FACULTY OF SOCIAL SCIENCE

DEPARTMENT OF ECONOMICS

DETERMINANTS OF ECONOMIC GROWTH IN BOTSWANA THROUGH THIRLWALL'S MODEL.

BY

PEO NNANG NAIMA BAITSILE

MAY 2020

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF ECONOMICS IN THE UNIVERSITY OF BOTSWANA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF ARTS DEGREE IN ECONOMICS

Declaration

I declare that this specific study has not been previously undertaken and as such its contents except where referenced, are my original work. This work shall not be submitted to any other institution for the award of any degree.

Acknowledgements

Glory be to God for his many blessings and for him being the head of my life.

Firstly, I thank my mother Ms. Constance D. Baitsile. You are not only my parent but my pillar of strength and number one cheerleader. I am achieving all my life's goals because of your love and support. My late grandfather, Bontlhabongwe Nelson Baitsile, who has supported me since the day I was born. I also want to thank my grandfather, Dr. Festus G. Mogae for financing my education and for all the constant support he gave me throughout this journey. Last but not least I want to thank Mr. Taonga M. Namate and Ms. Kovambo J. Kandenge, your constant emotional support, encouragement and love carried me throughout this journey. I am eternally grateful.

I would like to express my gratitude to my supervisor, Associate Professor G. R. Motlaleng, who has contributed a lot in my education.

I would like to acknowledge and thank the University of Botswana library services, goggle and YouTube for all the assistance they gave me in accessing the needed information timely and effectively. Learning throughout this journey was challenging at times but overall enjoyable.

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Abbreviations

AIC – Akaike Info Criterion

ARDL – Auto-Regressive Distribution Lag

ECM – Error Correction Model

REER – Real Effective Exchange Rate

TFP – Total Factor Productivity

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Abstract

The purpose of this paper is to estimate economic growth of Botswana. The study relies on the Thirlwall's model and its extension to estimate the price and income elasticities of export and import demand using the productivity data for the period of 1980-2016. The estimation for this work is based on the Auto-Regressive Distributed Lag, (ARDL), modeling to estimate the price and income elasticities, which is based on the conventional equations of exports and imports demand. The practical application of the estimated elasticities provides insights about the determinants of the economic growth of the Republic of Botswana, thus, the Thirlwall's hypothesis of balance of payments constrained growth is used.

The results from the imports and exports equations showed the following. The estimated price elasticities of demand for imports and exports were unexpected and statistically insignificant. The estimated income elasticities of demand for imports and exports were as expected and statistically significant. From the extended imports and exports equations, the price elasticities of imports were unexpected and statistically significant. The income elasticity of imports and exports were as expected and statistically significant.

Practical applications of the estimated price and income elasticities of demand for imports and exports gave the economic growth rates of 5.63 percent and 4.97 percent respectively for the Thirlwall and extended Thirlwall's model with the export growth rate of 4.87 percent. The overall results indicated that Thirlwall hypothesis holds in determining Botswana's economic growth rate. This correlated with the study done by Matsheka in 1998, where when calculating Botswana's economic growth rate, the results showed that Botswana's economic growth rate could be predicted using the Thirlwall's model.

CHAPTER ONE

1.1 Introduction

Since independence in 1966, Botswana has had the highest average economic growth rate in the world, averaging about 9 percent per year from 1966 to 1999 (Statistics Botswana, 2018). The economy generally grew well in the 2000s, but quickly fell into recession, shrinking to 7.8 percent in 2009, due to global downturn. It recovered very strongly in 2010 with rises in world commodity prices, recording growth of 6 to 7 percent in 2010 and continuing at more than four percent yearly in 2012 to 2015, (Statistics Botswana, 2018). Acemoglu et al (2011) explains that there is almost complete consensus that Botswana achieved rapid growth because it managed to adopt good policies and the foundation of diamond mining. Sekwati (2011) further states that the economy is heavily dependent on mining and agriculture, and has had to cope with the vagaries of the diamond market and frequent droughts during 1999 to 2003. Since the 1990s the government has encouraged foreign investment in export oriented industries, manufacturing, particularly car assembly which boosted exports until production was stopped in 2000 (Commonwealth Secretariat, 2019). The government has had extensive foreign exchange reserves and maintained budget surpluses until late 2014 to 2017 were it registered a budget deficit, (Statistics Botswana, 2018). Mbulawa (2015) claimes that foreign direct investment, (FDI), and controlled inflation have a positive and significant effect on economic growth with the main drivers of economic growth being it's past performance and FDI flows. Mosikari and Sikwila (2013) and Mosikari et al (2016), state that the effect of exports of goods and service is found to have a positive impact on economic growth of Botswana.

Romero and McCombie, (2014), saw the Keynesian perspective as best, describing the economic growth of a country as being led by the growth rate of demand. While the Kaldorian tradition emphasizes that balance of payments (BOP) equilibrium represents the most important constraint on the growth of demand. According to this approach, trade must be balanced in the long run. Where the country's equilibrium growth rate must correspond to the ratio between its income elasticity of demand for exports and its income elasticity of demand for imports, multiplied by the growth rate of external demand (Romero and McCombie, 2014). This relationship however, is known as Thirlwall's Law. According to Habiyaremye and Ziesemer (2009), the development of the export-led economic growth saw the rise of the East Asian economies during the 1980's and

1990's. Recently the emergence of China's economy as an impressively thriving economy is driven by strong export growth rates. Hence providing evidence to how exports can act as an important source of growth.

There have been notable changes regarding the trade policy of Botswana. The current trade policy, which was adopted in 2009, reflects an attempt by the government to address the country's strengths and inherent challenges (Ministry of Trade and Industry, 2009). These include the dependence on a limited number of commodity exports and a few export markets. A small industrial base, as well as a relatively small market and the tariff-based instruments of trade policy (Malefane and Odhiambo, 2016).

1.2 Problem Statement

The trajectory economic growth is seen as one of the most important indicators of the health of any economy. One of the benefits of a long run economic growth of a country is that it has a positive impact on national income, level of employment, which increases the standard of living and reduces poverty. Additionally, higher economic growth leads to extra tax income for government spending, which it can use to expand and develop the economy, and reduce budget deficits. Furthermore, as the population of a country grows, it requires the growth to keep up its standard of living and wealth. Botswana's economic growth structure is based on an export-led growth. However, the main challenge of Botswana's growth efforts is being heavily dependent on the mining sector for its exports with very little product diversification, (Mbulawa, 2015). With the 2005 currency devaluation, an increase in exports and decrease in imports were expected. This is because firstly, the response of traded quantities to exogenous shifts in relative prices is often used to measure a country's external performance. The price and income elasticities of imports is a trade-weighted average of the sectoral elasticities of substitution of the domestic consumer. While the price elasticity of exports is similar, the average is, however, taken across both sectors and destination markets (Imbs and Mejean, 2010). Price and income elasticities towards exports illustrate the resilience of exporters in the face of a sudden deterioration in their position. Secondly, while exports bring foreign exchange to the country, imports help in increasing the utility of consumers through raising the level and variety of goods and services consumed. At the same time,

the government can source revenue through taxes on exports and imports of which the trade based taxes depend on the price and income elasticities of exports and imports (Tennakoon, 2010).

The previously estimated income elasticities using the Thirlwall's model by Matsheka 1998 found the long run growth rate of Botswana's economy to be predicted by the ratio of the growth rate of exports to the income elasticity of demand for imports. However, this study was carried out for the period of 1975 to 1993. One would argue that the time relevance of these results has lapsed. This is because since then, Botswana has seen major policy changes which affected its trading trend. With new trade policies and agreements implementations since 1997, currency devaluation in 2005, the price and income elasticities of exports and income are bound to be affected. Therefore, this study answers the question; Is there any relationship among the elasticities of income and price demand with the economic growth of Botswana?

This paper presents a growth model that allows to estimate the price and income elasticities of export and import demands. Furthermore, these are used in computing the growth rate of Botswana through the Thirlwall's law.

1.3 Main Objective

The main purpose of this paper is to estimate the economic growth of Botswana through its price and income elasticities of export and import demand using Thirlwall's model. The study also aims at using productivity data in order to apply the extended Thirlwall's model for the period of 1980 to 2016.

1.4 Specific Objectives

1. To estimate the price and income growth elasticities for exports.
2. To estimate the price and income growth elasticities for imports, and;
3. Their practical application in Thirlwall's economic growth model and the extended Thirlwall's model.
4. Productive capacity lead to higher economic growth rates.

1.5 Hypothesis

H_o: Price elasticity of demand has a positive impact on imports.

H_1: Price elasticity of demand has no effect on imports.

H_o: Price elasticity of demand has a negative impact on exports.

H_1: Price elasticity of demand has no impact on exports.

H_o: Income elasticity of demand should boost both imports and exports.

H_1: Income elasticity of demand reduce should both imports and exports.

H_0: Productivity capacity leads to a higher economic growth rate.

H_1: Productivity capacity does not lead to a higher economic growth rate.

1.6 Significance of the Study

Price and income elasticities are essential as they can be applied in many relevant macroeconomic policies issues. They have an effect on both the monetary and fiscal policies and expenditure switching policies. Policies such as exchange rate, subsidy and tariff affect the country's balance of payments. The practical application of the estimated elasticities provides insights about the determinants of the economic growth of Botswana. There are limited studies on the economic growth of Botswana using the Thirlwall model and the extended Thirlwall's' model. Therefore, this paper contributes to literature dealing with growth effects of the trade between developing countries and advanced economies. In addition, the results found from the two models are interesting to compare. Thirlwall's economic growth model is based on balance of payments constraints. Therefore, with Botswana currently facing a trade deficit, which is a balance of payment constraint, the model is appropriate to use.

1.7 Organization of the Study

The rest of the study is organized as follows; CHAPTER TWO provides a brief background of Botswana's trade performance, trade policies, exchange rate policy as well as GDP growth trends.

CHAPTER THREE is the literature review. CHAPTER FOUR includes the methodology, variable description, estimation techniques and data sources. CHAPTER FIVE discusses model estimations and empirical analysis with their interpretations. CHAPTER SIX is the presentation of the conclusions based on the findings of the study and recommendations.

CHAPTER TWO

2.1 Background

2.1.1 Trade and Investment Policies

Following Botswana's independence in 1966, trade related interventions were implemented. These were done in order to assist the country's broader economic objectives which shaped the country's key strategies in assisting the economy (Malefane and Odhiambo 2016). These saw Botswana adopting a number of policies including the import substitution industrialization policy which operated from 1984 to 1998 (Ministry of Trade and Industry, 2009). However, the limitations of this policy was that it mainly focused on industry production for the domestic market. In 1984, Botswana also saw the adoption of the import substitution industrialization under the industrial Development policy. In 1995, a policy of reduction in corporate taxes was implemented which saw corporate taxes reduced from 35 percent to 25 percent and to 15 percent in manufacturing. In 1997, Botswana developed a new policy framework to assist in achieving the country's trade and investment goals. These were particularly in respect of diversifying the production base. The key trade supportive policies and legislation include the National Development Plan 10 (NDP 10), Industrial Development Policy, Competition Policy, Botswana's National Export Strategy, Investment Strategy for Botswana, and the Private Sector Development Strategy (World Trade Organization, 1998). From 1998, Botswana replaced the import substitution industrialization policy with the export-led growth strategy. This strategy serves as the key strategy for the economy of Botswana (Ministry of Trade and Industry, 2009). In aspirations of improving its exports, Botswana has become part of various organizations and trade agreements. Becoming a member of Southern Africa Custom Union, (SACU), Southern African Development Community (SADC) and World Trade Organization, (WTO), has influenced the country's trade policy instruments significantly. Having multilateral trade agreements with these organizations saw Botswana having to reduce and eliminate barriers of trade. These included an elimination of tariffs on trade with SADC (African Development Bank, 2009), as well as become transparent with trade-related regulations and measures that they apply. In line with the WTO's objectives, in 2007, Botswana notified the WTO of the removal of export subsidies, abolishment of agricultural safeguards and the implementation of measures addressing technical barriers to trade (Malefane and Odhiambo, 2016).

2.2 Composition of Botswana's trade

The composition of Botswana's principal trade has changed significantly over the past decades. During the 1980s, Botswana's exports consisted mainly of products of the primary sector, namely, mining products and products from the agriculture sector which also accounted for the main exports at that time, (Ministry of Trade and Industry, 2009). By 1985, Botswana's diamonds were accounting about 77.7 percent in total exports, while meat exports remained at 7.2 percent (Economist Intelligence Unit, 1996). Given the developments in Botswana's trade sector and other macroeconomic policy interventions, the composition of Botswana's principal exports evolved over the years. This saw the secondary sector also comprising of Botswana's principal exports. The second dominant export in 1994 was the vehicle exports, which accounted for 5.9 percent in total exports. While in 2012, all the four main exported products were primary sector exports. These primary sector exports jointly represented 88 percent in total exports (United Nations, 2013). Botswana's exports are dominated by diamonds which account for more than 60 percent of total exports, copper and nickel, beef and textiles (Statistics Botswana, 2019). While South Africa alone currently contributes 60.6 percent on Botswana's imports. These being food, beverages and tobacco, fuel, diamonds (finished products) and Machinery & Electrical Equipment (International merchandise trade Statistics, 2018).

2.3 Exchange Rate

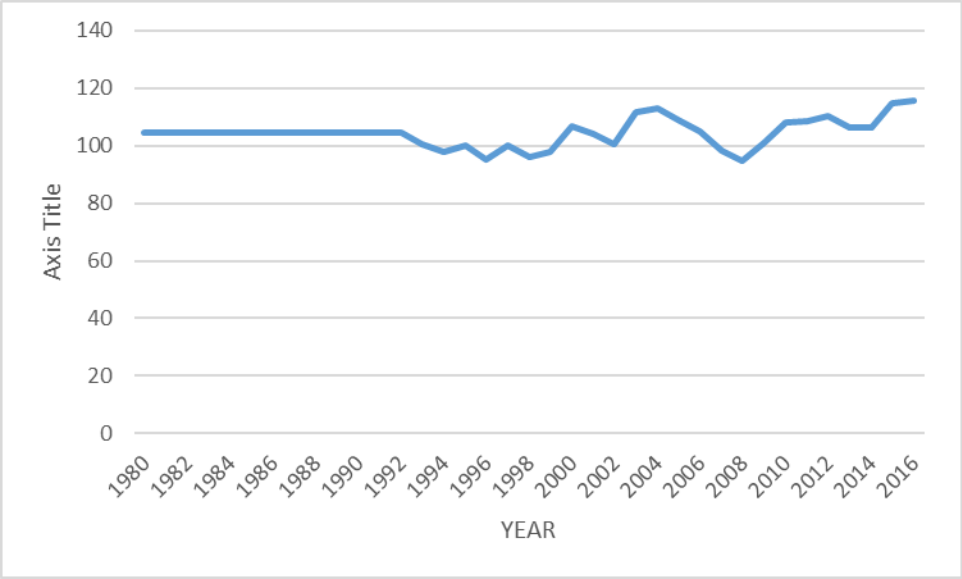
Exchange rate policies play a major role in facilitating economic growth and stability in an economy. It is generally considered to be the pillar of trade performance in any economy and plays a major role in the determinant of the balance of payments position and external performance of a country (Ndlela and Ndlela, 2002).

In May 2005, Botswana implemented a devaluation of 12.5 percent of the Pula which was accompanied by the adoption of the crawling peg system, (Bank of Botswana Annual Report, 2007). This devaluation was the second one prior to the 7.5 percent devaluation in 2004. The aim was to reverse the effect of the appreciation of the Pula and high inflation in the early 2000 (Gaolathe 2005). According to Bank of Botswana, (2013), this was to maintain the real effective exchange rate stability of the Pula in relation to the currencies of the country's main trading partners. With one of the main objectives being to improve the Government of Botswana's

revenues in terms of the Pula from diamonds exports (Paul and Motlaleng, 2008). Under the Crawling peg exchange rate regime, the exchange rate of the Pula could now be adjusted continuously in discrete steps (Gaolathe, 2005). Habiyaremye and Ziesemer (2009), state that a devaluation increases the value of exports and thus the amount of imports that can be bought from abroad. Simultaneously it negatively affects the amount of goods that can be imported if export demand is price inelastic. Gafar, (1995), emphasized the success of a devaluation, as a measure of exchange rate policy, a priori, depends on export and import price elasticities. That is on whether Marshall-Lerner condition is met. Senhadji and Montenegro (1998), explain that the high export elasticity means higher prospects for success of the real devaluation for generating the export revenues. Though scholars such as Rose (1990, 1991) and Ostry and Rose (1992), state that a real depreciation does not have a significant impact on the trade balance. Reinhart (1995), Senhadji and Montenegro (1998), Senhadji and Montenegro (1999), arguably provide strong support to the view that depreciations improve the trade balance. However, with consumer income continuously growing, the modern literature marginalizes the importance of the price elasticities and their role in achieving the competitive advantages (Algieri, 2004). Thus, the higher the income elasticity of exports, the greater their role is in achieving economic growth. In the case of Botswana, its exports remain dominated by diamonds and beef, and therefore vulnerable to demand shifts in any of these products. Therefore, it can be acknowledged that exchange rate policies remain one of the key macroeconomic tools that can help the country attain a more outward and diversified economy by promoting a non-traditional export-led growth and ultimately an improvement in trade performance (Nyambe, 2013).

Figure 2.1 below shows the behavior of the real effective exchange rate as provided by the World Bank National Accounts data 2019.

Figure 2.1 Botswana's Real Effective Exchange Rate.



Source: World Development Indicator- World Bank National Data, 2019.

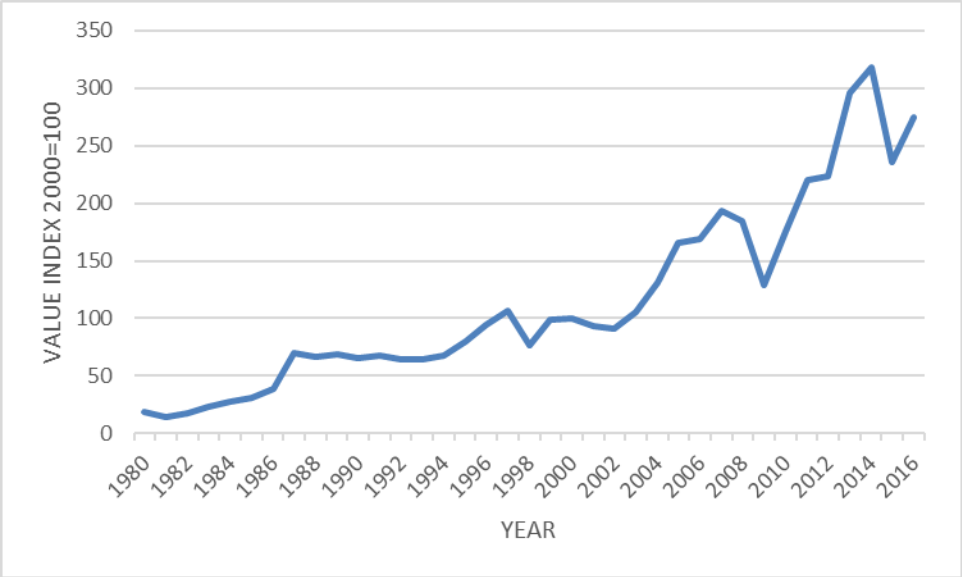
The figure above shows a steady level of Botswana's real effective exchange rate from 1980 to 1992. It then experienced a slight decline between 1992 and 1994. From 1994 to 2000, it experienced a steady increase and decline until it saw an increase in 2001. It further experienced a decline in 2002 and a rise again in 2004. Between 2005 and 2006, the real effective exchange rate had a significant decline and a slight increase in 2007. From 2007 to 216, it showed a steadily increase and decrease.

2.4 Export growth

In the 1980s, Europe was the top destination for Botswana's exports, with a share of 81 percent in 1985. The SACU member countries and the United States of America were among the top three destinations of Botswana's exports in 1985, with a joint share of 9 percent of Botswana's exports to these countries (Economist Intelligence Unit, 1987). This slump in export growth and decline in imports corresponded to the global financial crisis of 2009. However, in the subsequent years, growth rates in exports occurred, consistent with the implementation of new export promotion strategies, (Malefane and Odhiambo 2016). Although the growth of Botswana's exports fell substantially around the early 1990s. Europe was still the top destination of Botswana's exports with a share of 86 percent in 1994, (Economist Intelligence Unit, 1996). However, from 1994, there were improvements in export growth. By 1997, the export growth was 12.94 percent, which was an improvement from negative 0.26 percent experienced in 1990, (World Bank, 2014). During

the period between 2000 and 2012, Botswana's export growth fluctuated very much. By 2009, export growth had reached a record low performance as it plummeted to negative 37.67 percent (World Bank, 2014). On average, the export growth rate of Botswana during the period of 1980 to 2016 was 4.87 percent as provided by the Word Bank National Data 2019.

Figure 2.2. Botswana's Exports.



Source: World Development Indicator- World Bank National Data, 2019.

The table above shows the trend of Botswana's exports since 1980 provided by the world bank 2019. There was a significant and steady rise in exports from 1980 to 1997 and a significant drop between 1997 and 1998. It also experienced a rise from 1999 with a steady level in the early 2000's. It further experienced a step rise from 2002 to 2006 and went back to a steady increase level until a step decline from 2008. From then on, the level of exports increased significantly until 2014 where it again experienced a decline. Finally, in 2016, there was a rise in the level of exports.

2.5 Import growth

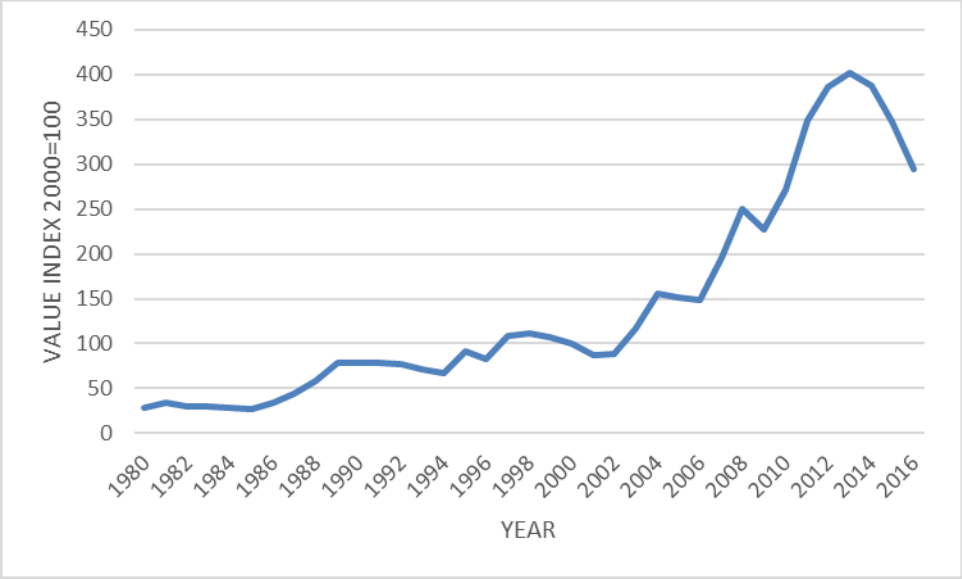
The growth in exports and imports in Botswana over the past decades has seen a number of cyclical movements. In the 1980's, Sub-Saharan Africa including SACU member countries and other African countries became the main suppliers of Botswana's imports with a joint share of 82 percent in 1985, (Malefane and Odhiambo 2016). Exceeding the percent shares of other top suppliers for Botswana's imports around that time. In 1985, the SACU member countries were the major

suppliers of Botswana's imports, with a share of 75 percent in total imports of which Europe, United Kingdom, and the United States of America accounted for less than 8 percent each in Botswana's imports (Economist Intelligence Unit, 1987).

According to Malefane and Odhiambo, (2016), diamonds, petroleum oils and electrical energy have been dominating Botswana's main import products in recent years. While there were slight improvements in imports, they also experienced a sharp decline in 2012. This saw the share of diamond imports standing at 26.9 percent of total imports, with petroleum oils accounting for 12.8 percent, followed by electrical energy with 2.9 percent (United Nations, 2013).

Figure 2.3 below shows the behavior of Botswana's imports during the periods of 1980 to 2016 as provided by World Bank National Data 2019.

Figure 2.3. Botswana's Imports.



Source: World Development Indicator- World Bank National Data, 2019.

The table above shows the imports trend of Botswana 1980 as provided by the World Bank 2019. Botswana's imports were significantly low from 1980 to 1985 where it saw a rise until 1989. From then onwards it reflected a steady level with a slight decrease between 1993 and 1994. It further showed a steady increase with slight declines over the years from 1994 to 2014, generally a positive growth, while between 2015 and 2016 it showed a highly significant decrease in imports.

2.6 Balance of Trade

According to Statistics Botswana (2018), Botswana's major exporting destinations are the United Kingdom, South Africa, China and Belgium. These countries collectively account for approximately 86 percent of Botswana's total trade and their exchange rates and incomes are most likely to affect Botswana's trade balance (Nyambe, 2013).

Figure 2.4. Botswana's Net Trade in goods.

Source: World Development Indicator- World Bank National Data, 2019.

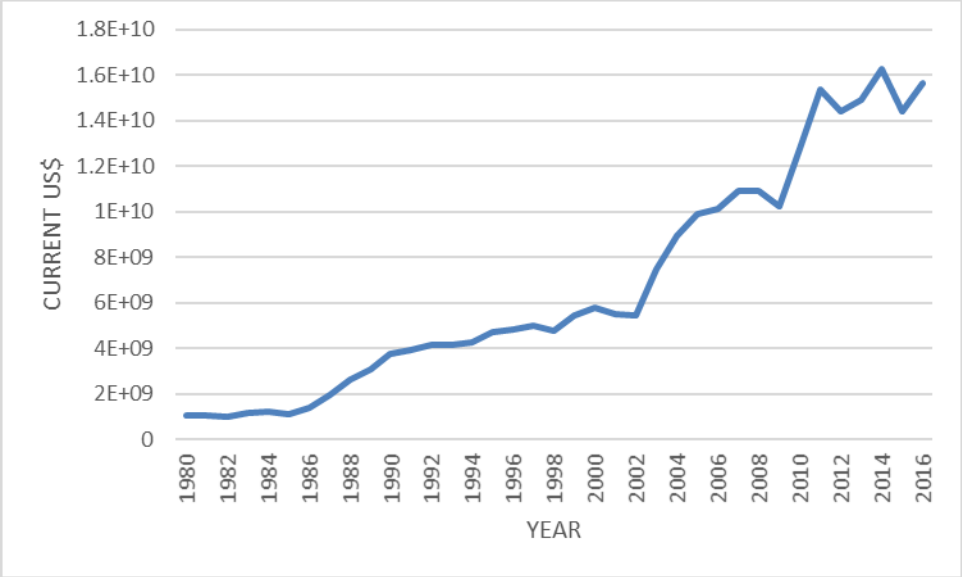
From 1971 to the early 1980's, there was a continuous, robust increase in Botswana's trade openness increasing from 94.7 percent in 1971 to 119.5 percent in 1980 (World Bank, 2014). However, Botswana's trade openness slowed down towards the middle of the 1980's, indicating a decline in the ratio of total trade to the gross domestic product (GDP). This decline also corresponded to Botswana's economic recession of the early 1980's. After 1987, the decline worsened through to the early 1990's with a significant reduction from 123.6 percent in 1987 to 86.2 percent in 1993 (World Bank, 2014). In 1994, the level of trade openness in Botswana was 88.2 percent. The improvements in Botswana's trade openness during this period coincided with the interventions in the economy that introduced measures toward a more liberal trade regime (Malefane and Odhiambo 2016). Although Botswana's trade openness recovered in 1994, its overall performance during the 1990's was relatively lower compared to the 1970's and the 1980's. The slowdown in Botswana's trade openness during the 1990's was in correspondence to the declining share of exports from the agriculture sector. According to SACU (2010), these improvements in trade

openness were a result of improved domestic production and international commodity prices, which increased the exports. It then declined steadily and continued to increase slowly while still on a surplus. Though it often experienced declines and increases, it still managed to maintain a surplus output until 2007. However, according to (Statistics Botswana, 2018), a sharp decline was experienced averaging -123.15 BWP Million from 2007 to 2008. From 2009, net trade began to grow steadily but unfortunately was still in the deficit where it reached all time low in 2012 of -6683 BWP Million in July of 2012, according to (Statistics Botswana, 2018). This could be associated with the world economic financial crisis which resulted in a reduction in Botswana's exports.

2.7 GDP Growth

From previous studies, it is concluded that Botswana's economic growth is dependent mainly on exports specifically diamonds, which makes it vulnerable to external shocks. For the focused study period, the total trade share to GDP indicates that the level of openness to trade in Botswana is around 87 percent on average (Statistics Botswana 2018). This refers to the degree to which a country allows trade with other countries. In 2008 the percentage share of exports declined from 49 percent to 33 percent in 2009. This could be attributed to an overall decline in exports performance during the period of the world economic recession (Statistics Botswana 2018).

Figure 2.5. Botswana's GDP Annual Growth.



Source: World Development Indicator- World Bank National Data, 2019.

Botswana's GDP growth rate during the period of study, 1980 to 2016, as given by the World Bank 2016, is seen to be growing at an increasing rate, averaging 6.52 percent during this period. However, a sharp decline was experienced in years between 2008 and 2009 which could have been associated with the world financial downfall. Though the economy seemed to recover steadily afterwards in the years of 2010 to 2011, the GDP later fell deduced again from 2014 to 2015 and been steadily rising again. This could also be aligned with the decline in net exports which caused a balance of trade deficit it experienced within the same period.

CHAPTER THREE

3.1 Literature

Since 1979, the Thirlwall's Law has been seen as an important alternative for explaining the growth differences between developed countries, as well as between developing countries (Kadievska-Vojnovic and Unevska, 2007). According to Davidson (1997), Thirlwall's Law is one of the most significant analytical contributions of Post Keynesian open economy growth theory. This is because it provides an explanation of the basis for the export-led growth theory and also confirms the applicability of Keynesian principles to long run economic growth. The growth model states that the long run growth rate of an open economy is approximated by the ratio of the economy's rate of growth of exports to the income elasticity of demand for imports, (Thirlwall 1979). The long run rate of economic growth is determined by the capacity to export and the dependence of the economy on imports. The model further argues that it is income that adjusts the balance of payments and not prices. Changes in relative prices do not affect export and import growth in the long-term, either due to the elasticity suspicion or due to the long-term constancy of relative prices (Blecker, 2013). It assumes that the international capital flow and the interest payments are balanced in the long run, given stable exchange rate. And that the long run economic growth of an open economy is limited by the export growth rate and the income elasticity of the import (Kadievska-Vojnovic and Unevska, 2007).

Thirlwall's Law is based on the basic Harrod (1933) foreign trade multiplier. Hussain (1999) explains the Thirlwall equation as a basic dynamic Harrod trade multiplier (Kadievska-Vojnovic and Unevska, 2007) which is opposite to the Harrod Trade multiplier. Thirlwall's Law for economic growth argues that the long run growth of the national income (y) is determined by the ratio of the export growth rate (x) and income elasticity of the import(π) ; $y = \frac{x}{\pi}$. The economic growth model, which is based on balance of payments constrains, argues that countries have different growth rates because of the different demand growth. The main reason for demand constraints in open economy is the balance of payments. Therefore, if demand grows faster than the growth of domestic capacity, then it leads to an increase in imports. Resulting in the domestic supply not being fully utilized. This will eventually create a deterioration cycle of balance of payments equilibrium. The economy will experience a domestic fall in investment, technological progress will slow down, which will lead to a fall in the productivity and in the competition of domestic export. On the contrary, if the demand grows up to the level of the existing capacity,

without encountering balance of payments problems, the demand pressures will determine capacity growth. This will see new investment in capital stock and increasing technological growth (Kadievska-Vojnovic and Unevska, 2007).

Romero and McCombie (2016), emphasize that income elasticities are normally associated with non-price factors. Their base of argument is that the higher a country's non-price competitiveness, the higher its income elasticity of demand for exports. The opposite holds for imports. Traditionally, literature considers that non-price factors are captured in the income elasticity of demand. This specification however, adopted in the face of unobservable differences in quality amongst other non-price competitive factors. The assumption is that goods with higher demand have higher quality, given relative prices (Romero and McCombie, 2016). By contrast, introducing differences in productivity to capture differences in the non-price competitiveness of the products within a country provides more information on the determinants of export and import demand. Furthermore, on a larger scale, comparing the aggregate productivity of different countries disregards differences in the sectoral composition of production between countries (Romero and McCombie, 2016). This makes introducing relative productivity into demand functions involve a stricter assumption when using aggregate data. In the case of an individual country, for example Botswana, if two sectors have different productive structures and different compositions of trade, comparing their aggregate productivity is like comparing oranges and computers. It is possible to argue that comparing the productivities of each industry involves a considerably less strict assumption than comparing aggregate productivities. Hence adopting a disaggregated approach to the determinants of export and import growth reveals that different goods present different income elasticities of demand, due to differences in their intrinsic characteristics. For example, different non-price elasticities of demand, due to differences in their quality and other non-price competitiveness factors (Romero and McCombie 2016).

Thirlwall's export-led economic growth model is based on the assumption that the export expansion stimulates the economic growth of the country, without leading into the worsening of the balance of payments. Moudud (2000) stated that the same rates of export growth in different countries do not produce the same rates of economic growth. Reason being the existence of different income elasticities of import demand. In recent years, many developing countries have diverted from import substitution policies to export- led policies. This has been strongly due to the

development of the Asian tigers and the actual economic expansion of China (Abbot and De Vita, 2002).

Bairam analyses (1993, 1997) showed that in time of world economic expansion, developing countries had a greater foreign income elasticity (ε) than domestic income elasticity (π). Their trade balance was improving. However, developed countries have a lower foreign income elasticity than domestic elasticity and their trade balance is worsening. Bairam showed that there is an inverse relationship between Harrod trade multiplier and level of the economic growth. The variability of foreign income elasticity depending of the country's growth changes and the constancy of domestic income elasticity. According to these results, Bairam concludes that for a long run purposes, growth rate can be calculated as $(1/\pi)x$, but not on the base of the second identity $(\varepsilon/\pi)z$. Where x is exports and z is foreign income. Bairam and Lawrence (2001) confirmed that the elasticities are constant for the given period of estimation. They concluded that the predictive power of Thirlwall's model is still good, at least for one of the identities for calculation of the GDP growth rate.

There are a few criticisms of the Thirlwall's model for economic growth. Most of them are related to the assumption of constant relative prices (terms of trade) as mentioned by Krugman (1989). McGregor and Swales (1985, 1986, 1991), argue that this assumption makes the model indistinguishable from the standard neoclassical models based on supply. They argue that the economic growth is not constrained by the balance of payments but by insufficient supply. Crafts (1988, 1990) and Balassa (1979), have similar points of view in which their arguments rely on limited supply. According to them, the differences in the export growth, hence in the apparent income elasticities, are solely due to differences in the commodity composition of export. McCombie (1981), Clavijo and Ros (2015) and Razmi (2015), all argued that such tests of Thirlwall's Law are testing a near identity that is likely to be satisfied for almost any country regardless of whether its growth is Balance of payments constrained in the sense of Thirlwall law or not. Thirlwall (1981) responded to this critique by pointing out that econometric estimates of the income elasticities η_x and η_m need not equal the observed ratios of growth rates $\frac{X}{Y*}$ and $\frac{M}{Y}$, respectively, as long as relative prices are controlled for in the estimated demand functions for exports and imports (Blecker 2016). The limitation of the Thirlwall's Law is that in the long run, no country can grow faster than the rate consistent with the balance of payments equilibrium on

the current account. Unless it can finance ever growing deficit which, in general, it cannot (Verdier-Chouchane, 2005).

3.2.1 Studies on developed Countries

Kadievska-Vojnovic and Unevska (2007), was to estimate the long run price and income trade elasticities and their practical application using Thirlwall's economic growth model for Macedonia. The estimation used the Autoregressive Distributed Lag Modeling approach (ARDL). The results confirmed the existence of long run relationship between export and import demand and relative prices and income. Evidence for high import elasticity on domestic income changes and relatively significant export elasticity to changes in the foreign income. The estimated price elasticities were found to be lower. Imports being more sensitive on price variations than the exports. The higher income elasticity of import than the income elasticity of export points out the trade balance deterioration. Practical application of the estimated income elasticity of import in the Thirlwall's economic growth model showed that the growth rate of the Macedonian economy largely depends on export growth rate and significantly is reduced by high-income elasticity of import.

Romero and McCombie (2014), estimated the import and export functions for 5 technological sectors in 14 Developed European countries. The estimates of income elasticities were done using Vector Error- Correction Models and cross-product panels. The results indicate that the income elasticities of imports and exports are higher for Medium- and High-Tech Manufactures. Furthermore, the tests indicate also that the Multi-Sectoral Thirlwall's Law holds for the countries analyzed.

Romero and McCombie (2016), proposes a general specification for export and import functions on developed counties that encompass the contributions of both Kaldorian and
Schumpeterian literatures on the determinants of trade performance. The aim was to provide evidence of the impact of non-price competitiveness, measured by relative total factor productivity growth, on export and import growth in different technological sectors. This is because it captures intra-industry non-price competitiveness. While inter-sector non-price competitiveness is still captured in the income elasticities of demand. The study showed that using the expanded export

and import functions leads to an expanded Thirlwall's Law. The results showed that the growth rates of exports and imports are partially determined by relative productivity growth and productive capacity. Furthermore, the investigation provided evidence of the validity of the expanded Thirlwall's Law. The investigation suggested adopting a disaggregated approach to the determinants of export and import growth, which reveals different goods present different income elasticities of demand.

3.2.2. Studies on Developing Countries

Perraton (2003) did a study where they derived elasticities of demand for exports and imports for 51 developing countries. They used the income elasticities to test Thirlwall's hypothesis of balance of payments constrained growth. The import and export demand functions were estimated using error correction techniques and long run elasticities were derived. However, reasonable estimates of the import demand function were only derived from for 34 of the 51 sample countries. Furthermore, from these it was only possible to derive reasonable estimates for 27 countries. The weak form and strong form of Thirlwall's hypothesis were identified. For a majority of countries, the Thirlwall's hypothesis in its 'weak' form could not be rejected. There was also a strong and significant relationship between the actual growth rates and their values predicted from Thirlwall's hypothesis. The overall support of the Thirlwall's hypothesis was not found for an explanation for growth rate differences. This suggested that the positive impact of exports on GDP growth may operate primarily through relieving an external demand constraint.

Britto and McCombie (2009), revisited Thirlwall's law for Brazil, testing its validity over the period from 1951 to 2006. The objective was to find new estimates that included data for seven years following the adoption of a floating exchange rate in 1999. During this time, significant changes were observed in the rate of growth of exports, management of foreign debt, and in monetary policy. These caused an increase in economic activity. The second aim was to build on previous tests of the law by applying an estimation technique that allowed to work with a notion of long run equilibrium specific to models of a Kaldorian inspiration. Tests of the hypothesis using McCombie's method contradicted the original version of Thirlwall's law and accepted Moreno-Brid's extended specification. The results revealed that the balance of payments has been a significant constraint to Brazilian GDP growth rates for over half a century. Although capital flows

were an important factor in reducing the external constraint and allowing faster GDP growth rates, the corresponding average rate of growth of interest payments was greater than that of export growth. The cointegration of the series indicates the existence of a long run path of growth. Which can be interpreted as an equilibrium path given by Thirlwall's law. A reflection of the interaction between the economic structure of the country and the rate of growth of exports.

Fasanyaa and Olayemia (2018) examined the validity of Thirlwall's law in Nigeria. The study examined the Balance of Payment, (BOP), and constraint growth model in Nigeria for the period of 1980 to 2012. They used the bounds testing Auto Regressive Distributed Lag (ARDL) approach. The empirical findings revealed that import is co-integrated with relative price and income. This meant that the equilibrium growth rates coincide with actual growth rates. In addition, the Thirlwall's law of actual growth rate being equal to the predicted growth rate by the balance of payment current account equilibrium holds. These results showed that the Thirlwall's law holds in Nigeria and the growth in Nigeria is balance of payment constrained.

Adesete et al, (2008), did a study with the objective of testing the validity of Thirlwall law on the Nigeria economy. If this law is applicable to the economy of Nigeria as a whole. The study employed the autoregressive distributed lag (ARDL) cointegration procedure. The Wald test statistic and graphical plotting of the actual growth rate and predicted growth rate was used as the test for Thirlwall hypothesis. The main findings of this study can be summarized as follows. Firstly, Nigeria total import is co-integrated with terms of trade proxy to relative price and gross domestic product proxy to Nigeria income. Nigeria total import is also co-integrated with Nigeria export. This can then be concluded as there is long run relationship between import and export, which confirms that there is long run balance of payment equilibrium. The estimated income elasticity of demand for import were statistically significant. Nigeria Import is income inelastic and statistically significant. Income was elastic and statistically significant in the error correction model. The predicted growth rates coincided with the actual growth rates. This indicated that Thirlwall hypothesis holds in Nigeria.

Ozturk and Acaravci (2010) did a study where they applied the Thirlwall's basic balance of payments constraint growth model to South Africa economic growth. They used an Autoregressive

Distributed Lag (ARDL) Bounds Testing approach and tested the Thirlwall's hypothesis of balance of payments constrained growth. The empirical results revealed four major findings. Firstly, the import is co-integrated with relative price and income. Secondly, the estimated income elasticities of demand for imports and demand for exports are high compared to the calculated export growth rate, which are very low. Lastly, the equilibrium growth rates coincide with actual growth rates. These empirical results support the Thirlwall's hypothesis that stated that the balance of payments position of the South African economy is the main constraint on its economic growth. This implied that a successful economic growth policy, would allow South Africa to have a rapid growth in demand and supply without suffering deterioration in its balance of payments.

Matsheka (1998) carried out a study on Botswana's economic growth using Thirlwall's model. The aim was to find the long run growth rate of income as the relationship between growth rate of exports and the income elasticity of demand for imports. The results showed that the growth rate of Botswana's economy could be predicted by the ratio of the growth rate of exports to the income elasticity of demand for imports. The implication of the results was that the long run growth rate of income in Botswana can be explained by long run growth rate of exports. Also, the extent to which the economic growth rate can be sustained in the long run depends on the size of the income elasticity to imports.

3.3 Research Gap

Firstly, it is the second study using Thirlwall's model in Botswana for different time periods. Secondly, it offers the extended Thirlwall's model with productivity to determine economic growth in Botswana.

CHAPTER FOUR

4.1 Methodology

The study uses the Thirlwall (1979) model instead of the Kaldor's 4 equation's growth model. This, according to McCombie and Thirlwall, (1994), is due to the original Kaldor-Dixon-Thirlwall model being inconsistent with another influential Kaldorian model, the balance-of-payments constrained growth model. The model suggests that in the long run, exports and imports are affected by prices. This, however, is a limitation, given that there is a considerable amount of evidence suggesting that price competition does not significantly affect export performance in the long run (McCombie and Thirlwall, 1994). Hence, the Kaldor-Dixon-Thirlwall model ceases to operate and the model loses much of its relevance. However, in the Thirlwall's Law approach, changes in relative prices do not affect export and import growth in the long run, and it explicitly incorporates the importance of non-price factors for long run growth. Thus solving the main critique directed at the Kaldor-Dixon-Thirlwall model.

The Thirlwall's (1979) model also requires a balance of payments constraint while adopting expanded export and import functions that explicitly account for non-price competitiveness via relative productivity growth (Romero and McCombie 2014).

Thirlwall's model consists of two main equations (Thirwalls1979):

$$X = (\frac{EP_f}{P_d})\eta_{Z^{\varepsilon}} \qquad (1)$$

And, $$M = (\frac{P_d}{EP_f})\emptyset_{Y^{\pi}} \qquad (2)$$

Where parameters ε, π, $\emptyset > 0$ and $\eta<0$. X, M, Y, Z are export, import, domestic income and foreign income, respectively, (Pd/Pf) is the ratio of domestic prices to foreign prices measured in common currency. E is the exchange rate while η and $\emptyset$ are price elasticities and ε and π are income elasticities of export and import, respectively. Taking the natural logarithms and differencing of equations (1) and (2), gives the following equations where the small letters denote the growth rates of the relevant variables:

$x = \eta(P_d - P_f + e) + \varepsilon z$ (3)

$m = \emptyset(P_d - P_f + e) + \pi y$ (4)

Thirlwall's law assumes the existence of current account equilibrium (X=M), which implies:

$\eta(P_d - P_f + e) + \varepsilon z = \emptyset(P_d - P_f + e) + \pi y*$ (5)

Rearranging Equation (5), and calculating as the domestic income growth rate, taking into account the balance of payments constrains gives;

$y* = [(\eta - \emptyset)/\pi](P_d - P_f) + (\epsilon/\pi)z$ (6)

Combining Equations (3) and (6) leads to a second definition for y*, where;

$y* = -(\emptyset/\pi)(Pd - Pf) + (1/\pi)x$ (7)

According to Thirlwall (1974, 1980b, 1982) and Kaldor (1978), the relative prices measured in common currency are constant over time, $(P_d - P_f) = 0$. Therefore, if the terms of trade are unchanged and if the capital flows are insignificant (McCombie 2009), then the growth rate, y* can be expressed as follows which is consistent to the balance of payments equilibrium.

$y = y* = (\varepsilon/\pi)z = (1/\pi)x$ (8)

Equation (8) suggests that y, (GDP growth rate) is determined by Harrod trade multiplier $(1/\pi)$ and export growth rate x (where x = e*z). Taking into account that the both income elasticities ε and π reflect the non-price aspects of the competition (quality, delivery, effectiveness of the marketing and distribution), then the more competitive country in external trade, will has ε higher and π with lower value.

The study will follow the model, which was used, by Romero and McCombie in (2016). They derived an extended version of the Thirlwall's model, which included the productivity variable within the investigation. This was done by combining the empirical evidence from the literatures by Kaldorian and Schumpeterian, which gave the general export and import functions:

$$X = \alpha \left(\frac{EP_f}{P_d}\right) \left(\frac{N_d}{N_f}\right)\varsigma\, C^{\sigma} Z^{\varepsilon} \qquad (9)$$

$$M = \mathrm{b} \left(\frac{P_d}{EP_f}\right)^{\emptyset} \left(\frac{N_f}{N_d}\right)^{v} C^{\varsigma} Y^{\pi} \qquad (10)$$

Where C denotes productive capacity, $N = O^{\omega} T$ denotes non-price competitiveness; O and T denote other non-price competitiveness and technological competitiveness respectively. η<0, $\emptyset$<0 are price elasticities, μ and v are the technology elasticities of demand for exports and imports respectively. σ and ς are productive capacity elasticity of demand for exports and imports respectively. α and b are parameters.

Since one of the aims of this study is to use productivity in the extended Thirlwall's model, the variable, C, productive capacity is included while $\left(\frac{N_d}{N_f}\right)$ variable is dropped. Incorporating it into the general export and import functions gives the extended version of the Thirlwall model. Thus taking logarithms and differencing equations (9) and (10) with respect to time yields the following where the small letters indicate growth rates:

$$x = \eta(\mathrm{P}_d - \mathrm{P}_f + e) + \varepsilon z + \sigma c \qquad (11)$$

$$m = \emptyset(\mathrm{P}_f - \mathrm{P}_d + e) + \pi y - \varsigma c \qquad (12)$$

Thirlwall's law assumes the existence of current account equilibrium (X = M),

$$X + P_d = M + P_f + E \qquad (13)$$

The long- run domestic income growth rate compatible with balance of payments equilibrium is derived by Substituting equations (11) and (12) into equation (13),

$$Y_{BOP} = \frac{(1 - \eta + \emptyset)\,(Pd - Pf + E) + (\sigma + \varsigma) + \varepsilon Z}{\pi} \quad (14)$$

If the Marshall-Lerner condition does not hold in the long run, then equation (14) can be reduced to express the Extended Thirlwall's Law. That is relative prices are to be constant in the long- run or price elasticities sum to unity.

$$Y_{BOP} = \frac{(\sigma + \varsigma) + \varepsilon Z}{\pi} \quad (15)$$

Equation (15) indicates that higher growth rates of productive capacity lead to higher equilibrium growth rates, holding other things constant.

Total factor productivity, C, will be calculated using the following equation used by Romero and McCombie 2016:

$$\ln TFP_t = \ln Y_t - (1 - \alpha_{ICTt} - \alpha_{NICTt}) \ln L_t - \alpha_{ICTt} lnK_{ICTt} - \alpha_{NICTt} lnK_{NICTt} \quad (16)$$

Where Y denotes real value added and K is capital stocks which is divided in two types of assets; Information and communication technology (ICT) assets and Non-ICT assets. (1-α) Labour shares, and L is the number of hours worked by persons engaged in production.

4.2 Estimation Method

4.2.1. The General Thirlwall's model

Using the general export and import demand functions given by equations (3) and (4) the equations to be estimated are thus:

$$x_t = \beta_0 - \beta_1 P_{dt} + \beta_1 P_{ft} + \beta_2 et + \beta_3 z_t + u_t \quad (17)$$

$$m_t = \gamma_0 - \gamma_1 P_{ft} + \gamma_1 P_{dt} + \gamma_2 e_t + \gamma_3 y_t + u_t \quad (18)$$

Where: β and γ denote the coefficients and u_t is a vector residual over time.

4.2.2 The Extended Thirlwall's model

Using the extended export and import demand functions given by equations (11) and (12) the equations to be estimated are thus:

$$x_t = \lambda_0 - \lambda_1 P_{dt} + \lambda_1 P_{ft} + \lambda_2 e_t + \lambda_3 c_t + \lambda_4 z_t + u_t \qquad (19)$$

$$m_t = \delta_0 - \delta_1 P_{ft} + \delta_1 P_{dt} + \delta_2 e_t + \delta_3 c_t + \delta_4 y_t + u_t \qquad (20)$$

Where: λ and δ denote the coefficients and ut is a vector residual over time.

Note: The prices coefficient ($-\lambda_1 P_{dt} + \lambda_1 P_{ft} + \lambda_2 e_t$ and $-\delta_1 P_{ft} + \delta_1 P_{dt} + \delta_2 e_t$) is replaced by the real effective exchange rate, REER, when estimating model parameters. The ARDL model estimates the model parameters.

4.3.1 Data and Variables

An aggregation of data from four of the major trading partners with Botswana being United Kingdom, Belgium, China and South Africa was used. The data used are time series data for the period of 37 years, (1980-2016). Reason being the availability of sufficient data and the implementation of several policies that have affected the exports and imports of Botswana since 1993. The variables used in the study are nominal exchange rate, domestic and foreign CPI are used as proxies for domestic and foreign prices, adjusted net national income per capita as proxies for domestic and foreign income. Labour and capital stock are used for the calculation of total factor productivity. These are obtained from the World Development indicators.

4.3.2 Justification of Variables Domestic and Foreign Income

Adjusted net national income per capita (current US$) is used as a proxy for both domestic and foreign income. This is because Net national income (NNI) is defined as gross domestic product plus net receipts of wages, salaries and property income from abroad, minus the depreciation of fixed capital assets. Therefore, according to World Bank Definitions Adjusted net national income is GNI minus consumption of fixed capital and natural resources depletion.

Exports and Imports

The balance of trade of a country is defined by its net exports, being exports minus imports, and is therefore influenced by all the factors that affect international trade. An important factor to note is that both goods and services are counted for exports and imports, and as a result, a nation has a balance of trade for goods and a balance of trade for services. Hence the inclusion of Imports and exports data in the study.

The Real Effective Exchange Rate

The prices coefficient, ($-\lambda_1 P_{dt} + \lambda_1 P_{ft} + \lambda_2 e_t$ and $-\delta_1 P_{ft} + \delta_1 P_{dt} + \delta_2 e_t$), is replaced by the real effective exchange rate, REER, when estimating model parameters. A country's real effective exchange rate, (REER), is an important measure when assessing its trade capabilities. The REER measures the value of a specific currency in relation to an average group of major currencies. It also identifies a country's trade flow and analyzes the effects of trade flow factors. The REER used in the study is from the Bank of Botswana. Defined as foreign currency per unit of domestic currency. Thus a basket of foreign currencies per unit of Pula. Therefore, an increase in the exchange rate represents an appreciation of the domestic currency whereas a decrease represents a depreciation of the domestic currency. According to economic theory, this means that an appreciation of the domestic currency will lead to an increase of imports while a depreciation of the domestic currency will lead to the reduction of imports.

The Total Factor Productivity (TFP)/ (C).

The TFP variable is obtained by computing it. This is done by dividing the total production by the weighted average of inputs, being labor and capital.

$$TFP = \frac{Total\ Product}{Weighted\ Average\ of\ Inputs} \qquad (21)$$

1. **GDP** is used as a proxy for total production in this study because Gross Domestic Product (GDP) measures the total value of final goods and services produced within a given country's borders. As a broad measure of overall domestic production, it functions as a comprehensive record of the country's economic health.

The weighted average of inputs = labour + capital stock

2. **Labour**- The labour force is defined as the people who are willing and able to work. In the study, the Labor describes the characteristics of the workforce.

3. **Capital stock**- It is known as the plant, equipment, and other assets that help with production. It is approximated using the sum of common stock and preferred stock at the prices at which they were initially sold to the public. Gross fixed capital formation is used as a proxy for capital stock. It consists of resident producers' investments, deducting disposals, in fixed assets during a given period. It also includes certain additions to the value of non-produced assets realized by producers or institutional units. Fixed assets are tangible or intangible assets produced as outputs from production processes that are used repeatedly, or continuously, for more than one year.

4.3.3 Expected Signs

Table 4.1 Expected Signs

Variable name	**Expected sign**
Price elasticity of demand for imports	+
Income elasticity of demand for imports	+
Price elasticity of demand for exports	-
Income elasticity of demand for exports	+

4.4 Analytical Technique

Given that this is annual time-series data, there is a need to pre-test for stationarity and the existence of a cointegration. The unit root test is utilized in order to determine the order of integration for the variables under consideration. Autoregressive distributed lag (ARDL) is used.

CHAPTER FIVE

5.0 Introduction

This chapter presents the results of various econometric tests performed and discusses the empirical results obtained from estimation of the empirical model. Firstly, the descriptive statistics and unit root tests are done for all the variables. Once this is completed, the focus will now be on empirical model estimations and analysis of the empirical results.

The variables used for model estimations are defined as follows: Logdomestic_income, Logdomestic_tfp referring to the domestic total factor productivity, Logreer replacing the prices coefficient, ($\lambda_1 P_{dt} + \lambda_1 P_{ft} + \lambda_2 e_t$ and $- \delta_1 P_{ft} + \delta_1 P_{dt} + \delta_2 e_t$), Logforeign_income, Logforeign_tfp, Logimports and Logexports.

5.1 Pre-Analysis Tests

5.1.1 Descriptive Statistic

Descriptive statistics provide information on the basic features of the data used in the study. They include measures of central tendency, dispersion and normality.

Table 5.1.Descripive Statistic of 37 observations.

Variables	Mean	Median	Minimum	Maximum	Standard deviation	Probability	Skweness	kurtosis	Jarge-Bera
Logdomestic_income	7.795	7.860	6.612	8.699	0.627	0.265	-0.529	2.223	2.653
Logdomestic_tfp	1.241	1.268	1.015	1.495	0.127	0.619	0.043	2.215	0.961
Logreer	4.647	4.651	4.552	4.749	0.048	0.978	0.003	2.832	0.044
Logforeign_income	9.373	9.384	8.322	10.344	0.571	0.291	-0.463	2.138	2.468
Logforeign_tfp	1.321	1.393	0.974	1.515	0.180	0.038	-0.987	2.412	6.536
Logimports	4.626	4.520	3.304	5.995	0.834	0.480	0.051	2.030	1.468
Logexports	4.472	4.542	2.685	5.763	0.811	0.426	-0.487	2.604	1.705

Source: Computed using EVIEWS 10

The measures of central tendency include the mean, which is the average value, the median, which is the middle value for each series, and the mode, which is the frequent value of the series. The minimum and maximum values indicate the smallest and the largest observation for each series. Range, variance, and standard deviation provides the deviation of observations from the sample mean for each of the sample variables measure dispersion. Normality is ascertained by observing the skewness, kurtosis and the Jarque-Bera statistic values.

The difference between the maximum and the minimum values in all the variables is not significantly high. The variable with the highest range is the Logexports with balance at 3.08 while the variable with the lowest range is the Logreer at 0.2. The standard deviation indicates that sample observations are not far off from the mean. The skewness of the variables under consideration, Logdomestic_income, Logforeign_income, Logforeign_tfp and Logexports are negatively skewed which means they have long left rails. On the other hand, Logdomestic_tfp, Logreer and Logimports are long right rails since they are positively skewed. The skewness values are not significantly far from zero, which is the benchmark for a normal distribution except for Logforeign_tfp, which is relatively close to 1.

The desirable kurtosis value is 3, which obtains for a normal distribution. Observing Table 5.1 above, the shapes of the distributions for Logdomestic_income, Logdomestic_tfp, Logreer, Logforeign_income, Logforeign_tfp, Logimports and Logexports have relatively flatter shapes since they have kurtosis values less than 3. The probability values of the Jarque-Bera statistic for Logdomestic_income, Logdomestic_tfp, Logreer, Logforeign_income, Logforeign_tfp, Logimports and Logexports are all less than 10 percent therefore we reject the null hypothesis of normal distribution. Thus, concluding that the residuals are not normally distributed.

5.1.2 Stationarity Test

The Stationarity of a series is established by undertaking the unit root tests. The unit root tests that are mostly employed in the time series analysis are the Augmented Dickey Fuller, (ADF), and the Phillips-Peron, (PP), tests. Because according to (Quantitative Micro Software, 1994-2004), he Phillips-Peron test modifies the t-ratio in the non-augmented Dickey Fuller test equation such that it does not affect the asymptotic distribution of the test statistic. Therefore the Phillips-Peron test is considered to be more reliable than the Augmented Dickey Fuller test and as such this study will employ the Phillips-Peron Test.

It is important to establish the order of integration of the series. This is because, the ARDL model will not function for any series integrated of order 2, I (2) and above.

5.1.2.1 Phillips-Peron Test

When testing for stationarity;

H_O = is such that the underlying series is nonstationary.

H_1 = is such that the series is stationary.

The decision to reject and to fail to reject the null hypothesis is taken based on the probability value. The level of significance is basically the probability of rejecting the null hypothesis when it is true.

Probability value < 0.01 a series is said to be stationary at the 1 percent level of significance.

0.01< Probability value < 0.05 a series is said to be stationary at the 5 percent level of significance.

0.05< Probability value < 0.10 a series is said to be stationary at the 10 percent level of significance.

Table 5.2 Unit Root Test with Intercept Only.

Phillips-Peron test					
Variable	**Level**		**1st difference**		
	t-statistic	**Probability**	**t-statistic**	**probability**	**I(d)**
Logdomestic_income	-1.140349	0.6890	-5.101928	0.0002***	I(1)
Logdomestic_tfp	-2.541598	0.1145	-5.254669	0.0001***	I(1)
Logreer	-2.187115	0.2142	-5.934119	0.0000***	I(1)
Logforeign_income	-1.666341	0.4393	-9.227245	0.0000***	I(1)
Logforeign_tfp	0.458975	0.9828	-4.589438	0.0008***	I(1)
Logimports	-0.942873	0.7627	-4.721614	0.0005***	I(1)
Logexports	-1.352533	0.5943	-6.256271	0.0000***	I(1)

*Note: All variables are expressed in natural logarithm. ***, **, *, means significant at 1%, 5% and 10% respectively. I (0) means the variable is stationery at levels while I (1) means that the variable is stationary at first difference.*

Table 5.2 above provides the Phillips-Peron unit root tests results where only the intercept was used. The results show that all the underlying series are I (1). Since none of the series under consideration is I (2), the data meets the criteria required to estimate the ARDL model.

Stationarity was also tested where both the intercept and trend was employed under the Phillips-Peron unit root. The results are shown on Table 5.3 below where the results reflect that all the

underlying series are either I (0) or I (1). These results corresponds with those obtained when testing using the intercept only where the series under consideration is not I (2). In conclusion, the stationarity of the series under consideration based on the Phillips-Peron test allows for usage of the ARDL model.

Table 5.3 Unit Root Test with Intercept and Trend.

Phillips-Peron test					
Variable	**Level**		**1st difference**		
	t-statistic	**Probability**	**t-statistic**	**probability**	**I(d)**
Logdomestic_income	-1.984004	0.5901	-5.067043	0.0012***	I(1)
Logdomestic_tfp	-2.784931	0.2117	-5.314622	0.0006***	I(1)
Logreer	-2.568066	0.2961	-6.254832	0.0000***	I(1)
Logforeign_income	-3.877255	0.0235**			I(0)
Logforeign_tfp	-1.651091	0.7520	-4.566874	0.0045***	I(1)
Logimports	-2.111563	0.5222	-4.654110	0.0036***	I(1)
Logexports	-2.482375	0.3344	-6.481627	0.0000***	I(1)

*Note: All variables are expressed in natural logarithm. ***, **, *, means significant at 1%, 5% and 1% respectively. I (0) means the variable is stationery at levels while I (1) means that the variable is stationary at first difference.*

5.2. Regression Testing

5.2.1 Cointegration Test

The series under consideration showed that they are intergrated of different orders, having a combination of I (0) and I (1) series. Therefore performing a cointegration is necessary to establish the long-run relationship. The appropriate cointegration test is the Bound test proposed by Pesaran, Shin and Smith 2001 as the use of the Johansen Cointegration is not valid. This is because the Johansen test is only valid when the series is of the same order.

5.2.1.1 Bounds Cointegration Test

H_o: no cointegration

H_1: there is cointegration

Decision criteria for bounds test: Reject at 1%, 5% and 10% level

If the calculated F-statistic is greater than the critical value for the upper bound I (1), then we conclude that there is cointegration, a long run relationship. The null hypothesis is rejected, and the long-run model is estimated, which is the error correction model (ECM).

If the calculated F-statistic is lower than the critical value for the lower bound I (0), then we conclude that there is no cointegration hence no long run relationship. The null hypothesis is accepted. Estimate the short run model that is the autoregressive distributed lag, (ARDL) model. Logimports as a dependent variable

Table 5.4 Bounds Cointegration Test results when Logimports is the dependent variable

Test Statistic	Value	k
F- statistic	1.101798	2
Critical Value Bounds		
Significance	I(0)	I(1)
0.1%	2.63	3.35
0.05%	3.1	3.87
0.025%	3.55	4.38
0.01%	4.13	5

Source: Computed using Eviews 10

From Table 5.4 above, the *F-statistic* is lower than the lower bound I (0) at 5 percent level significance. Therefore, it is concluded that there is no cointegration hence no long run relationship. We fail to reject the null hypothesis of no cointegration. As a result, we cannot proceed by estimating the error correction model and the long run model since the variables in the model do not move together in the long run. Therefore, an ARDL is estimated.

Table 5.5 Selected ARDL (1, 0, 1) when Logimports is the dependent variable

Variable	Coefficient	Standard Error	t-statistic	Probability
LOGIMPORTS(-1)	0.896253	0.111148	8.063620	0.0000
LOGREER	-0.471744	0.500116	-0.943268	0.3528
LOGDOMESTIC_INCOME	0.864844	0.175482	4.928388	0.0000
LOGDOMESTIC_INCOME(-1)	-0.729970	0.207089	-3.524907	0.0013
C	1.642178	2.585947	0.635039	0.5301

Source: Computed using Eviews 10

Table 5.5 above shows the selected ARDL results. The real effective exchange rate coefficient has a wrong negative sign, and it is insignificant. An appreciation of the domestic currency will lead

to an increase of imports in the short run. The domestic income variable has the correct positive sign and it is significant. This implies that domestic income explains the movements and influence imports in the short run.

Logexports as a dependent variable

Table 5.6 Bounds Cointegration Test results when Logexports is the dependent variable

Test Statistic	**Value**	**k**
F- statistic	2.477336	2
Critical Value Bounds		
Significance	I(0)	I(1)
0.1%	2.63	3.35
0.05%	3.1	3.87
0.025%	3.55	4.38
0.01%	4.13	5

Source: Computed using Eviews 10

From Table 5.6 above, the F-statistic is lower than the lower bound I (0) at 5 percent level significance. It is concluded that there is no cointegration hence no long run relationship. Therefore, we fail to reject the null hypothesis of no cointegration. Hence, the error correction model and the long run model cannot be estimated because the variables in the model do not move together in the long run. Therefore, an ARDL model is estimated.

Table 5.7 Selected ARDL (1, 0, 0) results when Logexports is the dependent variable

Variable	**Coefficient**	**Standard Error**	**t-statistic**	**Probability**
LOGEXPORTS(-1)	0.850372	0.093426	9.102064	0.0000
LOGREER	0.810874	0.669533	1.211104	0.2347
LOGFOREIGN_INCOME	0.135869	0.131407	1.033960	0.3089
C	-4.305498	3.247225	-1.325901	0.1943

Source: Computed using Eviews 10

Table 5.7 above shows the selected ARDL results. The real effective exchange rate coefficient has a wrong positive sign and it is insignificant. The foreign income variable has the correct positive sign yet it is insignificant.

LogimportsExt as a dependent variable

Table 5.8 Bounds Cointegration Test results when LogimportsExt is the dependent variable

Test Statistic	Value	k
F- statistic	14.54245	3
Critical Value Bounds		
Significance	I(0)	I(1)
0.1%	2.37	3.2
0.05%	2.79	3.67
0.025%	3.15	4.08
0.01%	3.65	4.66

Source: Computed using Eviews 10

From Table 5.8 above, the F-statistic is higher than the upper bound I (1) at 5 percent level significance suggesting that there is cointegration, a long run relationship. We therefore reject the null hypothesis of no cointegration. The long run model and error correction model are estimated because there is a long run relationship between the variables.

5.1.2.3 Long Run Causality Test Results when LogimportsExt is the dependent variable

Following the confirmation of the existence of a long run relationship, the long run model is estimated. The coefficients are interpreted as elasticities since all the coefficients are expressed in natural logs.

Table 5.9 Long run coefficients when LogimportsExt is the dependent variable

Variable	Coefficient	Standard Error	t-statistic	Probability
C	2.988275	2.194814	1.361516	0.1826
LOGREER	-0.887609	0.429165	-2.068224	0.0465
LOGDOMESTIC_INCOME	0.997633	0.040283	24.76548	0.0000
LOGFOREIGN_TFP	-1.524443	0.155238	-9.820021	0.0000

Source: Computed using Eviews 10

Table 5.9 above shows the long run coefficients of the model. The real effective exchange rate coefficient has the wrong negative sign and it is significant in the long run. The domestic income coefficient has the correct positive sign and it is significant. This implies that domestic income explains the movements and influence imports. The foreign total factor productivity coefficient is significant which implies that a decrease in foreign production will increase the amount of imports.

5.2.3.1 ECM Test Results when LogimportsExt is the dependent variable

Table 5.10 LogimportsExt as the Dependent Variable ECM Model

Variable	Coefficient	Standard Error	t- statistic	Probability
D(LOGREER)	-0.109244	0.464567	-0.235153	0.8159
D(LOGREER(-1))	-0.657228	0.473250	-1.388755	0.1763
D(LOGDOMESTIC_INCOME)	0.977481	0.152386	6.414497	0.0000
D(LOGDOMESTIC_INCOME(-1))	0.136997	0.144738	0.946516	0.3523
D(LOGFOREIGN_TFP)	-0.859195	0.572144	-1.501710	0.1448
D(LOGFOREIGN_TFP(-1))	-0.241011	0.540517	-0.445890	0.6592
ECT1(-1)	-0.712302	0.202421	-3.518920	0.0016

Source: Computed using Eviews10

The error correction model results are presented on Table 5.10 above. The error correction term, ECT1, is negative and significant as expected. This indicates that the model will always converge at a rate of 71.2 percent towards the long run equilibrium following a shock to the model.

The short run real effective exchange rate coefficient is insignificant which means that exchange rate movements do not explain the imports movements in the short run. The short run domestic income coefficient is positive and significant while its lagged term is insignificant and positive. This suggests that domestic income does not have an impact on imports in the short run. Foreign total factor productivity does not explain imports in the short run as indicated by the insignificant coefficients of the variable and its lagged term.

LogexportsExt as a dependent variable

Table 5.11 Bounds Cointegration Test results when LogexportsExt is the dependent variable

Test Statistic	Value	k
F- statistic	3.481360	3
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
0.1%	2.37	3.2
0.05%	2.79	3.67
0.025%	3.15	4.08
0.01%	3.65	4.66

Source: Computed using Eviews 10

From Table 5.11 above, the F-statistic is between the lower bound I (0) and higher than the upper bound I (1) at 5 percent level significance. This suggests that a conclusive inference cannot be made without knowledge of integration of the variables in the model. However, since the unit root

tests confirmed that all the variables are not integrated of higher orders, the study will follow (Baek, et al., 2009). According to Baek, et al. (2009), in an instance where the error correction term is negative and significant in the ARDL model, the variables in the model are said to be cointegrated. The study proceeds to estimate the error correction model, ECM.

5.1.2.4 Long Run Causality Test Results when LogexportsExt is the dependent variable

Following the confirmation of the existence of a long run relationship, the long run model is estimated. The coefficients are interpreted as elasticities since all the coefficients are expressed in natural logs.

Table 5.12 Long run coefficients when LogexportsExt is the dependent variable

Variable	**Coefficient**	**Standard Error**	**t-statistic**	**Probability**
Logforeign_income	1.309582	0.105458	12.41804	0.0000
Logreer	2.272603	1.277361	1.779139	0.0844
Logdomestic_tfp	0.998037	0.494435	2.018539	0.0517
c	-19.60229	6.200356	-3.161478	0.0034

Source: Computed using Eviews 10

5.12 above shows the long run coefficients of the model. The real effective exchange rate coefficient has a wrong positive sign and it is significant at 10 percent level. The foreign income coefficient has the correct positive sign and it is significant. This implies that foreign income movements explain exports (influence exports). The domestic total factor productivity, tfp, coefficient is significant which implies that an increase in domestic production will increase the amount of exports.

5.1.2.2 ECM Test Results when LogexportsExt is the dependent variable

Table 5.13 LogexportsExt as the Dependent Variable ECM Model

Variable	**Coefficient**	**Standard Error**	**t- statistic**	**Probability**
D(LOGEXPORTS(-1))	0.075226	0.198228	0.379492	0.7074
D(LOGREER)	0.336068	0.868797	0.386820	0.7020
D(LOGREER(-1))	0.256859	0.847435	0.303102	0.7642
D(LOGFOREIGN_INCOME)	0.250648	0.122811	2.040919	0.0515

D(LOGFOREIGN_INCOME(-1))	-0.043906	0.134083	-0.327454	0.7459
D(LOGDOMESTIC_TFP)	0.548417	0.393889	1.392315	0.1756
D(LOGDOMESTIC_TFP(-1))	0.124684	0.404628	0.308145	0.7604
ECT2(-1)	-0.277474	0.153696	-1.805339	0.0826

Source: Computed using Eviews10

The error correction model results are presented on Table 5.13 above. The error correction term, ECT2, is negative and significant as expected. This indicates that the model will always converge at a rate of 27.7 percent towards the long run equilibrium following a shock to the model.

The short run real effective exchange rate coefficient is insignificant which means that exchange rate movements do not explain the exports movements in the short run. The short run foreign income coefficient is positive and significant. Domestic total factor productivity does not explain exports in the short run as indicated by insignificant coefficients.

5.3 Empirical Analysis

As mentioned before the economic growth of Botswana is estimated through the Thirlwall's model. According to the World Bank national accounts data 2019, the average annual economic growth rate of Botswana between 1980 and 2016 was 6.52 percent while the average export growth rate was 4.87 percent.

Using equation 8 and the income elasticity coefficient from the selected ARDL in table 5.5, the economic growth rate is calculated as follows:

$$y = y* = (\frac{\varepsilon}{\pi})\ z = (\frac{1}{\pi})x \qquad (8)$$

π = 0.864 (Income elasticity of demand for imports)

Z = 4.87 (Export growth rate)

Therefore,

$$y = y* = (\frac{1}{0.864})\ 4.87 = 5.63$$

The economic growth rate is 5.63 percent. This is relatively close to the given 6.52 percent economic growth. However, if we only consider the income elasticity of exports only and do not consider income elasticity of the imports, the economic growth rate of the Republic of Botswana will be higher.

Furthermore, to calculate the economic growth rate of Botswana using the extended Thirlwall's model, equation (15) along with the long run coefficients inclusive of the total factor productivity coefficients of imports and exports are used.

$$Y_{BOP} = \frac{((\sigma + \varsigma) + Ez)}{\pi} \qquad (15)$$

σ= 0.998037 (Domestic total factor productivity)

ς= -1.524443 (Foreign total factor productivity)

π= 0.997633 (Income elasticity of imports)

Z= 4.87 (Export growth rate)

C = 3.643563327 (Capacity Variable), calculated using equation (16)

Therefore in absolute terms,

$$Y = \frac{((0.998037 + (-1.524443))\ (0.0364 + 4.87)}{0.997633} = 4.9735$$

The result of 4.97 percent calculated economic growth rate is significantly lower than the given 6.52 percent. This suggests that inclusive of the total factor productivities, the economic growth rate of Botswana is significantly small when using the Thirlwall's model as a tool of measure.

The calculated economic growth rates are presented below on table 5.14.

Table 5.14 Calculated Economic Growth Rates

Model	**Calculated Economic Growth Rates (%)**
Thirlwall's Model	5.63
Extended Thirlwall's Model	4.97

CHAPTER SIX

6.1 Conclusion

The purpose of this paper was to estimate the economic growth of Botswana using Thirlwall's model. The study also aimed at using productivity data in order to apply the extended Thirlwall's model for the period of 1980-2016. The Autoregressive Distributed Lag (ARDL) Bounds Testing method was used to estimate the price and income elasticities, which is based on the conventional equations of exports and imports demand. The practical application of the estimated elasticities provides insights about the determinants of the economic growth of the Republic of Botswana. Thus, the Thirlwall's hypothesis of balance of payments constrained growth is used.

The estimated results from the imports and exports equations showed that the estimated price elasticity for imports was negative and statistically insignificant. While the estimated price elasticity of demand for exports was positive and statistically insignificant. The estimated income elasticity for imports is also found to be positive and statistically significant. The estimated income elasticity of demand for exports was positive and statistically insignificant.

From the extended import and export equations, the price elasticity of imports was negative and statistically significant. The estimated price elasticity of exports was positive and statistically significant. The income elasticity for imports was positive and statistically significant. The income elasticity of exports was positive and statistically significant.

The income elasticity of demand is found to encourage both exports and imports as expected. The factor productivity is found to be negative for imports, which is unexpected and positive for exports as expected.

Furthermore, the empirical results from the cointegration analysis showed that in the case of imports, there was no long run relationship between the trade balance variables. In the case for exports, the cointegration analysis showed that there was no long run relationship between the variable.

However, in the extended imports and exports equations the reverse was true. These equations included the total factor productivity variable as independent variable. The empirical results from the cointegration analysis showed that there was long run relationship between the variables.

Using the calculated price and income elasticities from the Thirlwall's model, the calculated growth rates closely coincided with the actual growth rates. Thus, suggest that the economic growth rate of Botswana is specified by the price and income elasticities of exports and imports.

Using the calculated price and income elasticities as well as the total factor productivity elasticities from the extended Thirlwall's model showed that the calculated growth rate was significantly lower than the actual growth rate. This suggested that the productivity factor does not play a significant role in the economic growth of Botswana holding all things constant. Predicted growth rates do closely coincided with the actual growth rates according to the regression results.

Interestedly, the analysis from the normal imports and exports demand equations shows that the income elasticity of import is higher than the income elasticity of export, (0.865 (import) is greater than 0.136 (export)), which indicate to trade balance deterioration. The high import response to the domestic income changes demonstrates that income growth determines the domestic demand, which in turn provokes a significant import demand. Thus, given price inelasticity of exports, it is obvious that the foreign buyers do not consider the price of the Botswana's products when making their decisions. Thus, Botswana is a price taker.

The analysis from the extended imports and exports demand equations with the total factor productivity variable, shows that the income elasticity of import is lower than the income elasticity of export, (0.998 (import) is less than 1.31(export)), indicating a trade balance improvement. The low import response to the domestic income changes demonstrates that income growth does not determine the domestic demand in the long run, which in turn provokes a significant export demand.

The overall results indicate that Thirlwall hypothesis holds in determining Botswana's economic growth rate. This correlated with the study done by Matsheka in 1998, where Botswana's economic growth rate was calculated using Thirlwall's model. Though the focus was only on the income elasticity of demand for imports and exports, the results showed that a ratio of the growth rate of exports to the income elasticity of demand for imports predicted Botswana's economy. Thus, confirming that the Thirlwall's model applies in Botswana.

6.2 Recommendations

From the conclusion, it is therefore recommended that Botswana increases its exports and export diversification which would help increase her export growth rate. This would help increase Botswana's economic growth rate. The supply policies should be driven towards a higher income elasticity of export and lower income elasticity of import that will lead to increase in exports and higher growth rates. Exports diversification should be improved by increasing the non-price

aspects of exports, an increase in production of non-import dependent products as well as the exportation of high value added goods and services or final products.

The revision of the current microeconomic and macroeconomic policy of the Republic of Botswana is important. The macroeconomic management should actively manage the price elasticities and should create a policy that will raise the value of income demand for exports and reduce the value of income demand for imports.

Furthermore, an understanding of the relationship between exchange rate and trade flows is essential for successful exchange and trade policies, which are both particularly important for small open economies like Botswana, (Nyambe, 2013). It is highly advised that the exchange rate manipulation should not be over used due to possible adverse effects that stems from the high dependence of Botswana production on imported intermediate goods, (Nyambe, 2013). In addition, complementary policies are needed to increase the chances of for exchange rate policy to be successful in improving competitiveness and facilitating trade. Such as the microeconomic and macroeconomic policies that will encourage the increase of local production of goods and services with less use of imported inputs and resources should be coordinated with the exchange rate adjustments. Thus, improve the trade balance of the country.

6.3 Limitations of the Study

1. The main limitation of this study is that it relied on secondary data therefore the errors and omissions made in reporting it may have influenced the results derived.
2. The limited number of the independent variables towards the imports and exports equations may have not have fully explained the imports and exports terms of Botswana.
3. The results of the study provided limited information on the specifications of the goods and services imported and exported. Thus not giving a clear explanation of the major economic growth contributor of Botswana's growth.

6.4 Areas of further study

A further research study can be conducted to examine the economic growth rate of Botswana with the mining industry excluded as part of Botswana's exports.

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APPENDIX

Table A1: Selected ARDL (1, 0, 1) model (Logimports)

Dependent Variable: LOGIMPORTS
Method: ARDL
Date: 02/25/20 Time: 21:17
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LOGREER LOGDOMESTIC_INCO
ME
Fixed regressors: C
Number of models evalulated: 100
Selected Model: ARDL(1, 0, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGIMPORTS(-1)	0.896253	0.111148	8.063620	0.0000
LOGREER	-0.471744	0.500116	-0.943268	0.3528
LOGDOMESTIC_INCOME	0.864844	0.175482	4.928388	0.0000
LOGDOMESTIC_INCOME(-1)	-0.729970	0.207089	-3.524907	0.0013
C	1.642178	2.585947	0.635039	0.5301

R-squared	0.979771	Mean dependent var	4.661711
Adjusted R-squared	0.977161	S.D. dependent var	0.816113
S.E. of regression	0.123337	Akaike info criterion	-1.219550
Sum squared resid	0.471571	Schwarz criterion	-0.999617
Log likelihood	26.95190	Hannan-Quinn criter.	-1.142788
F-statistic	375.3602	Durbin-Watson stat	1.889107
Prob(F-statistic)	0.000000		

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

Table A2: Selected ARDL (1, 0, 0) model (Logexports)

Dependent Variable: LOGEXPORTS
Method: ARDL
Date: 02/25/20 Time: 21:21
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LOGREER LOGFOREIGN_INCOM
E
Fixed regressors: C
Number of models evalulated: 100
Selected Model: ARDL(1, 0, 0)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*

LOGEXPORTS(-1)	0.850372	0.093426	9.102064	0.0000
LOGREER	0.810874	0.669533	1.211104	0.2347
LOGFOREIGN_INCOME	0.135869	0.131407	1.033960	0.3089
C	-4.305498	3.247225	-1.325901	0.1943

R-squared	0.946465	Mean dependent var	4.515391
Adjusted R-squared	0.941446	S.D. dependent var	0.778769
S.E. of regression	0.188445	Akaike info criterion	-0.395578
Sum squared resid	1.136373	Schwarz criterion	-0.219632
Log likelihood	11.12041	Hannan-Quinn criter.	-0.334168
F-statistic	188.5809	Durbin-Watson stat	1.955538
Prob(F-statistic)	0.000000		

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

Table A3: Selected ARDL (2, 1, 0, 1) model (LogimportsExt)

Dependent Variable: LOGIMPORTS
Method: ARDL
Date: 02/25/20 Time: 21:25
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LOGREER LOGDOMESTIC_INCOME LOGFOREIGN_TFP
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(2, 1, 0, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGIMPORTS(-1)	0.341668	0.158089	2.161246	0.0397
LOGIMPORTS(-2)	-0.285251	0.110220	-2.588006	0.0154
LOGREER	-0.290342	0.486786	-0.596446	0.5558
LOGREER(-1)	-1.303042	0.470126	-2.771685	0.0100
LOGDOMESTIC_INCOME	0.914684	0.120098	7.616115	0.0000
LOGFOREIGN_TFP	-0.524073	0.508460	-1.030707	0.3118
LOGFOREIGN_TFP(-1)	-1.060783	0.532844	-1.990796	0.0567
C	6.729134	2.400642	2.803057	0.0093

R-squared	0.989386	Mean dependent var	4.694528
Adjusted R-squared	0.986634	S.D. dependent var	0.803568
S.E. of regression	0.092901	Akaike info criterion	-1.716931
Sum squared resid	0.233027	Schwarz criterion	-1.361423
Log likelihood	38.04629	Hannan-Quinn criter.	-1.594210
F-statistic	359.5424	Durbin-Watson stat	1.968572
Prob(F-statistic)	0.000000		

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

Table A4: Selected ARDL (1, 0, 0, 0) model (LogexportsExt)

Dependent Variable: LOGEXPORTS
Method: ARDL
Date: 02/25/20 Time: 21:30
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LOGREER LOGFOREIGN_INCOM E LOGDOMESTIC_TFP
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(1, 0, 0, 0)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGEXPORTS(-1)	0.837603	0.087088	9.617943	0.0000
LOGREER	1.294993	0.653774	1.980795	0.0565
LOGFOREIGN_INCOM E	0.196783	0.124789	1.576923	0.1250
LOGDOMESTIC_TFP	0.646256	0.264691	2.441547	0.0205
C	-7.875772	3.356702	-2.346283	0.0255

R-squared	0.955099	Mean dependent var	4.515391
Adjusted R-squared	0.949306	S.D. dependent var	0.778769
S.E. of regression	0.175343	Akaike info criterion	-0.515903
Sum squared resid	0.953097	Schwarz criterion	-0.295970
Log likelihood	14.28626	Hannan-Quinn criter.	-0.439141
F-statistic	164.8536	Durbin-Watson stat	2.099081
Prob(F-statistic)	0.000000		

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

Figure A1: Normality test when Logimports is the dependent variable

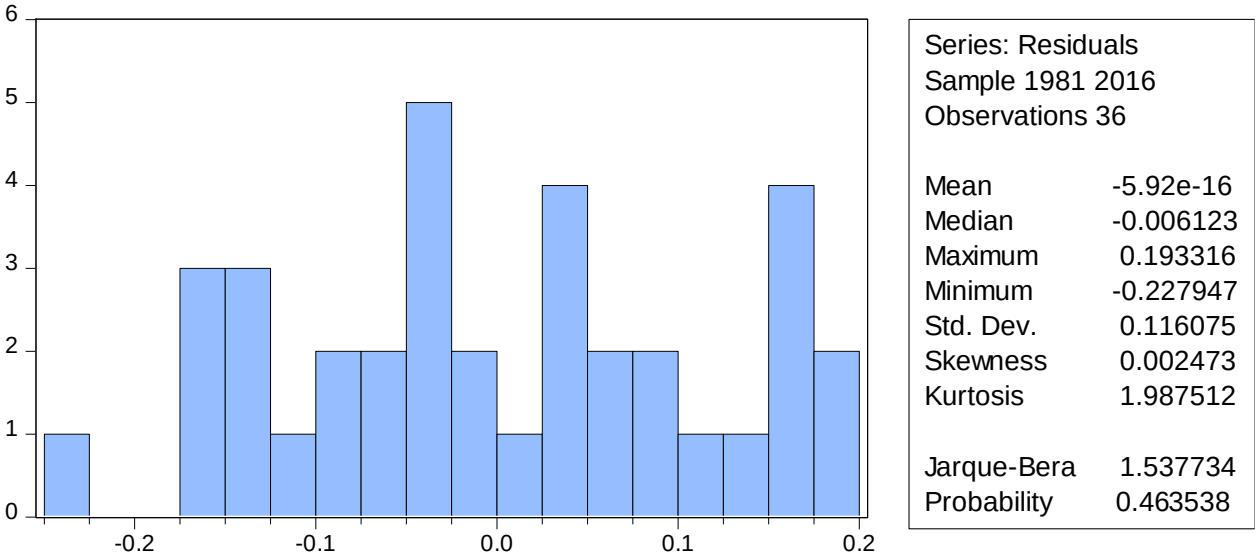


Figure A2: Stability test when Logimports is the dependent variable

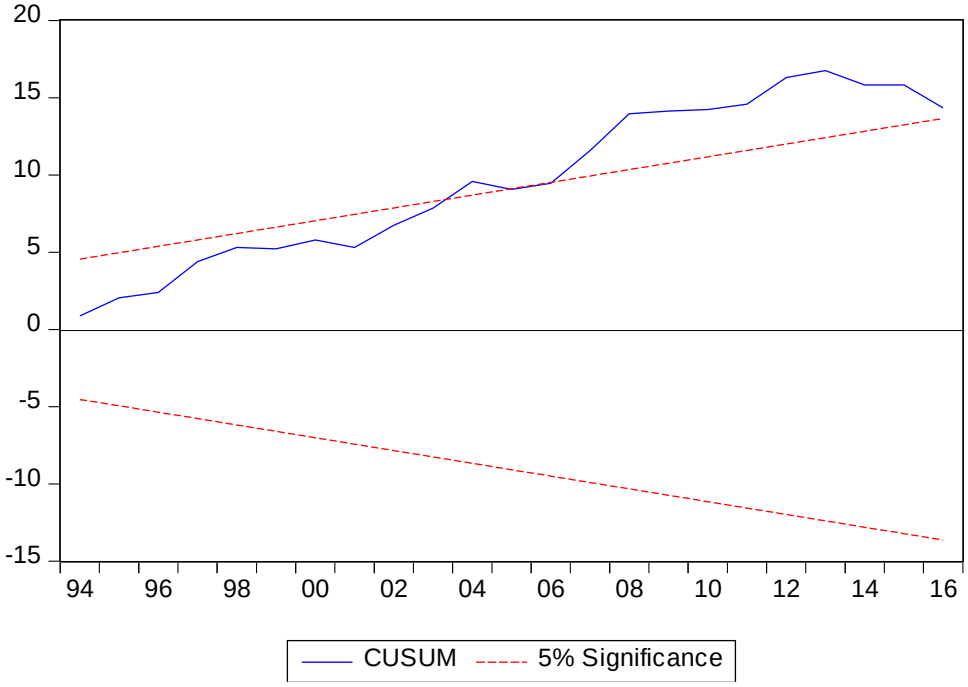


Figure A3: Normality test when Logexports is the dependent variable

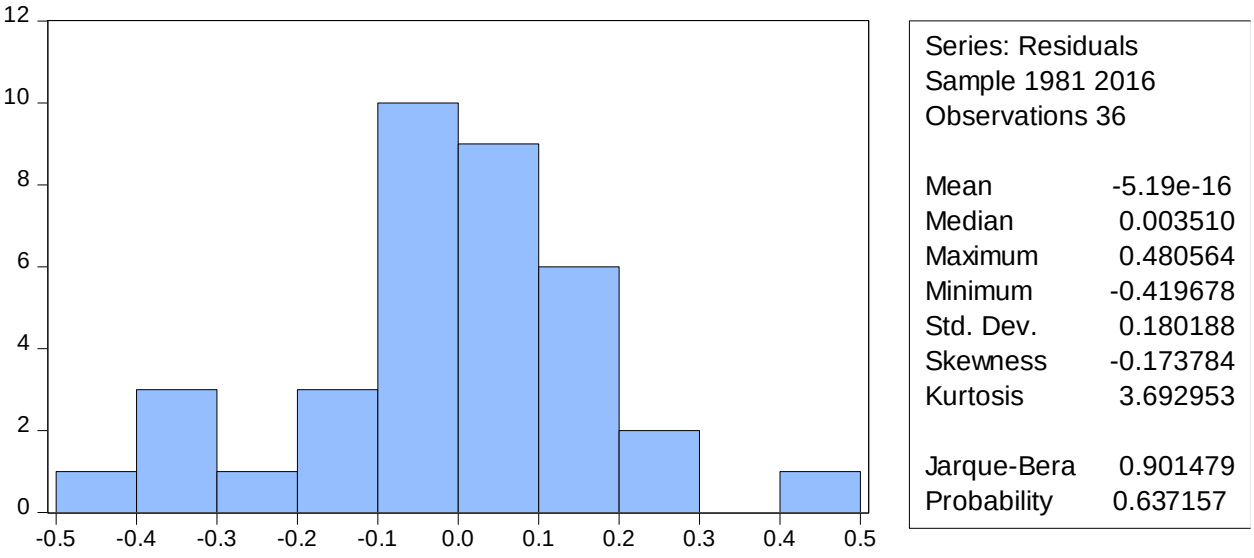


Figure A4: Stability test when Logexports is the dependent variable

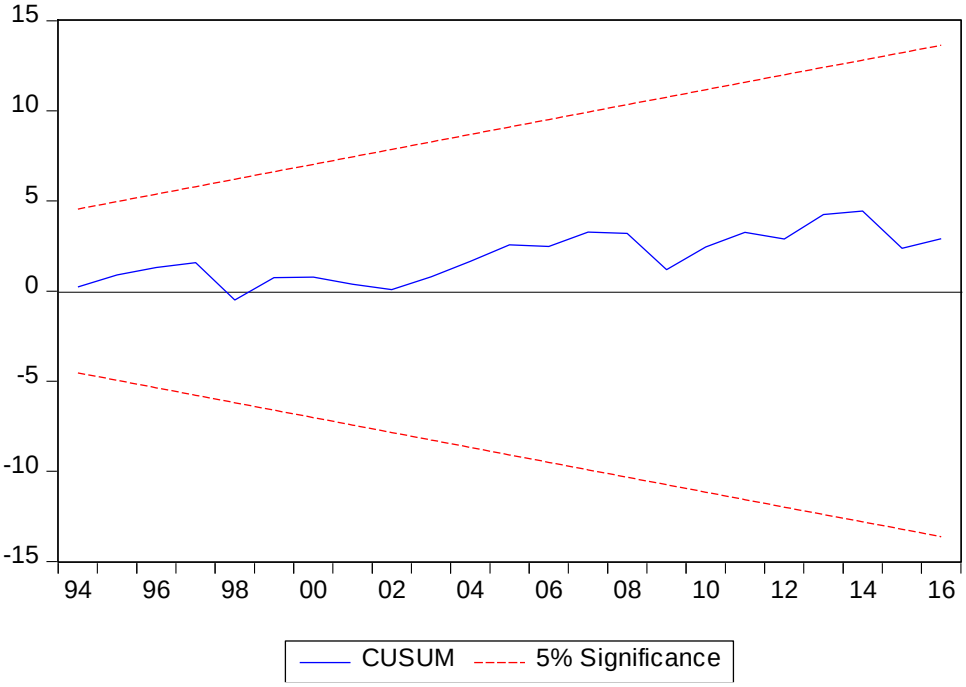


Figure A5: Normality test when Logimports is the dependent variable

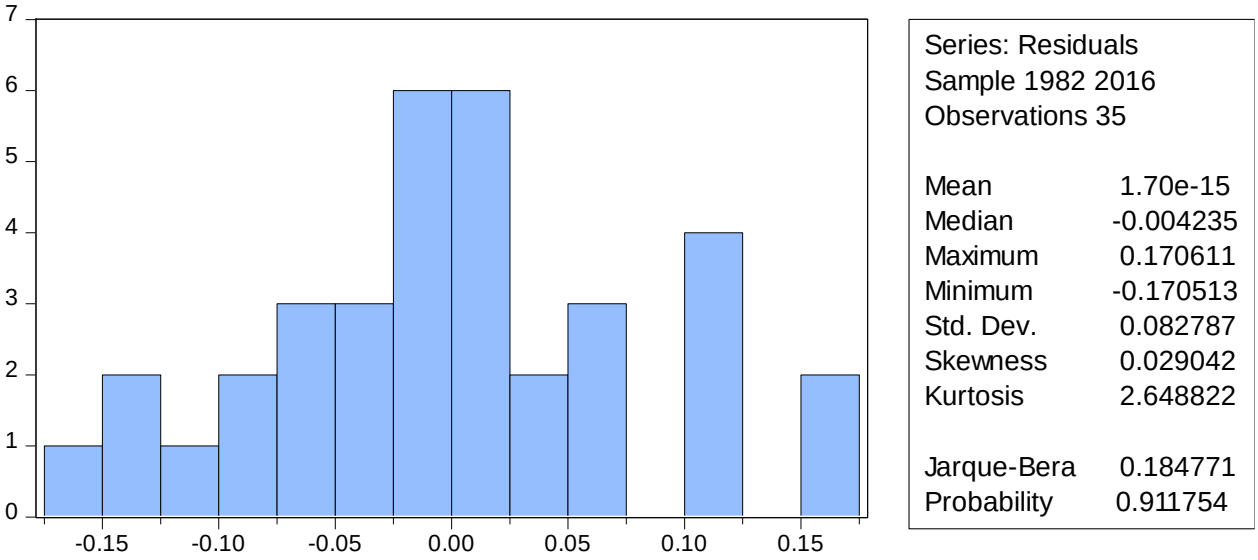


Figure A6: Stability test when LogimportsExt is the dependent variable

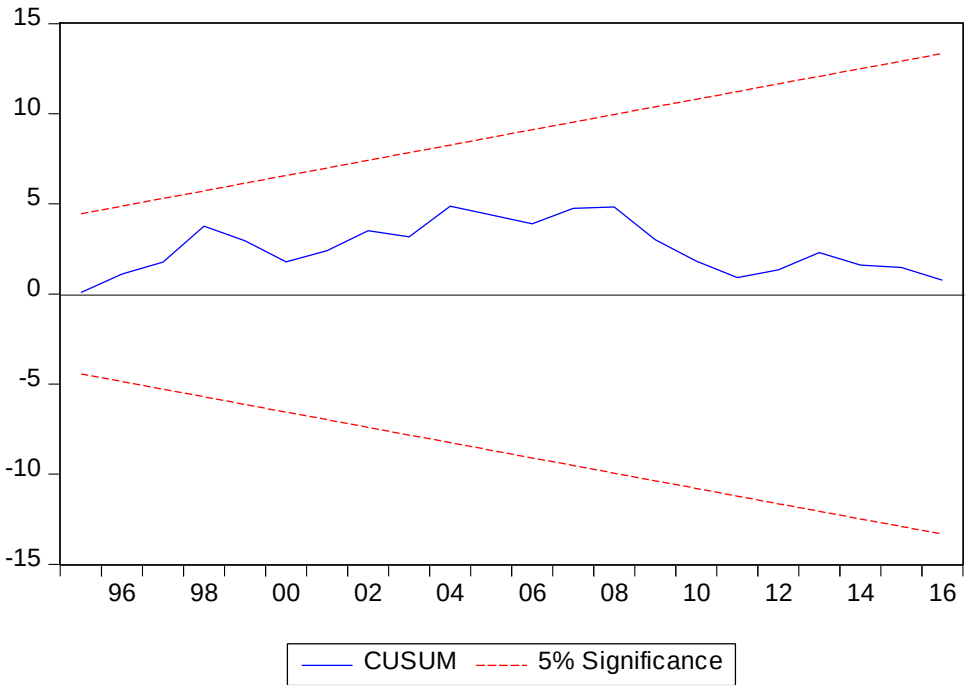
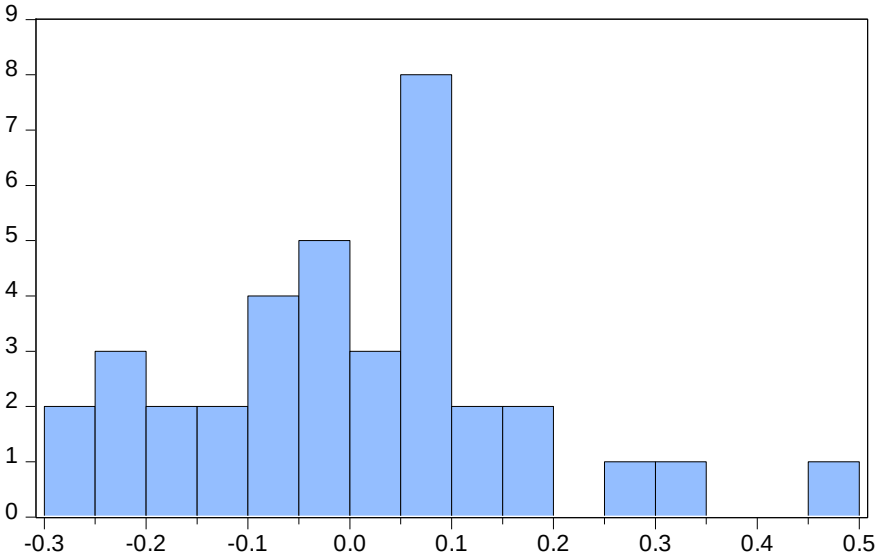


Figure A7: Normality test when Logexports is the dependent variable



Series: Residuals	
Sample 1981 2016	
Observations 36	
Mean	-6.18e-16
Median	-0.003759
Maximum	0.476140
Minimum	-0.277358
Std. Dev.	0.165019
Skewness	0.532179
Kurtosis	3.634959
Jarque-Bera	2.304049
Probability	0.315996

Figure A8: Stability test when LogexportsExt is the dependent variable