An Econometric Approach to Exchange Control Liberalization and Economic Growth: The Case of Botswana

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Abstract

This study assesses the impact of exchange control liberalisation on economic growth in Botswana. In literature it has been very unclear of how the liberalisation of exchange controls impacts economic growth as there has been mixed results. Botswana liberalised its exchange controls in 1999 and to date there has been no empirical study that assesses how their liberalisation has impacted Botswana's growth. This study attempts to fill in the gap. It uses quarterly data from 1981 until 2006. Cointegration and VECM methods are used for estimation. The results show that exchange control liberalisation had no impact on economic growth in Botswana for the period studied. Botswana's government needs to try and develop policies that will promote sectors that spur economic growth. Policies imposed should be in the form which enhance growth such as increasing capital stock and human capital in order to spur economic growth.

Keywords: Exchange control, Liberalisation, economic growth, Botswana.

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1.0 Introduction

In many countries, liberalised exchange control regimes have been done slowly throughout the years. According to Samarasiri (2008) exchange control liberalisation is a vital element of macroeconomic policy. The modern history of exchange controls started as controls on the foreign exchange outflows through the World War II period. This was done so as to try and protect foreign exchange resources of the economies.

Samarasiri (2008) defines exchange controls as the regulations which are forced on payments and receipts amongst the country residents and the residents of foreign countries (non residents) under certain requirements. Since to carry out these payments and receipts involves the exchange of domestic currency with the foreign currencies, the regulations are called exchange controls. In other words exchange controls are the regulations on the price, quantity and market behaviour in the foreign exchange market.

Therefore exchange control liberalisation is the removal or attempt to remove these exchange controls so as to have no regulations on the foreign exchange market. Some countries completely remove controls on the current account as well as the capital account, while others remove only the current account controls. Many countries such as England implemented exchange controls in the late 1940s. Exchange controls were an effort to try and decrease the outflow of the foreign exchange but to increase supply of the foreign exchange. Such regulations were largely on current account transactions as there was full control in the capital account (Samarasiri, 2008).

The reasons why a country would liberalise exchange controls would be to increase international trade and production for international markets. Liberalisation also takes place to assist in the development of technology and because of the failure of the Bretton Woods System of fixed exchange rates amongst major currencies. According to Jefferis (1997) many countries liberalised their exchange controls as economic liberalisation programmes which are usually forced upon by the IMF and World Bank.

The foreign exchange control targets are meant to ensure stability of the exchange rate of the domestic currency. This is done by buying foreign exchange which comes with exports, imports and transactions made internationally. They are also for the purpose of preventing monetary conditions from abroad impacting inflation, domestic interest rates as well as money supply (Yongzhong, 2009).

Some of the benefits of exchange control liberalisation are that: a country would become more attractive to foreign investors. This means more savings that go to the economy as well as the private sector which lead to improved efficiency and economic growth. Due to the inward investment there is also a positive net effect of jobs being created. Any economy which does not liberalise its exchange controls may end up being excluded from international investment flows. A liberalised exchange control may lead to a large amount of foreign exchange flowing out of the country, a decline of tax revenue from foreign exchange reserves as well as the lack of government to independently manage exchange rates and interest rates (Jefferis, 2008).

Jefferis (1997) points out that Botswana has had a liberal exchange control regime for a long time as compared to other Sub Saharan African countries. Botswana has been slowly liberalising its exchange control regime since 1976. However, in 1995 it completely removed its exchange controls in the current account transactions and in 1999 it removed the capital account exchange controls (Bank of Botswana, 2000).

The main objectives of this article are twofold. Firstly, to examine the impact of exchange control liberalisation on Botswana's economic growth. Secondly, to estimate the impact of other supporting variables. i.e. capital stock, labour, human capital and terms of trade on economic growth in Botswana. After the introduction a review of exchange control liberalisation and economic growth in Botswana is presented. Section 3 provides the methodology. Empirical findings and their interpretation as given in section 4. Section 5 presents conclusion and recommendations.

2.0 Overview of Economic Growth and Exchange Control Liberalisation in Botswana

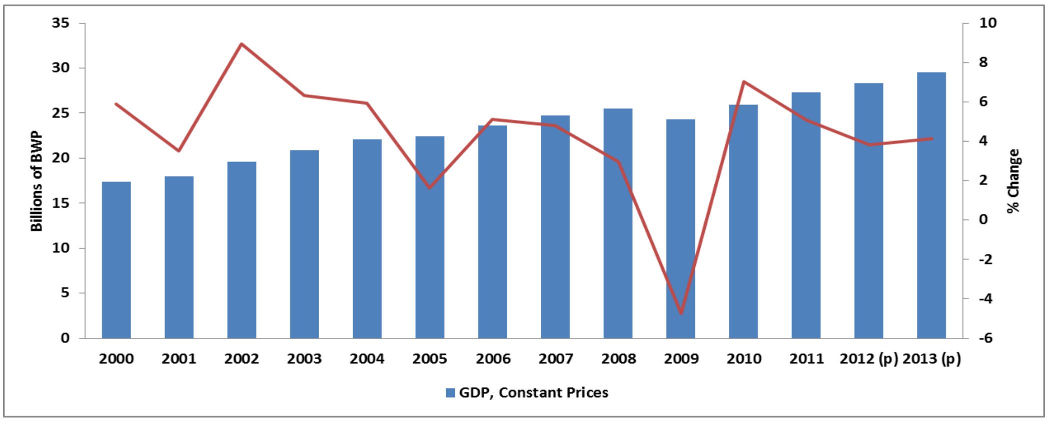
2.1 Economic Growth in Botswana

Botswana's economy has grown rapidly over the past four decades. It has been one of the fastest growing economies in the world. It has experienced constant surpluses on both its balance of payments and its government budget. It also has a stable currency and has build up large foreign exchange reserves. As indicated by African Economic Outlook (2012) Botswana's success has been due to the diamond deposits which have made it one of the largest exporters of diamonds. At independence the country's largest sector and main exporter was beef, it contributed 39% to GDP. After independence up until the 1970s the main source of foreign exchange was international aid which also largely occupied the government budget. Around 1974/75 the mineral sector began to take off, and income and mining sector growth increased at a fast pace.

According to Leith (2000) the growth of Botswana came with a transformation of economic activities. When Botswana gained independence the economic activities were mainly unskilled labour and land intensive, and very little capital was employed. Most goods were produced in the agricultural sector. Over the years the economy has grown and intensively uses more skilled labour and capital for the development of the economy.

However as a result of the financial crisis of 2008/09 the Botswana economy expressed negative growth (-4.9%) in 2009. The growth rate recovered to 7.2% in 2010 and then declined to around 4.8% in 2012 (see Figure 1). The largest share of real GDP growth comes from capital formation which accounts 56% of real GDP growth followed by the external sector (Bank of Botswana, 2012).

Figure 1: GDP growth rate and GDP constant prices[4]



Source: World Bank Data

[4] Line graph is GDP growth rate and bar graph is GDP constant prices)

2.2 Exchange Controls Liberalisation

Botswana started to implement exchange controls in 1976 after the introduction of its own currency. Before this, Botswana adopted exchange controls between the rand monetary area and the rest of the world. Exchange controls have never been used to openly allocate foreign exchange for Botswana. The main belief of the exchange control regime was that foreign currency should be liberally available for current account transactions. However, for capital account transactions there were more restrictions in the form of residents not being able to have savings and bank accounts abroad (Bank of Botswana, 2000). Liberalisation of the exchange controls now allows residents to save and invest abroad.

Some of the ways Botswana liberalised its exchange controls was by the Bank of Botswana giving out most current account transactions to the commercial banks. They handle them as authorised dealers. Residents travel allowances were made more liberal, as well as allowances on some of the service payments. Limits on foreign company's lending and regulations on the use of foreign credit cards were also made more liberal (Phaleng, 1994). Beginning of 1995 all the current account controls were abolished but capital account restrictions did not change. Botswana then completely abolished capital controls in 1999. According to Gabaraane (2003) there has been liberated movement of capital inflows as well as capital outflows since the removal of these restrictions. This then allows domestic households, domestic banks and domestic corporations to borrow and make deposits across the border without any particular limits.

The abolishing of capital controls also allows repatriation of profits by foreign investors. Botswana also offers investment incentives to foreign companies. For example the exemption from VAT and capital gains tax, a discounted corporate tax to attract more foreign investors.

3.0 Methodology and Estimation Procedure

3.1 Theoretical Framework

In modelling the impact of exchange control liberalisation on economic growth in Botswana, this study is in line with the approach by Chatterji *et al* (2013). They specified their model as:

$$lnY_t = lnC_t + \beta_1 lnK_t + \beta_2 lnH_t + \beta_3 lnL_t + \beta_4 lnT_t + \varepsilon_t; \quad (3.1)$$

where Y_t = aggregate production of the economy at time t, K_t = real physical capital stock at time t, L_t = employed labour force at time t, Ht = human capital stock at time t, T_t = trade openness at time t and e_t= error term and β_1= elasticity of production with respect to Kt, β_2= Elasticity of production with respect to human capital, β_3= elasticity of production with respect to labour force participation, β_4=elasticity of production with respect to trade openness. In the model there were four indicators of trade openness (T_t); import penetration ratio, trade share, total taxes on international trade as a percentage of revenues and its restrictions from KOF economic globalisation index. Real GDP is used to measure economic growth. Human capital was proxied by public education expenditures. Physical capital stock was proxied by net fixed capital stock and labour was proxied by the size of the labour force.

3.2 Model Specification

In consideration of the model by Chatterji *et al* (2013) specified above, the model estimated is specified as follows with a few adjustments:

$$ln\, Y_t = \beta_0 + \beta_1\, ln\, K_t + \beta_2\, ln\, L_t + \beta_3 ln H_t + \beta_4 \tau_t + \beta_5 ln\, \mu_t + \varepsilon_t \qquad (3.2)$$

Where;
Y_t= real GDP
K_t= gross fixed capital formation
L_t= total employment
Ht= senior secondary school enrolment
τ_t= dummy variable for exchange control liberalisation
μ_t= terms of trade

The modifications made from the model by Chatterji *et al* (2013) are that a dummy variable for exchange control liberalisation is used. Chatterji *et al* used four indicators to measure trade openness in his study. The variable terms of trade are included in this model which Chatterji *et al* did not include it. According to Greenaway *et al* (2002), Terms of trade has a major impact on economic growth for developing countries. Chatterji *et al* uses public education expenditures to proxy human capital, while this study uses senior secondary school enrolment as a proxy. Chatterji *et al* also used net fixed capital stock to proxy capital stock, while this study used gross fixed capital stock.

3.3 Vector Autoregressive (VAR) Estimation

This study uses a vector error correction model (VECM) in order to measure the impact of exchange control liberalisation on economic growth in Botswana. A VECM is developed from a VAR model. A VAR is a linear model consisting of n-equations and n-variables where every variable is explained by its own lagged values and current and past values of the remaining n-1 variables. If we consider a system with 6 variables; Y_t, K_t, L_t, H_t, τ_t, μ_t, then the VAR consists of 6 equations. A first order VAR is specified as:

$$\begin{aligned}
Y_t &= \beta_{10} + \beta_{11} Y_{t-1} + \beta_{12} K_{t-1} + \beta_{13} L_{t-1} + \beta_{14} H_{t-1} + \beta_{15} \tau_{t-1} + \beta_{16} \mu_{t-1} + \varepsilon_{1t} \\
K_t &= \beta_{20} + \beta_{21} Y_{t-1} + \beta_{22} K_{t-1} + \beta_{23} L_{t-1} + \beta_{24} H_{t-1} + \beta_{25} \tau_{t-1} + \beta_{26} \mu_{t-1} + \varepsilon_{2t} \\
L_t &= \beta_{30} + \beta_{31} Y_{t-1} + \beta_{32} K_{t-1} + \beta_{33} L_{t-1} + \beta_{34} H_{t-1} + \beta_{35} \tau_{t-1} + \beta_{36} \mu_{t-1} + \varepsilon_{3t} \qquad (3.3) \\
H_t &= \beta_{40} + \beta_{41} Y_{t-1} + \beta_{42} K_{t-1} + \beta_{43} L_{t-1} + \beta_{44} H_{t-1} + \beta_{45} \tau_{t-1} + \beta_{46} \mu_{t-1} + \varepsilon_{4t} \\
\tau_t &= \beta_{50} + \beta_{51} Y_{t-1} + \beta_{52} K_{t-1} + \beta_{53} L_{t-1} + \beta_{54} H_{t-1} + \beta_{55} \tau_{t-1} + \beta_{56} \mu_{t-1} + \varepsilon_{5t} \\
\mu_t &= \beta_{60} + \beta_{61} Y_{t-1} + \beta_{62} K_{t-1} + \beta_{63} L_{t-1} + \beta_{64} H_{t-1} + \beta_{65} \tau_{t-1} + \beta_{66} \mu_{t-1} + \varepsilon_{6t}
\end{aligned}$$

It is assumed that all variables are stationary. i.e., have a constant mean and variance, white noise and the means are uncorrelated. The above equations make up a first order VAR model. A general VAR (p) model is presented as:

$$X_t = A_1 X_{t-1} + \cdots + A_p X_{t-p} + \varepsilon_t \qquad (3.4)$$

$$X_t = \sum_{i=1}^{p} A_i X_{t-i} + \varepsilon_t \qquad (3.5)$$

The system can be represented in matrix form as follows:

$$\begin{bmatrix} Y_t \\ K_t \\ L_t \\ H_t \\ \tau_t \\ \mu_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \end{bmatrix} + \begin{pmatrix} A_{11}^1 & \cdots & A_{16}^1 \\ \vdots & \ddots & \vdots \\ A_{61}^1 & \cdots & A_{66}^1 \end{pmatrix} \begin{bmatrix} Y_{t-1} \\ K_{t-1} \\ L_{t-1} \\ H_{t-1} \\ \tau_{t-1} \\ \mu_{t-1} \end{bmatrix} + \cdots + \begin{pmatrix} A_{11}^6 & \cdots & A_{16}^6 \\ \vdots & \ddots & \vdots \\ A_{61}^6 & \cdots & A_{66}^6 \end{pmatrix} \begin{bmatrix} Y_{t-p} \\ K_{t-p} \\ L_{t-p} \\ H_{t-p} \\ \tau_{t-p} \\ \mu_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \qquad (3.6)$$

Ai is a (6*6) matrix of parameters
p is the VAR lag length
ε_t is a column vector (6*1) of random stochastic values

An element that is very critical in the specification of a VAR model is determining the lag length. If a higher order lag length than the true lag length is selected this will lead to an increase in the mean square forecast errors of the VAR. Fitting a lower lag length than the true lag length often generates auto-correlated errors (Gujarati and Porter, 2009).

In order to determine the optimal lag length you allow a different lag length for each equation at each time. This study adopts the Aikaike's Information Criterion (AIC) and Schwarz-Bayesian Information Criterion (SBC). These are the frequently used methods for estimating the optimal lag length for a VAR model. In the VAR context we can specify the AIC and SBC as follows:

$$AIC\ (p) = n ln(\hat{\sigma}^2) + 2p$$
$$SBC(p) = n ln(\hat{\sigma}^2) + \frac{p}{n}\ln(n)$$

where:

$$\hat{\sigma}^2 = (n-p-1)^2 \sum_{t=1}^{n} \varepsilon_t^2$$

Where:
n= sample size
p= lag length
ε_t=residuals

3.4 Vector Error Correction Model (VECM)

A distinctive benefit of the VECM is that each variable in the system is treated as if it is endogenous. It relates each variable to its own past values as well as the other variables past values. From the general VAR equation specified above in (4.4), we obtain the error correction model by subtracting X_{t-1} on both sides and rearrange the equation to obtain:

$$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + \Gamma_{k-1} \Delta X_{t-(p-1)} + \varepsilon_t \qquad (3.7)$$

$$\Delta X_t = \Pi X_{t-1} + \textstyle\sum_{j=1}^{p-1} \Gamma_j X_{t-j} + \varepsilon_t \qquad (3.8)$$

In matrix form our system becomes:

$$\begin{bmatrix} \Delta Y_t \\ \Delta K_t \\ \Delta L_t \\ \Delta H_t \\ \Delta \tau_t \\ \Delta \mu_t \end{bmatrix} = \Pi \begin{bmatrix} Y_{t-1} \\ K_{t-1} \\ L_{t-1} \\ H_{t-1} \\ \tau_{t-1} \\ \mu_{t-1} \end{bmatrix} + \Gamma_1 \begin{bmatrix} \Delta Y_{t-1} \\ \Delta K_{t-1} \\ \Delta L_{t-1} \\ \Delta H_{t-1} \\ \Delta \tau_{t-1} \\ \Delta \mu_{t-1} \end{bmatrix} + \Gamma_2 \begin{bmatrix} \Delta Y_{t-2} \\ \Delta K_{t-2} \\ \Delta L_{t-2} \\ \Delta H_{t-2} \\ \Delta \tau_{t-2} \\ \Delta \mu_{t-2} \end{bmatrix} + \cdots + \Gamma_{p-1} \begin{bmatrix} \Delta Y_{t-(p-1)} \\ \Delta K_{t-(p-1)} \\ \Delta L_{t-(p-1)} \\ \Delta H_{t-(p-1)} \\ \Delta \tau_{t-(p-1)} \\ \Delta \mu_{t-(p-1)} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \end{bmatrix} \qquad (3.9)$$

Where
Δ-is the first difference operator

$$\Pi = -(I - \Gamma_1 - \cdots - \Gamma_p) = -\Gamma(1)$$
$$\Gamma_j = -(\Gamma_{i+1} + \cdots + \Gamma_p) \qquad \text{where i=1,...,p-1}$$

Π and Γ are (n*n) coefficient matrices. Π informs us on the long run relationship between X_t variables. The rank of Π is given by the number of linearly independent combinations of the variables. To obtain this rank the trace(Tr) or the maximum eigen value (λ_{max}) statistics.

3.5 Unit Root Test

Since this study is using time series data it is necessary to check if the variables are stationary using an autoregressive model. This is done in order to avoid a spurious regression which may give us unreliable results. To avoid a spurious regression we start by testing the order of integration using the Augmented Dickey Fuller (ADF) test and Phillips Perron tests. The ADF test is an amendment of the Dickey Fuller test. It augments the DF equation by lagging values of the dependent variable, which is done to certify that that the error procedure in the estimating equation is residually uncorrelated (Gujarati and Porter, 2009). The Phillips Perron is done to validate the results of the ADF test. However the PP test is used in preference to the ADF test for this study. The reason for this is because the test does not need the homoscedasticity assumption in the error term (Phillips, 1987) and it automatically corrects for autoregressive homoscedasticity and serial correlation in the error term (Phillips and Perron, 1988).

3.6 Cointegration Analysis

To test if a long run relationship exists between the variables we use the Johansen (1988) and Johansen and Juselius (1990). This test is viewed as the most efficient as it is able to spot the number of cointegrating vectors amongst those variables that were non stationary at levels. Cointegration provides means of describing time series data into two sections. The long run equilibrium features (cointegrating vector) as well as the short run disequilibrium dynamics.

The Johansen maximum likelihood procedure is the best approach to estimate when there are more than one cointegrating vectors or variables. The eigen value statistics assesses the hypothesis that there exists r cointegrating vectors. Then the trace statistic assesses the hypothesis that the number of cointegrating vectors are less than or equal to r.

3.7 Impulse Response Function

Impulse responses function is a necessary instrument in empirical causal analysis and policy effectiveness analysis. Impulse response functions measure the effects of shocks or impulses on the future values of a variable. It traces the effect of a one standard deviation shock to one of the innovations or error terms on current and future values on the endogenous variables (Gujarati and Porter, 2009).

3.8 Variance Decomposition

The variance decomposition helps in interpreting the VAR model. The variance decomposition specifies how much information each variable contributes to the other variables in the autoregression.

3.9 Data Sources

This study uses secondary quarterly data from 1981 q1 to 2006 q4. Data sources for this study include Statistics Botswana and Bank of Botswana and World Bank. Due to unavailability of quarterly data for variables used in this study Al-Turki (1995) method is used to transform the available annual data into quarterly data. The essential equations used are:

$$Q_1 = -0.0391Y_{t+1} + 0.2344Y_t + 0.0547Y_{t-1} \tag{3.10}$$

$$Q_2 = -0.0234Y_{t+1} + 0.2656Y_t + 0.0078Y_{t-1} \tag{3.11}$$

$$Q_3 = -0.0078Y_{t+1} + 0.2656Y_t - 0.0234Y_{t-1} \tag{3.12}$$

$$Q_4 = -0.0547Y_{t+1} + 0.2344Y_t + 0.0391Y_{t-1} \tag{3.13}$$

4.0 Empirical Findings

4.1 Descriptive Statistics

Table 4.1 presents the descriptive statistics of the variables included in the model. The values of skewness and kurtosis show the normality test. For a variable to be normally distributed the value for skewness must be equal to zero and the kurtosis should be equal to 3. The Jarque-Bera (JB) normality test for normality is the one that computes the skewness and kurtosis measures of the OLS residuals. If the p-value of the JB statistic is greater than 0.05 we reject the hypothesis at 5% level of significance that the residuals are normally distributed. The Table above shows the results of the normality test for the variables which are; real GDP (LGDP), gross fixed capital formation (LGFCF), secondary school enrolment (LSEC), terms of trade (LTOT), total employment (LTOTEMP) and exchange control liberalisation (DLIB).

Table 4.1: Descriptive Statistics

	LGDP	LGFCF	LSEC	LTOT	LTOTEMP	DLIB
Mean	22.67206	21.34893	9.819261	-1.215539	10.80418	0.307692
Median	22.75458	21.48125	9.975337	-1.225860	10.95548	0.000000
Maximum	23.45087	22.13865	10.63187	-0.593097	11.22306	1.000000
Minimum	21.56963	20.36239	8.500998	-2.111428	10.04705	0.000000
Std. Dev.	0.545067	0.520313	0.718207	0.329945	0.362925	0.463774
Skewness	-0.461962	-0.551035	-0.452609	-0.427682	-0.740689	0.833333
Kurtosis	1.953193	2.065483	1.775589	3.271740	2.110461	1.694444
Jarque-Bera	8.447574	9.047486	10.04727	3.490461	12.93830	19.42310
Probability	0.014643	0.010848	0.006581	0.174605	0.001551	0.000061

From the Table we observe that at 5% level of significance all the variables are significant except for terms of trade. Therefore we conclude that the data for real GDP, gross fixed capital formation, secondary school enrolment, total employment and exchange control liberalisation follow a normal distribution and are normally distributed. However terms of trade does not follow a normal distribution as its p-value is greater than 0.05.

4.2 Unit Root Test

We have to determine stationarity properties of the relevant variables before we can run the cointegration test. The Phillips Perron (PP) test is used to examine if the variables have a unit root. The null hypothesis is that the variable under investigation has a unit root, against the alternative that the variable doesn't have a unit root. Table 4.2 shows the results for the unit root test where we have a constant only. Table 4.3 shows the results of the unit root test where we have a constant and a trend.

Table 4.2: Results for Unit Root Test with Constant

Variables	Unit Roots		I(D)
	PP test statistic		
With constant	Levels	1st difference	
LGDP	-3.006218	-13.75427	I(1)
LGFCF	-0.853496	-12.80537	I(1)
LTOT	-2.567115	-5.449499	I(1)
LSEC	-2.616871	-5.215704	I(1)
LTOTEMP	-2.595865	-5.108549	I(1)
DLIB	-0.654325	-10.09951	I(1)

All variables are evaluated at 1% significance level which is -3.498 for the PP with constant only

Table 4.3: Results for Unit Root with Constant and Trend

Variables	Unit Root		I(D)
	PP test statistic		
With constant and trend	Levels	1st Difference	
LGDP	-1.680073	-15.13726	I(1)
LGFCF	-2.015769	-12.75536	I(1)
LTOT	-2.365997	-5.993879	I(1)
LSEC	1.375588	-4.815373	I(1)
LTOTEMP	-1.025618	-5.014461	I(1)
DLIB	-1.994773	-10.09336	I(1)

All variables are evaluated at 1% significance level which is -4.052 for the PP with constant and trend

From the results presented in both Table 4.2 and Table 4.3 we can conclude that all the variables were found to be non-stationary at 1% level of significance i.e. we don't reject the null hypothesis. All variables are therefore stationary at first difference which means they are integrated of order one I(1). We can therefore proceed with the Johansens co-integration test as all the variables are integrated of the first order.

4.3 Johansen- Juselius Cointegration Test

Since all the variables are integrated of order one this allows us to use the Johansen Juselius cointegration test. This is to determine whether a long run relationship exists between the dependent variable (Real GDP) and the independent variables (Gross fixed capital formation, secondary school enrolment, total employment, terms of trade, exchange control liberalisation).

We start by first determining the optimal lag length which should be small enough to allow estimation. It must also be large enough to make sure that the errors are almost white noise. Five lag selection criteria are used which are Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan-Quinn information criterion (HQ), Final prediction error (FPE) and Likelihood Ratio (LR). Table 4.4 below presents the results.

Table 4.4: Optimal Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	198.5743	NA	8.56e-10	-3.851486	-3.695176	-3.788224
1	1066.915	1615.115	5.05e-17	-20.49831	-19.40414*	-20.05548
2	1127.668	105.7095	3.10e-17*	-20.99336*	-18.96133	-20.17096*
3	1151.194	38.11129	4.06e-17	-20.74387	-17.77398	-19.54190
4	1188.645	56.17752*	4.09e-17	-20.77290	-16.86515	-19.19137

* indicates lag order selected by the criterion

Three of the five selection criteria have chosen the optimal lag length to be two lags namely AIC, FPE and HQ. SIC has chosen the optimal lag length to be one and LR has chosen it to be four. Therefore we consider our optimal lag length to be two lags and it is used to test for cointegration.

The Johansen cointegration test looks at the trace statistic and the maximum eigenvalue statistic to decide the rank of the cointegrating vectors. We reject the null hypothesis of no cointegration when the trace statistic and the maximum eigenvalue statistic are greater than the critical value. However we fail to reject the null hypothesis if they are less than the critical value.

Table 4.5: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.373235	129.5408	95.75366	0.0000
At most 1 *	0.297640	82.35530	69.81889	0.0036
At most 2	0.205119	46.67111	47.85613	0.0643
At most 3	0.127902	23.48529	29.79707	0.2231
At most 4	0.056289	9.663110	15.49471	0.3076
At most 5	0.037036	3.811656	3.841466	0.0509
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 4.6: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.373235	47.18551	40.07757	0.0067
At most 1 *	0.297640	35.68419	33.87687	0.0301
At most 2	0.205119	23.18582	27.58434	0.1657
At most 3	0.127902	13.82218	21.13162	0.3798
At most 4	0.056289	5.851454	14.26460	0.6324
At most 5	0.037036	3.811656	3.841466	0.0509
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 4.5 shows that at 5% level of significance we reject the null hypothesis of no co-integrating equations for the trace test. It indicates that there are atleast two co-integrating equations at 5% level of significance. It implies that a long run relationship exists between the variables. The maximum eigen value statistic also indicates that there are at least two co-integrating vectors between the variables in the model shown by Table 4.6. Therefore we can conclude that there is a long run relationship between real GDP, gross fixed capital formation, secondary school enrolment, total employment and exchange control liberalisation.

4.4 Normalized Cointegrating Vector

Table 4.7: Normalized Cointegrating Vector Coefficients

	LGDP	LGFCF	LSEC	LTOT	LTOTEMP	DLIB
LGDP	1.000000	-0.283334	-0.896780	0.198141	0.508178	-0.006814
LGFCF	0.00732	1.000000	0.71116	0.02117	-2.58811	-0.53066
LSEC	-0.73398	0.92742	1.000000	1.1396	-2.055533	0.02896
LTOT	-6.07169	1.37762	0.92059	1.000000	4.029245	0.45074
LTOTEMP	-0.20974	-0.203873	0.02767	-0.00653	1.000000	-0.30513
DLIB	-13.6771	-11.9828	11.3612	1.58398	10.6384	1.000000

The normalised equations are obtained by normalising a specific variable, where we set the estimated coefficient to -1 and then we divide the cointegrating vector by the negative of the coefficient. If we have a cointegrating relationship this means that in the long run there is a relationship between GDP, gross fixed capital formation, secondary school enrolment, total employment, terms of trade and exchange control liberalisation. We can write the cointegrating vector coefficients in Table 4.7 as a long run function for real gross domestic product as follows:

$$\ln GDP_t = 0.283\ln GFCF_t + 0.897\ln SEC_t - 0.198\ln TOT_t - 0.508\ln TOTEMP_t + 0.007\ln DLIB_t \quad (4.1)$$

Equation 4.1 above shows whether the independent variables in the model contribute negatively or positively towards real GDP. We have the expected signs for gross fixed capital formation, secondary school enrolment and exchange control liberalisation which show a positive sign. Exchange control liberalisation has a positive effect on economic growth in the long run. We have a negative sign for terms of trade and total employment which were not expected. The result of an unexpected (negative sign) in terms of trade may be due to the fact that our terms of trade was defined as the ratio of value of exports over value of imports. We can write the cointegrating vector coefficients in Table 4.7 as a long run function for gross fixed capital formation as follows:

$$\ln GFCF_t = -0.007 \ln GDP_t - 0.711 \ln SEC_t - 0.021 \ln TOT_t + 2.588 \ln TOTEMP_t + 0.531 \ln DLIB_t \tag{4.2}$$

In equation 4.2 we observe that the signs are positive (expected) for only total employment and exchange control liberalisation. We have a negative sign for real GDP, secondary school enrolment and total employment. However our expectation looking at Botswana economy is that an increase in real GDP, secondary school enrolment, terms of trade, total employment and exchange control liberation will lead to an increase the capital formed in the country.

We can write the cointegrating vector coefficients in Table 4.7 as a long run function for secondary school enrolment as follows:

$$\ln SEC_t = 0.734 \ln GDP_t - 0.927 \ln GFCF_t - 1.139 \ln TOT_t + 2.056 \ln TOTEMP_t - 0.289 \ln DLIB_t \tag{4.3}$$

Equation 4.3 shows an expected (positive) sign for real GDP and total employment while the other variables have a negative unexpected sign. This means that an increase in real GDP and total employment will lead to an increase in enrolment of secondary school students. However an increase in capital stock, terms of trade and exchange controls would lead to a decline in the number of students enrolling in secondary schools. We can write the cointegrating vector coefficients in Table 4.7 as a long run function for terms of trade as follows:

$$\ln TOT_t = 6.072 \ln GDP_t + 1.378 \ln GFCF_t - 0.921 \ln SEC_t - 4.029 \ln TOTEMP_t - 0.451 \ln DLIB_t \tag{4.4}$$

In equation 4.4 the expected signs which are positive are real GDP and gross fixed capital formation. However we have a negative unexpected sign for secondary school enrolment, total employment and exchange control liberalisation. We can write the cointegrating vector coefficients in Table 4.7 as a long run function for total employment as follows:

$$\ln TOTEMP_t = 0.209 \ln GDP_t + 0.204 \ln GFCF_t - 0.028 \ln SEC_t + 0.0061 \ln TOT_t + 0.305 \ln DLIB_t \tag{4.5}$$

In equation 4.5 we observe that the signs are positive for all variables except secondary school enrolment. This is what we expected for total employment. We expect that if we increase real GDP, gross fixed capital formation, terms of trade and exchange control liberation this will increase the employment in the country. However secondary school enrolment has a negative sign. This may be because as you increase the number of enrolment in secondary schools this does not increase the total employment in Botswana. This equation conforms to the economic theory for Botswana. We can write the cointegrating vector coefficients in Table 4.7 as a long run function for exchange control liberalisation as follows:

$$\ln DLIB_t = 13.677 \ln GDP_t + 11.983 \ln GFCF_t - 11.361 \ln SEC_t - 1.584 \ln TOT_t - 10.638 \ln TOTEMP_t \tag{4.6}$$

In equation 4.6 above we observe that for the years when exchange controls were liberalised real GDP and gross fixed capital formation have a positive and expected sign. We also observe a negative (unexpected) sign for secondary school enrolment, total employment and terms of trade.

Equation 4.5 is the equation that follows economic theory. All the explanatory variables in this equation have a positive sign except for secondary school enrolment.

4.5 Vector Error Correction Model (VECM)

In table 4.8 the results for the vector error correction model are presented:

Table 4.8: VECM results for Real GDP

	Equation 1 Δ(LGDP)	Equation 2 Δ(LGFCF)	Equation 3 Δ(LSEC)	Equation 4 Δ(LTOT)	Equation 5 Δ(LTOTEMP)	Equation 6 Δ(DLIB)
Δ(LGDP(-1))	-0.360550 [-3.21237]	-0.321290 [-1.86512]	-0.025444 [-0.55124]	0.772628 [3.68892]	-0.004740 [-0.12580]	0.174396 [0.62548]
Δ(LGDP(-2))	-0.444021 [-3.91166]	-0.314464 [-1.80500]	-0.004684 [-0.10034]	0.421217 [1.98852]	-0.004020 [-0.10549]	-0.041013 [-0.14545]
Δ(LGFCF(-1))	-0.031661 [-0.48907]	-0.337311 [-3.39494]	-0.009267 [-0.34809]	-0.039621 [-0.32798]	0.010669 [0.49088]	0.009915 [0.06166]
Δ(LGFCF(-2))	-0.026067 [-0.40135]	0.049591 [0.49749]	-0.035493 [-1.32884]	-0.031224 [-0.25763]	0.012421 [0.56963]	0.240452 [1.49033]
Δ(LSEC(-1))	-0.101137 [-0.40380]	-0.119476 [-0.31080]	0.493069 [4.78695]	0.444759 [0.95158]	0.030978 [0.36839]	-0.092286 [-0.14832]
Δ(LSEC(-2))	-0.039678 [-0.15731]	0.349941 [0.90400]	0.210168 [2.02624]	0.120387 [0.25578]	0.082281 [0.97169]	-0.019587 [-0.03126]
Δ(LTOT(-1))	0.051178 [0.91570]	-0.113125 [-1.31880]	-0.014209 [-0.61820]	0.413046 [3.96039]	-0.008915 [-0.47513]	0.026374 [0.18996]
Δ(LTOT(-2))	-0.072624 [-1.25447]	-0.037219 [-0.41889]	-0.042234 [-1.77393]	0.104864 [0.97068]	-0.007734 [-0.39792]	0.097591 [0.67859]
Δ(LTOTEMP(-1))	0.074768 [0.23157]	0.557885 [1.12581]	-0.019897 [-0.14985]	-0.208882 [-0.34669]	0.506245 [4.67019]	0.239738 [0.29890]
Δ(LTOTEMP(-2))	0.243215 [0.77367]	-0.187449 [-0.38850]	-0.020458 [-0.15825]	0.086742 [0.14786]	0.098773 [0.93584]	-0.229916 [-0.29441]
Δ(DLIB(-1))	0.010202 [0.23331]	0.065403 [0.97453]	0.012248 [0.68110]	-0.009746 [-0.11943]	-0.005233 [-0.35644]	-0.028002 [-0.25779]
Δ(DLIB(-2))	0.032963 [0.75457]	0.195306 [2.91295]	0.007174 [0.39935]	-0.023665 [-0.29030]	0.000630 [0.04298]	-0.016183 [-0.14912]
C	0.032458 [4.35585]	0.021037 [1.83947]	0.008113 [2.64743]	-0.025722 [-1.84982]	0.001714 [0.68492]	0.005192 [0.28049]
ECT	0.0775 [1.3640]	0.3483 [3.9941]	0.0876 [3.7474]	-0.3189 [-3.0084]	-0.0017 [-0.0900]	-0.2269 [-1.6078]
R-squared	0.208727	0.313211	0.493075	0.343660	0.408581	0.058616
Adj. R-squared	0.090491	0.210587	0.417328	0.245586	0.320208	-0.082051
Sum sq. resids	0.151038	0.355787	0.025544	0.525957	0.017025	0.932064
S.E. equation	0.041666	0.063949	0.017135	0.077753	0.013989	0.103505
F-statistic	1.765342	3.052029	6.509461	3.504092	4.623363	0.416698
Log likelihood	185.2072	141.9386	274.9520	122.1988	295.4414	93.30367
Akaike AIC	-3.390241	-2.533438	-5.167366	-2.142551	-5.573098	-1.570370
Schwarz SC	-3.027749	-2.170946	-4.804874	-1.780059	-5.210606	-1.207878

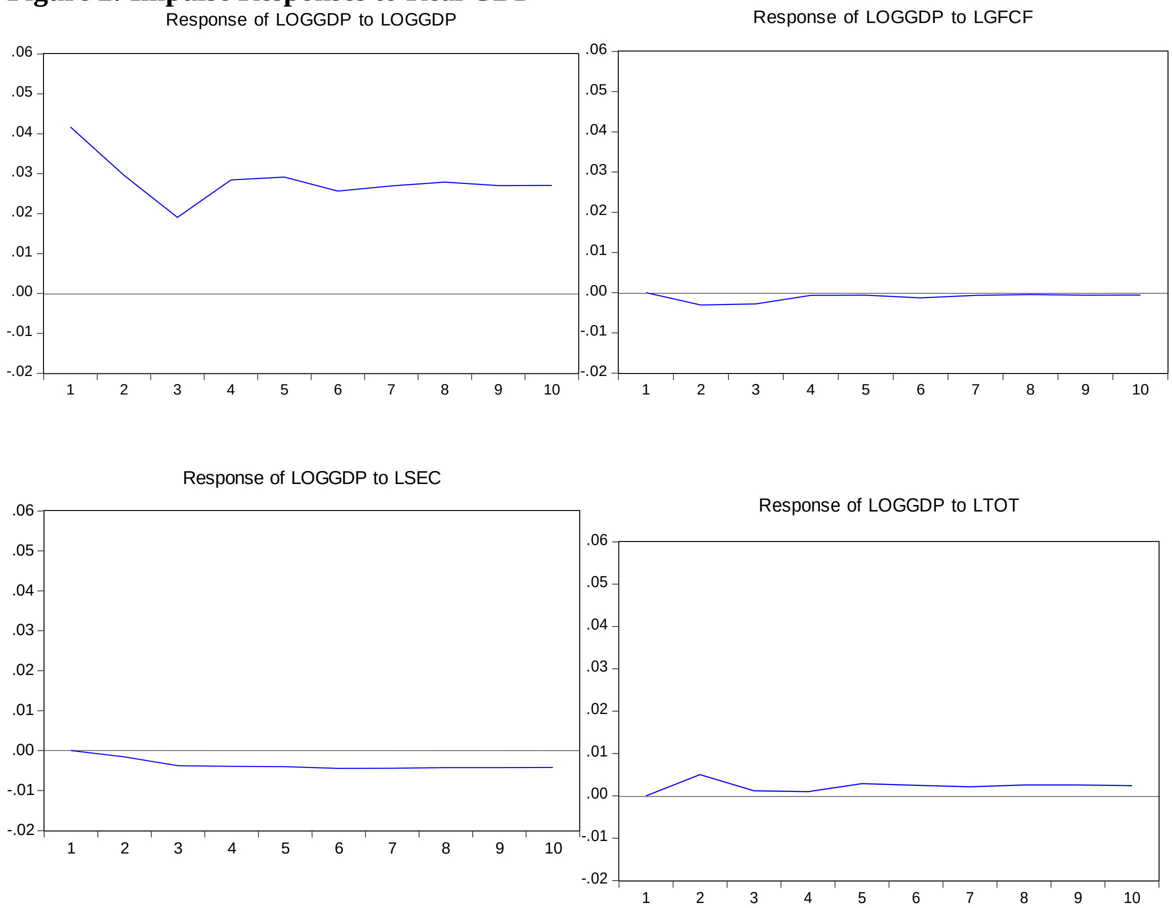
Equation 1 in Table 4.8 does not follow the error correction model as the ECT is not negative. The error correction term for terms of trade is the only one that is negative and statistically significant. This means that about 32% of the adjustment in terms of trade towards long run equilibrium takes place per quarter. The ECT for total employment and exchange control liberalisation have the correct (negative) signs but are statistically insignificant. Gross fixed capital formation and secondary school enrolments coefficients for ECT are significant but have the wrong (positive) sign.

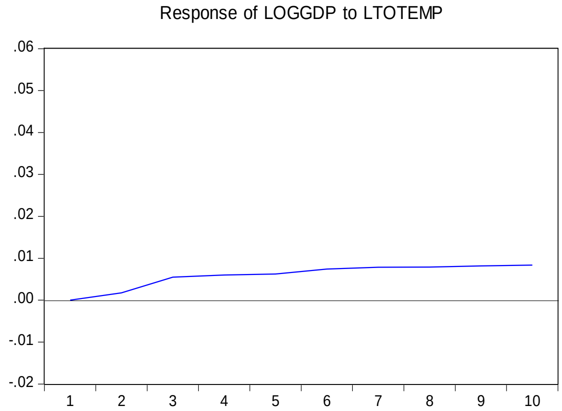
According to the dynamics of the real GDP equation (equation 1 in Table 4.8), only real GDP (for first and second lag) has a short run effect on itself in Botswana. Therefore in the short run gross fixed capital formation, secondary school enrolment, total employment, terms of trade and exchange control liberalisation do not have a significant effect on real GDP in Botswana.

4.6 Impulse Response Functions

Impulse response function analysis is used in the empirical literature to discover the dynamic relationship amongst the macroeconomic variables. An impulse response looks at how shocks in the economy affect the variables in the model.

Figure 2: Impulse Responses to Real GDP





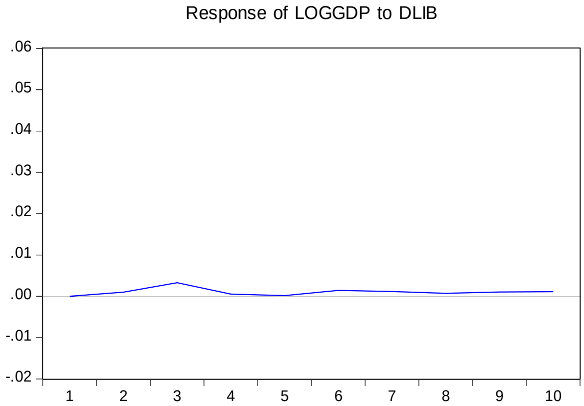


Figure.2 presents how one standard deviation impulse response in all variables affects the dependent variable. The first graph shows how a shock in real GDP affects itself. It shows that there is a decline from the first period to the third period then there is an incline from the third to the fourth period then there's a slight fluctuation till the last period. A shock on gross fixed capital formation leads to a negative marginal impact for the first three periods then there is a constant impact on real GDP till the last period. A shock on secondary school enrolment has a negative impact for the first two periods then a constant shock until the last period. A shock to terms of trade shows that for the first period there's an incline then the next period there's a decline then it's a constant impact till the last period. A shock on total employment has an incline in real GDP for the first two periods then a there will be a constant shock till the last period. A shock in exchange control liberalisation seems to have a marginal incline in the second period then the third period there is a marginal decline, from there we see no significant impact.

4.7 Variance Decomposition

Table 4.9: Variance Decomposition of Real GDP:

Period	S.E.	LGDP	LGFCF	LSEC	LTOT	LTOTEMP	DLIB
1	0.041666	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.051520	98.45317	0.354141	0.093771	0.946858	0.116148	0.035909
3	0.055511	96.56585	0.560427	0.543458	0.862469	1.084592	0.383200
4	0.062793	95.96470	0.449398	0.818496	0.699359	1.761135	0.306909
5	0.069682	95.41473	0.373277	0.992984	0.741303	2.227987	0.249722
6	0.074812	94.51033	0.353092	1.214454	0.753581	2.915129	0.253410
7	0.080067	93.84525	0.315182	1.364096	0.730541	3.503117	0.241817
8	0.085297	93.36714	0.280635	1.452256	0.734795	3.944848	0.220324
9	0.089997	92.88972	0.257075	1.528768	0.741866	4.371005	0.211563
10	0.094482	92.48053	0.237158	1.586842	0.737678	4.752028	0.205763

The variance decomposition determines the amount that the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. Therefore it evaluates the degree that real GDP is affected by gross fixed capital formation, secondary school enrolment, terms of trade, total employment and exchange control liberalisation in VECM.

The variance decomposition of real GDP is presented above in Table 4.9. The results show that the variation in real GDP is explained by 7.52% by the variables in the model. Where gross fixed capital formation explains 0.237% and secondary school enrolment explains 1.58%. Terms of trade accounts for 0.73% and total employment accounts for 4.75%. Exchange control liberalization accounts for the least in real GDP by 0.2%.

Due to the results not showing what we expected the non-mining GDP was tested as the dependent variable and all the results are in the appendix. However the results are not different from when real GDP is the dependent variable, exchange control liberalisation still has no impact on economic growth. Botswana's exchange controls were found to be important in the early years after the pula was introduced in 1976, however the controls fell away (Phaleng consultancies 1994). Botswana has sound economic management and a strong currency and has had a very high level of foreign exchange reserves so the removal of these controls made no difference as they were never strict.

We observe that from our long run cointegration equation (4.1) gross fixed capital formation and secondary school enrolment have a positive impact on real GDP. Terms of trade and total employment have a negative impact on real GDP. This means in the long run we expect capital stock and human capital to increase Botswana's growth, while labour and term of trade decrease growth in the long run. Botswana has an open economy and is heavily reliant on export earnings from diamonds. Therefore if there are fluctuations in terms of trade this may have a negative effect on economic growth. Botswana has had a volatile terms of trade. This may be the reason why our results show a negative effect on economic growth. Labour also has a negative effect on economic growth in the long run which is due to the high unemployment rate of around 20% in the 1990's (Siphambe, 2007).

Gross fixed capital formation and Secondary school enrolment seem to have a positive effect on economic growth in the long run. Capital stock and human capital are known to increase economic growth. Botswana's capital stock has been mainly due to the mineral sector and the mineral sector accounts for more than a third of GDP (African Economic Outlook, 2012). Countries with great increases in stock of capital usually have large growths in GDP. Botswana had a 20-fold increase in capital stock between 1965 and 1990 and this lead to large increases in its GDP (African Economic Outlook, 2012). The more enrolment there is in secondary schools shows that we have a more educated nation which we expect to increase employment and therefore lead to growth in GDP.

5.0 Concluding Remarks and Recommendations

5.1 Summary and Conclusions

This study investigated the impact of exchange control liberalisation on economic growth in Botswana. Quarterly data for the variables real GDP, gross fixed capital formation, secondary school enrolment, terms of trade, total employment and exchange control liberalisation was used to carry out the analysis for this study. The period used was 1981 Q1 to 2006 Q4.

To establish the impact that exchange control liberalisation has on economic growth in Botswana cointegration and vector error correction methods were used. A growth model is employed and the dependent variable is economic growth which is proxied by real GDP. Capital stock is proxied by gross fixed capital formation. Labour is proxied by total employment and Human capital is proxied by secondary school enrolment. In the model terms of trade was included as well which is said to have a major impact on economic growth in developing countries. The last and most important variable is exchange control liberalisation which is in the form of a dummy variable.

To start our econometric analysis we use the PP unit root test. The result show that all our variables are non-stationary at levels and only become stationary at first difference (integrated of order one). We then proceeded to the Johansen and Juselius cointegration test to analyse whether a long run relationship exists between the variables in the model. The cointegration results suggest that a long run relationship exists between real GDP and the explanatory variables in the model. The long run cointegrating equation suggests that gross fixed capital formation and secondary school enrolment have a positive impact on real GDP which is what we expected. Terms of trade and total employment have a negative impact on real GDP which was not expected. The results from the vector error correction model do not help us to say much about the speed of adjustment that takes place in the long run equilibrium.

The first objective of this study was to examine the impact of exchange control liberalisation on economic growth for Botswana. The VECM tells us that the first and second lagged values of real GDP are the only values that are significant in influencing real GDP. This means exchange control liberalisation has no impact on economic growth. This implies that real GDP in the current year is influenced only by real GDP in the past years. We can also observe that from the IRF a shock in exchange control liberalisation seems to have a marginal effect in the second period. However it generally has no impact on real GDP. The variance decomposition also shows that the variation in real GDP is largely due to itself as it ranges between 92% and 100% among the different periods. However exchange control liberalisation contributes the least to real GDP by 0.2%.

The second objective was to determine how the other supporting variables; namely gross fixed capital formation, secondary school enrolment, terms of trade and total employment; impact economic growth in Botswana. We observe that from our long run cointegration equation (4.1) gross fixed capital formation and secondary school enrolment have a positive impact on real GDP. Terms of trade and total employment and have a negative impact on real GDP. This means in the long run we expect capital stock and human capital to increase Botswana’s growth, while labour and term of trade decrease growth in the long run. The VECM results show that none of the supporting variables has a short run effect on real GDP. However the lags of real GDP have an effect on itself. The IRF shows that a shock in total employment and terms of trade affects real GDP positively while a shock in secondary school employment and gross fixed capital formation has a negative effect. The variance decomposition test shows that from the supporting variables total employment seems to contribute the most to real GDP with 4.75% followed by secondary school employment with 1.58%.

5.2 Policy Implications and Recommendations

Results show that only the previous periods of real GDP contribute to the current real GDP. Exchange control liberalisation has had no impact on economic growth for Botswana. Therefore government should try and develop and promote sectors that can spur economic growth. Results show that economic growth in previous periods affects growth in the current period. Policies imposed should be in the form of increasing capital stock and human capital in order to spur economic growth.

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