SAINT MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

THE EFFECT OF EXCHANGE RATES ON ECONOMIC GROWTH IN ETHIOPIA

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June 2016

Addis Ababa, Ethiopia

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APPROVED BY BOARD OF EXAMINERS

As members of the Board of Examining of the final MSc thesis open defense, we certify that we have read and evaluated the thesis prepared by Muluken Nigussie under the title "THE EFFECT OF EXCHANGE RATES ON ECONOMIC GROWTH IN ETHIOPIA" we recommend that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Development Economics.

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DECLARATION

I, the undersigned, declare that this Thesis is my original work; prepared under the guidance of Gemoraw Adinew. All the sources of materials used for this thesis have been dully acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

_____ _____

Name Signature and Date

ENDORSEMENT

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

_____ _____

Advisor Signature and Date

DEDICATION

To Mahder Tadesse my wife, Who Has helped me reach here.

ACKNOWLEDGMENT

Words are powerless to express my praise and adoration to the Almighty God and Saint Mary, for their love, comfort, kindness, blessing and mercy.

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ACRONYMS

ADF: Augmented Dickey-Fuller

AIC: Akaike Information Criteria

AR: Auto Regression

CPI: Consumer Price Index

CSA: Central Statistics Agency

DF: Dickey-Fuller

EEA: Ethiopian Economic Association

EPRDF: Ethiopian People's Revolutionary Democratic Front

ETB: Ethiopian Birr

NBE: National Bank of Ethiopia

NEER: Nominal Effective Exchange Rate

REER: Real Effective Exchange Rate

RGDP: Gross Domestic Product

VECM: Vector Error Correction Model

VIF: Variance inflation factor

ABSTRACT

This study attempts to investigate the effect of exchange rates on economic growth in Ethiopia using annual time series data spanning from 1985/86 to 2014/15. The explanatory variables in this study were real effective exchange rate, government final consumption expenditure, gross fixed capital formation, broad money supply and trade openness. The multilateral real exchange rates is used to measure real exchange rates. Results from Vector Error Correction Model revealed that real effective exchange rates, broad money supply and trade openness have a positive long run effect on economic growth, while government final consumption have a negative long run effect on the economic growth of Ethiopia. From the regression results, it was noted that undervaluation of the currency is contractionary in the long run and neutral in the short- run. As such, the effect of exchange rates on economic growth works through the supply channel. It is the reflection of various economic and policy shocks, mainly a strategy shifts, of the government. Based on the findings of this study, the researcher recommended that since the Ethiopian output is dominated by primary agricultural products and it is insensitive for the change in exchange rate. Government intervention is needed to balance the adverse effect of exchange rate movements until the economy well transformed from agricultural lead economy to industrial lead economy and becomes less dependent on imported raw materials.

CHAPER ONE

1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Countries have the same consensus on the possible effect of exchange rates on economic growth until the end of 1970s. There appears a consensus view on the fact that exchange rate devaluation or depreciation could boost domestic production through stimulating the net export component. This is possible because devaluation increases international competitiveness of domestic industries which leads to the diversion of spending from foreign goods to domestic goods. Up to this period, devaluation has expansionary effect on output. It would improve trade balance, alleviate balance of payment deficits, and accordingly expand output and employment (Acar, 2000).

Since 1992, Ethiopia, under the support and guidance of the IMF and the World Bank has undergone liberalization and enhanced Structural Adjustment Programs (SAPs) to restrain internal and external imbalances of the economy. One of the basic tasks of the new policy regime is to increasingly open the economy to foreign competition with a view of benefiting the economy from expanded markets. To this end, the government uses different tools such as: devaluation of the ETB and step-by-step liberalization of the foreign exchange market (Haile,1999).

In the recent period, devaluation has become the basic macroeconomic policy issue in most less developed countries. The effect is contractionary or expansionary depending on the structure of the economy. During the structural adjustment program, the International Monetary Fund (IMF) and World Bank (WB) suggested for developing countries to devalue their currency for the development of domestic firms. Devaluation increases the demand for domestic product and protects infant firms form outside competition (Genye, 2010). Krugman T. (1978) examine the negative effect of currency devaluation on output in developing countries which has used devaluation as a policy strategy. However, many researchers like Eichengreen, (2008), Mbaye, (2012), Acar (2000), Schweicker, Thiele and Wiebelt, (2006), Ngandu and Gebreselasie, (2006), Medina-Smith (2001), Schweicker et al., (2006) and Araujo and Soares (2011) found different results on the effects of currency devaluation on output in less developed countries.

1.2 STATEMENT OF THE PROBLEM

Even though ambiguous results were observed on the possible effect of devaluation, developing countries have actively used devaluation as a policy instrument. This study investigates the long run and short run effects of currency devaluation on real output growth in Ethiopia for two reasons. First, the country has short story of using exchange rate adjustments as a policy tools to promote external competitiveness. Since 1992, Ethiopia devalued its currency where the ETB exchange rate is adjusted continuously rather than discretely, as it was previously the case. Second, Ethiopia is heavily dependent on agricultural products and imported intermediate goods that would have contractionary effect on output. Despite the large number of studies on the effect of exchange rateson economic growth, they generally considered channels of exchange rates while the growth implications of currency adjustments are generally overlooked.The responses of productions andexports of the countries are highly heterogeneous depending on their characteristics such as export orientation, import dependency and liability of dollarization. The empirical evidence on the effects of currency adjustments on output is mixed and consequently government development approaches, where the manufacturing industry and its sub-sectors are being the main engine of economic growth, are the best possible option to guide policy directions of Ethiopia. This study, therefore, attempted to fill this research gap.

1.3 OBJECTIVE OF THE STUDY

The general objective of this study is to analyze the effect of exchange rates on economic growth in Ethiopia spanning from 1985/86 to 2014/15.

The specific objectives of the study will be as follows:

- To provide a review of the trends in exchange ratesand economic growth of Ethiopia over the period 1985/86-2014/15.
- To analyzethe short run and long run effect of exchange rates on economic growth in Ethiopia during the period 1985/86-2014/15.

1.4BASIC RESEARCH QUESTIONS

- What look like the trend of exchange rates and economic growth in Ethiopia?
- Does exchange rates have a long run effect on economic growth in Ethiopia?

1.5 HYPOTHESIS

H0: Exchange rates do have a long run effect on economic growth in Ethiopia.

H1: Exchange rates do not have a long run effect on economic growth in Ethiopia.

1.6 SIGNIFICANCE OF THE STUDY

The issue of nominal devaluations attracts so much attention in Ethiopia, discussions surrounding it mainly focus on inflation and are generally without any reference to overall economic activity. This generates a lack of attention to the role of exchange rate management for promoting economic growth and maintaining the external competitiveness. It is on this basis that this study adds value to the relevant macro policy discourse more effectively by carrying out an empirical investigation of the effects of exchange rate changes on economic growth based on the government development approaches. Even though the study focuses on Ethiopia, the results from this study can hopefully be used when evaluating the growth effects of exchange rates in other developing countries.

1.7 SCOPE AND LIMITATION OF THE STUDY

The study analyzes the effect of exchange rates on economic growth in Ethiopia. To achieve this objective, the period range from 1985/86 to2014/15 is chosen. This period is chosen based on two reasons the first is the official exchange rate was first announced in 1992 and the other is Ethiopia's heavily dependence on imported intermediate goods that would have contractionary effect on output.However, the effect of exchange rate changes on production and international trade dynamics vary with technology intensity and product complexity of the country. This study did not take in to consideration because I thought that it is insignificant in the context of Ethiopia.Another limitation of this study concerns data on the Ethiopian economy because it lacks consistency. Different data sources give different data for the same variable. To maintain accuracy and consistency, the study use data from Ministry of Finance and Economic Development, Central Statistics Agency and National Bank of Ethiopia which are more harmonized. The objectivity of the economy which is obsessed by factors like political and rules of law (property right) are not addressed here and might be consider other limitations of this study.

1.8 THE ORGANIZATION OF THE STUDY

This paper is organized as follows: Chapter I provides the introduction to the study; Chapter II reviews both the theoretical and empirical literature pertaining to the relationship between the exchange rates and economic growth; Chapter III presents a discussion on the research methodology; Chapter IVpresents both the descriptive and econometric results and the interpretation of the results; finally Chapter VI provides a summaryof main findings, conclusions based on the findings along with their policy implications.

CHAPER TWO

2. LITERATURE REVIEW

2.1. BRIEF DISCUSSION ON EXCHANGE RATE IN ETHIOPIA

2.1.1. DEFINITION

Exchange rate is a rate at which one country's currency is exchanged for the other currency. As cited by Fentahun (2011) from Pilbeam (1998), exchange rate can be expressed in two ways. These are domestic currency per unit of foreign currency and foreign currency units in terms of domestic currency. In this study data's taken from NBE, exchange rate is defined in terms of domestic currency per unit of foreign currency.

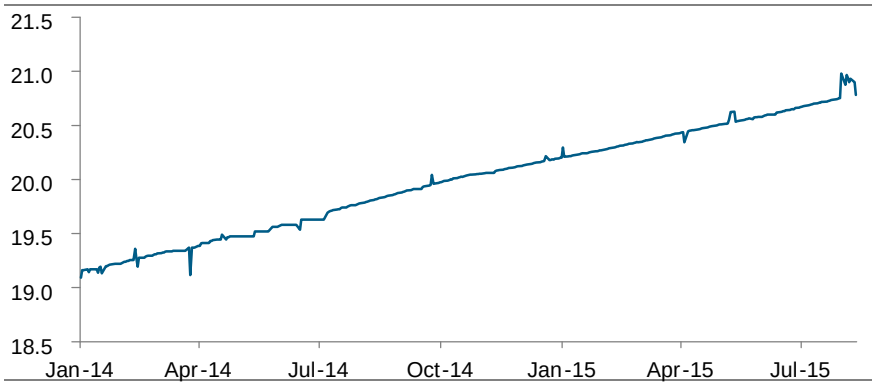

Figure 2.1: Gradual ETB depreciation continues (*ETB/USD)*
Source: National Bank of Ethiopia, Standard Chartered Research

Despite depreciation pressure across the region, the Ethiopian birr (ETB) has been depreciated only gradually.

2.1.2. EXCHANGE RATE POLICY IN ETHIOPIA

The Ethiopian legal affectionate currency was issued and the official exchange rate of this currency with US dollar was created on July 23, 1945. The name was initially Ethiopian dollar with the gold content 0.357690 gram corresponding to US$ of 0.4025 or an official rate of 2.48 ETB/USD. The gold content was almost constant up to the collapse of Britton woods system and devaluation of US dollar. After 1976 the name of the Ethiopian currency changed in to Ethiopian birr and the exchange rate of birr with dollar was remained fixed during Derg regimes (Fentahun, 2011).

Therefore, the Ethiopian currency has been pegged to the US dollar at the rate of 2.07 birr per US dollar until the huge devaluation in October 1992. This fixed official exchange rate was left unaltered for two decades despite the floating of the major world currencies including US dollar. As a result the birr became overvalued in terms of US dollar as well as many other foreign currencies. "From May 1993 up to the unification of the official and the public sale exchange rates on July 25, 1995, the exchange rate was partly determined by the government decree (applicable to the official rate) and partly by quasi-market forces (applicable to the auction rate) as represented by fortnightly auctions"(Derrese, 2001).

The National Bank of Ethiopia (central bank), follows a managed floating exchange rate regime where the local currency Birr is pegged to the US Dollar. Accordingly, drastic movements in the nominal exchange rate are not expected. The Birr continued to depreciate but at a very slow rate and it reached 21.5073/US$ at the end of 2015. This gradual depreciation is in line with the goal to enhance competitiveness of Ethiopian exports and attract FDI. The primary task of exchange rate policy in Ethiopia is promoting export and minimizing the adverse effect of exchange rate instability. The objective is limiting the gap between effective exchange rate indicating that the overvaluation of the birr has substantially been reduced and the parallel market exchange rate has declined significantly (Zerayehu, 2006).

2.1.3. EXCHANGE RATES AND ECONOMIC GROWTH IN ETHIOPIA

After the devaluation in 1992 the exchange rate is changed from fixed to managed floatingexchange rate in order to control overvaluation through a gradual depreciation of domestic currency every year. The gap between the unofficial and official rate also decreased compared to the period when the exchange rate was fixed. However during the fiscal year 2007/08 the rate of depreciation against other foreign currencies increased compared to the previous years. In the 2009/10 and September 2010/2011 the Ethiopian Birr was devalued to 23.7% and 16.5% respectively against the US dollar. This huge devaluation was expected to “decrease overvaluation and increase competiveness” (IMF, 2010; MOFED, 2009).

The increase in depreciation rate was expected to encourage the export sector. The higher increase in export rate, the better the rate of growth of the economy. The export of goods and services was 11% of the GDP in 2009 and yet the trade balance is negative. The world financial crisis where the major importing countries decreased their import quota might have a negative

role in the decrease of the export as well as low growth since export is one part of the GDP (NBE, 2010).

The level of real exchange rate is important on economic growth as it determines the value of imports and exports of a country. Walters and De Beer (1999) explain that a country's exchange rate is an important determinant of the growth of its cross-border trading and it serves as a measure of its international competitiveness.

2.1.4. REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

Nominal effective exchange rate and real effective exchange rate are commonly used as an indicator of external price competitiveness. NEER is a weighted average of bilateral nominal exchange rates of national currency against a basket of major foreign currencies. At the same time, conceptually, REER is defined as a weighted average of a country's currency against a basket of other major trading partners currency adjusted for the inflation. The foreign currencies weights in the basket are calculated based on the trade balance of Ethiopia. In total, the currencies of 16 major trading partners(Djibouti, Kenya, Sudan, U.A.R, France, Germany, Italy, Netherlands, U.K., Russia, Yugoslavia, U.S.A., China, P.Rep., Japan, and Saudi Arabia) are included in the calculation of nominal and real effective exchange rates (NBE,2014).

$$\text{NEER} = \prod_{i=1}^{n} \left(\frac{s_i}{s_i^*}\right)^{wi}$$

Where,

n-number of countries (currencies) from the basket; s_i-exchange rate of the national currency against the currency of the country i; s_i^*-exchange rate of the national currency against the currency of the country i during the base period; w_i- country's weight of the currency.

$$\text{REER} = \prod_{i=1}^{n} \left(\frac{s_i}{s_i^*} * \frac{p_i}{p_{ETHIO}}\right)^{wi}$$

Where,

n- number of countries (currencies) from the basket; s_i-exchange rate of the national currency against the currency of the country i; s_i^*-exchange rate of the national currency against the

currency of the country i; during the base period, w_i-country's weight of the currency in the basket;p_i-inflation rate in the country i; p_{ETHIO}-inflation rate in Ethiopia.

2.2 THEORETICAL LITERATURE REVIEW

This section examines theories that deal with exchange rates. The theories discussed in this section include the traditional views of exchange rates, the Structuralist or modern views of exchange rates, the Balassa- Samuelson Hypothesis and export led hypothesis.

2.2.1THE TRADITIONAL VIEW OF EXCHANGE RATES

This view holds that devaluation have expansionary effects on economic growth. This is popularly known as the traditional view. This approach holds that devaluation of a currency will cause local goods to be cheaper abroad and this will increase their demand, leading to an increase in exports (Salvatore, 2005). The view that devaluation has expansionary effects on output is evident in that devaluation of the currency improves trade balance, alleviates balance of payments difficulties and accordingly expands output and employment (Acar, 2000). The case for devaluation is that when a country devalue its currency, it enhances the cost competitiveness of its exports which are a component gross domestic product.

The traditional approach to exchange rates assumes that exchange rates affect economic growth through two main channels; the Total Factor Productivity growth channel and the Capital accumulation channel.

I. THE TOTAL FACTOR PRODUCTIVITY GROWTH CHANNEL

The Total Factor Productivity growth channel holds that currency depreciation shifts the output composition of a country from the production of non-traded goods to traded goods. The link from output composition to growth is through economy-wide productivity improvements, generated by the production of some types of traded goods (exported manufactured goods) through mechanisms such as technology and skill transfers associated with learning by doing that is external to the firm (Montiel and Serven, 2008). This shift to the production of traded goods and improvements technology results in an increase in investments locally, exports and ultimately economic growth.

The Total Factor Productivity growth channel places the structure of domestic production at the core of the argument (Eichengreen, 2008). A depreciated real exchange rate, equivalent to an increase in the price of tradables relative to non tradables, improves the profitability of the tradable sector. As production moves from the non tradables to the tradable sector characterized by higher (marginal social) productivity levels the overall productivity in the economy increases. Such economy-wide productivity improvement ultimately fosters growth (Mbaye, 2012). Acar (2000) explains that currency devaluation switches demand from imports to domestically produced goods by increasing the relative prices of imports. Export industries on the other hand become more competitive in international markets by stimulating domestic production of traded goods and inducing domestic industries to use more domestic inputs.

Dabla-Norris and Floerkemeier (2005) are of the view that changes in exchange rates have an effect on aggregate demand through improvements in international competitiveness as well as net exports.

In other words, when the rand weakens against other currencies, local people opt for domestic goods thus improving economic performance of the manufacturing sector. At the same time the country exports more and imports less resulting in favourable net exports. Ngandu and Gebreselasie (2006) further explain that increased exports, through the multiplier effect, are expected to increase aggregate demand, and ultimately domestic production and employment.

Given that depreciation tends to be inflationary, it is argued that the increase in the overall price level leads to the lowering of the real wage, which leads to more hiring and increased production, assuming that there is unemployment in the economy.

The criticism leveled against the Total Factor Productivity growth channel is that it does not give clear-cut ways in which it operates except for the learning by doing assumption. Also it lacks empirical support; Mbaye (2012) for instance argues that there is no empirical investigation on the TFP transmission channel of the effect of real exchange rate undervaluation on growth.

II. CAPITAL ACCUMULATION GROWTH CHANNEL

The capital accumulation approach is a view that holds that exchange rates affect economic growth through their effect on savings. This approach claims that real exchange rate undervaluation enhances growth through an increase in the capital stock of the economy as a

whole (Mbaye, 2012). A backdrop for this view is that a depreciated real exchange rate has a tendency to increase the domestic saving rate. Higher saving rates induced by depreciation stimulate growth by increasing the rate of capital accumulation.

According to Montiel and Serven (2008) while there is no consensus on the precise channels through which this effect is generated, an increasingly common view in policy circles points to saving as the channel of transmission, with the claim that a depreciated real exchange rate raises the domestic saving rate, which in turn stimulates growth by increasing the rate of capital accumulation. The capital accumulation channel holds that there are two sources of capital accumulation. Mbaye (2012) explains that in the first mechanism, the capital accumulation operates exclusively in the tradable goods sector whose share in GDP increases while in the second, the stock of capital in the economy increases through the expansion of overall savings and investment.

The relationship between a depreciated real exchange rate and the saving rate arises because a depreciated real exchange rate tends to shift aggregate demand away from traded to non-traded goods, requiring an increase in the real interest rate to maintain internal balance (Montiel and Serven, 2008). The increase in interest rates constrains aggregate demand in part by raising the domestic saving rate. Thus from this perspective, causation runs from the real exchange rate through the real interest rate to the saving rate which in turn increases economic growth. Dooley, et al. (2004) argue that high saving rates in many Asian countries, including China, are at least in part the result of the pursuit of such an exchange rate policy (depreciated currency) in their export driven strategies.

In understanding the capital accumulation channel of exchange rates, it is important to note that there are two conceptual links in the causal chain that underlies the capital accumulation channel. The first being the real exchange rate to the saving rate, and second, from the saving rate to growth (Montiel and Serven, 2008). The second link of saving and economic growth is familiar and has long been an underpinning of mainstream growth process. The first link of exchange rates and savings, however, is controversial both theoretically and empirically. Montiel and Serven (2008) further argue that if the real exchange rate is adopted as a policy target, an improvement in a country's current account balance resulting from depreciation, increases the country's saving rate relative to its rate of investment.

A more depreciated real exchange rate can also result in higher saving through a different channel (Levy-Yeyati and Sturzenegger, 2007). Thus, a more depreciated real exchange rate will result in firms paying lower wages in real terms. Lower wages in turn reduce costs of production, inducing firms to invest more. Consequently, firms increase their savings to finance their additional investment, which ultimately raises the aggregate savings. The validity of the capital accumulation channel is subject to debate, for instance, Bernanke (2005) argues that causation runs from a high saving rate to a depreciated exchange rate not the other way round. The rationale behind this reasoning is that, a high saving rate tends to depress domestic demand. In order to sustain internal balance, countries maintain a depreciated real exchange rate. If this view is correct, an empirical correlation between exchange rates and savings cannot be interpreted as the capital accumulation channel at work. Even if the causation runs in the correct direction from exchange rates to savings, the second link of savings to growth might not result because the same high real interest rate that induces a higher domestic saving rate would also tend to discourage domestic investment. Montiel and Serven (2008) believe that the existence of a link between the real exchange rate and the saving rate, as well as the interpretation of that link if it exists is questionable.

The traditional approach poses a challenge when it comes mostly to less economically developed countries which rely mostly on imported capital goods and infrastructure. In as much as devaluation of the currency makes exports cheaper for external buyers, imports in contrast become dearer for local buyers. Local firms which rely on imported capital goods pass the extra cost to customers in terms of high prices thus leading to inflation. Failure to consider this challenge in part resulted in the formulation of the Structuralist approach to exchange rates. Acar (2000) explains that consensus on the view that devaluation leads to output expansion was broken at the end of the 1970s. An alternative line of approach emerged, which raised the possibility that depreciation could be contractionary, especially in developing countries. This approach is referred to as the Structuralist approach.

2.2.2 THE STRUCTURALIST VIEWS OF EXCHANGE RATES

Contrary to the traditional approach, this view argues that currency depreciation might have a contractionary effect on output and employment, especially for less economically developed countries. This approach shows how currency depreciation might cause a reduction in output.

Depreciation of the currency can cause a contractionary effect on output in many ways, but the increase in the price of imports it causes is an important issue and requires much attention. Depreciation increases the cost of imports in particular, and the cost of domestic production in general, through imported inputs Acar, 2000). If the costs of inputs rise, it is possible that they may be a rise in the cost of production and firms will pass this on to their prices. This is because, firms can only get rid of an increase in the cost of production by increasing their prices. This increases the general price level. Acar (2000) notes that "decreasing imports in this context imply insufficient inputs necessary for production. Eventually, because of the lack of enough inputs and increasing costs, production will slow down, leading to a contraction in total supply". In this case, depreciation would be contractionary in that it causes a slowdown or decrease in the growth rate of output in the economy. Channels through which depreciation may create negative effects on aggregate demand are:

I. REDUCTION IN REAL WEALTH OR REAL BALANCES

As a result of depreciation, prices of traded goods increase relative to non-traded goods. This leads to an increase in the general price level. As prices rise, real money balances (M/P) decline (Acar, 2000). The larger the share of traded goods in the consumption, the more severe the increase in general price level and decrease in real money supply. As real money balances go down, expenditures also fall. Ngandu and Gebreselasie (2006) state that in order to restore real balances a fall in expenditure is needed thereby lowering consumption demand and providing an offsetting contractionary effect on output. The lowering of consumption also implies that the increase in import prices of final consumer goods will diffuse to the consumer price index.

II. NEW INVESTMENT CONSTRAINED BY RISING PRICES OF IMPORTED MACHINERY

A depreciating currency more often than not limits investment of capital and equipment which are usually imported in the case of less economically developed countries. As discussed above, after a depreciation of the Birr, imported goods become expensive and exported goods cheaper. Acar (2000) asserts that this channel seems to be applicable to most developing countries.

Developing countries during the growth phase import much of the capital goods and infrastructure abroad and the expenditure is too high when the currency is weaker. Depreciation on the contrary, may stimulate domestic capital and equipment industries if supported by right policies.

III. THE TIME LAG IN INDUCING NEW TRADED GOODS MAY BE TOO LONG

Traditional exports of developing countries frequently lie in sectors that offer unattractive demand prospects and limited inter-sectoral linkages, such as agriculture and minerals. This means that there may be limited potential for expansion in existing industries (Schweicker, Thiele and Wiebelt, 2006). Currency depreciation might not stimulate investment into new non-traditional exports, except it is generated through foreign direct investment.

IV. INCREASED DEBT AND DEBT SERVICE PAYMENTS IN LOCAL CURRENCY

One of the critical factors that play a role in macro-economic difficulties of less economically developed countries is the existence of a large amount of accumulated external debt stock and the interest burden on it (Caves et al. 1996). For a country that has accumulated external loans denominated in foreign currency, a devaluated local currency means that in real terms the country and businesses pay more than the real worth of the debt, thus influencing the country's debt servicing capacity. When the currency is depreciating, it is hard for Ethiopians and the government to pay their debts denominated in external strong currencies.

V. WAGE INDEXATION BASED ON FOREIGN AND DOMESTIC PRICE LEVELS

Increased prices for tradables caused by depreciation may lead labour to demand higher wages, which could produce adverse supply effects. Ngandu and Gebreselasie, (2006) agree that the possibility of an inflationary impact of depreciation might lead labour to demand higher wages. If wages are flexible they will adjust to the new prices following the depreciation. Similarly, if there exists a wage indexation mechanism, which automatically increases nominal wages in proportion to price changes, then production costs will increase through higher wages (Acar, 2000). An increase in wages contributes to higher input costs causing a reduction in production, causing

output to contract. This might not apply to the Ethiopian context because of high unemployment levels and wage rigidities.

VI. IMPORT COST CHANNEL

Acar (2000) contends that currency depreciation usually takes place when countries have a foreign trade deficit and related external balance difficulties. The opinion holds mostly for developing countries that usually run unfavorable trade balances. The effect of currency depreciation on aggregate demand for a country that has a trade deficit is negative. Following the depreciation, given that imports exceed exports, price increases of traded goods reduce the home country's real income and raise the real income of the outside world, since foreign exchange payments (import costs) exceed foreign exchange receipts (export revenues).Schweicker et al.

(2006) explain that within the home country the value of foreign savings goes up, aggregate demand goes down, and imports fall along with it. The larger the initial deficit, the greater the contractionary outcome.

The Structuralist approach to exchange rates in a nutshell is a view that holds that exchange rates depreciations can be contractionary. This approach explains that the contractionary effect is due mainly to an increase in price levels through a number of channels. Given this approach, a policy to depreciate the currency can end up contradicting macro policies that seek to stabilize the macro-economy through a reduction in inflation.

2.2.3 BALASSA-SAMUELSON HYPOTHESIS

The Balassa-Samuelson Hypothesis follows the work of Balassa and Samuelson of 1964 who gave a theoretical explanation of the long run trends in the real exchange rates (RER). According to Solanes and Flores (2009) the basis of the Balassa-Samuelson Hypothesis is that there is a positive correlation between the relative economic growth and real exchange rate. It is therefore anticipated that fast-growing countries usually experience real exchange rate appreciations as opposed to slow-growing countries. This theory is in contrast with the commonly held view that

depreciation enhances economic growth. It has been subjected to numerous empirical tests5 and found to be relevant in some counties, for example Japan and Korea.

The Balassa-Samuelson Hypothesis is based on the following assumptions: a) there are two sectors in the economy that produce tradable and non-tradable goods, respectively, with the same production function; b) the prices of tradable goods and the interest rate are determined in the world market; c) Purchasing Power Parity holds in the tradable sector; d) labour is perfectly mobile across sectors inside the country, but less mobile between countries; e) wages are led by developments in the tradable sectors, and then translated to the non-tradable sector (wage equalisation across sectors). Given the above assumptions the Balassa-Samuelson Hypothesis is such that:

1. The differentials in productivity growth rates between the tradable goods and non- tradable goods sectors cause relative price changes.
2. The ratio of non-tradable prices to tradable prices is higher in a fast growing country.
3. The ratio of tradable prices across countries remains constant.
4. A combination of 2 and 3 causes a real exchange rate appreciation.

The productivity differential between the tradable and non-tradable sectors is the main determinant of real exchange rates (MacDonald, 2000). Since improvements in the tradable sector productivity are normally linked to economic growth, a correlation between relative economic development and the real exchange rate is also postulated. Thus, it is expected that countries growing faster will tend to experience real exchange rate appreciations with respect to other, slowly growing economies (Solanes and Flores, 2009). This postulation challenges the notion that fast growing countries run depreciated currencies.

The Balassa-Samuelson Hypothesis though applicable in some instances is not in others. It usually suits fast growing countries than slow growing countries. According to Ito et al. (1999), the Balassa-Samuelson Hypothesis may not be applicable when the economy has just come out of being the primary goods exporter or planned economy even if the economy is growing fast.

2.2.4 EXPORT-LED GROWTH HYPOTHESIS

The export-led growth hypothesis postulates that export expansion is a key factor in promoting long-run economic growth. According to Medina-Smith (2001) the export-led growth hypothesis (ELGH) postulates that export expansion is one of the main determinants of growth. This view holds that countries do not only grow by increasing the amounts of labour and capital within the economy, but also by expanding exports. Advocates of export led growth hypothesis argue that exports can perform as an "engine of growth" (Schweicker et al., 2006). Araujo and Soares (2011) contend that stronger exposure to international competition by higher exports is considered to increase the pressure on the export industries to keep costs low and provide incentives for the introduction of technological change. In this vein the growth of exports is seen to have a stimulating influence on productivity of the economy as a whole via externalities of exports on other sectors.

Many industrial economies according to Garnaut et al. (1995) have come to recognize that reliance on world markets, a strategy known as outward looking, gives much greater scope for economic growth than reliance on domestic markets. Outward looking countries, instead of only relying on local markets, can enjoy extended markets abroad which help improve the balance of trade and ultimately exports. James et al. (1989) reckons that the success of the East Asian countries in the 1970s is a result of their adoption of export led growth. James, et al. (1989) further argues that the remarkable growth and industrialization first of Japan, and then of Hong Kong, Taiwan and the Asian tigers (Singapore and Korea) challenged the negativity regarding the applicability of export led growth strategy to other less developed countries.

Agosin (1999) is of the opinion that exports can be a catalyst for income growth, as a component of aggregate demand. The rationale behind this reasoning is that in a small open economy, demand for products is not sustainable in domestic markets to stimulate economic growth. Export markets, in contrast, are almost limitless and hence do not involve growth restrictions on the demand side. Kubo (2011) argued that exporting is beneficial as it enables related firms to avail of certain benefits, such as the enhancement of efficient resource allocation, exploitation of economies of scale, foreign technological knowledge through learning-by-doing and technological innovation stimulated by exposing foreign-market competition.

Palley (2011) believes that export-led growth generates a win–win outcome for developing and industrialized economies. Both the exporter and importer benefit from the global application of the principle of comparative advantage. This is so because export oriented strategies discourage the use of trade barriers and encourage free trade that will at the end benefit the countries involved. Free trade, on the other hand, comes with its own evils, for instance, it can cause an import boom and defeat the same purpose of export growth that countries need to achieve. If unregulated, free trade can lead to dumping whereby countries export poor quality products at cheap prices.

The export-led growth hypothesis is not without its own critiques. One such critique according to Palley (2011) is that in a Keynesian world of demand shortage, trade can reduce domestic demand, leading to reduced output, employment, and national welfare. In the Keynesian world, export subsidies are not a gift but may instead steal demand and employment.

The other criticism leveled against the export-led growth is that it disturbs free trade. Usually exporting countries devalue their currencies to make exports cheaper and reduce imports. This strategy invokes retaliation by other countries which may lead to exchange rate wars, were countries involved devalue their currencies. Also classical economists believe that any employment induced by depreciation is at worst temporary because monetary effects are neutral. Classical economists' standpoint is that money is neutral hence inflation caused by depreciation will not affect the real side of the economy (employment, economic growth and output).

2.3 EMPIRICAL LITERATURE REVIEW

A lot of researchers examined the effect of real exchange rate on economic growth using different methods and countries. They came to different conclusions depending on the country, method and time of study. This section presents the various studies done, the methods used, the countries of research and the results obtained.

I. EMPIRICAL LITERATURE FROM DEVELOPING COUNTRIES

Tarawalie (2010) employed econometric techniques using quarterly data to find the relationship between real effective exchange rates and economic growth in Sierra Leone. He also used a bivariate Granger causality test as part of the methodology to examine the causal relationship between the real exchange rate and economic growth. The empirical results suggest that the real effective exchange rate correlates positively with economic growth, with a statistically significant coefficient. These results which show a positive correlation between real effective exchange rate and economic growth are supported by the Balassa-Samuelson hypothesis.

Ndlela (2011) investigated implications of Real Exchange Rate Misalignment in developing countries with particular reference to growth performance in Zimbabwe. The study followed ARDL (autoregressive distributed lag) approach to the co-integration method. The main advantage of the ARDL method is that it can be applied irrespective of whether the variables are I(0), I(1) or fractionally integrated. The main findings show that exchange rate misalignment exerts a negative and highly statistically significant impact on growth. Also the findings support the notion that real exchange rate overvaluation was a key fundamental in the post-2000 economic growth contraction in Zimbabwe. In turn, Masunda (2011) investigated the impact of real exchange rate misalignment on sectoral output in Zimbabwe. To achieve this, the feasible generalized least squares panel data techniques using data for the period between 1980 and 2003 from a sample of Zimbabwean sectors that include agriculture, manufacturing and mining sectors was employed. The study indicated that real exchange rate misalignment is harmful to sectoral output. The findings of the study were that undervaluation negatively affects the sectoral output while exchange rate overvaluation negatively and significantly affects sectoral output.

McPherson et al. (2000) studied the direct and indirect relationship between the real and nominal exchange rates and GDP growth in Kenya for the period 1970 to 1996. A number of approaches that include the following: single equation regressions, a system of simultaneous equations, and a VAR model test and co-integration techniques were used. The results of the study showed no evidence of a statistically significant strong direct relationship between changes in the exchange rates and GDP growth, rather growth responds to fiscal, monetary policy and foreign aid. The results of this study are not supported by the theories reviewed in this chapter.

Acar (2000) studied the effects of depreciation on output growth in Less Developed Countries (LDCs). Data from 18 sample countries in a fixed-effect procedure were employed. LDCs were divided into two categories and two different regression analyses were conducted. Data from a group of 10 countries for both manufacturing product exporters as well as agricultural and primary product exporters to estimate a model of real output behavior for a period of 25 years were used. Data (for a 20 year period) from two different groups of countries (8 manufacturing exporters, 8 agricultural and primary exporters) were analyzed to investigate if there exists a qualitative difference between different countries in terms of the effect of devaluation on economic growth. The results indicate that depreciation creates a contractionary effect on output in the first year, whereas it has an expansionary effect in the following year.

Aguirre and Calderon (2005) evaluated the growth effects of real exchange rates (RER) misalignments and their volatility. Real exchange rates misalignments are calculated as deviations of actual real exchange rates from their equilibrium. The study covered the period 1965-2003 for 60 countries using panel and time series co-integration methods. The study employed the dynamic data techniques and the findings of the study were that real exchange misalignments negatively affect growth though the effects are non-linear, for instance, growth declines are larger in direct proportion with the size misalignments. The study's other findings were that although larger undervaluations hinder growth, small to moderate currency undervaluation enhance growth. The other finding is that growth is hampered by highly volatile real exchange rate misalignments.

Munthali et al. (2010) used a simple univariate model of GARCH to investigate the impact of the real exchange rate on economic growth in Malawi. The results show that real effective exchange rate (REER) volatility has adverse effects on economic performance. Also, an appreciated REER

is significantly and positively correlated with economic growth, reflecting Malawi's net-importer position. In contrast, REER volatility is significantly and negatively correlated with growth, reflecting investors' preference for a stable exchange rate. The positive relationship between real exchange rate and economic growth was also found in Nigeria. Akpan (2008) used the ordinary least squares (OLS) technique to investigate the link between the foreign exchange market and economic growth in an emerging petroleum-based economy (Nigeria) for the period between 1970 and 2003. The paper maintains that there is a positive relationship between the exchange rate, volatility and economic growth in Nigeria. Both these studies concurred with the Balassa-Samuelson Hypothesis.

Domac and Shabsigh (1999) examined the effect of real exchange rate misalignment on the collective economic growth of Egypt, Jordan, Morocco and Tunisia. The study constructed three measures of exchange rate misalignment based on the purchasing power parity, a black market exchange rate and a structural model. The results of the study were that real exchange rate misalignments, especially overvaluation, have adverse effects on growth.

The review of literature from developing countries presents mixed results, for instance, Tarawalie (2010) and Akpan (2008) found a positive correlation between exchange rates and economic growth. These results support the Balassa-Samuelson hypothesis. Acar (2000) confirmed the Structuralist approach that devaluations may be contractionary to growth. Aguirre and Calderon (2005), Domac and Shabsigh (1999) are aligned to the traditional approach that devaluations enhance economic growth. McPherson, Rakovski and Kennedy (2000) however found no direct relationship between exchange rates and economic growth. Exchange rate volatility also has negative effects on growth as is the case in Munthali et al. (2010).

Due to unavailability of data there is no significant research output on the effect of devaluation in Ethiopian economy. On the other hand, the empirical study on this topic that focus on Ethiopia has been extremely limited. Taye (1999) as cited in El-Ramly and Abdel-Haliem, (2008), "used a macro simulation approach to a macroeconomic model for Ethiopia. His finding indicated that devaluation has positive impact on the current account balance, because of the reduction in import and an increase in export, while it decreases output and employment."

According to Tirsit (2011), devaluation has contractionary effect in the short run. She used variables like private investments, openness, education, war beside the exchange rate and the

ordinary least squares (OLS) technique and found devaluation in Ethiopia has expansionary effect on output in the long run. In turn Yilkal W. (2012) analyzed the short and long run effect of currency devaluation on output growth in Ethiopia by using quarterly time series data over the period ranging from 1997/98 to 2009/10 and employing a Vector Auto regression model. He found that currency devaluations are contractionary in the long run and neutral in the short- run.

In conclusion, the reviewed studies from developing countries predicted mixed results concerning the effect of exchange rate on economic growth. Results demonstrated that economic growth reacts differently to an overvaluation or undervaluation of the currency in different countries. In some instances real exchange rate devaluations had a negative impact on economic growth, while in others a positive impact existed. Although a general conclusion on the effect of real exchange rate on economic growth in developing countries cannot be easily determined, the researcher based on cited researches (Domac and Shabsigh, 1999; Akpan, 2008; Tarawali, 2010, Tirsit 2011) are of the view that to a greater extent currency undervaluations are expansionary to economic growth in developing countries. To a lesser extent however, economic growth responds positively to currency overvaluations.

Though there is mixed results for the effect of devaluation on output among researchers, the current Ethiopian government uses devaluation as instrument for exchange rate policy to improve the balance of trade and the economic growth. Hence, the main objective of this paper is to examine the effect of exchange rate adjustments on output growth in Ethiopia.

CHAPTER THREE

3. DATA AND METHODOLOGY

3.1 INTRODUCTION

This chapter presents the research design, the theoretical framework and the empirical model. It also presents the data type and the data source, definitions, measurements and expected signs of variables, testing techniques for variables and diagnostic test techniques for residuals.

3.2 RESEARCH DESIGN

The study made use of the quantitative research design because of the quantifiable and the numerical data that is produced in the process. This research dealt with the manipulation of the empirical variables from time series data for the period 1985/86 to 2014/15. This period ranges from end of socialist Derg regime and coming of EPRDF in Ethiopia with various government policies and reforms. These include trade reforms, exchange rate policies and other global reforms like the liberalization of the economy and the Structural Adjustment Programs (SAPs).

3.3 DATA TYPE AND SOURCES

Due to the very nature of the study, the only source of data used in this study is secondary data sources based on a country level macroeconomic data. The Annual time series data for the period 1985/86 to 2014/15 on real gross domestic product, real effective exchange rate, government final consumption expenditure, gross fixed capital formation, broad money supply and trade openness were gathered from Ministry of Finance and Development and National Bank of Ethiopia. The choice of the period is basically based on the availability of data.

3.4 METHOD OF DATA ANALYSIS

Descriptive as well as Econometric methods are employed to discuss and analyze different issues in this study. In the descriptive technique, statistical and time series properties such as means, standard deviations, maximums, minimums and correlation matrices are used. These measurements are used to show the trending behaviour of economic growth with respect to real effective exchange rate and other variables. In the Econometric method part, emphasis is placed on investigating the effects of Real Effective Exchange Rate on the growth of Real Gross Domestic Product.The data is analyzed using EViews 8 software. The nature of the model is

given in natural logarithmic form to make the analysis and interpretation of the results easier in terms of percentage and growth rate.

3.5 MODEL SPECIFICATION

This study modifies (Acar, 2000) model. The reduced form equation for output in this model is formally specified below. Herebroad money supply is used instead of money supply term.

$y_t = \alpha + \gamma T + \beta_1 G_t + \beta_2 \Delta M_t^s + \beta_3 TT_t + \beta_4 E_t + e_t$ 1

Where

y_t: Real output

α : Constant term

γ : Parameter that captures the trend rate of growth

T: Time period

G: Relative size of government (the ratio of government expenditures to nominal output)

M^s: Money supply term (the difference between actual and expected rate of growth of nominal money supply)

TT: Terms of trade

E: Real exchange rate

ε: Error term with mean zero and constant variance.

The main objective of this study is to investigate the effect of the exchange rates on real economic growth (GDP). An output growth model specified as follows:

$Y = \beta_0 + \beta_1 REER + \beta_2 GFCE + \beta_3 GCF + \beta_4 M2 + \beta_5 TO + \varepsilon$ 2

Where:

β_0: The intercept

$\beta_1, \beta_2, \beta_3, \beta_4$ and β_5: Coefficients of the explanatory variables,ε: Error term which represents omitted variables and other errors in the specification of the model, RGDP: real gross domestic product, REER:real effective exchange rates, GFCE: government final consumption expenditure, GCF: gross fixed capital formation, M2: broad money supply, TO: trade openness.

To obtain elasticity coefficients and remove the effect of outliers, the variables have to be transformed to natural logarithms.

This can econometrically stated as:

$lnRGDP_t = \beta_0 + \beta_1 lnREER_t + \beta_2 lnGFCE_t + \beta_3 lnGCF_t + \beta_4 lnM2_t + \beta_5 lnTO_t + e_t$……...3

Where;

ln$RGDP_t$= Log of real gross domestic product

lnREER= Log of real effective exchange rate index

lnGFCE= Log of government final consumption expenditure

lnGFCF= Log of gross fixed capital formation

lnM2=Log of liquid liability or broad money supply

lnTO= Log of trade openness index

I. DEFINITION AND MEASURMENT OF VARIABLES

All of the variables included in the above model are stated in terms of natural logarithm. The reason behind taking the natural logarithm of the variables is that, it enables to correct skewed data into normal distribution which is a critical assumption in econometric estimation (Verbeek, 2004).

Natural Log of real gross domestic product: It represents real income or real gross domestic product. Real gross domestic product refers to the value of all final goods and services produced within the territory of a given country in a given period, usually a year. It is calculated at constant price. Since most economists argue that economic growth can be measured as growth in real GDP, it includes in the model as main dependent variable in order to measure economic growth. In order to avoid the inconsistency associated with different base year price while computing real GDP, this study was used the real GDP (constant value), which is deflated by Ministry of Finance and Economic Development (MoFED) based on the constant price of 2010/11 G.C. or 2003 E.C.

Natural Log of real effective exchange rate:As the measure of real exchange rate, Ipreferred to use multilateral real effective exchange rates instead of bilateral real exchange rates since they

can move in different, and even opposite directions after the collapse of Bretton Woods's system. The use of bilateral indexes can result in misleading and incorrect inferences regarding the evolution of a country's degree of competitiveness. Therefore, it is necessary to use a multilateral index of real exchange rate especially when evaluating policy related situations. Real effective exchange rate of 16 major trade partners (Djibouti, Kenya, Sudan, U.A.R, France, Germany, Italy, Netherlands, U.K., Russia, Yugoslavia, U.S.A.,China, P.Rep., Japan, and Saudi Arabia) instead of frequently used bilateral (usually against USD) real exchange rate was chosen because it is richer measure of competitiveness. Also Ethiopia trade is not only against the United States of America but against more countries hence an average for these trading partners is a more realistic measure.

Natural Log of government final consumption expenditure: Itis the government expenditure on goods and services that are used for the direct satisfaction of individual needs or collective needs of members of the community.It includes all government current expenditures for purchases of goods and services.

Natural Log of trade openness index: Itis the measure of openness to trade. In this study, trade intensity or trade ratio import plus export divided by GDP used as proxy for trade openness. The reason behind applying trade ratio as a measure of trade openness is that it popular measure of trade openness and it is widely used by various researchers. All variables are expressed in current prices. I used GDP deflator to make it real.

Natural Log of gross fixed capital formation: It is the net increase in physical assets (investment minus disposals) within the measurement period. It is proxy used to measure net investment.

Natural Log of broad money supply: Money supply is the amount of money within a specific economy available for purchasing goods or services. For the purposes of this study, the broad definition money supply (M2) is adopted which includes all bank notes and coins in circulation plus all deposits of the domestic private sector with banking institutions. The rationale behind choosing M2 as proxy for money supply is that it has a stable relationship with the domestic demand compared to M1.

M1 money is narrow money supply which used as transaction purpose and immediate repurchase. Narrow money means primary intended for transaction purpose, like checkable

deposits, traveler checks, demand deposit and currency apprehended by the public. M2 is defined as broad money supply and the national bank of Ethiopia used as a policy instrument to stabilize the economy. Broad money is a measure of the domestic money supply that includes M1 money. M2 money can be used for spending.

II. EXPECTED SIGNS

The parameter β_1 captures the effect of real effective exchange rate on output growth. For the purpose of this study, the sign of this parameter is critical. As long as the parameter is statistically significant, a positive sign will indicate an expansionary, while a negative sign will indicate a contractionary effect. An increase in government final consumption expenditure reduce the resources available for investment and can be contractionary and hence$\beta_2$is expected to be negative. $\beta_3$is expected to bepositive as a rise in gross fixed capital formation is expansionary to economic growth. β_4 and $\beta_5$are also expected to be positive because an increase in money supply and trade openness are expected to affect output positively.

Table 3.1: Expected sign of the independent variables

Variables	Expected signs
Real effective exchange rate	+/-
Government final consumption expenditure	-
Gross fixed capital formation	+
Broad money supply	+
Trade openness	+

3.6 UNIT ROOT TESTS

Stationarity is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time (Challis and Kitney, 1991). The assumption of the classical regression model necessitate that both the dependent and independent variables be stationary and the errors have a zero mean and finite variance. According to Newbold and Granger (1974) the effects of non stationarity includes spurious regression, high R^2 and low Durbin-Watson (dw) statistic. Below are basic reasons why data must be tested for non stationarity.

First, the stationarity or otherwise of a series can strongly influence its behavior and properties, for instance, persistence of shocks will be infinite for non-stationary series. Secondly, if two variables are trending over time, a regression of one, on the other hand, could have a high R^2 even if the two are totally unrelated and this is known as spurious regressions. Thirdly, if the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will be invalid. In other words, the usual “t-ratios” will not follow a t-distribution, so it is impossible to validly undertake hypothesis tests about the regression parameters (Bowerman and O'connell, 1979).

I. **Augmented Dickey-Fuller (ADF) test**

The augmented dickey fuller test modifies the work done by Dickey and Fuller (1979 and 1976 respectively).The aim of the Dickey Fuller theory was to test the hypothesis that $\emptyset = 1$ in:

$y_t = \emptyset y_{t-1} + \mu_t$ 4

Thus, the hypotheses are formulated:

H_0: Series contains a unit root H_1: Series is stationary.

The rejection of the null hypothesis under these tests means that the series does not have a unit root problem.

The standard Dickey Fuller test estimates following equation:

$\Delta y_t = \beta_1 + \beta_{2t} \varphi y \varepsilon_{t-1} + \mu_t$ 5

Where y_t is the relevant time series, Δ is a first difference operator, t is a linear trend and μ_t is the error term. The error term should satisfy the assumptions of normality, constant error variance and independent error terms. According to Gujarati (2004) if the error terms are not independent in equation (4), results based on the Dickey-Fuller tests will be biased.

The weakness of the DF test is that it does not take account of possible autocorrelation in the error process or term (μ_t). Clemente, et al (1998) noted that a well–known weakness of the Dickey–Fuller style unit root test with I(1) as a null hypothesis is its potential confusion of structural breaks in the series as evidence of non-stationarity.

Blungmart, (2000) stated that the weakness of the Dickey-Fuller test is that it does not take account of possible autocorrelation in error process, ε_t. If$\varepsilon_t$is auto-correlated, then the OLS estimates of coefficients will not be efficient and t-ratios will be biased. In view of the above mentioned weaknesses the Augmented Dickey-Fuller test was postulated and is preferred to the Dickey-Fuller test.

The presence of serial correlation in the residuals of the Dickey-Fuller test biases the results (Mahadeva and Robinson, 2004). When using the Dickey-Fuller test the assumption is that

theerror terms $\varepsilon_t$are uncorrelated. But in case the$\varepsilon_t$are correlated, Dickey and Fuller developed a test, known as the Augmented Dickey-Fuller test to cater for the above mentioned problem.

The Dickey-Fuller test is only valid where there is no correlation of the error terms. If the time series is correlated at higher lags, the augmented Dickey-Fuller test constructs a parameter correction for higher order correlation, by adding lag differences of the time series. The Augmented Dickey-Fuller test estimates the following equation:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta y_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

Where ε_t is a pure white noise error term and where $\Delta y_{t-1} = (y_{t-1} - y_{t-2}), \Delta y_{t-2} = (y_{t-2} - y_{t-3})$, etc. According to Gujarati (2004) the number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in (4.5) is serially uncorrelated. In ADF as in DF the test is whether $\delta = 0$ and the ADF test follows the same asymptotic distribution as the DF statistic, so the same critical values can be used.

The calculated value of ADF is then compared with the critical value. If the calculated value is greater that the critical, we reject the null hypothesis that the series have unit root, thus confirming that the series are stationary.

In a nutshell Gujarati (2004) states that an important assumption of the DF test is that the error terms μ_t are independently and identically distributed. The ADF test adjusts the DF test to take care of possible serial correlation in the error terms by adding the lagged difference terms of the regressand.

II. **Phillips-Perron (PP) Tests**

The Phillips-Perron tests are a more comprehensive theory of unit root non-stationarity. Gujarati (2004) states that the Phillips-Perron use non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. According to Brooks (2008) the tests are similar to ADF tests, but they incorporate an automatic correction to the DF procedure to allow for auto correlated residuals. The PP test and the ADF test have the same asymptotic distribution. Brooks (2008) explains that the PP tests often give the same conclusions as, and suffer from most of the same important limitations as, the ADF tests.

3.7 JOHANSEN CO-INTEGRATION TEST AND VECM

When dealing with time series data, there is need to check if the individual time series are either stationary or that they are co-integrated. If that is not the case, there is great chance of engaging in spurious (or nonsense) regression analysis (Gujarati, 2010). If two series appear to move together over time, it suggests that there exist an equilibrium relationship. This therefore shows that even though the variables are non-stationary in the short run if they are co-integrated, they will move closely together over time and their difference will be stationary.

The vector autoregressive (VAR) model is a general framework used to describe the dynamic interrelationship among stationary variables. Dolado *et al*. (1999) states that if the time series are not stationary then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences (for instance, I (1)). The VEC can also take into account any co-integration relationships among the variables.

In order to justify the use of vector error correction model (VECM) there is need to test for co-integration. A VECM is intended to be used with non-stationary series that are known to be co-integrated. Brooks (2008) contends that the VECM has co-integration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. Brooks (2008) also states that the co-integration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments estimated. Thus, the presence of a co-integration relation(s) forms the basis of the vector error correction model (VECM) specification.

There are several methods of testing for co-integration, but two often stand above the rest namely the Engle-Granger approach which is residual based and the Johansen and Julius (1990) technique which is based on maximum likelihood estimation on a VAR system. Brooks (2008) argues that the problems of the Engle-Granger approach include lack of power in unit root tests, simultaneous equation bias and the impossibility of performing hypothesis tests about the actual co-integration relationships.

In light of the above mentioned shortfalls of the Engle-Granger approach this study applies the vector error correction modeling (VECM) by Johansen (1991; 1995). The rationale behind being that this approach applies maximum likelihood estimation to a vector error correction (VEC) model to simultaneously determine the long run and short run determinants of the dependent variable in a model. This approach also provides the speed of adjustment coefficient, which measures the speed at which Gross Domestic Product reverts to its equilibrium following a short term shock to the system (Greene, 2000).

I. JOHANSEN TECHNIQUE BASED ON VARs

According to Greene (2000) the following steps are used when implementing the Johansen procedure:

Step 1: Testing for the order of integration of the variables under examination. All the variables should be integrated of the same order before proceeding with the co-integration test.

Step 2: This step involves setting the appropriate lag length of the model. Also in the step is the estimation of the model and the determination of the rank of Π.

Step 3: With regards to the deterministic components in the multivariate system the choice of the appropriate model is made. An analysis of the normalized co-integrating vector(s) and speed of adjustment coefficients is made.

Step 4: Step 4 includes the determination of the number of co-integrating vectors. Causality tests on the error correction model to identify a structural model and determine whether the estimated model is reasonable is done in this last step.

After ascertaining the existence of co-integrating relationships, the vector error correction model (VECM) is estimated to test for the short-run dynamics. We consider the following VAR of order P:

$$y_t = A_1 y_{t-1} + \cdots A_p y_{t-p} + Bx_t + \varepsilon_t \quad \text{.....7}$$

Where,

y_t is a k-vector of non-stationary I(1) variables, x_t is a d-vector of deterministic variables, and ε_t is a vector of innovations. In order to use the Johansen test, the VAR (4.6) above needs to be turned into a VECM specification (Brooks, 2008). We may rewrite this VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i-1}^{p-1} \Gamma_i \Delta y_{t-1} + Bx_t + \varepsilon_t \quad \ldots\ldots 8$$

Where:

$$\Pi = \sum_{i-1}^{p} A_i - I, \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j \quad \ldots\ldots 9$$

Granger's representation theorem asserts that if the coefficient matrix has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is I(0). R is the number of co-integration relations (the co-integration rank) and each column of β is the co-integrating vector. The elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π (Green, 2007).

3.8 IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSIS

I. IMPULSE RESPONSE ANALYSIS

The impulse response analysis traces out the responsiveness of the dependent variable in the VAR to shocks to each of the other variables. In this study therefore, it shows the sign, magnitude and persistence of real and nominal shocks to the real growth. Brooks (2008) further states that impulse response analysis is applied on the VECM and, provided that the system is stable, the shock should gradually die away. This study applies the generalized impulse response analysis. Lutkepohl (1993) cited in Rusike (2007) explains that this approach fully takes into account historical patterns of correlations amongst the different shocks.

II. VARIANCE DECOMPOSITION ANALYSIS

After performing the impulse response analysis further information on the link between economic growth and exchange rates is found using the variance decomposition analysis. Brooks (2008) explains that variance decomposition analysis provides the proportion of movements in the dependent variables that are due to its own shocks and against shocks to other variables.

3.9. DIAGNOSTIC CHECKS

The diagnostic tests are very important in the analysis of the effect of exchange rate adjustments on economic growth in Ethiopia because it validates the parameter estimation outcomes achieved by the estimated model. Diagnostic checks test the stochastic properties of the model such as residual autocorrelation, heteroscedasticity and normality, and many more. These mentioned tests are applied in this study and, hence, they are briefly discussed below.

I. HETEROSCEDASTICITY

The OLS makes the assumption that $V(\varepsilon_j) = \sigma^2$ for all j. That is, the variance of the error term is constant a condition termed homoscedasticity. If the error terms do not have constant variance, they are said to be heteroscedastic. The study employs the White heteroscedasticity test. According to Greene (2000) white test computes the White (1980) general test for heteroscedasticity in the error distribution by regressing the squared residuals on all distinct regressors, cross-products, and squares of regressors. The test statistic, a Lagrange multiplier measure, is distributed Chi-squared (p) under the null hypothesis of homoscedasticity. The null

hypothesis for the White test is homoscedasticity and if we fail to reject the null hypothesis then we have homoscedasticity. If we reject the null hypothesis, then we have heteroscedasticity.

II. RESIDUAL NORMALITY TEST

The assumption of normality is $\varepsilon_t \sim N(0, \sigma^2)$. The null is that the skewness (α_3) and kurtosis (α_4) coefficients of the conditional distribution of y_t (or, equivalently, of the distribution of ε_t) are 0 and 3, respectively:

H_0 : α_3 =0(if $\alpha_3 < 0$ then f (y_t/x_t) is skewed to the left)

$\alpha_4 = 3$ (if $\alpha_4 > 0$ then f (y_t/x_t) is leptokurtic)

The above assumptions can be tested using the Jarque-Bera test (JB). The JB test follows the null hypothesis that the distribution of the series is symmetric. The null hypothesis of normality would be rejected if the residuals from the model are either significantly skewed or leptokurtic (or both).

III. AUTOCORRELATION LM TESTS

Serial correlation happens when the error terms from different time periods (or cross-section observations) are correlated. In time series studies it occurs when the errors associated with observations in a given time period carry over into future time periods. Serial correlation (also called autocorrelation) in the residuals means that they contain information, which should itself be modeled. The Durbin-Watson statistic is used in the study to test for the presence of first order serial correlation in the residuals. The null hypothesis is no serial correlation($H_0 := 0$). The DW statistic lies in the 0 to 4 range, with a value near 2 indicating no first order serial correlation. The Lagrangian Multiplier was used to test for serial correlation.

CHAPTER FOUR

4. EMPIRICAL ANALYSIS AND DISCUSSIONS

4.1 INTRODUCTION

Results from this chapter explains the effect of exchange rates on economic growth in Ethiopia using annual data for the period between 1985/86 and 2014/15. This chapter is divided into two sections.The first section of the chapter dealt with the descriptivenatureof variables and trend of real exchange rate and economic growth in the period under consideration. The second section of the chapter is presented the econometric analysis results with discussions and the impulse response and variance decomposition analysis. The finallypresented diagnostic checks on the residuals of VECM.

4.2. DISCRIPTIVEDATA ANALYSIS

Table 4.1: Summary statistics

	LNRGDP	LNREER	LNGFCE	LNGCF	LNM2	LNTO
Mean	26.19546	4.937026	24.01997	24.80121	20.43848	-1.462662
Std. Dev.	0.559782	0.319283	0.512883	0.803108	0.533865	0.390637
Maximum	27.34070	5.651643	25.02938	26.72523	21.53243	-0.987332
Minimum	25.49257	4.538796	23.08347	23.54193	19.55608	-2.513022
Observations	30	30	30	30	30	30

Table 4.1 presents the summary statistics of the variables used to define real GDP growth in this study. It shows the number of observations, means, standard deviations, minimum and maximum values of each variable. All the variables have 30 observations. The average values of all variables are positive. Almost all variables have minimal standard deviations. The maximum and the minimum values show that the range is small and almost similar over all variables.

Table 4.2: Correlation matrix between the independent variables

Correlation	LNREER	LNGFCE	LNGCF	LNM2	LNTO
LNREER	1.000000				
LNGFCE	-0.341123	1.000000			
LNGCF	-0.266019	0.888039	1.000000		
LNM2	-0.375362	**0.897445**	**0.947570**	1.000000	
LNTO	-0.666766	0.784638	0.781967	0.786584	1.000000

The correlation matrix, given by table 4.2, may give a clue to identify which variables to consider in the main analysis. It shows whether the degree of correlation between any two explanatory variables is high or low. If two explanatory variables are highly [perfectly] correlated, it would be difficult to identify the independent impact of each explanatory variable on the dependent variable. In this case a formal test of multicollinearity has to be conducted to determine whichvariable to retain and which one to exclude from the final analysis. The informal test of correlation matrix suggests the exclusion of one or more of the variables with the highest value in the matrix. I can start with natural logarithm of broad money supply (M2) which has the highest score with at least two variables.

However, the correlation matrix provides only a clue and thus a formal test of multicollinearity has to be conducted to determine the variables entering the analysis.

Table 4.3: Variance Inflation factors of a full model

Variable	VIF	1/VIF
LNREER	3.022626	0.3308
LNGFCE	6.035149	0.1574
LNGCF	9.014081	0.11093
LNM2	9.260110	0.10799
LNTO	6.777121	0.14755
Mean	6.82181	

A formal test of multicollinearity is conducted with the help of variance inflation factor [VIF]. VIF shows how much the variance of a coefficient is "inflated" because of linear dependence with other predictors. A variable that has a VIF value of greater than 10 require further investigation. The level of tolerance defined as 1/VIF is also used to check the degree of collinearity among the independent variables. A variable with a tolerance value lower than 0.1 is considered as a linear combination of other independent variables (Eviews 3.1 User's Guide; 1999).

Table 4.3 shows VIF values of all variables are less than 10 and the level of tolerance 1/VIF values are also greater than 0.1. Thus variables are not a linear combination of other independent variables.

4.2.1 EXCHANGE EFFECTIVE EXCHANGE RATE AND ECONOMIC GROWTH

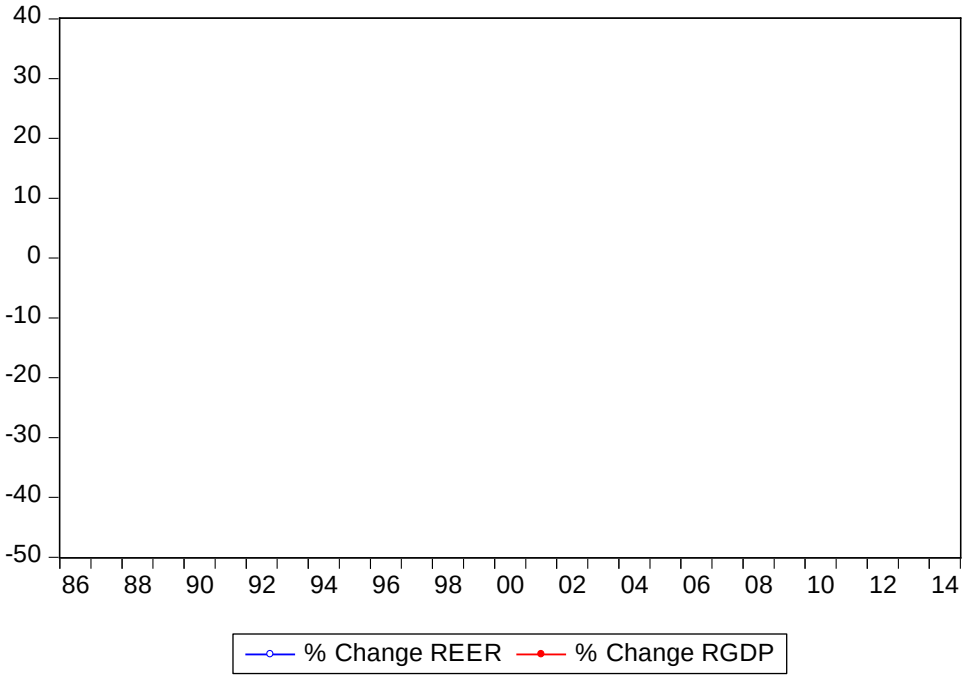

Figure 4.1: Trend of real effective exchange rates and Real GDP in percentage changes

The graphs of real effective exchange rate and real GDP are plotted against time on fig. 4.1. They seem to follow inverse trend for most of the study period. A decrease/increase in real effective exchange rate represents depreciation/appreciation of the domestic currency in this study. Except for years after the 2004, a decrease/depreciation of the real effective exchange rate is

accompanied by a fairly stable movement in the real gross domestic product. Before the reform period the real effective exchange rate declines/depreciates sharply and rises/appreciates suddenly after the reform period 1992 until 1999.

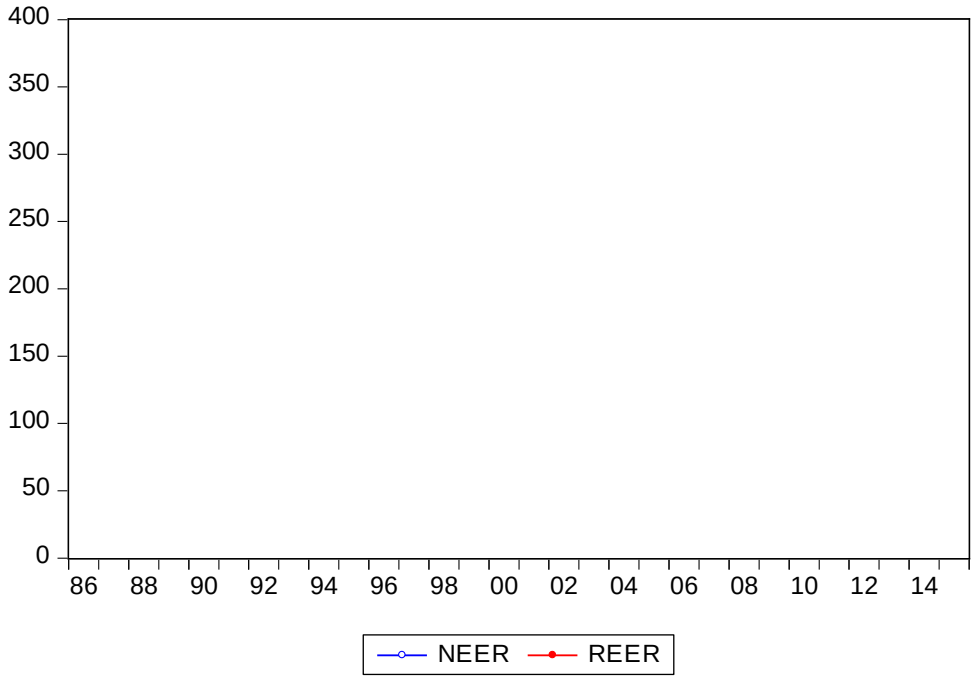

Figure 4.2: Trends in real effective exchange rates and nominal effective exchange rates: Average for the period - 16 trading partners

From the above line chart the real effective exchange rate less than nominal effective exchange rate shows the undervaluation of birr while the revers implies the overvaluation of birr. The real effective exchange rate starts to decline and move closely with nominal effective exchange rate from the beginning of the current government. It confirms that decline in REER is real devaluation as per the National Bank of Ethiopia's computation. Real effective exchange rate is defined as a composite of nominal exchange rate, price indices [foreign and domestic] and trade weights. Any change in either price indices and/or trade weights of trading partners has the power to affect/change the real effective exchange rate. Changes in one of these factors could be the reason for the variation of real effective exchange rate and nominal effective exchange rate for the period prior to 1992[reform period] though the nominal exchange rate was fixed. After the reform period, the nominal exchange rate is partly determined by the demand for and supply of foreign exchange among the commercial banks. Therefore, in addition to the above factors, any

change in demand for and supply of foreign exchange of the inter-banks market, also affects the real effective exchange rate during this period.

Ethiopia's inflation is currently higher than all its trading partners included in my analysis. As a result, despite depreciation pressure, NBE's real effective exchange rate calculation shows rapid ETB appreciation in recent years. An overvalued exchange rate is hampering the competitiveness of Ethiopia. The authorities have continued to favor gradual ETB depreciation but real effective exchange rate appreciation reveals increasing pressure for more significant devaluation. The ETB has depreciated gradually so far this year. However, ongoing deterioration of Ethiopia's current account position for the coming years will likely increase pressure on the authorities to devalue the currency on a larger scale. The authorities remain focused on improving export performance. Infrastructure development and reforms to improve the investment environment are key to increasing investment and enabling export-led sectors such as manufacturing to develop further. Increasing power-sector capacity and infrastructure projects including rail and road remain important in GTP II. The authorities are targeting huge investment spending on industrial parks over the next 10 years. This should help drive manufacturing performance over the medium term, but concerns remain about the affordability of such plans. Since export performance has been sluggish, hampered by softer commodity price trends and weak commodity exports; all of which has contributed to a wider trade deficit.

4.3 TESTS OF THE TIME SERIES DATA

4.3.1STATIONARITY TESTS

The opening stage of the Johansen procedure is to test for stationarity in time series. There are two main methods to test whether time series are stationary or not, namely; the graphical method which is informal and then the formal test. This study first presents the visual plot of graphs before the formal tests. The formal tests conducted are the Augmented Dickey-Fuller and the Phillips-Peron tests. These tests are very important as they give insight into the structural breaks, trends and stationarity of the data set (Brooks, 2008).The graphical results from the test for stationarity are presented in Appendix A and B. The informal method, however, is not enough to conclude that data is stationary as it is informal, hence the need for a more formal method to complement it. Consequently, other formal tests were conducted to support findings from the

graphical findings. In this regard, the Augmented Dickey-Fuller and the Phillips-Peron tests were adopted and the results are presented in Table 4.1(a) and 4.1(b) below.

Table 4.4 Stationarity results of the Augmented Dickey-Fuller test

Augmented Dickey-Fuller				
Order of integration	Variable	Intercept	Trend and Intercept	None
Level	LRGDP	2.932315	-0.331735	6.598178
1st difference	DRGDP	-3.918600***	-6.205928***	-0.20437
Level	LREER	-2.084972	-1.784539	-0.757074
1st difference	DREER	-4.201641***	-4.111850**	-4.254503***
Level	LGFCE	-0.202638	-1.804557	1.676351
1st difference	DGCFE	-4.098026***	-4.138530**	-3.911547***
Level	LGCF	1.526031	3.927666	2.693409
1st difference	DGCF	-5.081032***	-3.894111**	-1.221451
Level	LM2	0.701184	-1.555282	4.975718
1st difference	DM2	-2.05602	-2.190841	-2.973099***
Level	LTO	-0.985783	-2.060605	-0.946412
1st difference	DTO	-4.485758***	-3.450428*	-4.489703***
1%	Critical values	-3.689194	-4.323979	-2.650145
5%		-2.971853	-3.580623	-1.953381
10%		-2.625121	-3.225334	-1.609798
Values marked with a *** represent stationary variables at 1% significance level, and ** represent stationary at 5% and * represent stationary variables at 10%.				

Table 4.4 shows that the test in intercepts, intercepts and trends and none revealed that all the variables in levelswere not stationaryas reflected by the non-rejection of the null hypothesis at both 1% and 5 % significance levels. All the differenced variables test in intercepts were stationary at 1% significance level; hence the null hypothesis of unit root is rejected. For the test under trend and intercept and no trend and no intercept data series were all stationary at 1% and 5% significance level respectively.

Table 4.5 Stationarity results of the Phillips-Perron test

Phillips-Perron				
Order of integration	Variable	Intercept	Trend and Intercept	None
Level	LRGDP	2.932315	-0.331735	4.864413
1st difference	DRGDP	-4.168828***	-6.769424***	-2.386941**
Level	LREER	-2.103499	-1.747646	-0.835676
1st difference	DREER	-4.065072***	-3.967384**	-4.132922***
Level	LGFCE	-0.335725	-1.999084	1.643656
1st difference	DGCFE	-3.963587***	-4.126317**	-3.825801***
Level	LGCF	2.310291	-0.893955	2.708496
1st difference	DGCF	-5.081270***	-6.187912***	-4.357662***
Level	LM2	1.016686	-1.723237	5.579397
1st difference	DM2	-4.563617***	-5.849393***	-2.968891***
Level	LTO	-1.151022	-2.21516	-0.838591
1st difference	DTO	-4.467832***	-4.380167***	-4.431264***
1%	Critical values	-3.689194	-4.323979	-2.650145
5%		-2.971853	-3.580623	-1.953381
10%		-2.625121	-3.225334	-1.609798
Values marked with a *** represent stationary variables at 1% significance level, and ** represent stationary at 5% and * represent stationary variables at 10%.				

Table 4.5 shows the Phillips-Perron test results are similar to ADF tests, but they incorporate an automatic correction to the DF procedure to allow for auto correlated residuals. For variables in levels, the test in intercepts revealed that all of the variables were not stationary. All differenced variables on intercept were stationary at 1% significance level. On trend and intercept all variables were non-stationary in levelsbut all variables on trend and intercept were stationary at 1% and 5% significance level when first differenced. For the test under no trend and no intercept,

all variables in levels were non-stationary. When first differenced, all the variables were stationary at 1% and 5% significance level.

Both methods used to test for stationarity significantly revealed that the data series were nonstationary in levels and stationary when first differenced. Therefore, the series are integrated of the sameorder I(1).

4.4. TESTS FOR COINTEGRATION

If the variables are integrated of the same order, it is very important to determine whether there exists a long-run equilibrium relationship amongst them. Co-integration describes the existence of an equilibrium or stationarity relationship between two or more times series each of which is individually non stationary. For the purposes of this study co-integration examines the long run relationship between the real gross domestic product and its determinants. It is very important to assess whether there exists long run relationships between real gross domestic product and the chosen determinants, in order for a viable economic conclusion to be reached from the results obtained. The co-integration approach allows researchers to integrate the long run and short run relationship between variables within a unified framework (Andren, 2007). The Johansen co-integration approach is preferred over the Engle and Granger residual-based methodology to test for co-integration because of the obvious reasons mentioned in Chapter four.

Since all variables are non-stationary in level, the next procedure is to test for the existence of long run relationships among the variables in the model. The co-integration test using Johansen test requires the estimation of a VAR equation. The variables i.e. LNREER, LNRIR, LNGFCE, LNGCF, LNM2 and LNTO are entered as endogenous variables. Table 4.6 below presents the co-integration test results.

Table 4.6: Testing for co-integration in Johansen-Juselius procedure

Null hypothesis	Alternative hypothesis	Computed statistics: Order of VAR = 1	5% Critical values	Hypothesized No. of CE(s)
The Co-integration Rank Test (Maximum Eigenvalue)				
$r = 0$	$r = 1$	40.92424	40.07757	None *
$r = 1$	$r = 2$	26.58033	33.87687	At most 1
$r = 2$	$r = 3$	17.46233	27.58434	At most 2
$r = 3$	$r = 4$	16.14304	21.13162	At most 3
$r = 4$	$r = 5$	8.552719	14.26460	At most 4
$r = 5$	$r = 6$	2.81E-05	3.841466	At most 5
The Co-integration Rank Test (Trace)				
$r = 0$	$r \geq 0$	109.6627	95.75366	None*
$r \leq 1$	$r \geq 1$	68.73845	69.81889	At most 1
$r \leq 2$	$r \geq 2$	42.15811	47.85613	At most 2
$r \leq 3$	$r \geq 3$	24.69578	29.79707	At most 3
$r \leq 4$	$r \geq 4$	8.552747	15.49471	At most 4
$r \leq 5$	$r \geq 5$	2.81E-05	3.841466	At most 5

* denotes rejection of the hypothesis at the 0.05 level

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

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level

The trace test results based on the Johansen co-integration are shown in Table 4.6. The null hypothesis of the trace test is that the number of co-integrating equations is greater than the number of variables involved. If the test statistic is smaller than critical values of the trace tests we do not reject the null hypothesis. The results of the Johansen co-integration test based on the maximum eigenvalue. The maximum eigenvalue test was conducted on a null hypothesis of the number of co-integration equations (*r)* against the alternative hypothesis of number of co-integration equations plus one (*r +1)*. We do not reject the null hypothesis if the test statistic is smaller than the maximum eigenvalue test's critical values. The Johansen method is used for the test of co-integration as it is superior over the Engle-Granger method in allowing for the test of more than one co-integrating vectors.

Table 4.6 reports the results of the JJ co-integration tests using both the Maximal Eigenvalue and Trace tests. Considering the Maximal Eigenvalue results for VAR order 1, it is found that the null hypothesis of no co-integrating vector (CV), i.e. no long-run relationship, is strongly rejected against the alternative of exactly 1 co-integrating relationship as the computed statistics, 40.92424, turns out to be greater than the 5% critical value of 40.07757. However, the null hypothesis that there is at most 1 co-integrating vector cannot be rejected since the test statistic of approximately 26.58033 is less than the 5% critical value of about 33.87687.For that reason, the Maximal Eigenvalue statistics specified 1 co-integrating relationship at 5% significance level. The maximum Eigen value test in Table 4.6put forward that there is only 1 co-integrating relationship in the real gross domestic product model.

Table 4.6shows the results of the trace test (with order of VAR=1) which reflect that at least one co-integrating equation exists at 5% significance level. The null hypothesis of no co-integrating vectors is rejected since the trace (test) statistic of 109.6627 is greater than the 5% critical value of approximately 95.75366. However, the null hypothesis of (CV≤1) at most one co -integrating vector cannot be rejected against the alternative of at least 2 CVs. The computed test statistics in this case 68.73845 is less than the 5% critical value of 69.81889.Therefore, it can be concluded that there is one significant long run relationship between the given variables (using the trace test).

These indicates the existence of strong evidence for co-integration amongst the variables in my model. The co-integration vector represents the deviations of the endogenous variable from its long run equilibrium level. Since variables can either have short or long run effects, a vector error correction model (VECM) is used to disaggregate these effects.

4.5 DETERMINATION OF OPTIMAL LAG LENGTH

Co-integration test is usually preceded by a test of optimal lag length as the result of the test is affected by the number of lags included in the VAR model. The information criteria are used to determine the optimal lag length of the VAR model for co-integration test.

Table 4.7: VAR Lag Order Selection Criteria

Endogenous variables: LNRGDP LNREER LNTO LNM2 LNGCF LNGFCE

Exogenous variables: C

Sample: 1986 2015

Included observations: 28

Lag	LogL	LR	FPE	AIC	SC	HQ
0	38.02766	NA	4.09e-09	-2.287690	-2.002218	-2.200419
1	191.7787	230.6266*	9.71e-13*	-10.69848*	-8.700175*	-10.08758*
2	224.7771	35.35534	1.79e-12	-10.48408	-6.772934	-9.349542

Notes:

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 4.7 confirms that almost all criteria LR, FPE, AIC,SC and HQ are selected a lag length of 1 at 5% level of significance. Consequently, using the information criteria approach, the Johansen co-integration test was conducted using 1 lag for the VAR.

4.6. ESTIMATION RESULTS AND INTERPRETATION

4.6.1. VECTOR ERROR CORRECTION MODEL (VECM)

The detection of a co-integration equation in the previous section means that a VECM can be used. This has led to a distinction between the long and short run impacts of variables so as to establish the extent of influence that real exchange rates has on economic growth. Using the results from the co-integration test the VECM was specified.

I. **LONG RUN RELATIONSHIPS**

Table 4.8: Results of the long run co-integration equation

Variable	Coefficient	Standard error	t-statistic
Constant	-10.18669	-	-
LN_RGDP	1.000000	-	-
LN_REER	-0.665405	0.16308	-4.08027***
LN_GFCE	0.683307	0.11316	6.03858***
LN_GCF	0.149109	0.17518	0.85117
LN_M2	-1.672230	0.22009	-7.59791***
LN_TO	-0.920669	0.22472	-4.09702***

*** denotes significance at 1%.

The long run impact of real exchange rates on economic growth as presented in Table 4.8 is illustrated using Equation 11:

LNRGDP - 0.665LNREER + 0.683LNGFCE + 0.149LNGCF – 1.672LNM2 – 0.921LNTO – 10.1867 = 0…....10

This can be rewritten as,

LNRGDP = 0.665LNREER – 0.683LNGFCE – 0.149LNGCF + 1.672LNM2 + 0.921LNTO + 10.186……...….11

Equation 11 shows that REER (LNREER), M2 (LNM2) and TO (LNTO) have a positive long run relationship with GDP (LNRGDP). On the other hand, GFCE (LNGFCE) and GCF (LNGCF) show a negative long run relationship with GDP (LNRGDP). All the variables are statistically

significant in explaining economic growth except GCF since they have absolute tvalues greater than two.

The real effective exchange rate (LNREER) has positive sign and is statistically significant in explaining the economic growth in the long run. This result confirms that the null hypothesis (exchange rates have a long run effect on economic growth of Ethiopia) is accepted. Increase/appreciation of real effective exchange rate by 1% increases economic growth by 0.665%. The finding of this study shows that decrease in real effective exchange rate [depreciation] does not promote economic growth in the long run. Depreciation may encourage exports and increase the foreign earnings of the country for the time being, but it hurt the economy in the long-run as the cost of imported raw materials increase continuously. The positive sign of real effective exchange rate shows that the impact works through the aggregate supply channel in the long-run.This is in line with modern view discussed in the literature review.

The Modern view states that depreciation of the domestic currency has a net effect of decreasing the real GDP. For the modern viewers, the effect of exchange rate on economic growth works through the aggregate supply channel i.e. developing countries are dependent on foreign capital for investment and the demand for their export elasticity is low. Thus, its impact on increasing the costs of imported raw materials is much stronger than the positive effect it has on competitiveness. Hence, exchange rate adjustments will have a multiplying cost effect on economic growth in Ethiopia.

The government final consumption expenditure (LNGCE) has a negative and significant effect on economic growth of Ethiopia implying that, large size of government expenditure goes to recurrent expenditure. Thus, recurrent expenditure may have impeded growth by reducing the resources available for capital expenditure. Defense expenditure, poverty targeted expenditure, inflation targeted expenditure, voting campaign expenditure and expenditure on interest payment constitute the most important components of current expenditure. As a result, long run responsiveness of real GDP to the change in government final consumption expenditure is -0.683. It means that a one percent increase in government final consumption expenditure will decrease real GDP by 0.683 percent over time. This is explained by the fact that government spending of money for the purchase of consumption goods and services leads to the increase the aggregate demand for goods and services.

The gross capital formation (LNGCF) had a negative effect on economic growth of Ethiopia but it is found statistically insignificant effect in the long run.

The broad money supply (LNM2) had a positive and significant long run effect on economic growth. A 1% increase in broad money supply leads to an increases economic growth by 1.6722% which was contrary to the expected sign. The result was highly significant at 5 percent level of significance. Therefore, the results shows that increase in money supply improves economic growth. The national Bank of Ethiopia manages the supply of money through channels like the management of the reserve requirements and the management of the interest rate with the commercial banks. Thus, the expansionary policy may be implemented in Ethiopia since it is significant in the long run.

Lastly, Trade openness (LNTO) was also found to be positively related to economic growth of Ethiopia. Trade openness could increase the economic growth of Ethiopia by encouraging domestic productivity growth due to the increased competition and productivity spillovers between industries in different countries. It means that a one percent increase in trade openness will increase real GDP by 0.9206 percent over time.

II. SHORT RUN DYNAMICS

Table 4.9: Short Run Error correction model results

Variable	Coefficient	Standard error	t-statistic
D(LN_RGDP)	-0.181171	0.05388	-3.36267
D(LN_REER)	-0.068808	0.23310	-0.29518
D(LN_GFCE)	-0.415510	0.23602	-1.76045
D(LN_GCF)	-0.539062	0.22512	-2.39454
D(LN_M2)	0.156627	0.09286	1.68668
D(LN_TO)	-0.184289	0.19340	-0.95288

The change in the variables represent variation in the short run, while the coefficients obtained for the error correction term represents the speed of adjustment towards the long run relationship. From the results, the economic growth adjusts to equilibrium by -0.1811 and the speed of adjustment is approximately 18.1 percent. This means that if there is a deviation from equilibrium, 18.1 percent is corrected in one year as the variable moves towards restoring equilibrium. There is strong pressure on economic growth to restore long run equilibrium whenever there is a disturbance. This speed of adjustment is statistically significant with an absolute t-value of approximately 3.36267. The low speed of adjustment by economic growth in the short run may be insensitive as a result of the undeveloped structural strategies like low productivity growth. Therefore, there may be need for the vibrant strategies to enhance productivity level so that economic growth can be stimulated.

Also, from the results, the gross capital formation has a negative sign and hence improve economic growth towards equilibrium by -0.539062. This adjustment in the short run is significant with absolute t-value of approximately 2.39454even though the magnitude of the coefficient is small.

On the other hand, real effective exchange rate, government final consumption expenditure, money supply and trade openness adjustment to equilibrium is not statistically significant as there t-values are 0.29518, 1.76045, 1.68668 and 0.95288 respectively are below 2; even though broad

money supply has the positive adjustment effect (0.156627) in the short run. This implies in the short run, increased money supply adjusts to improve economic growth but the adjustment is not significant.

Turning to our variable of interest, REER, it is observed that in contrast to its long-run counterpart, the estimated short-run adjustment effect is negative. That is, the results suggest a contractionary impact of Birr depreciation in the short-run. The effect is small - a 10 per cent real devaluation is associated with just above half a percent (-0.0688) decline in GDP – and insignificant. The ECM technique permits the possibility of finding differing short and long-run effects and in this case the negative coefficient on the real exchange rate is plausible. It could be that currency depreciations led to certain adjustments in terms of resource allocation and inflationary pressure (including expectation about price changes), resulting in declining economic activity in the short-run. However, with the improvement in the incentive structure for resource allocation in favour of the more productive tradable sector, and given its enhanced competitiveness, the expansionary effect sets in the long-run.

4.7. DIAGNOSTIC TESTS ON THE RESIDUAL OF VECM

Tests of serial correlation, normality and hetroskedasticity on the residuals of the vector error correction models are conducted with the help of Lagrange-multiplier test, Jarque-Beta test, White-heteroskedasticity test respectively. From the tests, it was found that the nulls of no serial correlation, normality and constant variance could not be rejected. These results are confirmed in the appendix D.

4.8. IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSIS

I. IMPULSE RESPONSE ANALYSIS

The Impulse Response analysis for the above model is undertaken. All of the response is examined for 10 periods and the relevant variable comes to its long-run equilibrium back in this time period. This study uses generalized impulse response functions and in each case the shock to each variable is one standard error shock. The impulse response function shows the increment to each variable due to one standard error shock of the other variable taking in to account all interactions between the variables. The impulse responses are eventually expected to converge to a level that is consistent with the estimated long run co-integrating relationship. The graphical relationship of impulse responses to ten periods shock on the variables are represented at Appendix E.

As shown in Appendix E, the response of real gross domestic product to shocks emanating from the real effective exchange rate stock is zero in the early periods but it becomes positive in the long run, that is devaluation has no effect in the short run, but it becomes contractionary in the long run. This is consistent with the results obtained from both the long run co-integrating analysis and the short run error correction model. In line with the regression results obtained the response of real gross domestic product to real effective exchange rate is positive in the long run.

II. VARIANCE DECOMPOSITION ANALYSIS

Variance decomposition depicts the proportion of movements in one variable that are due to errors in own shocks and to each other variables in the system. Basically these give information on how important is each variable in explaining variations in the variable in question in the system.

Table 4.10: Variance decomposition of RGDP

Period	**S.E**	LNRGDP	LNREER	LNGFCE	LNGCF	LNM2	LNTO
1	0.042557	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.059109	91.21321	5.766996	0.523836	0.002003	2.109648	0.384306
3	0.081581	71.73833	14.63601	2.448253	0.071860	3.477187	7.628360
4	0.108597	55.93669	19.33149	5.997448	0.516497	3.540059	14.67781
5	0.137395	45.83169	21.28149	10.32402	0.938173	3.405152	18.21947
6	0.165745	39.80404	22.10329	13.77313	1.219889	3.204982	19.89467
7	0.191833	36.22886	22.51449	16.22453	1.378733	3.026119	20.62727
8	0.215285	34.01173	22.77528	17.90710	1.459938	2.893338	20.95261
9	0.236398	32.55788	22.96631	19.05029	1.502446	2.797437	21.12564
10	0.255626	31.54613	23.11343	19.84807	1.527018	2.728160	21.23719

The variance decomposition of real gross domestic product, which is represented in the above table, shows that in the very early periods the forecast error of this variable in question is attributed to the variable itself. The deviation explained by the real gross domestic product decreases to 31.5 percent in the tenth period from 100 percent in the first period. The deviation in economic growth explained by the variations in real effective exchange rate are insignificant explaining zero in the first period and significant explaining 23.1 percent in the 10th period. The variations of real gross domestic product due to variations in trade openness and government final consumption expenditure explains about 21.2 and 19.8 percent of the deviations in real GDP respectively in the 10^{th} period. The contribution of gross fixed capital formation and broad money supply to the variations in the forecast error of real gross domestic product are very less.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 SUMMARY OF THE FINDINGS AND CONCLUSIONS

How movements in the exchange rate affect overall economic activity has been a subject of longstanding controversy in macroeconomics and empirical scrutiny in applied policy analysis. In Ethiopia the news of Birr depreciation is mostly greeted with skepticism about macroeconomic soundness of the economy, triggering public and policy debates. The issue is certainly controversial as exporters often demand for downward adjustments of the domestic currency in order to become more competitive in international markets in sharp contrast to protests by consumers and others who rely on imported processed and semi-processed goods for their production and the increased Birr value of dollar (or other foreign currencies for that matter) get translated into their higher prices. In recent times when the country has witnessed a general rise in prices, currency depreciation is widely regarded as a wrong policy choice contributing to the inflationary pressure. The government use devaluation as a policy strategy to increase export and overvaluation of Ethiopian Birr. However, exports lack the required quality, and hence unable to become competitive in the world market for agricultural produces. As a result, Ethiopia remains net importer. The net effects of these combined interactions could currency depreciation and it is a reflection of various economic and policy shocks.A strategy shift towards accelerated and sustainable development programmes that entail huge demand for foreign currency from the aggregate demand intensifies the problem. Ethiopia has received no attention and the researcher try to fill this gap in this paper.

The objective of this study is to add to the existing empirical literature on the effect of exchange rate on economic growth in Ethiopia. The study is based on annual time series data spanning from 1985/86 to 2014/15. This paper has made use of the vector error correction model to see disaggregated long and short run relationships between the real GDP and a vector of variables including real effective exchange rate, gross fixed capital formation, government final consumption expenditure, broad money supply and trade openness. For empirical investigation, this study has preferred to use multilateral real exchange rates instead of bilateral real exchange rates which considered the real exchange rate of Ethiopiaand exchange rates of Ethiopia's most important trade partners.

The estimation strategy has duly examined the time series properties of the variables in regression analyses to avoid the problem of finding out spurious relationships and invalid inferences. In light of the non-stationarity of the model variables, the long and short run results of this study are confirmed by the help of co-integration and vector error correction models. The empirical analyses provide several major findings:

(i) The long-run effects of real devaluations are found to be negative, i.e. downward adjustments of Birr leading to the depreciation of the real exchange rate has an overall contractionary effect. That is, a 10 percent real depreciation of Birr would lead to 6.7% decrease in RGDP. However, in the short run, the effect of devaluations is neutral. Thus, in the long run devaluation negatively affects output growth in Ethiopia.

(ii) Based on the result, government final consumption expenditure has a negative and significant effect on economic growth of Ethiopia.

(iii) Finally, both broad money supply and trade openness are found to have positive and significant effects on the aggregate output of Ethiopia.

Several important policy implications are to be derived from these findings. First of all, there are important growth implications of exchange rate management. Real appreciation turn out to be expansionary, which can operate through two possible channels. Firstly, by enhancing frugality, the import competing sectors can help expand cheap output for the aggregate demand of the economy and the country's import dependence on imported raw materials and capital goods has been risen through gross transformation plans, overtime national saving increases considerably thereby generating larger expansionary effects.Ethiopia depends on foreign capital and the export elasticity of their product is insensitive. Devaluation increases the cost of foreign capital and increase the cost of imported items and raw materials. Since the major imported item in Ethiopia is petroleum which significantly affect the whole economy and domestic price as well. As a result, real appreciation improves real gross domestic product in the long run. Secondly, real exchange rate appreciations can also improve the competitiveness of the import-competing sectors through accessibility of new technology, supporting its growth and aggregate output.

Similarly, the depreciation of the real exchange rate will have adverse consequences for overall economic output. From that perspective Birr depreciations have triggered some of the adverse consequences. The analysis presented in this paper shows Ethiopia's domestic prices relative to those of tradable sector of its major trading partners have risen substantially. Real devaluations have not helped maintain Ethiopia's international competitiveness at more or less the same level since early 1990s.

The finding of the contractionary effect of real depreciations points towards a major policy issue concerning the role of the exchange rate as a development strategy. This has been a subject matter of recent debates and discussions in the literature showing that the undervaluation of the currency cannot stimulates economic growth. It has been argued that since bad institutions and market failures are more prevalent in the tradable sector, devaluations worse the consequences of these distortions. Given that one relevant question is what policy lesson can be drawn for Ethiopia?

5.2 POLICY IMPLICATIONS

It needs to be pointed out that to maintain a depreciated real exchange rate regime is going to be far more challenging than staging nominal devaluations. As there is the evidence of strong and significant effect of nominal devaluations on domestic prices, downward adjustments of the currency will result in mounting inflationary pressure decrease economic growth in the long run.

On the other hand, while one episode of nominal devaluations can help promote export competitiveness but decrease output over the long-run, rising import demand will also erode at least some significant portion of these gains. It has therefore been argued that countries seeking to use a competitive exchange rate to aid growth need to develop an exit strategy to avoid getting locked into a strategy that has outlived its usefulness.

Furthermore, it has also been pointed out that nominal devaluations may not always translate into real exchange rate depreciations. Fiscal and monetary policies, in particular, must be consistent with the exchange rate regime to tackle the problem of rising prices. That is why using the real exchange rate as a policy variable may be a very difficult option. In the long-run the movements in the real exchange rate is to be determined by fundamentals that influence the resource allocations between tradable and non-tradable sectors. Policies that can help more spending on tradables and/or avoid generating undue pressure on the prices of non-traded goods may prove to be more effective to promote international competitiveness.

This paper has highlighted the changing composition of Ethiopia's trade partners. Since the late 1990s, a set of fast-growing and emerging developing countries have gained more prominence, pushing down the relative significance of advanced and developed economies. Prices in developing countries are generally higher and faster growing countries are likely to have appreciated real exchange rates, as pointed out earlier. Therefore, the shifts in the significance of trading partners might provide opportunities for Ethiopia maintaining a competitive real exchange rate regime, provided that domestic inflationary pressure is contained. In this context, it is important to better understand the allocation of resources in non-traded and import-competing sectors and their implications for productivity and output growth, and prices.

In the face of a sustained improvement in terms of trade, the estimated positive effect on output could imply resources being allocated to import-competing sectors or high value added services sector. There has been a lot of discussion on whether developing countries can enhance their reliance on their domestic sectors to promote economic growth. Ethiopia has a relatively large domestic economy, compared to many other African countries with small population, and as such domestic demand management will always have an important influence on overall economic growth. While the need for maintaining competitiveness cannot be overemphasized a better understanding of inter-sectoral resource allocation and productivity growth will make informed exchange rate management that would promote competitiveness of exports as well as expansion of import-competing sectors.

In fine, the management of the exchange rate would remain a delicate task for policymakers. While the effects of nominal devaluations are likely to have negative effects on output growth, tackling inflation would be critically important. In the long-run Ethiopia needs to maintain its international competiveness for which nominal exchange rate adjustment will be an important instrument. Its effectiveness will however be depend on the nature of accompanying monetary and fiscal policies and other factors influencing the relative prices of traded goods designed to prevent the real effects from being dissipated by inflation.

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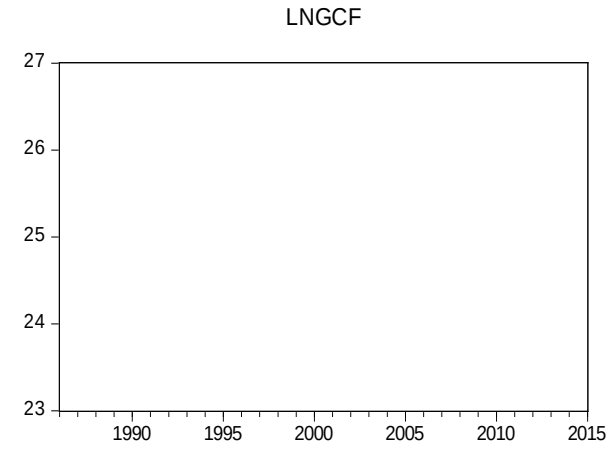
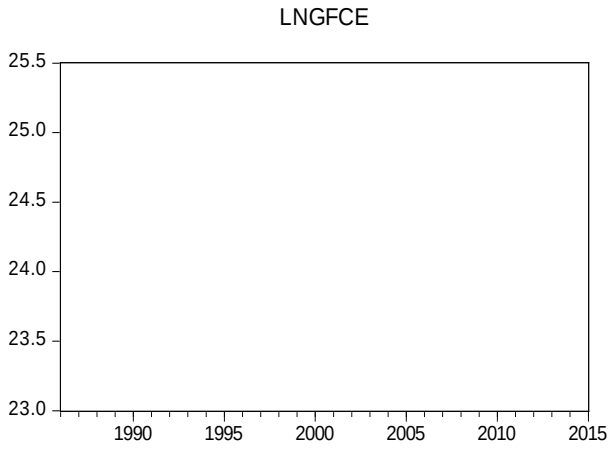
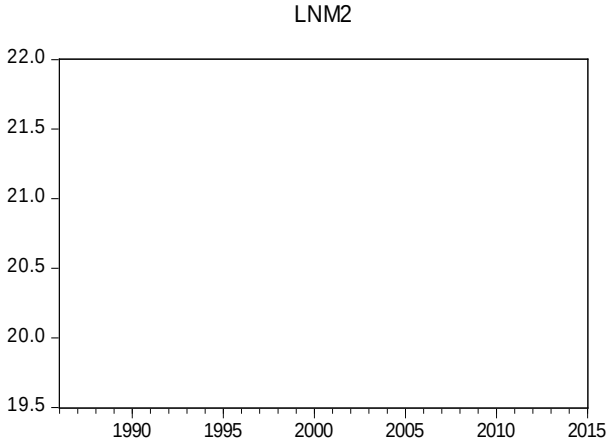
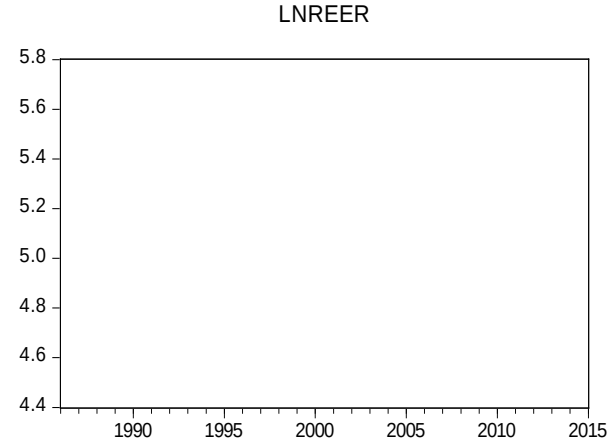
APPENDICES

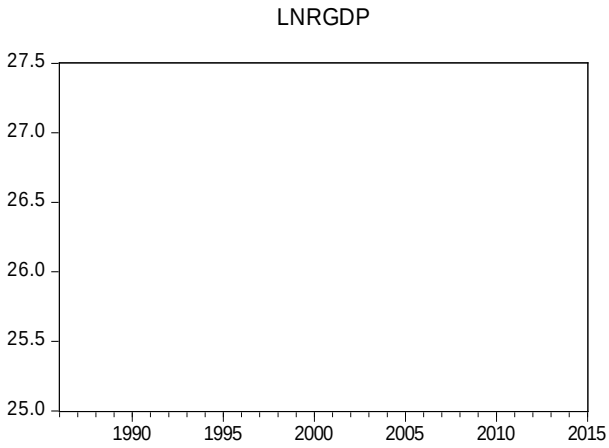
Appendix A: Plot of Variables at Level

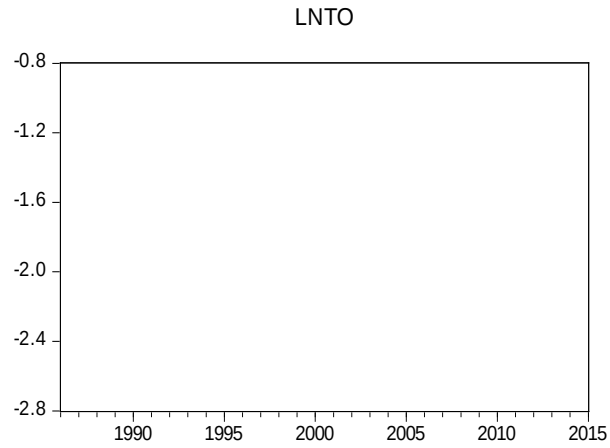






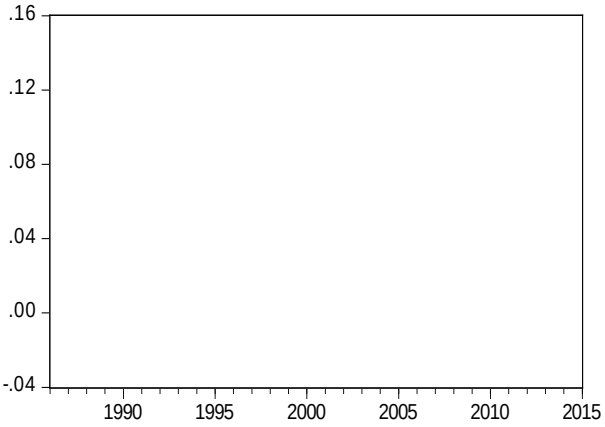




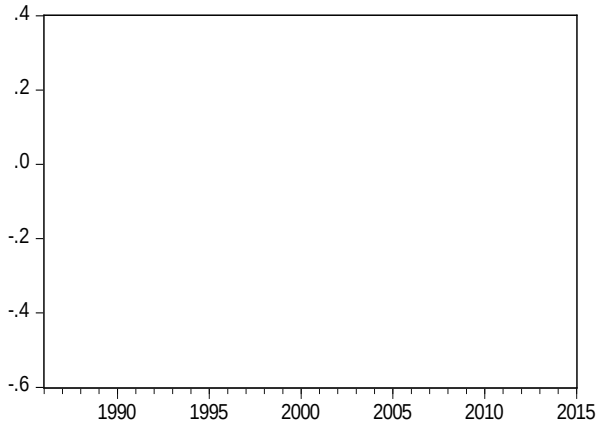


Appendix B: Plot of Variables at Differenced

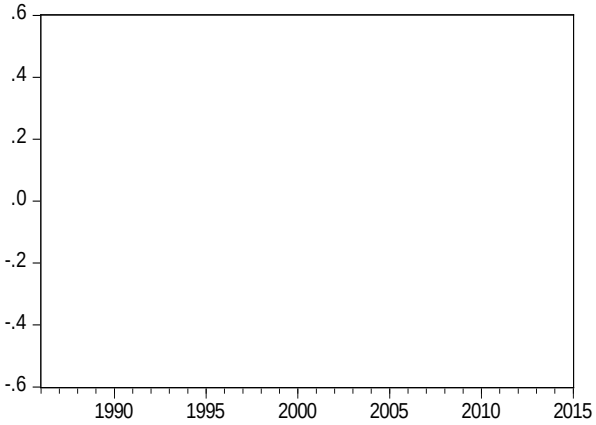
Differenced LNRGDP



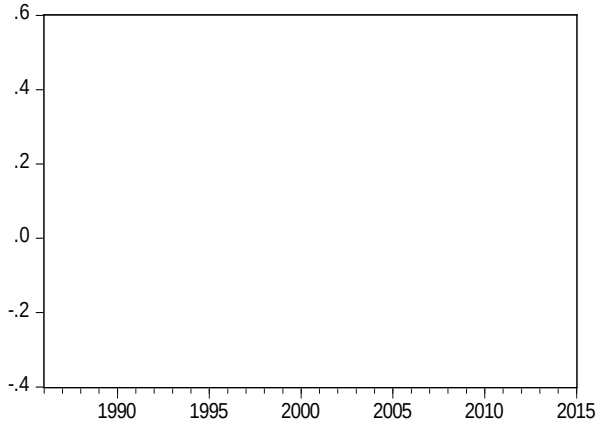
Differenced LNREER



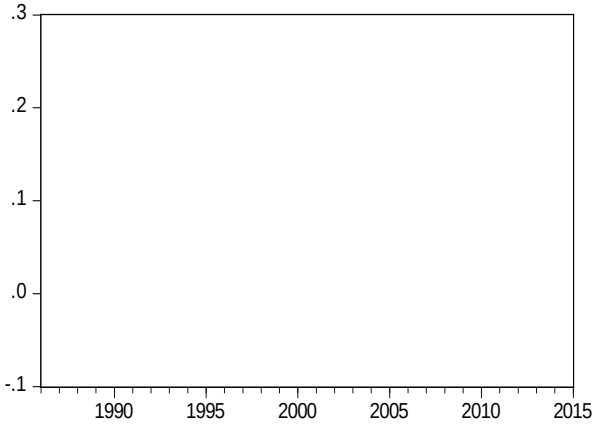
Differenced LNGFCE



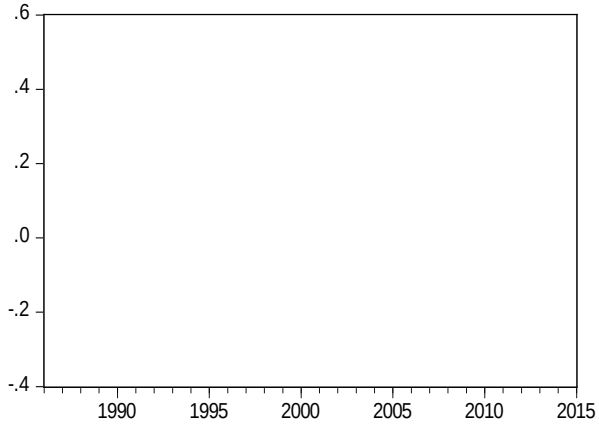
Differenced LNGCF



Differenced LNM2



Differenced LNTO



Appendix C: VECM estimation output

Vector Error Correction Estimates

Date: 05/21/16 Time: 23:08

Sample (adjusted): 1988 2015

Included observations: 28 after adjustments

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

Cointegrating Eq:	CointEq1
LNRGDP(-1)	1.000000
LNREER(-1)	-0.665405
	(0.16308)
	[-4.08027]
LNGFCE(-1)	0.683307
	(0.11316)
	[6.03858]
LNGCF(-1)	0.149109
	(0.17518)
	[0.85117]
LNM2(-1)	-1.672230
	(0.22009)
	[-7.59791]
LNTO(-1)	-0.920669
	(0.22472)
	[-4.09702]

C	-10.18669					
Error Correction:	D(LNRGDP)	D(LNREER)	D(LNGFCE)	D(LNGCF)	D(LNM2)	D(LNTO)
CointEq1	-0.181171	-0.068808	-0.415510	-0.539062	0.156627	-0.184289
	(0.05388)	(0.23310)	(0.23602)	(0.22512)	(0.09286)	(0.19340)
	[-3.36267]	[-0.29518]	[-1.76045]	[-2.39454]	[1.68668]	[-0.95288]
D(LNRGDP(-1))	0.057492	0.997592	-0.776449	0.143278	0.191437	-0.953447
	(0.23001)	(0.99517)	(1.00764)	(0.96109)	(0.39644)	(0.82568)
	[0.24995]	[1.00243]	[-0.77056]	[0.14908]	[0.48289]	[-1.15475]
D(LNREER(-1))	-0.029623	0.057817	-0.206687	-0.516441	0.306737	-0.342944
	(0.09255)	(0.40044)	(0.40546)	(0.38673)	(0.15952)	(0.33224)
	[-0.32006]	[0.14438]	[-0.50976]	[-1.33541]	[1.92285]	[-1.03222]
D(LNGFCE(-1))	0.084578	0.255983	0.445204	-0.102867	0.015942	-0.327131
	(0.06236)	(0.26980)	(0.27318)	(0.26056)	(0.10748)	(0.22385)
	[1.35632]	[0.94879]	[1.62971]	[-0.39479]	[0.14832]	[-1.46140]
D(LNGCF(-1))	-0.000630	-0.492226	0.148608	0.074582	0.033570	0.464713
	(0.06508)	(0.28159)	(0.28512)	(0.27195)	(0.11218)	(0.23363)
	[-0.00969]	[-1.74802]	[0.52122]	[0.27425]	[0.29926]	[1.98909]
D(LNM2(-1))	-0.102797	-0.320707	-0.277208	-0.007594	0.255572	-0.082350
	(0.14139)	(0.61175)	(0.61942)	(0.59080)	(0.24370)	(0.50756)
	[-0.72703]	[-0.52424]	[-0.44753]	[-0.01285]	[1.04871]	[-0.16225]
D(LNTO(-1))	-0.126141	-0.012147	-0.386125	-0.763580	0.324392	-0.268165
	(0.10680)	(0.46206)	(0.46785)	(0.44624)	(0.18407)	(0.38336)

	[-1.18115]	[-0.02629]	[-0.82532]	[-1.71116]	[1.76234]	[-0.69951]
C	0.061469	-0.025135	0.085087	0.090154	0.031244	0.063448
	(0.01541)	(0.06666)	(0.06749)	(0.06438)	(0.02655)	(0.05531)
	[3.98971]	[-0.37707]	[1.26066]	[1.40042]	[1.17659]	[1.14722]
R-squared	0.510611	0.192817	0.202754	0.375363	0.268218	0.316991
Adj. R-squared	0.339325	-0.089697	-0.076283	0.156740	0.012094	0.077937
Sum sq. resids	0.036223	0.678068	0.695167	0.632422	0.107606	0.466764
S.E. equation	0.042557	0.184129	0.186436	0.177823	0.073351	0.152768
F-statistic	2.981046	0.682505	0.726621	1.716943	1.047220	1.326025
Log likelihood	53.37355	12.35969	12.01102	13.33536	38.13049	17.58762
Akaike AIC	-3.240968	-0.311407	-0.286502	-0.381097	-2.152178	-0.684830
Schwarz SC	-2.860338	0.069223	0.094128	-0.000467	-1.771548	-0.304200
Mean dependent	0.061313	-0.014645	0.052701	0.093667	0.065194	0.022162
S.D. dependent	0.052358	0.176388	0.179708	0.193646	0.073798	0.159094

Determinant resid covariance (dof adj.)	3.76E-13
Determinant resid covariance	4.99E-14
Log likelihood	190.4078
Akaike information criterion	-9.743416
Schwarz criterion	-7.174165

Appendix D: Diagnostic Test on the residuals of VECM

D.1) Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 05/20/16 Time: 22:10

Sample: 1986 2015

Included observations: 28

Lags	LM-Stat	Prob
1	34.90790	0.5204
2	32.17571	0.6511
3	33.46631	0.5897
4	34.35110	0.5471
5	19.99860	0.9857
6	31.45815	0.6844
7	28.14936	0.8218
8	31.84356	0.6666
9	50.90207	0.0509
10	43.01580	0.1960

Probs from chi-square with 36 df.

D.2) Normality Test

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 05/20/16 Time: 22:11

Sample: 1986 2015

Included observations: 28

Component	Skewness	Chi-sq	Df	Prob.
1	-0.396472	0.733553	1	0.3917
2	-0.368037	0.632106	1	0.4266
3	0.008109	0.000307	1	0.9860

4	-0.548633	1.404660	1	0.2359
5	-0.046022	0.009884	1	0.9208
6	0.116769	0.063630	1	0.8008
Joint		2.844139	6	0.8281

Component	Kurtosis	Chi-sq	Df	Prob.
1	2.654203	0.139505	1	0.7088
2	2.509298	0.280920	1	0.5961
3	3.422297	0.208058	1	0.6483
4	2.617333	0.170840	1	0.6794
5	2.681830	0.118104	1	0.7311
6	1.928739	1.338867	1	0.2472
Joint		2.256293	6	0.8947

Component	Jarque-Bera	df	Prob.
1	0.873058	2	0.6463
2	0.913026	2	0.6335
3	0.208364	2	0.9011
4	1.575499	2	0.4549
5	0.127988	2	0.9380
6	1.402497	2	0.4960
Joint	5.100433	12	0.9545

D.3) Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 05/20/16 Time: 22:17

Sample: 1986 2015

Included observations: 28

Joint test:

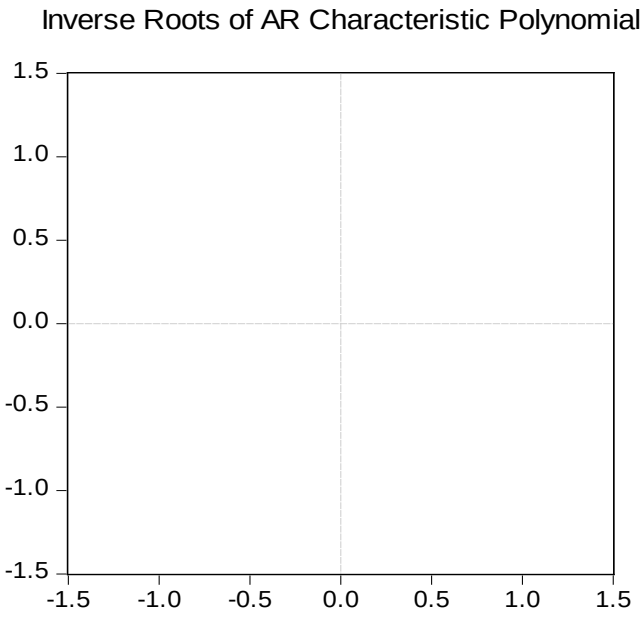
Chi-sq	Df	Prob.
305.1803	294	0.3146

Individual components:

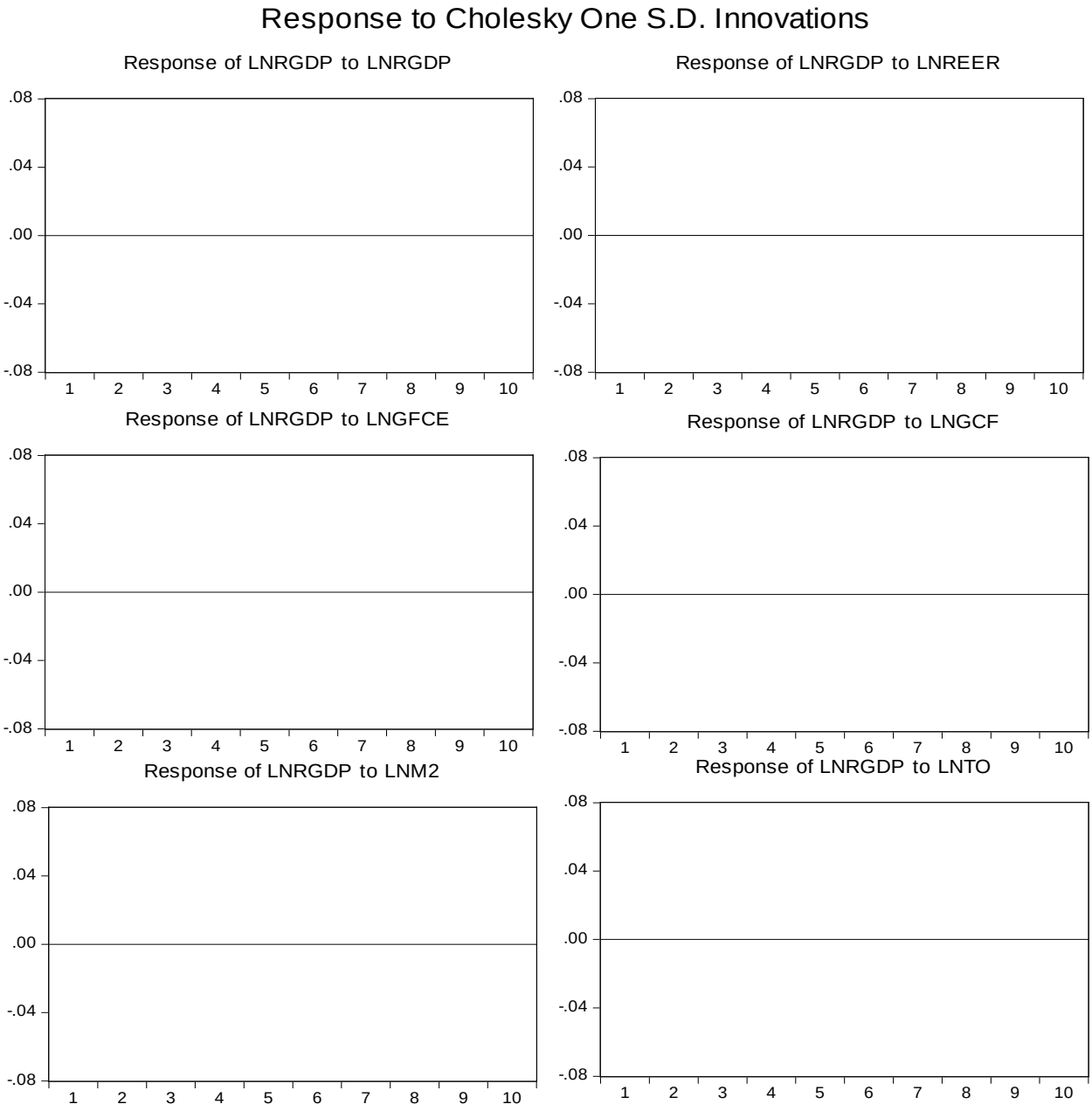
Dependent	R-squared	F(14,13)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.292250	0.383433	0.9566	8.183000	0.8796
res2*res2	0.783415	3.358754	0.0178	21.93561	0.0799
res3*res3	0.360362	0.523143	0.8788	10.09014	0.7556
res4*res4	0.730486	2.516789	0.0526	20.45362	0.1165
res5*res5	0.540110	1.090547	0.4407	15.12309	0.3698
res6*res6	0.681197	1.984112	0.1129	19.07352	0.1622
res2*res1	0.538757	1.084621	0.4445	15.08519	0.3724
res3*res1	0.474328	0.837874	0.6277	13.28118	0.5045
res3*res2	0.555197	1.159031	0.3979	15.54552	0.3419
res4*res1	0.530343	1.048556	0.4687	14.84961	0.3885
res4*res2	0.726316	2.464285	0.0566	20.33684	0.1199
res4*res3	0.525305	1.027574	0.4832	14.70855	0.3984
res5*res1	0.363152	0.529502	0.8745	10.16826	0.7498
res5*res2	0.228190	0.274537	0.9887	6.389310	0.9557
res5*res3	0.413429	0.654479	0.7793	11.57602	0.6403
res5*res4	0.529002	1.042928	0.4725	14.81207	0.3911
res6*res1	0.557927	1.171921	0.3902	15.62195	0.3370

res6*res2	0.812603	4.026535	0.0083	22.75289	0.0644
res6*res3	0.547337	1.122783	0.4201	15.32544	0.3563
res6*res4	0.746046	2.727884	0.0395	20.88929	0.1045
res6*res5	0.298715	0.395529	0.9515	8.364021	0.8695

D.4) The stability of the model



Appendix E: Impulse response analysis



Appendix F: Variance decomposition analysis