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MACROECONOMIC STABILTY IMPLICATIONS OF GTP-II: EVIDENCE FROM MACRO -ECONOMETIC MODEL FOR ETHIOPIAN ECONOMY

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MACROECONOMIC STABILTY IMPLICATIONS OF GTP-II: EVIDENCE FROM MACRO -ECONOMETIC MODEL FOR ETHIOPIAN ECONOMY

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This is to certify that the thesis prepared by Anteneh Bizualem, entitled: *Macroeconomic Stability Implications of GTP II; Evidence from Macro-Econometric Model for Ethiopian Economy* and submitted in partial fulfillment of the requirements for the degree of Master of Science (Economic Policy Analysis) compiles with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

This study tries to use a macro econometric model for policy analysis purpose of the Second Growth and Transformation Plan. First the macro-econometric model is developed for Ethiopian economy based on aggregate supply and aggregate demand framework. The model is composed of total 65 equations, out of which 12 equations are estimated equations and the rest are either identity or bridging equations. After the model is developed, how it performs with historical data is checked by performing dynamic simulations for the sample period 2000-2014 and it has performed well in tracing historical values. After the model performs well with historical data it is used to simulate for the two scenarios of the Second Growth and Transformation Plan: the increase in the government investment by 10 percent and an external shock which is an increase in import price by 10 percent. When the government investment increases by 10 percent, it has an increasing impact on the output of the economy. On the other hand, it creates an inflationary pressure. This shows that it may have a macroeconomic instability problem. When the import price increases by 10 percent, it has a negative impact on the output of the economy and also leads to an inflationary pressure. But the inflationary pressure that comes from the increase in the public investment is higher and leads to more macroeconomic instability problem. To avoid or minimize the instability problems that arise from these policy shocks the government should be cautious and take preventive actions accordingly. In general, the Second Growth and Transformation Plan has to be undertaken in a matter of which its effect on the economy's stability is minimal and the government should follow different measures to avoid the worst scenario.

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Acronyms

AD – Aggregate Demand

ADF- Augmented Dickey Fuller

AIC- Akaike Information Criterion

AIH- Absolute Income Hypothesis

APC- Average Propensity to Consume

AR- Autoregressive Process

ARDL- Autoregressive Distributive Lag Model

AS – Aggregate Supply

BoP- Balance of Payment

BPR- Business Process Reengineering

CES- Constant Elasticity of Substitution

CGE- Computable General Equilibrium Models

CPI- Consumer Price Index

CSA- Central Statistics Agency

DF- Dickey Fuller

DGP- Data Generating Process

DOLS- Dynamic Ordinary Least Square

DSGE- Dynamic Stochastic General Equilibrium Models

DW- Durbin Watson statistic

E.C. – Ethiopian Calendar

ECM- Error Correction Model

EEA- Ethiopian Economics Association

EMM- Ethiopian Macro Model

EPRDF- Ethiopian People's Revolutionary Democratic Front

ERCA- Ethiopian Revenue and Customs Authority

ETB- Ethiopian Birr

FDI- Foreign Direct Investment

FITA- Federal Inland Tax Authority

GDP –Gross Domestic Product

GNP- Gross National Product

GTP / GTP I– Growth and Transformation Plan (the first)

GTP II – The second Growth and Transformation plan

IMF – International Monetary Fund

JB- Jarque Berra

KIPPRA- Kenyan Institute for Public Policy Research and Analysis

KK- Keynes-Klein Model

KPSS- Kwiatkowski, Phillips, Schmidt and Shin test

KTMM - KIPPRA Treasury Macroeconomic Model

LCH-Life Cycle Hypothesis

MACMOD - Tanzanian Macro Model

MDGs – Millennium Development Goals

MOFED – Ministry of Finance and Economic Development

MoR- Ministry of Revenue

MPC- Marginal Propensity to Consume

NAMEX - Namibia Macro-econometric Model

NBE- National Bank of Ethiopia

OLS- Ordinary Least Square

PASDEP- Plan for Accelerated and Sustained Development to End Poverty

PIH- Permanent Income Hypothesis

PP- Phillips- Perron Test

RBC- Real Business Cycle theory

RIH- Relative Income Hypothesis

SAM- Social Accounting Matrix

SAP- Structural Adjustment Program

SDPRP - Sustainable Development and Poverty Reduction Program

VAT- Value Added Tax

ZAMMOD – Zambia Macro Model

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CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Ethiopia has implemented development plans since the time of the imperial regime of Emperor Haile Selassie I (1930-1974). In the imperial era there had been three development plans ranging between the years 1958-1962, 1963-67 and 1969-74. These plans have helped for the creation of different and important institutions for planning purpose at that time (Tesfaye, 1991). The first two plans were conservative; they have targeted low levels of investment and growth rates. The third plan, on the other hand, has a higher target which ends up with under implementation of its targets. But the institutionalization of development plans has begun in the imperial era and the modest achievements were bases for future.

In the Derg[1] era, before the launching of the Ten Year Perspective Plan (1984/85-1993/94), there were up to six annual campaign programs known as "Zemechas" (Tesfaye, 1991). These campaigns were designed to achieve limited and immediate objectives by addressing urgent problems of the time like illiteracy. So, the need for a policy tool that considers the long term objectives of the country was a question of the time and then the ten year perspective plan was launched in 1984/85. Its implementation is undertaken through elaboration of short and medium term plans. But before the end of this perspective plan, the Derg regime was toppled by EPRDF forces in may 1991.

[1] Derg- means in Geez "unity" and in Amharic it is used here for "committee"

In the early days of the 1990's the Structural adjustment program (SAP) was the order of the day in many developing countries through the custodian of Britton Wood Institutions (World Bank and IMF). The Ethiopian case was not different and it has implemented the Structural Adjustment Program with the new EPRDF led government. After the completion of the SAP in 1997 other programs like Sustainable Development and Poverty Reduction Program (SDPRP), which runs from 2000-2005 and Plan for Accelerated and Sustained Development to End Poverty (PASDEP) from 2005 to 2010 were implemented. The main objectives of these programs were achieving the Millennium Development Goals (MDGs).

In 2010/11 the country has launched the first Growth and Transformation Plan (GTP). This plan had the following objectives: maintaining at least an average real GDP growth rate of 11 percent, expand and ensure the qualities of education and health services, establishing favorable conditions for sustainable state building through the creation of stable democratic and developmental state and ensuring the growth sustainability with additional objective of meeting the MDGs through the process (MOFED, 2010). The successes in some sectors and it's below par performance in some sectors has given different lessons for the planners of the second Growth and Transformation Plan (GTP II) (NPC, 2015). And it has helped to select out sectors to focus on the second Growth and Transformation Plan (GTP II) and to restructure institutions.

Generally, the different development plans that have been implemented in the country until now did not help the country to become a middle income or developed country; it is among the least developed countries in the world. This does not mean that there were no any successes in the development plans at all. In the last decade, the Ethiopian economy was among the fastest growing economies of the world (IMF, 2013). But the decade was also a period where different macroeconomic instability problems (like the highest inflation level in the country's entire

history that happened in 2008) happened and drag the growth of the economy backwards. To minimize or avoid such macroeconomic instability problems, countries use different methods to assess the impact of different plans and policies on the economy before and in the time of their implementation. Building structural macro-econometric model for the whole economy and making policy analysis is one of these methods.

Macro-econometric modeling has originated from the works of Jan Tinbergen in the 1930's and it has been useful for policy analysis until now with different timely refinements and updates coming through. Even though this is the case of the international arena, in Ethiopia the number of macro-econometric models developed is limited. Among these the following are notable: Kidane and Kocklaeuner, 1985, Mered Lemma, 1993, Haile Kibret, 1996, Daniel Zerfu, 2001, MoFED-EMM, 2004, EEA, 2008, Tewodros Tebekew, 2011. A macro-econometric model that best describes the workings of the economy can make policy makers and researcher's policy exercise and analysis easier. For that the model building must be a continuous exercise. This paper has tried to develop a macro-econometric model for the Ethiopian economy with additional components of the economy considered than previous models and to use it for policy analysis of the second growth and transformation plan (GTP II) period.

1.2. Statement of the Problem

At any country level (whether developed or developing) having macro-econometric models is very important. These models provide the structural view of the economy in a comprehensive manner and help to have a consistent definition of aggregate resources of any country (Alemayehu and Addis, 2014, Were M. et al., 2013). The consistency gained by using macro-econometric models makes easy to have a forecast for future values and enables policy makers to make informed decisions. And also these macro-econometric models can be used as a laboratory

for testing different ideas and policy alternatives. Even though these models have the above mentioned and others benefits, the process of using these models for policy analysis is not free from criticisms.

The main critics of macro-econometric models come from the Lucas Critique (1976), which says using policy invariant macro-econometric coefficients for policy analysis are rejected under rational expectation theory (Valadkhani, 2003). According to Klein (1989) as cited in Valadkhani (2003), the change in the economy does not mean that there is also change in the parametric structure. And Lucas's critique has also led to new area of research (Fair, 1987) and helps macro-econometric models to include more concepts than before and to become up to date. Above all different methodologies have also developed that has increased the power of macro-econometric models (Hendry, 1980, Sims 1980, 1982) and Leamer (1983). As a response to these criticisms and with different refinements to macro-econometric modeling, it has continued as a powerful policy analysis tool (Hall, 1995) and it is still powerful today. This can be concreted by looking the number of countries that use these models at present. African countries are also developing and using these models at different institutional set up.

Many African government institutions are using macro models for planning and forecasting purposes. To mention some, Zambia Macro Model (ZAMMOD), Namibia Macro-econometric Model (NAMEX), Tanzanian Macro Model (MACMOD), Botswana Forecasting models, Cameroon macroeconomic models, Rwandan macro model and Kenyan KTMM. If we take the Kenyan case, Elliot et al. (1986) and Musila and Rao (2002)[2] have developed macro models for the economy. The model developed by the latter has missed the production function because of data scarcity (Welfe, 2013, p.231). After these models, the KIPPRA Treasury Macroeconomic

[2] The specification and other characteristics of this model are reviewed in empirical literature part of chapter two.

Model (KTMM), which is developed with demand driven Keynesian theoretical framework has registered success. KTMM is developed for budget and policy analysis purpose and will be updated in every year. The supply constrained nature of African economies is also considered in some macro-econometric models; (Alemayehu and Addis, 2014, for Rwanda, Ghartey and Rao, 1993, for Ghana, Olofin et al., 1985, for Nigeria) have used this theoretical framework. This theoretical framework can be called *structuralis*t version of AS and AD, because it considers the special characteristic of the economy to whom the model will be developed. So the recent development in macro-econometric modeling in Africa shows as there is huge demand for these types of models and countries are trying their best to develop their own macro model. In Ethiopia also, there are different macro-econometric models developed up until now.

The developed macro-econometric models for Ethiopian economy are limited in number and in their use for planning and policy analysis purpose as compared to other African countries. These models are also not used to analyze the impact of policies from a specific development plan. But using macro-econometric models for analyzing policies of a specific development plan is a common experience in other countries and GTP II presents a good opportunity for us. GTP II is the continuation of GTP I with some departures and it has the following specific objectives; achieving an average real GDP growth rate of 11 percent within a stable macroeconomic environment, developing the domestic engineering and fabrication capacity and improve productivity of the domestic productive sectors, further solidifying the on-going public mobilization and organized participation to ensure the public become both owners and beneficiaries from development outcomes and deepening the hegemony of developmental political economy by strengthening a stable democratic developmental state.

Stable macroeconomic environment has given an important role in this plan side by side with the growth objective. Therefore, the different policy actions to be taken by the government throughout the plan period should not create macroeconomic instability problem. For this knowing what and by how much is the instability implications of different policies is important. One of the methods is to study the implications of different policies before their implementation to minimize the problem to happen. To do this for developing a macro-econometric model is one tool.

So, this study has tried to develop a macro-econometric model that considers the supply constrained nature of the Ethiopian economy and other dynamics. Especially after developing the model, it is used to analyze the impacts of particular policies of the government in the second Growth and Transformation Plan (GTP II) on different sectors of the economy.

1.3. Objectives of the Study

The general objective of the study is to build a macro econometric model for the Ethiopian economy and to use it for analyzing policy interventions of different kind and external shocks. The model is used to analyze the policies in the second Growth and Transformation Plan of the country which has a span from 2015/16-2019/20.The specific objectives are:-

- Develop a macro econometric model by giving more emphasis to the supply constrained nature of the Ethiopian economy.
- Analyze the macroeconomic stability implications of macroeconomic policies of GTP II for the next five years (2008 E.C-2012E.C)
- Comparing the implications of policy schemes of GTP II on different macroeconomic variables.

1.4. Significance of the Study

When one country plans to undertake different policies, knowing the implications of those policies are very important. One way of knowing the implications of policies on the economy is making simulation analysis using macro-econometric model of the economy. In Ethiopia, different development plans have been implemented up to now. But the system to use macro econometric models for the analysis of these policies is lacking. If there were some, it is limited and does not cover the whole components of the economy.

So, this paper will have a significant contribution to forecast the macroeconomic stability implications of policies of the GTP II plan. This can again help policy makers and different stakeholders of the plan to take appropriate preventive mechanisms and to make some adjustments on policies that will have a dismal implication.

1.5. Organization of the Paper

This paper is organized in to seven chapters. The second chapter is the literature review, in which the review of both theoretical and empirical literatures is presented. The theoretical literature review part also includes the review of different macro model types and review of theory about the specification of behavioral equations of different actors in the economy. In chapter three, a comprehensive review of the Ethiopian economy and its performance is presented. This is followed by the model specification and theory about the estimation techniques used in the paper, which makes chapter four of the paper. Chapter five presents the empirical analysis part of the paper, while chapter six is all about the evaluation of the model developed and the simulation of different policies. The last chapter, chapter seven, presents conclusions and recommendations of the paper.

CHAPTER TWO

LITERATURE REVIEW

Specification of behavioral equations is the main component in developing macro-econometric models. The specification of these behavioral equations has passed through different development steps i.e., theoretical formulations. And also we have different ways of specifying the behavioral equations on our hands. So, in the modeling process we have to choose among these alternatives.

In this chapter, the reviews of these different alternatives and their development and how empirical models choose from these alternatives are presented. The theoretical literature focuses mainly on standard theories of different sectors of the economy and main type of modeling practices. The theoretical literature has two sections. The first are the review of the literature on supply driven and demand driven macro-econometric models and other variants of macro models like dynamic stochastic general equilibrium model (DSGE) and computable general equilibrium (CGE) models. The second section presents the theoretical literature on modeling practices of different sectors of the economy. This helps to show how the modeling of private agents' behavioral equations is done in the development of macroeconomic framework[3].The empirical literature part reviews some of the published and applied macro-econometric models from African countries and models developed for Ethiopian economy.

[3] Agenor and Montel (2008, p. 62) have discussed the need for modeling behavioral functions of private agents in macroeconomic framework.

2.1. Theoretical Literature Review

Macro-econometric models always need to be based on profound theoretical foundations to achieve their intended objectives. These theoretical foundations are different from their view of the economy based on the assumption they used and the component of the economy they give more emphasis. Some models focus only on demand side of the economy assuming that it is the aggregate demand that is the main constraint in the economy.

While, other models try to capture the supply constrained nature of developing economies. Those modelers that focus on the supply side of the economy thought that the main constraint of the economy, mostly in developing economies, is the supply side and it needs to be well disaggregated to get good information about the working of the economy. Other macro models base themselves solely on micro foundations and try to model the economy with different view. For these types of models DSGE and CGE models are good example. These two models and the theoretical underpinning behind them combined with the demand driven and supply driven macro-econometric models are reviewed in the next section.

2.1.1. Demand Driven Macro-econometric Models

The demand driven macro-econometric models used in developed countries are of the Keynes-Klein (KK) model type and they are used to deal mostly with problems of short-run instability of output and employment. This is because the main purpose of the KK model is to explain the Keynesian demand-oriented model of macroeconomic fluctuations (Valadhakini, 2004). In this type of models the supply side is not generally emphasized (Alemayehu & Addis, 2014).

According to Valadhakini (2004), the noteworthy characteristics of the KK models can be summarized as follows. The main one is that the models assume there is economy wide clearing

in the product market and they are formulated on the basis of discrete time. Other characteristics includes the use of lagged dependent and independent variables which gives a dynamic dimension to the model, the model is also known to be non-linear and it captures stochastic behavior by incorporating a random disturbance term. The implication of the assumption of clearing product market is that desired aggregate demand always equals aggregate supply. On the other hand, these models are criticized for the following reasons. They do not consider the supply side and also the neoclassical production function. There is also no adequate attention given to the role of the money market, relative prices and expectations, which is an additional criticism. In response to these criticisms, the monetarists has formulated St. Louis model and recent models have also come up with a method of incorporating these components of the economy.

In the modeling process, aggregate demand is disaggregated in to its components to get the clear view of its dynamics. The consumption function (mostly represented in line with Keynesian theory), investment function and the government expenditure are the main components. Additionally, the external sector (having import and export as its components) is also specified clearly and the new developments of these models have also the money market as an additional component. Since supply and prices does not play an important role in these models, policy makers can only use different methods to manage aggregate demand. The closure rule also emanates from this theory and in most cases it equates output to aggregate demand.

The supply side of the economy will passively adapts itself to demand and mostly prices are taken as given or changed parametrically (Backhouse, 1995). This situation does not hold for economies where adjusting the supply to demand is impossible or takes longer period because of structural conditions. In this type of economies, mostly developing countries including Sub-

Saharan African countries, it is important to give due emphasis to the supply constrained nature of the economy in modeling. In the next section we will try to see the theoretical review of macro-econometric models that uses this line of analysis.

2.1.2. Supply Driven Macro-econometric Models

In supply driven models (also called *structuralist* version of AD-AS framework in Almayehu &Addis, 2014) the main determinant of output is capacity utilization. These types of models agree with the stylized facts in most developing economies like Africa. Most of African economies have a lower capacity for satisfying the demand of their economies and it is more difficult to adjust the supply side of the economy. So, to understand the functioning of these types of economies, it is important to explicitly model the supply side of the economy.

To explicitly model the supply side of the economy the main analytical equations are production functions (Harris, 1985). The production functions are used to relate factor availability and technology. Most of the models use constant elasticity of substitution (CES) production functions in the modeling process. Additionally, the supply side is divided in to agricultural and non-agricultural sectors (Daniel, 2001 and Tewodros, 2011). Other models have also again disaggregated the non-agricultural sector as formal sector and informal sector (Alemayehu and Huizinga, 2004). Since the objective of the model building is the one that determines the disaggregation level, the agricultural sector can also be further disaggregated. First it can be subdivided into cash crops and food production for the domestic market and if the need arises it can be again further subdivided by types of agricultural products (Alemayehu and Huizinga, 2004). The disaggregation level as noted above is to be decided by the modelers' objective and it helps to better understand the economy. The closure rules also vary from model to model.

2.1.3. Dynamic Stochastic General Equilibrium Macro Models (DSGE)

Until the mid-1970s the dominant paradigm in macroeconomics was the Keynesian paradigm, in which short run fluctuation in output and employment are considered they are due to variations in aggregate demand. The policy prescription was also controlling these aggregate demand fluctuations. The stagflation (a situation in which there is simultaneous inflation and unemployment), which is closely related to the oil price shock in mid-1970s has become difficult to be explained by Keynesian paradigm and led to the demise of this school. And also this has brought the demand for change in the paradigm. The new paradigm must have micro foundation and also gives credit to the supply side shocks.

The first type of DSGE models comes at this juncture through the works of F. Kydland and E. Prescott [4](1982). Their work makes the core for the Real Business Cycle (RBC) theory. The RBC models are based on micro foundations and assume rational expectation for economic agents. Being based on micro foundation has helped these models to overcome the critics on Keynesian economics that does not have any room for micro foundation. Whereas, the rational expectation assumption able them to address the Lucas critique, which says that estimated parameters are policy invariant and using them for future is invalid. The RBC models assume that markets always clear and economic fluctuations are results of optimal inter-temporal decisions by economic agents and monetary fluctuations cannot explain the fluctuations in aggregate variables. This has led to the conclusion that money is neutral and there is no need to use economic policy to correct the fluctuations. (See Snowdon and Vane, 2005; 294-344, for

[4] Finn Kydland and Edward Prescott have shared together the noble prize in economics in 2004 for their analysis in macroeconomic fluctuations.

further discussion). But the neutrality of money has faced serious challenges which are based on empirical evidence, i.e. empirical evidences have shown that money is non-neutral. This non-neutrality argument implies that prices and wages are not flexible, which is against the RBC assumption of market always clear and it leads to the new development in DSGE models that incorporate these issues.

The new extended model has features of the RBC model and also included the new Keynesian assumption of imperfect competition. In new Keynesian economics prices are rigid because of menu costs, aggregate demand externalities, coordination failure and staggered price contracts (Snowdon and Vane, 2005; P. 357-432). Similarly wages are also rigid because of efficiency wages, union power and staggering wage contracts. New Keynesian economists have given a micro foundation for these rigidities introduced by J.M. Keynes (1936). The new model keeps hold of the basic elements of the RBC models like rational expectations and general equilibrium assumption. The model is known as New Keynesian DSGE model, while Goodfriend and King (1997) have coined the name “New Neoclassical Synthesis” because of its mixed composition.

The DSGE models, even though they have a profound theoretical basis it has been difficult to estimate and this has constrained the use of these models for policy analysis. Because of the difficulty in estimation most of the researchers relied in calibration of parameters in the past but recently through the advancement of computational technologies, estimated DSGE models has started to become common. In calibration, parameter values are calculated based on some theoretical properties or taken from other micro econometric studies and the researchers ask the model to generate data. Maximum likelihood estimation and Bayesian estimation technique are the most common procedures used in estimation of DSGE models. Since the DSGE models that are estimated from actual data have performed well, they become popular at central banks in

developed countries and they are now the dominant macroeconomic models used to analyze monetary policies in these countries (Senbeta, 2011; Tovar, 2009). But DSGE models have faced serious challenges and these challenges have got momentum after the recent global financial crisis.

According to Senbeta (2011), the lethal challenge to DSGE models and also to other conventional economic models comes from the behavioral school. This school rejects not only rational expectations hypothesis but it also rejects the assumption of rational economic agents, which is the basis in all economic models to say. Meeusen (2011) summarized the most critical shortcomings of DSGE models. The list includes; failure to capture heterogeneity of economic agents, the absence or the ad hoc assumption about the financial sector, the absence of involuntary unemployment, the linearization of non-linear functions and the empirical validation of these models (See the full discussion of these criticisms and the recent developments in DSGE models in Senbeta, 2011; p. 20-33).

Generally, DSGE models are the dominant models now in the developed countries central banks and there are also different trials to modify and make them useful in developing countries central banks'. This is because applying models that are developed for different uses in industrialized countries directly in developing countries is inappropriate and may give misleading result (Senbeta, 2011). Senbeta (2011) has discussed the modifications needed to DSGE models to apply them in low income countries. Among the modifications recommended the foreign exchange constraint, labor market segmentation, imperfect access of low income countries' economies to the international financial markets and monetary and fiscal rules to be incorporated are discussed in detail. And the development path of DSGE models tells us there is long way to go to apply these models in low income countries.

2.1.4. SAM and Computable General Equilibrium Models (CGE)

Social Accounting Matrix (SAM), as its name indicates, is a way of presenting economic and social transactions in a nation-wide economy, a region or a village economy using matrix framework. Jeffry Round (2003) defines SAM as follows: "SAM is a comprehensive, flexible, and disaggregated framework which elaborates and articulates the generation of income by activities of production and the distribution and the redistribution of income between social and income groups". This definition tells that SAM is compiled to represent the interdependencies in the socioeconomic system and it is comprehensive means that it can portray all economic activities in the system. While the flexibility property makes SAM easy to be used at different levels like national, regional and household. And its flexibility also contributes for SAM to be used to represent specific relationships in a system based on the objective of its preparation.

SAM is different from other alternative accounting systems because of the following peculiar characteristics. The first is that it is represented by single-entry accounts; while the second peculiar characteristic is its emphasis on factors, households and institutional dimensions. The last but not the least is that SAM is complete and comprehensive (Ibid). It is represented by a square matrix in which the columns represent payments, while the rows represent receipts. The sum of the column and the rows of the same entity must be equal. This shows that behind the SAM there is an assumption of equality between receipts and payments by different entities in the socioeconomic system. After representing the transactions in the socioeconomic system, the most common practice in SAM is to calculate multipliers. First the constant shares are calculated by dividing the value in each cell by the column total and place in a matrix to get the coefficient matrix. The inverse of the coefficient matrix is calculated after subtracting it from an equal dimension identity matrix. After this the multipliers can be calculated by multiplying the inverse

matrix with each shocks in which their effects to be analyzed. These multipliers show that what will happen to the other parts of the socioeconomic system when there is a change in on part of the system.

According to Round (2003), generally SAM has the following three benefits. Since the compilation of SAM uses different data sources, it increases data usage at different levels and also motivates useful data surveys. The second benefit is SAM is a smart way of displaying information in easily understandable way. The last is that it represents a useful analytical framework for modeling and is the basic component of computable general equilibrium models.

Computable general equilibrium models are equilibrium models in line with Walrasian general equilibrium framework, which assumes the existence of equilibrium in the economy if the markets are perfectly competitive. CGE models are based on the socioeconomic structure of a SAM, which serve as its source of data. Johansen (1960) is the pioneer of CGE modeling and there are many researchers that have adopted his modeling framework with refinements. The main task of CGE models is to analyze the complex linkages among economic agents that characterize a general equilibrium system. Since CGE models are general equilibrium models, they incorporate a complete specification of both demand and supply sides of all markets. And agents' decisions are price responsive in this case considering relative prices.

CGE models are always solved for a single period equilibrium and fundamentally are static models. But recently there is development to include the dynamic nature of economies in to these models. The methodology used in solving CGE models is calibration and they are not estimated like econometric models. This calibration is based on the exact replication of the base year data in the SAM. In CGE, producers are profit maximizes and choose the output level to produce and

the input level to purchase for its production based on prices. Households also maximize their utility and choose their level of consumption based on their income and prices. There are also macroeconomic components in CGE models. Among these; the balance of payments, the government budget, the saving-investment equilibrium and the aggregate supply of primary factors are few to be mentioned (de Javry and Sadoulate, 1995; p.387-434). There are two lines of CGE model development, i.e. neoclassical and structuralist (Robinson, 1989).

In neoclassical CGE models, the main assumptions are the optimizing behavior of economic agents and full employment. While, product and factor prices are the major equilibrating factors. Structuralists, on the other hand, give emphasis to the structural rigidities when the modeling is done. The other difference is, neoclassical CGE models are assumed to be homogenous in all prices, and that one price is chosen as numeraire. Structuralists choose either wage or exchange rate to be constant, without incorporating asset markets. Generally in CGE models, starting from foreign shocks like change in terms of trade and import price shocks, changes in domestic economic and social structure and changes in economic policies can be analyzed.

2.1.5. Theoretical Model of Aggregate Demand

Aggregate demand of an economy is composed of the domestic absorption components like private consumption, investment and government consumption and the trade balance component. The trade balance has exports and imports as its components. How these components of the aggregate demand modeled and theoretical views on the sectors are reviewed as follows.

2.1.5.1. Consumption Behavior

"Consumption is the sole end and purpose of all production." Adam Smith

Among the components of aggregate demand, consumption expenditure takes the highest share. This has lead to a close investigation of consumption behavior of households and the aggregate consumption behavior of the economy since the time of Keynes. On the other hand, consumption also determines the growth and development of an economy because it determines the saving level which is considered as a major determinant of economic growth in growth models. Keynes (1936) gives the first hypothesis of consumption behavior which is known as absolute income hypothesis (AIH) since it considers current income as a main determinant of consumption. After Keynes developed AIH, other hypotheses have developed to explain the *consumption puzzle*. These includes: Duesenberry's (1949) relative income hypothesis (RIH), Ando-Modigliani's (1954) life cycle hypothesis (LCH), Freidman's permanent income hypothesis (PIH) and the random walk hypothesis of Hall (1978). All these hypotheses base themselves on the micro foundations of economic theory (Campbell and Mankiw, 1989). The main logical underpinnings and discussions of these hypotheses are presented as follows.

Keynes (1936) has made three important conjectures about consumption function. These conjectures are not based on data rather based on introspection and causal observation (Mankiw, 2009, P. 433). The first of these conjectures is that the marginal propensity to consume (MPC), which is the amount consumed out of an additional unit of income, is between zero and one. The second says that the average propensity to consume (APC), which is the ratio of consumption to income, falls as income rises. And the last, but not least conjecture, says that income is the primary determinant of consumption and interest rate has no role to play in the consumption

function. Based on these conjectures the aggregate consumption function can be specified as a function of aggregate income.

The absolute income hypothesis as noted above developed through introspection and observation, faced the empirical data test and achieved success at first. But after World War II, AIH faced two anomalies that deviate from Keynes's conjectures. Both of the anomalies are on the second conjecture which says average propensity to consume falls as income increases. The first anomaly became clear after the prediction of *secular stagnation*[5] (a long depression of indefinite duration) by some economists using the AIH after the end of World War II was failed. These economists predicted secular stagnation because they thought that the increase in income, saving will increase and consumers will consume smaller and smaller part of their income. In addition to this, there is lack of enough profitable investment to absorb the huge saving and there was fear of depression at the end of the war. What happened at the end of the war was not the predicted rather it was inflation. This makes clear the failure of AIH to depict consumer behavior. The second anomaly, on the other hand, comes from the work of Kuznet (1942). Kuznet (1942) used time series data (from 1879 to 1938) of US economy to test Keynes's conjectures. He found that average propensity to consume (APC) is more or less constant for the period considered, which is different from Keynes's conjecture about APC. These two anomalies created consumption puzzle as it was called in the literature (Friedman, 1957, p. 4, Mankiw, 2009, P. 435, Campbell and Mankiw, 1989) and motivated other economists to solve it. The solution also must have to reconcile the cyclical/short run achievement of the Keynesian hypothesis and its failure to predict the long run consumption behavior.

[5] The economists that predict the secular stagnation has devised the continuation of government expenditure to avoid this curse of the economy.

Duesenberry (1949) developed the relative income hypothesis which states that consumers are not concerned not so much with their absolute consumption as that of their relative level to the rest of the population. In RIH, individuals who have income below the weighted average of the population tends to increase their average propensity to consume, while individuals who have income above the average will lower their consumption. This means that the propensity to save of an individual is an increasing function of his or her position in the income distribution. This also makes the hypothesis to become consistent with the cross-section evidence of consumption behavior. Other related models with RIH are the habit persistent models of consumption which adds the level of consumption attained in previous period as another influencing factor of consumption. This makes the saving-income ratio to depend on the level of present income relative to previous peak income.

Modigliani et al. (1957) developed the life-cycle hypothesis of consumption by giving emphasis to variability of people's income over their lifetime. Since income varies systematically, consumers smooth their consumption expenditure using saving. Saving also allows the consumers to move income from times where there is high income to those times with low income. In LCH, consumption is a function of wealth since it is one way of saving. Wealth does not vary proportionately with income and in short period higher income corresponds to low average propensity to consume. On the other hand, over long periods both wealth and income grows together and gives a constant APC. This helps LCH to solve the long run constraint of the *consumption puzzle* but its assumption that the representative agent knows when he/she will die and how much life time income he/she will have, family's size and extent and terms of credit are its short comings (Mankiw, 2009, p. 447-451, Modigliani, 1986).

The permanent income hypothesis (PIH), which was developed by Friedman (1957), gives more emphasis to peoples' experience with random and temporary changes in their income. Current income is viewed as a sum of permanent income[6] and transitory income[7]. According to PIH, consumption depends on permanent income and previous hypotheses use the wrong variable. In this hypothesis average propensity to consume depends on the ratio of permanent income to current income. Friedman has tested his hypothesis using both cross section and time series data and gets that PIH solves the consumption puzzle (Freidman, 1957).

Robert Hall (1978) has applied rational expectations theory to life cycle-permanent income hypothesis. And he has found that if permanent income hypothesis is correct and consumers have rational expectations, then changes in consumption overtime should be unpredictable and makes consumption to follow a random walk[8]. This has two implications; the first is that consumption lagged more than one period and has no predictive power for current consumption. While the second implication is consumption become unrelated to any economic variable that is observed in earlier periods even to lagged income. This again makes future changes in income irrelevant because information used in preparing them is already incorporated in today's consumption (Hall, 1978). Campbell and Mankiw (1989) have found that Hall's random walk hypothesis does not hold. This is because expected changes in income are associated with expected changes in consumption.

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[6] *Permanent income* is income that the consumer believes to get it for continues period of time or the predictable income level like salary.

[7] *Transitory income* is income that is not predictable or it is volatile income.

[8] *Random walk* means when a variable is unpredictable.

The consumption behavior of households in developing countries is different from that of industrial countries and this is documented in the literature (Gersovitz, 1988; Deaton[9], 1989, 1992; Rosenzweig, 2001, Agenor and Montel, 2008). The main reason for this difference emanates from the structure of households. In developing countries, individual households tend to be larger and more generations tend to live together, sharing resources[10]. And also the income structure of households in developing countries is different from industrial countries. These differences make difficult the application of theories developed in view of households in industrial countries directly for households in developing countries. Income decomposition (as permanent and transitory) matters, that is propensity to consume out of permanent income is greater than that of current income, which is consistent with theory of consumption smoothing. However, neither elasticity of consumption with respect to permanent income found to be unity, nor elasticity of consumption with respect to transitory income equals zero. This evidence supports strict PIH is not supported by the data of developing countries (Agenor and Montel, 2008). Thus old-fashioned Keynesian consumption function may therefore provide a better bench mark for analyzing fiscal policy than does the model with infinitely-lived consumers (Campbell and Mankiw, 1989).

2.1.5.2. Investment Behavior

Studying investment is important because of two main reasons; the first is since investment is highly volatile it helps to understand short run fluctuations and the second is because it is

[9] *Deaton* is the winner of the 2015 Nobel Prize in economics for his analysis of consumption and inequality.

[10] *Sharing of resources* has the following implications; no need for "hump" saving to finance retirement, households provides insurance for individuals against certain types of risks, households planning horizon is longer cited in Agenor and Montel, 2008.

important determinant of long run economic growth (Romer, 1996). Its volatility is high may be because of uncertainty about the expected profit from the investment scheme. There are three types of investment spending namely business fixed investment, residential investment and inventory investment[11].

The neoclassical (user cost) model of investment is designed for business fixed investment. The model examines the benefits and costs of firms owning capital goods. In this model, the level of investment, which is the addition to the stock of capital, is related to the marginal product of capital, the interest rate, and the tax rules affecting firms[12]. Investment is negatively related to interest rate because an increase in real interest rate raises the cost of capital and leads to a decrease in profit that is gained from owning capital and vice versa. This in turn leads to decrease in the incentive of firms to accumulate capital and therefore investment decreases. According to this model firm's investment decision to invest depends on whether marginal product of capital exceeds the cost of capital or not. The model also assumes that if a firm is willing to pay the cost of capital, the financial market will make the funds available (see Mankiw, 2009; Romer, 1996, p. 345-347).

The neoclassical model of investment has two major failings in describing the actual behavior. The first is that, since the model is concerned about firms' demand for capital; it implies that

[11] *Business fixed investment* includes the equipment and structures that businesses buy to use in production. On the other hand, *residential investment* includes the new housing that people buy to live in and that landlords buy to rent out. *Inventory investment* also includes those goods that businesses put aside in storage, including materials and supplies, work in progress, and finished goods (Mankiw, 2009, p.525)

[12] The full discussion of the development of the model can be viewed in Mankiw, 2009 p. 526-533 and Romer, 1996, p.346-348.

firms desired capital stocks are smooth functions of exogenous variables (Jorgenson, 1971). On the other hand, this implies that a discrete change in one of the exogenous variables leads to a discrete change in capital stock. But, this discrete change in the capital stock requires an infinite rate of investment which is impossible. This is because investment is also limited by the economy's output. The second problem is related to the ignorance of expectations in the model. Expectations about demand and costs are keys to any investment decisions. Expansion of capital stock by firms is resulted from expectation of firms that their sales will grow and the cost of capital is low and generally expectation of profitability (Romer, 1996, p. 347-348). In the model, as noted above, there is no room for liquidity constraint of investment projects. But when we come to reality, not only in developing countries in which lack of finance is a significant constraint to investment, getting finance has become difficult in industrial countries.

The Tobin-q models of investment add the consideration of adjustment cost and the effect of expectations on investment decisions. Tobin (1969) proposed that investment by firms is based on the ratio of market value of installed capital to replacement cost of installed capital. The ratio is called Tobin's q and used to relate the stock market valuation of capital with its original value. The firm increases its capital stock only if the market value (stock market) of capital exceeds what it costs to acquire it, and it decreases its capital stock if the stock market value of the capital is less than the replacement cost (see Branson, 1989; Romer, 1996 and Mankiw, 2009). Even though, marginal-q ratio gives additional information to characterize investment behavior than average-q, it is hard to measure the marginal-q. This makes knowing how marginal-q and average-q are related important in analyzing investment behavior (Hayashi, 1982).

Direct usage of the standard theories of investment in developing countries do has a huge gap (Blejer and Khan, 1984). This is because of the special features that developing countries has

including institutional and structural factors. Absence of well functioning financial markets, larger role of the government in capital formation, distortions created by foreign exchange constraints and market imperfections are some of the factors. So, when investment behavior analyzed in developing countries, these special features needs attention as much as possible.

2.1.5.3. The Government Sector

The role of the government in an economy is one of the main dividing lines between different schools of thoughts in Economics, mostly between Classical and Keynesian and their line successors. Classical economists have a strong believe in markets and the price mechanism, so they advocate for laissez faire policy by the government. These shows that classical believe that the government has the ability to influence the economy, but if it did so the result will be below what it will be achieved without the intervention. On the other hand, Keynesians strongly argue that the government has the power and the ability to do things well and achieve better outcomes because the price mechanism did not always produce the optimal outcome and fails.

The role of the government is also different among different economies like developing and developed. Its role is huge in developing economies because of least developed private sector and other factors. In modeling government behavior, the budget deficit status and the mechanisms used to finance it must be given more focus. Excessive budget deficits may lead to inflation, exchange rate crisis, external debt crisis and high real interest rate (Fisher and Easterly, 1990). These problems arise from the way that the government used to finance the budget deficit. The government can use; printing money (seignorage financing), borrowing from abroad and domestic lenders to finance the budget deficit. Seignorage financing is related to inflation, borrowing from abroad is by itself difficult since it is related to hefty interest rates and leads to

exchange rate crisis. Domestic borrowing creates a “credit squeeze” because it leads to higher interest rates since there is higher demand for loans that arise from the government. This will also pass to each component of aggregate demand (Fisher and Easterly, 1990; Easterly and Schmidt-Hebbel, 1994).

2.1.5.4. External Sector (Imports and Exports)

The external sector includes the relation of the domestic economy with the rest of the world through either buying from (import) or selling for (export). For any country, these transactions between domestic residents and foreign residents are recorded in balance of payments. Balance of payments shows the complete transaction of goods and services between the country and the rest. Understanding the approaches and theories of balance of payments gives us an insight on the view of the external sector. The theoretical models that are related with balance of payments include elasticity approach, absorption approach, Mundell-Fleming approach and the monetary approach.

Elasticity approach, associated with Robinson (1937) as cited in Johnson (1977) emphasized the analysis of devaluation. The approach is based on the application of Marshalian partial equilibrium analysis to the separate markets for exports and imports. It had an attraction of answering three questions about devaluation (Johnson, 1977). These questions are: whether devaluation would improve the balance of payments, whether it would increase domestic employment, and whether it would turn the terms of trade for or against the devaluing country. Marshal-Learner condition is one of the theories of balance of payment that elasticity approach is applied. Trade balance will be improved by real devaluation (real depreciation) of currency according to Marshal-Learner condition, only if the sum of elastcities (taken in absolute value) of

demand for import and export with respect to real exchange rate is greater than one. The real devaluation/depreciation results in current account deterioration if the sum of the elastcities is less than one and if the sum is one it will leave the current account unchanged (Harbeler, 1949; cited in Dhliwayo, 1996).

The efficiency of devaluation in developing countries is not as much of the developed countries because of supply constrained nature of exports and low elasticities of imports and exports. The other reason is that of lags in response of the current account. This is known as "J-curve" effect of devaluation. The real devaluation/depreciation of the currency will worsen the current account balance in the short run and only will improve in the long run given the Marshal-Learner condition is satisfied. The main critics of this approach are: it lacks the general equilibrium foundation since it is based on partial equilibrium analysis; it ignores the effect that devaluation may have on the domestic price level and on the domestic nominal wage formation (Johnson, 1977; Dhliwayo, 1996).

The absorption approach view the balance of trade from the point of the national income accounting i.e. current account balance is the difference between national income and domestic absorption. It emphasizes changes in real domestic income as a determinant of a nation balance of payment and exchange rate. Devaluation increases the domestic income relative to domestic absorption and current account improves given the marginal propensity to absorb is less than unity. When marginal propensity to absorb is greater than one, devaluation will improve the balance of payments through the direct effects on absorption. The expenditure reducing effects occurs though three channels, namely, the real cash balance, income redistribution and money illusion effects (Alexander, 1952; Machlup, 1955; as cited in Dhliwayo, 1996).

Mundell-Fleming model is the other model that is developed by Robert Mundell[13](1960, 1961a and 1961b) and Fleming (1962) for analyzing policy effects in the context of open economy. The model has based on the ideas of James Meade and also because of this some used to call it Meade-Mundell-Fleming model (Alfred Steinherr, 1975). Even though there is controversy over the question about who first developed the model, their ideas are presented together and has given a good understanding of the workings of the open economy. The model is based on an extreme and key assumption, which considers the economy as a small open economy with perfect capital mobility. The assumption of small economy makes the domestic interest rate to be determined by the world interest rate, while perfect capital mobility assumption implies that the economy can borrow or lend as much as it wants in the world financial market (Mankiw, 2009).

Mundell's first work (1960) has introduced what he called "principle of effective market classification", which says a policy instrument should be assigned to the target over which it has the strongest (relative to other targets) influence. The exchange rate regime i.e. fixed or floating exchange rate will determine whether to direct monetary policy towards internal or external balance. When the exchange rate regime is floating, both monetary and fiscal are more effective for restoring internal balance, while the first have the edge over the later relatively. Fiscal policy will be ineffective for restoring internal balance under the same floating exchange rate regime if capital is perfectly mobile (Boughton, 2003). Fleming (1962) also argues that monetary policy is more effective relative to fiscal policy under floating exchange rates and he showed that measuring the effect of floating exchange rate on the effectiveness of fiscal policy as an autonomous change in domestic spending with a fixed stock of money was ambiguous (Ibid).

[13] Robert Mundell is Nobel Prize winner in Economic science the year 1999 for his analysis of monetary and fiscal policy under different exchange rate regimes and his analysis of optimum currency areas.

The monetary approach to balance of payments main argument is that balance of payment is a monetary phenomenon and is not a real phenomenon. The following four assumptions are common for all of the monetary approach models of balance of payment. These are: the demand for money is a stable function, in the long run output and employment tends towards full employment, authorities cannot sterilize the monetary impacts of payments in the long run and after considering for tariffs and transport costs, arbitrage will ensure the prices of similar goods to be equal in the long run (Snowdon and Vane, 2005, P.188). According to Snowdon and Vane (2005) the influential contributions for this theory came from Johnson (1977) and Frenkel and Johnson (1976).

In this approach any discrepancy between actual and desired money balances results in a balance of payments deficit or surplus. This in turn provides the mechanism whereby the discrepancy is eliminated. The model predicts that there is an automatic adjustment mechanism that operates, without discretionary government policy, to correct balance of payments disequilibria. The adjustment process is through balance of payments and relates to the belief that is automatic adjustment mechanism expenditure-switching policies will only temporarily improve balance of payments if they induce an increase in the demand for money by raising domestic prices (Snowdon and Vane, 2005). This is the first implication of the model in fixed exchange rate regime. While, the other implications are: monetary policy becomes powerless when a small country maintains a fixed exchange regime with the rest of the world and inflation is viewed as international monetary phenomena. The later is explained by an excess demand expectations expansion (Johnson, 1977; Snowdon and Vane, 2005, P. 189-192).

2.1.6. Monetary Sector

In the monetary sector, what determines money demand is the main starting point and end point of its theoretical framework. According to McCallum (1989), "money is just one of many commodities" that has three main functions. These functions[14] are: medium of exchange, unit of account and store of value[15] (Ibid). On the other hand, in Mankiw (2009) money is defined as the stock of assets that can be readily used to make transactions. Starting from its definition and what it includes, there are different arguments among different school of thoughts and economists on the theory of money demand. Here, the views in the quantity theory of money, liquidity preference and modern quantity theory of money about money demand and its determinants are reviewed.

Quantity theory of money has two versions by itself; Fisher (1911) represents the classical view and Pigou (1917) represents that of the neoclassical. But the theory has its roots in the works of David Hume (1711-1776), who was philosopher and economist (Mankiw, 2009, p. 86). Fisher's (1911) theory, commonly named as "equation of exchange", relates the quantity of money in circulation (M_S) to the volume of transactions (T) and the price level of articles traded $(P_{T)}$ through transaction velocity of circulation (V_T)(Sriram, 1999). This proportionality factor (V_T) measures the average number of times a unit of money is employed in carrying out transactions in a given year. The equation can be given mathematically as follows: $M_S V_T = P_T T$.

[14] Some literatures add sources of deferred payments as fourth function of money (see Sriram, 1999).

[15] Store of value means that money is a way to transfer purchasing power from the present to the future, while unit of account function implies that money provides the terms in which prices are quoted and debts are recorded. Medium of exchange function means that money is what we use to buy goods and services (See Mankiw, 2009, p. 80-81).

Money is held simply to facilitate transactions and it does not have any intrinsic value (fiat money). In the classical economics framework of full-employment equilibrium, there exists a stable ratio between output and transaction, which leads to have a constant velocity of money and volume of transaction. Therefore, the equilibrium price level moves in strict proportion to the quantity of money and money does not affect real output being "neutral" (Sriram, 1999). The Cambridge approach or cash balance approach is the second version of the quantity theory of money that is associated with Pigou (1917).

This approach differs from Fisher's (1911) approach with three elements. First, in this approach emphasis is made on individual's choice rather than that of market equilibrium. Second, money is held for store of value in addition to medium of exchange function. And the third is that this approach pointed out the role of wealth and the interest rate in determining the demand for money. The velocity is termed as the "income velocity of circulation" and it is determined by technological and institutional factors (Sriram, 1999).

The liquidity preference theory is a Keynesian theory developed by Keynes (1936). The theory explains three motives of individuals for money demand. These motives are: transaction motive, the precautionary motive and the speculative motive (Keynes, 1936). The transaction demand for money has a stable relationship with the level of income and it depends on the level of income. This demand for money arises because of the non synchronization of payments and receipts. Precautionary demand, on the other hand, is demand of money for unscheduled expenditures like for illness and other uncertain payments. This demand for money also depends on the level of income because money is serving again as a medium of exchange. The name of the theory comes from the speculative demand for money. Individuals can hold their wealth either in money or in bonds. They get an interest payment from bonds and holding their wealth in terms of money does

not have return. The interest rate payment is therefore an opportunity cost of holding money and it affects the money demand negatively (Sriram, 1999). The major implication of Keynesian analysis is a situation called “liquidity trap”. When the interest rate is very low, everyone in the economy will expect it to increase in the future and prefers to hold money whatever is supplied. Based on Keynesian theory, there are further developments. Transaction models arise from the medium of exchange function, while the precautionary demand models treat net inflows as uncertain. Asset or portfolio models arise from the store of value function and money is also held as part of portfolio of assets of the individuals (Sriram, 1999).

The consumer demand theory approach or the modern quantity theory of money is developed by Milton Freidman (1956). According to Freidman (1956) demand for assets should be based on axioms of consumer choice and money is treated like one of the assets. He suggested a broad range of opportunity cost variables for holding money than that of the Keynesian analysis. This makes the effects of change in interest rate on money demand very little. The opportunity cost of holding money is expected inflation and it also serves as a proxy for yield on real goods.

Though there are diverse theories that differ in assigning the role of money by emphasizing on transactions, speculative, precautionary or utility, all of them share common important elements. The long run specification of money demand function is expressed by demand for real balances and is also a function of the chosen scale variable. The chosen scale variable is used to represent the economic activity and the opportunity cost of holding money (Sriram, 2001).

2.1.7. Theoretical Model of Aggregate Supply

Aggregate supply is explained by production functions that maps aggregate inputs into aggregate output. The definitions of "inputs" and "output" is also a great concept when someone is trying to explain production functions. Felipe and Fisher (2003), gives their view that what matters is what does "mapping aggregate inputs into aggregate output" exactly means in modeling aggregate supply. Aggregate supply is derived by relaying on microeconomic foundation of firm level aggregate production function. But, there is a large amount of literature that raises the problem of using aggregate production functions at macro level. In some literatures it was also concluded that there are no aggregate production functions at macro level (Felipe and Fisher, 2003; Felipe and McCombie, 2010). On the other hand, previously Romer (1987) has argued that though production function is a microeconomics concept theoretically, empirical evidence shows that it also works at macro level. While, Temple (2006) has argued that there is production function at macro level and showed this by using the value added approach.[16] He also added that the focus should be on identifying functional form in empirical estimation of production functions.

There are different conditions to be considered in choosing functional forms of production functions. These conditions differ based on the objective of the empirical estimation, but the following conditions are of common. First the functional form should be parsimony in parameter, i.e. it should not contain any more parameters than that is necessary. This is because excess parameter exacerbates the problem of multicollinearity. Secondly, it should be easy for interpretation. The third one is a computational ease. In this case the functional forms can

[16] The full derivation can be seen at Temple (2006) "Aggregate Production Functions and Growth Economics".

assume linear or non linear forms, but this is directly related to computational requirement and it has a trade off. The other two criteria are related to the model developed - the interpolative and extrapolative robustness. The interpolative robustness checks whether the production function is consistent within the range of observed data; and the extrapolative robustness checks the compatibility outside the range of observed data. The extrapolative robustness especially is very important in case of forecasting (Fuss et al. 2005, p.219-268).

Among the different functional forms of production functions the constant elasticity of substitution (CES) and its variant the Cobb-Douglas production functional form are the most commonly used. The main reason for this is there computational ease. In Cobb-Douglas production function, elasticity of substitution among factors of production is always unity; and technical development is Hicks neutral and the return to scale is also constant. The constant elasticity of substitution is introduced to improve the restriction of elasticity of substitution in the Cobb-Douglas production function (Fuss et al., 2005).

2.2. Empirical Literature Review

2.2.1. Published and Applied Macro-econometric Models from Africa

Macro-econometric models in Africa have a long history. The modeling process is started in most of the countries in the 1970s in which most of them become independent (Welfe, 2013, p. 230). After this time there are different models developed in those countries with different objectives and the modeling process expanded to many countries, but not to all. This expansion is mainly because of the success of macro-econometric models in developed countries and the expansion of development plans that require a framework for evaluation. The framework needed for evaluation of different policy instruments can be achieved by using a macro-econometric

model. In this section, some published and applied macro-econometric models from Africa and their characteristics are reviewed as follows.

Soludo (1995) have developed a macro-econometric model for Nigeria with an objective of developing a model that captures the then SAP environment in the economy. Additional to this the model developed is also used to evaluate consistency of some proposals for fiscal and monetary discipline. The model has two versions, which arises because of the assumption that the modeler takes about expectations of economic agents. The first version assumes forward-looking expectations for economic agents while the second version assumes backward looking or adaptive expectations. The modeler has tried to estimate the model with both expectation types and to compare the results.

The model is a medium sized one with 61 equations, out of which 19 are stochastic and the rest 42 definitional equations. It has also 23 exogenous variables and parameters. In the model the economy is disaggregated in to five major blocks; domestic absorption, external trade, monetary sector, production and prices sector and external debt sector. The domestic absorption block is comprised of private consumption expenditure, private investment expenditure and exogenous government expenditure on goods and services. The private consumption follows a liquidity-constrained or unconstrained inter-temporal utility maximization, while investment follows a partial adjustment mechanism. Exports and imports are modeled with relative prices. In the debt sector an attempt is made to capture the relationship between the external debt and government's budgetary behavior. In the fiscal rule, the government has the power to issue new debt. But this new debt is only restricted to be held by the domestic private sector and by external investors. Under this rule, government debt cannot be bought by the central bank, which is unrealistic assumption.

The rule also forecasts that changes in taxes are necessary to stabilize the debt-to-GNP ratio to a predetermined level after a given time. For estimation of the model annual time series data from 1970 to 1991 is used. After unit root tests are conducted for the variables, most of the equations are estimated in error correction forms. The dynamic properties of the model are also evaluated and two simulations for the period 1993-2010 are applied. These simulations are a permanent and immediate cut in the real value of government expenditures equivalent to 2.5% of real GDP and a 10% increase in the exogenously determined export price of oil. Generally, the model is unique since it has tried to compare the results of assuming different expectations could create on the modeling process. But the simulation period was very long and it creates a question on the reliability of the simulation results.

Akanbi and Du Toit (2010) have also constructed a macro-econometric model for Nigeria with an objective of explaining and providing a long-term solution for the persistent growth-poverty divergence experienced in that country. The model is constructed along four sectors as its core structural equations. The real sector, the external sector, the monetary sector and the government sector are disaggregates of the economy. In the real sector aggregate supply determines the real domestic output by estimating the production function, the domestic investment, labor demand, real wages and technological progress. The aggregate demand determines the aggregate household real consumption expenditure in the economy and the price block estimates the producer and consumer prices. The domestic investment is modeled as a function of output, user cost of capital, capacity utilization and the level of political instability as a governance indicator. The government sector is exogenously determined in the system and also total government expenditure is disaggregated into expenditures on social development, government transfer payments and other government expenditures. Other behavioral equations of the model include;

the level of socio-economic activity in the country, poverty, agricultural production, infrastructural development and household disposable income. There are two models used in the closure process. In the first model production function (GDP) is estimated making the supply side more active, while in the second model the production function is generated following the Keynesian identity. This makes the demand side of the economy to be more active in the second model. In both models the price equations serve as the link between the two sides of the economy.

For the estimation of the models, a time series data from 1970 to 2006 is used. And the Engle-Granger two step co-integration techniques, that captures both the long run and the short run dynamic properties of the economy is also used. Four different shocks were applied in the simulation part. These are: an increase in total government expenditure by 10%, a 10% rise in oil prices, world income shock and government shock. These shocks has given different results in the two models and this shows that the assumption of making aggregate demand or supply more active has a great implication on the expected outcome.

The Namibia Macro-econometric model (NAMEX) is the other model to be reviewed here. The model is developed with objectives of formulating a model that can give a good explanation of the Namibian economy, serve for forecasting purposes and can be used in the context of policy simulations. The model has four sectors: real sector, fiscal sector, monetary sector and price sector. The labor sector is not estimated because of lack of data which is the case for most of developing countries. The model has 38 variables out of which 16 are endogenous and 22 are exogenous. To assess the models' in-sample forecasting properties, the model is solved for the period from 1983 to 2002.

In the model private consumption is modeled as a function of disposable income, real interest rate and inflation rate. Private investment, on the other hand, is a function of change in capital stock, the world price index and disposable income. The total government expenditure is assumed to be exogenous and determined as the sum of public consumption and public investment. The export sector is a function of world income and the real exchange rate. The exchange rate is used as a proxy for the competitiveness of the country. Imports are modeled as a function of domestic demand that is substituted by gross domestic expenditure and the relative price level. In the fiscal sector, total direct and indirect taxes are modeled as endogenous variables, while the non-tax revenue is taken as exogenous variable. The model is estimated using standard ordinary least square regression in level form of the variables. This is the main shortcoming of the estimation of the model, because estimating in level form will give a misleading result. For the simulation of the model two scenarios are considered in the model. These are high government spending and low government spending.

Ameyaw (2004) has also constructed an aggregate structural macro-econometric model for Ghana with an objective of examining the determinants of the adverse Balance of Payments (BoP) position and the general price level. In the model it is assumed that the exchange rate system consists of a dual rate regime in which an official floating exchange rate and a quasi-illegal parallel market for foreign exchange co-exists together. The model is developed by giving more emphasis to the special characteristics of Ghanaian economy. For example, money demand function is formulated by taking consideration of the financial sector development in Ghana, which is not well developed similar to many developing economies. Real GDP, the three-month Treasury bill rate and the expected inflation rate are included in the model as main explanatory variables for the money demand function. Additionally, the trade equations are also

constructed with the consideration of the fact that Ghana is a small open economy and a price taker in the world market. In the money supply side, the model includes net credit to commercial banks, net claims on government, governments' net foreign asset and other assets as identities, while the money multiplier is left to be determined by the relationship between money supply and money demand.

In the model, the export equation is estimated as a function of relative prices and foreign demand. It also incorporates the price of foreign exchange in the unofficial or black market. On the other hand, the import equation is formulated by including capital availability and essential import variables in addition to the conventional explanatory variables of real domestic income and relative prices of imports. The capital availability variable is included as a proxy for FDI (foreign direct investment) or foreign capital flows. In the model closure; the balance of payment identity, money supply identity and trade balance definitions are used. Error-correction and co-integration techniques are used in the estimation process. Before the estimation is made, the time series properties of the variables are also checked to avoid misleading test statistic values. Misspecification tests for autocorrelation, hetroskedasticity, normality and reset tests of residuals and chow break-point tests of stability are done and the model has passed all the tests. The simulation results are presented and discussed in detail. Generally, the model is good enough to achieve its objectives and it has clear theoretical framework with application of recent econometric techniques.

Musila and Rao (2002) developed a demand-oriented macro-econometric model for Kenyan economy. The main objective of their model is to make decision by testing sensitivity of different macroeconomic variables for different policies including fiscal, monetary and exchange rate policy. Containing production, expenditure, monetary and price blocks, the model has 32

equations of which 20 are stochastic equations and the remaining 12 equations are accounting identities which close the model.

Production block is further disaggregated into five value-added sectors: resource sector (comprising of agriculture, forestry, fishing, mining and quarrying), manufacturing, construction, government services and other sector. To model each of these sectors, input-output formulation which gives a relationship between the values added from each of the sectors and the demand of the final user is used. Resource sector is identified so as to satisfy the domestic demand and export demand; thus value added is specified as a function of real consumption and export of goods.

The expenditure sector consists of consumption, investment, government and net export. Real consumption is specified as a function of real disposable income, interest rate and expected inflation which is in line with the Keynesian AIH, but with some adjustment of habit persistence so as to have a good approximation of the consumption behavior. The government sector is disaggregated into government expenditure and revenue. Current expenditure of government is treated as exogenous; whereas revenue from direct tax is assumed to vary directly with nominal GDP, i.e. in line with the automatic stabilizer hypothesis. The net export block includes export and import of goods and services sector. In this block both export and import sectors are further disaggregated into goods and services. Export is determined by real world income and the ratio of export price to the price of foreign substitutes. Demand for imports depends on country's real GDP and on the ratio of import price index to price of domestic substitutes. The authors have also included dummy variables to accommodate the effect of different policy changes through the period included.

In the monetary sector, money supply is modeled as exogenous; which is determined when monetary authority sets the interest rates. Additionally, the money demand is disaggregated into two components as narrow money and time and saving deposits. These two components are specified as a function of real GDP and nominal interest rate. Price block has included GDP deflator, consumer price index, export price index and import price index as a subset. Out of these, GDP deflator and the consumer price index are modeled in a mark-up-over-cost approach. Consumer price index is specified as a function of import price, GDP deflator and real money balance. GDP deflator is determined by import price and the exogenous variable factor cost. The export and import price indices are assumed to be determined on the world market and changes in domestic exchange rate. For the construction of the macro-econometric data spanning from 1970-1995 is used. The parameters for short run and long run dynamics are estimated using ordinary least square estimator.

2.2.2. Macro-econometric models of Ethiopian Economy

The first macro-econometric model for Ethiopian economy is developed by Kidane and Kocklauner (1985). The developed model is a supply driven one with 27 equations. Out of these equations, 19 are behavioral equations, 7 are identity equations and the remaining one equation is a bridging equation. The model is made up of four sectors: production, expenditure, external trade, and saving and trade gap. The production sector is subdivided in to agriculture, non-agriculture, construction and other services sectors. While the expenditure block is composed of private consumption, government consumption and investment.

The investment sector is also further disaggregated and includes agriculture, other commodities, construction and other service investments. From the external trade block, export sector is disaggregated into coffee export and other commodities for export. The disaggregation of the

export sector is because the country's export mainly comes from the coffee sector. While import is disaggregated in to imports of capital goods, intermediate goods, consumption goods, fuel and services. For model closure, the saving sector that is made up of private and government savings is related with trade gap by the only bridging equation included in the model. The model did not include the monetary sector and price equations. In addition to this the inter-sectoral linkages are not modeled. The model also faces problem of misspecification in the behavioral equations and statistical tests are not presented. This may lead to spurious regression.

Lemma (1993)[17] has also constructed a macro-econometric model for Ethiopia which has four blocks; production sector and investment, foreign trade, public finance and price block. The model is supply driven and has 53 equations of which 14 are behavioral equations and the rest are identities. It also captures the structural and institutional characteristics of the Ethiopian economy during the Derg regime (1974/75-1991).

The supply side is divided in to agriculture and non-agriculture sectors. In the model major sources of funding such as government savings, credit from banking system and foreign capital inflow are taken as a major determinant of the aggregate level of investment. In the foreign trade block, three export behavioral supply functions; private export for pulses, hide and coffee export functions are specified. Import demand contains capital and raw material goods, and consumer goods import, which is assumed to be exogenous. The governments' current expenditure and export tax rates are treated as policy instruments. Finally, the price block identifies two price equations based on consumer price index (CPI) and industrial sector price deflator.

[17] This review is based on Alemayehu and Daniel's review in 2004.

Alemayehu and Huizinga (2004) have produced the theoretical framework for Ethiopian Macro Model (EMM). The model is based on the aggregate demand-aggregate supply (AD-AS) framework. The supply side is disaggregated into formal sector, informal sector and agricultural sector. Agriculture is assumed to be exogenous because it is specified as a function of exogenous variables like rain fall, labor (assumed to grow by the level of population growth), land, fertilizer and quality of seeds. The formal sector's output is assumed to be demand driven in the short run and supply driven in the long run. Its supply is formulated as a function of labor, capital and intermediate imports. The output of informal sector is assumed to be residual and calculated by subtracting agricultural and formal sectors output from GDP. The demand for labor in the formal sector is a function of formal sectors output, wage and price level; but for the other two sectors labor is calculated residually and assumed to grow with growth of economically active population to be engaged in productive work and this assumption is similar to the assumption by Bodrat and Le Dem(1996).

Investment is specified following neoclassical investment theory, and factors that explain the structural context of developing countries are also included. It is explained as a function of output, real interest rate, public investment, capacity utilization, relative price of capital, and depreciation costs. The level of import depends on the percentage change in import due to output effect and relative prices, where import price is formulated as a function of exogenous price of imports in foreign currency, exchange rate and import tariff. Consumption is modeled as a function of current income and interest rate. It is also disaggregated into consumption of food and non food sectors. This is done to account for the food consumption that is assumed to take a large share of total consumption in developing countries.

Export is disaggregated into coffee export and other exports. The country is assumed as a price taker in the world market, and the law of one price holds for the major long existing export, which is coffee. Hence export of coffee is supply driven based on profit motive; and the behavioral equation is specified as the difference between exogenous world price and domestic cost. But for non-coffee export it is modeled as demand driven and determined by the income level of trading partners, real exchange rate and capital stock which is estimated by investment as a ratio to value added.

In the government sector, government expenditure and revenue are formulated using semi-behavioral equations. Price equations were specified for agriculture sector, formal sector and non formal sectors. To specify the determinants of price level neoclassical assumptions of microeconomics were in action. In the case of agriculture sector price of agriculture commodity is formulated as a function of domestic supply of agricultural output, imported food item, price of imports, nominal exchange rate, and autonomous consumption level. For the formal sector price is determined by wage, labor productivity, and user cost of capital, price of import, capacity utilization, indirect taxes, and subsidy. For informal sector price is formulated as a mark up over the informal sectors wage. And finally, the general price level is calculated as a weighted average of the price of each of the sectors.

In monetary block, demand for money is defined as a function of real GDP, the price level and the nominal interest. Interest rate i.e., interest on bonds, is specified as a function of total output, price level and money supply. Exchange rate is considered as floating, and it is specified as a function of level of import, export earning, aid and external finance. In the macro model, Alemayehu and Huizinga (2004) have also used a reduced input output matrix that gives a link between the components of aggregate demand and sectoral value-added.

Ethiopian Economic Association (2008) have also constructed a macro model for Ethiopian economy with a frame work of AD-AS but it is more inclined to the supply side so to elucidate the supply constrained nature of the economy. The model can be categorized to a class of medium-large kind of macro-econometric models as it consist 44 behavioral equations, 38 identities and bridge equations, and 61 exogenous variables. The EEA model contains 7 blocks: production, aggregate demand, labor market, prices, fiscal sector, monetary sector, and external sector block.

Each block is subdivided into different major sectors. The production block contains agriculture, industry and services sectors. Demand block consists of consumption and private and government investment, export and import sectors. This block identifies behavioral equations for consumption and investment; other sectors are treated in the external sector account. These sectors are included in demand block for the sake of creating identity only. Price block has specified two behavioral equation namely, general consumer price index and food prices. The fiscal Sector is sub divided into revenue and expenditure. The monetary sector is classified into two categories; the assets side and the liabilities side. Behavioral equations are specified for the asset side of the economy especially, for domestic credit. The external sector classification is based on the balance of payments and behavioral equations are identified for the trade account only. Also the real exchange rate categorized in this block is determined using behavioral equation. The equations of the model are developed using Dynamic OLS (DOLS) Method. The model is tested using a battery of tests.

CHAPTER THREE

REVIEW OF THE ETHIOPIAN ECONOMY

In this chapter, it is tried to offer the review of overall performance of the economy in the study period. This is aimed at giving the overall macroeconomic context of the country in relation to demand side, supply side, price, monetary and external sector developments.

3.1. Supply Side of the Economy

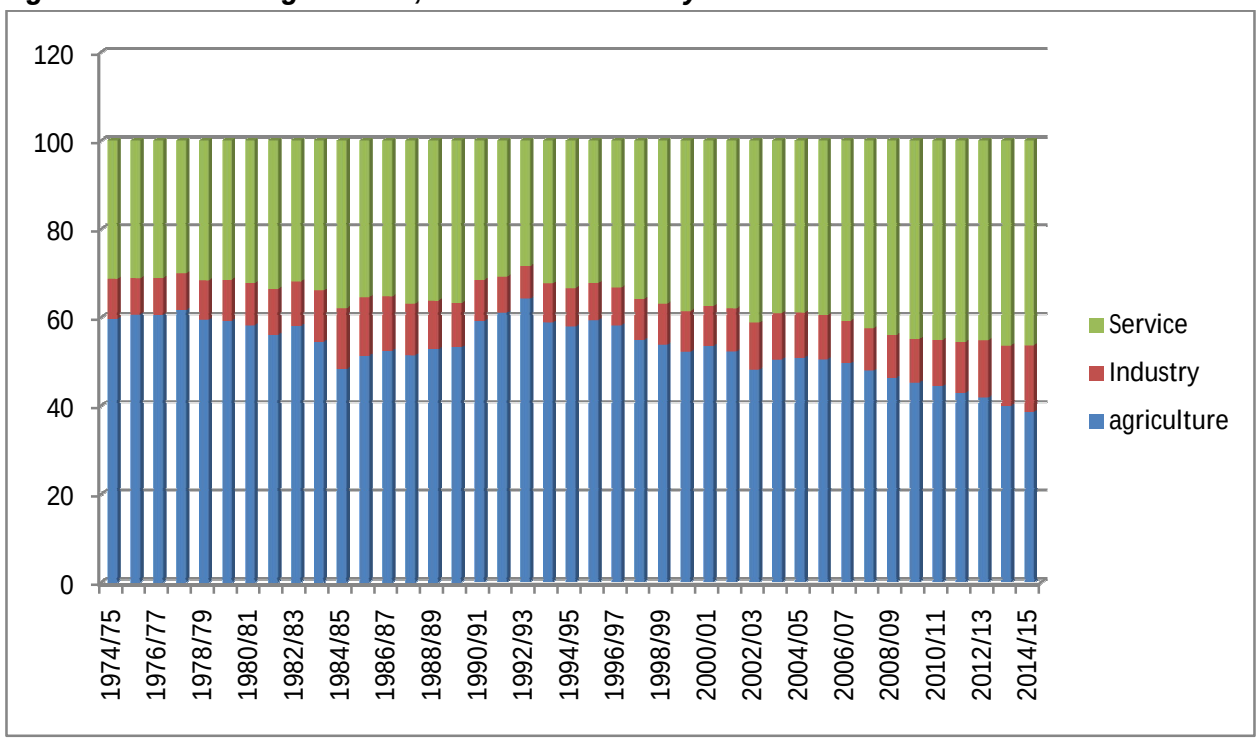
The supply side is also known as the real side of the economy and it includes the primary production sector (different agricultural activities), secondary sector (manufacturing, construction, electricity and water) and the tertiary sector (service sector like trade and other services). As similar to any developing countries, out of these sectors agriculture has the highest contribution to the economy in terms of value added and employment in Ethiopia. It has an average share of 53 percent over the period 1974/75- 2014/15. The sector's contribution varies from the highest 65 percent share in the year 1992/93 to the lowest share of 38.5 percent in the year 2014/15. This tells that the process of structural change in the economy is a very slow. In the period where the economy has achieved a double digit growth (2003/04-2014/15), the agricultural sector's contribution is 45.7 percent on average. Out of this period if we take the first growth and transformation period only the sector's share has declined from 44.4 percent in 2010/11 to 38.5 percent in 2014/15, having an average share of 41.5 percent over the same period. Since the sector has the highest contributions in terms of value added and employment, the government has given a great emphasis for the sector, even though the achievement is not satisfactory. The reasons for this unsatisfactory result especially in the GTP-I period are;

according to National Planning Commission (2015), slow transition of the production system to cash crop production and the productivity of producing food items did not grow as it were expected.

The industrial sector has a more or less constant share over the study period, which indicates that its development was stagnant throughout the last four decades. It has an average share of 10 percent from GDP over the period 1974/75-2014/15. The sectors' highest contribution to gross domestic output is registered in 2014/15- having 15.1 percent share (the second largest being in 1984/85 which was 13.7 percent). The former share shows that there is glimpse of hope of industrialization of the economy in GTP-I, while in the latter period the contribution is higher only because of the drought that decreased the share of agriculture substantially. When we take specifically the GTP-I period the share of the industrial sector has increased from 10.4 percent in 2010/11 to 15.1 percent in 2014/15 and it has an average contribution of 12.8 percent over the same period.

Service sector is the leading sector in contribution to the economy having 46.4 percent share in GDP in the year 2014/15. The sector has also registered an average share of 36.8 percent over the period 1974/75 up to 2014/15. When we further look within the service sector the wholesale and retail trade, real estate and renting subsectors have a major contribution. Figure 3.1 shows the contribution of each sector to the economy.

Figure 3.1: Share of Agriculture, Service and Industry



Source: Own computation based on MoFED and EEA Data Set

The economy's growth rate is on average 4.8 percent for the last four decades and it has become impressive in the latest decade. The average growth rate in the EPRDF regime is 7.3 percent which is higher than the pre-EPRDF period. The economy has grown by 10.8 percent for the period between 2003/04-2014/15. But even with this highest growth rate the structure of the economy is almost as it is before this period, the only exception is that the service sector has become the leading sector and there is a significant decline in the share of agriculture. In GTP-I, the economy has registered an average growth rate of 10.1 percent a little less of the planned 11 percent average growth rate.

3.2. Demand Side of the Economy

Consumption is dominant in the demand side of the GDP as it constitutes on average 83 percent of the GDP between 1974/75 and 2014/15. In the EPDRF period (1991/92 up to present) it has 78.8 percent share of the GDP, on average. Real gross capital formation as a share of GDP has also increased from 11.5 percent which was before 1991/92 to 21.8 percent in post 1991/92. In the GTP-I period consumption has 69.1 percent share of GDP on average, while the average share of gross capital formation in GDP was 30.9.

Table 3.1: Share of Demand Components from GDP for different periods

Demand Component	1974/75-2014/15	1974/75-1991/92	1992/93-2014/15	2010/11-2014/15
Consumption Expenditure	82.8	88.4	78.8	69.1
Private Consumption	70.2	73.1	68.1	61.3
Government Consumption	12.6	15.3	10.7	7.8
Gross Capital Formation	17.2	11.6	21.2	30.9
Resource Balance	9.8	5.6	12.8	14.4

Source: Own Computation based on EEA Consistent Data Series

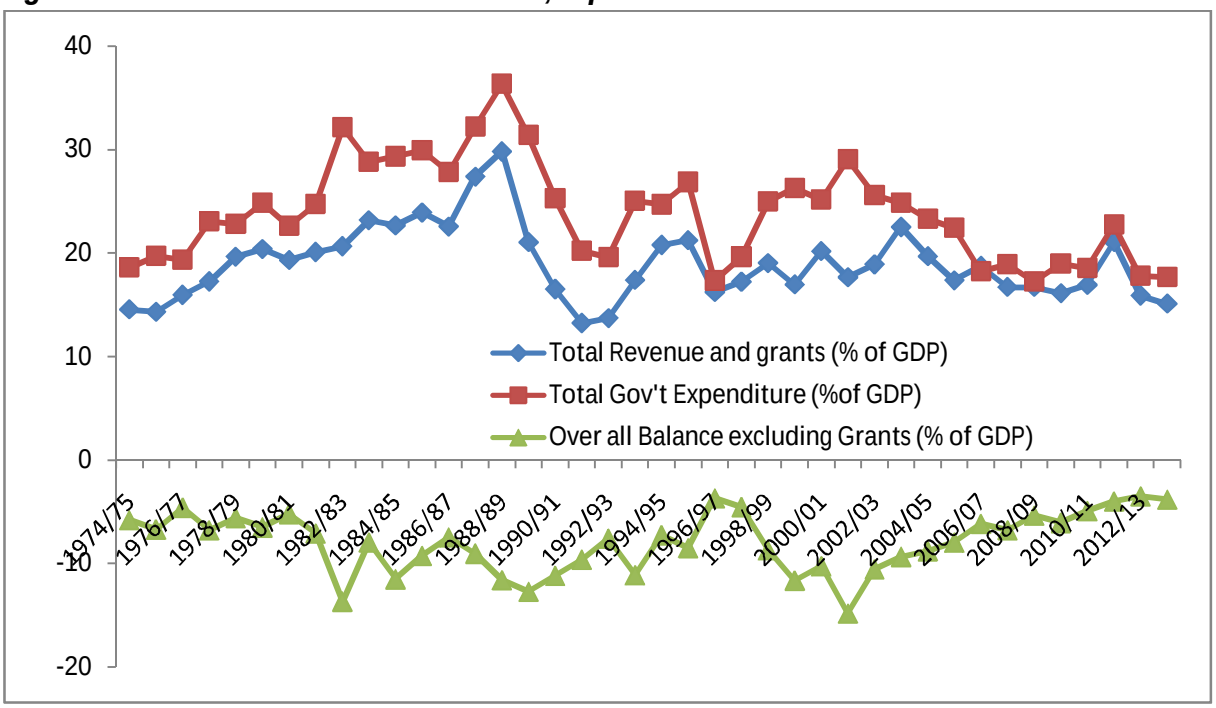
3.3. Fiscal Development

Government gets revenue in the form of tax revenue, non-tax revenue and grants. On the other hand, the collected revenue is used to achieve different development goals and spent either in the form of current or capital expenditures. The balance between the government's revenue and expenditure determines the status of the government budget. In this section, the Ethiopian government's performance in generating revenue and the composition of its expenditure is reviewed.

Throughout the last four decades (1974/75-2014/15), the Ethiopian government gets on average 63.3 percent of its receipt from tax revenue, 21.3 percent from non-tax revenue and 15.4 percent from grant. When we look to the revenue structure by excluding the grant element, the share of tax revenue is 74.7 percent and the share of non-tax revenue is 25.3 percent, on average over the same period. Starting from mid-nineties, the share of tax revenue from the total government revenue has started to surge; this can be attributed to the liberalization of the economy, tax reform measures which are taking place starting from 2001, measures taken to strengthen institutions that collect revenue in federal and regional level and focus of the government on expanding its tax collection base (MoFED, 2006).

The other fiscal component is the expenditure side and out of the total expenditure 68.2 percent is covered from revenue sources, while 12.7 percent is from grant and the rest 19.9 percent covered from domestic and foreign borrowing.

Figure 3.2: Trend in Government Revenue, Expenditure and Overall balance as % of GDP



Source: Own Computation Based on MoFED Data

The share of current expenditure and capital expenditure from the total government expenditure varies overtime with the emphasis of policies and the political ideology. Current expenditure includes expenditures on civil servant salaries, military expenditures and different utility and miscellaneous expenses. On the other hand, capital expenditure includes economic and social development expenditures. In the Ethiopian case, current expenditure is the dominant expenditure type as it constitutes on average 64 percent of the total government expenditure between 1974/75-2014/15. While, capital expenditure constitutes 36 percent of the total government expenditure on average over the same period. In the last decade of the study period the share of the capital expenditure has increased substantially due to massive infrastructural expenditures by the government. Specifically, in GTP-I period, the share of capital expenditure have reached on average 56.7 percent of the total expenditure.

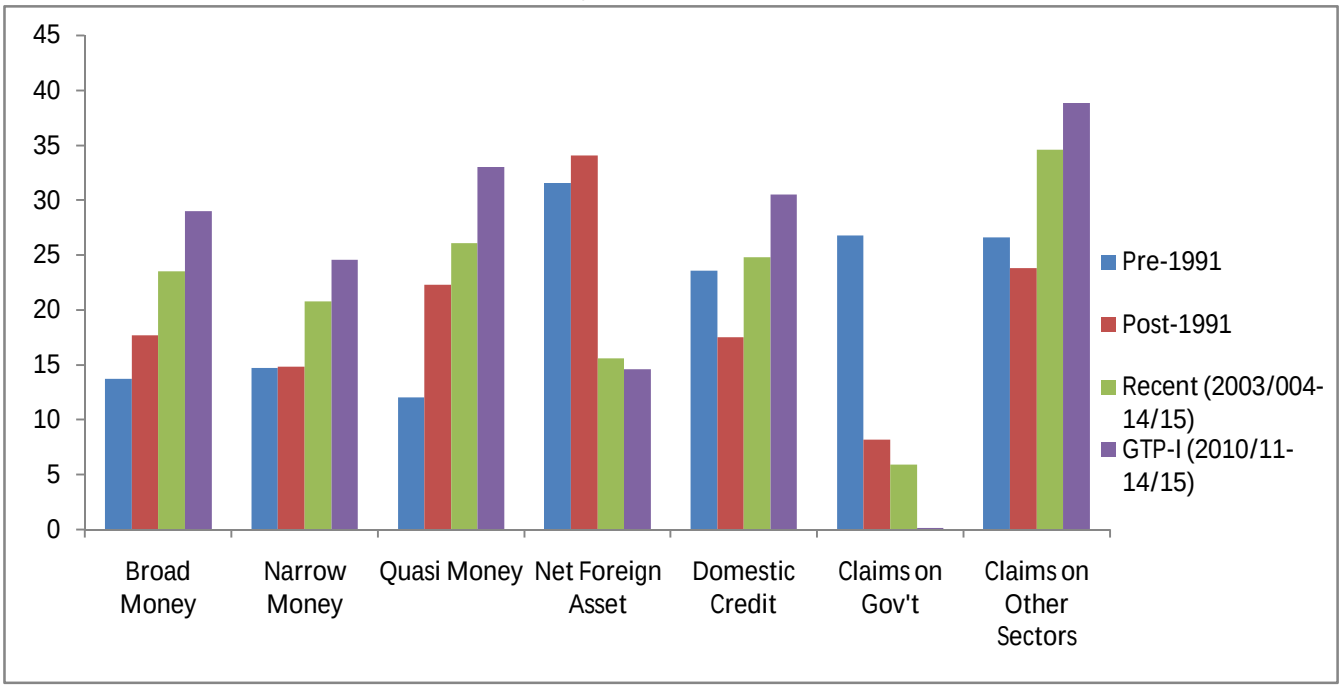
3.4. Monetary Developments

The monetary sector development can be reviewed by closely monitoring the evolution of the broad money, narrow money and their components throughout the study period. Broad money has been growing on average at 15.5 percent annually for the period 1974/75 to 2013/14. On the other hand, narrow money has been growing on average with 14.6 percent annual growth rate over the same period. For different sub-periods in the study period the two monetary aggregates have also different average growth rates. If we take the Derg period (1974/75-1990/91), the average growth rate of broad money and narrow money has been 12.9 and 14.4 percent respectively. Similarly, for the period from 1991/92 up to 2013/14 broad money has 17.3 percent average annual growth, while narrow money has 14.1 percent average annual growth. This shows that broad money has expanded with higher rate in the EPRDF period than the Derg period and the growth rate of narrow money is similar for the two periods.

On the other hand, if we take the period 2003/04-2013/14, in which the economy has registered double digit growth, the average annual growth rate of the broad money was 21.4 percent. Specifically for the GTP-I period, its average annual growth rate was 29 percent, where the highest growth rate was registered in the year 2010/11 which was 39.2 percent. This is far high from the average annual growth of broad money. While, the average annual growth rate of narrow money (includes currency outside of banks and net demand deposits) was 21.3 percent for the period 2003/04-2013/14 and for GTP-I period its average annual growth rate was 24.6 percent.

The growth of broad money is highly affected by the growth of net foreign asset and domestic credit. For the GTP-I period these two determinants have grown by 14.6 and 30.5 percent respectively. Figure 3.3 shows the growth rate of broad money and its determinants.

Figure 3.3: Growth rate of Broad Money and Its determinants



Source: Own Computation based on NBE Data

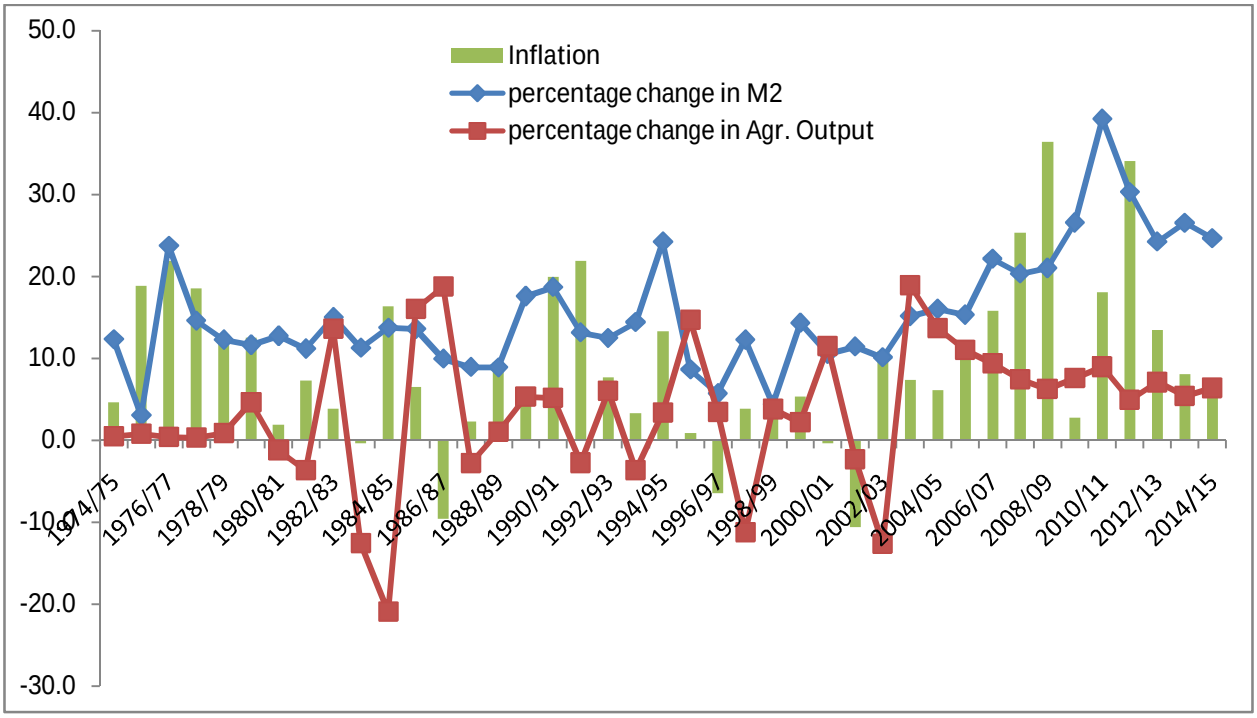
3.5. Price Development

In this section the development of the average price of goods and services over time is reviewed. In countries like Ethiopia, inflation has more connection with agricultural output and monetary factors (Alemayehu and Kibrom, 2011). The agricultural output is related to inflation highly because it is the highest supplier of food items which constitutes the highest share from the goods and services bundle. On the other hand, this will have a clear implication on the relation between factors that affect agricultural output and inflation. For example, since drought affects agricultural output highly it would have also implication for inflation. For instance in drought

years of 1984/85, 1991/92, 2002/03 agriculture output has declined by 20.8, 2.7, 12.6 percent respectively and this was joined by inflation rate up to 16.4, 21.9, and 10.9 percent respectively.

According to monetarists' explanation of inflation, it is everywhere a monetary phenomenon that results from monetary growth. This theory also works in Ethiopia and the monetary growth explains inflation (Alemayehu and Kibrom, 2011). The period 2003/04-2008/09 was a period in which the Ethiopian economy experienced highest level of inflation. And also this inflation level has a strong co-movement with monetary growth that existed over similar period. Figure 3.4 presents the relationship between agricultural output change, inflation and growth in broad money.

Figure 3.4: Inflation, Percentage change in agriculture output and Growth rate of broad money



Source: Own Computation based on data from MoFED, NBE and CSA

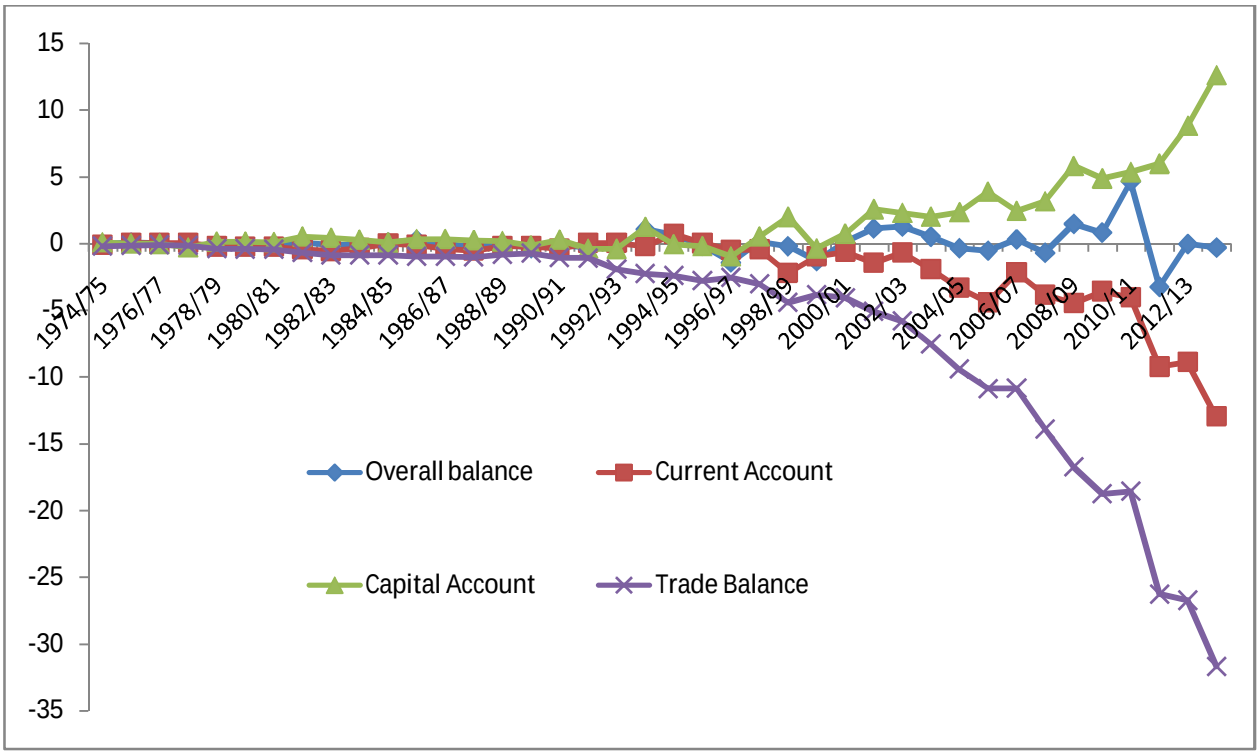
This inflationary period (2005/6 up to 2008/9) has created high macroeconomic instability and erodes the real income of households. The main reason for these periods inflation had been money supply growth, imported inflation (such as the increase in the price of fuel, steel, fertilizer), inefficient market structures and inflationary expectations by the market participants (see MOFED, 2009; Alemayehu and Kibrom, 2011; Abebe and Andinet, 2013).

3.6. External Sector Development

The external sector development of any economy is evaluated based on balance of payments, which summarizes the transactions between the economy in concern and its trading partners or the rest of the world. Balance of payment is composed of two components; capital account and current account and its position is determined by the interaction of these two components.

In Ethiopia, except for the years 1972/72 and 1973/74 the current account balance is always below zero and also trade balance is negative throughout the study period. Specifically, trade balance as a percentage of GDP has increased from 4.03 percent in 2000/01 to 31.65 percent in 2013/14 (it is negative since it is trade deficit). On the other hand, capital account has expanded positively from 0.74 percent to 12.6 percent for the same period. The overall balance is also deficit. This shows that the economy is not able to cover the exchange rate demand for its imports through exchange earnings of export. So, to cover this imbalance there is huge flow of capital to the economy in the form of loan, aid and foreign direct investment. The development of the overall balance, capital account, current account and trade balance as a percentage of GDP is presented in figure 3.5.

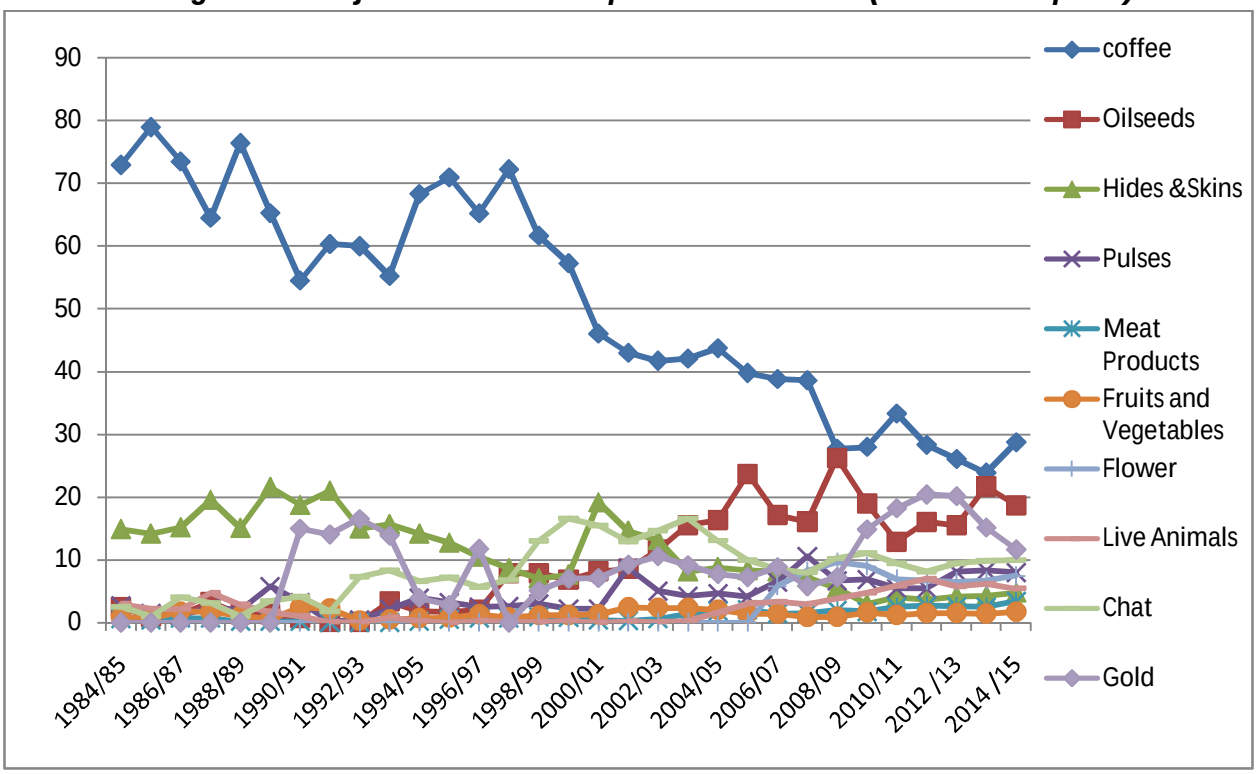
Figure 3.5: Trends in Balance of Payment, Capital account and Current account and Trade Balance as a Percentage of GDP (Millions of Birr)



Source: Own Calculation based on NBE and MoFED data

The export sector is highly dominated by the export of primary commodities and recently minerals have also become very important. The main export commodities of the economy includes; coffee, oilseeds, pulses, chat, flower, animal and animal's primary products like leather and leather products and gold. From the total merchandise export coffee contributes about 52 percent on average for the period 1984/85-2014/15. If we take the GTP-I period the share of coffee is only 28 percent of total major exports. In this period the export performance is disappointing mainly because of lower global commodity prices and/or lower volume of exports (NBE, 2015). Figure 2.6 shows the trend of major export commodities as a share of total exports.

Figure 3.6: Major Commodities Exports and Its Trend (% of Total Exports)



Source: Own Calculation Based on NBE data

Export has an average annual growth rate of 17.7 percent over the year 1974/75-2013/14. In the Derg period i.e., 1974/75 up to 1990/91 it has registered an average annual growth rate of 3.16 percent. The average annual growth rate of export is 28 percent for the EPRDF period. Specifically the average annual growth rate of exports is 21 percent for GTP I period, which is below average growth rate for the whole EPRDF period. The performance of the export sector is not satisfactory for the GTP I period. The main reasons for this are, according to National Planning Commission (2015), the decrease in international price for gold and coffee starting from the third year of the plan, a decline in production capacity of the economy and operate below its potential, lack of expansion in manufacturing goods export.

The import sector is mainly composed of raw materials, semi finished commodities, petroleum and petroleum products, capital goods like import of tires of heavy vehicles, aircraft and consumer goods. For the GTP I period, consumer goods have an average share of 29.2 percent from the total imports, while the rest 70.8 percent being the share of other imports. Non-durable imports like cereals, other food items, medical and pharmaceutical and textile fabrics constitute 66.5 percent share from the total consumer imports. On the other hand, durable items like radio and television, tires, cars and other vehicles constitute 33.5 percent of the total consumer imports. Merchandise import has been growing with an average annual growth rate of 18.7 percent for the period 1974/74 up to 2013/14. In the Derg regime its average annual growth rate was 9.7 percent while, for EPRDF period it was 25 percent. Specifically in GTP I period, merchandise import have been growing by 25.9 percent, on average.

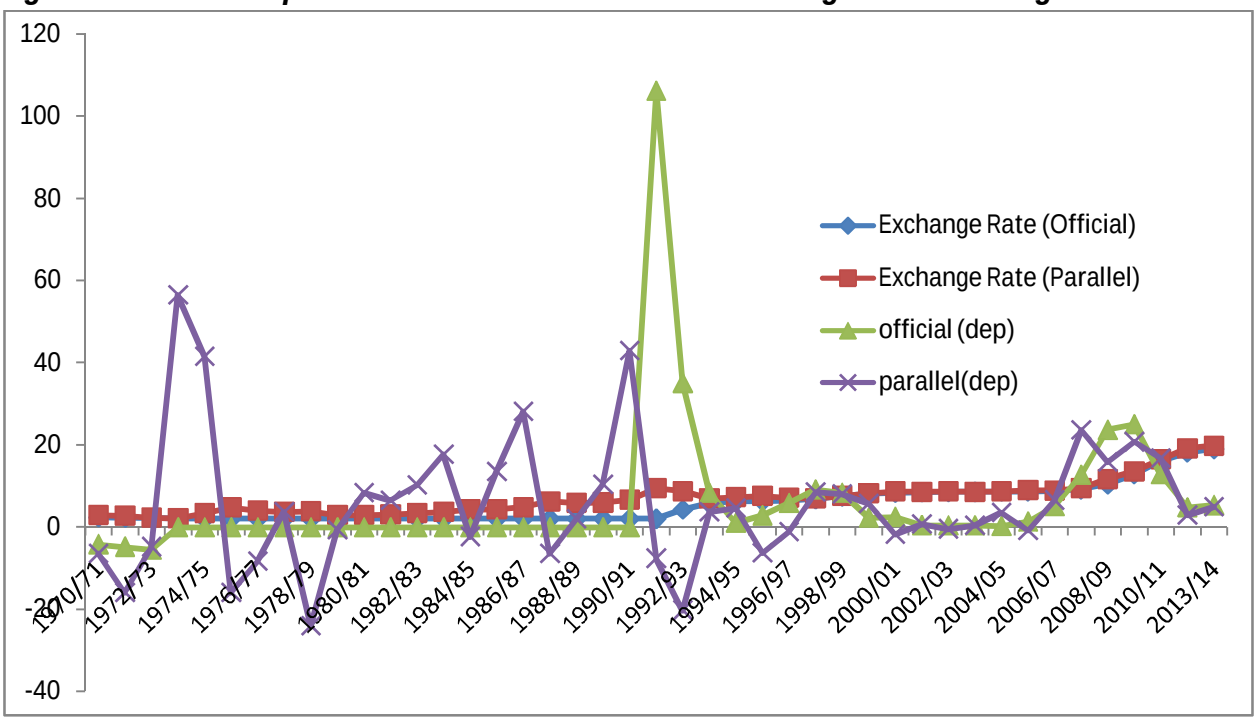
Trade deficit was 6 percent of GDP for the study period between 1974/75-2013/14 on average. In the Derg regime it was below one percent of the GDP, while for the EPRDF period it becomes almost 10 percent of GDP. Specifically for GTP-I period the trade deficit was on average about 24.1 percent of GDP. This indicates that the economy as a whole needs the export sector to move forward and increase its capacity of generating foreign exchange to cover the high demand for foreign exchange for imports and debt payments, which are now covered mainly through foreign loans and foreign aid.

3.7. Foreign Exchange Market Development

An exchange rate is the price of one nation's currency in terms of another currency. The exchange rate of Ethiopian Birr has been changed many times after the Britton Woods international monetary system, which was agreed in July 1949. This system was led by the International Monetary Fund (IMF) and it has two main features; first the currency of every IMF member country was attached to some fixed par value in terms of US dollar and the second is the convertibility of the US dollar in to gold (35 US dollar was equal to one ounce gold). The system changed in to the present system because US has suspended the convertibility of dollar in to gold in August 1971 and the world switched to a de facto dollar standard (see Bordo, 1993; Haile, 2008; Hall S. G. et al, 2009).

In the imperial regime, the exchange rate of Ethiopian Birr was 2.44 per US dollar for the period 1942 up to 1959 and it was slightly devalued in 1960 to 2.5 per US dollar, which is used till the early 1970's. The Derg regime has used a fixed predetermined exchange rate system and the exchange rate was fixed to 2.07 ETB per US dollar for the whole period (Haile, 2008). But in this period the parallel exchange rate has appreciated on average by 10.6 percent and this leads to an increase in the premium overtime. In the year 1992/93 the EPRDF led government has liberalized the exchange market and devalued the Ethiopian Birr by 106 percent. This action led the premium to decline from 4.6 to 2 and helped to narrow the gap between the parallel and official exchange rates even though it does not remove the premium. Figure 3.7 shows the official and parallel exchange rate values for the study period and their percentage depreciation.

Figure 3.7: Annual Depreciation of Parallel and Official Exchange Rate of Birr against Dollar



Source: Own Computation Based on NBE data

CHAPTER FOUR

Model Specification and Methodology of the Study

4.1. Introduction

Macro-econometric model is a model that is composed of different behavioral equations, institutional and definitional relationships that represent the workings of the economy (Valdhakini, 2004). The behavioral equations of different agents in the economy are defined based on consistent economic theory and the specific characteristics of the agents in the economy are included. Demand side of the economy has been given a great focus in macro-econometric models of the 1970s, but these demand oriented models have faced forecasting failure. This failure is mostly visible for supply-side shocks and it makes mandatory to extend the specifications of the model to include supply side factors (Wallis, 1994). In addition to this, the demand oriented models do not give sufficient emphasis to the role of monetary market, relative prices and expectations. To fill these gaps different modeling approaches were developed and modeling through aggregate demand and aggregate supply framework is one of these approaches (Soludo, 2002; Valdhakini, 2004).

This model is also developed along AD-AS framework based on Alemayehu and Huzinga (2004[18]). The supply side includes formal sector, informal sector and the agricultural sector in Alemayehu and Huzinga (2004). Agricultural output is determined by rainfall, land, labor and

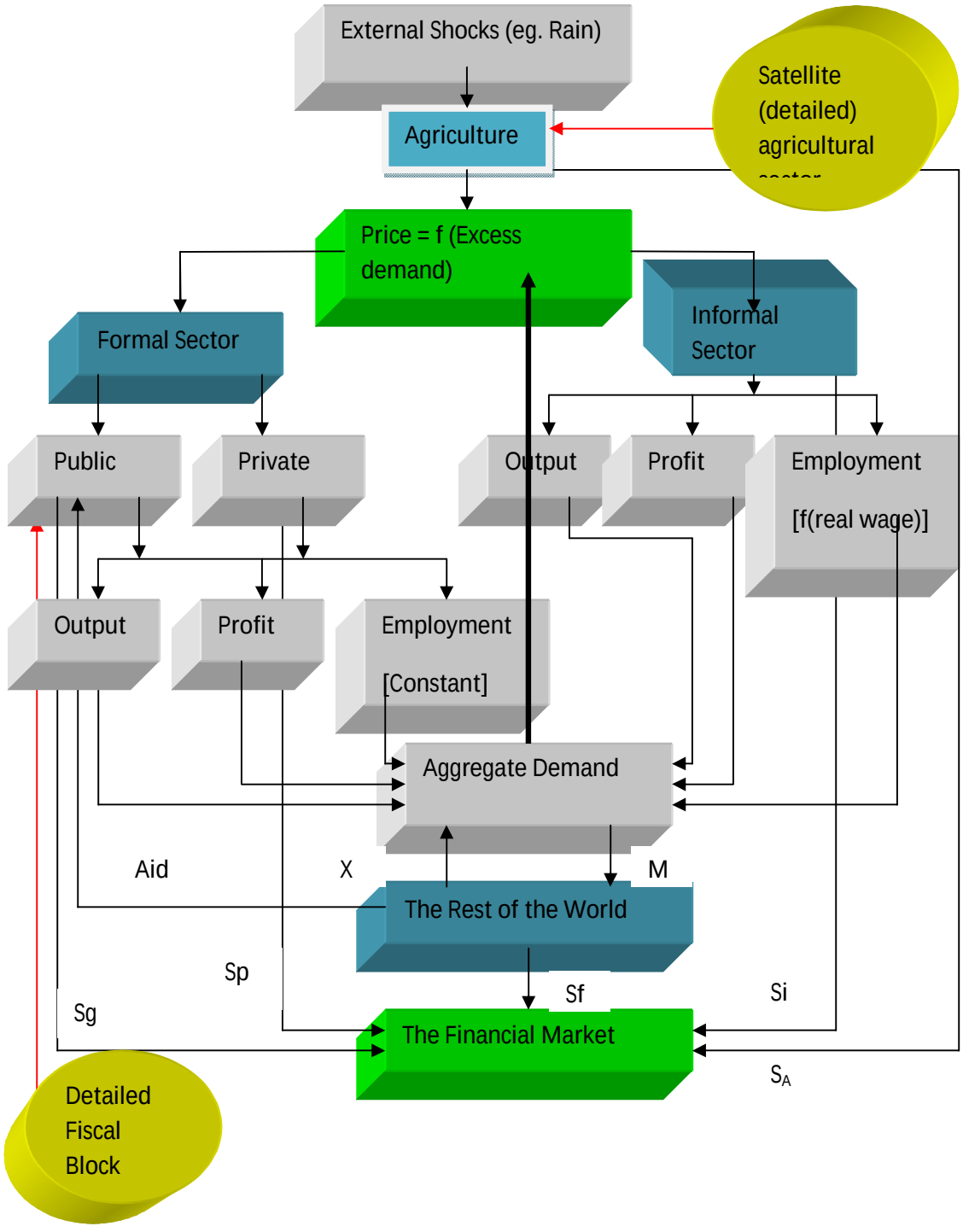
[18] The theoretical discussion in this section is based on Alemayehu and Huzinga (2004), unless explicitly acknowledge by other citation. Thus, we avoid repeatedly citing this source in the rest of the chapter.

the use of fertilizers. The formal private sector is modeled along neoclassical lines, which is based on the theory of profit maximization (Alemayehu and Huzinga, 2004).

The short-run aspect of the economy is related to output volatility, while the long-term growth is modeled as a function of increase in output of the agriculture sector. Output volatility prevailed mainly in the agricultural sector, because rainfall is the most important determinant of the output variation. Whereas, the increase in the agricultural output comes through the combination of better seeds, the use of fertilizer, and better infrastructure. In the short-run, in addition to the fluctuating supply condition of agricultural output, the formal sector is demand determined. The two components are linked through price of food. (Ibid)

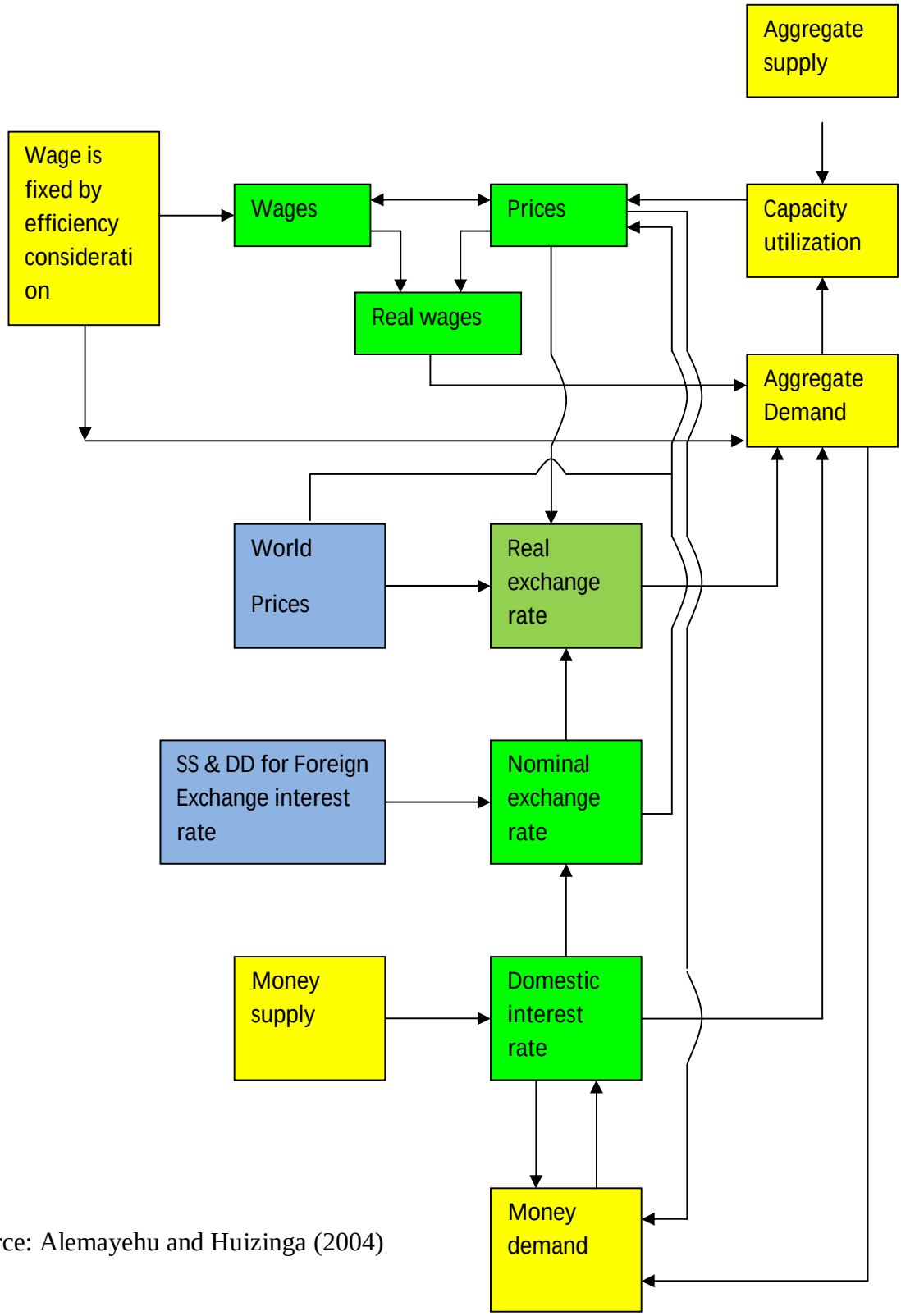
The real sector modeling is briefly summarized by Figure 1. In the real sector modeling, the aggregate demand (consumption, investment, government spending, and exports) will determine the level of imports and total-value added (Alemayehu and Huzinga, 2004). This value added is disaggregated in to agricultural and formal as noted above. The main feedback mechanism in the real economy works through the wage-price spiral, the interest rate and the real exchange rate (Alemayehu and Huzinga, 2004). Figure 2 shows the relationships modeled in the nominal side of the economy.

Figure 4.1: Flow Chart for Ethiopian Macro model: The real Sector



Source: Alemayehu and Huizinga (2004)

Figure 4.2: A Flow Chart for Ethiopian Macro Model: The Nominal Side



Source: Alemayehu and Huizinga (2004)

4.2. Model Specifications

In the model, the sub systems are specified as a function of their specific determinants following the line of economic theory and taking into consideration the special structural features of the country. The behavioral equations, identities, and bridge equations of the model are presented below.

4.2.1. Aggregate Supply

The aggregate supply of the model is sub-divided in to two sectors with agricultural and formal sector as its components. These sectors have a Cobb-Douglas constant elasticity of substitution production function[19] which is based on Alemayehu and Huzinga (2004).

4.2.1.1. Agricultural Production Function

The supply from agricultural sector is assumed to follow an augmented CES production function (Alemayehu and Huzinga, 2004). The output is determined by the agricultural capital (K) that is used in agriculture (such as oxen in Ethiopia and other machineries), the labor force that is participating in the sector (L) and the rainfall level (RF). Thus the agricultural output is specified as:

$$logY_{at} = B_{Ya0} + B_{Ya1}logK_{at} + B_{Ya2}logL_{at} + B_{Ya3}logRF_{t-1} \quad (4.1)$$

Where, Y_a is the agricultural output, K_a is capital in the agriculture sector, L_{at} is labor in agriculture and RF is the amount of rainfall.

[19] The Cobb-Douglas production Function is by itself non-linear, but the natural logarithmic transformation of all the data of the output and the inputs make the regression to be linear.

4.2.1.2. The formal Sector

The formal sector of the economy consists of the manufacturing and service sectors of both public and private ownership. The output in these sectors is determined by the amount of capital (K), the labor force employed (L), intermediate imports (Z). The intermediate imports (Z) are very important in this sector similar to the rainfall in the agricultural sector. Collecting all these factors the formal sector production function is specified as follows:

$$logY_{Ft} = B_{fo} + B_{f1}logL_{ft} + B_{f2}logK_{ft} + B_{f3}logZ_{ft} \qquad (4.2)$$

4.2.2. Aggregate Demand

4.2.2.1. Private Consumption

Following Alemayehu and Huzinga (2004) and in line with the permanent income and lifecycle hypotheses, the private consumption function is specified as a function of disposable income and the real interest rate. The impact of wealth on consumption is not modeled because of lack of data. The specification of the function goes as follows:

$$logRPC_t = B_{rpco} + B_{rpc1}logRGDI_t + B_{rpc2}logDIR_t \qquad (4.4)$$

Where, RPC is the real private consumption, $RGDI$ is the real disposable income and DIR is the saving deposit interest rate.

4.2.2.2. Private Investment

Leaving the public investment part of total investment exogenous private investment is specified as a function of its determinants. The starting point of argument in the specification of this behavioral function is the demand for inputs in the production functions (Alemayehu and

Huizinga, 2004). So, to specify the private investment we derive the demand for capital from the production function and include additional behavioral factors that affect private investment in Ethiopia. At last the private investment function is specified as follows;

$$logPINV_t = B_{PINV0} + B_{PINV1} logRGDP_t + B_{PINV2} logRPUINV_t + B_{PINV3} logCPI_t \qquad (4.5)$$

Where; PINV is private investment, RGDP is the real GDP, RPUINV is public investment, CPI is the consumer price index.

From the total investment the public investment is taken as exogenous policy variable, while the private investment is specified as it is noted above based on the optimal level of capital stock. The total investment in the country is the sum of the private investment and the public investment.

$$INV = PRIV + PUINV$$

4.2.2.3. Government Fiscal Block

The government sector is composed of the revenue and the expenditure side. Specification is done for both the revenue and the expenditure side, although the expenditure side is partly exogenous.[20] The government gets its revenue from tax revenue, non-tax revenue sources or from grants. Government expenditure is disaggregated in to two components as current and capital expenditures. Wages and salaries, expenditures on goods and services, interest payments for loans which can be domestic or foreign, subsidies and transfers are included in the current expenditure. In this model from the revenue side tax revenue and from the expenditure side the

[20] This method is also similar to Tewodros (2011).

current government expenditures are specified as a function of their respective determinants. The behavioral equations and the identities of the government fiscal block are given below.

4.2.2.3.1. Government Revenue

Government revenue sources are tax sources, non-tax sources and external grants. The tax revenue comes from direct taxes, indirect taxes and foreign trade taxes. While the non-tax revenue includes the revenue from the sale of goods and services by various departments, charges, fees, pension contribution, and investment revenue. In this model tax revenue is specified as a function of factors that affect it differently. Among these factors; the level of economic activity, degree of trade and foreign aid are included. The nominal gross domestic income is used as a proxy for the level of economic activity and it represents the tax base of the government and is expected to affect tax revenue positively. Degree of trade is included to have the impact of the movement in international trade especially the import side, since export tax in the country is negligible. The aid variable which is composed of grants and loans is included in the model to check for the fiscal response of taxes to these variables (Alemayehu and Huzinga, 2004). Additional to these factors the consumer price index is used to have the impact of inflation on the tax revenue. Thus the tax revenue is specified as:

$$logTXR_t = B_{t0} + B_{t1}NGDI_t + B_{t2}logM_t + B_{t3}AID_t + B_{t4}CPI_t \qquad (4.6_a)$$

Where, TXR is total tax revenue; NGDI is nominal gross domestic income; M is total import; AID is foreign aid which is composed of grants and loans, and CPI is the consumer price index. The total government revenue identity is given as:

$$TGR_t = TXR_t + \overline{NTXR}_t + \overline{Grant}_t \qquad (4.6_b)$$

Where, TGR is total government revenue; NTR is non tax revenue, and *Grant* is foreign grant. The latter two are assumed to be exogenous.

4.2.2.3.2. Government Expenditure

Government finance its expenditure either from tax and non-tax revenue or by borrowing from domestic and international sources and also though foreign aid. Therefore the current expenditure of the government is specified as a function of tax revenue, foreign aid, and the price level.[21]

$$logGRE_t = B_{G0} + B_{G1}logTXR_t + B_{G2}logAID_t + B_{G3}logCPI \qquad (4.7_a)$$

From the above specifications the total government expenditure identity is given by:

$$TGE_t = GRE_t + \overline{GCE}_t \qquad (4.7_b)$$

Where, TGE is total government expenditure and GCE is total government capital expenditure.

The government sector closure is the public deficit, which is the difference between government revenue and government expenditure. This is given as:

$$PUBDEF_t = TGR_t - TGE_t \qquad (4.7_c)$$

[21] This specification is similar to Tewodros (2011).

4.2.2.4. External Sector

The external sector is composed of export and import behavioral functions. The behavioral functions here give more emphasis to the specific characteristics of the Ethiopian economy.

4.2.2.4.1. Export Sector

In the specification of the export sector, it is recognized that Ethiopia is a small country in the international market and cannot influence the market price, so the country is a price taker. Most of its exports are primary products and their prices are determined in the international market. The export of the country is determined by the following factors: real income of trading partners which represent the demand side of the export, Ethiopia's competitiveness in the market for the exports measured through the real effective exchange rate and the capacity of the country to supply. The export of most of developing countries is supply constrained; meaning that even if there is high demand it is difficult to adjust the supply to meet this high demand. This on the other hand depends on the problem of capital accumulation (Alemayehu and Huzinga, 2004). In line with this argument, the export equation is specified as:

$$logX_t = B_{X0} + B_{X1} logROWGDP_t + B_{X2} logREER_t + B_{X3} logINVGDP_t \quad (4.8)$$

Where; X is export; $ROWGDP$ is income of the trading partners of Ethiopia; $REER$ is the real effective exchange rate; INVGDP is investment to GDP ratio.

4.2.2.4.2. Import Sector

The import equation is also specified following Alemayehu and Huzinga (2004) and Alemayehu and Addis (2014). Import demand is specified as a function of real effective exchange rate,

remittance and the real gross domestic output. The domestic output is used as a proxy for the domestic demand for imports.

$$logM_t = B_{M0} + B_{M1}logREER_t + B_{M2}logRGDP_t + B_{M3}REM_t \quad (4.9)$$

Where M is real import, $RGDP$ is real GDP, REER is the real effective exchange rate, REM is remittance from abroad. In Tewodros (2011) and Daniel (2001) the import sector is disaggregated in to two parts as consumer goods and intermediate and capital goods. We have avoided such disaggregation in this model to have the aggregate view.

4.2.3. Monetary Sector

The monetary sector modeling helps to have the view of how monetary variables are related to other sectors of the economy. Money demand is specified as a function of its important determinants. These determinants include real GDP, nominal interest rate and the price level. Money supply is exogenously determined and it is expressed as an identity of its components. And finally the two sides come together through the monetary multiplier.

4.2.3.1. Money Demand

The money demand is specified as a function of the real GDP, interest rate and the price level. GDP is used as a proxy for the income level of the country and the output level, and it is expected to affect the money demand positively. Deposit interest rate is the opportunity cost of holding money, so it is expected to affect the money demand negatively. Following these arguments the money demand function is given as:

$$logM_{2t} = B_{M0} + B_{M1}logRGDP_t + B_{M2}logDIR_t + B_{M3}logCPI_t \quad (4.10)$$

Where, M_2 is the broad money, RGDP is the real GDP, DIR is the deposit interest rate and CPI is the price level.

4.2.3.2. Money Supply

Money supply is affected by the holding of net foreign asset, domestic credit, and the holding of other net assets. The domestic credit on itself can be claims by the government and claims by other sectors. For the closure of the monetary sector the money demand and supply are equilibrated though money multiplier. This is expressed as:[22]

$$M^S{}_t = \mu M_2 = \mu(NFA + NDA) \qquad (4.11)$$

Where, NFA is net foreign asset, NDA is net domestic asset and μ is the money multiplier (calculated as a ratio of M_2 to reserve money).

$$NDA = GC + NGC + ONA \qquad (4.12)$$

$$DC = GC + NGC \qquad (4.13)$$

Where, GC is credit claimed by the government and NGC is credit claimed by other sectors and ONA is other net assets.

4.2.4. Price Sector

The price sector includes the investment price, export price, import price and consumer price. These prices help to get equilibrium between demand and supply side of the economy.

4.2.4.1. Consumer Price

[22] This closure is similar to Tewodros (2011) and it is adopted from McCallum (1989).

The consumer price is determined by different factors like; capacity utilization rate, real effective exchange rate, interest rate, money balance. Following these arguments the consumer price is specified as follows:

$$logCPI_t = B_{CP0} + B_{CP1}logREER_t + B_{CP2}logLIR_t + B_{CP3}M2_t + B_{CP4}CUR_t \quad (4.14)$$

Where; CPI is consumer price index, $REER$ is real effective exchange rate, LIR is lending interest rate and is the $M2$ real money balance.

4.2.4.1. Export Price

The export price in the economy is affected by factors likes of capacity utilization rate, lending interest rate and import price. The impact of import price is clear since Ethiopia's exports use high amount of imported raw materials from abroad. This on the other hand implies the increase or decrease in import price will have an impact in the export price. When the import price increases the export price will also increase because the cost of production has increased. Therefore the export price function is specified as:

$$logXP_t = B_{XPO} + B_{XP1}logCUR_t + B_{XP2}logLIR_t + B_{XP3}logMP_t \quad (4.15)$$

Where; XP is export price, LIR is lending interest rate, CUR is capacity utilization rate and MP is import price.

4.2.4.2. Investment Price

The investment price is also affected by factors like capacity utilization rate, per unit cost of output, import price and real interest rate. These factors are the costs of inputs used for installing investment. The capacity utilization rate shows how the resources of the country are being used.

If there is high capacity utilization rate in the country, then resources are used in their best positions meaning that starting new investment is costly. So the increase in capacity utilization rate increases investment price and vice versa. On the other hand, per unit cost of output, import price and real interest rate all affect positively since they all are the costs of inputs used in investment. Following Alemayehu and Addis (2014), the investment price equation is specified as follows;

$$logINVP_t = B_{INVPO} + B_{INVP1}logCUR_t + B_{INVP2}logPUC_t + B_{INVP3}logMP_t + B_{INVP4}logLIR_t \quad (4.16)$$

Where; $INVP$ is investment price, CUR is capacity utilization rate, PUC is per unit cost of output, LIR is lending interest rate.

4.3. Estimation Technique

4.3.1. Introduction to Estimation Techniques

To develop the macro-econometric model, time series data is used and the individual behavioral equations are estimated using autoregressive distributed lag (ARDL) bound test approach to co integration developed by Pesaran et al. (2001). To use time series data it has to pass through different stages to get the correct relationship between the variables used in the model. First the time series properties of the variables like stationary, order of integration, and the existence of a long run relationship among the non-stationary variables (co integration) must be checked.

Stationary property of the variables is a pre-requisite to apply the standard estimation or testing procedures in a dynamic time series model (Verbeek, 2004, P. 309). This is because analysis made using non-stationary variables may lead to *spurious regression* in which estimators and test

statistics are misleading. There are two types of non-stationary series; trend stationary and difference stationary processes. Trend stationary (TS) process consist data generating process which can be explained by a deterministic function of time called trend, plus a stationary stochastic process with mean zero. Difference stationary means that the series becomes stationary after differencing. The techniques to transform these two non-stationary processes to stationary process are different and when a unit root test is conducted it must be through precaution. But Pesaran et al. (2001) claim that for autoregressive distributed lag (ARDL) model there is no need of pre-testing the variables for existence of unit roots. This is because one of the method's advantage is it does not require the order of integration of the variables used in the model to be similar.

Handling variables with mixed order of integration i.e., I (0) and I (1) is only one of the advantages of ARDL approach; there are others. First, ARDL approach is better suited for small sample size data than other methods like the Johansen co integration approach (Pesaran et al., 2001; Ouattara, 2004). Second, it avoids the problems of endogeneity, omitted variable bias and autocorrelation. And also it allows for a rigorous modeling of the short run and long run relationship of non-stationary variables simultaneously (Ouattara, 2004).

4.3.2. Unit Root Test/Test for Order of Integration

According to Pesaran et al. (2001) for ARDL approach unit root test is not mandatory step since it can handle variables with mixed order of integration. But to avoid the inclusion of I (2) variables in the analysis, if there are any, testing the existence of unit root and the order of integration of the variables is very important. This is because in the presence of I (2) variables

the computed F-statistics provided by Pesaran et al. (2001) are not valid since they assume only I (0) and I (1) variables in the computation (Ouattara, 2004).

The order of integration of a series shows that the given series (X_t) becomes stationary after it is differenced *d* times. This is said to be integrated order of *d*, which is represented as $X_t \sim (d)$. So the stochastic component of the given series is removed only after differencing the series *d* times. If the order of integration of a given series is zero, this means that the given series is stationary in level form or without any differencing. There are different methods developed to investigate the presence of unit roots including Dickey–Fuller (1979) test, Kwiatkowski, Phillips, Schmidt and Shin (1992) (KPSS test), Augmented Dickey Fuller (ADF), and Phillips-Perron (PP) test. In this paper the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests are used to test for the unit root of the macroeconomic variables considered.

For the discussion on how the unit root test is conducted let us take the following data generating process:

$$y_t = \rho y_{t-1} + \mu_t \qquad \mu_t \sim IID(0, \delta^2)$$

$$y_0 = 0 \qquad (4.16)$$

Then, our objective is to test the hypothesis $H_0: \rho = \rho_0$ for $|\rho_0| < 1$. To perform the test we have to run a regression on the equation (4.16) and the *t-statistic* $\frac{\rho - \rho_0}{Se(\rho)}$ has asymptotically a standard normal distribution and can be compared with tables of significance points for N(0,1). The test statistic will be approximately t-distributed for small samples. But when $|\rho_0| > 1$, there is non-stationary process i.e., there is at least one unit root, test statistic will not hold because the distribution of the test statistic given is not asymptotically normal. When we face these types of

problems we revert to use the critical values developed by Dickey and Fuller (1976). These critical values are related to the following three different cases:

$$y_t = \rho y_{t-1} + \mu_t \quad (4.17)$$

$$y_t = \beta_1 + \rho y_{t-1} + \mu_t \quad (4.18)$$

$$y_t = \beta_1 + \beta_2 t + \rho y_{t-1} + \mu_t \quad (4.19)$$

Where; $\mu_t \sim IID(0, \delta^2)$; t is time trend, equation (4.17) represent a random walk, equation (4.18) represents a random walk with drift and equation (4.19) represents a random walk with drift and time trend. In all the above three cases the null hypothesis is that $\rho = 1$. Through mathematical transformation the above models can be written as:

$$\Delta y_t = \gamma y_{t-1} + \mu_t \quad (4.17a)$$

$$\Delta y_t = \beta_1 + \gamma y_{t-1} + \mu_t \quad (4.18a)$$

$$\Delta y_t = \beta_1 + \beta_2 t + \gamma y_{t-1} + \mu_t \quad (4.19a)$$

This is where $\gamma = \rho - 1$ and the null hypothesis is similar to testing the hypothesis $\gamma = 0$ in the transformed model. The Dickey-Fuller test is based on DGP of AR (1), but a sequence may follow a DGP of AR (P). In this case the error terms in the Dickey-Fuller test of AR (1) will be auto correlated. This problem can be solved by incorporating the lagged difference terms of the dependent variable and we will have the Augmented Dickey Fuller test (ADF). The ADF test can be represented as follows given y_t follows P^{th}order AR process:

$$\Delta y_t = \beta_1 + \beta_2 t + \gamma y_{t-1} + \sum_{i=1}^{p} \rho_i \Delta y_{t-p} + \mu_t \quad (4.20)$$

Where; μ_t is a pure white noise error term and $\Delta y_{t-1} = (y_{t-1} - y_{t-2}) = \Delta y_{t-2} = (y_{t-2} - y_{t-3})$

The unit root test is done by testing the null hypothesis $\gamma = 0$ against the alternative $\gamma < 0$. The above ADF test shows for the case where both the intercept and the trend are included, so it is possible to test for the specific cases as similar to the DF test (Enders, 1995).

Phillips and Perron (1988) have developed another approach of testing unit root which is non-parametric. The PP test solves the problem of auto correlated error terms in DF by adjusting the DF statistics rather than adding lagged differences of the dependent variable as it is for ADF. The adjustment helps PP to consider the auto correlation in the error terms and to conduct inference with the same distribution applied for DF test. The data generating processes are also similar to that of the three models used in Dickey Fuller tests, the only difference being that the error terms are not assumed to be white noise.

4.3.3. Auto Distributive Lag Bounds Test Approach (ARDL)

ARDL approach to co integration is developed by Pesaran and Shin (1999) and has become a popular method after then for finding the long run relationship between variables. The popularity comes from that the method gives a consistent estimate for the long run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I (1) or I (0) or mutually co integrated.

On the other hand, this helps us to make inference without requiring the series in the model to have similar order of integration, only the variables considered has to be either I (0) or I (1) (Pesaran et al, 2001). The ARDL method uses means of bound testing approach (Pesaran et al, 2001) to test the existence of long run relationship among the variables. First the ARDL model

will be estimated and a test using the non standard F-statistics will be made to check the presence of long run relationship. This statistic has two sets of critical values for a given level of significance calculated based on assuming if all series are I (0) or I (1).

According to this test there are three possibilities that we face in the step to decide the existence of long run relationship. First, if the F-statistic falls below the lower critical value then the null hypothesis i.e., there is no co integrating relationship could not be rejected; second if the F-statistic falls between the two bounds test then it becomes inconclusive to decide. The third possibility is if the F-statistic is above the upper bound, then the null hypothesis will be rejected and we can conclude that there exists long run relationship between the variables considered.

After the test is undertaken and the existence of long run relationship, the long run equation and the error correction models can be estimated. The long run equations are estimated by taking the ARDL model chosen and the residual found from this equation will be the equilibrium correction term. ARDL approach can be illustrated using an example of the money demand equation that is specified in this study. The money demand equation that is given in equation (4.10) is;

$$logM_{2t} = B_{M0} + B_{M1}logRGDP_t + B_{M2}logDIR_t + B_{M3}logCPI_t$$

Following Pesaran et al. (2001) the ARDL representation of the above model is given as;

$$\begin{aligned}\Delta logM2_t = {} & B_{M0} + \sum_{i=1}^{P} B_{M1}\,\Delta logM2_{t-i} \\ & + \sum_{i=0}^{P} B_{M2}\Delta logRGDP_{t-i} + \sum_{i=0}^{P} B_{M3}\Delta logDIR_{t-i} + \sum_{i=0}^{P} B_{M4}\Delta logCPI_{t-i} \\ & + B_{M0}logM2_{t-1} + B_{M1}logRGDP_{t-1} + B_{M2}logDIR_{t-1} + B_{M3}logCPI_{t-1} \\ & + U_t \qquad (4.21)\end{aligned}$$

To test the presence of co integration among the variables a joint significance test on the null hypothesis ($H_0 = B_{M0} = B_{M1} = B_{M2} = B_{M3} = 0$) which implies there is no co integration. The decision is made based on the position of the non standard F-statistic compared to the given bound values as discussed above.

If there is co-integration, then the short run dynamics can be provided by constructing an error correction model of the following form;

$$\Delta logM2_t = B_{M0} + \sum_{i=1}^{K} B_{M1}\,\Delta logM2_{t-i} + \sum_{i=0}^{K} B_{M2}\Delta logRGDP_{t-i} + \sum_{i=0}^{K} B_{M3}\Delta logDIR_{t-i} + \sum_{i=0}^{K} B_{M4}\Delta logCPI_{t-i} + \emptyset ECM_{t-1} + \epsilon_t \qquad (4.22)$$

Here Δ is the first difference operator, $\emptyset$ measures the speed of adjustment and all the Bs are the coefficients relating to the short run dynamics.

Where ECM is the error correction term which is defined as;

$$ECM_t = logM2_t - \hat{B}_{M0} - \sum_{i=1}^{K} \hat{B}_{M0}\, logM2_{t-i} - \sum_{i=0}^{K} \hat{B}_{M1} logRGDP_{t-i} - \sum_{i=0}^{K} \hat{B}_{M2} logDIR_{t-i} - \sum_{i=0}^{K} \hat{B}_{M3} logCPI_{t-i} \qquad (4.23)$$

CHAPTER FIVE

EMPRICAL ANALYSIS AND DISCUSSION OF RESULTS

In this chapter, the estimated sub models and their respective interpretations are presented. First the time series behavior of the variables i.e., unit root tests which shows the order of integration of the variables are tasted. In this paper, Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests of unit root are used to reach to a conclusion about the stationary of the variables.

The sub-models of the macro econometric model are estimated through ARDL model using Eviews 9 software, which has its own special platform to deal with ARDL estimation. The estimated models are presented with their respective discussions as follows.

5.1. Time Series Behavior of the Variables-Unit Root Tests

ARDL co-integration approach does not handle variables that are integrated order of two. Therefore to avoid the inclusion of I (2) variables, it is a must to conduct a unit root test and reach a conclusion that all the variables are not I (2). In this paper, Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests are used for testing the unit roots of the variables in the model. The test results are presented in the appendix section.[23] From the unit root test results we can conclude that there is no variable which is I (2) and all the variables are either I (0) or I (1). So we can use the ARDL model estimation technique and interpret our results accordingly.

[23] The results of the unit root tests are presented in Appendix 3 and it includes both the ADF and PP tests results.

5.2. Results of the Estimated Structural Equations

After the unit root test of the variables is done, the behavioral equations included in the model are estimated using the ARDL estimation approach. In this section the behavioral equations, both in the short run and long run and the results of the diagnostic tests are presented with their respective discussions. For testing normality, the Jarque Berra statistics is used. While for testing serial correlation the Breusch-Godfrey LM test is used. The heteroskedasticity statistics is checked using the Breusch-Pagan-Godfrey test. The ARDL model is automatically chosen by the Eviews using the Akiake Information Criterion (AIC). All these diagnostic tests are presented in Table 5.1 at the end of this chapter for all the estimated behavioral equations.

5.2.1 Aggregate Supply

5.2.1.1. Agricultural Production Function

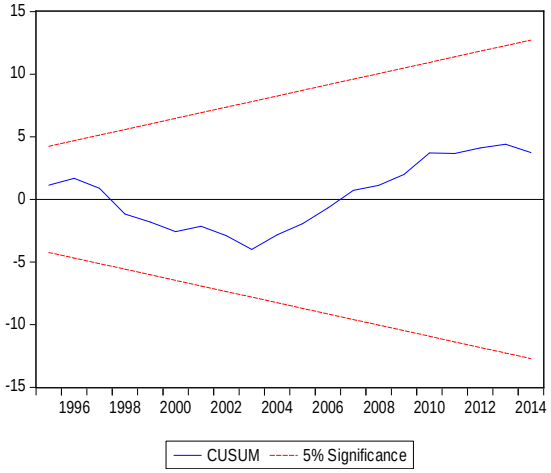
The real agricultural value added (RAGVA) is specified as a function of agricultural capital stock (RAGCS), agricultural labor force (LFAG) and rainfall (RF). Agricultural value added is positively and significantly related to all of its determinants in the short run. While in the long run, agricultural labor force affects agricultural value added positively but it is not significant. In the long run it is expected that the agricultural sector will become more mechanized and the contribution of labor can be relatively insignificant or below par. The two dummies, drought dummy and war dummy, included are also found to affect agricultural value added negatively and significantly in the short run. The estimated agricultural production function is given as follows:

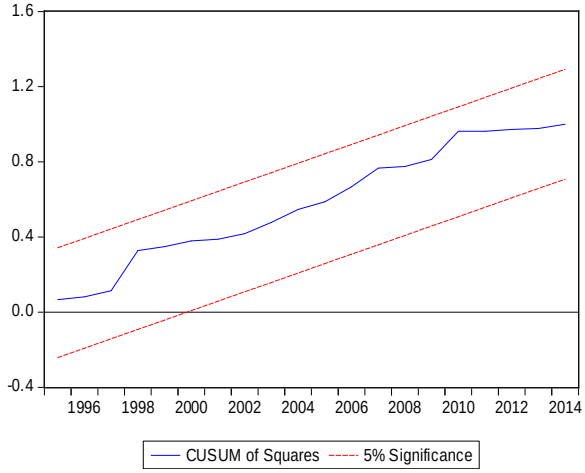
$$\Delta(LnRAGVA) = -89.55 + 2.641\Delta LnLFAG + 1.807\Delta LnRAGCS + 0.473\Delta LnRF + 0.267\Delta LnRAGVA(-1)$$
$$(-1.28) \quad (1.75)^{***} \qquad (2.39)^{**} \qquad (2.34)^{**} \qquad (2.34)$$
$$-2.033\Delta LnRAGCS(-1) - 0.128\Delta DR - 0.091\Delta DW - 0.095\Delta @trend - 0.51ECM_{t-1}$$
$$(-2.52)^{**} \qquad (-2.82)^{**} \quad (-2.01)^{**} \quad (-2.01)^{**} \quad (-2.93)^{*}$$
$$+5.17LnLFAG + 1.24LnRAGCS + 0.93LnRF - 0.24DR - 0.179DW - 0.18@trend$$
$$(1.22) \qquad (3.98)^{**} \qquad (1.75)^{***} \quad (1.69) \quad (-1.43) \quad (0.19)$$

The error correction term has the correct sign and it shows that around 51 percent of the disequilibrium will adjust towards the equilibrium within a year. A one percent increase in rainfall, agricultural labor force and agricultural capital leads to the increase of agricultural value added by 0.47, 2.64 and 1.80 percent respectively in the short run.

Again here in the long run, a one percent increase in rainfall leads to 0.92 percent increase in the agricultural value added, which is well higher than the short run effect. The impact of agricultural capital shows that a one percent increase leads to 1.24 percent increase in agricultural value added and it is significant at one percent level of significance. This shows that mechanization of agriculture can result in a good increase in the value added of the agricultural sector in the long run. The stability of the model is checked using CUMSUM and CUMSUMSQURE methods and the graphs that show the results are presented as follows;

Figure 5.1: Parameter Stability test for Agricultural production function





5.2.1.2. The Formal Sector

The real formal sector value added (RFSVA) is estimated as a function of capital stock (RFSCS), labor force (LFFS) and intermediate imports (Z) that are used in the sector. From the estimated equation it is found that labor force and intermediate imports do not affect the sectors value added significantly in the short run. Even their sign is negative. The estimated formal sector equation is presented as follows;

$$\Delta(LnRFSVA) = \underset{(-4.61)}{-9.41} - \underset{(-0.55)}{0.098}\Delta LnLFFS + \underset{(3.38)^{*}}{0.059}\Delta LnRFSCS - \underset{(-0.85)}{0.052}\Delta LnZ - \underset{(-2.50)^{**}}{0.507}\Delta LnLFFS(-1)$$

$$+\underset{(2.68)^{**}}{0.045}\Delta LnRFSCS(-1) - \underset{(-1.75)^{***}}{0.125}\Delta LnZ(-1) - \underset{(-1.36)}{0.224}\Delta LnRFSVA(-1) + \underset{(2.89)^{*}}{0.083}\Delta D00 - \underset{(-4.45)^{*}}{0.017}\Delta @trend$$

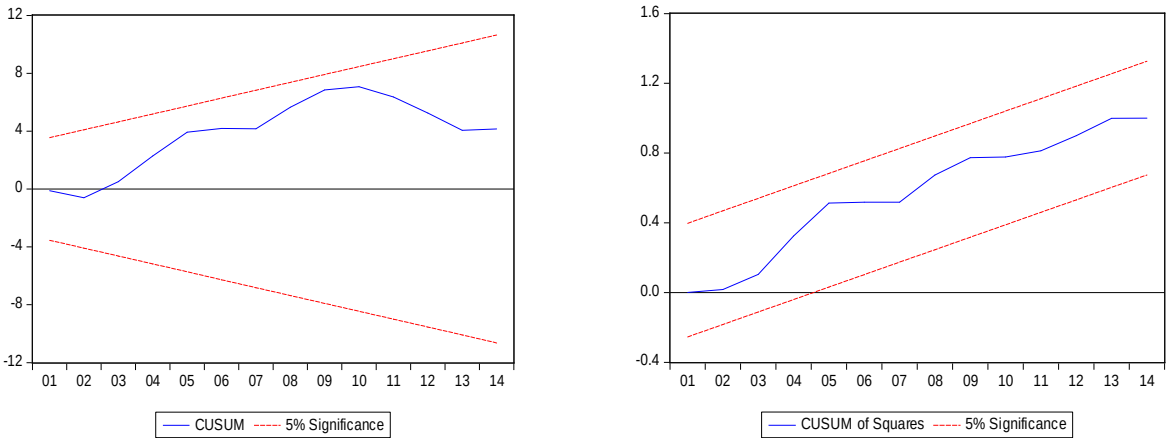
$$\underset{(-4.42)^{*}}{-0.57}ECM(-1) + \underset{(7.82)^{*}}{1.164}LnLFFS + \underset{(1.85)^{***}}{0.076}LnRFSCS + \underset{(5.77)^{*}}{0.337}LnZ + \underset{(2.69)^{**}}{0.147}D00 - \underset{(-4.52)^{*}}{0.03}@trend$$

The error correction term in the model has the correct negative sign and shows that out of the total disequilibrium 57 percent will adjust towards the equilibrium within a year. The seasonal

dummy included for the period after the year 2000 have a positive sign which shows that the sector has expanded well after the millennium than the previous period. The capital stock affects the value added of the sector positively and significantly and a one percent increase in the capital stock leads to 0.059 percent increase in the value added of the sector.

In the long run all the determinants of the formal sector value added have positive and significant effect which is in line with economic theory. A one percent increase in labor force used in the sector leads to 1.164 percent increase in the value added of the sector in the long run. This shows that the training of workers and the availability of qualified labor contributes positively in the near future. On the other hand, a one percent increase in the capital stock leads to 0.076 percent increase in the value added of the formal sector. While intermediate imports contribute 0.337 percent increase in the formal sector value added for one percent increase. The stability of the model is checked using the CUMSUM and CUMSUMSUARE and the graphs that show the results are presented as follows;

Figure 5.2: Parameter Stability test for Formal Sector production function



5.2.2. Aggregate Demand

5.2.2.1. Private Consumption

The real private consumption (RPC) function is estimated as a function of the real disposable income (RGDI) and the deposit interest rate (DIR). The real disposable income affects the real private consumption positively and significantly both in the short run and in the long run. The deposit interest rate affects negatively the real private consumption and it is significant only in the long run. In the long run, it is assumed that the economy will expand and the financial sector also starts to interact with everyone's livelihood, making the deposit interest rate important in household's consumption decision. And the increase in the income of the people in addition to the increase in the banking service may help to make the economy sensitive to interest rate and it affects real consumption negatively. The estimated real private consumption equation is presented as follows:

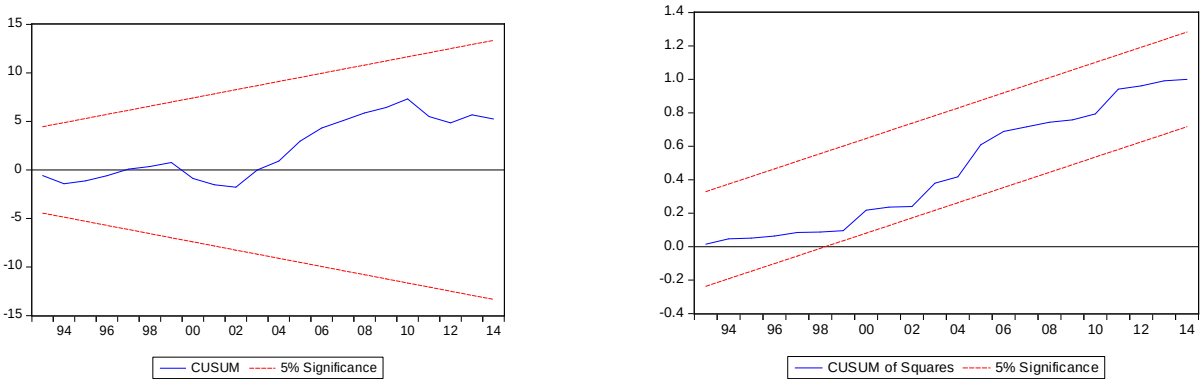
$$\Delta(\text{LnRPC}) = \underset{(-0.31)}{-0.136} + \underset{(9.71)^{*}}{0.891}\Delta\text{LnRGDI} \underset{(-1.19)}{-\ 0.043}\Delta\text{LnDIR} + \underset{(1.85)^{***}}{0.062}\Delta\text{LnDIR}(-1) + \underset{(2.28)^{**}}{0.08}\Delta\text{DEPRDF}$$

$$\underset{(-2.00)^{**}}{-0.0055}\Delta@\text{trend} \underset{(-3.29)^{*}}{-\ 0.54}\ ECM(-1) + \underset{(16.63)^{*}}{0.90}LnRGDI \underset{(-1.81)^{***}}{-\ 0.11}LnDIR + \underset{(2.29)^{**}}{0.146}DEPRDF \underset{(-2.16)^{**}}{-\ 0.01}@trend$$

From the above estimated equation we can see that the error correction term has the correct negative sign and it shows that out of the total disequilibrium about 54 percent will adjust towards the equilibrium within a year. The dummy variable included for the period after year 1991 shows that there is an increase in the real private consumption than the period before year 1991. This is also consistent with the descriptive statistics which is presented in chapter three of this paper.

When the real disposable income increases by one percent, real consumption increases by 0.90 percent. And when the deposit interest rate increases by one percent in the long run the real consumption decreases by 0.11 percent. The dummy included for the period of the EPRDF shows that there is an expansion in real private consumption for this period than that of the previous period. The parameter stability of the real private consumption function is checked using the CUMSUM and CUMSUMSQUARE and the graphs below show the stability of the model.

Figure 5.3: Parameter Stability test for Real Private Consumption



5.2.2.2. Real Private Investment

The real private investment (RPINV) is estimated as a function of real domestic income (RGDP), inflation rate (CPI) and public investment (RPUINV) which is included to see the effect of public investment on the private investment. The real gross domestic product of the country is used as a proxy for the real domestic income. Consumer Price index is used as a proxy for inflation rate. The estimated real private investment equation is the following;

$$\Delta(LnRPINV) = -4.71 + 1.44\Delta LnRGDP - 0.467\Delta LnRPUINV - 0.673\Delta LnCPI - 0.884\Delta LnCPI(-1)$$
$$(-1.15) \quad (2.60)^{*} \qquad (-2.83)^{*} \qquad (-1.22) \qquad (-1.73)^{***}$$
$$-0.286DEPRDF - 0.466D85 - 0.96ECM(-1) + 1.50LnRGDP - 0.485LnRPUINV + 0.565LnCPI$$
$$(-2.11)^{*} \qquad (-1.77)^{***} \qquad (-5.56)^{*} \qquad (3.18)^{*} \qquad (-3.27)^{*} \qquad (2.27)^{**}$$
$$-0.298DEPRDF - 0.485D85$$
$$(-2.12)^{*} \qquad (-1.53)$$

From the above estimated equation the real GDP affects investment positively and significantly. This is in line with the existing economic theory, because an increase in domestic income creates a market for goods and services and also supplies resources for investors. In the short run a one percent increase in real GDP leads to 1.44 percent increase in the real private investment. While in the long run, a one percent increase in real GDP leads to 1.5 percent in the real private investment.

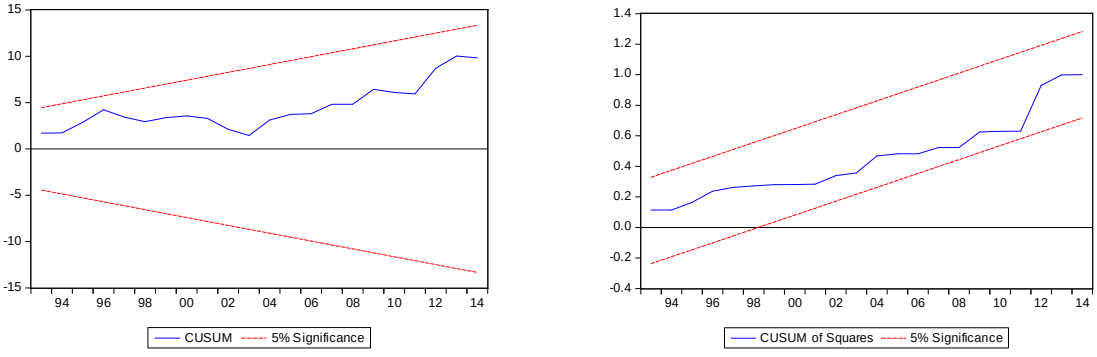
The real public investment has a negative effect i.e., it crowds out the real private investment. In the theory both positive and negative effects are expected and each has their own explanations. The negative effect can be explained by the following reasons; the first and the most important is the expansion in the public investment will take more resources and creates competition, the second is the increase in deficit of the government which works more in the developed world. Some studies that tried to find out the impact of different types of public investment also get different results on the effect of the social and physical public investments on the private investment (e.g. Teklebirhan, (2015), has found that public social infrastructure investment,

which is one part of the public investment, has a significant negative impact on real private investment).

The effect of the inflation rate is also found to be negative in the short run and positive in the long run, but it is not significant in the short run. On the other hand, the previous year inflation rate affects real private investment negatively and significantly with ten percent level of significance. The short run effect shows that when inflation increases by one percent the real private investment decrease by 0.67 percent. This is explained by the instability of the economy, which creates uncertainty on investors and leads to a decrease in investment.

In the long run, a one percent increase in the inflation rate leads to 0.56 percent increase in the real private investment. The positive effect of inflation on private investment, on the other hand, can be explained by the attractiveness of some sectors for new investors because of the increase in price (here we can take the cement industry in Ethiopia as an example). So, attractiveness is more important than the instability created by inflation on a net basis. The stability of the model is checked using the CUMSUM and CUMSUSQUARE methods and the results are presented by the graphs below.

Figure 5.4: Parameter Stability test for Real Private Investment



5.2.3. Government sector

From the government sector the tax revenue and recurrent government expenditure are estimated as a function of their respective determinants. The short run and long run estimated equations of the government sector are presented as follows.

5.2.3.1. Tax Revenue

The tax revenue (TXR) is estimated as a function of nominal gross domestic income (NGDI), import (M), consumer price index (CPI) and foreign aid (AID). The nominal gross domestic income is used to measure the tax base, while import is included to have the impact of foreign trade on tax revenue. The impact of nominal gross domestic income, foreign aid and import is expected to be positive, while the impact of inflation is not known a priori. The estimated tax revenue function is as follows;

$$\Delta(\text{LnTXR}) = -7.94 + 0.386\Delta\text{LnNGDI} + 0.18\Delta\text{LnM} + 0.179\Delta\text{LnAID} - 0.447\Delta\text{LnCPI}$$
$$(-4.70)^{*} \quad (3.38)^{*} \quad (3.27)^{*} \quad (3.59)^{*} \quad (-2.53)^{*}$$
$$-0.244\Delta\text{LnCPI}(-1) - 0.116\Delta LnAID(-1) + 0.213\Delta D00 - 0.071\Delta@trend - 0.40ECM(-1)$$
$$(-1.81) \quad (-2.29)^{*} \quad (3.32)^{***} \quad (-7.40)^{*} \quad (-6.78)^{*}$$
$$+0.967LnNGDI + 0.453LnM + 0.77LnAID - 0.16LnCPI + 0.543D00 - 0.178@trend$$
$$(3.71)^{*} \quad (3.07)^{*} \quad (3.90)^{*} \quad (0.59) \quad (3.30)^{*} \quad (-4.70)^{*}$$

The nominal gross domestic income affects tax revenue positively and a one percent increase leads to a 0.386 percent increase in the tax revenue in the short run. On the other hand, when import increases by one percent the tax revenue increases by 0.18 percent. Foreign aid also has a positive impact on tax revenue and a one percent increase in foreign aid leads to 0.179 percent increase in tax revenue. This is because foreign aid can be used for modernizing tax collecting

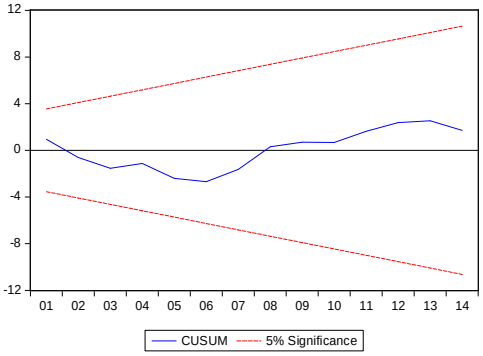
institutions and for the construction of different infrastructures that are again useful for expanding economic activities, which leads to an increase in tax base and tax revenue. Inflation has a significant negative effect on the tax revenue, in which a one unit increase in the inflation leads to 0.447 percent decrease in the tax revenue collected.

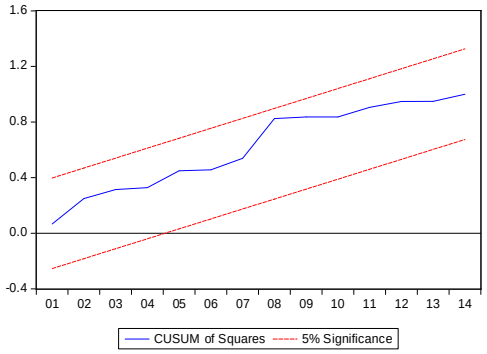
The dummy is included for the period after the year 2000 and it shows that tax revenue has increased within this period than the previous period. Within this period, the Ethiopian government has introduced new tax policy and tax administration reforms. The tax policy reform includes the introduction of new types of taxes like VAT (Value added tax) and the tax administration reform comes up with new institutional set up. In the institutional reform, Ethiopian Revenue and Customs Authority (ERCA) was formed back in 2009 by merging the Federal Inland Tax Authority (FITA) and Ethiopian Customs Authority (ECA) with the regulatory body of Ministry of Revenues (MoR) through the BPR[24] process. The positive effect of the dummy tells that these reforms have contributed positively for tax revenue. And again this period was where the Ethiopian economy has registered growth and it is not a surprise to get the positive result from the period dummy.

The one percent increase in nominal GDI, import and foreign aid leads to a 0.967, 0.453 and 0.77 percent increase in the tax revenue respectively in the long run. Inflation affects the tax revenue negatively also in the long run, but it is not significant. The parameter stability is checked using CUMSUM and CUMSUMSQUARE and the result is presented as follows.

[24] BPR stands for Business Process Reengineering which is an organizational reform undertaken by the Ethiopian government.

Figure 5.5: Parameter Stability test for Tax Revenue Function





5.2.3.2. Government Recurrent Expenditure

From the overall government expenditure, only the recurrent government expenditure is specified as a function of its determinants and the capital expenditure is left to be exogenous. The recurrent expenditure (GRE) is estimated as a function of tax revenue (TXR), foreign aid (AID) and the price level (CPI). A seasonal dummy is included in the analysis for the year 1999 which represents the war period between Ethiopia and Eritrea. The estimated government recurrent expenditure equation is presented as follows;

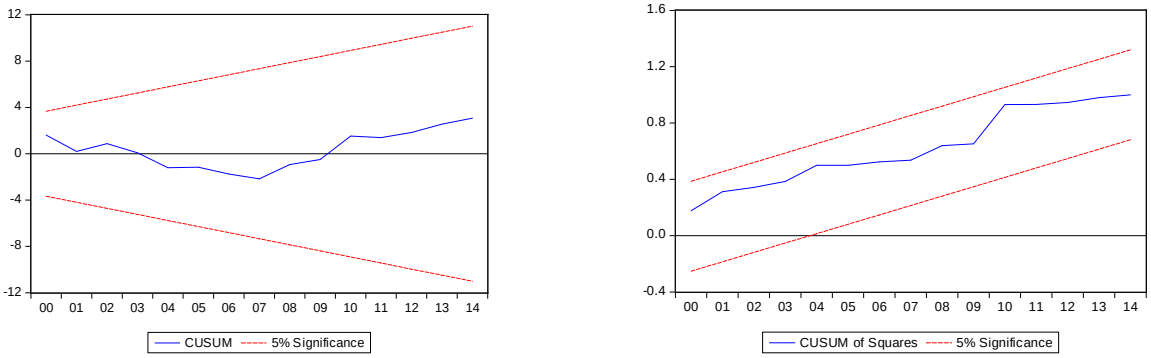
$$\Delta(LnGRE) = 5.296 + 0.316\Delta LnTXR - 0.143\Delta LnAID + 0.237\Delta LnCPI + 0.196\Delta LnGRE(-1)$$
$$(7.56)^{*} \quad (4.82)^{*} \quad (-1.99)^{***} \quad (1.34) \quad (1.40)$$
$$+0.174\Delta LnAID(-1) - 0.409\Delta LnCPI(-1) + 0.219\Delta D99 + 0.056@trend - 0.67ECM(-1)$$
$$(2.38)^{**} \quad (-2.27)^{**} \quad (2.16)^{**} \quad (2.89)^{*} \quad (-4.64)^{*}$$
$$+0.473LnTXR - 0.383LnAID + 0.298LnCPI + 0.328D99 + 0.084@trend$$
$$(4.82)^{*} \quad (-3.34)^{*} \quad (1.75)^{***} \quad (1.75)^{***} \quad (5.03)^{*}$$

From the above equation, the total tax revenue of the government affects the recurrent expenditure of the government positively and significantly. A one percent increase in tax revenue in the short run leads to 0.316 percent increase in the government recurrent expenditure. The

surprising result is that foreign aid affects recurrent expenditure negatively. This may show that foreign aid is being used for developmental expenditures and what the country pays for loans that are included in foreign aid are not as much relative to payments for both domestic and foreign borrowing. When foreign aid increases by one percent the government's recurrent expenditure decreases by 0.143 percent in the short run. When we look at the inflation, its increase leads to an increase in the recurrent expenditure of the government. A one percent increase in inflation rate leads to 0.237 percent increase in the recurrent expenditure. This can be explained easily since the government is one of the buyers in the market; then inflation will increase its expenditure. The dummy included for the year 1999, which was a period war between Ethiopia and Eritrea, has a positive effect in the short run. The error correction term has the correct negative sign and it shows that 66 percent of the disequilibrium adjusts to the equilibrium within a year.

In the long run, a one percent increase in tax revenue and the consumer price leads to a 0.47 and 0.29 increase in government's recurrent expenditure respectively. While, one percent increase in foreign aid leads to 0.38 percent decrease in the recurrent expenditure. The reason for the negative effect of foreign aid may be due to the nature of the foreign aid delivered to the country. Most of the foreign aid is project oriented and these projects are also included in the investment section not in the recurrent expenditure of the government balance sheet. The parameter stability is checked using the CUMSUM and CUMSUMSQUARE and the results are presented as follows.

Figure 5.6: Parameter test for Government Recurrent Expenditure Function



5.2.4. External Sector

5.2.4.1. Export Sector

The real export demand (RX) is specified as a function of the income of trading partners[25] (ROWGDP), the real effective exchange rate (REER)[26] and the investment to GDP (INVGDP) ratio. Since most of Ethiopia's exports are primary products from the agriculture sector, drought dummy is included to have the impact of drought in the export performance. The estimated export function is given as follows;

[25] The income of Ethiopia's trading partners is calculated as follows. I have taken the ten countries which have highest share in Ethiopia's exports destination and the average of their real GDP is taken as a proxy for the income of Ethiopia's trading partners. The list of the countries include: Saudi Arabia, Sudan, China, Belgium, Germany, Netherlands, Sweden, Switzerland, Turkey and United States of America.

[26] The Real effective exchange rate is used rather than the real exchange rate to have the competitiveness of Ethiopia's exports in the international market. On the other hand both can be used here and they do not have as much difference.

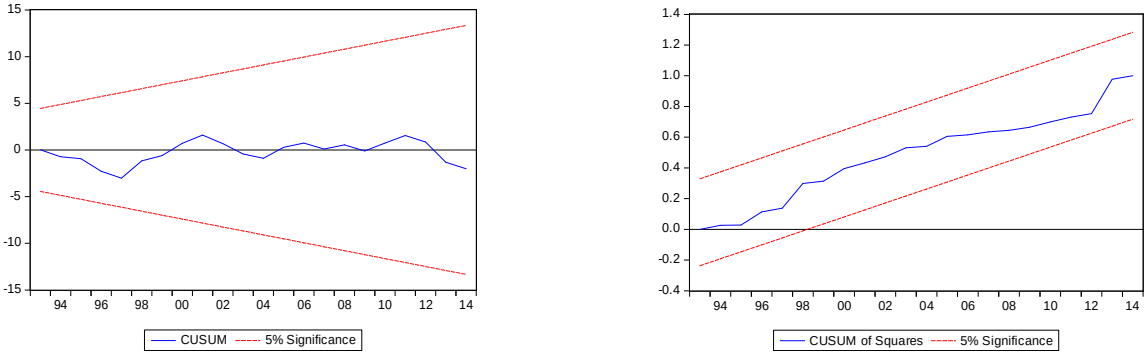
$$\Delta(\text{LnRX}) = -14.45 + 2.07\Delta\text{LnROWGDP} + 0.441\Delta\text{LnREER} + 0.414\Delta\text{LnINVGDP} - 0.37\Delta\text{DR}$$
$$(-1.70) \quad (7.67)^{*} \quad (2.31)^{**} \quad (2.32)^{**} \quad (-3.43)^{*}$$
$$+0.409\Delta\text{LnREER}(-1) - 0.052\Delta@\text{trend} - 0.29\,\text{ECM}(-1) + 1.89\text{LnROWGDP} - 0.28\text{LnREER}$$
$$(2.81)^{**} \quad (-3.63)^{*} \quad (-2.80)^{**} \quad (3.58)^{*} \quad (0.75)$$
$$+2.76LnINVGDP - 1.26DR - 0.18@trend$$
$$(3.08)^{*} \quad (-2.55)^{**} \quad (-2.16)^{*}$$

In the short run all the determinants of export have positive and significant effect. When the income of Ethiopia's trading partners increase by one percent the export demand increases by 2.07 percent. Whereas when the real effective exchange rate increases by one percent, export increases by 0.44 percent. The positive effect of the real effective exchange rate in the short run, tells that export increase could be tempted to increase by the increase in the real effective exchange rate. This is understandable since most of the country's exports are primary products. So, the increase in the real effective exchange rate will affect export performance only on the short run. This is due to that most of the exports are supply constrained and needs time to increase their supply. The investment to GDP ratio entered in the equation to capture the effect of capacity to produce and it shows that as investment to GDP ratio increases the export of the country also increases. In drought periods export will decrease compared to non drought periods, because most of the country's exports are primary products.

Looking in to the long run relationship of the real export and its determinants, only the real effective exchange rate have changed sign and it affects negatively and significantly. Since most of the country's exports are primary goods and they are supply constrained in nature, the increase in exchange rate could not trigger an increase in exports. Rather the devaluation/depreciation results in decrease of the export. The impact of the investment to GDP ratio becomes elastic in

the long run. This is because committing more resources for investment would increase exports and also these investments are a long run help to increase exports. The stability of the parameters is checked using the CUMSUM and CUMSUMSQUARE and the results are presented as follows.

Figure 5.7: Parameter Stability test for Real Export Function



5.2.4.2. Import Sector

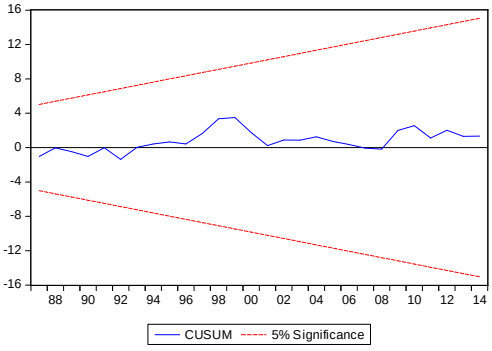
The import sector (M) is specified as a function of real GDP (RGDP), real effective exchange rate (REER) and remittance (REM). The real export of the country is not included individually in the model because it is the part of the real GDP. The real GDP of the country is used as a proxy for the national income of the country and it represents the demand for import. While the real effective exchange rate shows the impact of changes in the exchange rate i.e. depreciation and appreciation on import demand. The availability of exchange rate is the other major determinant of import in Ethiopia and its impact is captured through the remittance that the country gets from its citizens and workers with Ethiopian origin working abroad. The estimated import equation looks like;

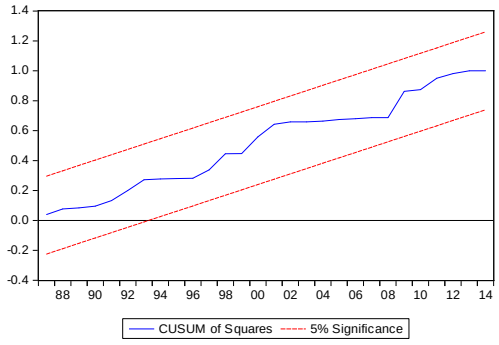
$$\Delta(\text{LnM}) = -5.76 + 0.86\Delta\text{LnRGDP} - 0.35\Delta\text{LnREER} + 0.16\Delta\text{LnREM} - 0.63\text{ECM}(-1) + 1.35\text{LnRGDP}$$
$$(-1.71) \quad (2.66)^{*} \quad (-3.18)^{*} \quad (3.14)^{*} \quad (-4.62)^{*} \quad (4.19)^{*}$$
$$-0.54LnREER + 0.25LnREM$$
$$(-4.90)^{*} \quad (2.89)^{*}$$

In the short run the determinants of import demand have the correct sign and they are significant. The real GDP of the country, which is used as a proxy for domestic income level, affects the import demand positively. This means that as income increases by one percent the import demand will increase by 0.86 percent. The real effective exchange rate depreciation, on the other hand, affects import demand negatively. This is because the depreciation of the domestic currency relative to the competing currencies makes import expensive. The inflow of remittance affects the import demand positively, and a one percent increase in the remittance leads to 0.16 percent increase in import demand in the short run.

From the long run equation, a one percent increase in the real GDP leads to 1.35 percent increase in the import demand. This is also cordial with economic theory because it is known that the increase in income leads to diversified demand of goods and services and increases imports. The real effective exchange rate affects the import demand negatively and significantly. A one percent increase in real effective exchange rate leads to 0.54 percent decrease in import demand in the long run. On the other hand, the increase in remittance inflow motivates import demand in the long run and a one percent increase leads to 0.25 percent increase in import. The stability of the import demand function is checked using CUMSUM and CUMSUMSQUARE and the graphs of these tests are presented as follows.

Figure 5.8: Stability Test for Real Import Function





5.2.5. Money Demand

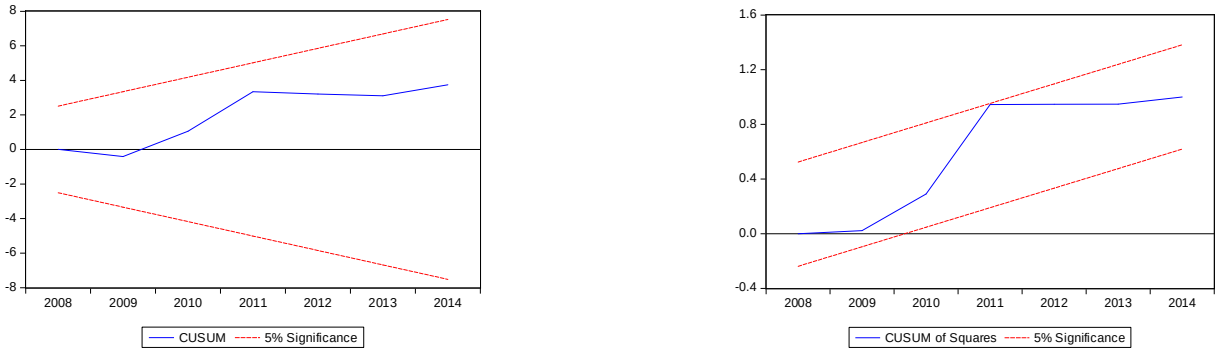
The real money demand (RM2) is estimated as a function of real GDP, consumer price based (CPI) and deposit interest rate (DIR). The real GDP is used as a proxy for the national income level and it has a significant positive impact in both short run and long run. The consumer price index, on the other hand, has a negative and significant effect both in the short run and long run. While the deposit interest rate has the expected negative sign, but it is not significant both in the short run and long run. The estimated money demand equation is presented as follows;

$$\Delta(\text{LnRM2}) = -0.50 + 0.291\Delta\text{LnRGDP} - 0.645\Delta\text{LnCPI} - 0.019\Delta\text{LnDIR} - 0.063\Delta\text{D811}$$
$$(-0.45) \quad (4.02)^{*} \quad (-7.85)^{*} \quad (-0.77) \quad (-2.19)^{**}$$
$$0.033\Delta@\text{trend} - 0.50ECM(-1) + 0.582LnRGDP - 0.388LnCPI - 0.039LnDIR - 0.127D811$$
$$(3.10)^{*} \quad (-3.75)^{*} \quad (5.61)^{*} \quad (-3.77)^{*} \quad (-0.76) \quad (-2.77)^{*}$$
$$+0.067@trend$$
$$(10.76)^{*}$$

As the real GDP, which is a proxy for national income, increases by one percent the money demand increases by 0.291 percent in the short run. And in the long run one percent increase in real GDP leads to 0.582 percent increase in the real money demand. One percent increases in

consumer price index decreases the money demand by 0.645 percent in the short run. This is because in inflationary period people demand more of fixed assets rather than money like houses and cars in our country case. In Ethiopia up to now there are no alternative financial assets so people can change their holding in to tangible assets when there is inflation. The dummy included for the period between the years 2008-2011 is a seasonal dummy and it shows that relative to other periods there is a decrease in money demand in this period. The stability of the model is checked using the CUMSUM and CUMSUMSQUARE statistics and the graphs are presented below.

Figure 5.9: Stability Test for Real Money Demand Function



5.2.6. Determination of Prices

5.2.6.1. Consumer Price

The consumer price (CPI) is estimated as a function of real capacity utilization rate (CURR), money supply (M2), lending interest rate (LIR) and the real effective exchange rate (REER). All the determinants included affect the consumer price positively and significantly both in the short run and in the long run. In the short run, a one percent increase in capacity utilization rate leads to 0.099 percent increase in the consumer price index. While a one percent increase in the money supply leads to 0.258 percent increase in the consumer price index. Whereas, the one percent increase in lending interest rate and real effective exchange rate leads to 0.19 and 0.393 percent increase in consumer price respectively. The estimated consumer price function looks as follows;

$$\Delta(\text{LnCPI}) = \underset{(-10.10)^{*}}{-5.09} + \underset{(4.25)^{*}}{0.099}\Delta\text{LnCURR} + \underset{(3.72)^{*}}{0.258}\Delta\text{LnM2} + \underset{(4.55)^{*}}{0.19}\Delta\text{LnLIR} + \underset{(7.36)^{*}}{0.393}\Delta\text{LnREER} -$$

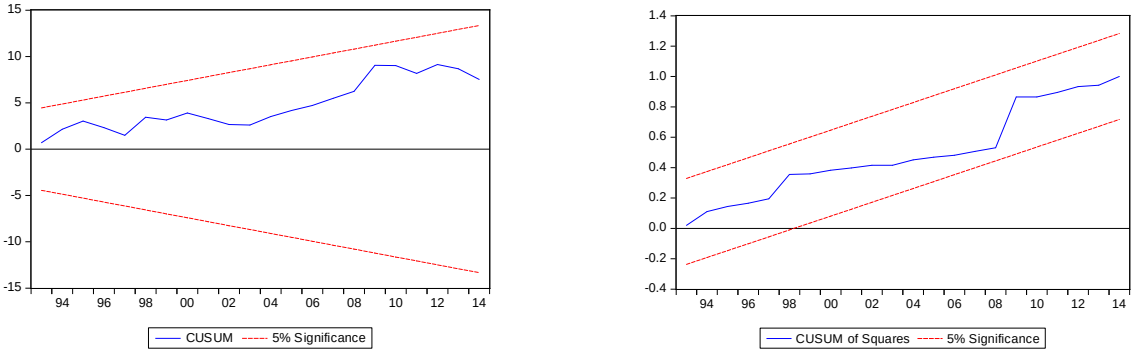
$$\underset{(-1.60)}{0.085}\Delta\text{LnREER}(-1) + \underset{(2.45)^{**}}{0.094}\Delta\text{DEPRDF} - \underset{(-3.74)^{*}}{0.43}\text{ECM}(-1) + \underset{(2.58)^{**}}{0.23}\text{LnCURR} + \underset{(27.2)^{*}}{0.596}\text{LnM2} + \underset{(2.57)^{**}}{0.194}\text{LnLIR}$$

$$+\underset{(4.21)^{*}}{0.406}LnREER + \underset{(1.83)^{***}}{0.21}DEPRDF$$

The real capacity utilization rate affects the consumer price positively and significantly in the long run. A one percent increase in the capacity utilization rate leads to 0.23 percent increase in the consumer price. The increase in capacity utilization leads to use resources efficiently and this again may lead to competition among sectors for resources. The competition for resources will increase cost of production, and this may lead to an increase in the consumer price. Money supply has also a significant positive effect on the consumer price and it is significant at one percent significance level in the long run.

One percent increase in the money supply leads to 0.59 percent increase in the consumer price. This finding is similar to Alemayehu and Kibrom (2013), in which they find that the increase in money supply strongly explains the inflationary problems in the country mostly the inflationary pressure that happened between the years 2005 and 2009. The increase in the lending interest rate also affects the consumer price positively and significantly. One percent increase in the lending interest rate leads to 1.49 percent increase in the consumer price in the long run. The increase in lending interest rate is associated with production cost and as it increases, the production cost will increase and again this leads to the increase in the consumer price. The real effective exchange rate also affects the consumer price positively and significantly. The depreciation of Ethiopian Birr makes import expensive and this again makes the consumer price to increase. So in Ethiopia the increase in the price of imported goods also contributes to the increase in the consumer price. The dummy variable is included for regime shift and it shows that the consumer price increases for the EPRDF period than the previous period and it is significant at 10% level of significance. The stability of the model is checked using the CUMSUM and CUMSUMSQUARE statistics and the results are presented as follows;

Figure 5.10: Stability Test for Consumer Price Function



5.2.6.2. Export Price

The export price (XP) is estimated as a function import price (MP), real capacity utilization rate (CURR) and the lending interest rate (LIR). The import price affects the export price positively and significantly both in the short run and long run. While capacity utilization rate and the lending interest rate affects the export price negatively in the short run. The estimated export price equation is given as follows;

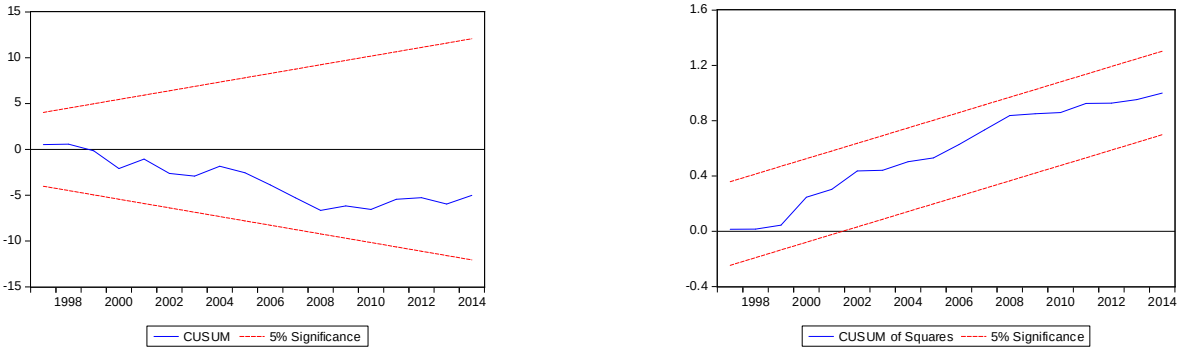
$$\Delta(LnXP) = 0.336 + 1.49\Delta LnMP - 0.421\Delta LnCURR - 0.041\Delta LnLIR - 0.70\Delta LnMP(-1)$$
$$(2.17)^{**} \quad (5.02)^{*} \quad (-2.81)^{*} \quad (-0.56) \quad (-2.25)^{*}$$
$$-0.11\Delta LnLIR(-1) - 0.022\Delta@trend - 0.84\ ECM(-1) + 2.617LnMP - 0.5LnCURR + 0.121LnLIR$$
$$(-1.57) \quad (-3.77)^{*} \quad (-4.65)^{*} \quad (6.58)^{*} \quad (-2.70)^{*} \quad (2.04)^{***}$$
$$-0.026@trend$$
$$(-3.78)^{*}$$

From the short run equation the export price is positively affected by the import price, meaning that one percent increase in the import price leads to1.49 percent increase in the export price. Whereas a one percent increase in the real capacity utilization rate leads to a 0.421 percent decrease in the export price. The coefficient of the lending interest rate is negative, but it is not statistically significant. The adjustment term has the correct sign, which is negative and it shows that 84 percent of the disequilibrium adjusts towards equilibrium within a year.

In the long run again the import price affects the export price positively and significantly in which a one percent increase in the import price leads to 2.62 percent increase in the export price. This may be explained as in the long run, Ethiopia could export more manufactured goods

which use imported raw materials and the increase in the import price may leads to an increase in the export price. The lending interest rate affects the export price positively in the long run and it is significant only at ten percent level of significance. Since the lending interest rate is one of the cost components of exporters, its increase leads to an increase in the cost of production and as a result in the export price. The stability of the model is checked using the CUMSUM and CUMSUMSQUERE and the result is presented as follows.

Figure 5.11: Parameter Stability Test for Export Price



5.2.6.3. Investment Price

The investment price (INVP) is specified as a function of capacity utilization rate (CURR), import price (MP), lending interest rate (LIR) and per unit cost of output (PUC). For the investment price, GDP deflator is used as its proxy. Based on economic theory, import price, lending interest rate and per unit cost of output are expected to have a positive relationship with the investment price. Meaning that when these variables increase, the investment price also increases and when these variables decreases the investment price will decrease.

While the impact of capacity utilization rate on investment price is not known a priori. If the capacity utilization rate increases, the economy will became capable of using its idle resources (if there are any) and investment price may decline. If there are no idle resources, the increase in

capacity utilization rate leads to competition in resources and may result in higher investment price. The estimated investment price equation is presented as follows:

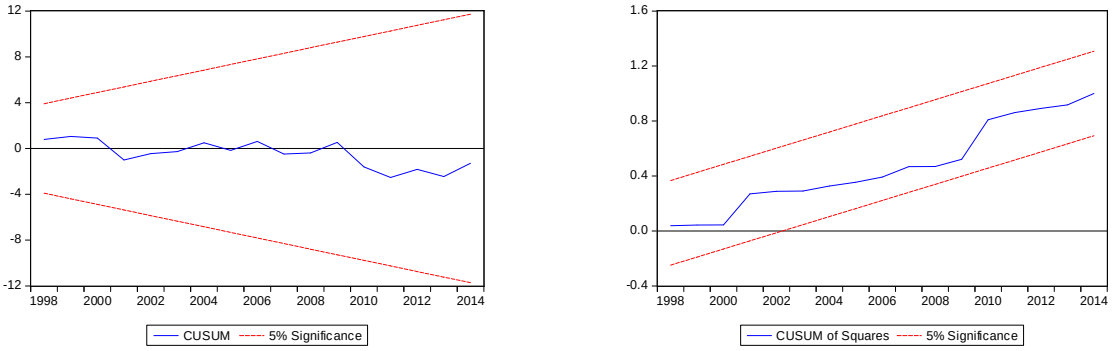
$$\Delta(LnINVP) = -4.373 - 0.362\Delta LnCURR + 0.148\Delta LnMP + 0.204\Delta LnLIR - 0.527\Delta LnPUC$$
$$(-17.30)^{*} \quad (-2.77)^{**} \quad (0.89) \quad (4.07)^{*} \quad (-4.19)^{*}$$
$$-0.363\Delta LnCURR(-1) - 0.36\Delta LnMP(-1) + 0.064\Delta LnLIR(-1) + 0.139\Delta LnPUC(-1)$$
$$(-2.28)^{**} \quad (-1.67) \quad (1.66) \quad (1.17)$$
$$-0.149\Delta DEPRDF + 0.06\Delta@trend - 0.89ECM(-1) - 0.179LnCURR + 0.963LnMP + 0.146LnLIR$$
$$(-2.11) \quad (8.97)^{*} \quad (-4.68)^{*} \quad (-1.31) \quad (3.08)^{*} \quad (2.32)^{**}$$
$$-0.469LnPUC - 0.167DEPRDF + 0.067@trend$$
$$(-3.90)^{*} \quad (-2.39)^{**} \quad (8.97)^{*}$$

From the above estimated equation, the capacity utilization rate affects the investment price negatively and significantly. This result supports the argument that the capacity utilization rate is low in Ethiopia and the increase in capacity utilization rate helps to use the resources of the economy more efficiently and this contributes in lowering the investment price. The increase in import price leads to an increase in investment price, similar to the increase in lending interest rate. A one percent increase in lending interest rate leads to 0.204 percent increase in the investment price in the short run and it is significant.

The other surprising result is the negative impact of the increase in per unit cost of output on the investment price and it is also significant at one percent level of significance. The dummy included is for the period after 1991 and it shows that the investment price is lower than the previous period. This can be explained by the market situation that is created after the regime change and the infrastructural development that also contributes to the decrease in investment price in this particular period.

From the above estimated equation, the error correction term has the correct negative sign and it shows that out of the total disequilibrium 89 percent will adjusts towards the equilibrium within a year. According to the long run estimated equation the import price and the lending interest rate affects investment price positively and significantly. When import price increases by one percent, investment price increases by 0.96 percent and it is significant at five percent level of significance. On the other hand, when lending interest rate increases by one percent, the investment price increases by 0.146 percent. The capacity utilization rate also has a similar effect with the short run and affects the investment price negatively, even though it is not significant. The stability of the parameters in the estimated model is tested using the CUMSUM and CUMSUMSQUARE tests and it is presented as follows.

Figure 5.12: Parameter Stability Test for Investment Price



At the end of this chapter, we have to present the diagnostic tests of the estimated behavioral equations.[27] These diagnostic tests includes the selected ARDL model, normality test (Jarque-Berra), Serial Correlation test (LM), Heteroskedasticity (BPG) and Ramsay test. In addition to this, the Durbin-Watson and standard error of the general model are also presented in the next table.

[27] The results of the diagnostic tests from Eviews software are presented in the appendix

Table 5.1:- Diagnostic Tests of the Estimated Behavioral Equations

Equation	ARDL	Normality (JB)	LM Serial Correlation	Hetroskedasticity Test (BPG)	Ramsey Test	S.E.	DW
Agricultural Production function	(2,0,2,0)	4.03 (0.13)	1.75 (0.41)	8.293 (0.60)	0.83 (0.37)	0.05	2.10
Formal Sector Function	(2,2,2,2)	1.75 (0.41)	5.16 (0.07)	17.404 (0.18)	0.39 (0.54)	0.03	2.50
Private Consumption	(1,1,2)	4.85 (0.08)	2.04 (0.36)	3.19 (0.92)	0.48 (0.49)	0.04	2.28
Private Investment	(1,0,0,2)	0.74 (0.68)	2.73 (0.25)	15.89 (0.05)	2.25 (0.14)	0.21	1.71
Tax Revenue	(1,0,0,2,2)	1.52 (0.46)	1.107 (0.29)	15.69 (0.15)	0.01 (0.90)	0.05	2.26
Gov. Recurrent Expenditure	(2,0,2,2)	1.38 (0.50)	5.56 (0.06)	15.92 (0.14)	0.78 (0.38)	0.08	2.45
Export	(1,1,2,1)	2.12 (0.35)	3.706 (0.15)	5.44 (0.85)	3.01 (0.09)	0.10	1.78
Import	(1,0,0,0)	1.98 (0.36)	0.58 (0.74)	4.6 (0.32)	2.19 (0.15)	0.12	2.12
Money Demand	(1,0,1,0)	0.72 (0.69)	5.39 (0.06)	10.89 (0.14)	0.76 (0.38)	0.04	2.04
Consumer Price	(1,0,0,1,2)	0.54 (0.76)	3.358 (0.18)	9.028 (0.43)	0.017 (0.89)	0.04	2.06
Export Price	(1,2,0,2)	1.06 (0.59)	5.73 (0.056)	0.92 (0.33)	1.17 (0.29)	0.07	2.04
Investment Price	(1,2,2,2,2)	0.84 (0.65)	5.74 (0.056)	7.27 (0.94)	0.15 (0.70)	0.036	2.04

Note (P-values are in bracket)

CHAPTER SIX

MODEL EVALUATION AND COUNTERFACTUAL SIMULATION

6.1. Introduction

The previous chapter has presented the estimated individual equations of the macro econometric model. In this chapter, the model performance as a full system and the results of selected simulation experiments are presented.

After the individual behavioral equations are estimated the next step is to examine how the model fits with historical data. This is because the fit of the individual behavioral equations does not guarantee the good fit of the full model in our disposal. Giving stress to this point Challen and Hagger (1983:164) have said:

> "It is possible that every stochastic equation of the system performs adequately on the basis of the individual equation evaluation procedures but that the system as a whole gives a poor representation of the real economy in which the historical time paths of the endogenous variables were generated."

Thus in this chapter first how the model performs with tracking historical data is presented and it follows by the simulation experiments using the developed model.

6.2. Performance of the Model

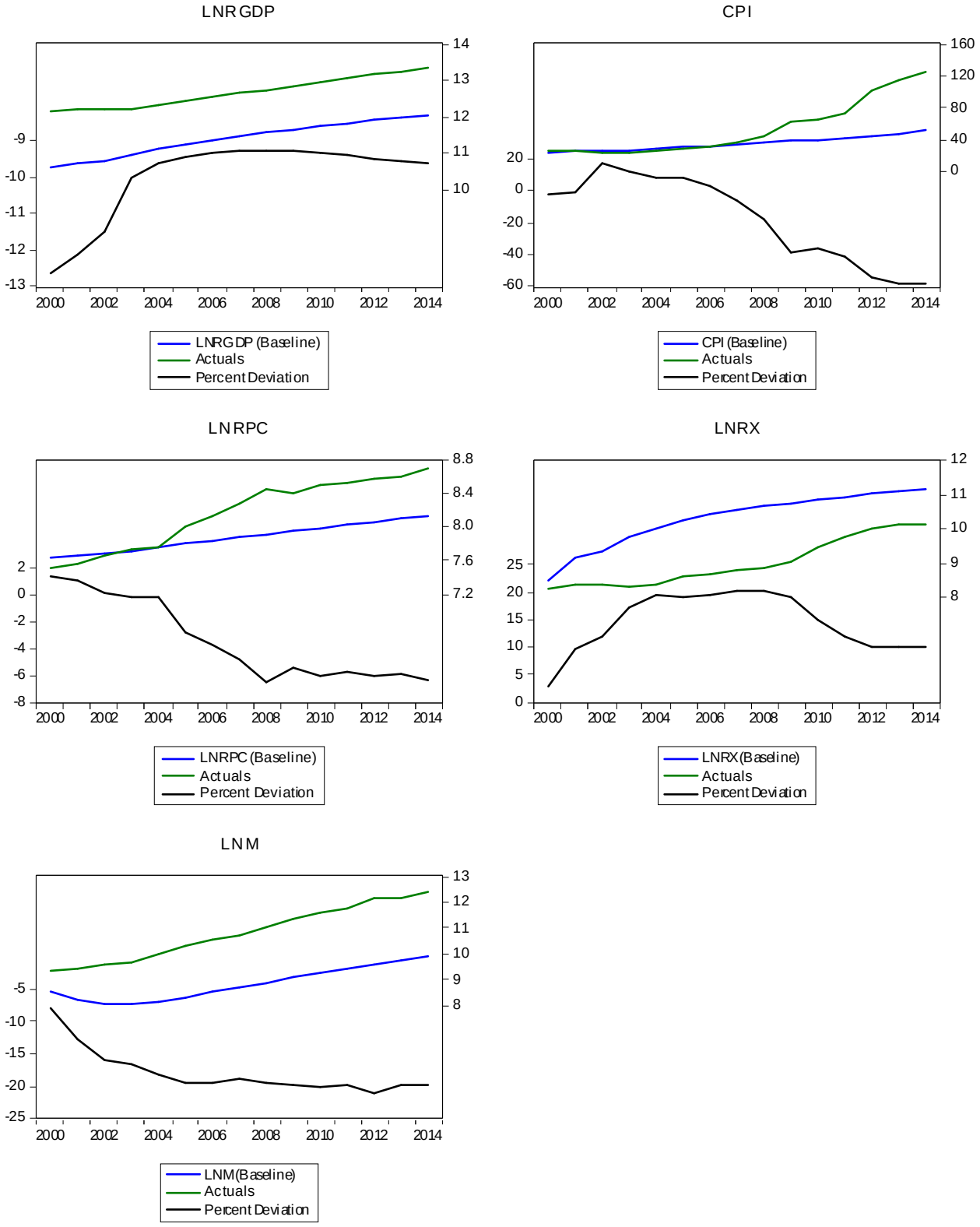
The examination of the performance of the model in tracking historical data is done using with-in-sample tracking performance of the model. Before using the model for a policy simulation, it is a must to check its stability and its performance in reproducing historical values. The model

has worked well in this aspect and it is found to be stable. This is tested by dynamically solving the model for the sample period between the year 2000 and 2014. Throughout this sample period, the model's ability to reproduce historical values is analyzed by comparing the actual values and the baseline values of some selected variables. To check the in-sample performance of the model, the following variables are chosen. These are: $LnRGDP, LnRPC, LnRX, LnM$ and CPI. Graphs that show the ability of the model in tracking the historical values and the deviations between the baseline values and the actual are presented in Figure 6.1.

The selected macroeconomic variables are the natural logarithm of real GDP, the natural logarithm of Real Private Consumption, the natural logarithm of the Real export, the natural logarithm of Real Import and the Consumer Price Index. In the graphs below highest deviation of the baseline from the actual values is observed in the consumer price index graph, while the lowest deviation is observed in the natural logarithm of the Real Private consumption[28]. Even though there is a difference in success of tracking the historical values of different variables, when we look the model as a whole it has performed well. This will be the base to use the model to simulate the impact of different policy interventions on different macroeconomic variables, because it shows only the dynamics within the model. Meaning that there is no policy applied in this case. Therefore, since the model has performed enough in-sample-tracking we can use it for policy analysis purposes and the results will be discussed in the second section of this chapter.

[28] The percentage deviation and the two values for the baseline results and the actual results for the above selected macro variables are presented in the appendix section, Appendix 4A.

Figure 6.1: Base Run and Forecast Values of Major Macroeconomic Variables



6.3. Simulation Experiments Using the Model

After checking the model works well in tracking the historical values of the endogenous variables in the model, the next step is using the model to experiment different policy tools and to watch their impact on the macro economy and its stability. In this part of the paper we present the result of two different policy scenarios. The first being a policy tool that is expected to be implemented by the government in the GTP-II period and the second one being an external shock from the global economy that could hit the domestic economy in this plan period.

The impact of these policies is analyzed by looking to the percentage deviation between the values of the endogenous variables without these policies (Baseline) and the values when the policies are present (scenarios). We have used here a graphical representation of the impact of the policies and the percentage deviations of the policies from the baseline scenarios are presented in table format at the appendix section.

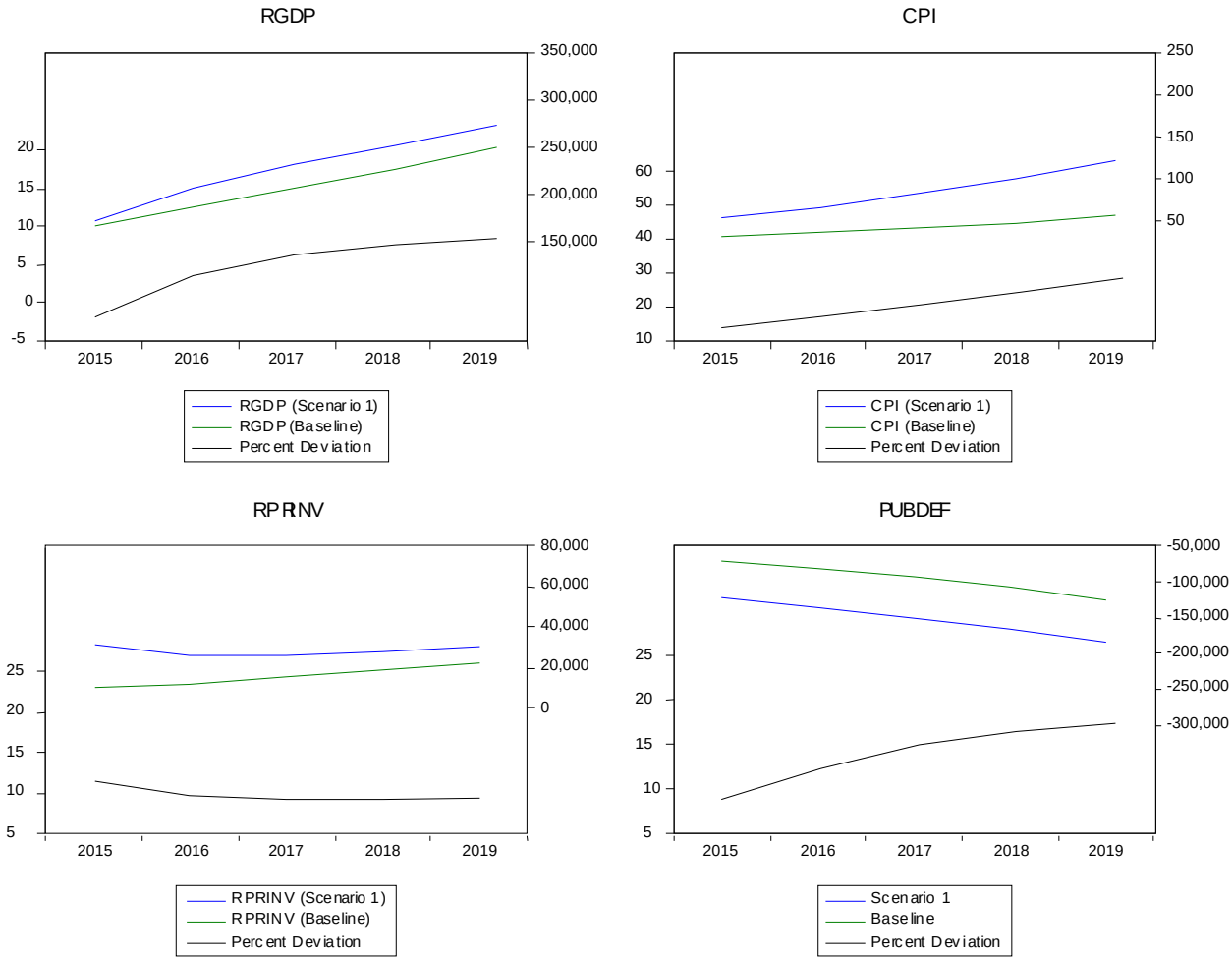
6.3.1. Increase in Government Investment By 10%

In the GTP II, there are different plans that initiate an increase in the public sector investment. Among the pillars of the GTP II; bridging critical infrastructure gaps, accelerate human development, increasing the productive capacity and efficiency of the economy all motivates an increase in public sector investment. Again in the GTP II, the construction of railway projects and different power and irrigation dams is being underway. Most of these projects are launched in the GTP I. The other projects that increase public investment are the construction of different industrial parks that is underway in the country at different industrial sites. These all together highly increase the public investment and this is not a surprise, since the government claims to be developmental state. The private sector in the country is also not developed and it is not able

to have a huge share on these plans. But this does not to mean that it does not contribute any. Observing this case in the GTP II, here the impact of an increase in the public investment by 10% (the percentage is arbitrarily selected) on selected macroeconomic variables is analyzed.

The impact of the 10% increase in the real pubic investment on other variables is analyzed here by using $RGDP, CPI, RPRINV$ and $PUBDEF$ as sample indicators and its impact on other variables is presented in the appendix section.

Figure 6.2: The Effect of the Proposed 10% increase in Public Investment (Deviation from Base run, in %)



The increase in the public investment has an increasing impact in the consumer price (CPI), Real GDP, Real Private Investment and the Public deficit. Since public investment is one part of investment, its increase has led to an increase in the real output i.e. RGDP of the country. In the first year of the scenario, the RGDP has increased by 0.3 percent from the base run. While for the next four years of the plan it has showed on average a 7.55 percent increase from the base run. The policy shock has also a significant increasing impact on the consumer price, which shows it results in an inflationary pressure.

In the first year of the GTP II, the consumer price has increased by 15.6 percent from the base line run. This shows that the increase in the public investment will have an inflationary impact. So, increasing the public investment by 10 percent will create macro economic instability, which is represented by the inflationary pressure. The average impact of the policy on inflation is that, it increases by 19.4 percent throughout the GTP II plan period. The inflationary pressure will have its own impact on other variables and policy makers should take care off to minimize it.

When we come to the impact of the policy on the real private investment, it shows that there is an increase from the base line because of the policy intervention. Even though the relationship between the two variables is negative in the estimated equation, the simulation shows that there is an increase in the private investment, on average. This can be explained as follows: if the increase in the public investment is linked with the private investment through backward and forward linkage, it can increase the private investment. But the increase will not be as much as the public investment. The real private investment has shown an increase of 3.04 percent over the course of the plan period, on average. This is below the 10 percent increase in the public investment.

The last but not the least indicator selected was the public deficit variable. The increase in the public investment increases the total expenditure of the government; therefore it directly affects the public deficit. To increase the public investment, the government has to increase its revenue or it have to borrow. The public deficit shows that it has increased in the policy period, registering an average of 10.86 percent deviation from the base line run throughout the GTP II plan period. The increase in public investment has led to the deterioration of the fiscal balance of the government. This deterioration, on the other hand, will have an impact on the macroeconomic environment and macroeconomic stability. From this we can infer that the government has to be cautious how to finance its deficit, not to create a macroeconomic instability.

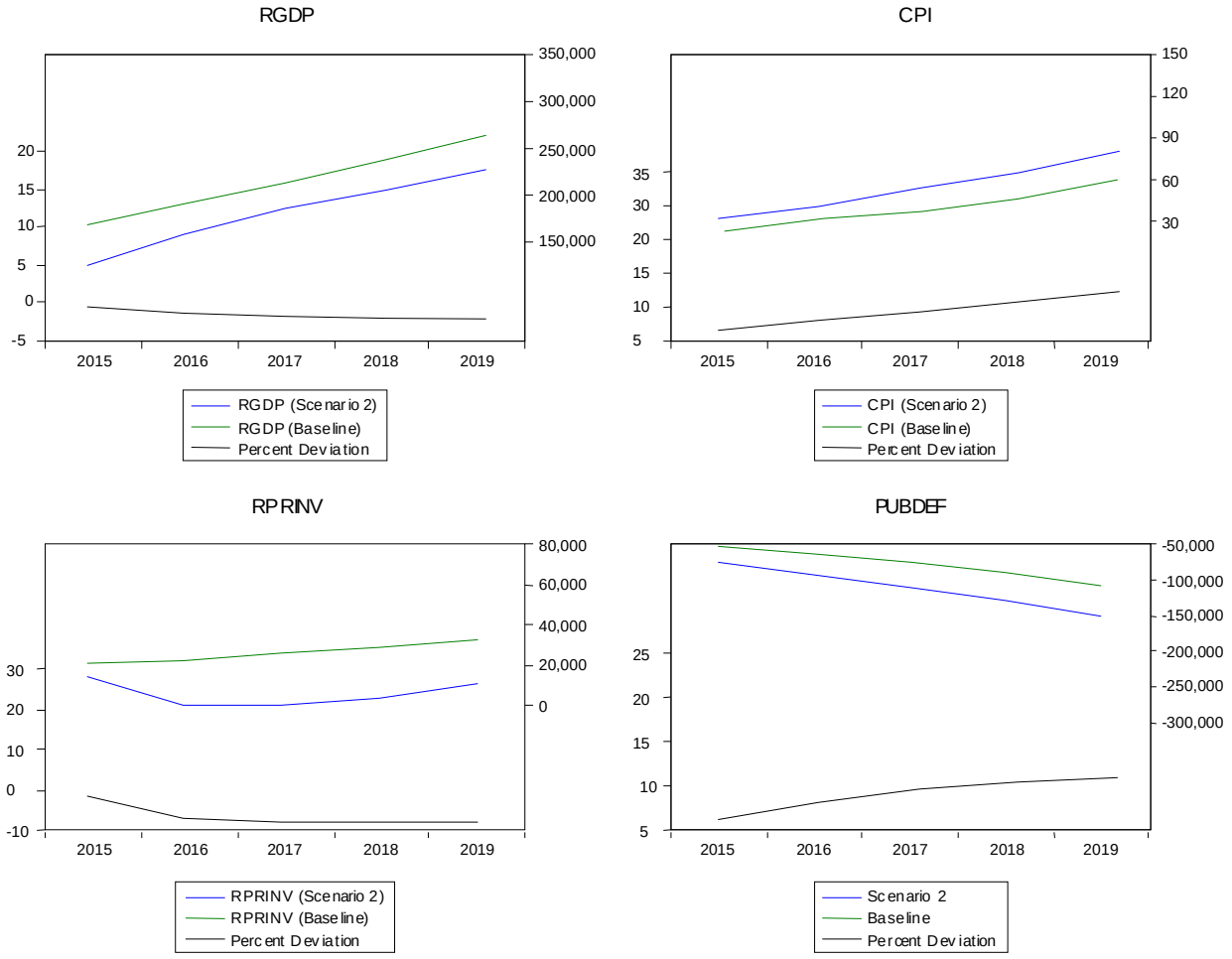
6.3.2. Increase in Import Price By 10%

For analyzing the impact of global macroeconomic shock using the model, a simulation of an increase in the import price by 10% is considered. When the import price increases, while the export price is unchanged, the move deteriorates the terms of trade of that particular economy. In the supply side of the economy, the increase in import price will have an impact on the industries that use imported raw materials. While from the demand side the increase in import price affects the amount of imports and exports, and then clearly will affect the trade balance.

The increase in import price by 10% is again analyzed by selecting sample variables. These variables include $RGDP, CPI, RPRINV$ and $PUBDEF$; where they are real GDP, Consumer Price Index, Real Private Investment and public deficit respectively. The increase in import price does not necessarily decrease imports; rather it depends on the types of import. In our case most of the country's imports are expected to be capital goods like machineries and technological goods. So

this has an implication that the increase in imports may increase the amount paid to imports and deteriorates the trade balance which is under critical condition at present for the Ethiopian economy.

Figure 6.3: The Effect of the Proposed 10% increase in Import Price (Deviation from Base run, in %)



The increase in import price by 10% has led the real GDP of the country to decrease in the GTP-II period and it shows on average 1.52 percent of deviation downwards from the base run. The increase in import price increases the import expenditure and since import is a deduction from the gross domestic product calculation, the decrease in RGDP is expected. This finding is

congruent with Tewodros (2011), who made an import price shock with similar magnitude. Since the modeling process is different, here the deviation on average is higher than that was in his.

The increase in the import price has a direct impact in the domestic price as it depicted in the consumer price index graph. The 10 percent increase in the import price has resulted in 11.6 percent increase on average in the inflation and also the export price has increased by 6.7 percent at the same period, on average. On the other hand, the investment price has increased on average by 11 percent. This is not a surprise since investments in the country demands huge import of machineries and raw materials, which increase the cost and the price of investment. The increase in the consumer price, investment price and export price shows that the economy is vulnerable to external shocks, most importantly from the increase in import price. And the increase in the domestic prices will create uncertainty and affects the macroeconomic stability. The policy shock also increases the public deficit on average over the plan period by 6.7 percent from the baseline. The increase in the import price increases the government expenditure, since the public sector is the highest importer in the country. And this again worsens the public deficit in the plan period.

When we compare the two simulation exercises, we can conclude the following things. The first is that both have an impact on major macroeconomic variables. The two shocks directly or indirectly touches all macroeconomic variables. The real GDP has showed an increase in the case of the increase in public investment, while it decreases because of the increase in import price. On the other hand, on both shocks inflation has increased from the base run. But the increase from the policy shock on the public investment is higher. The second concept we infer from the above simulation is the impact on the public deficit. Both simulations have resulted in

an increase on the public deficit. The increase in public deficit from the first simulation, the increase in public investment by 10 percent, is higher. The increase in public deficit will have an implication on the stability of the economy and the government has to be curious.

CHAPTER SEVEN

CONCLUSION AND POLICY RECOMMENDATIONS

7.1. Conclusion

This study has attempted to build a macro-econometric model for Ethiopian economy and to use it for policy analysis of the GTP II plan. The macro-econometric model is developed in Aggregate supply and Aggregate Demand framework. To estimate the behavioral equations of the model, ARDL (Autoregressive distributed lag) model is used. The ARDL model is estimated using the Eviews software version 9, which has a special plat form for estimating ARDL. The model has a total 65 equations out of which 12 are estimated equations and the rest are identity and bridging equations.

The results from the estimated equations can be concluded as follows. The agricultural value added positively affected by the capital stick, labor force and the rain fall. Similarly the formal sector value added is positively affected by the capital stock, the labor force and the intermediate imports used in the sector. The two add up to give the total value added in the economy. When we come to the demand side, the real gross domestic income affects real private consumption positively. While the deposit interest rate affects the real private consumption negatively.

The real private investment is estimated as a function of the real GDP, real public investment and the consumer price index. The increase in the real GDP affects the real private investment positively, while the public investment crowds out private investment. Surprisingly the attractiveness effect of the increase in inflation is higher than the instability problem it creates for the private investment. From the government sector the tax revenue and the recurrent expenditure are estimated. Tax revenue is positively affected by the nominal gross domestic

income, imports and foreign aid, while inflation affects tax revenue negatively. On the other hand, tax revenue positively affects the recurrent expenditure of the government. Inflation also affects the recurrent expenditure positively. Foreign aid affects the recurrent expenditure negatively and this may be explained by the project based nature of foreign aid. In addition to this most of the foreign aid is used for developmental projects.

In the external sector, export is estimated as a function income of the rest of the world, real effective exchange rate and investment to GDP ratio. Investment to GDP ratio and the income of trading partners affect the export of the county positively, while the appreciation in the real effective exchange rate affects negatively. The import demand of the country, on the other hand, is positively affected by the increase in the domestic income and the flow of remittance from abroad. While the appreciation of the real effective exchange rate makes imports expensive and negatively affects its demand. The broad money demand is positively affected by the increase in domestic income, while the deposit interest rate and inflation affects negatively.

Within the determination of prices in the model three prices i.e., consumer price, export price and investment price are estimated as a function of their respective determinants. Real effective exchange rate, lending interest rate, money supply and the capacity utilization rate all affect the consumer price positively. On the other hand, import price and lending interest rate positively affects investment and export prices.

The models' ability to track historical data is checked by solving the model using dynamic solutions for the sample period 2000-2014 and it has worked well in tracing historical values. After its ability to trace historical values is checked the model is used for policy simulation purpose. In this paper two policy shocks are applied. These are; a 10% increase in real public

investment and a 10% increase in import price. Based on this two policy experiments the following recommendations are given.

7.2 Policy Recommendations

Based on the two policy experiments that are applied in the developed macro-econometric model for the economy, we can infer the following recommendations.

- The increase in the real public investment expands the output of the country and also increases the private investment by a lesser magnitude than the shock, but resulted in inflationary pressure in the economy. This has an implication of macroeconomic instability. To avoid or minimize the instability that face the economy, the government has to be cautious in its investment expansion and must concentrate on sectors that are difficult for the private sector. To get more reward for the economy from its investment, the government must try to link its investments with private investors.
- The increase in import price has a significant negative effect in the economy, which shows a sign of macroeconomic instability. The policy implication from this is that to minimize the dependence on imports, the country has to work hard to produce goods which have high demand domestically. This includes giving incentives for investors, who produce substitutes for imports domestically.

Generally, macro-econometric modeling and using a macro-econometric model for policy analysis is not done at a point. It is a continuous process through time and it needs to update the model through time to make it up-to-date. The highest problem of building macro-econometric models in developing countries like Ethiopia is lack of data and consistency problem of the data.

Therefore, the government bodies that have the resources must have to participate in building models that represent the workings of the economy.

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Appendices

Appendix 1: List of Variable Used in the Estimated Model and Definitions

Name	Label
AID	Net Official Development Assistance and Official Aid Received
LnAID	The Natural logarithm of AID
LFAG	Labor Force for Agricultural Sector
LnLFAG	Labor Force for Agricultural Sector
DR	Drought Dummy; 1984, 1992 and 2002=1 and 0 otherwise
DW	War Dummy; 1976, 1977, 1988, 1989, 1990, 1991, 1997 and 1998=1 and 0 otherwise
RAGCS	Real Agricultural Capital Stock
LnRAGCS	The Natural logarithm of Real Agricultural Capital Stock
RAGVA	Real Agricultural Value Added
LnRAGVA	The Natural logarithm of Real Agricultural Value Added
RF	Rainfall
LnRF	The Natural logarithm of Rainfall
D00	Period Dummy for the period after 2000=1, 0 otherwise
LFFS	Formal Sector Labor Force
LnLFFS	The Natural logarithm of Formal Sector Labor Force
RCSFS	Real Capital Stock for Formal Sector
LnRCSFS	The Natural logarithm of Real Capital Stock Formal Sector
Z	Intermediate Imports
LnZ	The Natural logarithm of Intermediate Imports
RFSVA	Real Formal Sector Value Added
LnRFSVA	The Natural logarithm of Real Formal Sector Value Added
DEPRDF	Dummy for EPRDF period, for the period after 1991=1, 0 otherwise
DIR	Deposit Interest Rate
LnDIR	The Natural logarithm of Deposit Interest Rate
RGDI	Real Gross Domestic Income
LnRGDI	The Natural logarithm of Real Gross Domestic Income
RPC	Real Private Consumption
LnRPC	The Natural logarithm of Real Private Consumption
D85	Period Dummy for the period after 2000, 2000-2014=1, 0 otherwise
M	Imports
LnM	The Natural logarithm of Imports
NGDI	Nominal Gross Domestic Income
LnNGDI	The Natural logarithm of Nominal Gross Domestic Income
TXR	Tax Revenue
LnTXR	The Natural logarithm of Tax Revenue
D99	Dummy for the year 1999, 1999=1, 0 otherwise
GRE	Government Recurrent Expenditure

LnGRE	The Natural logarithm of Government Recurrent Expenditure
INVGDP	Investment to GDP Ratio
LnINVGDP	The Natural logarithm of Investment to GDP Ratio
ROWGDP	GDP of the Rest of the World
LnROWGDP	The Natural logarithm of GDP of the Rest of the World
RX	Real Export
LnRX	The Natural logarithm of Real Export
REER	Real Effective Exchange Rate
LnREER	The Natural logarithm of Real Effective Exchange Rate
REM	Remittance
LnREM	The Natural logarithm of Remittance
CURR	Real Capacity Utilization Rate
LnCURR	The Natural logarithm of Real Capacity Utilization Rate
LIR	Lending Interest Rate
LnLIR	The Natural logarithm of Lending Interest Rate
M2	Broad Money Supply
LnM2	The Natural logarithm of Broad Money Supply
D811	Dummy for the Period between 2008 and 2011, 2008-2011=1 and 0 otherwise
RM2	Real Money Demand
LnRM2	The Natural logarithm of Real Money Demand
INVP	Investment Price
LnINVP	The Natural logarithm of Investment Price
MP	Import Price
LnMP	The Natural logarithm of Import Price
PUC	Per Unit Cost of Output
LnPUC	The Natural logarithm of Per Unit Cost of Output
XP	Export Price
LnXP	The Natural logarithm of Export Price
GDPDEF	GDP Deflator
RC	Real Consumption
NGDP	Nominal GDP
RGC	Real Government Consumption
RINV	Real Investment
RTVA	Real Total Value Added
TB	Trade Balance
TGR	Total Government Revenue
NTXR	Non-tax Revenue
GRANT	Grant
TGE	Total Government Expenditure
GCE	Government Capital Expenditure
PUBDEF	Public Deficit
DC	Domestic Credit
GC	Government Credit
NGC	Non-Government Credit

Appendix 2: Estimated Equations and Identities of the Model

NGDI = NGDP - TXR

RGDI = NGDI /GDPDEF * 100

LnRGDI = Log (RGDI)

LNRPC = 0.891289022916 * D(LNRGDI) - 0.043128160515 * D(LNDIR) + 0.062441874495 * D(LNDIR(-1)) + 0.079323287655 * D(DEPRDF) - 0.005820020954 * D(@TREND()) - 0.541610019081 * (LNRPC - (0.90151614 * LNRGDI(-1) - 0.11110606 * LNDIR(-1) + 0.14645831 * DEPRDF(-1) - 0.13628554 - 0.01074578 * @TREND())) + LNRPC(-1)

RPC = EXP (LnRPC)

RGC = EXP (LnRGC)

RC = RPC + RGC

LNRPRINV = 1.444258564310 * D(LNRGDP) - 0.466140761422 * D(LNRPUINV) - 0.672786294712 * D(LNCPI) - 0.884442333723 * D(LNCPI(-1)) - 0.286634608883 * D(DEPRDF) - 0.466550154302 * D(D85) - 0.961525810279 * (LNRPRINV - (1.50204867 * LNRGDP(-1) - 0.48479277 * LNRPUINV(-1) + 0.56554292 * LNCPI(-1) - 0.29810392 * DEPRDF(-1) - 0.48521854 * D85(-1) - 4.71107203)) + LNRPRINV(-1)

RPRINV = EXP (LnRPRINV)

rpuinv = exp(lnrpuinv)

LnRPUINV = LOG (RPUINV)

RINV = RPRINV + RPUINV

LNRX = 2.068998109122 * D(LNROWGDP) + 0.441242296235 * D(LNREER) + 0.409223964913 * D(LNREER(-1)) + 0.414113072203 * D(LNINVGDP) - 0.367074090892 * D(DR) - 0.052608351306 * D(@TREND()) - 0.291310645603 * (LNRX - (1.89635397 * LNROWGDP(-1) - 0.28285668 * LNREER(-1) + 2.76063559 * LNINVGDP(-1) - 1.26007785 * DR(-1) - 14.45824495 - 0.18059193 * @TREND())) + LNRX(-1)

RX = EXP (LnRX)

LnINVGDP = Log (RINV / RGDP)

LNM = 0.857630327904 * D(LNRGDP) - 0.344079149718 * D(LNREER) + 0.157716136723 * D(LNREM) - 0.633854803919 * (LNM - (1.35303909 * LNRGDP(-1) - 0.54283591 * LNREER(-1) + 0.24882061 * LNREM(-1) - 5.76796376)) + LNM(-1)

RM = EXP (LnM)

RGDP = RPC + RINV + RGC + RX - RM

LnRGDP = Log (RGDP)

LNRAGVA = 0.268838384991 * D(LNRAGVA(-1)) + 2.641828132918 * D(LNLFAG) + 1.806672474534 * D(LNRAGCS) - 2.033366057356 * D(LNRAGCS(-1)) + 0.473350008670 * D(LNRF) - 0.127729756687 * D(DR) - 0.091794260307 * D(DW) - 0.095414319701 * D(@TREND()) - 0.511404059853 * (LNRAGVA - (5.16583332 * LNLFAG(-1) + 1.23983483 * LNRAGCS(-1) + 0.92558907 * LNRF(-1) - 0.24976289 * DR(-1) - 0.17949459 * DW(-1) - 89.54954843 - 0.18657325 * @TREND())) + LNRAGVA(-1)

RAGVA = EXP (LnRAGVA)

LNRFSVA = - 0.224094534336 * D(LNRFSVA(-1)) - 0.097882284592 * D(LNLFFS) - 0.506683636879 * D(LNLFFS(-1)) + 0.058878882228 * D(LNRCSFS) + 0.045946532752 * D(LNRCSFS(-1)) - 0.052004340627 * D(LNZ) - 0.125221516093 * D(LNZ(-1)) + 0.083294178696 * D(D00) - 0.017055439324 * D(@TREND()) - 0.567169027376 * (LNRFSVA - (1.16421622 * LNLFFS(-1) + 0.07580558 * LNRCSFS(-1) + 0.33713128 * LNZ(-1) + 0.14685953 * D00(-1) - 9.41114061 - 0.03007118 * @TREND())) + LNRFSVA(-1)

RFSVA = EXP (LnRFSVA)

RTVA = RAGVA + RFSVA

LnMP = Log (MP)

mp = exp (lnmp)

LNCPI = 0.099785999012 * D(LNCURR) + 0.258295069257 * D(LNM2) + 0.190264262816 * D(LNLIR) + 0.393436475085 * D(LNREER) - 0.085371106796 * D(LNREER(-1)) + 0.094416752521 * D(DEPRDF) - 0.433068112384 * (LNCPI - (0.23041641 * LNCURR(-1) + 0.59643059 * LNM2(-1) + 0.19478733 * LNLIR(-1) + 0.40617842 * LNREER(-1) + 0.21801825 * DEPRDF(-1) - 5.09186434)) + LNCPI(-1)

CPI = EXP (LnCPI)

LNXP = 1.494946710946 * D(LNMP) - 0.700142895064 * D(LNMP(-1)) - 0.421565531576 * D(LNCURR) - 0.041824504397 * D(LNLIR) - 0.115978294996 * D(LNLIR(-1)) - 0.022088466508 * D(@TREND()) - 0.843639616501 * (LNXP - (2.61721896 * LNMP(-1) - 0.49969860 * LNCURR(-1) + 0.12168186 * LNLIR(-1) + 0.33615634 - 0.02618235 * @TREND())) + LNXP(-1)

XP = EXP (LnXP)

LNINVP = - 0.523842616479 * D(LNCURR) - 0.363255194261 * D(LNCURR(-1)) + 0.148415004454 * D(LNMP) - 0.360363541976 * D(LNMP(-1)) + 0.203531693702 * D(LNLIR) + 0.064315050477 * D(LNLIR(-1)) - 0.527615434183 * D(LNPUC) + 0.139735554729 * D(LNPUC(-1)) - 0.149403182778 * D(DEPRDF) + 0.060208872511 * D(@TREND()) - 0.890315600330 * (LNINVP - (-0.17907363 * LNCURR(-1) + 0.96364581 *

LNMP(-1) + 0.14673081 * LNLIR(-1) - 0.46996942 * LNPUC(-1) - 0.16780924 * DEPRDF(-1) - 4.37373064 + 0.06762644 * @TREND())) + LNINVP(-1)

INVP = EXP (LnINVP)

TB = RX * XP - RM * MP

ngdp = gdpdef * rgdp

LNTXR = 0.386206113600 * D(LNNGDI) + 0.180799551110 * D(LNM) - 0.447057479247 * D(LNCPI) - 0.244874788302 * D(LNCPI(-1)) + 0.179720054627 * D(LNAID) - 0.116415637857 * D(LNAID(-1)) + 0.213319008258 * D(D00) - 0.071182313774 * D(@TREND()) - 0.399433658167 * (LNTXR - (0.96688425 * LNNGDI(-1) + 0.45263975 * LNM(-1) - 0.16046020 * LNCPI(-1) + 0.77191377 * LNAID(-1) + 0.53405366 * D00(-1) - 7.94260824 - 0.17820810 * @TREND())) + LNTXR(-1)

txr = exp(lntxr)

TGR = TXR + NTXR + GRANT

LNGRE = 0.196753104062 * D(LNGRE(-1)) + 0.315522347581 * D(LNTXR) - 0.142996148891 * D(LNAID) + 0.174477223622 * D(LNAID(-1)) + 0.236849847843 * D(LNCPI) - 0.409290619951 * D(LNCPI(-1)) + 0.218671618327 * D(D99) + 0.056545369674 * D(@TREND()) - 0.667298127059 * (LNGRE - (0.47283566 * LNTXR(-1) - 0.38279780 * LNAID(-1) + 0.29808319 * LNCPI(-1) + 0.32769704 * D99(-1) + 5.29649859 + 0.08473779 * @TREND())) + LNGRE(-1)

gre = exp (lngre)

TGE = GRE + GCE

PUBDEF = TGR – TGE

LNRM2 = 0.291163896955 * D(LNRGDP) - 0.645327813178 * D(LNCPI) - 0.019968962680 * D(LNDIR) - 0.063562537883 * D(D811) + 0.033608822946 * D(@TREND()) - 0.499844990687 * (LNRM2 - (0.58250838 * LNRGDP(-1) - 0.38883534 * LNCPI(-1) - 0.03995031 * LNDIR(-1) - 0.12716450 * D811(-1) - 0.50023024 + 0.06723849 * @TREND())) + LNRM2(-1)

RM2 = exp (LnRM2)

DC = GC + NGC

INFLATION = CPI – CPI (-1)

Appendix 3: Unit Root Test Results of the Variables used in the estimated equations

Variables	Tests				Order of Integration
		Intercept	Intercept & Trend	None	
LnRAGVA	ADF	2.423	-0.356	3.031	I(1)
	PP	2.872	-0.826	2.771	
D(LnRAGVA)	ADF	-6.212*	-7.507*	-2.28**	
	PP	-5.575*	-13.216*	-5.02*	
LnLFAG	ADF	-0.222	-2.586	19.152	I(1)
	PP	-0.226	-2.734	19.476	
D(LnLFAG)	ADF	-5.707*	-5.634*	-0.628	
	PP	-5.764*	5.764*	-0.691	
LnRAGCS	ADF	-0.379	-1.887	-2.029	I(1)
	PP	-0.425	-2.173	-1.993	
D(LnRAGCS)	ADF	-5.629*	-5.591*	-5.223*	
	PP	-5.616*	-5.590*	-5.244*	
LnRF	ADF	-4.234*	-4.197*	-0.111	I(0)
	PP	-3.950*	-3.87**	-0.149	
D(LnRF)	ADF	-7.373*	-7.289*	-7.474*	
	PP	-13.078*	-13.044*	-13.388*	
LnRFSVA	ADF	3.296	0.403	2.402	I(1)
	PP	3.296	0.145	3.233	
D(LnRFSVA)	ADF	-3.609**	-4.349*	-2.642	
	PP	-3.530*	-4.334*	-2.453**	

LnRCSFS	ADF	-2.289	-4.055**	0.592	
	PP	-2.092	-4.055**	1.353	
D(LnRCSFS)	ADF	-8.529*	-8.438*	-8.541*	I(1)
	PP	-13.041*	-16.558*	-10.679*	
LnLFFS	ADF	0.893	-1.369	2.154	
	PP	0.842	-1.004	2.595**	
D(LnLFFS)	ADF	-7.630*	-7.871*	-6.594*	I(1)
	PP	-7.679*	-8.405*	-6.542*	
LnZ	ADF	0.972	-1.112	4.366	
	PP	1.194	-1.122	4.781	
D(LnZ)	ADF	-7.165*	-7.536*	-2.244**	I(1)
	PP	-7.096*	-7.508*	-5.353*	
LnRPC	ADF	1.649	-2.494	2.398	
	PP	1.427	-2.727	1.860	
D(LnRPC)	ADF	-6.298*	-8.241*	-2.214*	I(1)
	PP	-6.407*	-8.028*	-5.862*	
LnRGDI	ADF	2.313	-2.576	2.773	
	PP	1.874	-2.803	1.964	
D(LnRGDI)	ADF	-5.033*	-7.101*	-2.259**	I(1)
	PP	-5.093*	-7.101*	-4.60*	
LnDIR	ADF	-2.024	-2.108	0.533	
	PP	-2.178	-2.3	-0.537	I(1)
D(LnDIR)	ADF	-5.819*	-5.742*	-5.896*	

	PP	-5.819*	-5.742*	-5.896*	
LnRPRINV	ADF	1.014	-2.597	1.834	
	PP	0.404	-2.351	1.658	
D(LnRPRINV)	ADF	-9.356*	-9.776*	-8.929*	I(1)
	PP	-9.187*	-10.213*	-8.836*	
LnRPUINV	ADF	-0.485	-2.406	2.306	
	PP	-0.259	-2.406	3.912	
D(LnRPUINV)	ADF	-7.042*	6.956*	-6.194*	I(1)
	PP	-7.390*	-7.317*	-6.195*	
LnLIR	ADF	-2.024	-2.108	-0.533	
	PP	-2.178	-2.300	-0.537	
D(LnLIR)	ADF	-5.819*	-5.742*	-5.896*	I(1)
	PP	-5.819*	-5.742*	-5.896	
LnRGDP	ADF	4.280	1.121	1.879	
	PP	6.679	0.690	4.084	
D(LnRGDP)	ADF	-1.775	-6.258*	0.596	I(1)
	PP	-4.273*	-5.804*	-2.899*	
LnCURR	ADF	0.093	-2.233	0.287	
	PP	-5.610*	-5.630*	-5.636*	
D(LnCURR)	ADF	-4.353*	-5.228*	-4.638*	I(1)
	PP	-6.215*	-8.467*	-6.703*	
LnTXR	ADF	2.899	0.866	3.118	
	PP	2.899	0.866	5.339	

D(LnTXR)	ADF	-3.758*	-4.177*	-2.294*	I(1)
	PP	-3.806*	-4.175*	-2.111***	
LnNGDP	ADF	4.726	1.146	3.280	
	PP	3.894	0.696	5.557	
D(LnNGDP)	ADF	-3.457*	-4.699*	-0.958	I(1)
	PP	-3.633*	-4.771*	-1.46	
LnM	ADF	1.696	-0.909	5.901	
	PP	1.787	-0.882	5.901	
D(LnM)	ADF	-3.111**	-6.374*	-1.711	I(1)
	PP	-5.947*	-6.347*	-3.720*	
LnGRE	ADF	0.974	-0.852	5.942	
	PP	0.919	-0.852	5.721	
D(LnGRE)	ADF	-5.152*	-4.296*	-3.246*	I(1)
	PP	-5.159*	-5.217*	-3.174*	
LnAID	ADF	-0.007	-2.951	3.711	
	PP	0.461	-3.097	6.229	
D(LnAID)	ADF	-7.064*	-7.003*	-2.533*	I(1)
	PP	-7.676*	-7.652*	-5.346*	
LnRX	ADF	0.324	-2.305	2.100	
	PP	0.489	-2.272	2.330	
D(LnRX)	ADF	-5.519*	-5.623*	-4.928*	I(1)
	PP	-5.520*	-5.771*	-4.928*	
LnROWGDP	ADF	0.652	-2.922	4.795	

	PP	0.461	-2.332	4.106	
D(LnROWGDP)	ADF	-3.811*	-3.795**	-2.681*	I(1)
	PP	-3.599*	-3.557**	-2.628*	
LnREER	ADF	-1.047	-1.875	-0.413	
	PP	-1.161	-2.017	-0.404	
D(LnREER)	ADF	-4.986*	-4.916*	-5.030*	I(1)
	PP	-4.899*	-4.821*	-4.941*	
LnINVGDP	ADF	-1.556	-4.161	-1.276	
	PP	-1.278	-4.011**	-1.341	
	ADF	-5.052*	-5.013*	-8.849*	I(1)
D(LnINVGDP)	PP	-11.879*	-12.796*	-9.739*	
	ADF	0.371	-2.012	2.512	
LnREM	PP	1.563	-1.395	7.824	
	ADF	-5.70*	-12.10*	-4.89*	I(1)
D(LnREM)	PP	-5.58*	-5.09*	-4.91*	
LnM2	ADF	1.941	1.189	3.912	
	PP	2.752	1.868	11.476	
D(LnM2)	ADF	-3.283*	-3.841*	-0.616	I(1)
	PP	-3.405*	-4.013**	-0.079	
LnRM2	ADF	0.933	-4.057	4.140	
	PP	1.016	-4.049	3.995	I(1)
D(LnRM2)	ADF	-5.486*	-5.705*	-1.540	
	PP	-6.050*	-6.257*	-4.454*	

LnXP	ADF	-0.335	-1.423	0.512	
	PP	-0.501	-1.526	0.459	
D(LnXP)	ADF	-5.463*	-5.604*	-5.368*	I(1)
	PP	-5.466*	-5.603*	-5.397*	
LnMP	ADF	0.481	-1.369	1.211	
	PP	0.511	-1.344	1.042	
D(LnMP)	ADF	-5.051*	-5.305*	-4.701*	I(1)
	PP	-5.045*	-5.306*	-4.735*	

Note: (*), (**) shows that the test is significant at 1 and 5 percent level of significance. The Mackinnon critical values for both ADF and PP test, when both constant and trend terms included are -4.2268 and -3.5366 for 1 and 5 percent level of significance respectively. When only the constant term is included the Mackinnon critical values for both ADF and PP are -3.6210 and -2.9434 for 1 and 5 percent level of significance respectively. When both trend and constant are not included the Mackinnon critical values for both ADF and PP test becomes -2.6289 and -1.95011 again for 1 and 5 percent level of significance respectively.

Appendix 4: Simulation Results

Appendix 4A: Base line Values Versus Actual (Deviation, in Percentage)

Year	CPI			LnRGDP			LnRPC		
	Baseline	Actual	%	Baseline	Actual	%	Baseline	Actual	%
2000	24.9	25.5	-2.4	10.6	12.1	-12.6	7.63	7.52	1.37
2001	25.5	25.7	-0.8	10.7	12.2	-12.1	7.65	7.67	1.14
2002	26.6	22.8	16.7	10.8	12.2	-11.5	7.68	7.72	0.17
2003	27.8	24.9	11.5	11.0	12.2	-10.0	7.72	7.7	-0.09
2004	29.2	27.2	8.0	11.1	12.3	-9.6	7.76	8.02	-0.15
2005	30.7	28.5	7.7	11.2	12.4	-9.5	7.80	8.14	-2.74
2006	32.4	31.5	2.8	11.4	12.5	-9.3	7.84	8.28	-3.74
2007	34.2	36.4	-6.0	11.5	12.6	-9.3	7.88	8.46	-4.84
2008	36.2	44.3	-18.3	11.6	12.7	-9.3	7.92	8.41	-6.45
2009	38.3	62.8	-39.0	11.7	12.8	-9.3	7.96	8.51	-5.39
2010	40.6	64.3	-36.8	11.7	12.9	-9.3	8.00	8.52	-6.09
2011	43.1	74.3	-42.1	11.8	13.1	-9.4	8.03	8.59	-5.74
2012	45.7	100.9	-54.8	11.9	13.2	-9.5	8.07	8.61	-6.05
2013	48.4	115.6	-58.1	12.0	13.2	-9.5	8.10	8.61	-5.93
2014	51.4	124.9	-58.9	12.1	13.3	-9.6	8.14	8.69	-6.39
Average						**-9.98**			**-3.39**

Year	LnRX			LnM		
	Baseline	Actual	%	Baseline	Actual	%
2000	8.5	8.3	2.8	8.6	9.3	-8.0
2001	9.2	8.4	9.6	8.2	9.4	-12.7
2002	9.4	8.4	11.9	8.1	9.6	-15.9
2003	9.8	8.3	17.2	8.1	9.7	-16.7
2004	10.0	8.4	19.5	8.2	10.0	-18.3
2005	10.3	8.6	19.1	8.3	10.4	-19.5
2006	10.4	8.7	19.6	8.5	10.7	-19.6
2007	10.6	8.8	20.2	8.7	11.1	-18.7
2008	10.7	8.9	20.1	8.9	11.3	-19.5
2009	10.8	9.0	19.1	9.1	11.6	-20.0
2010	10.9	9.4	14.9	9.3	11.8	-20.1
2011	10.9	9.8	11.9	9.4	12.2	-19.8
2012	11.0	10.0	9.9	9.6	12.2	-21.0
2013	11.1	10.1	9.9	9.8	12.2	-19.7
2014	11.2	10.2	10.1	10.0	12.4	-19.9
Average			**14.3**			**-17.9**

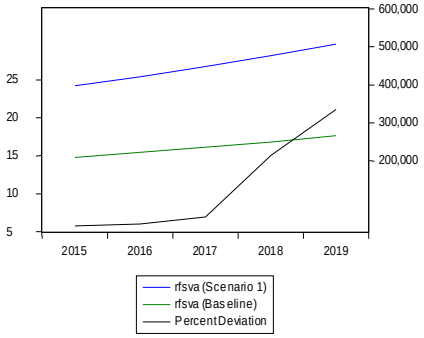
Appendix 4B: The Impact of 10% increase in public investment on Some Macro Variables (Deviation from the Base run, in %)

Year	RGDP			CPI		
	Scenario 01	Baseline	%	Scenario 01	Baseline	%
2015	188,629.2	188,065	0.3	63	54.5	15.6
2016	218,348.5	203,304	7.4	67.8	57.8	17.3
2017	232,803	219,626	6.0	72.8	61.2	19.0
2018	256,311	237,106	8.1	78.5	64.9	20.9
2019	278,072	255,819	8.7	84.5	68.81	22.5
Average			**6.1**			**19.14**

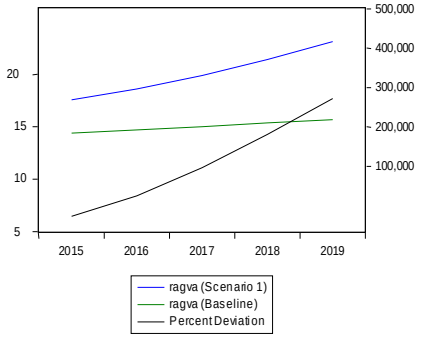
Year	RPRINV			PUBDEF		
	Scenario 01	Baseline	%	Scenario 01	Baseline	%
2015	17,333	16,860.9	2.8	-74,126	-68,955	7.5
2016	19,672	18,771.9	1.6	-88,987	-80,433	9.7
2017	21,650	20,878.1	3.7	-103,987	-93,514	11.2
2018	23,987	23,198.3	3.4	-112,200	-1.E+05	12.2
2019	26,703	25,751	3.7	-112,800	-1.E+0.5	12.8
Average			**3.04**			**10.68**

Appendix 4C-1: The impact of a 10 percent Increase in Public Investment shock on different variables (Graphical Representation)

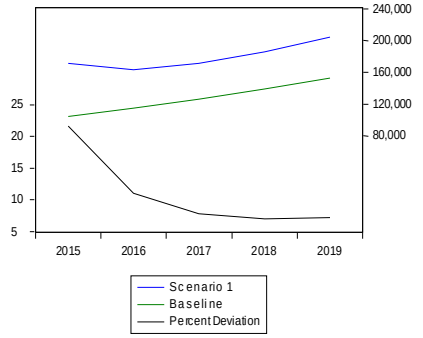
rfsva



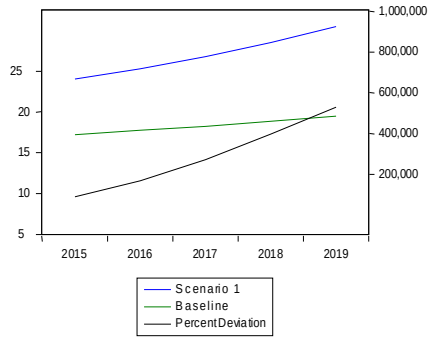
ragva



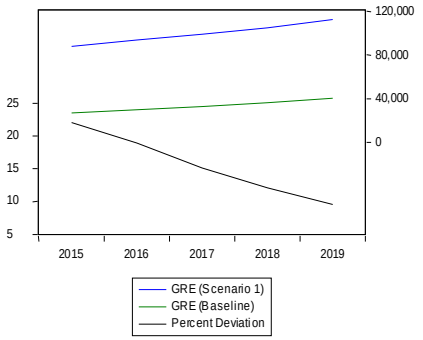
RINV



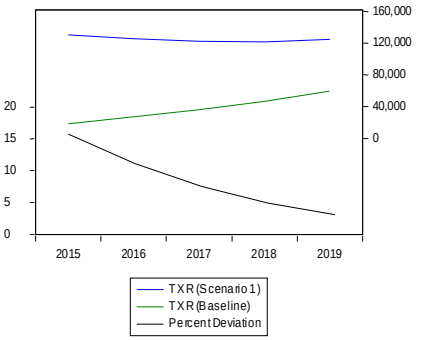
RTVA



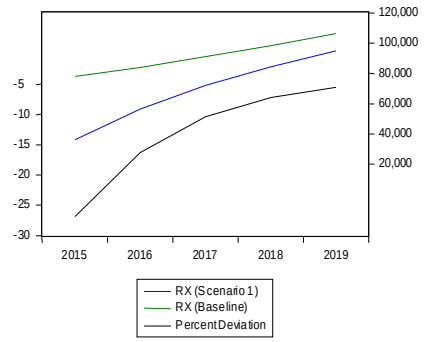
GRE



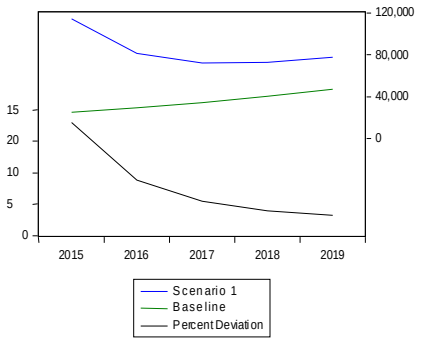
TXR



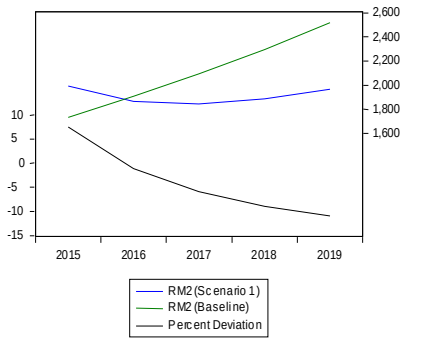
RX



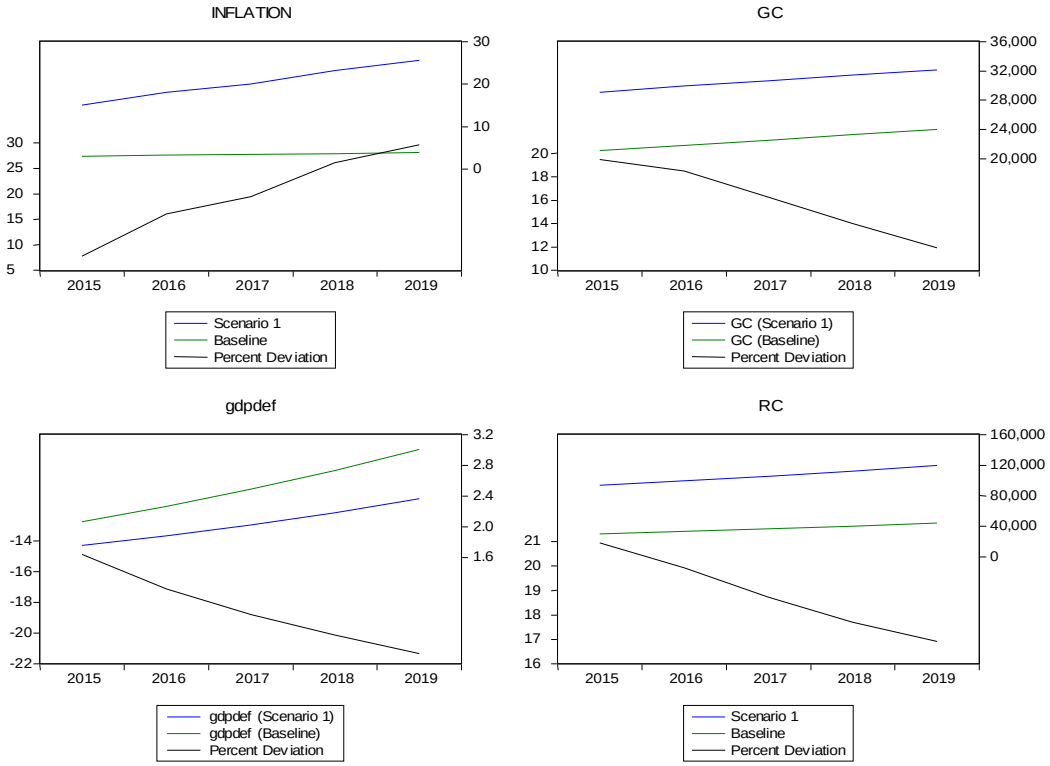
RM



RM2



Appendix 4C -2: The impact of a 10 percent Increase in Public Investment shock on different variables (Graphical Representation)

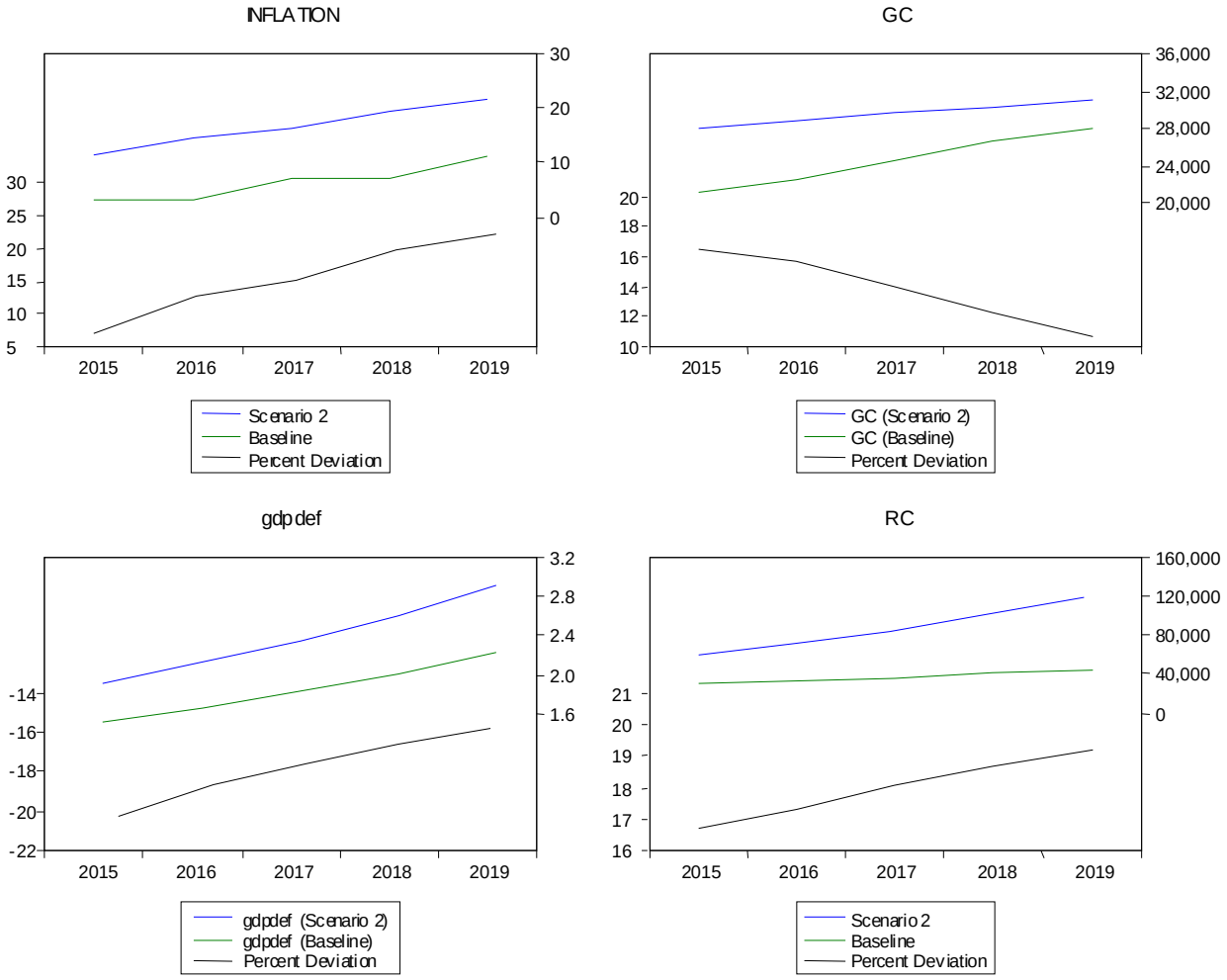


Appendix 4D: The Impact of a 10 Percent Increase in the Import Price on Selected Macro Variables

Year	RGDP			CPI		
	Scenario 02	Baseline	%	Scenario 02	Baseline	%
2015	186,560	188,065	-0.8	59.1	54.5	8.4
2016	200,457	203,304	-1.4	63.4	57.8	9.6
2017	218,308	219,626	-0.6	68.3	61.2	11.5
2018	232,126	237,106	-2.1	74.1	64.9	14.2
2019	248,911	255,819	-2.7	78.2	68.81	13.6
Average			**-1.52**			**11.6**

Year	RPRINV			PUBDEF		
	Scenario 02	Baseline	%	Scenario 02	Baseline	%
2015	15,950	16,860.9	-5.4	-72,747.5	-68,955	5.5
2016	17,626.8	18,771.9	-6.1	-86,465.5	-80,433	5.7
2017	19,374.8	20,878.1	-7.2	-99,311.8	-93,514	6.2
2018	21,458.4	23,198.3	-7.5	-107,400	-1.E+0.5	7.4
2019	23,356.2	25,751	-9.3	-108,700	-1.E+0.5	8.7
Average			**-7.1**			**6.7**

Appendix 4E-1: The Impact of 10 % increase in Import Price on Selected Variables (Graphical Representation)



Appendix 4E-2: The Impact of 10 % increase in Import Price on Selected Variables (Graphical Representation)