

Original Paper

The Impact of Rand/Pula Exchange Rate Volatility on Botswana's Economic Growth

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Abstract

This paper undertakes an investigation of the impact of the Rand/Pula exchange rate volatility on Botswana's economic growth. The paper is using annual time series data, from 1977 to 2018. The Generalized Method of Moment (GMM) is employed to evaluate the impact of the real exchange rate volatility on Botswana's economic growth. The GARCH model results found the Pula/Rand exchange rate to be volatile. The Rand/Pula exchange rate volatility does not have an impact on Botswana's economic growth. This finding mirrors those of Kaur et al. (2019) and Musyoki et al. (2012). They found negative but insignificant impact of exchange rate volatility on economic growth in Malaysia and Kenya, respectively. Our empirical findings suggest that Botswana's economic growth is largely explained by trade openness and growth of labour force and not influenced by the Rand/Pula exchange rate volatility.

Keywords

exchange rate, exchange rate volatility, GARCH model, economic growth

1. Introduction

This paper investigates the impact of Rand/Pula exchange rate volatility on Botswana's economic growth. The Pula and the Rand are Botswana's and South Africa's currencies respectively. Exchange rates are described as the cost of foreign currency per unit of domestic currency or domestic currency per unit of foreign currency. Exchange rates allow us to express the cost or price of a good or service in a common currency (Edwards, 1988; Krugman & Obstfeld, 2000). Exchange rates are used as a form of decision rule between the domestic country and the international economy. Hence, exchange rates are key influencers of the direction of a nation's economic growth. Exchange rates are therefore in turn

of critical importance in determining macroeconomic stability and act as an incentive to engage in trade (Williamson, 2009).

Most nations adopt the fixed exchange rate, as it guards against inflation. Fixed exchange rate is a regime whereby the exchange rate is pegged to a major currency or a basket of currencies (Yagci, 2001). On the other hand, a floating exchange rate is one in which the value of the currency in terms of another is determined by the demand and supply in the foreign exchange market. A floating exchange rate does not, however, imply that the authorities are not engaged on controlling the level of the exchange rate. On the contrary, the authorities employ domestic policy instruments, such as interest rates, to realise their objective with respect to the exchange rate and economic growth (Masalila & Motshidisi, 2003).

In May 2005, Botswana adopted the crawling peg exchange rate mechanism (Bank of Botswana, 2006). The “crawling peg” exchange rate system, allows the foreign exchange rate to vary but only on the basis of a predetermined formula by sale and purchase of international reserves (McKenzie, 1983). The use of a currency basket in place of a peg to a single currency, normally tends to stabilize a country’s effective exchange rate. The Pula is currently pegged to a basket of currencies consisting of the South African Rand and the Special Drawing Rights (SDR). The Special Drawing Rights is an international reserve asset. It was created by the International Monetary Fund (IMF) in 1969 to supplement its member countries’ official reserves (Hoguet & Tadesse, 2011). The value of the SDR is based on a basket of major currencies which consist of the U.S. dollar, Euro, Japanese yen, Pound sterling and Chinese yuan. The Pula basket weights are proportioned at 45 percent Rand and 55 percent SDR (Bank of Botswana, 2018). The Pula is pegged to Botswana’s major trading partners’ currencies. The appreciation or depreciation of the Pula will then fluctuate relative to the changes in these currencies (Taye, 2012, Bank of Botswana, 2017, Ntwaepelo & Motsomi, 2019).

The South African Rand is one of the most volatile currencies in the world (Fowkes et al., 2016; Oseifuah & Korkpoe, 2018). Since 1996, there has been five incidences of substantial real exchange rate depreciation, which were followed by a steep appreciation thereafter (Nemushungwa et al., 2013). Note that the Rand holds a significant weight of 45% on the Pula exchange rate basket. This necessitates the need to examine the behaviour of the Pula-Rand exchange rate volatility on Botswana’s economic growth. There has been vast empirical literature on the impact of the Rand/Pula exchange rate volatility on various macroeconomic indicators such as inflation levels, employment level, purchase power parity, trade balance in Botswana. This includes studies by Modisaatsone and Motlaleng (2012) and Rapelana (2014). However, little exploration has been done on its impact on economic growth in Botswana. Therefore, testing the impact of the Pula-Rand exchange rate volatility on Botswana’s economic growth is an attempt to address the existing research gap. The volatile nature of the Rand with 45% weight in the Pula currency basket may directly translate into the Rand/Pula exchange rate volatility. Ultimately, this may have an impact on Botswana’s economic performance. Volatile exchange rates are linked to unpredictable movements in the relative prices in the economy.

Therefore, exchange rate stability is one of the main factors influencing foreign investments, price stability and stable economic growth (Ajao, 2015).

In the recent years, Botswana's economy has been experiencing slow economic growth rate. From 2000 to 2018, the highest economic growth rate recorded was 11.3% in 2013, followed by 8.65% in 2010. In 2017 and 2018, the economy experienced low growth rates of 2.9% and 4.5% respectively (Statistics Botswana, 2018). Therefore, it is critical to recognise the impact of the volatile nature of the Rand on the Pula given the 45% weight it has in the currency basket. Economic question that arise is that, is the Rand/Pula exchange rate volatility responsible for crippling Botswana's rate of economic growth. Furthermore, Botswana is still a mineral-based economy and it has not succeeded in significantly diversifying its economy away from diamonds (Lewin, 2011). Therefore, it is important to evaluate, if the Rand/Pula exchange rate volatility has influence on Botswana's economic growth.

Exchange rate volatility can also have an indirect effect on the economic growth through its impact on the key determinants of the economic activity. These are trade flows, investment, and employment. These effects may be, increases in transaction costs and decreases in international trade. It is assumed international trade and economic growth are positively associated. Volatile exchange rates make international trade and investment decisions more difficult because volatility increases exchange rate risk. Exchange rate risk refers to the potential to lose money because of a change in the exchange rate (Suranovic, 2006). Exchange rate volatility also decreases investments in a country, thus lowering the capital in a given economy (Tavlas, 2003). Hence, exchange rate volatility has a significant impact on economic growth. Therefore, it is crucial, to identify the impact of exchange volatility on a nation's economic growth. Hence this paper divulge the impact of the Rand/Pula exchange rate volatility on the economy of Botswana.

The paper proceeds as follows. Section II provides a brief background of Botswana's exchange rate system, volatile Rand and economic growth in Botswana. Section III is a review of relevant previous studies. Section IV provides the methodology. Empirical findings are discussed in Section V. Conclusions of the paper are given in Section VI.

2. Botswana's Exchange Rate System, Volatile Rand and Botswana's Economic Growth

2.1 Botswana's Exchange Rate System

Botswana adopted the crawling peg exchange rate mechanism in May 2005 (Bank of Botswana, 2016). The "crawling peg" exchange rate system, allows the foreign exchange rate to vary but only on the basis of a predetermined formula by sale and purchase of international reserves (McKenzie, 1983). The use of a currency basket in place of a peg to a single currency, normally tends to stabilize a country's effective exchange rate.

The choice of an appropriate exchange rate regime is a paramount decision made to favour the progressive growth of any a nation's economy. The exchange rate policy issues have been a great area of concern in developing countries in recent years. This preceded the introduction of IMF and World

Bank stabilization and adjustment policies. It incorporated devaluation of exchange rate, introduction of new exchange rate management policies and trade liberalization measures (Atta et al., 1999).

The crawling peg exchange rate system allows the country to benefit from the advantages of the two extreme exchange rate regimes. Under the flexible exchange rate regime, the main advantage is invulnerability to currency crisis and the ability to absorb adverse shocks. On the fixed exchange rate system, the main advantage is that it promotes international trade and investment (Yagci, 2001).

Given a situation whereby the Pula had been allowed to float, large inflows of diamond revenues would have caused the Pula to appreciate. The appreciation of the Pula would have made non-mineral export sectors to be uncompetitive which would make economic diversification extremely difficult to achieve (Motlaleng, 2009). Furthermore, that would have triggered the economy to experience the undesirable Dutch disease. Dutch disease can arise due to an appreciation of the real exchange rate due to a natural resource boom from a tradable resource discovery. This reduces the international competitiveness of other tradable sectors as resource based exports crowd out commodity exports produced by those sectors. This may ultimately slow the growth of a country's exports. Consequently, it may harm a country's long-term economic growth goals (Barder, 2006). The ripple effects on the economy would be inconsistent with the nation's development and diversification objectives (Masalila & Motshidisi, 2003).

In an attempt to control the adverse effect of volatility of an independent float and the strait jacket of a fixed exchange rate, Botswana, has chosen an intermediate exchange rate regime. This enables her to enjoy the advantages of the two extreme exchange rate mechanisms. At the introduction of the Pula currency in 1976 Botswana had adopted a fixed but adjustable peg system. The Pula was pegged to the US dollar and, before 1980, the peg was revalued due to anti-inflationary reasons. The single currency peg coincided with a period in which the Rand was also pegged to the US dollar. Specifically, the exchange rate at which the Pula was pegged to the US dollar was also equal to that of the Rand against the Dollar. This demonstrated equality between the Pula and the Rand. This effect ended when the Rand was taken off the US dollar peg and allowed to float. To subdue the effects of exchange rate volatility between the Pula and the Rand, the Pula basket was introduced in 1980 (Masalila & Motshidisi, 2003). Given the volatile nature of the Rand, the Pula basket mitigated the volatility of the Rand by the less volatile currencies in the basket till the employment of the crawling peg exchange rate mechanism in May 2005. It is therefore apparent that the Pula has been facing the challenge of exchange rate volatility posed by the volatile Rand.

2.2 Volatility of the South African Rand

Volatility represents the degree to which a variable changes over time. The larger the magnitude of a variable change, or the more quickly it changes over time, the more volatile it is (Suranovic, 2006). Exchange rate stability is one of the main factors influencing foreign investments, price stability and stable economic growth. The larger the fluctuations in an exchange rate are between two countries, the more volatile the exchange rate is described as (Bauwens et al., 2006).

The Rand has been a volatile currency (Miyajima, 2019; Fowkes et al., 2016; Hanusch et al., 2018). South Africa's Rand has over the years, maintained the world's most volatile currency status. For the past few years, the South African Rand has seen a rapid depreciation (Oseifuah & Korkpoe, 2018). Therefore this, will directly affect the Pula-Rand exchange rate.

Recent literature shows that the South African Rand is a volatile currency (for instance, Miyajima, 2019; Hanusch et al., 2018). Miyajima paper found that higher exchange rate volatility tends to increase core inflation but to a relatively limited extent in South Africa. He argues that the results support policy of allowing the rand to float freely. This is found to work as a shock absorber with South Africa's inflation targeting regime. The South African Rand has been relatively volatile due to domestic and external disturbances. The Rand acts as a shock absorber based on the South African Reserve Bank's free-floating exchange rate policy. For instance, domestic shocks have elevated the Rand volatility to above the US stock price volatility index. This is a commonly-used indicator of global uncertainty. The relatively high Rand volatility is argued to have an implication on South Africa's inflation (Miyajima, 2019).

Additionally, Hanusch et al. (2018) also posits that South Africa, has been experiencing high volatility of the Rand in recent years. They argue that reducing the Rand's volatility could boost its FDI inflows by 0.25 percentage points of GDP. It was found that South Africa's exchange rate volatility is mainly driven by the following. First commodity price shocks. Second, domestic policy uncertainty and global market volatility. Both Foreign and domestic factors have contributed to low foreign investment (FDI). It is explained that investors explicitly mentioned the high exchange rate volatility in South Africa as a factor that deters them from investing in the country. Modisaatsone and Motlaleng (2012) found the Rand/Pula exchange to have been highly volatile for the period 1993 to 2009. This was argued to be major challenge for Botswana. The volatile Rand/Pula exchange rate make international trade decisions difficult because volatility increase exchange rate risk. They concluded that if the benefits of an effective exchange rate management are to be realized exchange rate volatility has to be addressed by policy makers in Botswana. Therefore, this paper extends the frontiers of knowledge by investigating the impact of the Rand/Pula exchange rate volatility on Botswana's economic growth.

2.3 Botswana's Economic Growth

Economic growth is among the major key objectives of any economic policy. The other important variable in the formulation of economic policies is the exchange rate. This is because fluctuations of the real exchange rate can cause high fluctuation in the foreign trade and balance of payments. Therefore, exchange rate systems, remains a key factor in the economic policy (Basirat et al., 2014). Botswana had distinguished itself as a nation with the world's highest economic growth rates from independence in 1966. Between 1965 and 2005, the real annual economic growth averaged 9 percent per year. Per capita income increased from USD 5,700 in 2005/06 to USD 7,000 in 2006/07. This changed the economic status of the nation transitioning it to an upper middle income country (Statistics Botswana, 2018).

During the period 1977/78 to 2005, the key drivers of the economy had been mining, which was contributing 42 percent of the GDP, followed by government services which covered 15 percent. It was then followed by trade, hotels and restaurants with 10.5 percent and financial and business services accounting for 9.7 percent. The mining sector has been the largest contributor to GDP since 1977/78, taking the leading from the agricultural sector (UNDP, 2009).

The economy of Botswana has enjoyed rapid growth in per capita income. This is result of effective economic management and prudent management of the country's resource wealth. The country's GDP per capita rose from USD 80 at the time of its independence in 1966 to USD 6 924 in 2016. Nonetheless, despite efforts and strategies to diversify the economy, the economic base remains narrow and growth has not been satisfactorily sufficiently inclusive. Botswana's main economic growth driver remains the extraction and processing of diamonds for export. It provided 88 percent of the country's exports in 2016 (Honde & Abraha, 2017).

Economic growth has been strong over the past few decades with real GDP growth recording 9.2 per cent in 2000/01. In recent years, economic growth in Botswana has slowed down (Statistics Botswana, 2018).

Botswana achieved its highest GDP growth rate in 1988, which recorded the growth rate of 19.45%. This was largely accounted for by the rapid growth of the diamond mining sector in the country. This was the period in which mining contributed the uppermost, recording a share of 50% to the GDP, in 1988/89 (Bank of Botswana, 2000). Thereafter the contribution of mining to the GDP declined leading to the overall decline in the GDP growth rate. The lowest growth rate the economy experienced was in 2009, at -7.7%. This was chiefly contributed to by the global economic recession. This was a ripple effect of the contraction of the mining sector, which contributed to only 24% in 2009, dwindling from 41.2% in 2008 (Bank of Botswana, 2009). One more significant plunge in the GDP growth rate was recorded in 2015, at -1.7%. This was also attributed to the decline in the mining output, which fell by 11.8% compared to the previous year. The 11.8% shrinkage was principally due to a 12.2% decline in the diamond production which was scaled down in response to the subdued global demand (Bank of Botswana, 2015).

3. Review of Previous Studies

Studies on the impact of exchange rate volatility on economic growth have shown mixed results. For instance, Olofsson (2019) studied on the relationship between exchange rate volatility and economic growth based on 36 OECD countries. The effect of exchange rate volatility on growth was analysed through a content analysis and four panel-data regressions using the fixed effects panel model. The study used two types of exchange rate volatility, the nominal exchange rate volatility and effective nominal exchange rate volatility against 143 trading partners. The result revealed that both measures of exchange rate volatility, nominal exchange rate volatility and effective nominal exchange rate have a negative effect on economic growth. Additionally, the results showed evidence of bidirectional

causality, meaning that exchange rate volatility affects economic growth and economic growth affects exchange rate volatility.

Azid et al. (2005) investigated the impact of exchange rate volatility on growth and economic performance in Pakistan. The study used the GARCH to measure the volatility in the exchange rate series. The results of the study showed that excessive volatility of exchange rate regimes had no effect on the economic performance of manufacturing product in Pakistan. Sanginabadi and Heidari (2012) studied the effects of exchange rate volatility on economic growth of Iran. The study results showed a significant relationship between Iranian growth volume and real exchange rate volatility. The long-run results of ARDL model showed a negative effect of exchange rate volatility on economic growth.

Kaur et al. (2019) investigated the impact of exchange rate volatility on economic growth in Malaysia, for the period from 2000-2016. The results showed a negative but insignificant impact of exchange rate volatility on economic growth in Malaysia. The insignificance was explained to have resulted due to the consistent effort of Malaysian authorities in introducing structural reforms to boost productivity. Barguelli et al. (2018) explored the impact of the exchange rate volatility on economic growth. The study was based on 45 developing and emerging countries for the period 1985 to 2015. They used the GARCH model to measure exchange rate volatility. The study employed the GMM estimator. Their results showed that the nominal and real exchange rate volatility have a negative impact on economic growth.

Sabina et al. (2017) investigated exchange rate volatility in Nigeria and its impact on economic growth. They employed the GARCH model in estimating the volatility of exchange rate. They used the GMM in estimating the impact of volatility and economic growth in Nigeria. Their results revealed that exchange rate volatility exerts a negative pressure on the growth of the Nigerian economy.

Oloyede and Fapetu (2018) explored the effect of exchange rate volatility on economic growth in Nigeria from 1986 to 2014. The GMM was used to determine the effect of real exchange rate volatility on economic growth. They found that there was high volatility of real effective exchange rate. It was also revealed that real effective exchange rate was negatively and significantly related to economic growth. This finding implied that exchange rate volatility was harmful to the growth of the Nigerian economy. Furthermore, Adeniyi and Olasunkanmi, (2019) studied on the impact of exchange rate volatility on economic growth in Nigeria from 1980 to 2016. ARCH and GARCH were used to test for the exchange rate volatility. They concluded that there was an existence of exchange rate volatility. Furthermore, their results established an insignificant positive relationship between exchange rate volatility and economic growth in Nigeria.

Wandeda (2014) identified the effect of exchange rate volatility on the economic growth in Kenya. The study found that exchange rate volatility positively impacts GDP growth but does not significantly affect GDP growth rate. Alagidede and Ibrahim (2016) studied on the causes and effects of exchange rate volatility on economic growth based on Ghana. The GARCH was used in estimation of exchange

rate volatility. It was concluded that excessive volatility was found to be detrimental to economic growth.

4. Methodology

4.1 Model Specification

This paper follows the analysis used by Oloyede and Fapetu (2018), which tested the magnitude of the impact of exchange rate volatility on the economy of Nigeria. The control variables used in the study were Gross Fixed Capital Formation, Labour Force, Terms of Trade, Trade Openness, Government Expenditure and Financial Depth. In this paper, to represent the influencers of economic growth in the domestic economy of Botswana, the control variables used are: Trade Openness, Government Expenditure, Labour, Foreign Exchange Reserves, inflation and a dummy variable. The model follows gross domestic rate (GDPgrowth), a proxy for economic growth as dependent on volatility of real exchange rate (VolRER). The variables are specified in the econometric model as follows:

$$\ln\text{GDPgrowth}_t = B_0 + B_1 \ln\text{VolRER}_t + B_2 \ln\text{GE}_t + B_3 \ln\text{LF}_t + B_4 \ln\text{INF}_t + B_5 \ln\text{OPEN}_t + B_6 \ln\text{FOR}_t + B_7 \ln Z_t + \varepsilon_t \quad (1)$$

Where:

GDPgrowth=Gross Domestic Product Growth Rate

VolRER=Volatility Of Real Exchange Rate. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) is used to construct exchange rate volatility in the Rand/Pula exchange rate.

GE=Government Expenditure

LF=Labour Force

INF=Inflation

OPEN=Trade Openness

FOR=Foreign Exchange Reserves

Z=Dummy Variable; 1 if there is positive Gross Domestic Product Growth Rate ;0 if there is negative Gross Domestic Product Growth Rate

ln=Natural Logarithm

t=Time Subscript

ε =Error Term

4.2 Generalized Method of Moments (GMM)

This paper employs the GMM to evaluate the impact of the exchange rate volatility on economic growth. GMM was first formalized by Hansen in 1982. The paper uses the Two Step System GMM by Arellano and Bover, (1995) and Blundell and Bond (1998). GMM is used to estimate this impact using the GARCH as a measure of exchange volatility. GMM is a method for constructing estimators, analogous to Maximum Likelihood (ML). GMM uses assumptions about specific moments of the random variables instead of assumptions about the entire distribution. This makes GMM more robust than ML, at the cost of some efficiency (Caner, 2009). The choice of GMM is also to overcome the

problem of endogeneity and simultaneity bias. Before employing the model, the properties of time series will be conducted using both Augmented Dickey fuller test (ADF) and the Philips-Perron test (PP) to determine the stationarity of the variables.

5. Empirical Results

This section presents the empirical results on the of impact exchange rate volatility on Botswana's economic growth and the Rand/Pula exchange rate volatility results. Section 5.1 presents the correlation matrix. Section 5.2 presents the unit root test results. The unit root test was used to determine the behaviour and characteristics of individual series of variables. The GARCH model results of exchange volatility given in Section 5.3. Lastly, Section 5.4 presents the empirical of the impact of the exchange rate volatility on Botswana's economic growth.

5.1 Correlation Matrix

Correlation matrix was used to determine the strength of relationship between the dependent variable (GDP) and the explanatory variables (independent variables). Table 1 shows the correlation between the variables used in this paper. The entries on the main diagonal give the correlation between one variable and itself while the entries off the main diagonal, give the pair-wise correlation among the variables. The pair-wise correlation is very low, this shows that there is no problem of multi-collinearity of the variables. The real exchange rate volatility variable (RER) shows that it is negatively related to GDP growth rate (GDP) as (R=-0.3532).

Table 1. Correlation Matrix

	GDP	RER	LF	OPEN	GE	INF	FOR
GDP	1.0000						
RER	-0.3532	1.0000					
LF	0.5597	-0.0903	1.0000				
OPEN	0.6379	-0.5218	0.5578	1.0000			
GE	0.0362	0.2719	0.1607	0.1351	1.0000		
INF	0.3103	-0.1718	0.2827	0.2436	0.4069	1.0000	
FOR	0.4930	-0.3089	0.5531	0.5208	0.0657	0.2114	1.0000

Source: EViews 10 computations.

5.2 Unit Root Test Results

The process of testing for unit root in time series data is very important. A unit root test is conducted to check if a time series variable is non-stationary or not. In this paper, we begin with the Augmented Dickey-Fuller (Dickey & Fuller, 1979) unit-root test. However, it is now understood that the outcomes of ADF test are lag dependent. According to Agiakoglu and Newbold (1992), the ADF test often tends

to under-reject the null hypothesis of no unit-root. Therefore, in confirmation to the outcomes of the ADF test, we also apply the Phillips-Perron (PP, 1988) unit-root test in (Gbatu et al., 2017).

Table 2. Augmented Dickey–Fuller Unit Root Results

VARIABLE	AUGMENTED DICKEY-FULLER UNIT ROOT TEST					
	LEVELS		FIRST DIFFERENCE		ORDER OF	INTEGRATION
	INTERCEPT	INTERCEPT AND TREND	INTERCEPT	INTERCEPT AND TREND		
	T	T	T	T		
LNGDP	-4.346970***	-4.890195***	-8.024852***	-8.004099***	I(0)	
LNRER	-2.433896	-2.419167	-5.857971***	-5.803689***	I(1)	
LNLF	-3.366549**	-4.915386*	-12.32340***	-5.803689***	I(0)	
LNOPEN	-1.375979	-1.989940	-5.532976***	-5.467822***	I(1)	
LNGE	-1.345967	-2.004218	-5.481532***	-5.521016***	I(1)	
LNINF	-1.357259	-2.605494	-8.447381***	-8.584685***	I(1)	
LNFOR	-2.416893	-2.324664	-6.363547***	-6.215484***	I(1)	

Note. All values in the table are t-statistics.

* Significant at 10% significance level.

** Significant at 5% significance level.

*** Significant at 1% significance level.

The results of the unit root test using the ADF test in Table 2, show that the natural log of GDP (LNGDP) and the natural log of LF (LNLF) are both stationary at levels with intercept, at 1% and 5% level of significance respectively. The natural log of RER, OPEN, GE, INF and FOR show stationarity after first differencing with intercept at 1% level of significance. The Phillips Perron unit root test results in Table 3, show that LNGDP and LNLF are stationary at levels with intercept. LNRER, LNOPEN, LNGE, LNINF and LNFOR show stationary at first differencing with intercept at 1% level of significance using the Phillips Perron test.

Table 3. Phillips Perron Unit Root Results

PHILLIPS PERRON UNIT ROOT TEST					
VARIABLE	LEVELS		FIRST DIFFERENCE		ORDER OF INTERGRATION
	INTERCEPT	INTERCEPT AND TREND	INTERCEPT	INTERCEPT AND TREND	
LNGDP	-4.471681***	-4.971719***	-9.753473***	-9.044210***	I(0)
LNRRER	-2.483400	-2.379722	-5.902894***	-5.855648***	I(1)
LNLFF	-3.978509***	-4.976633***	-13.38881***	-12.93803***	I(0)
LNOPEN	-1.629052	-2.293050	-5.531496***	-5.466241***	I(1)
LNGE	-1.304658	-1.898509	-5.446088***	-5.704795***	I(1)
LNINF	-1.203411	-2.663678	-8.455437***	-8.849678***	I(1)
LNFOR	-2.469936	-2.663678	-8.455437***	-8.849678***	I(1)

Note. All values in the table are t-statistics.

* Significant at 10% significance level.

** Significant at 5% significance level.

*** Significant at 1% significance level.

Source: EViews 10 computations

5.3 The GARCH Model

The result of the GARCH test in Table 4 indicate that there is the presence of volatility in the Rand/Pula exchange. These findings establish the presence of time-varying conditional volatility of the Rand/Pula exchange rate. This results also indicates that the persistence of volatility shocks, as represented by the sum of the ARCH and GARCH parameters ($\alpha+\beta$). The result of the GARCH (1, 1) test suggests the persistence of volatility over the periods in consideration. It implies that the periods of high (low) exchange rate shocks tend to be followed by periods of high (low) exchange rate shocks for a prolonged period.

Table 4. 4 GARCH Model Result

VARIABLE	COEFFICIENT	STD ERROR	Z-STATISTIC	PROB.
Mean Equation				
Constant (C)	0.069796	0.015157	4.604932	0.0000***
LNRER(-1)	0.744760	0.071818	10.37011	0.0000***
Variance Equation				
Constant (C)	0.000834	0.000735	1.133681	0.2569
Arch (α)	0.875528	0.435590	2.009979	0.0444**
Garch (β)	0.166744	0.293696	0.567742	0.5702
($\alpha + \beta$)	0.875528			
R-squared	0.643680			
Adjusted R-squared	0.634543			
DW-Statistic	1.622008			

Note.

** denotes statistical significance at 5% level

*** denotes statistical significance at 1% level

Source: EViews 10 computations

5.4 GMM Estimation Result

We employed the GMM model to examine the impact of the exchange rate volatility on Botswana's economic growth. The robustness of the results are reinforced with the diagnostic checks of the model in Table 5.

Table 5. GMM Model Diagnostic Checks

Estimate	Technique	t-stat	Prob
Functional Form	Ramsey RESET test for omitted variables/ functional form	0.62	0.6085
Normality	Jarque-Bera normality test based on a test of skewness and kurtosis of residuals.	3.063	0.2162
Serial Correlation	Breusch-Godfrey Lagrange Multiplier (LM) test of residual serial correlation	0.48	0.63
Conditional Heteroscedasticity	White's test for heteroscedasticity based on the regression of squared residuals on squared fitted values	35.09	0.2017

Source: Stata 14.2 Computations

The results illustrate that the model functional form test calculated t-stat=0.62; p-value=0.6085. Therefore, the p-value is insignificant at the 10% level. It suggests that the null hypothesis, that the model has no omitted variables is accepted. Furthermore, Jarque-Bera normality test was used to for the normality of the variables used. The Jarque-Bera normality test results exhibited that the residuals are normally distributed (t-stat=3.063; p-value=0.2162). Since the p-value is insignificant at 10%, thus the null hypothesis of normal distribution is accepted.

The Breusch-Godfrey Lagrange Multiplier test was used to for the presence of serial correlation. The LM test proved the failure to reject the null hypotheses, hence there is no serial correlation, as (t-stat=0.48; p-value=0.63). The White's test is used to test for the presence of heteroscedasticity. The White's test results have resulted in t-stat=35.09; p-value=0.2017. Hence, the failure to reject the null hypotheses, that there is no heteroscedasticity in the residuals. The results show that the residuals were rather found to be homoscedastic. The diagnostic test results show that the estimation is appropriate hence we proceed with the estimation model interpretation.

The results in Table 6 indicate that the Rand/Pula exchange rate volatility has an expected insignificant negative impact on Botswana's economic growth. This implies that the volatility of the Rand/Pula exchange rate has no impact on Botswana's economic growth. The negative but insignificant impact of exchange rate volatility on Botswana's economic growth mirrors the findings of Kaur et al. (2019) and Musyoki et al. (2012). Both studies found negative but insignificant impact of exchange rate volatility on economic growth in Malaysia and Kenya, respectively.

Table 6. GMM Estimation Result

DEPENDENT VARIABLE: LNGDP				
VARIABLE	COEFFICIENT	STD. ERROR	T-STATISTIC	P-VALUE
C	-2.005472	9.257217	-0.22	0.830
LNRRER	-3.084511	4.748983	-0.65	0.521
LNLFF	0.2409777	0.1391728	1.73	0.093*
LNOPEN	0.14155077	0.0522654	2.71	0.011**
LNGE	-0.1533467	0.1617304	-0.95	0.350
LNINF	0.1025337	0.1810523	0.57	0.575
LNFOR	0.0058282	0.0261375	0.22	0.825
Z	-10.36422	2.31428	-4.48	0.000***
R-SQUARED	0.6993			
ADJUSTED	0.6356			
R-SQUARED				

Note.

* denotes statistical significance at 10% level.

** denotes statistical significance at 5% level.

*** denotes statistical significance at 1% level

Source: Stata 14.2 Computations

Labour Force (LF) is significantly related to economic growth rate. This shows that Labour Force is positively related to economic growth. These results are as per the expected sign and are consistent with the empirical results by Kargi (2014). The result show that, a percentage change in the Labour force will cause a 0.241% increase in economic growth. It must be noted that Labour Force and economic growth exhibit an inelastic relationship.

Trade Openness (OPEN) indicates a positive relationship with economic growth. A percentage change in the Trade Openness effects a 0.142% increase in the economic growth. Hence, Trade Openness and economic growth also exhibit an inelastic relationship. These results are as per the expected signs and consistent with the empirical results of Frankel and Romer (1999), Edwards (1998) and Sachs et al. (1995). This explains that trade openness positively contributes to the growth of Botswana's economy. This is concurring with empirical literature. It explains that open trade has been positively correlated to a healthy economy. These results are coherent with Botswana's open economy with trade ratio of over

a unit. Government Spending has had no impact on Botswana's economic growth in our study. Furthermore, results shows that inflation rate does not affect economic growth, *ceteris paribus*. It is also shown that Foreign Exchange Reserves have an insignificant positive impact on economic growth. Lastly, Dummy Variable indicates that past negative economic growth rates adversely impact current growth rates. The R-square suggests that 69.93% of Botswana's economic growth is explained by the variation of the independent variables.

6. Conclusions

The results of the GARCH model proved the presence of volatility in the Rand/Pula exchange rate. The findings established the presence of time-varying conditional volatility of the Rand/Pula exchange rate. The results further indicated the persistence of volatility shocks. The conclusive results from the GMM model suggest that the Rand/Pula exchange rate volatility has a negative but insignificant impact on Botswana's economic growth. This finding corroborates those of Kaur et al. (2019) and Musyoki et al. (2012). Their studies found negative but insignificant impact of exchange rate volatility on economic growth in Malaysia and Kenya, respectively. Our principal findings are that Botswana's economic growth is largely explained by trade openness and growth of labour force and not influenced by the Rand/Pula exchange rate volatility.

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