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BOTSWANA INSTITUTE FOR DEVELOPMENT POLICY ANALYSIS

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ABSTRACT

This paper estimates the impact of exchange rate volatility on non-diamond exports in Botswana using an Autoregressive Distributed Lag (ARDL) model. The model used quarterly data for the period 1995-2018, to estimate both the long and short run dynamics. The estimated results show that real GDP in the non-diamond sector, GDP growth of OECD countries, transport investment and water & electricity investment have a positive impact on non-diamond exports. While the lending interest rate, inflation differentials, exchange rate volatility and misalignment impact non-diamond exports negatively. The findings indicate that the coefficients with respect to the exchange rate volatility in both models are relatively low, suggesting that it has not had harmful impacts on non-diamond exports. This reflects the emphasis given to a stable and competitive exchange rate that will attract increased foreign demand which, as a result, could lead to export diversification. However, Botswana's export structure is still undiversified, despite efforts made to diversify the sector. To achieve the national objectives of sustainable export and economic diversification, the policy should continue encouraging a stable and competitive exchange rate. Other policies intended to boost export growth should focus on: expanding the production base of the non-diamond sector, committing more investment in the transport sector, and improving water & electricity infrastructure.

1. INTRODUCTION

After the Bretton Woods fixed exchange rate system was abandoned in 1973, many countries changed their exchange rate policies from fixed to flexible exchange rate system. However, this approach has left many countries experiencing greater volatility in exchange rate patterns which, as a result, has led to low performance of exports (Serenis & Tsounis, 2012). Exchange rate volatility occurs when exchange rate fluctuates sharply, which could result in low demand for exports in the international market (De Grauwe, 1988). Since the flexible exchange rate system was adopted, the impact of its volatility on the performance of exports has remained a subject of interest in many countries, especially in developed and developing countries (Asseery & Peel, 1991; Arize, 1995; Cheong, Mehari & Williams, 2006; Benson & Godwin, 2010).

Botswana, like other countries, has amended its exchange rate policy over years. When Botswana introduced its currency in 1976, the Pula, a single currency fixed peg exchange rate system was implemented by pegging the Pula to US Dollar, with adjustable pegs during the period 1976-1980 (Bank of Botswana, 1987 & 2007; Iyke & Odhiambo, 2015). However, this policy was abandoned in 1980, and a fixed basket peg exchange rate system was adopted by introducing the Pula basket. The Pula was pegged to a basket of currencies of its major trading partners, for example; United States, United Kingdom, France, Germany, Japan and South Africa.

The currencies of the first five countries comprise the Special Drawing Rights (SDR), which is the unit of account of the International Monetary Fund (IMF), and the currency of the sixth country is South African Rand (ZAR). In 1999, the currencies of Germany and France were replaced in the SDR by the Euro, while the Chinese Renminbi was brought into the SDR in 2016 to reflect trade patterns. The fixed basket peg exchange rate system was preferred because it was consistent with the national policy objective, which has, amongst others, sought to lessen the appreciation of the Pula due to large inflows of diamond revenues and contracting the Dutch Disease (Bank of Botswana, 2007; Cowan & Phetwe, 1997; Masalila & Motshidisi, 2003; Motlaleng, 2009; Harvey, 1996).

Since 2005, a crawling band exchange rate mechanism has been implemented to attract increased foreign demand for Botswana's exports. The main principle of the current framework is to encourage competitiveness of tradeable goods in the international market (Bank of Botswana, 2007; Masalila & Motshidisi, 2003; Leith, 2020; World Bank, 2006; Motlaleng, 2009). Under the crawling band mechanism, the exchange rate is adjusted gradually using the annual rate of the crawl in order to offset inflation differentials between Botswana and its major trading partners. The adjustments were done to attain a stable and competitive real effective exchange rate as a means of promoting the competitiveness of tradeable goods, including both exports and import substitutes. Empirical research suggests that, since the introduction of the crawling band mechanism, the movement of the Pula exchange rate has experienced

minimal variations which is an indicator of exchange rate stability (Taye, 2013; Iyke & Odhiambo, 2015; Bosupeng, Dzator & Nadolny, (2019). These developments were consistent with the policy objective of maintaining a stable and competitive exchange rate in order to promote export growth and diversification.

The history of Botswana's exchange rate policy, as will be discussed in Section 2.1, indicates that the Pula was devalued by 10% in 1982, 5% in 1984, 15% in 1985, 5% in 1990, 5% in 1991, 7.5% in 2004 and 12% in 2005. On the other hand, it was revalued by 5% during 1977, 1980 and 1989. There were also periods of technical adjustments in 1994, 1996 and 1997 (Bank of Botswana, 2007). However, Botswana's export structure is still heavily dependent on diamond exports, despite efforts made to encourage export diversification. Other export commodities contribute little to total exports, and this was also observed by Jordaan & Eita (2009).

Available evidence shows that the share of diamond exports in total exports was estimated at an average of 66.2% during the period 1995-2018. During the same period, the shares of other exports to total exports; including copper-nickel, beef, salt & soda ash, textiles, vehicles & transport equipment and other remaining exports were estimated at averages of 6.5%, 1.9%, 1.3%, 2.2%, 3.0% and 18.9%, respectively (Statistics Botswana, various issues). This indicates that diversification of Botswana's export structure is limited. Cowan & Phetwe (1997), Sekwati (2010) and Grynberg (2011) argued that Botswana is experiencing low progress in economic diversification due to, amongst others, lack of investment for industrial development, low productivity and high cost of utilities.

However, in the case of Botswana, dependency on one export commodity could be seen as a threat to export and economic performance, since the country will become more vulnerable to external shocks, for example, the 2008/09 global financial and economic crisis (Sekwati, 2010). Rather than depending on one export commodity, a more diversified export base could lead to increased and more sustainable export performance, further leading to sustainable economic growth (Elbadawi, 1998). Therefore, the contribution of exports to growth performance is not only stimulated by export volume, but also by export composition. Given that a change in exchange rate policy may be expected to affect the general trade dynamics, the impact of exchange rate volatility on the growth of non-diamond exports needs to be understood.

This study is important for Botswana because the Government is committed to transforming the economy to one of export-led growth through expanding the export base, and reducing the country's heavy reliance on diamond exports. The objective of this study is, therefore, to estimate the impact of volatility of the Pula exchange rate on non-diamond exports. A number of studies related to the exchange rate in Botswana did not focus on establishing the relationship between exchange rate volatility and non-diamonds exports. Most of them focused on estimating the exchange rate equilibrium and misalignment (World Bank, 2006; Iimi, 2006; Taye, 2013; Iyke & Odhiambo,

2015). The study which was prepared by the Botswana Institute for Development Policy Analysis (BIDPA) for the World Bank study, examined how the exchange rate influences export competitiveness (World Bank, 2006). However, export competitiveness was measured as the level of non-mining GDP per capita.

Motlaleng (2009) observed the trend of the Pula exchange rate and its variation before and after the crawling band mechanism was introduced in 2005. Modisaatsone & Motlaleng (2013) looked at the impacts of exchange rate volatility on imports. Other studies examined how exchange rate volatility impacts price levels in Botswana (Leith, 1991; Atta et al., 1999). Galebotswe & Andrias (2011) conducted a study to find if exchange rate devaluation is contractionary or expansionary for the economy of Botswana. Bosupeng, Dzator & Nadolny, (2019) examined the impacts of exchange rate misalignment on outward capital flight in Botswana. No empirical analysis has been conducted to estimate the impact of exchange rate volatility on non-diamond exports. Therefore, the purpose of this study is to fill this gap.

The rest of this paper is organised as follows. Section 2 provides an overview of Botswana's exchange rate policy and National Export Strategy, Section 3 reviews the literature, Section 4 outlines the methods of analysis and data, Section 5 provides discussion of the results and Section 6 covers the conclusion and policy implications.

2. EXCHANGE RATE POLICY AND EXPORT STRATEGY IN BOTSWANA

2.1 BOTSWANA'S EXCHANGE RATE POLICY

Botswana's exchange rate system is managed in such a way that it promotes competitiveness of tradeable goods and services in both the domestic and international markets, which is consistent with the national objective of export growth and diversification. Therefore, the Pula exchange rate is determined based on a basket peg of currencies of major trading partners to Botswana, including United States, United Kingdom, France, Germany, Japan and South Africa. However, the currencies of Germany and France were replaced in the SDR by the Euro in 1999, while the Chinese Renminbi was brought into the SDR in 2016. The Pula basket is, therefore, pegged to a trade-weighted basket of currencies including the SDR and South African Rand.

Since the introduction of the Pula in 1976, the exchange rate policy in Botswana has been consistently based on a fixed (pegged) exchange rate system (Bank of Botswana, 1987). At independence in 1966, Botswana was a member of the Rand Monetary Area (RMA), which set a common regional monetary policy for South Africa, Botswana, Lesotho and the then South West Africa (now Namibia) and Swaziland (now Eswatini). At that time, the RMA used the South African Rand (ZAR) as a common currency which was pegged to the US Dollar. Due to economic developments, Botswana withdrew from

RMA and introduced its currency (the Pula) in August 1976. A single currency fixed peg exchange rate system was adopted, where the Pula was pegged to the US Dollar at the same rate as the Rand. In 1979, the Rand was allowed to float; and as a result, there was rapid appreciation of the Rand against the US Dollar due to high Gold prices (Bank of Botswana, 1987 and 2007; Iyke & Odhiambo, 2015).

Following the floating of the Rand, Botswana's single currency fixed peg to the US Dollar was changed to a basket of currencies in 1980, partly to offset the effect of exchange rate volatility between the Pula and the Rand. Generally, the Pula was pegged to a basket of currencies of Botswana's major trading partners to subdue the impact of the volatility of any single currency on the movement of the Pula exchange rate (Masalila & Motshidisi, 2003). The composition of the Pula basket was partly determined by trade patterns; for example, the shares of bilateral trade of the respective countries. South Africa was given a larger share reflecting the need to safeguard local firms against changes in import prices eroding their competitiveness (Bank of Botswana, 2007). In addition, the selection of currencies in the Pula basket was guided by major currencies used in the transaction payments of goods and services in the international market.

A fixed basket peg system was considered relevant to the economy of Botswana, which is small and relatively undiversified. At the time, it was considered implausible for Botswana to sustain floating exchange rate system. A floating exchange rate system was not considered appropriate because it was assumed it would lead to, amongst others, the appreciation of the Pula due to large inflows of foreign exchange earnings from diamond exports. This would have a negative impact on the demand of other export commodities and domestic tradable goods. Therefore, it was feared that allowing the Pula to float freely would erode the competitiveness of other export commodities and domestic tradable goods; thus limiting industrial development and export diversification, leading to Dutch Disease. The exchange rate policy, which was amended in 1980, focused on anti-inflation and competitiveness of tradeable goods, including both exports and substitutes for imports. However, during the early 1990s, the competitiveness objective became more dominant (Bank of Botswana, 2007; Masalila & Motshidisi, 2003; Motlaleng, 2009).

In May 2005, the crawling band mechanism was introduced, to further strengthen the competitiveness of tradeable products. The crawling band mechanism allowed gradual adjustment, where the Pula exchange rate is adjusted by the rate of the crawl. The rate of the crawl is determined by the differentials between Botswana's expected inflation and forecast inflation of trading partners (Bank of Botswana, 2007). This approach is used in Botswana as a means of encouraging a stable real effective exchange rate that can promote competitiveness of tradeable products and enhance industrial development.

Historically, since the introduction of the Pula exchange rate, adjustments of the Pula have been characterised mostly by devaluations. The chronology of the Pula exchange rate, as shown by Table 1, shows that the Pula exchange rate was devalued 7 times; by

10% in 1982, 5% in 1984, 15% in 1985, 5% in 1990, 5% in 1991, 7.5% in 2004 and 12% in 2005. On the other hand, revaluations occurred only 3 times; by 5% during 1977, 1980 and 1989, whereas, technical adjustments were made in 1994, 1996 and 1997.

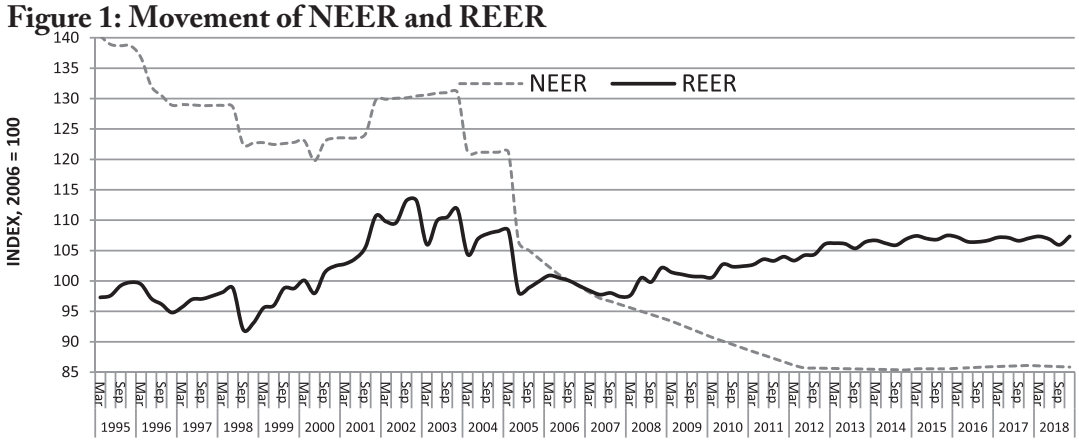
Table 1: Changes in the Pula Exchange Rate

Date	Development Action	Reason
1966-1976	Member of Rand Monetary Union	No Independent Exchange Rate or Monetary Policy.
August 1976	Pula introduced, Pegged at US$ 1.15	Pula pegged at the same rate as the Rand to ensure Pula 1=Rand 1.
April 1977	5% Pula revaluation	Anti-inflation measure.
January 1979	Rand taken off US$ peg & floated	Rand appreciates against US$ due to high gold prices.
June 1980	Pula taken off US$ peg, Pula basket introduced, including Rand & SDR	Reduce Rand/Pula exchange rate volatility.
November 1980	5% Pula revaluation	Anti-inflation measure.
May 1982	10% Pula devaluation	Part of stabilisation measures in response to balance of payments crisis.
February 1984	Foreign debt standstill for South Africa and run on the Rand	Pula rapid depreciation against the US$, as Rand depreciates against US$.
July 1984	5% Pula devaluation	Competitiveness measure.
August 1984	Rand weight in Pula basket adjusted	To reduce the drift of the Pula from the rand.
January 1985	15% Pula devaluation	Competitiveness measure.
January 1986	New Pula basket is introduced	Due to rapid Rand appreciation.
June 1989	5% Pula revaluation	Anti-inflation measure.
August 1990	5% Pula devaluation	Competitiveness measure.
August 1991	5% Pula devaluation	Competitiveness measure.
June 1994	Removal of Zimbabwe Dollar from the basket	To reflect changes in trade patterns.
1994, 1996 & 1997	Technical adjustments	Due to depreciation of the Rand against US$ and appreciation of Pula against the Rand.
February 2004	7.5% Pula devaluation	Competitiveness measure.
May 2005	12% Pula devaluation & adoption of crawling band mechanism	Competitiveness measure & Policy change to crawling peg.
May 2005	Trading margins increased from +/- 0.125% around the centre rate to +/- 0.5%	To increase inter-bank trading in the foreign exchange market.
March 2009	Trading margins decreased from +/-0.5% around the centre rate to +/- 0.125%	To reduce the cost of foreign exchange transactions to customers.

Source: Bank of Botswana

Developments in exchange rate policy discussed above have allowed the Pula exchange rate to be stable over time, more especially under the crawling band mechanism introduced in 2005. The movements of both the Real Effective Exchange Rate (REER) and Nominal Effective Exchange Rate (NEER) showed relatively small variations from 2006 to 2018, when compared with the period from 1995 to 2005, as shown in Figure 1. This reflects the effectiveness of the crawling band mechanism in maintaining the stability of the Pula exchange rate. From 1995 to 2000, the NEER experienced a steady downward trend, and thereafter followed an upward trend until 2003. It trended downward from 2004 to 2011, and exhibited a constant trend from 2012 to 2018. On the other hand, the REER was trending downward from 1995 to 1998, and thereafter experienced an upward trend until 2002. From 2003 to 2006, REER was trending downward and followed a steady upward trend from 2007 to 2018.

Figure 1: Movement of NEER and REER



Source: Botswana of Botswana

2.2 BOTSWANA NATIONAL EXPORT STRATEGY

Botswana's National Export Strategy for 2019-2024 reflects the emphasis given to diversification of exports through expanding the export base in order to increase the production of export-related goods and services, as well as identifying new ones. This strategy is consistent with the Government's diversification and competitiveness objectives. Diversification and competitiveness of local products in international markets are intended to be achieved by encouraging a stable and competitive exchange rate that can attract increased foreign demand for Botswana's tradable goods, and expand the export base by increasing the current level of production of exports.

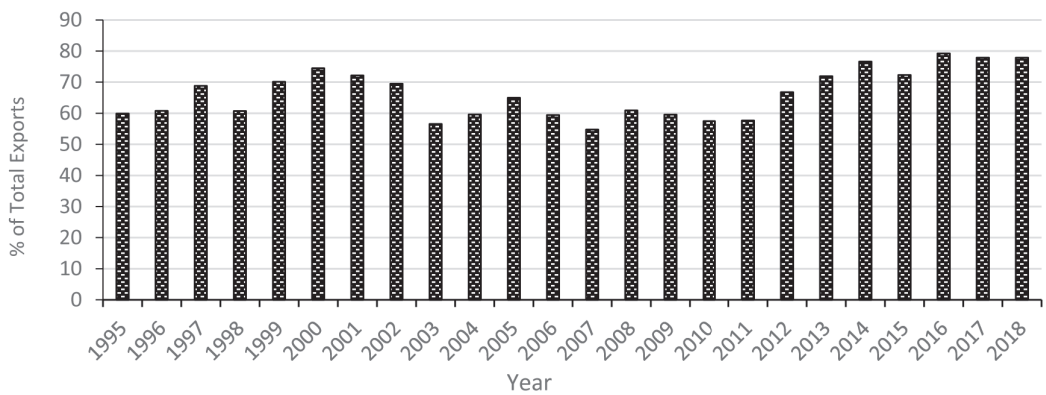
The first National Export Strategy was for the period 2010-2016; it was subsequently followed by the revised edition which is targeted for the period 2019-2024, with the objective of aligning it to the current industrial revolution dynamics. Like the previous strategy, the new strategy is also more focused in the promotion of Arts and Crafts,

Garments and Textiles, Jewellery and Semi-Precious Stones, Leather and Leather Products, Light Manufacturing and Indigenous Products. In addition to the previous strategy, the new strategy put more emphasis on institutional and regulatory frameworks that can provide a more conducive environment for local production.

It is expected that the new export strategy will diversify sources of income, encourage sustainable use of resources, develop human skills, achieve social development, strengthen governance, improve social security and increase the level of employment. The strategy acknowledged that the Botswana export structure is dominated by diamonds; hence the need to find other sources of income. However, Grynberg (2011) argued that encouraging exports growth is going to be difficult because firms targeted to expand the export sector are small in size and are unlikely to sustain their export position due to, amongst others, cost of transport, shortage of skills and government intervention.

Despite Government's efforts to diversify the exports sector, as indicated in various National Export Strategies, the sector is still dominated by diamond exports, indicating the dependency of Botswana's export structure in one export commodity. Figure 2 shows the annual shares of diamond exports in total exports during the period 1995-2018, which was estimated at an average of 66.2%.

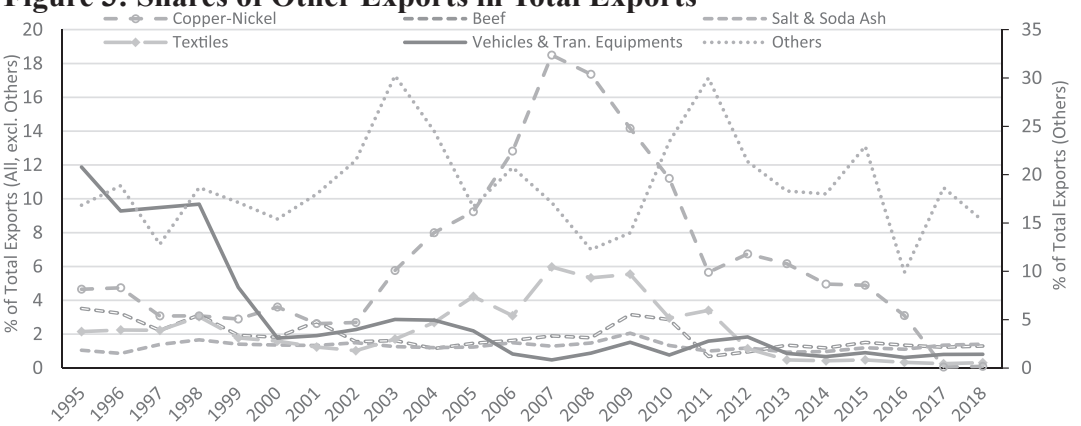
Figure 2: Shares of Diamond Exports to Total Exports



Data Source: Statistics Botswana

However, the shares of other export commodities had little contribution to total exports during the period covered in the analysis of this study. Figure 3 shows the shares of other exports in total exports; including copper-nickel, beef, salt & soda ash, textiles, vehicles & transport equipment and other remaining exports which were estimated at averages of 6.5%, 1.9%, 1.3%, 2.2%, 3.0% and 18.9%, respectively. As indicated earlier, dependency on one export commodity could be seen as a major economic concern as was experienced during the 2008/09 global financial and economic crisis. The estimation procedure conducted in this study, therefore, focuses on the non-diamond exports depicted in Figure 3.

Figure 3: Shares of Other Exports in Total Exports



Data Source: Statistics Botswana

3. LITERATURE REVIEW

Empirically, several studies have estimated the impacts of the exchange rate and its volatility on aggregated exports (Mohamad & Jusoff, 2008; Benson & Godwin, 2010; Sekkat & Varoudakis, 2000; Cheong, Mehari & Williams, 2006). Elbadawi (1998) and Obeng (2017) looked at non-traditional exports, while others focused on sectoral exports (Serenis & Tsounis, 2012; Awokuse & Yuan, 2006; Mwansakilwa, Tembo & Mugisha, 2013). Theoretically, exchange rate appreciation (depreciation) would lead to decreased (increased) demand for exports, while high (low) exchange rate volatility will cause demand for exports to decline (rise). However, the impact of the level of the exchange rate volatility on exports is ambiguous from the literature. Arize (1995) suggested that the impact of an increase in the level of exchange rate volatility could be negative, while others suggest a positive impact (Asseery & Peel, 1991). Therefore, the overall impact depends on what dominate between high and low exchange rate volatility.

Serenis & Tsounis (2012) used an Autoregressive Distributed Lag (ARDL) model to estimate the impacts of the exchange rate volatility on sectoral exports of Germany, Sweden and the United Kingdom (UK). They used quarterly data for the period 1973-2010. Sectoral exports of the respective countries were regressed on the relative price of exports, real domestic GDP, and exchange rate volatility. Exchange rate volatility was measured as the standard deviation of the moving average of the logarithm of the exchange rate. In addition, a time trend and a dummy were also included as explanatory variables. A dummy variable was generated at high and low peaks of the exchange rate to capture exchange rate misalignment. Coefficients with respect to exchange rate volatility and misalignment both indicated a negative impact on sectoral exports for these countries.

Sekkat & Varoudakis (2000) estimated the impacts of the exchange rate volatility on growth of exports for the Sub-Saharan Africa region. In this study, the share of export volumes to total GDP was treated as the dependent variable. The ratio of manufacturing GDP to total GDP, the real effective exchange rate, the exchange rate volatility and the exchange rate misalignment were used as explanatory variables. The impacts of exchange rate volatility and misalignment on exports were similar to what has been found by Serenis & Tsounis (2012). They both had a negative impact on the growth of exports in Sub-Saharan Africa. In addition, the coefficient with respect to the real effective exchange rate also had a negative impact on exports in the region.

Another study conducted by Elbadawi (1998) assessed how the exchange rate affects non-traditional exports in the African region. The model estimated the ratio of non-traditional exports to GDP as a function of exchange rate misalignment, exchange rate volatility, the ratio of machinery imports to GDP, terms of trade, real GDP per worker of OECD countries, and index of schooling (measured as an average of primary and secondary enrolment ratios). The results showed that imports of machinery, education, terms of trade, and real GDP per worker of OECD countries have significant positive impacts on non-traditional exports. While the coefficients with respect to exchange rate volatility and misalignment have negative impacts on non-traditional exports.

Mohamad & Jusoff (2008) undertook a study to examine the impacts of the exchange rate on the supply of exports of four Southeast Asian countries, including Indonesia, Malaysia, Singapore and Thailand. The study used the fixed effects model, where exports were treated as a dependent variable. Terms of trade, macroeconomic stability, the variability of the exchange rate, foreign demand, investment in capital goods and human capital were identified as explanatory variables. The results indicated that the variability of the exchange rate has a negative impact on exports. The results obtained also indicated that income of OECD countries as a measure of foreign demand has a positive impact on Southeast Asian countries' exports.

Mwansakilwa, Tembo & Mugisha (2013) investigated the impacts of the exchange rate on the demand for Zambia's flower exports from the Netherlands, Germany and the UK. They used an Error Correction Model (ECM) with time series data for the period 1990-2010. The quantity of flower exports was used as a dependent variable. Flower production, domestic GDP, GDP of importing countries, the real effective exchange rate, exports from competing countries, domestic population, population of importing countries, the domestic consumer price index, world prices, domestic credit to the private sector and the domestic interest rate entered the model as explanatory variables. The results indicated that production of flowers, relative depreciation, world prices, foreign GDP and foreign population increase the level of flower exports. While interest rate negatively affects flower exports.

Akinlo & Adejumo (2014) estimated the impacts of exchange rate volatility on non-Oil exports in Nigeria. They used an Error Correction Model (ECM) with quarterly time series data for the period 1986-2008. Non-Oil exports were regressed on a set of macroeconomic indicators, including; real foreign income (OECD industrial production), real intermediate imports, the real exchange rate and the exchange rate volatility. In the short run, all the variables have a positive impact on non-Oil exports, except for exchange rate volatility, although it was not significant. In the long run, foreign income, and the exchange rate had a positive impact on non-Oil exports, whereas the exchange rate volatility and imports have a negative impact on non-Oil exports.

A similar study was later conducted by Ndidi & Alaba (2019), who examined how non-Oil exports respond to exchange rate volatility in Nigeria. An Error Correction Model (ECM) was estimated using recent annual data for the period 1981-2017. Non-Oil exports were estimated as a function of exchange rate volatility, the lending interest rate, foreign direct investment and government expenditure. The results indicated that non-Oil exports respond negatively to exchange rate volatility. This study recommended that the government should promote policies that can encourage a stable exchange rate in order to influence non-Oil Exports. Still in Nigeria, another study examined the impact of exchange rate volatility on non-Oil exports (Inam & Oscar, 2018). An ECM was estimated with annual time series data for period 1970-2015. Non-oil exports were estimated as a function of the degree of openness (exports plus imports/GDP), the prime lending interest rate, the exchange rate volatility, money supply, government expenditure and inflation. The results indicated that non-Oil exports respond negatively to exchange rate volatility.

4. METHODS OF ANALYSIS AND DATA

4.1 MODEL SPECIFICATION

The model used to estimate the impacts of the exchange rate volatility on non-diamond exports in Botswana is specified by equations 1 and 2, which are long run and short run representations of an ARDL model, respectively. The specifications follow the model used by Serenis & Tsounis (2012), who examined how sectoral exports of Germany, Sweden and the United Kingdom (UK) respond to exchange rate volatility. Non-diamond exports are treated as a dependent variable and regressed on a set of macroeconomic indicators, including exchange rate volatility.

The long run specification of the ARDL model is as follows:

$$\log(NDE_t) = \alpha_0 + \alpha_1 \log(NDE_{t-1}) + \alpha_2 \log(rGDP_t) + \alpha_3 \log(REERv_t) + \alpha_4 \log(ITR_t) + \alpha_5 \log(WEcr_t) + \alpha_6 INF^{df}{}_t + \alpha_7 IR_t + \alpha_8 OECDg_t + a_9 Dreer + u_t \quad 1$$

where *NDE* is non-diamond exports and *rGDP* is real Gross Domestic Product excluding the diamond sector. *REERv* is exchange rate volatility, calculated as the standard deviation of the quarterly moving average of the logarithm of the REER (Serenis & Tsounis, 2012). REER was measured as the trade-weighted average of bilateral real exchange rate of the SDR and Rand per unit of the Pula. However, REER was dropped from the model because it was insignificant. Real investments in the transport sector and the water & electricity sector are represented by *ITR* and *WEcr*, respectively. Inflation differentials between Botswana and its major trading partners (SDR and Rand) is INF^{df}. The lending interest rate charged by commercial banks for lending money to customers is represented by *IR*. The GDP growth rate of OECD countries is denoted by *OECDg*. Equation 1 also includes a dummy variable *(Dreer)* for high and low peaks of the REER, which captures exchange rate misalignment. Greek letters, α, t and u, are the long run parameters, time period and an error term, respectively.

The short run model is specified by equation 2. Since there is the presence of a long run relationship amongst the variables, as will be discussed in Sub-Section 5.2, the short run dynamics include an error correction term which measures the speed at which the model adjusts to equilibrium. In equation 2, ε_{t-1} and the β are an error correction term and short run parameters, respectively. The rest of the terms are as defined in equation 1.

$$\Delta \log(NDE_t) = \beta_0 + \sum_{i=1}^{m1} \beta_1 \Delta \log(NDE_{t-i}) + \sum_{i=0}^{m2} \beta_2 \Delta \log(rGDP_{t-i}) + \sum_{i=0}^{m3} \beta_3 \Delta \log(REERv_{t-i}) + \sum_{i=0}^{m4} \beta_4 \Delta \log(ITR_{t-i}) + \sum_{i=0}^{m5} \beta_5 \Delta \log(WEcr_{t-i}) + \sum_{i=0}^{m6} \beta_6 \Delta(INF^{df}{}_{t-i}) + \sum_{i=0}^{m7} \beta_7 \Delta IR_{t-i} + \sum_{i=0}^{m8} \beta_8 \Delta OECDg_{t-i} + \beta_9 Dreer + \beta_{10} \varepsilon_{t-1} + u_t \quad 2$$

NDE, *rGDP* and *OECDg* are all measured in 2006 constant prices. *rGDP* reflects export supply capacity of a domestic economy; therefore, it is expected to positively impact non-diamond exports. *OECDg* is used to control for the demand for non-diamond exports in the international market, and is expected to have a positive impact on non-diamond exports. An increase in OECD GDP growth will induce more demand for domestic tradeable products. The REER used to generate exchange rate volatility *(REERv)* was rebased to 2006. Exchange rate volatility is expected to reduce external demand for non-diamond exports, due to uncertainty in the relative prices of non-diamond exports in the international market. However, the extent to which the exchange rate volatility impacts non-diamond exports will depend on whether the volatility is high or low, which is measured by the magnitude of its coefficient. A high/low exchange rate volatility would

have more/less severe impacts in the demand for non-diamond exports. Exchange rate volatility is expected to have a negative impact on non-diamond exports (Serenis & Tsounis, 2012).

The lending interest rate *(IR)* is used to reflect the cost of investment. A low lending interest rate will induce capital investment, which, as a result, will lead to a rise in the production of non-diamond exports. Higher domestic prices relative to foreign prices will lead to non-diamond exports being relatively more expensive in the international market; and as a result, it will lead to less demand for non-diamond exports. It is expected to have a negative impact on non-diamond exports. Investments in the water & electricity sector *(WEcr)* as well as in the transport sector *(ITR)* will potentially stimulate the production and supply of non-diamond exports. Hence they act as enabling factors for industrial development; they are expected to have a positive impact on non-diamond exports. A dummy variable at high and low peaks of the REER, which captures exchange disequilibrium, is expected to have a negative impact on non-diamond exports. Disequilibrium of the exchange rate brings uncertainty to relative prices of exports; as a result, it is expected to reduce the demand for non-diamond exports (Serenis & Tsounis, 2012; Sekkat & Varoudakis, 2000).

4.2 DATA AND DATA SOURCES

Quarterly time series data used in the analysis of this study for the period 1995-2018 were collected from different sources. Real GDP, excluding the diamond sector, non-diamond exports, domestic inflation rate, investment related to the transport, and water & electricity sectors were obtained from Statistics Botswana (Statistics Botswana, various issues). Real GDP excluding the diamond sector was generated by subtracting diamond GDP from total GDP. Real non-diamond exports were generated by subtracting nominal diamond exports from total nominal exports and deflating it with the domestic tradeable price index, also collected from Statistics Botswana. The real effective exchange rate and the commercial banks' prime lending interest rate were collected from Bank of Botswana statistics (Bank of Botswana, various issues). The real effective exchange rate was used to generate exchange rate volatility and misalignment. The growth rate of OECD countries, the inflation rate of SDR countries and that of South Africa (for the Rand) were obtained from the OECD Statistics Database (OECD, 2018).

5. RESULTS AND DISCUSSION

5.1 STATIONARITY TEST

The stationary test of the variables used in this study was conducted to detect if there is presence of unit root amongst the variables and determine their order of integration. The results are presented in Table 2. Based on the Augmented Dickey-Fuller (ADF) test, the results indicate that some variables were stationary at levels, I(0), while others

became stationary after second differencing, I(1). The results were further re-affirmed by the Phillips-Perron test, which was consistent with ADF test.

Table 2: Stationarity Test

	Test assuming intercept				*Test assuming intercept and trend*			
	ADF test		*Phillips-Perron*		*ADF test*		*Phillips-Perron*	
Non-Diamond Exports	-2.86	I(0)	-2.66	I(0)	-4.83	I(0)	-4.71	I(0)
Real GDP, excl. Diamonds	-5.68	I(1)	-5.89	I(1)	-7.65	I(0)	-7.04	I(0)
REER Volatility	-10.17	I(0)	-10.17	I(0)	-10.25	I(0)	-10.28	I(0)
Transport Investment	-8.91	I(1)	-16.34	I(1)	-8.91	I(1)	-17.77	I(1)
Water & Electricity Investment	-2.81	I(0)	-2.82	I(0)	-10.70	I(1)	-10.71	I(1)
Inflation Differentials	-2.04	I(1)	-2.68	I(1)	-3.78	I(1)	-3.85	I(1)
Lending Interest Rate	-6.90	I(1)	-6.95	I(1)	-7.20	I(1)	-7.27	I(1)
OECD GDP Growth	-8.65	I(1)	-8.62	I(1)	-8.66	I(1)	-8.63	I(1)

Note: ADF is Augmented Dickey-Fuller test.

5.2 CO-INTEGRATION TEST

To determine the presence of the long run relationship, an ARDL Long Run Form and Bounds Test was performed. If the F-test statistic is less than the I(1) bound value, the null hypothesis that there is no long run relationship cannot be rejected. The results of F-Bound Test are reported in Table 3.

The F-test statistic of 8.44 is evidently more than the I(1) bound value (1.86) at the 1% level of significance, implying that the null hypothesis of no co-integration can be rejected. The results suggest that variables are jointly co-integrated and have a long run relationship. Therefore, an ARDL model will be used because it is suitable for the combination of I(0) and I(1) variables, for which there is a long run relationship amongst them.

Table 3: F-Bounds Test

Test Statistics	Value	Significance	I(0) Bound	I(1) Bound
F-Statistic	8.44	10%	3.64	4.08
		5%	2.45	3.74
		1%	1.96	1.86

Note: F-Statistic is F-test Statistic

5.3 ESTIMATES OF AN ARDL MODEL

Table 4 shows the long run coefficients of the impact of exchange rate volatility as well as the other macroeconomic indicators on non-diamond exports, estimated using equation 1. The model fits the data reasonably well, as explained by the R-squared and adjusted R-squared, which are estimated at 86.78% and 83.08%, respectively. More than 83% of the variation in non-diamond exports is explained by the independent variables. In an effort to check for robustness of the estimated results, diagnostic tests were performed for the long run model (Appendix, Table A1). There was no serial correlation and heteroscedasticity detected in the model. In addition, the residuals were found to be normally distributed. A multi-collinearity test was conducted to find if there is the existence of high correlation between any two or more explanatory variables, the results are presented in Appendix, Table A4. The results show that there is no problem of multi-collinearity because there are no high correlation coefficients amongst the explanatory variables. All the estimated coefficients yielded theoretically expected signs and were statistically significant, except for inflation differentials.

The results show that the elasticities of non-diamond exports with respect to the first lag of non-diamond exports, real non-diamond GDP, real GDP growth rate of OECD countries, investment in the transport sector as well as the water & electricity sectors are positive. While the elasticities of non-diamond exports with respect to REER misalignment, REER volatility, the lending interest, and inflation differentials are negative.

Table 4: Long Run Results

Variable	Coefficient	T-Statistic	Probability
Constant	(2.89)	(4.15)	0.0057***
Real Non-Diamond Exports	1.61	7.84	0.0000***
Real Non-Diamond GDP	1.84	7.13	0.0428***
REER Volatility	(0.07)	(1.68)	0.1042*
Real Transport Investment	0.47	1.81	0.0743*
Real Water & Elect. Investment	0.63	2.54	0.0655*
Inflation Differentials	(0.02)	(0.74)	0.4628
Real Lending Interest Rate	(0.17)	(1.94)	0.0560*
Real OECD GDP Growth	0.71	2.35	0.0217**
REER Misalignment	(0.19)	(0.12)	0.0038***
Statistical Measure	**Value**	**Statistical Measure**	**Value**
R-Squared	0.8678	SSE	4.7676
Adj. R-Squared	0.8308	F-Stat. (Prob.)	0.0000

*Note: ***, **, and * indicate the coefficient are significant at the 1%, 5% and 10% level of significance, respectively. Figures in parentheses are negative.*

Non-diamond exports respond negatively to the exchange rate volatility, indicating that it hinders the growth of non-diamond exports due to less foreign demand for non-diamond exports. As mentioned earlier, the extent to which exchange rate volatility affects non-diamond exports depends on whether the volatility is high or low, which is measured by the magnitude of its coefficient. As it can be observed from Table 4, it is estimated at -0.07, which is relatively low, suggesting that it has not had harmful impacts on non-diamond exports. A percentage change in exchange rate volatility will reduce non-diamond exports by 0.07%. This illustrates the efforts made by the government to maintain a stable exchange rate. However, the economy of Botswana is still dominated by diamond exports, despite the efforts made to have a stable exchange rate and maintain the competitiveness of tradeable products. The findings are consistent with other studies (Serenis & Tsounis, 2012; Sekkat & Varoudakis, 2000).

Other variables which may be of interest are: Real non-diamond GDP, real investment in the water & electricity sector, as well as real investment in the transport sector. The estimated results indicate that a percentage change in real non-diamond GDP will increase non-diamond exports by 1.84%, suggesting that the growth of the non-diamond sector has the potential to boost non-diamond exports. Coefficients with respect to real investment in the water & electricity sector as well as in the transport sector are relatively low, which were estimated at 0.63 and 0.47, respectively, indicating that investment in both sectors will increase non-diamond exports. However, the findings suggest that a rise in non-diamond exports is less than proportionate to the increase in the investments in the water & electricity sector and in the transport sector. This could be explained by, amongst others, lack of investment, and the high costs of utilities and services.

Table 5 shows the short-run results estimated using equation 2. The R-squared and adjusted R-squared for the short run dynamics were estimated at 81.2% and 78.7%, respectively. Diagnostic tests were also conducted and the results are presented in the Appendix, Table A2. There was no presence of serial correlation and heteroscedasticity in the short run model. In addition, residuals are normally distributed. All the estimated coefficients yielded the theoretically expected signs, and were statistically significant.

Table 5: Short Run Results

Variable	Coefficient	T-Statistic	Probability
Constant	0.34	3.22	0.0344**
Real Non-Diamond Exports	0.98	4.64	0.0001***
Real Non-Diamond GDP	1.25	2.94	0.0308**
REER Volatility	(0.04)	(6.32)	0.0058**
Real Transport Investment	0.18	2.06	0.0168**
Real Water & Elect. Investment	0.43	2.54	0.0037**
Inflation Differentials	(0.01)	(2.70)	0.1017*
Real Lending Interest Rate	(0.09)	(2.01)	0.0820*
Real OECD GDP Growth	0.48	3.35	0.0945*
REER Misalignment	(0.12)	(3.74)	0.0612*
Error Correction Term	(0.76)	(4.61)	0.0004***
Statistical Measures	**Value**	**Statistical Measures**	**Value**
R-Squared	0.8123	SSE	4.7676
Adj. R-Squared	0.7874	F-Stat. (Prob.)	0.0000

*Note: ***, **, and * indicate the coefficient are significant at the 1%, 5% and 10% level of significance, respectively. Figures in parentheses are negative.*

The coefficient for non-diamond exports with respect to exchange rate volatility is negative, but relatively low, indicating a minimal impact on the growth of the non-diamond exports. The results suggest that the volatility of the Pula exchange rate has not had a harmful impact on non-diamond exports, which could have been influenced by the stability of the exchange rate.

6. CONCLUSIONS AND POLICY IMPLICATIONS

The objective of this study is to estimate the impact of exchange rate volatility on non-diamond exports in Botswana, using an ARDL model with quarterly time series data for the period 1995-2018. The estimated results indicate that non-diamond exports respond negatively to exchange rate volatility. In the long run, a percentage change in exchange rate volatility will reduce non-diamond exports by 0.07%. While in the short run, it will reduce non-diamond exports by 0.04%. The findings suggest that exchange rate volatility hinders the growth of non-diamond exports, but with very little impact due to exchange rate policies which have consistently sought to promote a stable exchange rate. These results are consistent with findings obtained in other studies (Serenis & Tsounis, 2012; Sekkat & Varoudakis, 2000).

In the long run, the coefficients with respect to real non-diamond GDP, transport

investment and water & electricity investment have a positive impact on non-diamond exports. The estimated results indicate that a percentage change in real non-diamond GDP will boost non-diamond exports by 1.84%, suggesting that the non-diamond sector has the potential to promote export diversification. The coefficients for non-diamond exports with respect to investments in the transport sector (0.47) and water & electricity sector (0.63) are relatively low, suggesting that a rise in non-diamond exports is less than proportionate to the increase in the investments in both sectors. These findings are consistent with what was noted by Phetwe (1997), Sekwati (2010) and Grynberg (2011), who stated that diversification of Botswana's export structure has been limited by, amongst others, lack of industrial development, limited investment, and high costs of utilities as well as services.

As noted earlier, other export commodities are contributing little to total exports, leading to a relatively undiversified structure of exports and the whole economy. Statistics show that the shares of different export commodities to total exports, including diamonds, copper-nickel, beef, salt & soda ash, textiles, vehicles & transport equipment and other exports were estimated at averages of 66.2%, 6.5%, 1.9%, 1.3%, 2.2%, 3.0% and 18.9%, respectively. This indicates that Botswana's export sector is still relatively undiversified, and dominated by diamond exports. This could be seen as an economic threat because dependency on one export commodity could expose the economy to external shocks, as was experienced during the 2008/09 global financial and economic crisis.

Therefore, if the objective of the exchange rate policy is to increase the demand for local export products in the international market and diversify the export base, the policy should continue encouraging a stable and competitive exchange rate that can attract increased foreign demand for tradeable products. On the other hand, other strategic policies that can promote export diversification should focus on expanding the production of the non-diamond sector in order to increase non-diamond-related products. Providing a more conducive environment by committing more investment in the transport sector as well as in the water & electricity sector will enable the government to achieve the objectives of sustainable export and economic diversification.

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APPENDIX

Table A1: Diagnostic Tests (Long Run Model)

Test	P-Value	Conclusion
Histogram Normality Test	0.48	Residuals are normally distributed
LM Serial Correlation	0.15	Variance in residuals is constant over time
Heteroscedasticity (ARCH)	0.19	No cross section correlation in residuals

Table A2: Diagnostic Tests (Short Run Model)

Test	P-Value	Conclusion
Histogram Normality Test	0.25	Residuals are normally distributed
LM Serial Correlation	0.11	Variance in residuals is constant over time
Heteroscedasticity (ARCH)	0.13	No cross section correlation in residuals

Figure A1: Stability Test (Long Run)

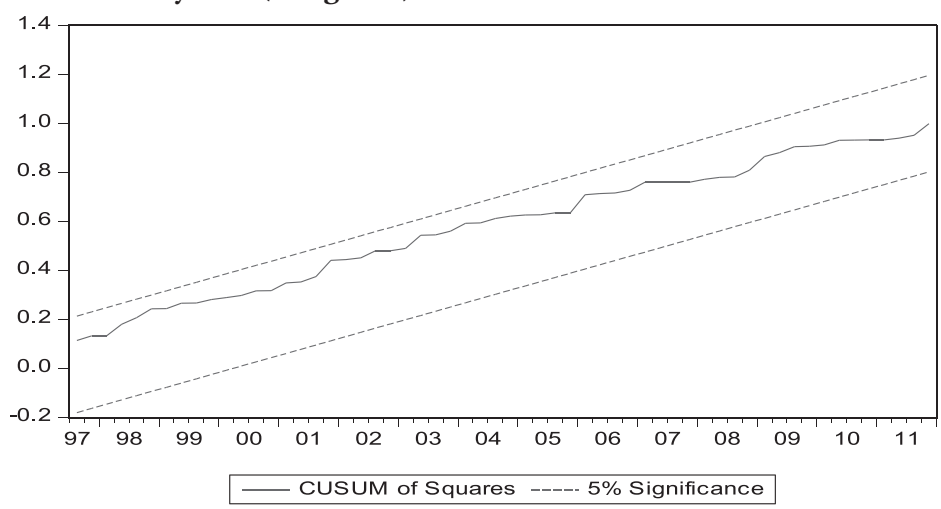

Figure A2: Stability Test (Short Run)

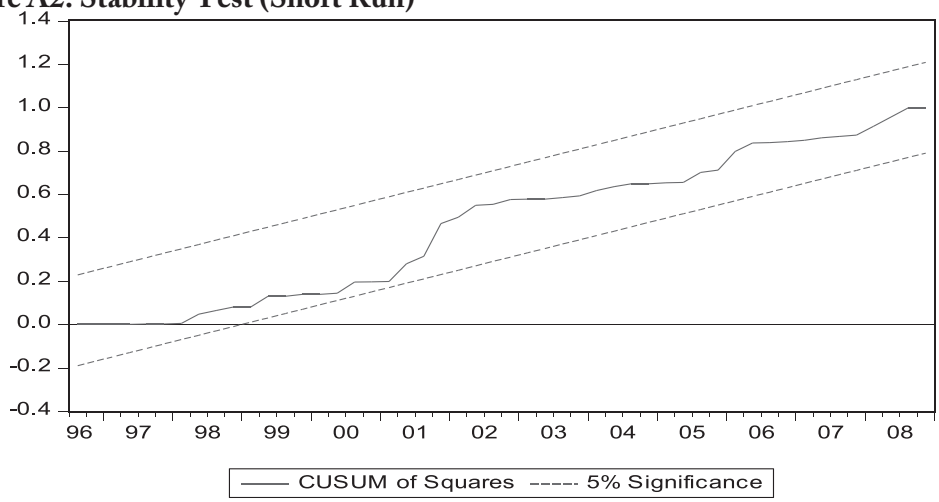

Table A3: Descriptive Statistics

	NDE	*rGDP*	*ITR*	*WEcr*	*REERv*	*INF^{df}*	*R*	*OECDg*
Mean	3577.4	17499.1	397.0	81.7	0.055	3.31	12.7	2.14
Median	3662.1	14858.1	393.1	70.9	0.035	3.55	13.9	1.93
Maximum	7681.7	41618.9	751.9	186.8	0.577	10.0	17.0	19.9
Minimum	866.6	3358.2	146.5	12.4	0.007	-1.11	6.50	-13.1
Std. Dev.	1672.9	11561.9	174.3	45.4	0.079	2.48	3.58	5.35
Observations	84	84	84	84	84	84	84	84

Table A4: Multi-Collinearity Test (Correlation Analysis)

	rGDP	*ITR*	*WEcr*	*REERv*	*INF^{df}*	*R*	*OECDg*
rGDP	1	0.56	0.46	-0.32	-0.67	-0.62	0.56
ITR	0.56	1	0.58	-0.22	-0.21	-0.48	0.60
WEcr	0.46	0.58	1	-0.11	-0.16	-0.24	0.56
REERv	-0.32	-0.22	-0.11	1	0.13	0.22	-0.20
INF^{df}	-0.67	-0.21	-0.16	0.13	1	0.45	-0.63
R	-0.62	-0.48	-0.24	0.22	0.45	1	-0.53
OECDg	0.56	0.60	0.56	-0.20	-0.63	-0.53	1

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