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An Application of Thirlwall's Model to Botswana's Economic Growth

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Abstract: This paper estimates economic growth of Botswana using Thirlwall's and the Extended Thirlwall's models for the period of 1980-2016. Parameters from the Thirlwall's model shows the calculated growth rate of 5.63 percent while the actual growth rate was 6.52%. These growth rates are very close to each other. This indicates that price and income elasticities of exports and imports influence Botswana's economic growth. Our empirical findings support those of Matsheka (1998). These empirical findings suggest that the Thirlwall's law holds in Botswana. i.e., Botswana's economic growth rate is balance of payments constrained. The Extended Thirlwall's model showed lower growth rate of 4.26% which is less than the actual growth rate. This suggested that the productivity factor has not played a significant role in the economic growth of Botswana. This might not be surprising. Botswana's economic growth is driven by the growth of diamonds exports where productivity might not be easily measured like in the manufacturing and services industries. These findings are in contrast to those of Romero and McCombie (2016) when investigating the impact of relative productivity growth on trade performance on developed countries. It is recommended that Botswana should improve her exports diversification strategies to increase economic growth without deteriorating her balance of payments.

Keywords: Growth; Thirlwall's Model; Balance of Payments; Elasticities; Botswana

JEL: F14; F43

INTRODUCTION

This paper aims to calculate economic growth of Botswana using Thirlwall's and the Extended Thirlwall's models for the period of 1980-2016. Thirlwall's models employs price and income elasticities of exports and imports to compute economic growth. Economic growth is an important indicator of a healthy economy. Benefits of a long run economic growth of a country are positive impact on national income and level of employment which increase the standard of living and reduces poverty. Additionally, higher economic growth leads to extra tax income for government spending. Higher revenues from economic growth can be 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. 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). It is therefore important to identify the determinants of economic growth of Botswana. 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 elasticity 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). Export elasticities 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. The trade based taxes depend on the price and income elasticities of exports and imports (Tennakoon 2010).

Matsheka (1998) through Thirlwall's model 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. Matsheka's study only employed the Thirlwall's model while this paper use both Thirlwall's and Extended Thirlwall's models to a certain economic growth of Botswana. Furthermore, this paper use Autoregressive Distributed Lag (ARDL) technique to find parameters of interest unlike Matsheka who employed OLS method. This paper covers the period of 1980 to 2016 while Matsheka covered the period 1975 to 1993. Therefore, this paper answers the question; Is there any relationship among the elasticities of income and price demand with the economic growth of Botswana?

The paper is organized as follows. Section II provides a brief background of Botswana's trade policies, exports, imports and GDP growth trends. Section III is a review of previous studies. Section IV provieds the methodology. Empirical findings are discussed in Section V. Conclusions of the paper are given in Section VI.

II. BOTSWANA'S TRADE POLICIES, EXPORTS, IMPORTS AND GDP GROWTH RATES

Botswana has adopted a number of policies including the import substitution industrialization policy which operated from 1984 to 1998

(Ministry of Trade and Industry, 2009; Malefane and Odhiambo, 2016). The limitations of this policy was that it mainly focused on industry production for the domestic market. 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 following. Industrial Development 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 currently serves as the key strategy for the economy of Botswana (Ministry of Trade and Industry, 2009). Botswana is member of the following various organizations and trade agreements. The Southern Africa Custom Union, (SACU), Southern African Development Community (SADC) and World Trade Organization, (WTO). These organizations have 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. In 2007, Botswana removed export subsidies and implemented measures addressing technical barriers to trade to be WTO's compliant (Malefane and Odhiambo, 2016).

The growth in exports and imports in Botswana over the past decades has seen a number of cyclical movements. The growth of Botswana's exports had fallen substantially around the early 1990s. However, from 1994, improvements in export growth were realized. By 1997, the export growth was 12.94 percent. This 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. The GDP annual growth rate of Botswana during the period of study (1980 to 2016) averaged 6.52 percent (World Bank, 2019).

III. REVIEW OF PREVIOUS STUDIES

Since 1979, the Thirlwall's Law has been seen as an important alternative for explaining the growth differences between developed countries and 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. It provides an explanation of the basis for the export-led growth theory and 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. This is 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. Therefore, 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 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).

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. 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. This results 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. (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 is 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).

Introducing differences in productivity to capture differences in the non-price competitiveness of the products 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 (e.g., 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).

Bairam analyses (1993, 1997) showed that in time of world economic expansion, developing countries had a greater foreign income elasticity than domestic income elasticity. 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/?)x, but not on the base of the second identity (?/?)z. Bairam and Lawrence (2001) 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 as mentioned by Krugman (1989). McGregor and Swales (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) 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) argued that such tests of Thirlwall's Law are testing a near identity that is likely to be satisfied for almost any country. This is regardless of whether its growth is Balance of payments constrained in the sense of Thirlwall's law or not. Thirlwall (1981) responded to this critique by pointing out that econometric estimates of the income elasticities need not equal the observed ratios of growth rates respectively. This would hold as long as relative prices are controlled for in the estimated demand functions for exports and imports (Blecker 2013).

Romero and McCombie (2016) through expanded Thirlwall's Law showed that the growth rates of exports and imports are partially determined by relative productivity growth and productive capacity. The investigation provided evidence of the validity of the expanded Thirlwall's Law. Kadievska-Vojnovic and Unevska (2007) through Thirlwall's economic growth model confirmed that the growth rate of the Macedonian economy largely depends on export growth rate. The growth rate was found to be significantly reduced by high-income elasticity of import.

Perraton (2003), posits that the weak form and strong form of Thirlwall's hypothesis were identified for some developing countries. 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.

Through the Thirlwall's law Britto and McCombie (2009) revealed that the balance of payments has been a significant constraint to Brazilian GDP growth rates for over half a century. Capital flows were an important factor in reducing the external constraint and allowing faster GDP growth rates. The cointegration of the series indicates the existence of a long run path of growth. This can be interpreted as an equilibrium path given by Thirlwall's law. Fasanyaa and Olayemia (2018), examined the validity of Thirlwall's law in Nigeria. 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. These results showed that the Thirlwall's law holds in Nigeria and the growth in Nigeria is balance of payment constrained. Still in Nigeria Adesete et.al, (2008) established that the predicted growth rates coincided with the actual growth rates. This indicated that Thirlwall hypothesis holds in Nigeria. Ozturk and Acaravci (2010) empirical results supported the Thirlwall's hypothesis economic growth South Africa. i.e., the balance of payments position of the South African economy is the main constraint on its economic growth. In the case of Botswana, 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. Additionslly, the extent to which the economic growth rate can be sustained in the long run depends on the size of the income elasticity of imports. This paper extends the frontiers of knowledge by estimating economic growth of Botswana using Thirlwall's and the Extended Thirlwall's models for the period of 1980-2016.

IV. METHODOLOGY

Thirlwall's model consists of export (X) and import (M) equations (Thirwalls 1979).

$$X = \left(\frac{EP_f}{P_d} \right)^{\eta} Z^{\varepsilon} \tag{1}$$

$$M = \left(\frac{P_d}{EP_f} \right)^{\phi} Y^{\pi} \tag{2}$$

Where $\varepsilon, \pi, \phi > 0$ and $\eta<0$. X, M, Y, Z are export, import, domestic income and foreign income elasticities,respectively, Pd/pf is the ratio of domestic prices to foreign prices measured in common currency, η and ϕ 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:

$$x = (p_d - pf + e) + \varepsilon z \tag{3}$$

$$m = \phi(p_f - p_d + e) + \pi y \tag{4}$$

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

$$(p_d - p_f + e) + \varepsilon z = \phi(p_d - p_f + e) + \pi y* \tag{5}$$

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

$$y* = [(\eta - \phi)/\pi](p_d - p_f) + (\epsilon/\pi)z \tag{6}$$

Combining Equations (3) and (6) leads to a second definition for

$$y* = -(\phi/\pi)(p_d - p_f) + (1/\pi)x) \tag{7}$$

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.

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

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, then the more competitive country in external trade, will have ?? higher and ?? with lower value. This paper follow the Extended Thirlwall's model 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 paper use only productivity in the Extended Thirlwall's model. The variable, C, productive capacity is included while we drop other variables (see, Romero and McCombie in (2016). Incorporating it into the general export and import functions gives the extended version of the Thirlwall model in equations (9) and (10) with productivity variable.

$$x = (pd - p_f + e) + \varepsilon z + \tag{9}$$

$$m = \phi(p_f - p_d + e) + \pi y - \varsigma c \tag{10}$$

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

$$X = M \tag{11}$$

The long- run domestic income growth rate compatible with balance of payments equilibrium is derived by Substituting equations (9) and (10) into equation (11),

$$Y_{BOP} = \frac{(1-\eta+\phi)(P_d - P_f + E) + (\sigma+\varsigma)c + \varepsilon Z}{\pi} \tag{12}$$

If the Marshall-Lerner condition does not hold in the long run, then equation (12) 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.

$$Y_{BOP} = \frac{(\sigma+\varsigma)c + \varepsilon Z}{\pi} \tag{13}$$

Equation (13) indicates that higher growth rates of productive capacity lead to higher equilibrium growth rates, holding other things constant.

In this paper the price coefficients ($-\lambda_1 p_{dt} + \lambda_1 p_{ft} + \lambda_2 e_t$ and $-\delta_1 p_{ft} + \delta_1 p_{dt} + \delta_2 e_t$) are replaced by the real effective exchange rate (reer) when estimating model parameters. It measures a country's competitiveness relative to its trading partners. An appreciation of the real effective exchange rate discourages exports and increase imports. Therefore, the general export and import demand functions given by equations (3) and (4) are expressed as follows for estimation.

$$x_t = \beta_0 - \beta_1 reer_t + \beta_2 z_t + u_t \tag{14}$$

$$m_t = \gamma_0 - \gamma_1 reer_t + \gamma_2 y_t + u_t \tag{15}$$

The income growth elasticity for imports and export growth rate are used in applying the Thirlwall's model. Using the extended export and import demand functions (9) and (10) the equations to be estimated for the Extended Thirlwall's model are as follows.

$$x_t = \lambda_0 - \lambda_1 reer_t + \lambda_2 c_t + \lambda_3 z_t + u_t \tag{16}$$

$$m_t = \delta_0 - \delta_1 reer_t + \delta_2 c_t + \delta_3 y_t + u_t \tag{17}$$

V. EMPIRICAL RESULTS

We presents econometric tests performed and discuss the empirical results. The variables used for model estimations are defined as follows: Logimports; Logdomestic_income; Logreer (real effective exchange rate) for prices coefficient ($-\lambda_1 p_{dt} + \lambda_1 p_{ft} + \lambda_2 e_t$ and $-\delta_1 p_{ft} + \delta_1 p_{dt} + \delta_2 e_t$); Logdomestic_tfp referring to the domestic total factor productivity; Logforeign_tfp foreign total factor productivity, Logforeign_income, and Logexports.,

5.1. Stationarity Test

Table 5.1 below 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 5.2 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 5.1: 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.

5.2. Cointegration Test

The series under consideration showed that they are intergrated of different orders. Therefore performing a cointegration is necessary to establish the long-run relationship. The appropriate cointegration test is the Bound test

Table 5.2: 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.

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. In the Bounds Cointegration Test, if the calculated F-statistic is greater than the critical value for the upper bound I (1), we conclude that there is cointegration. i.e., 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.

Table 5.3: Bounds Cointegration Test results:Logimports 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 5.3 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. Therefore, an ARDL is estimated.

Table 5.4: Selected ARDL (1, 0, 1) Logimports dependent variable

Variable	*Coefficient*	*Standard Error*	*t-statistic*	*Probabilit*
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 (LOGRER) coefficient has a wrong negative sign, and it is insignificant. Matsheka (1998) also found the price term with a wrong sign and insignificant. Economic literature also posits that changes in relative prices do not affect export and import growth in the long-term. This is due to the elasticity suspicion or due to the long-term constancy of relative prices (Blecker, 2013). 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.

In the Extended Thirlwall's model estimation we present the results for both import and exports functions. This is in order to obtain the coefficients for domestic and foreign total factor productivity variables.

Table 5.5: Bounds Cointegration Test results: LogimportsExended 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 5.5 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.

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 5.6: Long run coefficients: Logimports Extended 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 5.6 above shows the long run coefficients of the model. The real effective exchange rate coefficient has the wrong negative sign and it is significant. 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 with a wrong sign.

Table 5.7: LogimportsExtended 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 5.7 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 influence imports. The short run domestic income coefficient is positive and significant. 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.

Table 5.7: Bounds Cointegration Test results:LogexportsExtended 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 5.7 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.

Following the confirmation of the existence of a long run relationship, the long run model is estimated.

Table 5.8: Long run coefficients: LogexportsExtended 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

Table 5.8 above shows the long run coefficients of the model. The real effective exchange rate coefficient has a wrong positive sign. The foreign income coefficient has the correct positive sign and it is significant. This implies that foreign income movements influence exports. The domestic total factor productivity, coefficient is significant which implies that an increase in domestic production will increase the amount of exports. We proceed to estimate the error correction model.

Table 5.9: Logexports Extended 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 Eviews 10

The error correction model results are presented on Table 5.9 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. Measuring Growth Rates

As mentioned before the economic growth of Botswana is estimated through the Thirlwall's model. 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:

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

π = 0.864 (Income elasticity of demand for imports)

x = 4.87 (Export growth rate)

Therefore,

$$y = y* = \left(1/0.864\right)4.87 = 5.63$$

The economic growth rate is 5.63 percent. This is relatively close to the given 6.52 percent economic growth. Therefore Botswana's growth rate is explained by the Thirlwall's model.

Furthermore, we calculate the economic growth rate of Botswana using the Extended Thirlwall's model.

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

σ = 0.998037 (Domestic total factor productivity)

ς = -1.524443 (Foreign total factor productivity)

π = 0.997633 (Income elasticity of imports)

εZ = 4.17

C = 3.643563327 (Capacity Variable; 0.0364%)

Therefore in absolute terms,

$$Y = \frac{(0.998037 + (-1.524443))0.0364 + 4.17}{0.997633} = 4.26$$

The result of 4.26 percent calculated economic growth rate is significantly lower than the actual 6.52 percent growth rate. This suggests that inclusive of the total factor productivities makes economic growth rate of Botswana is significantly small when using the extented Thirlwall's model. This is not surprising for the case of Botswana who's economy is dominated by mining sector. The literature (Romero and McCombie, 2016) argue that for an individual country, if two sectors have different productive structures and different compositions of trade, comparing their aggregate productivity is like comparing oranges and computers. However, we can still conclude that the Extended Thirlwall's Law explains Botswana's economic growth rate.

VI. CONCLUSIONS

This paper measures Botswana's economic growth using Thirlwall's and the extended Thirlwall's models for the period of 1980-2016. The Autoregressive Distributed Lag (ARDL) Bounds Testing method was used to estimate the price and income elasticities. The practical application of the estimated elasticities provides insights about the determinants of the economic growth of Botswana. Using the Thirlwall's model, the calculated growth rate of 5.63% closely coincided with the actual growth rate of 6.52

percent. This suggest that the economic growth rate of Botswana is influenced by the price and income elasticities of exports and imports. The extended Thirlwall's model showed that the calculated growth rate was 4.26% significantly lower than the actual growth rate. This suggested that the productivity factor did not play a significant role in the economic growth of Botswana. However, we can a test that the predicted growth rates through Thirlwall's models closely coincided with the actual growth rates. The foregoing indicate that Thirlwall hypothesis holds in determining Botswana's economic growth rate. This corroborates with the findings of Matsheka in (1998) where Botswana's economic growth rate was calculated using Thirlwall's model. It can therefore be concluded that the Thirlwall's model applies to Botswana's economic growth.

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