normality test and heteroscedasticity test. Based on this the stability of the long-run coefficient is tested by the short-run dynamics. Therefore, test the cumulative sum of recursive residuals (CUSUM) tests are applied to assess the parameter stability.

The test for the existence of heteroskedasticity from E-view result shows that the chi-square is 29.05959 and p-value is 0.2614which is above 5% level of significance (see ANNEX). This led us not to reject the null hypothesis which assumed no existence of heteroskedasticity. Therefore, it is clearly shown that there is a no violation of CLRM (classical linear regression model) nohomoscedasticity assumption which led to unbiased and efficient estimators.

### 4.2.2. Test for co-integration

Having tested our time-series for stationary, the next step of time-series analysis is testing for co-integration, which amounts to checking whether the linear combination of the variables (i.e. LnRGDP, LnPRINV, LnPUBINV, LnODA, LnM2, INF) is also stationary or not (i.e. I(0)). It

requires that the variables of interest have the same order of integration. It is only when the variables are integrated of the same order that a linear relationship among them can be expected. Variables are said to be co-integrated if a long run equilibrium relationship exists among them. The E-view Johansen Co-integration test result (see table 4.5) given us that the trace test indicates 3 co-integrating equations are obtained at the 0.05 level denoting rejection of the hypothesis at the 0.05 level. Therefore, the variables are said to be co-integrated and this necessitates the estimation of an Error Correction Model (ECM) involving long run relationships. That means how the short run disequilibria will have speed of adjustment (i.e. how long it takes to adjust) to come in equilibrium.

**Table4. 4The Johansen Co-integration TestResult**

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.837488 | 155.3601 | 95.75366 | 0.0000 |
| At most 1 * | 0.758955 | 95.39887 | 69.81889 | 0.0001 |
| At most 2 * | 0.563290 | 48.44741 | 47.85613 | 0.0439 |
| At most 3 | 0.330294 | 21.10736 | 29.79707 | 0.3510 |
| At most 4 | 0.195340 | 7.877124 | 15.49471 | 0.4786 |
| At most 5 | 0.021139 | 0.705058 | 3.841466 | 0.4011 |

Note :Trace test indicates 3 cointegratingeqn(s) at the 0.05 level

**Table4. 5Test Result for autocorrelation**

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| F-statistic | 0.084046 | Prob. F(3,14) | 0.9676 |
| Obs*R-squared | 0.583811 | Prob. Chi-Square(3) | 0.9001 |

On the other hand, to observe that the error terms are auto-correlated tests of autocorrelation was undertaken. The autocorrelation test result showed that p-value is 0.9676 which is above 5% level of significance. This led to the not to rejection of the null hypothesis which assumed no existence of autocorrelation. Also as it was depicted in figure 6 Correlogram LM test below shows all regressors are inside the boundary confirms no autocorrelation in the model. Therefore,

the test result from autocorrelation and heteroskedasticity test, we confirmed that there is no problem of model stability.

Finally we used to test model normality and stability test using Histogram and CUSUM test respectively. The result of CUSUM test as it is depicted in figure 4.5 below showed that the model is between the boundary lines still we can proceed using the model because it is stable. Alsonormality test of Model using histogram as shown in figure 4.6 below residuals are normally distributed. Therefore our model after passes all necessary tests I am happy to use ARDL model results.

**Figure 4. 5 CUSUM test of model stability**

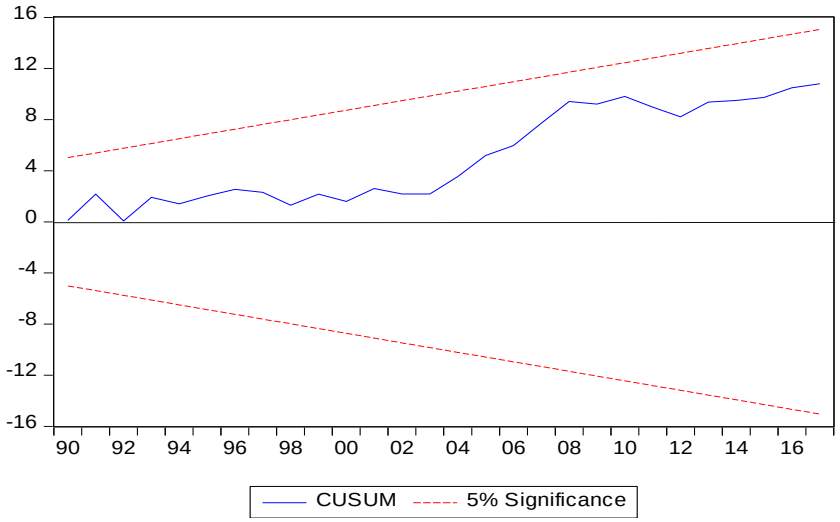
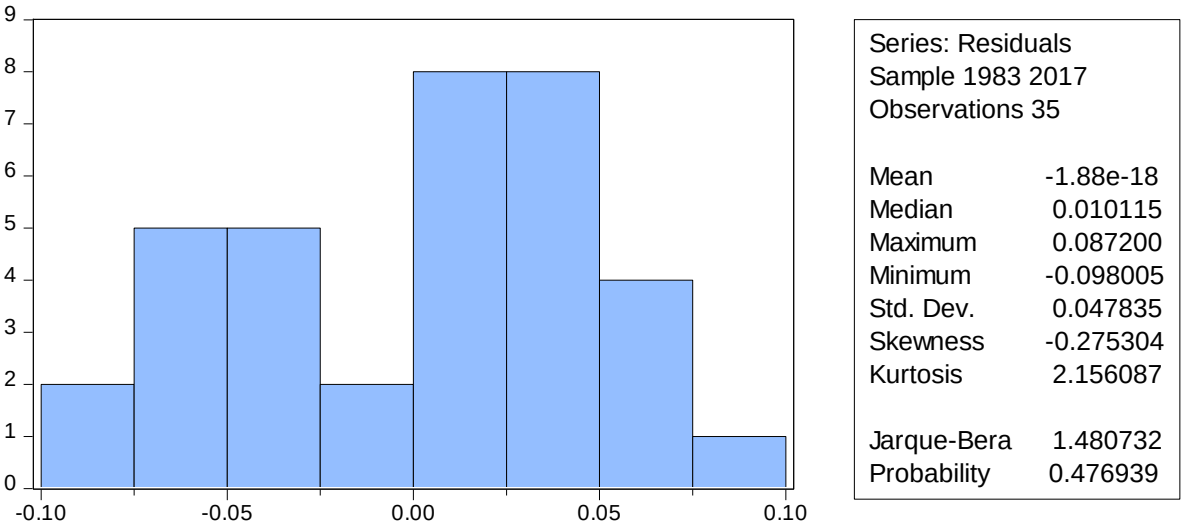



**Figure 4. 6 Normality test of Model Histogram**



### 4.2.3. ARDL model result and analysis

After the r autoregressive distributed lag models(ARDL) is estimated, an optimal lag model of ARDL(1, 1, 0, 3, 2, 3) is obtained based on the information criteria results, and the ARDL is estimated by making use of these and the results of the ARDL bound test. The ARDL consists of two parts: the long-run co-integrating coefficients (used to derive the long-run co-integrating relationship), and the short-run coefficients (for the short-run analysis) and error correction model.

### 4.2.4. Short run equations formulation and analysis

The short-run coefficient of private investment as it is indicated in table 4.6 below shows that a positive significant causal effect on growth from changes in private investment, suggesting that private investment can be useful for an economy to grow and this will call for promoting private investment. As shown in the above model, one percent increases in private investment increases growth rate by 0.1 percent in the short run.

The short-run impact of public investment on economic growth is found to be positive and statistically significant, which means that a one percent increase in public investment increases economic growth by 0.12 percentage points in the short run; the negative sign of public investment is indicative of a “crowding out” effect on growth in the short run. This result may be observed because public spending has a long gestation period; we look for the impact after a long period but consume resources in the interim that can be used for private resources.

**Table4. 6ARDL short run relationship: dependent variable is D (LnRGDP)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| C | 0.012278 | 0.013901 | 0.883252 | 0.3894 |
| D(LNRGDP(-1)) | 0.642884 | 0.129439 | 4.966684 | 0.0001 |
| D(LNPRINV) | 0.049526 | 0.027150 | 1.824140 | 0.0858 |
| D(LNPRINV(-1)) | -0.050275 | 0.027752 | -1.811594 | 0.0878 |
| D(LNPUBINV) | 0.120010 | 0.027128 | 4.423845 | 0.0004 |
| D(LNODA) | -0.046387 | 0.037204 | -1.246845 | 0.2294 |
| D(LNODA(-1)) | -0.008314 | 0.042913 | -0.193729 | 0.8487 |
| D(LNODA(-2)) | 0.039833 | 0.041181 | 0.967257 | 0.3470 |
| D(LNODA(-3)) | 0.082128 | 0.038301 | 2.144261 | 0.0468 |
| D(LNM2) | -0.023622 | 0.029991 | -0.787631 | 0.4418 |
| D(LNM2(-1)) | 0.020006 | 0.036346 | 0.550423 | 0.5892 |
| D(LNM2(-2)) | 0.053903 | 0.030775 | 1.751515 | 0.0979 |
| INF | -0.001367 | 0.000519 | -2.631153 | 0.0175 |
| INF(-1) | -0.000507 | 0.000516 | -0.982546 | 0.3396 |
| INF(-2) | 0.001621 | 0.000486 | 3.338765 | 0.0039 |
| INF(-3) | -0.001969 | 0.000618 | -3.184272 | 0.0054 |
| CointEq(-1)* | -0.357116 | 0.052891 | -6.751930 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.848360 | Mean dependent var | 0.057548 |
| Adjusted R-squared | 0.714560 | S.D. dependent var | 0.066091 |
| S.E. of regression | 0.035310 | Akaike info criterion | -3.542903 |
| Sum squared resid | 0.021195 | Schwarz criterion | -2.817324 |
| Log likelihood | 74.45790 | Hannan-Quinn criter. | -3.298768 |
| F-statistic | 6.340509 | Durbin-Watson stat | 1.974506 |
| Prob(F-statistic) | 0.000248 | | |

**Nate:** Selected Model: ARDL (1, 1, 0, 3, 2, 3)

Short run equationsformulated,looks like the following.

**D(LNGDP) = 0.021 + 0.643*D(LNRGDP(-1)) + 0.1*D(LNPRINV(-1)) -0.12*D(PUBINV) + 0.082*D(LNODA(-3)) + 0.1*D(LNM2(-2)) - 0.002*INF(-3) - 0.36ECT**

In short-run impact of official development assistance on economic growth is found to be positive and statistically significant, which means that a one percent increase in official development assistance increases economic growth by 0.082 percentage points in the short run; the negative sign of public investment is indicative of a "crowding out" effect on growth in the short run. This result may be observed because public spending has a long gestation period; we

look for the impact after a long period but consume resources in the interim that can be used for private resources.

Furthermore, this finding is consistent with studies by Shiferaw*et al.,* 2015; Miguel and Nader (2003) and Festus (2006). With respect to Ethiopia, Alemayehu and Befekadu (2005) have explored the role of investment as one of the short-run determinants of Ethiopia's growth rate. With regard to the relative contribution of public investment and private investment to economic growth, this paper found that public investment is a greater contributor than private investment to the country's economic growth; This is consistent with studies by Khan and Reinhart (1990) and Khan and Kumar (1997), who found that for developing countries, although public investment contributes to the productive performance of the economies, private investment also has influence on economic growth.

With respect to broad money supply (M2), broad money supply has positive and significant impact on real GDP in Ethiopia, both in the short run and in the long run. The result here suggests that a one percentage-point increase in broad money supply intheshort run raisesrealGDPby0.082 percent.Thisresultissoundand consistent with the theoretical prediction of the classical growth model and the endogenousgrowth model, as well asthe World Bank gap model.

In general from the short run model result of the D (LnRGDP) equation in the ARDL model, we can see that the short-run impact of private investment (PRINV), public investment (PUBINV), official development assistance(ODA), broad money supply (M2) and inflation (INF) on economic growth (real GDP) are analyzed. The coefficients of the ARDL lagged model (1, 1, 0, 3, 2, 3) respectively in the table 4.6 can be interpreted as the short-run parameters representing the short-run impact of independent variables on economic growth. Based on the result private investment (PRINV), public investment (PUBINV), official development assistance, broad money supply (M2) and inflation (INF) together significantly explains 85 percent on real GDP.

The coefficient of the error correction term for the growth equation possesses the expected negative sign, indicating that it is error-correcting. This guarantees that although the actual real GDP may temporarily deviate from its long-run equilibrium value, it would gradually converge to its equilibrium. The error correction term of -0.36 shows that 36 percent of the deviation of the

actual real GDP from its equilibrium value is eliminated every year; hence, full adjustment would require a period of less than two years.(see table 4.6)

**Table4. 7ARDL short run relationship: dependent variable is D (LnPRINV)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| C | -0.071348 | 0.088958 | -0.802045 | 0.4330 |
| D(LNPRINV(-1)) | -0.267190 | 0.147534 | -1.811044 | 0.0869 |
| D(LNPRINV(-2)) | -0.066712 | 0.117961 | -0.565539 | 0.5787 |
| D(LNPRINV(-3)) | -0.152566 | 0.111141 | -1.372727 | 0.1867 |
| D(LNRGDP) | 0.408001 | 0.764585 | 0.533624 | 0.6001 |
| D(LNPUBINV) | -0.312400 | 0.141176 | -2.212835 | 0.0401 |
| D(LNODA) | 0.356996 | 0.202802 | 1.760322 | 0.0953 |
| D(LNODA(-1)) | -0.532468 | 0.199097 | -2.674418 | 0.0155 |
| D(LNODA(-2)) | 0.393684 | 0.216330 | 1.819827 | 0.0855 |
| D(LNODA(-3)) | 0.803326 | 0.251399 | 3.195423 | 0.0050 |
| D(LNM2) | -0.013605 | 0.155738 | -0.087362 | 0.9313 |
| D(LNM2(-1)) | 0.545353 | 0.192254 | 2.836627 | 0.0109 |
| D(LNM2(-2)) | 0.901784 | 0.212410 | 4.245498 | 0.0005 |
| D(LNM2(-3)) | 0.809060 | 0.182091 | 4.443152 | 0.0003 |
| INF | 0.000543 | 0.002917 | 0.186287 | 0.8543 |
| CointEq(-1)* | -0.486468 | 0.146662 | -10.13535 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.851794 | Mean dependent var | 0.201159 |
| Adjusted R-squared | 0.736524 | S.D. dependent var | 0.379740 |
| S.E. of regression | 0.194921 | Akaike info criterion | -0.129494 |
| Sum squared resid | 0.683892 | Schwarz criterion | 0.550736 |
| Log likelihood | 17.13666 | Hannan-Quinn criter. | 0.099383 |
| F-statistic | 7.389497 | Durbin-Watson stat | 2.095291 |
| Prob(F-statistic) | 0.000073 | | |

**Note:** Selected Model: ARDL (3, 0, 0, 3, 3, 0) lags respectively

**D(LNPRINV) = -0.071 +0.05*D(LNPRINV(-3)) + 0.41*D(LNRGDP) -0.312*D(PUBINV) + 0.803*D(LNODA(-3)) + 0.81*D(LNM2(-3)) - 0.001*INF(-3) - 0.49ECT**

There is also evidence to support the theory of a short-run "crowding-out" effect of public investment (an increase of one percent reduces private investment by 0.312 percent). Public investment can crowd out private investment through different channels.

First, government investment can crowd out private investment through increased borrowing. For example, if public-sector investments are financed by borrowing, this leads to an increase in

the market interest rate and thus raises the cost of capital for the private sector, crowding out the private sector. In the case of tax financing of public-sector investment, the tax may distort the resource allocation decisions of private investors in the economy by changing relative prices.

Second, public investment can exert a negative influence on private investment. If both the private and public sectors compete for a limited amount of resources in the economy, the costs of financing private investment increase, while the availability of credit to the private sector declines, this could crowd out investment in the private sector. Furthermore, investments undertaken by highly subsidized state economic enterprises are often financed through the printing press, external debts and deficit spending. Finally, public investment may substitute for private investment when they both produce goods and services that are in direct competition in a marketplace, particularly if public production is subsidized by the government. This suggests that there is a kind of competition for resources between the public and the private sectors, at least in the short run.

The coefficient of the ECM model for the private investment equation possesses the expected negative sign, indicating that it is error-correcting. In other words, any deviation from the long-run equilibrium is corrected back to equilibrium, although at a slow pace of approximately 49 percent in each subsequent period.

The short-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a one percent increase in real GDP increases public investment by 2.58 percent in the short run.(see table 4,8 below)

This result is in line with Wagner's Law, which emphasizes economic growth as the fundamental determinant of public-sector growth. This finding is consistent with studies by Satish and Rahul (2010); Wahab (2004); Bird (1971); Nagarajan and Spears (1990); Murthy (1993); and Hondroyiannis and Papapetrou (1995), in which government expenditures was found to grow simultaneously with economic growth.

**Table 4. 8 ARDL short run relationship: dependent variable is D (LnPUBINV)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| C | 0.015947 | 0.083161 | 0.191761 | 0.8494 |
| D(LNPUBINV(-1)) | -0.235705 | 0.150711 | -1.563953 | 0.1295 |
| D(LNRGDP) | 2.577599 | 0.831533 | 3.099814 | 0.0045 |
| D(LNPRINV) | -0.388602 | 0.144523 | -2.688852 | 0.0121 |
| D(LNODA) | -0.245444 | 0.237588 | -1.033068 | 0.3107 |
| D(LNM2) | -0.011754 | 0.177801 | -0.066108 | 0.9478 |
| INF | 0.007598 | 0.003436 | 2.211211 | 0.0357 |
| INF(-1) | 0.006562 | 0.003433 | 1.911479 | 0.0666 |
| CointEq(-1)* | -0.235705 | 0.122668 | -10.07357 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.490906 | Mean dependent var | 0.160566 |
| Adjusted R-squared | 0.358918 | S.D. dependent var | 0.339206 |
| S.E. of regression | 0.271594 | Akaike info criterion | 0.428617 |
| Sum squared resid | 1.991613 | Schwarz criterion | 0.784125 |
| Log likelihood | 0.499204 | Hannan-Quinn criter. | 0.551338 |
| F-statistic | 3.719336 | Durbin-Watson stat | 1.619694 |
| Prob(F-statistic) | 0.006068 | | |

**Note:** selected model ARDL(1, 0, 0, 0, 0, 1)

**D(PUBINV) = -0.016 +0.24*D(PUBINV) (-1)) + 2.58*D(LNRGDP) - 0.39*D(LNPRINV(-3)) - 0.25*D(LNODA) - 0.012*D(LNM2) - 0.01*INF(-1) - 0.24ECT**

The public investment short run equation results tells us that the short-run impact of private investment on public investment is found to be negative and statistically significant, which means that a one percent increase in private investment decreases public investment by 0.39 percent in the short run. This finding is in line with sound theoretical argument: booming private investment inversely affects public investment. Theoretically, one can argue that increased private investment and burden on government can be decreases to undertake its investment programs, thereby giving to a negative relationship between private and public investment.

The short-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a one percent increase in real GDP increases public investment by 2.58 percent in the short run.

This result is in line with Wagner's Law, which emphasizes economic growth as the fundamental determinant of public-sector growth. This finding is consistent with studies by Satish and Rahul (2010); Wahab (2004); Bird (1971); Nagarajan and Spears (1990); Murthy (1993); and Hondroyiannis and Papapetrou (1995), in which government expenditures was found to grow simultaneously with economic growth.

The coefficient of the ECM model for the public investment equation possesses the expected negative sign, indicating that it is error-correcting. The coefficient is -0.24 (see table 4.8), suggesting a slow adjustment process in government investment. Nearly 24 percent of the disequilibria from the shock of the previous period return to the long-run equilibrium in the current year.

### 4.2.5. Long-run relationship

As explained previously, there are three co-integrating relationships based on the Johansen cointegration test. This study aimed to examine the following: the impact of public investment, private investment and trade openness on economic growth; the impact of private investment, trade openness and economic growth on public investment; and the impact of public investment, trade openness and economic growth on private investment. The three equations are solved through ad-hoc normalization. And the Johansen test was used to confirm the appropriateness of the three selected equations, which confirmed the validity of selecting the above-listed equations by providing more weight for them.

**Table4. 9ARDL Estimated Long-Run Model for LnRGDP**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPRINV) | -0.002097 | 0.116093 | -0.018060 | 0.9858 |
| D(LNPUBINV) | 0.336052 | 0.147267 | 2.281919 | 0.0356 |
| D(LNODA) | 0.188343 | 0.241994 | 0.778294 | 0.4471 |
| D(LNM2) | 0.140813 | 0.230773 | 0.610179 | 0.5498 |
| INF | -0.006219 | 0.004403 | -1.412529 | 0.1758 |

EC = D(LNRGDP) - (-0.0021*D(LNPRINV) + 0.3361*D(LNPUBINV) + 0.1883 *D(LNODA) + 0.1408*D(LNM2) -0.0062*INF )

The results, after formulating the above table the long run model represented as follows.

D(LNRGDP) = -0.0021*D(LNPRINV) + 0.3361*D(LNPUBINV) + 0.1883*D(LNODA) + 0.1408*D(LNM2) -0.0062*INF )

This long-run equation for economic growth that relates private investment (PRINV), public investment (PUBINV), official development assistance(ODA), broad money supply (M2) and inflation (INF) upon which the long-run analysis is based. This result shows that in the long run, economic growth in Ethiopia can be explained by these independent variables.

The long-run impact of public investment on economic growth is found to be positive and significant, which means that a one percent increase public investment will raise the real GDP by 0.34 percent in the long run. This finding is in line with the theoretical prediction of the endogenous growth model which states that fiscal policy (including public investment policy) can determine the national level of output.

Furthermore, this finding is consistent with studies by (Aschauer, 1989a; Eberts, 1986; Munnell, 1990; Tatom, 1991) in which a significant positive relationship between public investment and economic growth was observed. Similarly, more recent studies of the effects of public investment on growth have included (Nazima and Kiani,2011; Mansouri, 2008; Muhammed, 2006; Milbourne et al.,2003; Aschauer,2000; Pereira,2000, 2001a and 2001b; Mittnik and

Neumann,2001) and have revealed that public investment has a positive and statistically significant impact on economic growth. This finding is not unique to the Ethiopian case as suggested by Muhammed (2006), who argues that public investment has an important positive impact on the country's economic growth.

Other variables like private investment (PRINV), official development assistance (ODA), broad money supply (M2) and inflation(INF) are found to be statistically not significant in the long run model.

**Table4. 10ARDL Long-Run Model for LnPRIINV (Private investment)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP) | 0.274477 | 0.514213 | 0.533780 | 0.6000 |
| D(LNPUBINV) | -0.210163 | 0.100972 | -2.081389 | 0.0519 |
| D(LNODA) | 0.687225 | 0.236412 | 2.906891 | 0.0094 |
| D(LNM2) | 1.508671 | 0.450012 | 3.352516 | 0.0035 |
| INF | 0.000366 | 0.001961 | 0.186384 | 0.8542 |

EC = D(LNPRINV) - (0.2745*D(LNRGDP) -0.2102*D(LNPUBINV) + 0.6872 *D(LNODA) + 1.5087*D(LNM2) + 0.0004*INF )

**D(LNPRINV) = (0.2745*D(LNRGDP) -0.2102*D(LNPUBINV) + 0.6872*D(LNODA) + 1.5087*D(LNM2) + 0.0004*INF )**

From long run model of ARDL estimate result of using private investment dependent variable we can observe that public investment, official development assistance and broad money supply exert significant long-run effects on the level of private investment.

The long-run impact of real public investment on private investment is found to be negative and statistically significant which means one percent increase in public investment reduces private investment 0.21 percent. This is because public investment is taken in aggregate form which merges the effect of public investment in different sectors, and makes possible to identify which public sectors have crowding out effect. And this shows the underlying relationship between public and private investment.

The long-run impact of economic growth (real GDP) on private investment is found to be positive but statistically insignificant,

The long-run impact of official development assistance on private investment is found to be positive and statistically significant, which means that a one-percent increase in official development assistance increases private investment by 0.69 percent in the long run.

This finding is in line with the sound theoretical argument that 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. By encouraging the transfer of ideas, opportunities for investment are created where they were once unavailable. 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 by Aysan*et al.,* (2006) in which it was found that trade openness and human development affects private investment positively.

Money supply is found to have long run impact on private investment significantly. A one percent increase in broad money supply increases private investment by 1.51 percent.

**Table4. 11Estimated Long-Run Model for LnPUBINV (Public investment)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP) | 2.085934 | 0.658655 | 3.166962 | 0.0038 |
| D(LNPRINV) | -0.314478 | 0.127069 | -2.474862 | 0.0199 |
| D(LNODA) | -0.198627 | 0.191971 | -1.034668 | 0.3100 |
| D(LNM2) | -0.009512 | 0.144069 | -0.066024 | 0.9478 |
| INF | 0.011459 | 0.003795 | 3.019496 | 0.0055 |

EC = D(LNPUBINV) - (2.0859*D(LNRGDP) -0.3145*D(LNPRINV) -0.1986 *D(LNODA) -0.0095*D(LNM2) + 0.0115*INF )

**D(LNPUBINV) = (2.0859*D(LNRGDP) -0.3145*D(LNPRINV) -0.1986*D(LNODA) - 0.0095*D(LNM2) + 0.0115*INF )**

The public investment equation results reveal that the long-run impact of private investment on public investment is found to be negative and statistically significant, which means that a one percent increase in private investment decreases public investment by 0.31 percent in the long

run. This finding is in line with sound theoretical argument: booming private investment inversely affects public investment. Theoretically, one can argue that increased private investment and burden on government can be decreases to undertake its investment programs, thereby giving to a negative relationship between private and public investment.

The long-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a one percent increase in real GDP increases public investment by 2.1 percent in the long run.

This result is in line with Wagner's Law, which emphasizes economic growth as the fundamental determinant of public-sector growth. This finding is consistent with studies by Satish and Rahul (2010); Wahab (2004); Bird (1971); Nagarajan and Spears (1990); Murthy (1993); and Hondroyiannis and Papapetrou (1995), in which government expenditures was found to grow simultaneously with economic growth.

# CHAPTER FIVE

# 5. CONCLUSION AND POLICY IMPLICATION

## 5.1.Conclusion

Investment for poor capital scarce countries remained an important source of finance to satisfy development needs in terms of investment and employment creation. Despite a lot of literature on the subject and researchers regarding the economic growth impact of both public and private investment have not reached a clear consensus. Thus one can find both success and failure stories.

The significant effect of public investment on growth in the long run could be attributed to volatility of private investment flows to Ethiopia through infrastructure accessibility and/or diversion of government expenditure resources into productive use. Some of the projects funded through government expenditure on the form of public investment do not provide benefits as expected but they die within the expenditure period therefore; sustainability of projects to strengthen the economic growth and on basic market need is a key to development. It could be hypothesize that the insignificant effect of public investment on growth is due to allocation of more budget to social sectors, which contribute to welfare rather than economic growth. Ethiopia should focus on private investment rather than strong public enterprises investment to stimulate economic growth.

The study has examined the impact of private investment and public investment on economic growth in Ethiopia with special emphasis given to the nexuses of both investment sectors on economic growth. The study made an effort to establish whether there exists long run and short run relationship between private investment, public investment and economic growth using annual data covering the period 1982 to 2017. For this purpose, the equations of economic growth, private investment and public investment were estimated. Multivariate cointegration technique was used for the analysis of the long run relation. So also VECM analysis was used to assess the short run relationships and its linkage with the long run equilibrium path.

Having checked the existence of unit root, we took the first differencing as a corrective measure for the above problems associated with the variables. Hence, the unit roots were removed leading to rejection of the null hypothesis (below 5% significance level) for one variables only lnINF

(inflation).Except inflation at first differencing unlike others is not stationary (i.e., has a unit root), thus, to correct we need took second differencing but not useful in ARDL model we reject the variable from the model. Finally, all variables became stationary I (0) and I (1) the making the graph smooth.

The short-run the result private investment, public investment, official development assistance, broad money supply and inflation have significantly explains 85 percent on real GDP. In addition, such variables as labor force and human capital are found to have no significant role in the short run.The short-run coefficient of private investment indicates a positive significant causal effect on economic growth from changes in private investment, suggesting that private investment can be useful for an economy to grow and this will call for promoting private investment.

The short-run impact of public investment on economic growth is found to be positive and statistically significant, which means that a one percent increase in public investment increases economic growth by 0.12 percentage points in the short run; the negative sign of public investment is indicative of a "crowding out" effect on growth in the short run.

The short-run impact of official development assistance on economic growth is found to be positive and statistically significant, which means that a one percent increase in official development assistance increases economic growth by 0.082 percentage points in the short run; With respect to broad money supply, broad money supply has positive and significant impact on real GDP in Ethiopia, both in the short run and in the long run. The result here suggests that a one percentage-point increase in broad money supply in the short run raises real GDP by 0.082 percent.

The short-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a one percent increase in real GDP increases public investment by 2.58 percent in the short run. The public investment short run equation results tells us that the short-run impact of private investment on public investment is found to be negative and statistically significant, which means that a one percent increase in private investment decreases public investment by 0.39 percent in the short run.

The long-run impact of public investment on economic growth is found to be positive and significant, which means that a one percent increase public investment will raise the real GDP by 0.34 percent in the long run.Other variables like private investment, official development assistance, broad money supply and inflation are found to be statistically not significant in the long run model.

The long-run impact of trade openness on economic growth is found to be positive and statistically significant, which means that a 10-percentage-point increase in trade openness raises economic growth (real GDP) by 3.1 percentage points in the long-run.

The long-run impact of real public investment on private investment is found to be negative and statistically significant which means one percent increase in public investment reduces private investment 0.21 percent.The long-run impact of economic growth (real GDP) on private investment is found to be positive but statistically insignificant.

The public investment equation results reveal that the long-run impact of private investment on public investment is found to be negative and statistically significant, which means that a one percent increase in private investment decreases public investment by 0.31 percent in the long run. This finding is in line with sound theoretical argument: booming private investment inversely affects public investment.

The long-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a one percent increase in real GDP increases public investment by 2.1 percent in the long run.Money supply is found to have long run impact on private investment significantly. A one percent increase in broad money supply increases private investment by 1.51 percent.The long-run impact of official development assistance on private investment is found to be positive and statistically significant, which means that a one-percent increase in official development assistance increases private investment by 0.69 percent in the long run.

### 5.2. Policy Implication

Government should have to take the prior step to improve the status of private investors and mitigate the investment obstacles such as road, electric power, water supply, Internet and

establish the transparent administration system to improve the existing poor investment climate. Long-run sustainability of projects should be emphasized and project delay must be mitigated.

In Ethiopia there is no easy business doing platform then, policies and institutions that promote both public and private investment should be strengthened and good governance need to be established for fighting corruption and lubricate the business sector.

The government should have to identify the different investment opportunities which are not commonly practices on private investors in Ethiopia such kind of mineral, ICT and commercial farming because the private investors got comparative advantage on new coming business.

The public investment has the form of major government expenditure scheme. The planned public investment must be considering the country prioritize macro and micro economic policies and strategies to improve the aggregate gross domestic product of the country.

### 5.2.1. Recommendation for Further Study

The nexuses of private investment, public investment and economic growth literature has not gone through its full circle and therefore; this calls for further research to investigate the possible relationships through which investment can have positive significant influence on the country economic growth.

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# APPENDEXES

**TABLE 1: Schedule and Budget**

**Activity schedule**

The timely completion and follow up of the research requires a carefully work plan that could guide the researcher in pointing out what to do at what point of time.The amount of time required to conduct the study is estimate as indicated here under.

| No. | Activity | Month (2020) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1 | Literature review | * | * | * | * | * | | | |
| 2 | Preparation of proposal | | | * | * | * | | | |
| 3 | Preparation of instrument | | | * | * | * | | | |
| 4 | Data Collection | | | | | | * | * | |
| 5 | Analysis and interpretation | | | | | | | * | * |
| 6 | conclusion and Recommendation | | | | | | | * | * |
| 7 | First Draft Submission | | | | | | | | * |
| 8 | Final Report Preparation | | | | | | | | * |
| 9 | Thesis Defense | | | | | | | | * |

**Stationary and Secretarial Service Expense**

| No. | Item | Unit | Qty. | Unit Cost in Birr | Total Cost in Birr |
|---|---|---|---|---|---|
| 1 | Duplicating, line and square paper | Ream | 10 | 140 | 1400 |
| 2 | Pen | Pcs | 20 | 7 | 140 |
| 3 | Pencil/fixer | Pkt | 1 | 25 | 25 |
| 4 | Lead | Pkt | 1 | 15 | 15 |
| 5 | Eraser | Pcs | 2 | 5 | 10 |
| 6 | CD RW | Psc | 10 | 50 | 500 |
| 7 | Flash Disk | Psc | 2 | 450 | 900 |
| 8 | Staples | Pkt | 1 | 75 | 75 |
| 9 | Mobile card | Pcs | 25 | 100 | 2500 |
| 10 | Printing and photocopying proposal | Page | 28 | 3 | 84 |
| 11 | Printing and photocopying of draft & final | Page | 360 | 11 | 3900 |
| 12 | Biding the final research report | Pcs | 5 | 60 | 300 |
| 13 | Printing and photocopying reference materials | - | 3200 | - | 3200 |
| **Total Stationary and secretarial service cost** | | | | | **13,049** |

**Cost Summary;**the above estimated costs are summarized as follows:

| No | Description | Expense in Birr | Remark |
|---|---|---|---|
| 1 | Stationary and Secretarial Services | **13,049** | |
| | Sub total | **13,049** | |

ANNEX 2: **GDP Unit root test**

Null Hypothesis: LNRGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 2.965625 | 1.0000 |
| Test critical values: | 1% level | -3.626784 | |
| | 5% level | -2.945842 | |
| | 10% level | -2.611531 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRGDP)
Method: Least Squares
Date: 06/14/20 Time: 12:03
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNRGDP(-1) | 0.050877 | 0.017156 | 2.965625 | 0.0055 |
| C | -1.310038 | 0.460191 | -2.846730 | 0.0074 |

| | | | |
|---|---|---|---|
| R-squared | 0.205513 | Mean dependent var | 0.054401 |
| Adjusted R-squared | 0.182146 | S.D. dependent var | 0.065400 |
| S.E. of regression | 0.059145 | Akaike info criterion | -2.763700 |
| Sum squared resid | 0.118936 | Schwarz criterion | -2.675727 |
| Log likelihood | 51.74660 | Hannan-Quinn criter. | -2.732995 |
| F-statistic | 8.794929 | Durbin-Watson stat | 1.822761 |
| Prob(F-statistic) | 0.005491 | | |

**ANNEX 2: LNPRINV unit root test at level**

Null Hypothesis: LNPRINV has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -0.107387 | 0.9411 |
| Test critical values: | 1% level | -3.626784 | |
| | 5% level | -2.945842 | |
| | 10% level | -2.611531 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPRINV)
Method: Least Squares
Date: 06/14/20 Time: 12:04
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNPRINV(-1) | -0.003630 | 0.033802 | -0.107387 | 0.9151 |
| C | 0.274983 | 0.780356 | 0.352381 | 0.7267 |

| | | | |
|---|---|---|---|
| R-squared | 0.000339 | Mean dependent var | 0.191446 |
| Adjusted R-squared | -0.029063 | S.D. dependent var | 0.365374 |
| S.E. of regression | 0.370646 | Akaike info criterion | 0.906812 |
| Sum squared resid | 4.670859 | Schwarz criterion | 0.994786 |
| Log likelihood | -14.32262 | Hannan-Quinn criter. | 0.937517 |
| F-statistic | 0.011532 | Durbin-Watson stat | 2.262662 |
| Prob(F-statistic) | 0.915113 | | |

**ANNEX 3: LNPUBINV unit root test at level**

Null Hypothesis: LNPUBINV has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 1.484982 | 0.9989 |
| Test critical values: | 1% level | -3.626784 | |
| | 5% level | -2.945842 | |
| | 10% level | -2.611531 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPUBINV)
Method: Least Squares
Date: 06/14/20 Time: 12:10
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNPUBINV(-1) | 0.043041 | 0.028984 | 1.484982 | 0.1468 |
| C | -0.834162 | 0.670081 | -1.244867 | 0.2217 |

| | | | |
|---|---|---|---|
| R-squared | 0.060908 | Mean dependent var | 0.157556 |
| Adjusted R-squared | 0.033287 | S.D. dependent var | 0.334813 |
| S.E. of regression | 0.329193 | Akaike info criterion | 0.669609 |
| Sum squared resid | 3.684520 | Schwarz criterion | 0.757583 |
| Log likelihood | -10.05297 | Hannan-Quinn criter. | 0.700315 |
| F-statistic | 2.205172 | Durbin-Watson stat | 2.363126 |
| Prob(F-statistic) | 0.146762 | | |

**ANNEX 4: LNODA unit root test at level**

Null Hypothesis: LNODA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.392870 | 0.5749 |
| Test critical values: | 1% level | -3.626784 | |
| | 5% level | -2.945842 | |
| | 10% level | -2.611531 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNODA)
Method: Least Squares
Date: 06/14/20 Time: 12:02
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNODA(-1) | -0.092063 | 0.066096 | -1.392870 | 0.1727 |
| C | 2.007187 | 1.402572 | 1.431075 | 0.1615 |

| | | | |
|---|---|---|---|
| R-squared | 0.053981 | Mean dependent var | 0.054251 |
| Adjusted R-squared | 0.026157 | S.D. dependent var | 0.222483 |
| S.E. of regression | 0.219554 | Akaike info criterion | -0.140488 |
| Sum squared resid | 1.638928 | Schwarz criterion | -0.052515 |
| Log likelihood | 4.528790 | Hannan-Quinn criter. | -0.109783 |
| F-statistic | 1.940087 | Durbin-Watson stat | 2.178594 |
| Prob(F-statistic) | 0.172701 | | |

**ANNEX 5: LNM2 unit root test at level**

Null Hypothesis: LNM2 has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 2.018858 | 0.9998 |
| Test critical values: | 1% level | -3.639407 | |
| | 5% level | -2.951125 | |
| | 10% level | -2.614300 | |

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNM2)
Method: Least Squares
Date: 06/15/20 Time: 13:07
Sample (adjusted): 1984 2017
Included observations: 34 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNM2(-1) | 0.060954 | 0.030192 | 2.018858 | 0.0525 |
| D(LNM2(-1)) | -0.704519 | 0.180675 | -3.899361 | 0.0005 |
| D(LNM2(-2)) | -0.352351 | 0.177244 | -1.987942 | 0.0560 |
| C | -0.302891 | 0.291715 | -1.038311 | 0.3074 |

| | | | |
|---|---|---|---|
| R-squared | 0.341767 | Mean dependent var | 0.154104 |
| Adjusted R-squared | 0.275944 | S.D. dependent var | 0.273860 |
| S.E. of regression | 0.233032 | Akaike info criterion | 0.034848 |
| Sum squared resid | 1.629116 | Schwarz criterion | 0.214420 |
| Log likelihood | 3.407577 | Hannan-Quinn criter. | 0.096088 |
| F-statistic | 5.192192 | Durbin-Watson stat | 2.143974 |
| Prob(F-statistic) | 0.005222 | | |

**ANNEX 5: INF unit root test at level**

Null Hypothesis: INF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.496153 | 0.0001 |
| Test critical values: | 1% level | -3.626784 | |
| | 5% level | -2.945842 | |
| | 10% level | -2.611531 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 06/14/20 Time: 12:12
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| INF(-1) | -0.939968 | 0.171023 | -5.496153 | 0.0000 |
| C | 8.518910 | 2.793009 | 3.050084 | 0.0044 |

| | | | |
|---|---|---|---|
| R-squared | 0.470468 | Mean dependent var | 0.094444 |
| Adjusted R-squared | 0.454894 | S.D. dependent var | 18.97433 |
| S.E. of regression | 14.00899 | Akaike info criterion | 8.171229 |
| Sum squared resid | 6672.565 | Schwarz criterion | 8.259202 |
| Log likelihood | -145.0821 | Hannan-Quinn criter. | 8.201934 |
| F-statistic | 30.20770 | Durbin-Watson stat | 1.994072 |
| Prob(F-statistic) | 0.000004 | | |

## Unit root test at first difference

### ANNEX 7: D(LNRGDP)unit root test

Null Hypothesis: D(LNRGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.210848 | 0.0022 |
| Test critical values: | 1% level | -3.632900 | |
| | 5% level | -2.948404 | |
| | 10% level | -2.612874 | |

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRGDP,2)
Method: Least Squares
Date: 06/14/20 Time: 12:14
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP(-1)) | -0.696499 | 0.165406 | -4.210848 | 0.0002 |
| C | 0.039500 | 0.013923 | 2.836945 | 0.0077 |

| | | | |
|---|---|---|---|
| R-squared | 0.349513 | Mean dependent var | 0.002333 |
| Adjusted R-squared | 0.329802 | S.D. dependent var | 0.077818 |
| S.E. of regression | 0.063706 | Akaike info criterion | -2.613633 |
| Sum squared resid | 0.133929 | Schwarz criterion | -2.524756 |
| Log likelihood | 47.73858 | Hannan-Quinn criter. | -2.582953 |
| F-statistic | 17.73124 | Durbin-Watson stat | 1.871276 |
| Prob(F-statistic) | 0.000184 | | |

**ANNEX 8: D(LNPRINV)unit root test**

Null Hypothesis: D(LNPRINV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.580809 | 0.0000 |
| Test critical values: | 1% level | -3.632900 | |
| | 5% level | -2.948404 | |
| | 10% level | -2.612874 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPRINV,2)
Method: Least Squares
Date: 06/14/20 Time: 12:14
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPRINV(-1)) | -1.135074 | 0.172482 | -6.580809 | 0.0000 |
| C | 0.217062 | 0.071129 | 3.051651 | 0.0045 |

| | | | |
|---|---|---|---|
| R-squared | 0.567537 | Mean dependent var | 1.19E-05 |
| Adjusted R-squared | 0.554432 | S.D. dependent var | 0.558543 |
| S.E. of regression | 0.372833 | Akaike info criterion | 0.920071 |
| Sum squared resid | 4.587139 | Schwarz criterion | 1.008948 |
| Log likelihood | -14.10125 | Hannan-Quinn criter. | 0.950752 |
| F-statistic | 43.30705 | Durbin-Watson stat | 2.049860 |
| Prob(F-statistic) | 0.000000 | | |

**ANNEX 9: D(LNPRUBINV)unit root test**

Null Hypothesis: D(LNPUBINV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.135566 | 0.0000 |
| Test critical values: | 1% level | -3.632900 | |
| | 5% level | -2.948404 | |
| | 10% level | -2.612874 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPUBINV,2)
Method: Least Squares
Date: 06/14/20 Time: 12:15
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPUBINV(-1)) | -1.064394 | 0.173479 | -6.135566 | 0.0000 |
| C | 0.170662 | 0.064130 | 2.661173 | 0.0119 |

| | | | |
|---|---|---|---|
| R-squared | 0.532877 | Mean dependent var | 0.003791 |
| Adjusted R-squared | 0.518722 | S.D. dependent var | 0.495272 |
| S.E. of regression | 0.343591 | Akaike info criterion | 0.756715 |
| Sum squared resid | 3.895805 | Schwarz criterion | 0.845592 |
| Log likelihood | -11.24251 | Hannan-Quinn criter. | 0.787395 |
| F-statistic | 37.64517 | Durbin-Watson stat | 1.971529 |
| Prob(F-statistic) | 0.000001 | | |

**ANNEX 10: D(LNODA)unit root test**

Null Hypothesis: D(LNODA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.790640 | 0.0000 |
| Test critical values: | 1% level | -3.632900 | |
| | 5% level | -2.948404 | |
| | 10% level | -2.612874 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNODA,2)
Method: Least Squares
Date: 06/14/20 Time: 12:15
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNODA(-1)) | -1.149410 | 0.169264 | -6.790640 | 0.0000 |
| C | 0.069492 | 0.038792 | 1.791391 | 0.0824 |

| | | | |
|---|---|---|---|
| R-squared | 0.582874 | Mean dependent var | 0.005126 |
| Adjusted R-squared | 0.570234 | S.D. dependent var | 0.339465 |
| S.E. of regression | 0.222542 | Akaike info criterion | -0.111961 |
| Sum squared resid | 1.634317 | Schwarz criterion | -0.023083 |
| Log likelihood | 3.959309 | Hannan-Quinn criter. | -0.081280 |
| F-statistic | 46.11279 | Durbin-Watson stat | 1.713751 |
| Prob(F-statistic) | 0.000000 | | |

**ANNEX 11: D(LNM2)unit root test**

Null Hypothesis: D(LNM2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -9.404375 | 0.0000 |
| Test critical values: | 1% level | -3.632900 | |
| | 5% level | -2.948404 | |
| | 10% level | -2.612874 | |

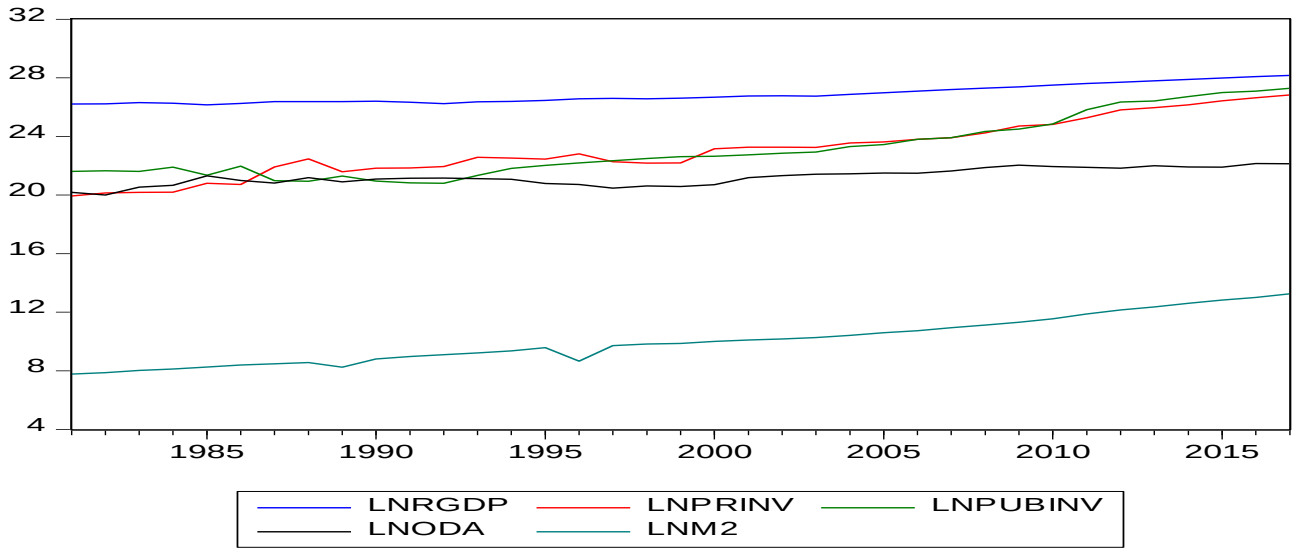
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNM2,2)
Method: Least Squares
Date: 06/15/20 Time: 13:09
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments

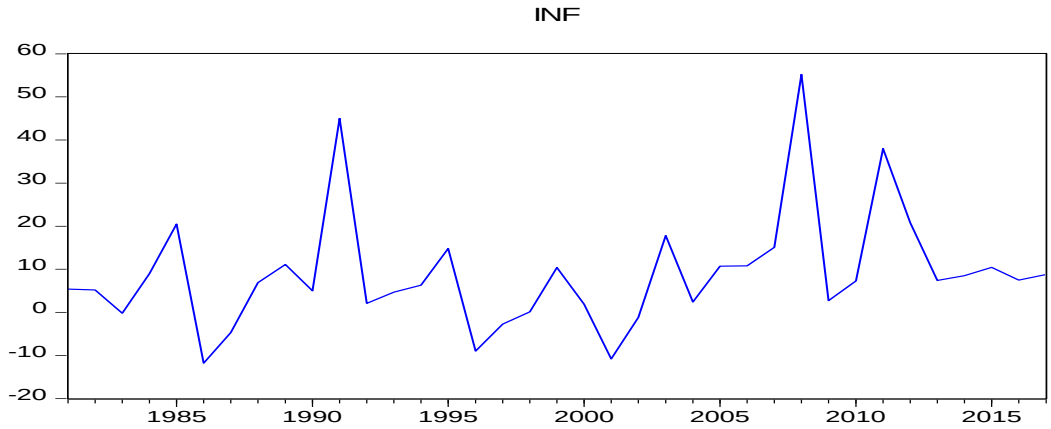
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNM2(-1)) | -1.458189 | 0.155054 | -9.404375 | 0.0000 |
| C | 0.222197 | 0.047244 | 4.703211 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.728266 | Mean dependent var | 0.004194 |
| Adjusted R-squared | 0.720032 | S.D. dependent var | 0.460271 |
| S.E. of regression | 0.243539 | Akaike info criterion | 0.068364 |
| Sum squared resid | 1.957268 | Schwarz criterion | 0.157241 |
| Log likelihood | 0.803626 | Hannan-Quinn criter. | 0.099045 |
| F-statistic | 88.44227 | Durbin-Watson stat | 2.206335 |
| Prob(F-statistic) | 0.000000 | | |

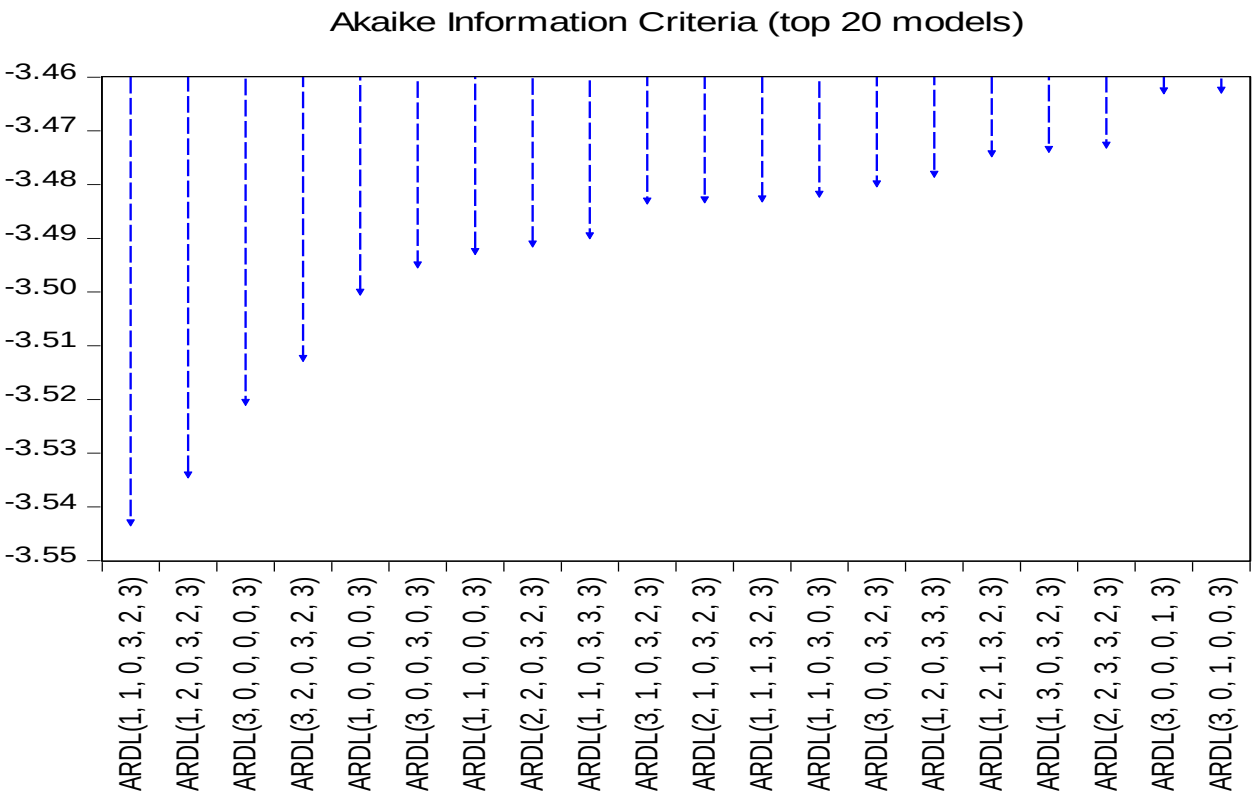
Trend of variables at level



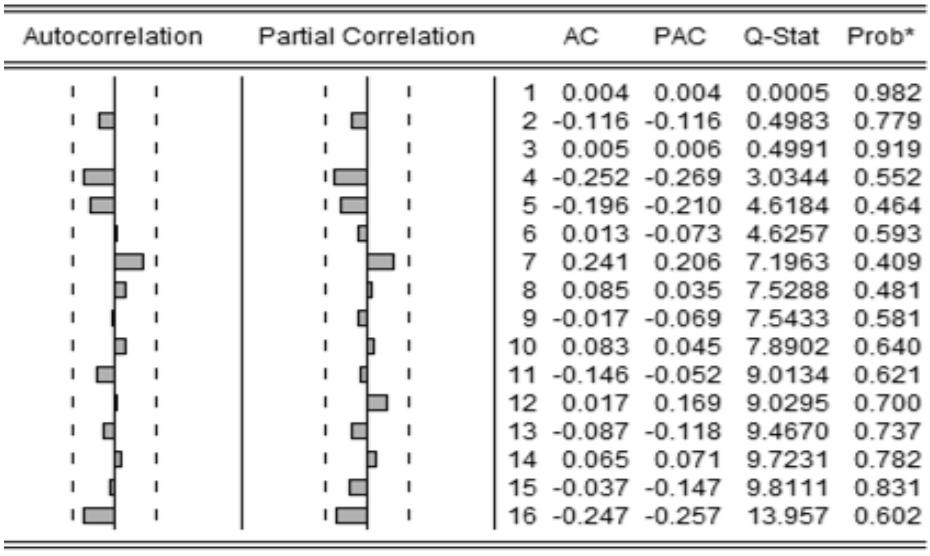

Trend of variable Inflation (INF)




**Model selection Criteria AIC**




**Autocorrelation test result of Correlogramregressors**



| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob* |
|---|---|---|---|---|---|---|
| | | 1 | 0.004 | 0.004 | 0.0005 | 0.982 |
| | | 2 | -0.116 | -0.116 | 0.4983 | 0.779 |
| | | 3 | 0.005 | 0.006 | 0.4991 | 0.919 |
| | | 4 | -0.252 | -0.269 | 3.0344 | 0.552 |
| | | 5 | -0.196 | -0.210 | 4.6184 | 0.464 |
| | | 6 | 0.013 | -0.073 | 4.6257 | 0.593 |
| | | 7 | 0.241 | 0.206 | 7.1963 | 0.409 |
| | | 8 | 0.085 | 0.035 | 7.5288 | 0.481 |
| | | 9 | -0.017 | -0.069 | 7.5433 | 0.581 |
| | | 10 | 0.083 | 0.045 | 7.8902 | 0.640 |
| | | 11 | -0.146 | -0.052 | 9.0134 | 0.621 |
| | | 12 | 0.017 | 0.169 | 9.0295 | 0.700 |
| | | 13 | -0.087 | -0.118 | 9.4670 | 0.737 |
| | | 14 | 0.065 | 0.071 | 9.7231 | 0.782 |
| | | 15 | -0.037 | -0.147 | 9.8111 | 0.831 |
| | | 16 | -0.247 | -0.257 | 13.957 | 0.602 |

## ANNEX 13: ARDL Output for Real GDP

Dependent Variable: D(LNRGDP)
Method: ARDL
Date: 06/16/20 Time: 10:33
Sample (adjusted): 1985 2017
Included observations: 33 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): D(LNPRINV) D(LNPUBINV) D(LNODA) D(LNM2) INF
Fixed regressors: C
Number of models evalulated: 3072
Selected Model: ARDL(1, 1, 0, 3, 2, 3)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| D(LNRGDP(-1)) | 0.642884 | 0.129439 | 4.966684 | 0.0001 |
| D(LNPRINV) | 0.049526 | 0.027150 | 1.824140 | 0.0858 |
| D(LNPRINV(-1)) | -0.050275 | 0.027752 | -1.811594 | 0.0878 |
| D(LNPUBINV) | 0.120010 | 0.027128 | 4.423845 | 0.0004 |
| D(LNODA) | -0.046387 | 0.037204 | -1.246845 | 0.2294 |
| D(LNODA(-1)) | -0.008314 | 0.042913 | -0.193729 | 0.8487 |
| D(LNODA(-2)) | 0.039833 | 0.041181 | 0.967257 | 0.3470 |
| D(LNODA(-3)) | 0.082128 | 0.038301 | 2.144261 | 0.0468 |
| D(LNM2) | -0.023622 | 0.029991 | -0.787631 | 0.4418 |
| D(LNM2(-1)) | 0.020006 | 0.036346 | 0.550423 | 0.5892 |
| D(LNM2(-2)) | 0.053903 | 0.030775 | 1.751515 | 0.0979 |
| INF | -0.001367 | 0.000519 | -2.631153 | 0.0175 |
| INF(-1) | -0.000507 | 0.000516 | -0.982546 | 0.3396 |
| INF(-2) | 0.001621 | 0.000486 | 3.338765 | 0.0039 |
| INF(-3) | -0.001969 | 0.000618 | -3.184272 | 0.0054 |
| C | 0.012278 | 0.013901 | 0.883252 | 0.3894 |

| | | | |
|---|---|---|---|
| R-squared | 0.848360 | Mean dependent var | 0.057548 |
| Adjusted R-squared | 0.714560 | S.D. dependent var | 0.066091 |
| S.E. of regression | 0.035310 | Akaike info criterion | -3.542903 |
| Sum squared resid | 0.021195 | Schwarz criterion | -2.817324 |
| Log likelihood | 74.45790 | Hannan-Quinn criter. | -3.298768 |
| F-statistic | 6.340509 | Durbin-Watson stat | 1.974506 |
| Prob(F-statistic) | 0.000248 | | |

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNRGDP, 2)
Selected Model: ARDL(1, 1, 0, 3, 2, 3)
Case 3: Unrestricted Constant and No Trend
Date: 06/16/20 Time: 10:44
Sample: 1981 2017
Included observations: 33

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.012278 | 0.013901 | 0.883252 | 0.3894 |
| D(LNRGDP(-1))* | -0.357116 | 0.129439 | -2.758946 | 0.0134 |
| D(LNPRINV(-1)) | -0.000749 | 0.041369 | -0.018099 | 0.9858 |
| D(LNPUBINV)** | 0.120010 | 0.027128 | 4.423845 | 0.0004 |
| D(LNODA(-1)) | 0.067260 | 0.074473 | 0.903142 | 0.3791 |
| D(LNM2(-1)) | 0.050287 | 0.078599 | 0.639784 | 0.5308 |
| INF(-1) | -0.002221 | 0.001166 | -1.905546 | 0.0738 |
| D(LNPRINV, 2) | 0.049526 | 0.027150 | 1.824140 | 0.0858 |
| D(LNODA, 2) | -0.046387 | 0.037204 | -1.246845 | 0.2294 |
| D(LNODA(-1), 2) | -0.121961 | 0.056851 | -2.145262 | 0.0467 |
| D(LNODA(-2), 2) | -0.082128 | 0.038301 | -2.144261 | 0.0468 |
| D(LNM2, 2) | -0.023622 | 0.029991 | -0.787631 | 0.4418 |
| D(LNM2(-1), 2) | -0.053903 | 0.030775 | -1.751515 | 0.0979 |
| D(INF) | -0.001367 | 0.000519 | -2.631153 | 0.0175 |
| D(INF(-1)) | 0.000348 | 0.000827 | 0.420192 | 0.6796 |
| D(INF(-2)) | 0.001969 | 0.000618 | 3.184272 | 0.0054 |

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPRINV) | -0.002097 | 0.116093 | -0.018060 | 0.9858 |
| D(LNPUBINV) | 0.336052 | 0.147267 | 2.281919 | 0.0356 |
| D(LNODA) | 0.188343 | 0.241994 | 0.778294 | 0.4471 |
| D(LNM2) | 0.140813 | 0.230773 | 0.610179 | 0.5498 |
| INF | -0.006219 | 0.004403 | -1.412529 | 0.1758 |

EC = D(LNRGDP) - (-0.0021*D(LNPRINV) +
0.3361*D(LNPUBINV) + 0.1883
*D(LNODA) + 0.1408*D(LNM2) -0.0062*INF )

| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| | | | Asymptotic: n=1000 | |
| F-statistic | 5.871254 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |
| | | | Finite Sample: | |
| Actual Sample Size | 33 | | n=35 | |
| | | 10% | 2.508 | 3.763 |
| | | 5% | 3.037 | 4.443 |
| | | 1% | 4.257 | 6.04 |
| | | | Finite Sample: n=30 | |
| | | 10% | 2.578 | 3.858 |
| | | 5% | 3.125 | 4.608 |
| | | 1% | 4.537 | 6.37 |

| t-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -2.758946 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

ARDL Error Correction Regression
Dependent Variable: D(LNRGDP, 2)
Selected Model: ARDL(1, 1, 0, 3, 2, 3)
Case 3: Unrestricted Constant and No Trend
Date: 06/16/20 Time: 10:44
Sample: 1981 2017
Included observations: 33

ECM Regression
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.012278 | 0.005597 | 2.193937 | 0.0424 |
| D(LNPRINV, 2) | 0.049526 | 0.014915 | 3.320533 | 0.0040 |
| D(LNODA, 2) | -0.046387 | 0.027120 | -1.710422 | 0.1054 |
| D(LNODA(-1), 2) | -0.121961 | 0.036542 | -3.337576 | 0.0039 |
| D(LNODA(-2), 2) | -0.082128 | 0.022328 | -3.678180 | 0.0019 |
| D(LNM2, 2) | -0.023622 | 0.016534 | -1.428682 | 0.1712 |
| D(LNM2(-1), 2) | -0.053903 | 0.016632 | -3.240901 | 0.0048 |
| D(INF) | -0.001367 | 0.000384 | -3.557402 | 0.0024 |
| D(INF(-1)) | 0.000348 | 0.000440 | 0.790448 | 0.4402 |
| D(INF(-2)) | 0.001969 | 0.000392 | 5.026640 | 0.0001 |
| CointEq(-1)* | -0.357116 | 0.052891 | -6.751930 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.887899 | Mean dependent var | 0.003627 |
| Adjusted R-squared | 0.836944 | S.D. dependent var | 0.076867 |
| S.E. of regression | 0.031039 | Akaike info criterion | -3.845933 |
| Sum squared resid | 0.021195 | Schwarz criterion | -3.347097 |
| Log likelihood | 74.45790 | Hannan-Quinn criter. | -3.678090 |
| F-statistic | 17.42512 | Durbin-Watson stat | 1.974506 |
| Prob(F-statistic) | 0.000000 | | |

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| F-statistic | 5.871254 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |

t-Bounds Test — Null Hypothesis: No levels

relationship

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| t-statistic | -6.751930 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---|---|---|---|
| F-statistic | 0.084046 | Prob. F(3,14) | 0.9676 |
| Obs*R-squared | 0.583811 | Prob. Chi-Square(3) | 0.9001 |

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 06/16/20 Time: 10:46
Sample: 1985 2017
Included observations: 33
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP(-1)) | -0.002001 | 0.171803 | -0.011646 | 0.9909 |
| D(LNPRINV) | -0.003543 | 0.031769 | -0.111520 | 0.9128 |
| D(LNPRINV(-1)) | 0.004174 | 0.034430 | 0.121239 | 0.9052 |
| D(LNPUBINV) | -0.003157 | 0.036470 | -0.086562 | 0.9322 |
| D(LNODA) | 0.000516 | 0.040792 | 0.012656 | 0.9901 |
| D(LNODA(-1)) | -0.000167 | 0.056913 | -0.002937 | 0.9977 |
| D(LNODA(-2)) | 0.003228 | 0.050202 | 0.064292 | 0.9496 |
| D(LNODA(-3)) | -0.001127 | 0.042634 | -0.026426 | 0.9793 |
| D(LNM2) | -0.002299 | 0.033718 | -0.068177 | 0.9466 |
| D(LNM2(-1)) | -0.001011 | 0.040986 | -0.024669 | 0.9807 |
| D(LNM2(-2)) | -0.000911 | 0.034205 | -0.026641 | 0.9791 |
| INF | 6.92E-05 | 0.000590 | 0.117342 | 0.9083 |
| INF(-1) | 2.20E-05 | 0.000588 | 0.037393 | 0.9707 |
| INF(-2) | 1.30E-05 | 0.000533 | 0.024410 | 0.9809 |
| INF(-3) | 2.07E-05 | 0.000690 | 0.030007 | 0.9765 |
| C | -0.000239 | 0.015330 | -0.015566 | 0.9878 |
| RESID(-1) | 0.002641 | 0.407220 | 0.006485 | 0.9949 |
| RESID(-2) | -0.152304 | 0.303854 | -0.501240 | 0.6240 |
| RESID(-3) | 0.016267 | 0.300008 | 0.054223 | 0.9575 |

| | | | |
|---|---|---|---|
| R-squared | 0.017691 | Mean dependent var | 3.68E-18 |
| Adjusted R-squared | -1.245277 | S.D. dependent var | 0.025736 |
| S.E. of regression | 0.038564 | Akaike info criterion | -3.378934 |
| Sum squared resid | 0.020820 | Schwarz criterion | -2.517309 |
| Log likelihood | 74.75242 | Hannan-Quinn criter. | -3.089024 |
| F-statistic | 0.014008 | Durbin-Watson stat | 1.982326 |
| Prob(F-statistic) | 1.000000 | | |

ANNEX 13: ARDL Output for private investment

Dependent Variable: D(LNPRINV)
Method: ARDL
Date: 06/18/20 Time: 08:55
Sample (adjusted): 1985 2017
Included observations: 33 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): D(LNRGDP) D(LNPUBINV) D(LNODA) D(LNM2) INF
Fixed regressors: C
Number of models evalulated: 3072
Selected Model: ARDL(3, 0, 0, 3, 3, 0)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| D(LNPRINV(-1)) | -0.267190 | 0.147534 | -1.811044 | 0.0869 |
| D(LNPRINV(-2)) | -0.066712 | 0.117961 | -0.565539 | 0.5787 |
| D(LNPRINV(-3)) | -0.152566 | 0.111141 | -1.372727 | 0.1867 |
| D(LNRGDP) | 0.408001 | 0.764585 | 0.533624 | 0.6001 |
| D(LNPUBINV) | -0.312400 | 0.141176 | -2.212835 | 0.0401 |
| D(LNODA) | 0.356996 | 0.202802 | 1.760322 | 0.0953 |
| D(LNODA(-1)) | -0.532468 | 0.199097 | -2.674418 | 0.0155 |
| D(LNODA(-2)) | 0.393684 | 0.216330 | 1.819827 | 0.0855 |
| D(LNODA(-3)) | 0.803326 | 0.251399 | 3.195423 | 0.0050 |
| D(LNM2) | -0.013605 | 0.155738 | -0.087362 | 0.9313 |
| D(LNM2(-1)) | 0.545353 | 0.192254 | 2.836627 | 0.0109 |
| D(LNM2(-2)) | 0.901784 | 0.212410 | 4.245498 | 0.0005 |
| D(LNM2(-3)) | 0.809060 | 0.182091 | 4.443152 | 0.0003 |
| INF | 0.000543 | 0.002917 | 0.186287 | 0.8543 |
| C | -0.071348 | 0.088958 | -0.802045 | 0.4330 |
| CointEq(-1)* | -0.486468 | 0.146662 | -10.13535 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.851794 | Mean dependent var | 0.201159 |
| Adjusted R-squared | 0.736524 | S.D. dependent var | 0.379740 |
| S.E. of regression | 0.194921 | Akaike info criterion | -0.129494 |
| Sum squared resid | 0.683892 | Schwarz criterion | 0.550736 |
| Log likelihood | 17.13666 | Hannan-Quinn criter. | 0.099383 |
| F-statistic | 7.389497 | Durbin-Watson stat | 2.095291 |
| Prob(F-statistic) | 0.000073 | | |

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNPRINV, 2)
Selected Model: ARDL(3, 0, 0, 3, 3, 0)
Case 3: Unrestricted Constant and No Trend
Date: 06/18/20 Time: 08:59
Sample: 1981 2017
Included observations: 33

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.071348 | 0.088958 | -0.802045 | 0.4330 |
| D(LNPRINV(-1))* | -1.486468 | 0.214018 | -6.945517 | 0.0000 |
| D(LNRGDP)** | 0.408001 | 0.764585 | 0.533624 | 0.6001 |
| D(LNPUBINV)** | -0.312400 | 0.141176 | -2.212835 | 0.0401 |
| D(LNODA(-1)) | 1.021538 | 0.361826 | 2.823284 | 0.0113 |
| D(LNM2(-1)) | 2.242592 | 0.554738 | 4.042616 | 0.0008 |
| INF** | 0.000543 | 0.002917 | 0.186287 | 0.8543 |
| D(LNPRINV(-1), 2) | 0.219278 | 0.154746 | 1.417022 | 0.1736 |
| D(LNPRINV(-2), 2) | 0.152566 | 0.111141 | 1.372727 | 0.1867 |
| D(LNODA, 2) | 0.356996 | 0.202802 | 1.760322 | 0.0953 |
| D(LNODA(-1), 2) | -1.197010 | 0.268195 | -4.463200 | 0.0003 |
| D(LNODA(-2), 2) | -0.803326 | 0.251399 | -3.195423 | 0.0050 |
| D(LNM2, 2) | -0.013605 | 0.155738 | -0.087362 | 0.9313 |
| D(LNM2(-1), 2) | -1.710845 | 0.358839 | -4.767720 | 0.0002 |
| D(LNM2(-2), 2) | -0.809060 | 0.182091 | -4.443152 | 0.0003 |

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP) | 0.274477 | 0.514213 | 0.533780 | 0.6000 |
| D(LNPUBINV) | -0.210163 | 0.100972 | -2.081389 | 0.0519 |
| D(LNODA) | 0.687225 | 0.236412 | 2.906891 | 0.0094 |
| D(LNM2) | 1.508671 | 0.450012 | 3.352516 | 0.0035 |
| INF | 0.000366 | 0.001961 | 0.186384 | 0.8542 |

EC = D(LNPRINV) - (0.2745*D(LNRGDP) -
0.2102*D(LNPUBINV) + 0.6872
*D(LNODA) + 1.5087*D(LNM2) + 0.0004*INF )

| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| | | | Asymptotic: n=1000 | |
| F-statistic | 13.39896 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |
| | | | Finite Sample: n=35 | |
| Actual Sample Size | 33 | | | |
| | | 10% | 2.508 | 3.763 |
| | | 5% | 3.037 | 4.443 |
| | | 1% | 4.257 | 6.04 |
| | | | Finite Sample: n=30 | |
| | | 10% | 2.578 | 3.858 |
| | | 5% | 3.125 | 4.608 |
| | | 1% | 4.537 | 6.37 |

| t-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -6.945517 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

ARDL Error Correction Regression
Dependent Variable: D(LNPRINV, 2)
Selected Model: ARDL(3, 0, 0, 3, 3, 0)
Case 3: Unrestricted Constant and No Trend
Date: 06/18/20 Time: 09:00
Sample: 1981 2017
Included observations: 33

ECM Regression
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.071348 | 0.030973 | -2.303582 | 0.0334 |
| D(LNPRINV(-1), 2) | 0.219278 | 0.101520 | 2.159947 | 0.0445 |
| D(LNPRINV(-2), 2) | 0.152566 | 0.082494 | 1.849420 | 0.0809 |
| D(LNODA, 2) | 0.356996 | 0.138040 | 2.586175 | 0.0186 |
| D(LNODA(-1), 2) | -1.197010 | 0.171309 | -6.987451 | 0.0000 |
| D(LNODA(-2), 2) | -0.803326 | 0.174597 | -4.601037 | 0.0002 |
| D(LNM2, 2) | -0.013605 | 0.105695 | -0.128724 | 0.8990 |
| D(LNM2(-1), 2) | -1.710845 | 0.208596 | -8.201720 | 0.0000 |
| D(LNM2(-2), 2) | -0.809060 | 0.127076 | -6.366719 | 0.0000 |
| CointEq(-1)* | -0.486468 | 0.146662 | -10.13535 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.935370 | Mean dependent var | 0.005886 |
| Adjusted R-squared | 0.910080 | S.D. dependent var | 0.575044 |
| S.E. of regression | 0.172437 | Akaike info criterion | -0.432525 |
| Sum squared resid | 0.683892 | Schwarz criterion | 0.020962 |
| Log likelihood | 17.13666 | Hannan-Quinn criter. | -0.279940 |
| F-statistic | 36.98568 | Durbin-Watson stat | 2.095291 |
| Prob(F-statistic) | 0.000000 | | |

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| F-statistic | 13.39896 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |

| t-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -10.13535 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

**ANNEX 13: ARDL Output for public investment**

Dependent Variable: D(LNPUBINV)
Method: ARDL
Date: 06/18/20 Time: 09:08
Sample (adjusted): 1983 2017
Included observations: 35 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): D(LNRGDP) D(LNPRINV) D(LNODA) D(LNM2) INF
Fixed regressors: C
Number of models evalulated: 729
Selected Model: ARDL(1, 0, 0, 0, 0, 1)
Note: final equation sample is larger than selection sample

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| C | 0.015947 | 0.083161 | 0.191761 | 0.8494 |
| D(LNPUBINV(-1)) | -0.235705 | 0.150711 | -1.563953 | 0.1295 |
| D(LNRGDP) | 2.577599 | 0.831533 | 3.099814 | 0.0045 |
| D(LNPRINV) | -0.388602 | 0.144523 | -2.688852 | 0.0121 |
| D(LNODA) | -0.245444 | 0.237588 | -1.033068 | 0.3107 |
| D(LNM2) | -0.011754 | 0.177801 | -0.066108 | 0.9478 |
| INF | 0.007598 | 0.003436 | 2.211211 | 0.0357 |
| INF(-1) | 0.006562 | 0.003433 | 1.911479 | 0.0666 |
| CointEq(-1)* | -0.235705 | 0.122668 | -10.07357 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.490906 | Mean dependent var | 0.160566 |
| Adjusted R-squared | 0.358918 | S.D. dependent var | 0.339206 |
| S.E. of regression | 0.271594 | Akaike info criterion | 0.428617 |
| Sum squared resid | 1.991613 | Schwarz criterion | 0.784125 |
| Log likelihood | 0.499204 | Hannan-Quinn criter. | 0.551338 |
| F-statistic | 3.719336 | Durbin-Watson stat | 1.619694 |
| Prob(F-statistic) | 0.006068 | | |

*Note: p-values and any subsequent tests do not account for model selection.

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| C | 0.015947 | 0.083161 | 0.191761 | 0.8494 |
| D(LNPUBINV(-1)) | -0.235705 | 0.150711 | -1.563953 | 0.1295 |
| D(LNRGDP) | 2.577599 | 0.831533 | 3.099814 | 0.0045 |
| D(LNPRINV) | -0.388602 | 0.144523 | -2.688852 | 0.0121 |
| D(LNODA) | -0.245444 | 0.237588 | -1.033068 | 0.3107 |
| D(LNM2) | -0.011754 | 0.177801 | -0.066108 | 0.9478 |
| INF | 0.007598 | 0.003436 | 2.211211 | 0.0357 |
| INF(-1) | 0.006562 | 0.003433 | 1.911479 | 0.0666 |
| CointEq(-1)* | -0.235705 | 0.122668 | -10.07357 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.490906 | Mean dependent var | 0.160566 |
| Adjusted R-squared | 0.358918 | S.D. dependent var | 0.339206 |
| S.E. of regression | 0.271594 | Akaike info criterion | 0.428617 |
| Sum squared resid | 1.991613 | Schwarz criterion | 0.784125 |
| Log likelihood | 0.499204 | Hannan-Quinn criter. | 0.551338 |
| F-statistic | 3.719336 | Durbin-Watson stat | 1.619694 |
| Prob(F-statistic) | 0.006068 | | |

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNPUBINV, 2)
Selected Model: ARDL(1, 0, 0, 0, 0, 1)
Case 3: Unrestricted Constant and No Trend
Date: 06/18/20 Time: 09:10
Sample: 1981 2017
Included observations: 35

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.015947 | 0.083161 | 0.191761 | 0.8494 |
| D(LNPUBINV(-1))* | -1.235705 | 0.150711 | -8.199160 | 0.0000 |
| D(LNRGDP)** | 2.577599 | 0.831533 | 3.099814 | 0.0045 |
| D(LNPRINV)** | -0.388602 | 0.144523 | -2.688852 | 0.0121 |
| D(LNODA)** | -0.245444 | 0.237588 | -1.033068 | 0.3107 |
| D(LNM2)** | -0.011754 | 0.177801 | -0.066108 | 0.9478 |
| INF(-1) | 0.014160 | 0.004741 | 2.986733 | 0.0059 |
| D(INF) | 0.007598 | 0.003436 | 2.211211 | 0.0357 |

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNRGDP) | 2.085934 | 0.658655 | 3.166962 | 0.0038 |
| D(LNPRINV) | -0.314478 | 0.127069 | -2.474862 | 0.0199 |
| D(LNODA) | -0.198627 | 0.191971 | -1.034668 | 0.3100 |
| D(LNM2) | -0.009512 | 0.144069 | -0.066024 | 0.9478 |
| INF | 0.011459 | 0.003795 | 3.019496 | 0.0055 |

EC = D(LNPUBINV) - (2.0859*D(LNRGDP) -
0.3145*D(LNPRINV) -0.1986
*D(LNODA) -0.0095*D(LNM2) + 0.0115*INF )

| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| | | | Asymptotic: n=1000 | |

| | | | | |
|---|---|---|---|---|
| F-statistic | 14.27017 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |
| | | | Finite Sample: | |
| Actual Sample Size | 35 | | n=35 | |
| | | 10% | 2.508 | 3.763 |
| | | 5% | 3.037 | 4.443 |
| | | 1% | 4.257 | 6.04 |

| t-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| t-statistic | -8.199160 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |

ARDL Error Correction Regression
Dependent Variable: D(LNPUBINV, 2)
Selected Model: ARDL(1, 0, 0, 0, 0, 1)
Case 3: Unrestricted Constant and No Trend
Date: 06/18/20 Time: 09:13
Sample: 1981 2017
Included observations: 35

ECM Regression
Case 3: Unrestricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.015947 | 0.042187 | 0.378008 | 0.7084 |
| D(INF) | 0.007598 | 0.002301 | 3.302767 | 0.0027 |
| CointEq(-1)* | -0.235705 | 0.122668 | -10.07357 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.761197 | Mean dependent var | 0.003791 |
| Adjusted R-squared | 0.746272 | S.D. dependent var | 0.495272 |
| S.E. of regression | 0.249475 | Akaike info criterion | 0.142903 |
| Sum squared resid | 1.991613 | Schwarz criterion | 0.276218 |
| Log likelihood | 0.499204 | Hannan-Quinn criter. | 0.188923 |
| F-statistic | 51.00090 | Durbin-Watson stat | 1.619694 |
| Prob(F-statistic) | 0.000000 | | |

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| F-statistic | 14.27017 | 10% | 2.26 | 3.35 |
| k | 5 | 5% | 2.62 | 3.79 |
| | | 2.5% | 2.96 | 4.18 |
| | | 1% | 3.41 | 4.68 |

t-Bounds Test — Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| t-statistic | -10.07357 | 10% | -2.57 | -3.86 |
| | | 5% | -2.86 | -4.19 |
| | | 2.5% | -3.13 | -4.46 |
| | | 1% | -3.43 | -4.79 |