DETERMINANTS OF TRADE BALANCE IN LIBERIA: A VECTOR ERROR CORRECTION MODEL APPROACH

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DECLARATION/APPROVAL

I, hereby, declare that this research paper is my original work and that it has not been presented at any other university or institution for the award of a degree.

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DEDICATION

This research paper is dedicated to my beloved parents, Mr. Henry B. Kollie and Mrs. Mary T. Kollie, who have always stood ready to support my education from the very beginning.

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While it is true that care was taken to conduct this study, the views and policy recommendations proffered, and errors of omission or addition that may have been committed are entirely mine and that they should not be attributed to any individual or institution mentioned above.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADF	-	Augmented Dickey-Fuller
ARDL	-	Autoregressive Distributed Lags
BoP	-	Balance of Payment
BoT	-	Balance of Trade
BP	-	Bai and Perron
FEVD	-	Forecast Error Variance Decomposition
GDP	-	Gross Domestic Product
GoL	-	Government of Liberia
IRF	-	Impulse Response Function
L$ / LD	-	Liberian Dollar
LISGIS	-	Liberia Institute of Statistics & Geo-Information Services
LNTP	-	Liberia National Trade Policy
MLC	-	Marshall-Lerner Condition
ODP	-	Open Door Policy
OECD	-	Organization for Economic Co-operation and Development
PP	-	Phillips-Perron
SSA	-	Sub-Saharan Africa
US$ / USD	-	United States Dollar
VAR	-	Vector Autoregression
VECM	-	Vector Error Correction Model
WDI	-	World Development Indicators
WTO	-	World Trade Organization
ZA		Zivot and Andrews

ABSTRACT

The issue of international trade and gains from trade have been of major concern to economies of the world. For the Liberian case, the Balance of Trade (BoT) has, in recent decades, been unfavourable. Recent statistics shows that the deficit is increasing beyond bound on a yearly basis. This study is, therefore, intended to empirically establish the factors that influence the position of the balance of trade for the Liberian economy. The motivation for this study is drawn from the Keynesian-Absorption approach to the balance of trade. It maintains that to improve trade balance, output growth should exceed expenditure growth.

We used Johansen cointegration to test for the long run relationship between BoT and its determinants, and we found existence of a long run relationship; thus indicating that the Vector Error Correction Model (VECM) estimation technique was appropriate in establishing the determinants of Liberia's trade balance. However, due to the issue of over-parameterization of the VECM estimates, we used the Impulse Response Function (IRF) and the Forecast Error Variance Decomposition (FEVD) to interpret the findings of the VECM estimation.

Using secondary, annual time series data spanning from 1970 to 2015, and the VECM estimation technique, we found that gross domestic product and lending interest rate positively impact BoT in the long run; while exchange rate, trade openness and money supply negatively influence BoT in the long run. We also found merchandise import and primary commodity export having inconsistent effects on BoT from the short run to the long run.

Based on these findings, we found evidence of the Keynesian-Absorption Approach to BoT; thus, we recommend that to improve Liberia's BoT, effort should be made to increase domestic output over expenditure; there should also be efforts to diversify the export commodities of Liberia. And efforts should be made to have stability in the exchange rate.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

International trade is a key factor for growth in many economies of the world (Singh and Nyandemo, 2003). It serves as a tool to widening markets and creating surpluses even if one nation does not have the ability to produce everything relatively cheaper than others. With international trade, both trading partners stand to benefit from static and dynamic effects of trade; there are increments in the volume of commodities consumed, there are increases in the quantity and quality of goods produced due to specialization, there is the transfer of new knowledge and technology among trading partners, among others (Zahonogo, 2016).

Several arguments have been proffered with regards to factors influencing the position of Balance of Trade (BoT). The elasticity approach, for example, states that BoT position is influenced by either depreciation or appreciation of the exchange rate. Still, the monetary approach argues that changes in BoT is as a result of changes in money supply. The Keynesian-Absorption approach, on the other hand, combines the elasticity approach with Keynesian macroeconomics. It maintains that the BoT position is influenced by the interplay of national output/income and total expenditure (Bahmani-Oskooee, 1992).

To identify factors influencing the position of the balance of trade, this study uses the Keynesian-Absorption approach to the BoT. This approach argues that trade will be beneficial if a nation reduces expenditure/absorption, or increases output/income. This comes from the backdrop that a rise in expenditure or absorption induces a rise in import, which results to trade deficit.

1.1 Background of the Liberian Economy

Liberia is one of the smallest and poorest economies of the world. It is located on the West Coast of Africa with population of about 4.8 million people (Government of Liberia, 2014a). Declaring independence on July 26, 1847; Liberia is on record for being the oldest independent republic in Africa. At the same time, with respect to economic performance, the pattern of Gross Domestic Product (GDP) growth has not been stable. Liberia has been taking inconsistent trends in history;

for example, GDP growth was recorded as -51 percent in 1990 and 106.3 percent in 1997 (World Development Indicators, 2018; Kollie, 2018).

Liberia's track record of economic performance can be dated as far back as the 1920s. In 1926, the United States Government established a rubber plantation in Liberia which led to huge improvements in economic performance. Unfortunately, economic performance deteriorated as a result of the great depression of the 1930s. In an effort to revamp the economy, the Government of Liberia (GoL) introduced a national investment policy, known as the Open Door Policy (ODP) in the 1940's. As a primary objective of the ODP, foreign investments were allowed to all foreign investors without restriction. The implementation of the ODP was a gateway to economic prosperity for Liberia; with its peak ranging from 1950 to 1960.

As a result of the foreign direct investments (FDI), in 1960 employment level in the rubber sector expanded to over 15,000 workers down from 8,200 workers in 1927. The revenue generated from the exportation of rubber increased to US$42 million in 1960, which was previously recorded at US$4 million in 1940. This further means that between 1930 and 1960, earnings from rubber exportation made up about 46 percent of the total government revenue. Additionally, there was also huge revenue generated from the iron ore industry. For example, earnings from the exportation of iron ore was recorded as US$35 million in 1960, down from US$6 million in 1953. With this, the iron ore sector accounted for 20 percent of the total government revenue by 1960. Due to the ODP, the service sector through the Liberian Maritime, experienced a boom. Between 1950 and 1960, Liberia had the largest number of ships flying her flag. With tremendous increase in the number of ships registered under the Liberian flag, revenue from the maritime sector increased to US$5 million in 1960 down from US$2.6 million in 1950. Due to the tremendous performance of the Liberian economy, as a result of the ODP, the Liberian economy recorded the world's second highest GDP growth rates between 1950 and 1960; next to Japan (Sirleaf, 1989). The GDP growth rate was 15 percent.

However, with regards to economic development, the huge GDP growth rate did not lead to improvement in the overall wellbeing of Liberians (Sirleaf, 1989). Experts argue that part of the reasons for the low standard of living in Liberia is due to the failure of GoL to diversify the economy. GoL only concentrated on the exportation of primary commodities (Kollie, 2018).

On the other side of the growth records, the spillover effect of the ODP came to a standstill in the 1980s, as the prices of Liberia's export commodities (mainly natural rubber and iron ore) fell on the world market. Furthermore, the economy of Liberia went into total devastation with the introduction of a military regime in 1980. Later, in that same decade, the country went into a brutal civil war that lasted for 14 years (spanning from 1989 to 2003). As a result of these activities, GDP growth rate for Liberia was recorded in negative figures from 1980 up to 1995 (WDI, 2018; Dukuly, 2007). GDP per capital also took a downward trend from $1,571.3 USD in 1979 to $115.44 USD in 1995. The civil war also led to high poverty level, vulnerability to illnesses/diseases, persistent trade deficits, and high rate of illiteracy. Although there were some positive GDP growth rates[1] recorded from 1996 to 2001, they did not have much impact on the economy as they were used to compensate for the huge losses in previous years.

With the civil war coming to an end in 2003, the Liberian economy started showing some signs of recovery. GDP growth rate was recorded in positive figures from 2006 up to 2013. The GDP growth rate fluctuated between 5 percent and 9 percent inclusively. Regrettably, the economy of Liberia went into another stalemate in 2014. The Ebola Virus Disease and the fall in primary commodity prices resulted to a drastic fall in GDP growth from 8.7 percent in 2013 to 0.7 and 0.0 percent in 2014 and 2015 respectively (Jackson, 2015; WDI, 2018).

Notwithstanding, GoL is still focused on improving economic performance and the overall reduction of poverty in Liberia; as enshrined in her "Vision 2030" agenda. The Vision 2030 policy document has in place strategies that will enable Liberia to transcend to the status of a middle income country by 2030. In addition, the Government of Liberia has reverted to improving her economy through international trade. With Liberia's membership to the World Trade Organization (WTO) being established in 2016, the nation is on the right footing to gain from trade. Already, several policies such as the Vision 2030 and the Liberia National Trade Policy (LNTP) have earmarked private participation in international trade, so as to make trade serve as an engine for growth.

[1] For example, GDP growth was recorded as 106.3 percent in 1997.

In table 1 below, we present a section of selected macroeconomic variables for the Liberian economy. The values of the selected variables range from 1980 to 2015; and are averaged on a six year basis.

Table 1: Macroeconomic Indicators (1980 – 2015)

Year	**Trade Balance (US$)**	**GDP (US$)**	**Primary commodity export (% of GDP)**	**Merchandise import (% of GDP)**
1980 - 1985	76,166,666.67	848,051,416.7	26.63	48.21
1986 - 1991	59,833,333.33	728,460,733.3	29.66	56.33
1992 - 1997	66,333,333.33	184,366,666.7	70.33	259
1998 - 2003	-99,783,333.33	468,410,766.7	36.48	79.51
2004 - 2009	-332,145,000	728,824,000	37.26	68.08
2010 - 2015	-879,166,666.7	1,761,182,850	45.54	71.85

Source: WDI (2018) & Author's calculation

Table 1 reveals that from the set of six years, the average percentage of GDP spent on merchandise import has been extensively increasing, and primary commodity export has also been increasing. And due to rise in import, coupled with the exportation of primary commodities, the trade balance has accumulated negative figures on average in the last three set of years. The exploitation of natural resources (mainly rubber and iron ore) accounted for the increase in the proportion of primary commodity export. On the other hand, increase in the importation of basic commodities (i.e. foodstuffs, pharmaceuticals, clothes, etc.) caused the proportion of import (out of GDP) to increase hugely. For example, between 1992 and 1997, 259 percent of Liberia's GDP was used on merchandise import. This is an indication that the country was under-producing and thus had to borrow so as to facilitate importation of basic commodities. The prolonged civil war also caused the percentage of GDP that was used on import to rise, as leaders were also involved in the importation of arms and ammunitions.

1.1.1 Liberia's Trade Policy

The Government of Liberia has come to the realization that one possible way to improve her economy is through international trade. As such, she has embarked on major trade reforms. For the first time since the 1940s, GoL instituted a national trade policy document to spearhead

economic recovery through international trade. The trade policy referred to as 'The Liberia National Trade Policy (LNTP)' was established in 2014 and is expected to run for six years. The LNTP is the first policy document that is geared towards promoting inclusive growth through trade competitiveness, where the private sector is given more attention as the engine of growth (GoL, 2014b). The primary focus of the LNTP is to create a conducive environment that will encourage and improve international trade. It is intended to do this by promoting domestic production of goods and services (through the provision of subsidies and other incentives to traders). Trade facilitation and regional economic integration; rule of law and measures to resolve trade disputes; diversification of export (through value added production) - are all enshrined in the objectives of LNTP.

For this study, we have analyzed the position of Liberia's BoT in three phases. The first phase runs from the year 1980 up to 1988. During this period, Liberia experienced improvements in her BoT (i.e. surplus). This rise in trade surplus can be ascribed to the Open Door Policy employed by the William V.S. Tubman's led government in the 1940s.

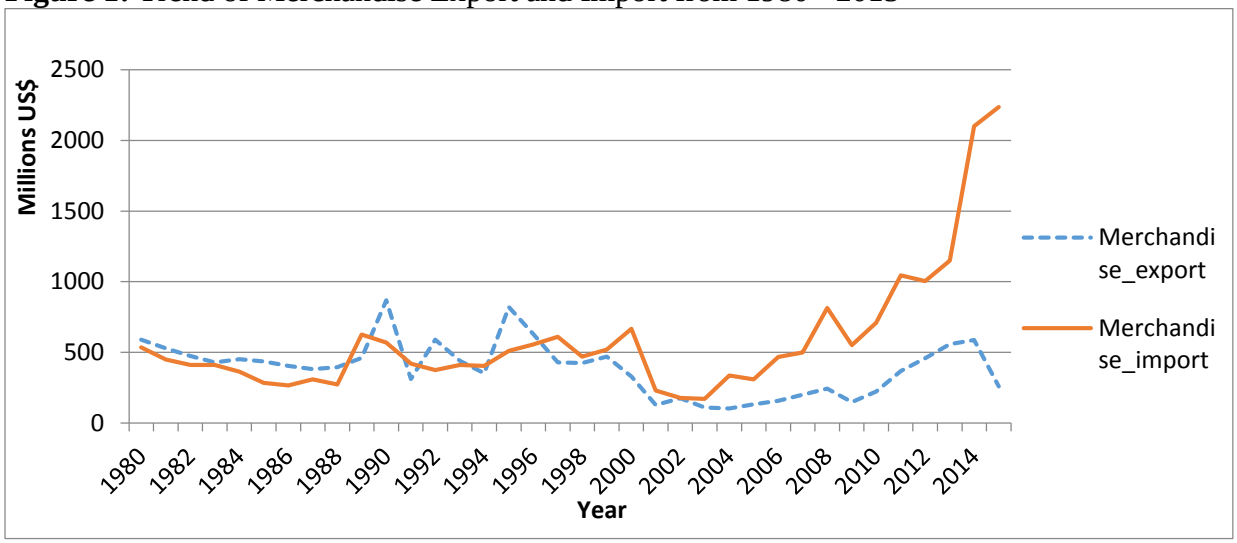
The second phase can be considered as the period of economic and political instability or fluctuations. This phase runs from 1989 to 1996, at which time the country was at war. Even though the war continued beyond this period, we can clearly describe it as a period where neither export nor import had a definite trend. They fluctuated on a yearly basis. For example, in 1989 the total value of merchandise export was US$460 million and the total value of merchandise import was US$625 million accounting for an overall deficit of US$165 million in merchandise trade. The following year, in 1990, the total value of merchandise export recorded was US$868 million and import was US$570 million, giving a total trade balance of US$298 million as surplus in merchandise trade (WDI, 2018). This fluctuation continued up to 1996.

The third phase runs from 1997 to 2015. This phase can be considered as the phase of high mass consumption of foreign goods. In other words, it is the period in which import has persistently risen above export. As a small economy, Liberia imports almost everything she consumes, ranging from her staple food (rice) to pharmaceuticals, clothes and other luxurious goods like cars. This rise in import has, for the time being, worsened the BoT. The huge values of import over export

can also be attributed to the third half of the Liberian civil war, the export of primary commodities, and the deadly Ebola Virus Disease that erupted in 2014 (Jackson, 2015).

As is evident in figure 1, the three phases of Liberia's trade balance are presented from year to year, with the middle phase accounting for more fluctuations.

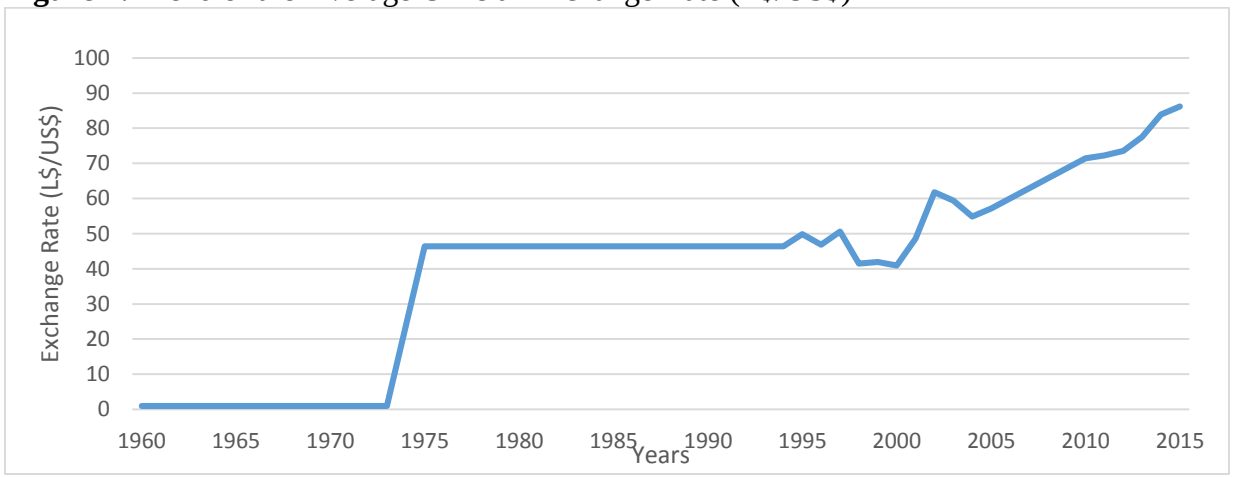
Figure 1: Trend of Merchandise Export and Import from 1980 - 2015



Source: WDI (2018)

In figure 2 below, we present the trend of the average nominal exchange rate for Liberia from 1960 to 2015.

Figure 2: Trend of the Average Official Exchange Rate (L$/US$)



Source: WDI (2018)

Figure 2 shows that from 1960 up to 1973, the official exchange rate was stable at L$1/1US$. The reason for the one-to-one parity is that the legal tender in Liberia was solely the US dollar. According to Conteh (2010), in fiscal year 1961-1962, GoL minted and issued Liberian Dollar coin with face values ranging from L$0.01 to L$1.0. This new Liberian dollar circulated alongside the US dollar, thereby leading to a dual currency arrangement. However, the exchange rate was still maintained at one to one parity, until it was devalued from 1L$/1US$ to L$46/1US$ in 1975. Later on, in the 1980s, the National Bank of Liberia[2] minted and issued a five dollar coin. With the civil war leading to massive looting of commercial banks, the Interim Government intended to withdraw the previous five dollar coin and replaced it with another five Liberian dollar bank note, referred to as 'Liberty'. But the previous five dollar coin was not totally removed from the economy. In fact, it was used mainly by Liberians outside of the capital city (Monrovia), while the Liberty banknote was used by residents of the capital city. These two Liberian dollars were being used alongside the United States dollar. However, in 1999, the Central Bank of Liberia printed new bank notes with face values[3] L$5; L$10; L$20; L$50 and L$100. With these developments in the monetary system, exchange rate started experiencing fluctuations on a yearly basis from 1995. And since 2005, there has been a continuous increase in the amount of Liberian dollar given off in order to obtain a unit of the United States dollar, (depreciation). Part of the reasons for this continuous depreciation is due to the fact that Liberia's demand for imported goods has far exceeded her supply of exports. As such, the demand for the US dollar increases and thus its price.[4]

1.2 Problem Statement

Recent statistics shows that Liberia has been running unfavourable trade balance that seems to be unsustainable, as deficit is taking an upward trend every year. Liberia is on record for recording huge benefits (i.e. surplus) from international trade in the 1950s and 1960s, which at some point in time, made her to have the second highest GDP growth rate in the world (Sirleaf, 1989). However, since the beginning of the civil war in 1989, trade balance has never been favorable on the overall. Worst of all, since 1997 to date, Liberia has perpetually experienced a negative trade balance even though efforts have been made by the government to curb trade deficits.

[2] The National Bank of Liberia was replaced by The Central Bank of Liberia in 1999.
[3] In 2017, GoL printed and added a L$500 banknote to the existing banknotes.
[4] See Figure 1 for the import – export disparity

This has a negative impact on the government and people of Liberia. Over reliance on importation of basic commodities usually leads to import shocks. These scenarios are accompanied by imported inflation, which further worsens the wellbeing of the Liberian people. In the view of Miller and Russek (1989) and Moon (2005), continuous large trade deficits are worrisome as they lead to the transfer of wealth or resources to foreigners. Such a scenario further leads to a fall in the standard of living for future generations.

In view of the above, this study is, therefore, designed to identify the underlying factors influencing the balance of trade position for Liberia, with a view to inform policy makers to address these issues through conducive trade policies.

1.3 Research Questions

In order to establish the determinants of BoT in Liberia with a view of providing policy measures, we seek to provide answers to the following questions:

i. What are the key factors influencing the balance of trade in Liberia?
ii. Are there evidence of a long run relationship between balance of trade and its determinants?
iii. What policies can be implemented to improve the balance of trade in Liberia?

1.4 Objectives of the study

The general objective of this study is to empirically establish factors determining the balance of trade in Liberia.

The specific objectives are to:

i. establish the determinants of Liberia's balance of trade;
ii. estimate the long run relationship between balance of trade and its determinants;
iii. identify areas of policy interventions based on the findings of the study.

1.5 Justification of the Study

Though efforts are being made by the Government of Liberia to improve the economy through international trade, those efforts are still being faced with unending challenges. To have a realization of her efforts – that is, to gain from international trade, appropriate trade

policies/strategies need to be implemented to combat unfavourable BoT (or to have favourable trade balance). In that light, empirical evidence establishing the determinants of BoT could prove indispensable to trade policy makers, such that those information are likely to reduce the likelihood of policy mistakes. This study is, therefore, intended to empirically establish the determinants of Liberia's BoT, with a view of proffering policy recommendations.

1.6 Organization of the study

The rest of this paper is structured as follows: Chapter two presents the literature review; including the theoretical, empirical and overview of the literature. Chapter three outlines the econometric methodology adopted in identifying the determinants of BoT in Liberia. It also presents the empirical model, the data used and their sources, and variables descriptions and definitions. The technique used for estimation is also presented in the third chapter along with various pre and post estimation tests. Chapter four presents the findings and discussions of the study. And chapter five gives the summary, conclusion and policy recommendations of the study.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Chapter two looks at various ideas/theories that have been postulated by researchers over the years as it relates to international trade balance. The chapter comprises of three sections. The first section presents the theoretical literature, and the second section provides the empirical literature. And then, the chapter closes by summarizing or providing the overview of the related literatures reviewed.

2.1 Theoretical Literature

The issue of trade and the gain from trade have been of major concern to both developing and developed nations. Theories have proven that nations will only go to free trade if they know that they will accumulate some gain. Contemporary trade theories have evolved around several ideas, ranging from the Elasticity Approach up to the Monetary Approach to BoT. This study is keen in discussing these trade theories.

2.1.1 Elasticity Approach, Marshall-Lerner Condition, and J-Curve Phenomenon

The focus of the elasticity approach is to correct trade balance using exchange rate policy. It calls for devaluation of domestic currency in the instance where there is trade deficit (Ali, Johari and Alias, 2014). This leads to domestic exports being cheaper from foreign perspective, thereby encouraging export. However, this happens best when foreign demand is elastic. After devaluation, we will have improvement in the BoT if the reduction in imports is more than the reduction in export, from domestic point of view.

To further understand the workings of the elasticity approach, we analyze the Marshall-Lerner Condition (MLC). The MLC maintains that currency devaluation will improve trade balance (i.e. surplus) if and only if import and export demands are adequately elastic. This goes to mean that the sum of import and export demands elasticities should be greater than one. This is symbolically written as:

$$e_X + e_M > 1 \quad \ldots \ldots \ldots (2.1)$$

Where e_X and e_M are elasticities of export and import respectively. In the event where $e_X + e_M < 1$, trade balance worsens when currency is depreciated. In such case, the equilibrium is said to be unstable, thus having inefficient impact on BoT (Borkakati, 1998; Ali et al., 2014).

The analysis of the elasticity approach is also done using the J-Curve phenomenon. When a devaluation policy is implemented, the trade balance firstly worsens (i.e. deficit) in the short-run but later improves in the long-run. BoT usually worsens in the short run because prices are relatively constant in that short run and again, demands by consumers do not adjust speedily. Nevertheless, since the demand for export and import tends to be elastic with the passage of time, the export price of the devaluating country falls thereby making export cheaper for foreigners and import more expensive for the domestic economy. To that end, domestic demand gradually shifts from imported, foreign goods to domestically produced goods. At the same time the volume of export increases. These scenarios further improve the BoT but only in the long run, where there are now adjustments made in the volume of trade.

2.1.2 Keynesian Absorption Approach to BoT

The elasticity approach goes a long way in analyzing the impact of devaluation on BoT. However, it has met some criticisms over the years. The elasticity approach is a partial equilibrium approach which pays less attention to fluctuations in production as a result of devaluation (Ali et al., 2014). As a result of this criticism, the absorption and monetary approaches were developed to provide a facelift to policy makers. The absorption approach merges the elasticity approach with Keynesian macroeconomics to come up with a more realistic explanation of BoT analysis. It was formally modeled in the early 1950s by Meade (1951), Alexander (1952) and others. The main emphasis of this model is to improve trade balance through austerity measure; that is – reducing total spending within an economy. It can be symbolically represented as:

$$\Delta(x - m) = \Delta y - \Delta(c + i + g) \qquad (2.2)$$

Equation (2.2) indicates that BoT will improve only if domestic output growth exceeds domestic absorption. This is an indication of reduction in total absorption so as to improve the BoT. Hence, the Keynesian model can also be described as expenditure reducing policy.

2.1.3 Monetary Approach to BoT

The monetary approach to BoT argues that currency devaluation is purely a monetary phenomenon, and as such it should be understood in monetary context. Devaluation affects BoT through its effects on real money supply. For example, if the monetary authority increases money supply, it induces an increase in the real balances of the domestic economy thereby leading to trade deficit; as expenditure now rises above income (Johnson, 1972; Miles, 1979; Dornbusch, 1973). To curb the situation, the government tends to devalue her currency. This devaluation leads to increase in domestic prices of imports, thereby reducing the effect of the real money supply. This, further leads to reduction in spending, thereby improving trade balance.

To sum up the theories behind currency depreciation as a curb to trade deficit, it is worth noting that devaluation will work best when the domestic economy has the capacity to produce. In short, the real sector that consists of agriculture, mining and manufacturing should be active. In the absence of productive efficiency, devaluation will lead to an unintentional shock within the economy. Issues such as inflation will ensue, BoT will worsen further, and citizens' welfare will greatly reduce (Ali et al., 2014).

2.1.4 Primary Commodities export

The exportation of primary commodities as proportion of total export has largely increased for many developing countries, of which Liberia is of no exception. Madeley (1996) points out that one of the major causes of unfavourable trade balance (i.e. trade deficit) in least developed countries is the reliance on primary commodities for exports. He argues that countries that depend on the exportation of primary commodities to generate major export earnings most often stand on the losing end as far as international trade is concerned. His argument comes from the background that since the 1980s, there have always been fluctuations in the world prices of primary commodities. Based on these happenings, it is a poor policy for developing countries, like Liberia, to depend on earnings from primary commodities export for developmental purposes. Reliance on primary commodities export could lead to internal distortion of economic projections, because the prices of those commodities are most likely to be influenced by world price fluctuations (AfDB, OECD, and UNDP, 2017). Exploitation and or exportation of primary commodities also have the propensity to spark up civil war as countries involved are usually associated with corruption and greed (Fearon, 2005).

Further on the account of primary commodity export, Singh and Nyandemo (2003) argue that trade deficit will always be the end result of countries that heavily rely on primary commodities export. They asserted that throughout Africa, Asia, and some other developing countries of the world, the exportation of primary products has traditionally accounted for a huge proportion of individual country's GNP. However, most of those countries are net importers of basic commodities such as food, clothes, pharmaceuticals, etc. As a result, import demands increasingly exceed the capacity to generate sufficient revenues from exports in those countries. This is, therefore, reflected as a trade deficit.

The level of national income has also been of paramount concern to policy makers when it comes to international trade balance. Increase in national income may improve or worsen trade balance depending on which activities the national income is used to undertake. For example, if national income is used to, say, import productive goods, it may worsen BoT in the short run; but there will be improvement in the long run (Wiggins and Brooks, 2010). In such scenario, BoT deficit scenario is welcoming.

2.2 Empirical Literature

Several empirical studies have been done to identify the determinants of BoT in both developing and developed economies. The position of BoT can be substantially linked to the interplay of the following policies: exchange rate, fiscal, and monetary policies (Bahmani-Oskooee, 1992). Duasa (2007) employed an empirical test to ascertain as to whether these policies were effective in the case of Malaysia's BoT, or whether one of them was more powerful than the others. Using the ARDL bound test to cointegration and a secondary, annual time series data spanning from 1974 to 2003, he found that there was a positive and long run relationship between BoT and fiscal policy (Keynesian-Absorption approach) and a negative and long run relationship between BoT and money supply. He did not, however, find a long run relationship between BoT and exchange rate for the Malaysian economy. The author's main conclusion is that unfavourable BoT should be corrected by the use of fiscal and monetary policies as compared to exchange rate policy.

The improvement in a country's BoT cannot be done in isolation to trade facilitation. As part of the functions of the WTO, trades are to be freed and predictable as much as possible. This calls for trade facilitation. Seck (2017) argues that in a state of efficient trade facilitation, export would rise

significantly over import. He applied the Gravity model of trade to a two period panel data for selected Sub-Saharan African (SSA) Countries. As a result of unavailability of data for many SSA countries, he chose 2007 and 2012 for his analysis. His main conclusion was that trade facilitation produces a greater magnitude in determining the position of the balance of trade.

On account of empirical evidence as it relates to the exchange rate of a country, there has been consensus amongst researchers that exchange rate depreciation improves BoT in the long run as maintained by the Marshall-Lerner Condition (Stucka, 2004; Onafowora, 2003; Brahmasrene, 2002; Bahmani-Oskooee, 2001; Baharumshah, 2001; Rincon, 1999; Shirvanai and Wilbratte, 1997). However, there have also been few mixed findings with respect to exchange rate depreciation. While several empirical studies have supported the MLC, others have found no support for it. For example, Shahbaz, Awan and Ahmad (2011) applying ARDL Bound test to a quarterly macroeconomic time series data, ranging from 1980 to 2006, found a negative and long run effect of exchange rate devaluation on Pakistan's BoT. Furthermore, they found evidence of the Keynesian-absorption approach to BoT. This indicates that reduction in spending improves BoT in Pakistan. Their findings also establish a negative impact of money supply on BoT. Additionally, in a related study using autoregressive distributed lag approach on a quarterly time series data covering 1980 to 2006, Shahbaz, Jalil and Islam (2012) confirmed the existence of a negative and long run effect of currency devaluation on BoT for the Pakistani economy.

Similar results were found by Ezenekwe, Metu and Kalu (2015) for the Nigerian economy. Using the Error Correction Model and an annual time series dataset spanning from 1970 to 2012, they found that exchange rate devaluation negatively affects the Balance of Payment for Nigeria. They, therefore, concluded that for the Nigerian economy, exchange rate devaluation leads to a rise in import value over export. This severely affects the balance of trade, which later reflects in the overall BoP deficit. On the other hand, other researchers have found no relationship between currency devaluation and trade balance (Karunaratne, 1988; Duasa, 2007).

On government budget deficit, like the exchange rate devaluation analysis, consensus has been reached amongst policy makers that huge public deficits have adverse effect on BoT in developing countries. As government expenditure rises above revenue, its savings level falls. A fall in savings induces a fall in investment, thereby leading to low output for export purposes. This further leads to trade deficit as import demand will be in excess of export supply. This term has been coined as

"The twin deficits" (Miller and Russek, 1989; Abell, 1990). While researchers have argued that budget deficit has direct impact on trade deficit, Abell (1990) argues that though the budget deficit negatively impacts trade deficit, it has an indirect effect rather than a direct one. Using macroeconomic time series data ranging from 1979 to 1985 for the Federal State of Dallas, and applying causality testing and impulse response functions, he found that the 'twin deficits' are interlinked through the transmission mechanism of interest and exchange rates. Thus, maintaining that the negative impact of the budget deficit on trade balance is an indirect one.

Most of the studies reviewed have used time series analysis to meet their objectives. However, none of them controlled for unit root in the presence of structural breaks. With the presence of structural breaks in time series analysis, the results of the traditional unit root tests are meaningless. This leads to a situation where the null hypothesis of non-stationarity maybe falsely rejected. Our study overcomes this shortcoming by testing for unit root in the presence of structural breaks. And where structural breaks are found, we control for them by introducing dummy variables.

2.3 Overview of the Literature

From the literature review carried out, several studies have pointed out factors influencing the position of trade balance in developed and developing countries. Some researchers have argued that trade deficit is not totally a bad phenomenon for a developing country if that deficit has the propensity to spur future economic growth. However, in the instance where the deficit becomes unsustainable, it becomes an unfavourable situation for the deficit country. Prospects of such country prioritizing generational altruism seems almost impossible. In that light, they have advocated for developing countries to put in strategies so as to increase export over import. Many researchers have found that exchange rate devaluation positively impacts the BoT in the long run. However, there were few studies that got mixed findings with regards to the effect of exchange rate devaluation on BoT; some found negative effects of exchange rate devaluation on BoT, while others did not find any relationship.

Consensus was reached among researchers when it comes to primary commodities export. The literature points out that over reliance on primary commodities export, to some extent, worsens the BoT. Budget deficit, as a result of excess government expenditure, along with excess money supply were also seen to have negative impact on trade balance; though some researchers found

an indirect effect of government spending on trade balance. To that end, from the reviewed literature and based on theory, we have identified factors such as gross domestic product, primary commodity export, merchandise import, nominal exchange rate, lending interest rate, trade openness, and domestic money supply as the key drivers of trade balance in Liberia.

Many of the related literature we reviewed carried out time series estimation technique as a basis for reaching their conclusions. However, they did not focus on the effect of estimating a time series data that has structural breaks in its series. This study overcomes such gap by testing for unit root in the presence of structural breaks. Additionally, of all the studies conducted (as presented in the literature review), none of them has empirically analyze the determinants of trade balance for the Liberian economy. This poses a huge gap in the existing literature. As such, this study is necessary in that it is intended to fill this gap.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter presents the methods used to establish the determinants of trade balance in Liberia. It is subdivided into seven sections. The first section presents the theoretical framework of the study. The second section presents the empirical model used. The third section looks at the various pre-estimation tests conducted. In the fourth section, we look at the test for cointegration, which will inform us as to which estimation technique to adopt. The fifth section specifies the estimation technique used. Section six presents post-estimation tests conducted. And section seven provides the sources of the data, and the definitions and descriptions of the estimable variables.

3.1 Theoretical Framework

The theoretical framework used in this study is adopted from the Keynesian-Absorption Approach to the Balance of Trade. The Keynesian-Absorption Approach relates trade balance to the change in real income minus the change in total expenditure. It combines both the elasticity approach with Keynesian macroeconomics to provide a more realistic explanation of analyzing trade balance. It analyzes the effects of changes in the exchange rate on BoT through changes in either income or absorption or both. And then, maintains that currency devaluation will improve BoT if it increases output more than expenditure, or decreases expenditure more than output (Ezenekwe et al., 2015).

The Keynesian-Absorption Approach starts with the National Income equation, written as follows:[5]

$$Y = C + I + G + (X - M) \quad (3.1)$$

Where:

$$C = a + bY \quad (3.2)$$

$$I = g + hY \quad (3.3)$$

$$G = j + kY \quad (3.4)$$

[5] We closely followed the work of Ezenekwe et al (2015)

From equations (3.1), (3.2), (3.3) and (3.4), b is the marginal propensity to consume; h is the marginal propensity to invest; and k is the marginal propensity for government spending. The conglomeration of the marginal propensities $(b + h + k)$ gives the economy's marginal propensity to absorb / spend. Y is national income; C is consumption; I is investment; G is government spending; X is export and M is import. a, g and j are autonomous parameters. In the formulation of equations (3.2), (3.3) and (3.4), we assume that C, I and G are increasing function of national income.

From equation (3.1), the first three components on the right hand side are known as absorption or total expenditure. And the last two components are referred to as the balance of trade. These can be simplified as follow:

$$A = C + I + G \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

$$BoT = X - M \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

Therefore, substituting equations (3.5) and (3.6) into (3.1), we can rewrite equation (3.1) as follows:

$$Y = A + BoT \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

We then rearrange equation (3.7) and make BoT the subject, and take rate of change as follows:

$$\Delta(BoT) = \Delta Y - \Delta A \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

Equation (3.8) constitutes the Keynesian Absorption approach, and it indicates that when output growth is higher than total expenditure growth, we will have BoT surplus. The reverse holds true for BoT deficit when output growth is lower than the growth in total expenditure/absorption. By emphasizing on the effect of exchange rate devaluation, the absorption approach argues that devaluation affects the BoT by either changing income, absorption or both of them (Ezenekwe et al, 2015). After devaluation, BoT will improve if the increase in income, as a result of devaluation, outweighs the increase in absorption; or if devaluation leads to greater decrease in absorption than income; or if income is increased while absorption is decreased.

Devaluation affects the national income through two channels; the idle/unemployed resources and the terms of trade channels (Ezenekwe et al, 2015). The idle or unemployed resources channel

argues that devaluation usually induces increase in the prices of imported goods. With this, domestic demand shifts to the previously idle resources; thereby increasing income. The terms of trade channel argues that in the face of devaluation, export becomes cheaper from foreigners' point of view. This leads to a rise in export, thereby increasing national income.

In order to analyze the joint effect of the marginal propensity to spend on BoT, we substitute equations (3.2), (3.3) and (3.4) into (3.5) and then take rate of change. Here, we further assume that $a + g + j = 0$.

$$\Delta A = (b + h + k)\Delta Y \quad \ldots \ldots (3.9)$$

We further substitute equations (3.9) into (3.8) in order to analyze the impact of exchange rate devaluation/depreciation on BoT.

$$\Delta(BoT) = [1 - (b + h + k)]\Delta Y \quad \ldots \ldots (3.10)$$

But $\Delta(BoT) > 0$ if $(b + h + k) < 1$ in absolute terms.

Equation (3.10) portrays the impact of exchange rate devaluation/depreciation on BoT. It maintains that devaluation will improve BoT if the marginal propensity to absorb is less than one.

3.2 Empirical Model

Using the Keynesian-Absorption Approach as a basis for our study and based on theory, we construct our empirical model in its functional form as follows:

$$(BoT)_t = f(GDP_t, Trent_t, Import_t, Exrt_t, Interest_t, Topen_t, Msupply_t,) \quad \ldots \ldots (3.11)$$

Where $(BoT)_t$ is balance of trade at time t; GDP_t is Gross Domestic Product at time t; Trent_t is total natural resources rent at time t; Import_t is merchandise import at time t; Exrt_t is nominal official exchange rate at time t; Interest_t is lending interest rate at time t; Topen_t is trade openness at time t; and Msupply_t is money supply at time t.

We, then, write the empirical model in a non-linear form; where the explanatory variables have a joint effect on the explained variable.

$$(BoT)_t = \beta_0 \text{GDP}_t^{\beta_1} \text{Trent}_t^{\beta_2} Import_t^{\beta_3} Exrt_t^{\beta_4} Interest_t^{\beta_5} Topen_t^{\beta_6} Msupply_t^{\beta_7} \quad \ldots \ldots (3.12)$$

In order to control for the presence of outliers that might arise among our variables, and following the works of Koutmos (2012), Akram (2009) and Cong et al (2008), we transform equation (3.12) into its natural logarithmic form as follows:

$$ln(BoT)_t = \beta_0 + \beta_1 \ln(BoT)_{t-k} + \beta_2 \ln(GDP)_{t-k} + \beta_3 \ln(Trent)_{t-k} + \beta_4 \ln(Import)_{t-k} + \beta_5 \ln(Exrt)_{t-k} + \beta_6 \ln(Interest)_{t-k} + \beta_7 \ln(Topen)_{t-k} + \beta_8 \ln(Msupply)_{t-k} + \varepsilon_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . (3.13)$$

Where all variables are previously defined under equation (3.11); *ln* is natural logarithm; *k* is the optimal lag length; ε_t is a stochastic error term; and ($\beta_1 \dots \dots \dots \dots . \beta_8$) are estimable parameters.

This study intends to use the Vector Autoregressive (VAR) approach or Vector Error Correction Model (VECM) in establishing the determinants of BoT in Liberia. However, the selection of VAR or VECM will be informed by the test for cointegration. The VAR approach was initially developed by Sims (1980) as a simultaneity model. It is a multivariate time series technique where all variables are considered endogenous and are regressed on their lagged values. Here, the issue of *a prior expectation* is lacking since VAR does not consider exogenous variables in its analysis. Instead, the lagged values of the endogenous variables are the ones that explain them. By so doing, the VAR model helps overcome the problem of endogeneity (Gujarati and Porter, 2009; Conteh, 2010). In the instance where the VAR approach with p maximum lag is used, it is fitted as follows:

$$y_t = v + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots \dots + \alpha_p Y_{t-p} + \mu_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . . \dots . . (3.14)$$

Where y_t is a $(Kx1)$ vector of endogenous variables at time t (which in our case are balance of trade, gross domestic product, primary commodity export, merchandise import, nominal exchange rate, lending interest rate, trade openness, and domestic money supply). v is a $(Kx1)$ vector of parameters; and $\alpha_1 - \alpha_p$ are (KxK) matrices of estimable parameters; and μ_t is a $(Kx1)$ vector of white noise innovation.

On the other hand, using the VECM approach, equation (3.14) can be rewritten as follows:

$$\Delta y_t = v + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \, \Delta y_{t-i} + \mu_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . . \dots \dots \dots \dots \dots \dots \dots (3.15)$$

Where $\Pi = \sum_{j=1}^{j=p} \alpha_j - i_k$ and $\Gamma = -\sum_{j=i+1}^{j=p} \alpha_j$

From equation (3.13), VECM can identify the cointegrating space or the number of cointegrating vectors.

The selection of lag length plays a major role in the overall reliability of a forecast. Incorporating too few lags leads to model misspecification; and too many lags lead to multicollinearity or the loss of degree of freedom. The Akaike Information Criterion is used to select the optimal lag length as is recommended by Gujarati and Porter (2009).

3.3 Pre-estimation Tests

To ascertain that our variables are reliable for forecasting, we employ several time series tests. Tests, such as normality test, unit root test, cointegration test, as well as descriptive statistical test are used in this study.

3.3.1 Normality Test

In econometric analysis, if a variable is not normally distributed, its error term will also be non-normally distributed. This further leads to non-normality of the estimated parameters. As a result, hypothesis testing will be affected. The normality test establishes whether the data is evenly distributed (i.e. whether the mean, median, and mode are equal) (Gujarati and Porter, 2009). To determine the normality status of our variables, we employ the original test developed by Shapiro and Wilk (1965) known as the Shapiro-Wilk W tests for normality. The Shapiro-Wilk 'W' test is used in the event where the number of observation is less than 2,000. The null hypothesis is that the variable is normally distributed at the chosen level of significance (for our case, the chosen level of significance is 5 percent); while the alternative hypothesis maintains non-normality of the variable.

3.3.2 Unit Root Test

In order to come up with the analysis of dependency or independency of the variables, we employ non-stationarity tests to test our variables for unit root. Econometric estimations in the presence of unit root lead to either spurious regression problem or inconsistent regression problem. To test for non-stationarity in our model, this study uses the Augmented Dickey-Fuller (ADF), and the Phillips-Perron (PP) unit root tests. We also use the Bai and Perron (1998; 2003) tests to test for structural breaks among the variables/series.

3.3.2.1 The Augmented Dickey-Fuller Test for Unit Root

The Augmented Dickey-Fuller (ADF) test is an improved version of the standard Dickey-Fuller (AD) test. Whereas the standard Dickey-Fuller test follows an AR(1) process, the ADF test incorporates several lags thereby overcoming the problem of autocorrelation that the standard AD test could not solve if the process was not AR(1). The ADF test fitted equation is given below:

$$\Delta y_t = \alpha + \beta y_{t-1} + \delta t + \sum_{j=1}^{k} \phi_j \, \Delta y_{t-j} + e_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3.16)$$

Where α is the constant term; δt is the time trend; and k is the maximum number of lags specified. The ADF test null hypothesis states that the variable under consideration contains at least a unit root. While the alternative hypothesis states that the variable does not contain a unit root. In the event where we fail to reject the null hypothesis after the ADF test, we will carry on the process of differencing until the variable becomes stationary (Gujarati and Porter, 2009).

3.3.2.2 The Phillips-Perron Test for Unit Root

The Phillips-Perron (PP) unit root test is a non-parametric test that is used to test whether or not a variable has unit root. It was developed by Phillips and Perron (1988) as an improvement to the ADF test. As such, the PP test statistics is similar to that of the ADF test statistics. But it has been adjusted through robustness to account for serial correlation. In order to have a reliable conclusion of the PP test, the PP test requires a specification of lags order. Even though the PP test is more powerful than the ADF test, both of them usually have the same critical values at all levels of significance. Like the ADF test, the PP test has the null hypothesis of the presence of at least a unit root. The criterion for rejecting or failing to reject the null hypothesis remains the same as the ADF. The PP test generates two test-statistics: the Z(rho) and the Z(t) statistics. But this study chooses the Z(t) statistics for the purpose of analysis. The fitted regression for the PP test is expressed as follows:

$$y_t = \alpha + \beta y_{t-1} + e_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3.17)$$

3.3.2.3 Unit Root Tests in the Presence of Structural Breaks

The analysis of structural breaks in time series econometrics has taken some relevance in recent time (Glynn, Perera and Verma, 2007). Structural break or structural change occurs as a result of unexpected shifts in time series variables. When there is a shift in a variable, it could lead to a shift

in the mean or a shift in other parameters of the process that produced the series. As a result of the presence of a shift, estimated parameters tend to be unrealistic when used to forecast. Furthermore, the traditional tests for unit root (i.e. ADF, PP, etc.) are ineffective in testing for unit root when structural breaks are present (Conteh, 2010; Zivot and Andrews, 1992). Factors such as war, economic crises, change in political regime, etc. are regarded as major causes of structural breaks. Time series models that test for structural breaks have more accurate forecast than others that do not (Ndirangu, Garcia and Gitau, 2014). As such, in order to have a reliable forecast of the determinants of BoT, we test for break points/dates using the Bai and Perron (1998; 2003) unit root tests for structural breaks. The Bai and Perron (BP) unit root test is one of the most powerful tests when testing for structural breaks as it is used to identify multiple breaks that exist in a series. The null hypothesis of the BP test is that there is γ break point. And the alternative hypothesis is that there is $\gamma + 1$ break point; where $\gamma = 0, \dots \dots .$ n. The fitted equation for the BP test is written as follows:

$$Y_t = X_t'\beta + Z_t'\delta_j + \mu_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. \dots \dots \dots \dots \dots .. (3.18)$$

Where Y_t is the explained variable at time t; X_t and Z_t are $(px1)$ and $(qx1)$ vectors of covariates; β and δ_j are vectors of coefficients; and μ_t is a stochastic error term (Bai and Perron, 1998; 2003).

3.4 Test for Cointegration

The choice of whether to estimate a VEC or VAR model depends on the level of cointegration. Cointegration, in time series analysis, occurs when the linear combination of two I(1) series becomes I(0). In such a case, I(0) eliminates the non-stationarity in the two series (Gujarati and Porter, 2009). The presence of cointegration is an indication of a long run relationship or long run equilibrium between or among variables. The power of cointegration is that it can allow us to capture equilibrium relationship between non-stationary series once that equilibrium exists between those of stationary series. There are several tests for cointegration, including the Engel-Granger test, the Pesaran, Shin and Smith ARDL-Bound test, and the Johansen (1995) test for cointegration. However, this study uses the Johansen (1995) test for cointegration, as it is effective when there are multiple cointegrating equations. Our main point of reference for interpretation of the Johansen (1995) test is based on the trace statistic, which is given as:

$$LR_{trace} = -T \sum_{i=r+1}^{k} \ln(1 - \hat{\lambda}_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3.19)$$

where T is the number of observations and the $\hat{\lambda}_i$ are the estimated eigenvalues. In the event where long run relationship is found, VECM is used. But if long run relationship is lacking, VAR model is used.

3.5 Model Estimation

The estimation of our empirical model is determined by the results of the test for cointegration, as outlined in section (3.4)**.** With the presence of a long run equilibrium, the VEC model is estimated, and if long run equilibrium is lacking, VAR model is used. However, whether we use VAR or VEC model, the problem of over parameterization as a result of lagged values of all the variables used usually ensues. One possible way to avoid such over-crowdedness of estimated parameters is to use either the Impulse Response Function (IRF), the Dynamic-Multiplier Function, or the Forecast Error Variance Decomposition (FEVD) (Gujarati and Porter, 2009; Conteh, 2010). This study, therefore, uses the IRF and FEVD to explain its findings.

3.5.1 Impulse Response Function

In the estimation of VAR or VEC model, IRF traces out the effect of a shock to an endogenous variable on itself and/or on another endogenous variable (Lutkepohl, 2005; Gujarati and Porter, 2009). For example, IRF traces how BoT will respond to long run shocks in GDP, import expenditure, exchange rate, money supply, etc. This analysis can be extended to all variables used in a study. In a nutshell, if there is a shock in any of our variables, the impact that that shock brings on the variable itself and on other variables is captured or explained by the IRF.

3.5.2 Forecast-Error Variance Decomposition

The Forecast-Error Variance Decomposition (FEVD) helps in establishing the extent to which a shock in an endogenous variable influences other variables. It measures the fraction of the forecast-error variance of an endogenous variable that can be attributed to shocks on itself or on another endogenous variable.

3.5.3 Granger Causality Test

Granger (1969) causality test establishes whether or not one time series data can be used to predict another time series. Usually, the Granger causality test is done to establish as to whether or not there is a long run relationship (among/between variables). In a simple regression model of two variables, say BoT and import, we say that import granger causes BoT if the past value of import significantly explains BoT. This is also true when past values of BoT explain import. To test the null hypotheses that import does not granger-cause BoT on one hand; and that BoT does not granger-cause import on the other hand, we use two equations:

$$(BoT)_t = \sum_{i=1}^{k} \alpha_i \, (Imp)_{t-i} + \sum_{j=1}^{k} \delta_j \, (BoT)_{t-j} + \mu_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.20)$$

$$(Imp)_t = \sum_{i=1}^{k} \beta_i \, (Imp)_{t-i} + \sum_{j=1}^{k} \phi_j \, (BoT)_{t-j} + \mu_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.21)$$

Where $(BoT)_t$ is balance of trade at time t; $(Imp)_{t-i}$ is the lagged or past value of import; $(BoT)_{t-j}$ is the past value of balance of trade. In both equations (3.20) and (3.21), if the sum of the estimated parameters are statistically significant, we reject the null hypothesis of no granger causality. Granger causality, when present between/among variables, can take one of two types: unidirectional causality where only one variable is significant in causing the other; and feedback/bidirectional causality where the two variables cause each other (Gujarati and Porter, 2009).

3.6 Post-estimation Tests

To establish the validity of our empirical results, we will carry out series of post-estimation tests. As such, this study employs the Langragian-Multiplier (LM) test for residual autocorrelation; the inverse root test for model stability; and the residual normality test for normality of the residuals.

3.7 Variables definition and description

BoT: Balance of Trade is defined as the difference between merchandise export and import. The values of BoT are recorded in current US dollar, and are measured in its natural logarithmic form. For the purpose of our estimation, balance of trade is represented by BoT.

GDP: Gross Domestic Product, is the monetary value of all final goods and services produced within Liberia in a given year. This is also a measure of the performance of an economy. The GDP used in this study is nominal GDP and is recorded in current USD. Furthermore, it is measured in natural logarithm; and is represented as GDP in our empirical model. Following Duasa (2007), we use GDP as a proxy for national income or output.

TRENT: Total natural resources rent consists of the total money earned from the leasing/selling of a country's natural resources, such as oil, natural gas, coal, mineral, forest, etc. This is used as a proxy for primary commodity export. It is recorded as a percentage of total GDP. We represent this as TRENT in our empirical model. For this study, we measure Trent in natural logarithmic form.

IMPORT: Merchandise import is the monetary value of all goods bought by Liberia from the rest of the world. It is recorded in current US dollar, and is measured in natural logarithm. In our estimable equation, it is denoted by IMPORT.

EXRT: Exrt is the nominal official exchange rate. For the analysis of this paper, the nominal official exchange rate is the amount of Liberian Dollar paid in order to obtain a unit United States Dollar. It is recorded as the average nominal exchange rate within a year; and is used as a proxy for real exchange rate as there is no data on said variable for Liberia (Conteh, 2010). We measure it in natural logarithm; and is represented in our model as EXRT.

INTEREST: This is the interest rate charged by financial institutions on loans given to the private sector. In this study, following Koutmos (2012), Akram (2009) and Cong et al (2008), the lending interest rate is recorded in percentage and is measured in natural logarithm. It is represented as INTEREST in our estimable equation.

TOPEN: Trade openness is the ratio of total merchandise trade to GDP. In other words, it is the value of export plus import, all divided by GDP. In this study, trade openness is used as a proxy for trade facilitation and it is measured in natural logarithm. It is represented in our empirical model as TOPEN.

MSUPPLY: We use money supply to represent monetary policy in this study. The monetary aggregate used is broad money. For this study, it is recorded in current US dollar, and is measured in natural logarithm. In our estimable equation, we represent it as MSUPPLY.

3.7.1 Sources of Data

We use secondary, annual time series data spanning from 1970 to 2015, for analysis. Data were gathered for balance of trade, gross domestic product, primary commodity export, merchandise import, nominal exchange rate, lending interest rate, trade openness, and domestic money supply. The dataset was obtained from the database of the World Development Indicators, 2018; and is reported in Appendix 7.

CHAPTER FOUR: EMPIRICAL RESULTS AND DISCUSSIONS

4.0 Introduction

The objective of this chapter is to present the findings of this study. It is subdivided into seven sections. Section one analyzes the descriptive statistics – both tabular and graphical. Section two looks at the optimal lag length selection criteria. In section three, we look at various tests for unit roots, including test for break points/dates. Section four looks at the Johansen test for cointegration, which informs us that the VECM estimation technique is appropriate. Section five looks at the VECM estimation and its interpretation through the IRF and FEVD. Section six discusses the Granger Causality test results. And section seven presents various post-estimation tests that were conducted.

4.1 Descriptive Statistics

This section presents the description of the variables used in the study. It gives the overview of the characteristics of the variables. For example, the mean indicates the average value of the series; the skewness measures the degree of symmetry of the series, and kurtosis measures the flatness or peakedness of the distribution of the series. The summary statistics is reported in Table 2 for our logged variables, and the summary statistics for the variables at level is reported in Appendix 1A.

Table 2: Summary Statistics

Variables	Obs	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
LNBOT	46	-0.273	19.719	-21.245	19.907	-0.002	1.003
LNGDP	46	20.198	0.681	18.700	21.433	-0.304	2.849
LNTRENT	46	3.566	0.394	2.866	4.414	0.534	2.639
LNIMPORT	46	19.886	0.577	18.826	21.415	0.377	3.348
LNEXRT	46	3.599	1.145	-8.33E-11	4.457	-2.734	8.913
LNINTEREST	46	2.802	0.141	2.592	3.097	0.351	2.404
LNTOPEN	46	0.315	0.679	-0.501	2.289	1.299	3.960
LNMSUPPLY	46	13.647	2.378	10.442	18.737	0.596	2.516

Source: Author's computation based on dataset
Note: LN attached to a variable indicates that that variable is in logarithm

Table 2 shows that LNBoT has a mean of -0.273 during the forty-six year period of the study. Standard deviation for LNBoT stands at 19.719. At the same time, the minimum and maximum

values are -2.245 and 19.907 respectively. The negative mean value of LNBoT suggests that LNBoT has not been favourable on the overall. During the forty-six year period, LNGDP was found to have a mean of 20.198 with a standard deviation of 0.681. At the same time, the minimum and maximum values for LNGDP were recorded as 18.7 and 21.433 respectively. The average amount spent on merchandise import (mean) during the period stands at 19.886; with its standard deviation being 0.577; and then a minimum and maximum of 18.826 and 21.415 respectively. LNMSUPPLY has a mean of 13.647. We also record a standard deviation of 2.378 for LNMSUPPLY; with 10.442 and 18.737 serving as minimum and maximum values respectively.

Additionally, Table 2 reveals that most of the series are not normally distributed as seen from the skewness values. A normally distributed series should have a skewness value of zero. Nevertheless, some of the series have skewness values that mirror around zero, though some still show negative skewness. For kurtosis, a normally distributed series has a kurtosis value of three. Again, table 2 shows that majority of the variables are platykurtic (having flatter curves, with kurtosis values below three); with the exception of LNIMPORT, LNEXRT and LNTOPEN which are leptokurtic (having highly peaked curves since their kurtosis values are greater than three). These analyses led us to conducting a normality test on the series, and the results are reported in section (4.1.2).

4.1.1 Graphical Data Analysis

In time series econometrics, graphical analysis of variables is a helpful tool in knowing the trends the variables have taken in past periods. Additionally, trend analysis gives a clue as to whether a variable contains unit roots and or structural breaks. We carried out such analysis on the variables used in this study; and the results of the logged variables are reported in figure 3, with the results of the variables at level being reported in Appendix 1B.

Figure 3: Graphical/trend analysis of variables used

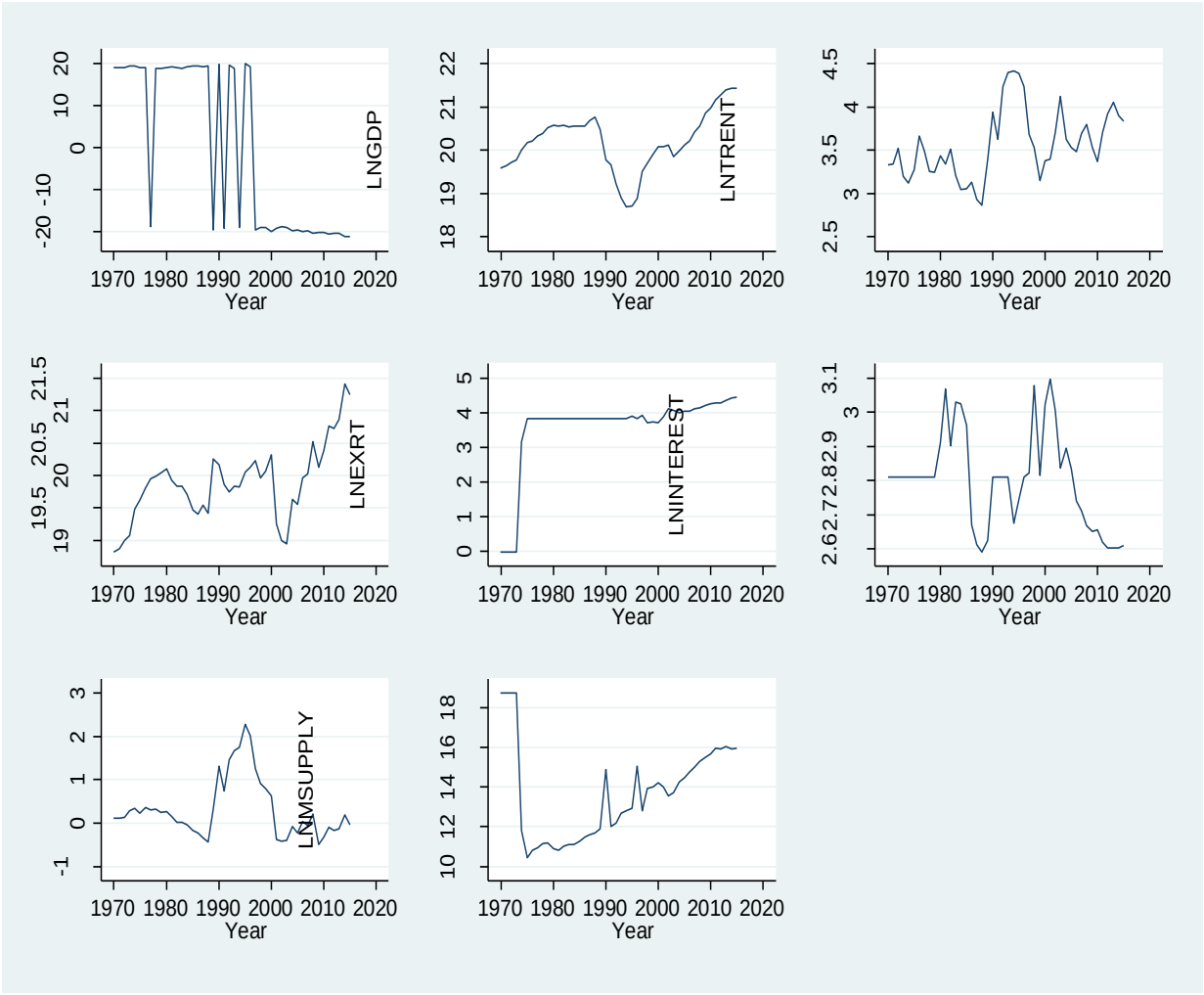


Figure 3 shows that LNBoT was favourable (i.e. surplus) from 1970 up to 1988, with the exception of a minor deficit in 1977. Between 1989 and 1996, the trend in LNBoT was inconsistent (recording both deficit and surplus). From 1997 up to 2015, LNBoT took a persistent downward trend. The trend in Gross Domestic Product shows that LNGDP took an increasing trend from 1970 up to 1988. It had a decline after 1988, and that decline ran up to 1995. From 1996 up to 2015, GDP has been increasing (except for 2003, where there was a sharp fall). Figure 3 shows high volatility in the trend for LNTRENT. This means that the percentage of GDP coming from the sale of natural resources has been unstable. This can be attributed to the fact that prices of primary commodities have met several instabilities on the global market. LNIMPORT shows an increasing trend in import from 1970 up to 1980; and a decrease from 1981 to 1988. The trend in LNIMPORT has been unstable between 1989 and 2003. Since 2004, the general trend in

LNIMPORT has been increasing. For LNEXRT, the analysis shows that there has been stability in the exchange rate from 1975 up to 1995. After 1995, the trend shows volatility in the exchange rate, with most of it being on an increasing level. The trend analysis shows that the lending interest rate (LNINTEREST) was stable between 1970 and 1979 inclusively. However, since the 1980s, lending interest rate has been highly unstable. This can be attributed to the ushering in of a military regime in 1980, and the prolonged Liberian civil war from 1989 to 2003. Figure 3 further shows that trade openness gradually declined between 1970 and 1989. Notwithstanding, LNTOPEN took an increasing trend from 1990 up to 1997. Since 2001, trade openness index has declined on the overall. For LNMSUPPLY, the figure shows that money supply has been relatively stable from 1970 to 1973. There was a gradual increase in LNMSUPPLY from 1974 up to 1989. Following the eruption of the civil war in 1989, money supply has been increasing up to 2015.

4.1.2 Normality Test Results

The concept of normality of a variable indicates its distribution level. If a variable is normally distributed, its statistical properties such as the mean, median, mode, etc. are equal. We performed the original Shapiro and Wilk (1965) Wald Test for normality in this study. The null hypothesis of the test is that the variables are normally distributed. We have reported the normality test result in table 3 for the logged variables; and the normality test result for the variables at level is reported in Appendix 1C.

Table 3: Shapiro-Wilk Normality Test

Variable	Obs	W	V	Z	Prob>Z	Verdict
LNBOT	46	0.660	14.961	5.741	0.0000	Non-normal
LNGDP	46	0.967	1.436	0.768	0.2212	Normal
LNTRENT	46	0.960	1.781	1.224	0.1104	Normal
LNIMPORT	46	0.968	1.414	0.736	0.2310	Normal
LNEXRT	46	0.515	21.375	6.498	0.0000	Non-normal
LNINTEREST	46	0.937	2.794	2.180	0.0146	Non-normal
LNTOPEN	46	0.857	6.306	3.908	0.0001	Non-normal
LNMSUPPLY	46	0.945	2.425	1.880	0.0300	Non-normal

Note: LN attached to a variable indicates that that variable is in logarithm

Table 3 reveals that three of the variables (LNGDP, LNTRENT and LNIMPORT) are normally distributed, while the rest are non-normally distributed. Notwithstanding, using multivariate

reduced form equation like the VAR or VECM, non-normality of a variable is not a major problem (Conteh, 2010; Nyawira, 2017). The problem arises when the residuals are non-normal.

4.2 Optimal Lag Length Selection Criteria

Optimal lag selection is a crucial decision in time series econometrics. Inclusion of too many lags leads to the issue of multicollinearity and the loss of degree of freedom; and inclusion of too few lags leads to misspecification of the model (Gujarati and Porter, 2009). As such, optimal lags need to be selected based on an information criteria. Selection of optimal lag length helps avoid the problems of autocorrelation and heteroskedasticity. This was done for this study, and the result is contained in Table 4.

Table 4: Optimal Lag Selection Criteria

Lag	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	2.28e-06	9.710	10.044	9.832
1	4.13e-09	3.339	6.349	4.435
2	2.22e-09	2.353	8.037	4.423
3	5.97e-10	-0.117	8.242	2.927
4	6.42e-13*	-10.290	0.744	-6.272
5	N/A	-352.599*	-338.890*	-347.607*

Source: Author's computation based on dataset

From table 4, the three information criteria (AIC, SC and HQ) indicate that the optimal lag length to be used in this study is five (5). This means that there is an agreement amongst the various information criteria. Even if there were no agreement amongst the information criteria, we would choose the Akaike Information Criteria, as it is robust over other criteria when dealing with yearly time series data (Gujarati and Porter, 2009).

4.3 Unit Root Test Results

We employed the Augmented Dickey-Fuller and Phillips-Perron tests to test for unit root or non-stationarity in our model. The null hypothesis of these two tests is that the series contains a unit root; while the alternative hypothesis states that the series does not contain a unit root. Table 5 reports the results of the ADF and PP tests.

Table 5: ADF and PP Unit Root Test

Variables	Augmented Dickey-Fuller Test			Phillips-Perron Test		
	Test Statistics	Lag Difference	Conclusion	Test Statistics	Band-width	Conclusion
LNBOT	-6.505***	0	I(0)	-6.581***	4	I(0)
LNGDP	-2.244	2	I(1)	-1.408	4	I(1)
ΔLNGDP	-3.614**	0	I(0)	-3.688**	3	I(0)
LNTRENT	-2.626	0	I(1)	-2.626	0	I(1)
ΔLNTRENT	-6.155***	0	I(0)	-6.148***	5	I(0)
LNIMPORT	-2.128	0	I(1)	-2.163	1	I(1)
ΔLNIMPORT	-6.962***	0	I(0)	-6.964***	2	I(0)
LNEXRT	-3.032	0	I(1)	-4.226***	22	I(0)
ΔLNEXRT	-5.715***	0	I(0)	-	-	-
LNINTEREST	-2.675	0	I(1)	-2.697	2	I(1)
ΔLNINTEREST	-7.820***	0	I(0)	-7.823***	1	I(0)
LNTOPEN	-1.798	0	I(1)	-1.999	3	I(1)
ΔLNTOPEN	-6.359***	0	I(0)	-6.378***	3	I(0)
LNMSUPPLY	-3.170	0	I(1)	-5.310***	32	I(0)
ΔLNMSUPPLY	-5.221	1	I(0)	-	-	-

Note: Δ indicates first difference; ** and *** indicate rejection of the null hypothesis at 5%, and 1% levels respectively; ADF and PP Critical values at levels: 10% (-3.187), 5% (-3.513), and 1% (-4.176). ADF and PP Critical values at first difference: 10% (-3.188), 5% (-3.516), and 1% (-4.181).

Table 5 reveals that LNBOT is stationary at level for both ADF and PP tests. Thus, we rejected the null hypothesis of non-stationarity. All other variables were seen to contain unit root; with the exception of LNEXRT and LNMSUPPLY which were stationary at level for the PP test but non-stationary at level for the ADF test. All variables that were non-stationary at level were differenced once and they obtained stationarity status. Non-stationarity, in this case, suggests that there is a possibility of a long run relationship among the variables. As such, we checked for cointegration using the Johansen (1995) test for cointegration as it is robust in testing for multiple cointegrating equations. The cointegration test results are contained in section (4.4).

Even though the analyses of the ADF and PP tests are important in bringing our parameter estimates to robustness, they are powerless when structural breaks are present in a series. In such case, forecasts tend to be unrealistic when there are structural breaks. We solved such problem by testing for unit root in the presence of structural breaks. The Bai and Perron (1998; 2003) structural break test is used and the results are reported in table 6.

Table 6: Bai-Perron Structural Break Test

Variable	Optimal Breakpoint	Scaled F-Statistic	Critical Value**
LNBOT	1997	108.9833*	8.58
LNGDP	1976, 1990, 1998, 2009	31.10463*	11.83
LNTRENT	1990, 1997	24.78642*	10.13
LNIMPORT	1976, 2008	17.48256*	10.13
LNEXRT	1976	98.77621*	8.58
LNINTEREST	2006	22.80523*	8.58
LNTOPEN	1990, 2001	100.9944*	10.13
LNMSUPPLY	1976, 1990, 2004	15.91301*	11.14

Note: LN attached at the beginning of a variable indicates log value; * indicates that the null hypothesis is rejected at 5 percent level; ** denotes Bai-Perron Critical Values. We trimmed at 0.15.

Table 6 presents the results of the Bai-Perron structural break test, and several structural breaks were found amongst the variables. The breaks range from 1976 up to 2009, with many occurring in the 1990s. These breaks can be attributed to the prolonged Liberian civil war that lasted from 1989 to 2003 and some minor economic instabilities. As such, to correct for the structural breaks, we introduced a dummy variable called POLESTAB. It takes the value of one where there was either political or economic instability, and zero otherwise. The periods (1989 - 2003 and 2014) accounted for the value of one in the POLESTAB variable.

4.4 Cointegration Test Results

Cointegration analysis enables us to choose between the VAR and VECM estimation techniques. We applied the Johansen (1995) cointegration test in this study, and the results are presented in table 7. We also treated the dummy variable as an exogenous variable in the execution of the cointegration test.

Table 7: Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	Prob.
None *	0.895	304.687	159.530	0.0000
At most 1 *	0.780	207.923	125.615	0.0000
At most 2 *	0.683	142.807	95.754	0.0000
At most 3 *	0.599	93.371	69.819	0.0002
At most 4 *	0.439	54.026	47.856	0.0118
At most 5***	0.345	29.142	29.797	0.0594
At most 6	0.133	10.943	15.495	0.2150
At most 7 *	0.106	4.808	3.841	0.0283

Note: * indicates rejection of the null hypothesis at 5% significance level, and *** indicates failure to reject the null hypothesis at 5% level of significance.

Table 7 reveals that there are five (5) cointegrating equations amongst the series. From the trace statistics and the p-value obtained in row seven (7) of table 7, we failed to reject the null hypothesis that there is at most five cointegrating equations. Such a failure to reject the null hypothesis led us to establish that there is a long run relationship among the series. And since the cointegrating equations are more than one, we use the Vector Error Correction Model for estimation in this study.

4.5 VECM Estimation

From the analysis provided in section 4.4, we use the VECM estimation technique to carry out our analysis. However, due to the issue of over-parameterization of the estimates from the VEC model, we use the Impulse Response Function and the Forecast Error Variance Decomposition to interpret our findings. The VECM estimates are reported in Appendix 2. In Appendix 2, the VECM results show that the error correction term for our mean equation is statistically significant at 5 percent level and has the theoretically expected sign. The error correction term captures the speed of adjustment to long run equilibrium. With the error correction term being -0.957, it means that 95.7 percent of previous years errors will be corrected in the following year. This signifies that the speed of adjustment from short run to long run equilibria is very high. Additionally, the R-squared of 0.783 was obtained for our equation of interest. This is an indication that 78.3 percent of the variations in the dependent variable (LNBOT) is explained by changes in the independent variables.

4.5.1 Impulse Response Function

The IRF traces out the impact of a shock in a variable on itself or on another variable. In other words, if there is a shock in any of the variables, the impact that that shock brings on the variable itself and on other variables is captured or explained by the IRF. The IRF analysis is done for only our variable of interest (LNBOT). Here, we analyze how LNBOT responds to a shock in any of the dependent variables over time. We present the results of the IRF for LNBOT in table 8 with a graphical analysis reported in Appendix 3.

Table 8: Impulse Response of LNBOT

Period	LN BOT	LN GDP	LN TRENT	LN IMPORT	LN EXRT	LN INTEREST	LN TOPEN	LN MSUPPLY
1	12.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	-3.696	2.249	-1.330	-0.353	-2.141	0.144	0.095	-2.267
3	-0.586	-1.513	-1.987	0.670	-0.005	0.355	-0.196	-1.435
4	1.105	1.430	0.920	2.099	-3.541	2.328	-1.746	-1.386
5	-1.572	4.539	0.599	1.253	-1.121	-0.898	-0.256	-4.464
6	0.479	1.515	-0.663	-0.797	0.179	0.645	-0.280	-0.928
7	-0.914	4.313	-0.275	1.652	-1.371	0.386	-1.615	-2.976
8	-1.323	3.179	1.641	-0.135	-2.363	-1.218	0.133	-1.760
9	2.561	4.853	1.398	1.159	-0.664	1.027	-0.126	-1.980
10	0.419	4.983	1.459	0.465	-0.570	0.370	-0.363	-2.681

Table 8 shows that when there is a one standard deviation shock in LNBOT, LNBOT itself will respond by decreasing and increasing over time. It firstly goes to negative in period 2 and 3; improves in period 4. But later worsens in period 5, and so forth. This is an indication that a sudden (negative) change in the current value of LNBOT will lead to an inconsistent trend in its future values.

For a one standard deviation shock in LNGDP, LNBOT will respond by increasing over time, with the exception of period 3. This signifies that increase in output positively impact LNBOT – an evidence of the Keynesian-Absorption approach to the balance of trade. In a scenario where domestic output is greater than import (or expenditure on import), balance of trade tends to improve. This, to a large extent, supports the postulation of the Keynesian-Absorption Approach of the Balance of Trade, where it maintains that BoT will improve if and only if the growth in output is higher than the growth in expenditure.

LNBOT shows an inconsistent response when there is a one standard deviation shock in both LNTRENT and LNIMPORT. It is positive at some periods and negative at other periods. This is an indication that reliance on the exportation of primary commodities is not totally a good strategy, as their returns are associated with fluctuations. Additionally, over reliance on import leads to other forms of shocks that later affect the BoT. For example, imports are usually accompanied by 'imported inflation'.

A shock in LNEXRT has continuous negative impact on LNBOT with the exception of periods 1 and 6. This suggests that exchange rate depreciation negatively affects BoT in Liberia. With Liberia being a net-importer, an increase in the exchange rate means that the prices of imported goods tend to rise, thus limiting quantities imported. However, some of these imported goods are used to produce other goods that can be exported (i.e. palm oil). In this regard, the gallons of palm oil produced and exported for example will be few, thereby contributing very little to the improvement of the BoT. When the earnings from export are matched with the expenditure on import, the difference is a deficit.

For a one standard deviation shock in LNINTEREST, LNBOT's response will mostly be positive, except in periods 5 and 8. An increase in the lending interest rate, for example, is a form of contractionary monetary policy. This is geared towards reducing the volume of domestic currency in circulation. In this regards, with an increase in lending interest rate, the money supply falls thereby leaving the public with limited quantity of money. With a fall in the quantity of money available to the public, expenditure on import also falls. This, in the end, improves the balance of trade as import expenditure is reducing as a result of high lending interest rate, holding other factors constant.

Finally, on account of LNBOT's response to shocks, LNBOT will respond negatively when there is a shock in both LNTOPEN and LNMSUPPLY. This suggests that when a small, poor country opens to international trade, its import volume increases over export as it does not have the capacity to compete with the exports of other large countries. Also, the result suggests that an increase in money supply induces import for a small country like Liberia. These two scenarios, further, worsen the BoT.

4.5.2 Forecast Error Variance Decomposition

We also use the FEVD to explain the results of the VEC estimation. The FEVD captures the fraction or percentage of the forecast-error variance of an endogenous variable that can be attributed to shocks on itself or on another endogenous variable. The forecast was done for ten years into the future. And for the sake of simplicity, we divided the results of the FEVD into two periods; the short run and the long run, where we chose year/period two to represent the short run, and year/period ten to represent the long run. Like the analysis on the IRF, we have focused only

on the variable of interest (LNBOT). The FEVD results are presented in table 9 with their graphical analyses reported in Appendix 4.

Table 9: Forecast Error Variance Decomposition of LNBOT

Pd	S.E.	LN BOT	LN GDP	LN TRENT	LN IMPORT	LN EXRT	LN INTEREST	LN TOPEN	LN MSUPPLY
1	12.055	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	13.255	90.49	2.88	1.01	0.07	2.61	0.01	0.01	2.93
3	13.600	86.15	3.97	3.09	0.31	2.48	0.08	0.03	3.89
4	14.710	74.20	4.34	3.03	2.30	7.91	2.57	1.43	4.21
5	16.231	61.88	11.39	2.63	2.49	6.98	2.42	1.20	11.03
6	16.384	60.82	12.03	2.74	2.68	6.86	2.53	1.21	11.14
7	17.440	53.95	16.73	2.44	3.26	6.67	2.28	1.92	12.74
8	18.136	50.42	18.55	3.08	3.02	7.87	2.56	1.78	12.73
9	19.177	46.88	22.99	3.29	3.07	7.16	2.58	1.60	12.45
10	20.072	42.83	27.15	3.53	2.85	6.61	2.39	1.49	13.15

Table 9 reveals that when there is a shock in LNBOT in the short run (i.e. period 2), 90.49 percent of the forecast error variance is explained by LNBOT itself. With this, the table reveals that the fraction of forecast error variance that is explained by the other variables is low in the short run. This is an indication that LNBOT is determined independently in the short run. However, in the long run (i.e. period 10), 42.83 percent of the fluctuations in LNBOT is explained by LNBOT itself; and 27.15 percent of the fluctuations in LNBOT is explained by LNGDP. This is an indication that LNGDP is strongly endogenous in influencing LNBOT in the long run. This, further, supports the postulation of the Keynesian-Absorption approach that an increase in output over expenditure improves the balance of trade in the long run.

The individual impacts of LNTRENT, LNIMPORT, LNINTEREST and LNTOPEN are seen to be very small in explaining fluctuations in LNBOT in the long run. This goes to mean that these four variables exhibit a strong exogenous effect (i.e weak effect) in explaining forecast error variance in LNBOT in the future. On the other hand, the impacts of nominal exchange rate and money supply are seen to be relatively strong in determining LNBOT in the long run; as LNEXRT and LNMSUPPLY explain 6.61 and 13.15 percent of forecast error variance of LNBOT respectively. Here, there is an evidence that LNEXRT and LNMSUPPLY can explain forecast error variance of LNBOT in the long run, even though their explanatory power is weak.

4.6 Granger Causality Test

Establishing a directional relationship between or among macroeconomic variables is an important way of advancing policy recommendation for forecast purposes. Granger causality establishes as to whether past values of a variable are capable of influencing the current value of another variable; or whether the current value of a variable is capable of determining the future value of another variable. We conducted Granger causality test and the results are reported in Appendix 5.

From the Granger causality test results contained in Appendix 5, we found evidence of a bidirectional causality among the following variables: LNGDP and LNBOT; and LNMSUPPLY and LNBOT. This is an indication that past values of LNGDP granger cause current value of LNBOT and vice versa. And also, past values of LNMSUPPLY granger cause current value of LNBOT and vice versa. In these scenarios, if there was an increase in past values of LNGDP, for example, it increases the current value of LNBOT. And if there was an increase in past values of LNBOT, it also increases current value of LNGDP. Granger causality establishes the directional relationship between or among variables, but it does not point out whether the relationship is positive or negative. Nevertheless, based on the findings contained in Table 8, we argue that if there was an increment in the past values of LNMSUPPLY, it will reduce the current value of LNBOT. And if past values of LNBOT were increased, they will reduce current value of LNMSUPPLY.

We also found unidirectional causality running from LNBOT to LNIMPORT at 10 percent significance level. This goes to mean that an increase (improvement) in past values of LNBOT significantly reduces current value of LNIMPORT. Also; unidirectional causality running from LNBOT to LNINTEREST, at 5 percent significance level, indicates that improvement in past values of LNBOT leads to an increase in the current value of LNINTEREST (i.e. a form of contractionary monetary policy). On the other hand, we did not find any causality relationship between the following variables: LNTRENT and LNBOT; LNEXRT and LNBOT; and LNTOPEN and LNBOT.

4.7 Post-Estimation Test

We carried out various post-estimation tests to ascertain that parameter estimates are reliable. In a model where post-estimation tests results are not reliable, any forecast made based on those estimates will be unreliable. In this study, we conducted various post-estimation tests including the residuals normality test, residuals serial correlation test, and VECM stability test.

4.7.1 Residuals Normality Test

We used the Orthogonalization Cholesky (Lutkepohl) technique to test for normality of the residuals. The null hypothesis here is that the residuals are multivariate normal. The result of the residuals normality test is reported in Table 10. Also, graphical analyses of the residuals normality test are reported in Appendix 6.

Table 10: Residuals Normality Test

Equations	**Chi-sq**	**df**	**Prob.**
LNBOT	0.640	1	0.4238
LNGDP	1.500	1	0.2207
LNTRENT	0.050	1	0.8222
LNIMPORT	0.547	1	0.4595
LNEXRT	1.202	1	0.2730
LNINTEREST	0.243	1	0.6223
LNTOPEN	1.056	1	0.3041
LNMSUPPLY	1.906	1	0.1674
JOINT	7.144	8	0.5212

From Table 10, since all the p-values are greater than 0.05, we failed to reject the null hypothesis of residuals normality for all of our equations, including the joint equation. The same result is shown for the graphical analysis reported in Appendix 6. This is an indication that parameter estimates obtained from our equations are reliable for policy analysis.

4.7.2 Residual Serial Correlation Test

Avoiding serial correlation is a major concern in time series econometrics. Serial correlation occurs when errors from past periods are moved to future periods. This has serious repercussion on inferences. To ascertain the validity of our model, we tested for residual serial correlation using the Langragian Multiplier (LM) test. The null hypothesis of the LM test is that the model has no

serial correlation at lag h. Lag h, in this study, is represented by 10. The results of the LM test is reported in table 11, and is explained using two similar statistics along with their probability values. The statistics used are: the Likelihood Ratio (LRE) and the Rao F-Statistics.

Table 11: VEC Residual Serial Correlation LM Test

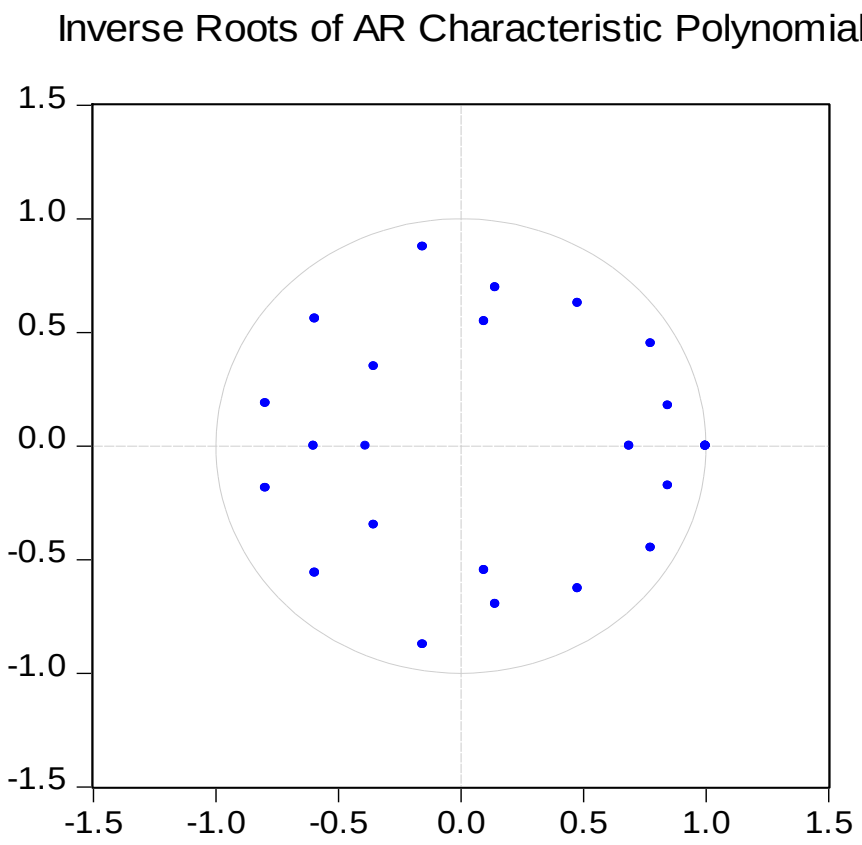
Lag	LRE Statistics	df	Prob.	Rao F-Statistics	df	Prob.
1	94.897	64	0.0073	1.756	(64, 35.3)	0.0358
2	69.808	64	0.2887	1.029	(64, 35.3)	0.4728
3	66.583	64	0.3882	0.954	(64, 35.3)	0.5738
4	63.606	64	0.4904	0.888	(64, 35.3)	0.6660
5	74.101	64	0.1819	1.135	(64, 35.3)	0.3468
6	65.225	64	0.4339	0.924	(64, 35.3)	0.6163
7	67.066	64	0.3724	0.965	(64, 35.3)	0.5586
8	46.928	64	0.9461	0.568	(64, 35.3)	0.9754
9	69.609	64	0.2944	1.025	(64, 35.3)	0.4789
10	65.493	64	0.4247	0.930	(64, 35.3)	0.6079

Table 11 reveals that the probability values for the LRE and the Rao F-statistics are all greater than the 5 percent level of significance from lag 2 up to lag 10. But they are both lower than the 5 percent significance level at lag 1. This is an indication that the model included appropriate optimal lags, and those lags have overcome serial correlation. With this, we fail to reject the null hypothesis of the LM test from lags 2 to 10; even though the null hypothesis cannot be accepted at lag 1. On the overall, the model does not contain serial correlation.

4.7.3 Model Stability Test

Stability of the VEC model is a crucial thing for forecast reliability. If a VEC model is not stable, it means that the results obtained from the IRF and the FEVD are not valid. A VEC model is said to be stable if all roots have moduli less than one and lie inside the unit circle. We performed the inverse roots test, and the result is reported in figure 4.

Figure 4: Inverse Roots of AR Characteristic Polynomial



From figure 4, we see that all roots lie within the unit circle, thereby implying that our model is stable. A stable model further implies that parameter estimates are valid and are reliable for forecast or policy purposes.

CHAPTER FIVE: SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.0 Introduction

The objective of this chapter is to provide the overview of the study. In this chapter, the main findings are briefly discussed and policy recommendations are proffered based on the findings. Limitation of the study and suggestion for further studies are also included.

5.1 Summary

This study is geared towards establishing factors that determine the balance of trade in Liberia from 1970 to 2015. Specifically, the study seeks to establish the determinants of Liberia's balance of trade; to estimate the long run relationship between balance of trade and its determinants; and to identify areas of policy interventions based on the findings of the study.

The motivation of this study is drawn from the Keynesian-Absorption Approach to the Balance of Trade; which argues that to improve trade balance, output growth should exceed expenditure growth. To achieve the objectives of this study, we used the Vector Error Correction estimation technique to carry out our empirical estimation. This decision was based on the Johansen cointegration test result, which indicated a long run relationship – thus, the appropriateness of VECM. We also used the Granger Causality test to estimate the long run relationship between BoT and its determinants.

To control the issue of outliers in the series, which would lead to non-normality of the error term, we transformed all of the variables to their natural logarithmic form (except for the dummy variable, POLESTAB). We further carried out other pre-estimation tests such as the ADF and PP unit root tests to determine unit roots in the variables; and the Bai and Perron Structural break test – to determine unit root in the presence of structural breaks.

We estimated the relationships among the variables using VECM and then used the IRF and FEVD to explain our results. The results of the IRF indicate that an increase in output/GDP leads to improvement in the BoT in the long run. In this way, output growth is seen as a major contributor to the BoT – an evidence of the Keynesian-Absorption Approach. Primary commodity export and merchandise import show mixed impacts on BoT, while lending interest rate has mostly positive

effect on BoT. Exchange rate, trade openness and money supply show long run negative impacts on BoT. This is an indication that exchange rate depreciation worsens Liberia's BoT in the long run. And also, increase in money supply leads to increase in import – which negatively affects the BoT.

For the FEVD's results, it is evident that output/GDP has high influence in determining BoT in the long run. Nominal exchange rate and money supply were seen to have relatively strong impact in the determination of BoT in the long run. Primary commodity export, merchandise import, lending interest rate, and trade openness were strongly exogenous (i.e. weak) in accounting for the fraction of forecast error variance in BoT.

5.2 Conclusion

In the establishment of the determinants of BoT in Liberia, this study concludes that gross domestic product has a long run and positive influence in determining Liberia's BoT. This is an indication that as GDP increases over time, it leads to improvement in trade balance. This finding is also in support of the Keynesian-Absorption approach to BoT. It postulates that increase in output over expenditure improves BoT.

Primary commodity export and merchandise import were seen to have an inconsistent effect on BoT. This implies that over reliance on earnings from primary commodity export for developmental purposes would not yield tangible result, since the global prices of primary commodities are liable to fluctuations. This is why in the case of stable global prices, primary commodity export improves the BoT and in the case of say, low, prices the BoT worsens.

Nominal exchange rate, trade openness, and money supply were found to have a negative influence on BoT in the long run. The implication here is that exchange rate depreciation negatively affects BoT for a small country like Liberia. Since Liberia is a net importer of basic commodities, increasing the exchange rate will only make those commodities expensive. Additionally, the low productive capacity will not permit Liberia to gain from competitive exportation. These scenarios further worsens the BoT. Similar implication can be attributed to money supply. Increasing money supply where the domestic economy is not producing, a large portion of that money will be used

to import foreign goods. But reducing money supply through monetary policy instruments (i.e. interest rate) could imply a reduction in import, thus improving the BoT.

5.3 Policy Recommendations

Based on the findings of our empirical estimation (as explained by the IRF and FEVD), we recommend the following policies to the Government of the Republic of Liberia:

- That the Government might wish to consider diversifying her export products and rely less on exports of primary commodities. This can be achieved by investing in national corporations that have capacities to transform raw materials into finished products. As seen from this study, over reliance on primary commodities export leads to inconsistency in the BoT. This is partly because primary commodities are associated with fluctuations in their global prices.

- That the Government implement austerity measures on specific sectors in the economy. Austerity measures such as reducing importation of commodities that do not have the propensity to increase domestic output, should be prioritized. For example, about 80 percent of GoL fiscal budget is allocated to recurrent expenditure. And most often, expenditures on these recurrent activities do not produce any tangible output. Reducing the importation of fancy cars for government officials, for example, should be encouraged.

- That the government encourage trade facilitation (trade openness); but with some measures put in place. Trade facilitation is one of several ways for a small country to gain from international trade. But this gain comes when various sectors in the economy are functional. For example, in the absence of, say, productive capacity, trade openness will only enable the domestic economy to import more. To make trade openness serve as a beneficial tool for BoT improvement, efforts should be made to improve Liberia's productive capacity.

- That the Government, through the Central Bank of Liberia, put in mechanism to effectively monitor the exchange rate. Theories have suggested that exchange rate depreciation/devaluation leads to improvement in the balance of trade. But this is not always the case. In order to improve BoT through exchange rate depreciation, the domestic economy should not have capacity constraints. But Liberia is seen to have capacity

constraints – as the real sector of the economy is still lagging. As such, a mechanism should be put in place to monitor the exchange rate, thus having at least a stable exchange rate.

- That contractionary monetary policy be considered by the government so as to improve Liberia's BoT. With reduction in money supply (or increase in lending interest rate), import expenditure tends to reduce thus improvement in BoT. However, said monetary policy should be done with care so as to avoid policy dilemma. For example, increment in lending interest rate should be done with serious caution, because at certain point in time, increasing lending interest rate discourages domestic investment thus reducing domestic output.

5.4 Limitations of the Study

Due to lack of comprehensive data on Balance of Payments variables for the Liberian economy, this study reduced its scope to analyzing the Balance of Trade. The BoT is just a small component of the BoP. It would have been more appealing were we to analyze the determinants of the balance of payments for the Liberia economy.

5.5 Suggestions for Further Research

In as much as this study has established the determinants of trade balance in Liberia from 1970 to 2015, there is still a need to conduct further studies, as analysis on international trade is a broad spectrum of the macro economy. Additionally, some key policy variables were absent in our study. Variables like corruption index, illegal trade of merchandise, political patronage, real exchange rate, etc. were not included[6]. As such, future studies should try incorporating some of these variables.

[6] Real Exchange Rate was proxied by Nominal Exchange Rate.

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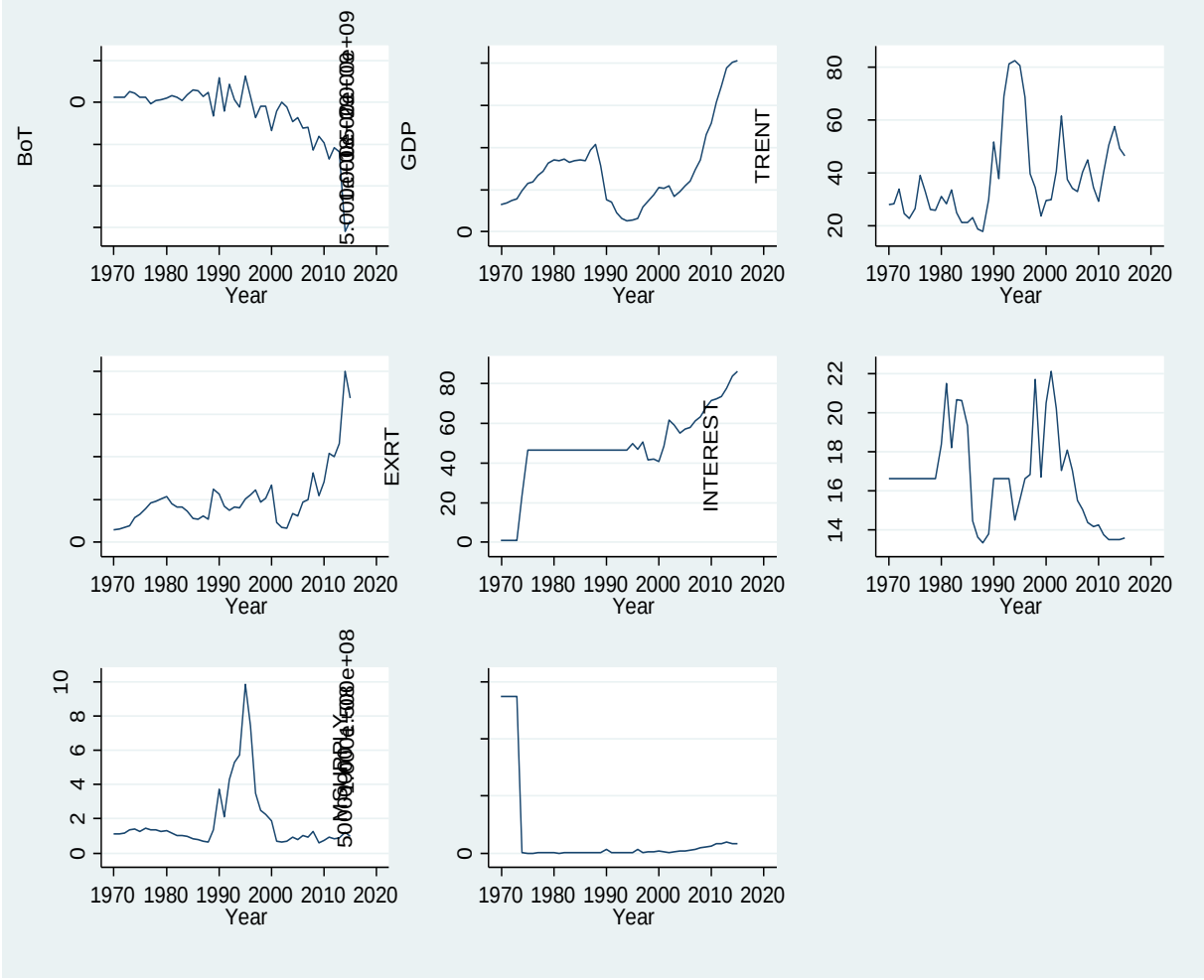
APPENDIX 1: Descriptive Statistics (tables and graphs)

Appendix 1A: Summary statistics of variables at level

Variables	Obs	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
BOT	46	-1.32E+08	3.75E+08	-1.55E+09	3.10E+08	-2.181	8.300
GDP	46	7.30E+08	4.85E+08	1.32E+08	2.03E+09	1.282	4.170
TRENT	46	38.32	16.808	17.562	82.589	1.277	3.868
IMPORT	46	5.16E+08	3.64E+08	1.50E+08	2.00E+09	2.349	9.201
EXRT	46	48.376	19.079	1.000	86.188	-0.832	4.489
INTEREST	46	16.636	2.410	13.358	22.140	0.621	2.691
TOPEN	46	1.835	1.895	0.606	9.866	2.632	9.860
MSUPPLY	46	13760067	38597165	34276.88	1.37E+08	2.906	9.501

Appendix 1B: Graphical/trend analysis of variables at level



Appendix 1C: Shapiro-Wilk Normality test (variables at level)

Variable	Obs	W	V	Z	Prob>z	Verdict
BoT	46	0.762	10.491	4.988	0.00000	Non-normal
GDP	46	0.866	5.925	3.776	0.00008	Non-normal
TRENT	46	0.858	6.243	3.887	0.00005	Non-normal
IMPORT	46	0.748	11.088	5.106	0.00000	Non-normal
EXRT	46	0.897	4.546	3.214	0.00066	Non-normal
INTEREST	46	0.920	3.508	2.664	0.00387	Non-normal
TOPEN	46	0.613	17.058	6.020	0.00000	Non-normal
MSUPPLY	46	0.374	27.583	7.040	0.00000	Non-normal

APPENDIX 2: VECM Estimation Results

Vector Error Correction Estimates
Date: 06/19/18 Time: 22:36
Sample (adjusted): 1973 2015
Included observations: 43 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5
LNBOT(-1)	1.000	0.000	0.000	0.000	0.000
LNGDP(-1)	0.000	1.000	0.000	0.000	0.000
LNTRENT(-1)	0.000	0.000	1.000	0.000	0.000
LNIMPORT(-1)	0.000	0.000	0.000	1.000	0.000
LNEXRT(-1)	0.000	0.000	0.000	0.000	1.000
LNINTEREST(-1)	34.372	3.974	0.220	3.391	3.513
	(27.446)	(0.588)	(0.468)	(0.767)	(1.569)
	[1.252]	[6.761]	[0.471]	[4.420]	[2.238]
LNTOPEN(-1)	2.931	1.273	-0.232	0.290	0.907
	(4.935)	(0.106)	(0.084)	(0.138)	(0.282)
	[0.594]	[12.044]	[-2.762]	[2.101]	[3.216]
LNMSUPPLY(-1)	6.672	0.058	-0.096	-0.039	0.037
	(1.436)	(0.031)	(0.024)	(0.040)	(0.082)
	[4.645]	[1.872]	[-3.936]	[-0.962]	[0.449]
C	-185.848	-32.538	-2.824	-29.000	-14.397

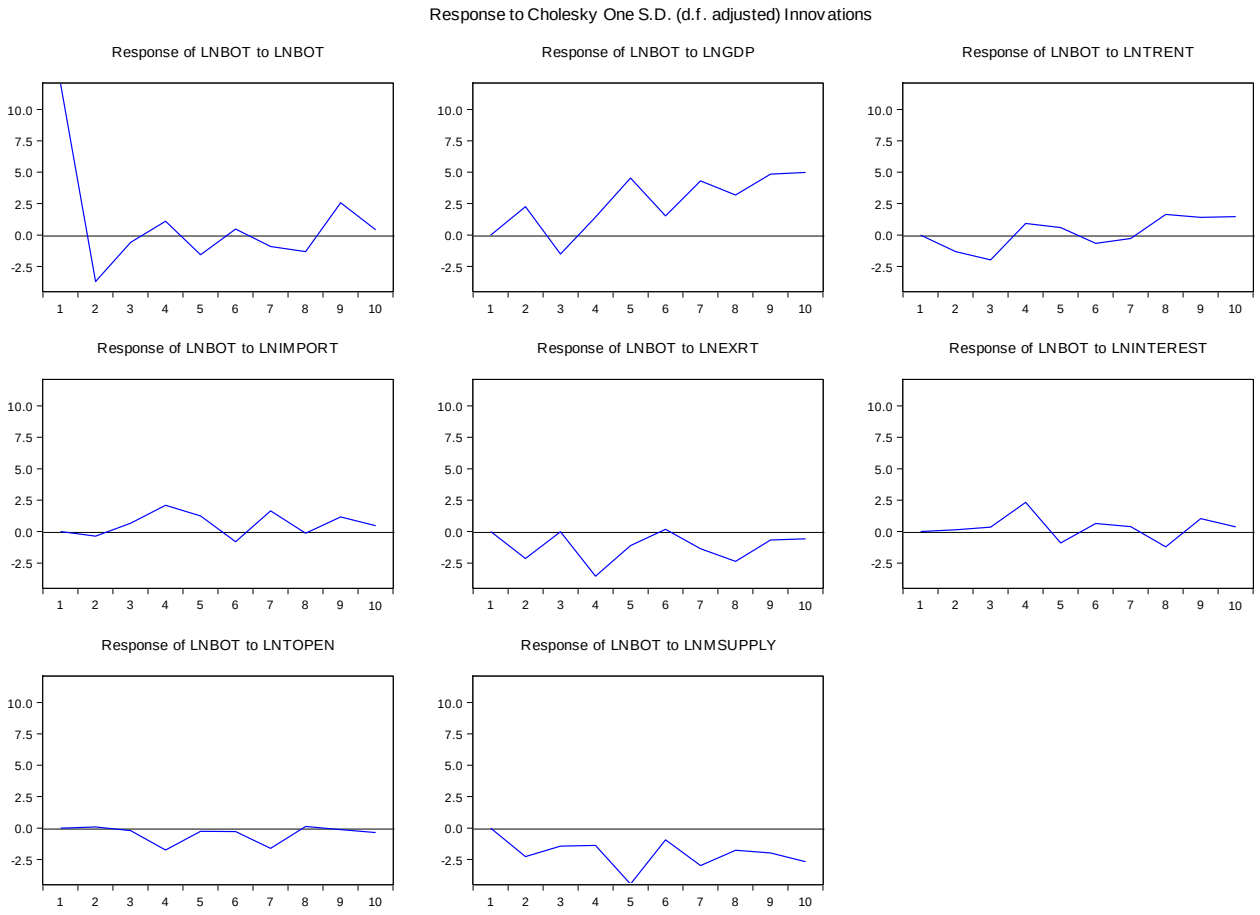
ERROR CORRECTION:	D(LNBOT)	D(LNGDP)	D(LNTRENT)	D(LNIMPORT)	D(LNEXRT)	D(LNINTEREST)	D(LNTOPEN)	D(LNMSUPPLY)
CointEq1	-0.957	0.003	-0.006	-0.0043	-0.012	0.002	-0.004	0.028
	(0.368)	(0.003)	(0.005)	(0.006)	(0.014)	(0.003)	(0.006)	(0.035)
	[-2.603]	[1.013]	[-1.271]	[-0.747]	[-0.858]	[0.672]	[-0.677]	[0.794]
CointEq2	27.611	0.302	-0.481	0.336	1.779	0.020	-0.494	-4.669
	(26.278)	(0.229)	(0.347)	(0.428)	(1.002)	(0.196)	(0.432)	(2.491)
	[1.051]	[1.315]	[-1.385]	[0.785]	[1.775]	[0.104]	[-1.143]	[-1.874]
CointEq3	15.982	0.283	-0.779	0.7301	-0.015	-0.036	0.383	-0.023
	(14.631)	(0.128)	(0.193)	(0.238)	(0.558)	(0.109)	(0.241)	(1.387)
	[1.092]	[2.220]	[-4.029]	[3.062]	[-0.026]	[-0.328]	[1.590]	[-0.017]
CointEq4	1.003	-0.229	0.264	-0.914	-1.605	-0.055	0.004	3.722
	(25.682)	(0.224)	(0.339)	(0.419)	(0.979)	(0.192)	(0.423)	(2.435)
	[0.039]	[-1.023]	[0.778]	[-2.184]	[-1.639]	[-0.288]	[0.009]	[1.529]

CointEq5	-19.788	0.053	0.075	0.014	-0.164	0.029	-0.141	0.498
	(6.040)	(0.053)	(0.080)	(0.098)	(0.230)	(0.045)	(0.099)	(0.573)
	[-3.276]	[0.999]	[0.946]	[0.142]	[-0.710]	[0.635]	[-1.419]	[0.869]
D(LNBOT(-1))	-0.328	0.002	0.002	-0.001	0.003	0.000	-0.009	-0.020
	(0.278)	(0.002)	(0.004)	(0.005)	(0.011)	(0.002)	(0.005)	(0.026)
	[-1.181]	[0.953]	[0.579]	[-0.323]	[0.294]	[0.099]	[-2.074]	[-0.771]
D(LNBOT(-2))	-0.361	0.001	0.007	0.003	0.012	0.000	-0.003	-0.045
	(0.263)	(0.002)	(0.003)	(0.004)	(0.010)	(0.002)	(0.004)	(0.025)
	[-1.374]	[0.549]	[1.913]	[0.592]	[1.223]	[0.190]	[-0.653]	[-1.811]
D(LNGDP(-1))	-10.301	0.008	0.775	0.658	-0.302	-0.127	0.217	1.549
	(31.766)	(0.277)	(0.420)	(0.518)	(1.211)	(0.237)	(0.523)	(3.011)
	[-0.324]	[0.030]	[1.847]	[1.272]	[-0.250]	[-0.534]	[0.414]	[0.514]
D(LNGDP(-2))	-36.927	0.462	-0.417	1.708	0.461	-0.053	0.576	0.318
	(28.284)	(0.247)	(0.374)	(0.461)	(1.078)	(0.211)	(0.465)	(2.681)
	[-1.306]	[1.872]	[-1.117]	[3.707]	[0.428]	[-0.253]	[1.236]	[0.119]
D(LNTRENT(-1))	-18.444	-0.341	0.311	-0.880	-0.718	0.145	-0.456	1.802
	(13.702)	(0.120)	(0.181)	(0.223)	(0.522)	(0.102)	(0.226)	(1.299)
	[-1.346]	[-2.854]	[1.718]	[-3.942]	[-1.374]	[1.420]	[-2.024]	[1.387]
D(LNTRENT(-2))	-30.099	0.057	0.086	-0.211	0.313	0.112	-0.466	-0.803
	(14.271)	(0.125)	(0.189)	(0.232)	(0.544)	(0.107)	(0.235)	(1.353)
	[-2.109]	[0.454]	[0.458]	[-0.906]	[0.576]	[1.047]	[-1.982]	[-0.594]
D(LNIMPORT(-1))	-14.351	0.234	-0.760	-0.801	-0.220	0.343	-0.841	0.660
	(24.949)	(0.218)	(0.330)	(0.407)	(0.951)	(0.186)	(0.411)	(2.365)
	[-0.575]	[1.076]	[-2.306]	[-1.970]	[-0.231]	[1.840]	[-2.047]	[0.279]
D(LNIMPORT(-2))	-21.544	0.210	-0.139	-0.431	0.621	0.395	-0.660	-2.613
	(22.532)	(0.197)	(0.298)	(0.367)	(0.859)	(0.168)	(0.371)	(2.136)
	[-0.956]	[1.068]	[-0.465]	[-1.175]	[0.723]	[2.344]	[-1.781]	[-1.224]
D(LNEXRT(-1))	5.272	0.156	-0.277	-0.145	-0.175	-0.096	-0.287	-1.136
	(11.554)	(0.101)	(0.153)	(0.188)	(0.440)	(0.086)	(0.190)	(1.095)
	[0.456]	[1.552]	[-1.813]	[-0.768]	[-0.396]	[-1.116]	[-1.507]	[-1.037]
D(LNEXRT(-2))	1.038	0.086	-0.003	-0.104	-0.213	0.075	-0.171	-0.220
	(11.615)	(0.101)	(0.154)	(0.189)	(0.443)	(0.087)	(0.191)	(1.101)
	[0.089]	[0.850]	[-0.018]	[-0.550]	[-0.481]	[0.866]	[-0.894]	[-0.199]
D(LNINTEREST(-1))	-14.397	-0.706	1.027	0.268	-0.550	-0.596	1.405	1.952
	(31.847)	(0.278)	(0.421)	(0.519)	(1.214)	(0.238)	(0.524)	(3.019)
	[-0.452]	[-2.542]	[2.440]	[0.516]	[-0.453]	[-2.504]	[2.680]	[0.647]
D(LNINTEREST(-2))	-22.821	-0.192	0.640	0.606	-0.659	-0.114	0.953	1.509
	(28.462)	(0.248)	(0.376)	(0.464)	(1.085)	(0.213)	(0.468)	(2.698)
	[-0.802]	[-0.775]	[1.703]	[1.307]	[-0.608]	[-0.538]	[2.034]	[0.560]

D(LNTOPEN(-1))	2.503	-0.208	0.897	1.211	0.607	-0.166	0.961	-0.639
	(25.496)	(0.222)	(0.337)	(0.415)	(0.972)	(0.190)	(0.420)	(2.417)
	[0.098]	[-0.937]	[2.663]	[2.914]	[0.624]	[-0.870]	[2.290]	[-0.264]
D(LNTOPEN(-2))	18.651	-0.120	-0.008	0.951	-0.200	-0.289	0.899	1.699
	(23.137)	(0.202)	(0.306)	(0.377)	(0.882)	(0.173)	(0.381)	(2.193)
	[0.806]	[-0.592]	[-0.027]	[2.522	[-0.226]	[-1.673]	[2.361]	[0.774]
D(LNMSUPPLY(-1))	1.921	0.065	-0.153	-0.061	-0.167	-0.053	-0.103	-0.262
	(4.875)	(0.043)	(0.064)	(0.079)	(0.186)	(0.036)	(0.080)	(0.462)
	[0.394]	[1.528]	[-2.375]	[-0.766]	[-0.896]	[-1.452]	[-1.281]	[-0.567]
D(LNMSUPPLY(-2))	-1.959	0.068	-0.069	-0.076	-0.102	0.046	-0.134	-0.107
	(4.868)	(0.042)	(0.064)	(0.079)	(0.186)	(0.036)	(0.080)	(0.462)
	[-0.402]	[1.593]	[-1.076]	[-0.956]	[-0.549]	[1.252]	[-1.672]	[-0.232]
C	5.157	0.082	-0.003	-0.045	0.113	-0.127	-0.047	-0.099
	(4.587)	(0.040)	(0.061)	(0.075)	(0.175)	(0.034)	(0.076)	(0.435)
	[1.124]	[2.057]	[-0.056]	[-0.600]	[0.648]	[-3.700]	[-0.628]	[-0.227]
POLESTAB	-5.149	-0.180	0.127	0.190	-0.001	0.151	0.251	0.205
	(6.217)	(0.054)	(0.082)	(0.101)	(0.237)	(0.046)	(0.102)	(0.589)
	[-0.828]	[-3.310]	[1.548]	[1.878]	[-0.005]	[3.251]	[2.449]	[0.347]
R-squared	0.783	0.883	0.837	0.813	0.585	0.657	0.864	0.674
Adj. R-squared	0.544	0.755	0.657	0.608	0.129	0.281	0.714	0.35
Sum sq. resids	2906.38	0.221	0.508	0.772	4.224	0.162	0.787	26.118
S.E. equation	12.055	0.105	0.159	0.196	0.460	0.090	0.198	1.143
F-statistic	3.280	6.893	4.656	3.956	1.283	1.745	5.776	1.877
Log likelihood	-151.604	52.290	34.426	25.420	-11.127	58.965	24.995	-50.295
Akaike AIC	8.121	-1.362	-0.531	-0.113	1.587	-1.673	-0.093	3.409
Schwarz SC	9.063	-0.420	0.411	0.829	2.529	-0.731	0.849	4.351
Mean dependent	-0.936	0.040	0.007	0.052	0.104	-0.005	-0.004	-0.065
S.D. dependent	17.857	0.213	0.272	0.314	0.493	0.106	0.371	1.380

Determinant resid covariance (dof adj.)	8.23E-10
Determinant resid covariance	1.80E-12
Log likelihood	93.282
Akaike information criterion	6.080
Schwarz criterion	15.255
Number of coefficients	224

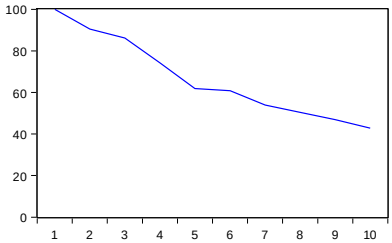
APPENDIX 3: Graphs for Impulse Response of LNBOT



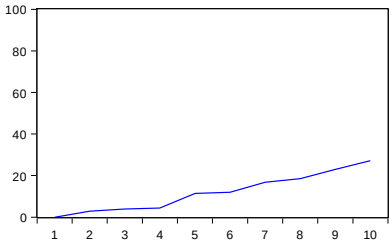
APPENDIX 4: Graphs for FEVD of LNBOT

Variance Decomposition using Cholesky (d.f. adjusted) Factors

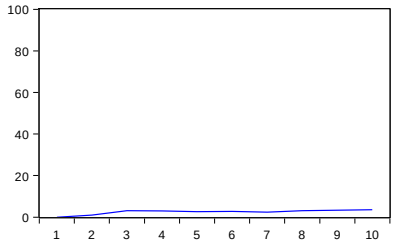
Percent LNBOT variance due to LNBOT



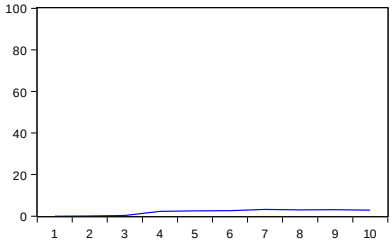
Percent LNBOT variance due to LNGDP



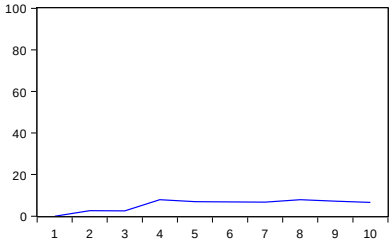
Percent LNBOT variance due to LNTRENT



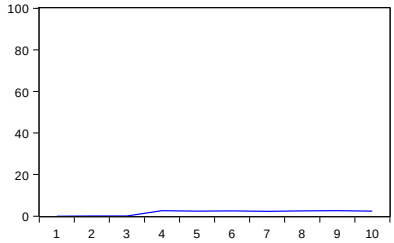
Percent LNBOT variance due to LNIMPORT



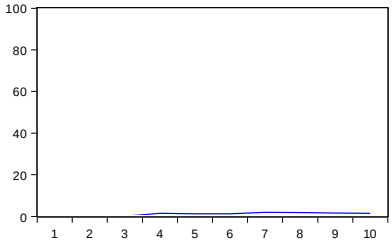
Percent LNBOT variance due to LNEXRT



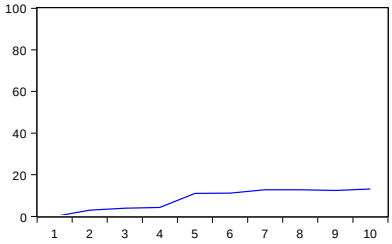
Percent LNBOT variance due to LNINTEREST



Percent LNBOT variance due to LNTOPEN



Percent LNBOT variance due to LNMSUPPLY



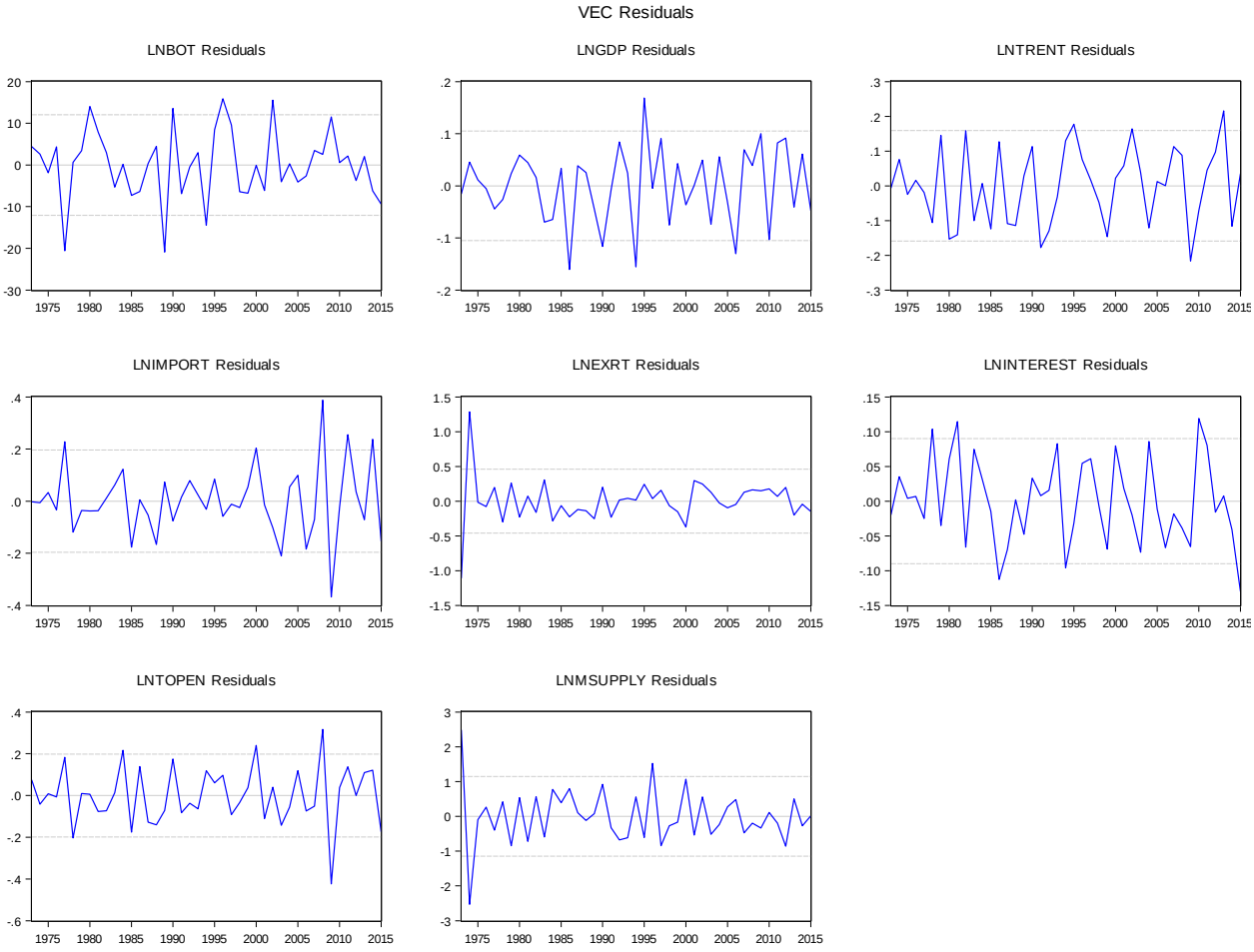
APPENDIX 5: Granger Causality Test Results

Pairwise Granger Causality Tests
Date: 06/19/18 Time: 23:47
Sample: 1970 2015
Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGDP does not Granger Cause LNBOT	40	2.28257	0.0654
LNBOT does not Granger Cause LNGDP		3.04342	0.0209
LNTRENT does not Granger Cause LNBOT	40	1.13797	0.3676
LNBOT does not Granger Cause LNTRENT		1.68635	0.1627
LNIMPORT does not Granger Cause LNBOT	40	0.40601	0.8685
LNBOT does not Granger Cause LNIMPORT		2.33252	0.0606
LNEXRT does not Granger Cause LNBOT	40	1.41330	0.2458
LNBOT does not Granger Cause LNEXRT		1.28109	0.2990
LNINTEREST does not Granger Cause LNBOT	40	0.72233	0.6353
LNBOT does not Granger Cause LNINTEREST		2.64980	0.0375
LNTOPEN does not Granger Cause LNBOT	40	0.72797	0.6311
LNBOT does not Granger Cause LNTOPEN		1.62104	0.1797
LNMSUPPLY does not Granger Cause LNBOT	40	5.83309	0.0005
LNBOT does not Granger Cause LNMSUPPLY		2.68335	0.0357
LNTRENT does not Granger Cause LNGDP	40	2.02840	0.0964
LNGDP does not Granger Cause LNTRENT		0.90805	0.5039
LNIMPORT does not Granger Cause LNGDP	40	0.92924	0.4900
LNGDP does not Granger Cause LNIMPORT		1.16894	0.3517
LNEXRT does not Granger Cause LNGDP	40	1.26873	0.3044
LNGDP does not Granger Cause LNEXRT		0.97778	0.4592
LNINTEREST does not Granger Cause LNGDP	40	1.44890	0.2331
LNGDP does not Granger Cause LNINTEREST		0.91401	0.5000
LNTOPEN does not Granger Cause LNGDP	40	1.41869	0.2439
LNGDP does not Granger Cause LNTOPEN		1.49834	0.2164
LNMSUPPLY does not Granger Cause LNGDP	40	3.93462	0.0059
LNGDP does not Granger Cause LNMSUPPLY		1.33455	0.2764
LNIMPORT does not Granger Cause LNTRENT	40	1.54907	0.2005
LNTRENT does not Granger Cause LNIMPORT		0.43549	0.8486
LNEXRT does not Granger Cause LNTRENT	40	1.88464	0.1202
LNTRENT does not Granger Cause LNEXRT		0.73586	0.6252
LNINTEREST does not Granger Cause LNTRENT	40	2.03162	0.0959
LNTRENT does not Granger Cause LNINTEREST		0.16130	0.9849
LNTOPEN does not Granger Cause LNTRENT	40	0.62926	0.7055
LNTRENT does not Granger Cause LNTOPEN		1.15111	0.3608
LNMSUPPLY does not Granger Cause LNTRENT	40	3.75042	0.0076
LNTRENT does not Granger Cause LNMSUPPLY		1.16876	0.3518
LNEXRT does not Granger Cause LNIMPORT	40	2.11071	0.0850
LNIMPORT does not Granger Cause LNEXRT		0.89812	0.5105
LNINTEREST does not Granger Cause LNIMPORT	40	4.72709	0.0021
LNIMPORT does not Granger Cause LNINTEREST		0.58288	0.7408

LNTOPEN does not Granger Cause LNIMPORT	40	1.83581	0.1295
LNIMPORT does not Granger Cause LNTOPEN		1.16214	0.3552
LNMSUPPLY does not Granger Cause LNIMPORT	40	0.81469	0.5680
LNIMPORT does not Granger Cause LNMSUPPLY		2.63645	0.0383
LNINTEREST does not Granger Cause LNEXRT	40	1.26907	0.3043
LNEXRT does not Granger Cause LNINTEREST		1.04136	0.4210
LNTOPEN does not Granger Cause LNEXRT	40	0.79887	0.5793
LNEXRT does not Granger Cause LNTOPEN		0.12893	0.9916
LNMSUPPLY does not Granger Cause LNEXRT	40	2.36553	0.0576
LNEXRT does not Granger Cause LNMSUPPLY		1.96408	0.1064
LNTOPEN does not Granger Cause LNINTEREST	40	1.59440	0.1872
LNINTEREST does not Granger Cause LNTOPEN		0.58493	0.7392
LNMSUPPLY does not Granger Cause LNINTEREST	40	0.71041	0.6442
LNINTEREST does not Granger Cause LNMSUPPLY		1.09809	0.3889
LNMSUPPLY does not Granger Cause LNTOPEN	40	0.76483	0.6039
LNTOPEN does not Granger Cause LNMSUPPLY		2.71238	0.0342

APPENDIX 6: VECM Residuals Normality Graphs



APPENDIX 7: Dataset

Year	BoT	GDP	TRENT	IMPORT	EXRT	INTEREST	TOPEN	MSUPPLY	POLESTAB
1970	64000000	3.23E+08	27.94713	1.5E+08	1.00000	16.63598	1.126587	137150995.7	0
1971	65000000	3.42E+08	28.23485	1.57E+08	1.00000	16.63598	1.10967	137150995.8	0
1972	65000000	3.68E+08	33.78361	1.79E+08	1.00000	16.63598	1.14915	137150995.7	0
1973	1.31E+08	3.87E+08	24.43403	1.93E+08	1.00000	16.63598	1.336027	137150995.8	0
1974	1.12E+08	4.87E+08	22.66807	2.88E+08	23.71936	16.63598	1.412862	133355.6746	0
1975	63000000	5.78E+08	26.41911	3.31E+08	46.43873	16.63598	1.255304	34276.88334	0
1976	61000000	5.97E+08	39.16094	3.99E+08	46.43873	16.63598	1.439643	50485.60164	0
1977	-1.7E+07	6.73E+08	32.88827	4.64E+08	46.43873	16.63598	1.353619	56696.43194	0
1978	23000000	7.17E+08	25.94961	4.81E+08	46.43873	16.63598	1.373319	70006.54638	0
1979	30000000	8.14E+08	25.77531	5.07E+08	46.43873	16.63598	1.282448	71750.0675	1
1980	54000000	8.55E+08	31.02785	5.35E+08	46.43873	18.4	1.315064	55041.47798	1
1981	80000000	8.47E+08	28.25251	4.49E+08	46.43873	21.5	1.155326	48731.87907	1
1982	65000000	8.64E+08	33.51161	4.1E+08	46.43873	18.225	1.024385	60834.04869	1
1983	17000000	8.23E+08	24.70037	4.12E+08	46.43873	20.69167	1.021406	67329.12857	1
1984	89000000	8.48E+08	21.04771	3.63E+08	46.43873	20.625	0.960543	67823.89898	1
1985	1.52E+08	8.51E+08	21.22728	2.84E+08	46.43873	19.34167	0.845769	79845.38429	1
1986	1.37E+08	8.41E+08	22.80358	2.67E+08	46.43873	14.45	0.797893	94740.8973	0
1987	74000000	9.73E+08	18.75642	3.08E+08	46.43873	13.63333	0.709293	108943.1752	0
1988	1.24E+08	1.04E+09	17.56201	2.72E+08	46.43873	13.35833	0.643359	119555.0052	0
1989	-1.7E+08	7.86E+08	29.60868	6.25E+08	46.43873	13.81667	1.37988	144750.7402	1
1990	2.98E+08	3.84E+08	51.56445	5.7E+08	46.43873	16.63598	3.740895	2953375.37	1
1991	-1.1E+08	3.48E+08	37.6915	4.2E+08	46.43873	16.63598	2.100575	164401.9852	1
1992	2.15E+08	2.24E+08	68.91213	3.75E+08	46.43873	16.63598	4.317673	196658.0533	1
1993	30000000	1.6E+08	81.35214	4.1E+08	46.43873	16.63598	5.299252	325741.6796	1
1994	-5.2E+07	1.32E+08	82.58936	4.05E+08	46.43873	14.525	5.733737	363921.5462	1
1995	3.1E+08	1.35E+08	80.63153	5.1E+08	49.83833	15.56667	9.866469	409189.4137	1
1996	75000000	1.59E+08	68.81489	5.55E+08	46.8375	16.63598	7.434128	3491060.449	1
1997	-1.8E+08	2.96E+08	39.68502	6.1E+08	50.57	16.825	3.514701	362503.8023	1
1998	-4.5E+07	3.6E+08	34.26993	4.7E+08	41.5075	21.73833	2.488877	1108487.098	1
1999	-5.1E+07	4.42E+08	23.4587	5.2E+08	41.9025	16.71917	2.238569	1213785.923	1
2000	-3.4E+08	5.29E+08	29.43881	6.68E+08	40.9025	20.52667	1.884458	1505486.105	1
2001	-1E+08	5.21E+08	29.75533	2.29E+08	48.59191	22.14	0.684453	1204147.698	1
2002	-2100000	5.43E+08	40.46677	1.78E+08	61.75417	20.205	0.652486	782089.092	1
2003	-6.1E+07	4.16E+08	61.51365	1.7E+08	59.37883	17.05667	0.669712	926091.1176	1
2004	-2.3E+08	4.75E+08	37.44393	3.37E+08	54.90583	18.09523	0.928165	1578271.265	0
2005	-1.8E+08	5.5E+08	34.21342	3.1E+08	57.09583	17.03333	0.802182	1956597.924	0
2006	-3.1E+08	6.04E+08	32.69042	4.67E+08	58.01333	15.5025	1.033891	2550182.296	0
2007	-3E+08	7.39E+08	40.22311	4.99E+08	61.27222	15.04615	0.94665	3254382.248	0
2008	-5.7E+08	8.5E+08	44.73975	8.13E+08	63.2075	14.39803	1.242058	4361960.018	0

2009	-4E+08	1.16E+09	34.25037	5.51E+08	68.28667	14.18667	0.605836	5360855.115	0
2010	-4.9E+08	1.29E+09	29.14738	7.1E+08	71.40333	14.2425	0.720819	6302885.056	0
2011	-6.8E+08	1.55E+09	40.39352	1.04E+09	72.22667	13.75083	0.913226	8542067.397	0
2012	-5.5E+08	1.74E+09	50.38742	1E+09	73.51477	13.51833	0.843676	8240379.114	0
2013	-5.9E+08	1.95E+09	57.6075	1.15E+09	77.52	13.48939	0.877986	9356173.561	0
2014	-1.6E+09	2.01E+09	49.2579	2E+09	83.8925	13.50167	1.212618	8157661.048	1
2015	-1.4E+09	2.03E+09	46.44058	1.69E+09	86.18837	13.60667	0.959931	8426586.109	1