Are Devaluations Contractionary in Small Import-dependent Economies? Evidence from Botswana

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Abstract

This study tests the contractionary devaluation hypothesis in the context of a small open import-dependent economy. Using an error-correction model that controls for monetary policy, fiscal policy, base country output and interest rates, the study finds that currency devaluations are contractionary in the long run and expansionary in the short-run. Other results are that increases in government consumption expenditure and base country output are expansionary, while monetary policy has the expected negative output effect.

Keywords: contractionary devaluation, error-correction model, small import-dependent economy

1. Introduction

The impact of exchange rate changes on economic activity is a subject of interest, especially in developing and emerging market economies. A standard textbook characterization suggests that devaluations or currency depreciations have expansionary effects on domestic production and incomes. The basic idea of the traditional view is that devaluation raises the real volume of exports and reduces the real volume of imports, thus providing extra income and jobs to the exporting and import-competing sectors. This expenditure-switching from imports to domestic goods in turn boosts aggregate demand and ultimately output. This view of the exchange rate effect has led policymakers in fixed exchange rate systems to actively use currency devaluations as a tool to promote exports and economic growth. However Diaz-Alejandro (1963) and Cooper (1971) have long cautioned against unqualified acceptance of this view, pointing to the possibility that devaluations could be contractionary in developing countries.

A seminal paper by Krugman and Taylor (1978) formalized the channels through which devaluations could lead to output contraction in developing and emerging market economies. Since, then empirical research turned up evidence of contractionary devaluation in this group of countries. Using data from 12 developing countries, Edwards (1986) has shown that currency devaluation is contractionary in the short run and neutral in the long run. Taye (1999) found that, contrary to the conventional wisdom, devaluation decreases output and employment in Ethiopia. Miteza (2006) found that real devaluations are contractionary in five transition economies of the Czech Republic, Hungary, Poland, Slovakia and Romania.

Theoretical arguments in support of the contractionary devaluation hypothesis can be divided into demand side and supply-side effects.[16] On the demand side, Diaz-Alejandro (1963) and Krugman and Taylor (1978) argue that currency devaluation can lead to a reduction in output by depressing the wage share. For example, devaluation may lead to immediate increases in prices, but because nominal wages take time to adjust, real wages may decline temporarily. This may generate a redistribution of income from groups with lower marginal propensity to

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[16] See Bahmani-Oskooee and Miteza (2003) and Frankel (2005) for a detailed review of the different channels through which devaluations and appreciations could be contractionary in developing and emerging market economies.

save (wage earners) to groups with higher marginal propensity to save (exporters and firm owners), which would in turn dampen aggregate demand and hence output. Similarly, since money supply takes time to catch up, real money balances may decline leading to a reduction in aggregate demand and output. Moreover, if price elasticities of imports and exports are low, devaluation might worsen the international terms of trade, making the country pay more in real exports for each unit of imports purchased. If the terms of trade worsen following currency devaluation, real purchasing power of households will fall, inducing them to cut back on spending, which might lead to a recession. On the supply side, Van Wijnbergen (1986) uses a model with intermediate goods and informal financial markets to show that under certain conditions devaluation can be recessionary. This view is supported by Miller et al. (2006), who argue that even if devaluation discourages imports, some inputs must be imported because they are not available domestically and this can increase the cost of production and thus decrease output. As pointed out by Frankel (2005) and Bebczuk et al. (2006), a contractionary devaluation may also arise when firms face currency mismatches which produce adverse effects on their balance sheets. Finally, counter-inflationary macroeconomic polices used to control the inflation effects of devaluation may increase the cost of financing working capital and thus dampen output (Kamin and Rogers, 1997).

Despite the abundance of both theoretical and empirical evidence pointing to possible contractionary devaluations in developing and emerging market economies, many developing countries continue to actively use currency devaluations as a tool to promote exports and economic growth. In this paper we examine the impact of exchange rate changes on real economic activity in Botswana. We focus on Botswana for two reasons. First, the country has a long history of using exchange rate adjustments as a policy tool to promote external competitiveness and export diversification. Until recently, the pula would be devalued whenever the authorities considered it to have appreciated beyond what they regarded to be consistent with the competitiveness of the non-mining sector. Since May 2005, the country moved to a crawling-peg exchange rate system where, the pula exchange rate is adjusted continuously rather than in discrete steps as it was previously the case. Second, Botswana's heavy dependence on imports of intermediate and capital goods raises a possibility of contractionary devaluation. Finally, literature on the output effects of currency devaluations in Botswana is very thin. Yiheyis (2006), which is the closest recent antecedent to our study, addresses this question by including Botswana in a pool of 20 African nations covering the period 1981-1999. However, results from panel data studies have limited policy implications for individual countries as they do not explicitly account for country-specific effects. Our study contributes to this literature in two ways. First, it covers a more recent period, 1993-2010. Second, it considers Botswana alone and thus has the advantage of adequately controlling for the country-specific effects. The other paper, Motlaleng (2004), only examines the importance of exchange rate changes on exports in Botswana.

The rest of the paper is organized as follows. The next section presents an overview of the exchange rate management in Botswana. Section 3 reviews some recent empirical literature on exchange rate-output nexus. This is followed by a discussion of the analytical framework used in this study. Section 5 discusses the data and estimation results of the study. Conclusions and policy recommendations are presented in section 6.

2. Exchange rate regimes and policy objectives

For much of the period under study, Botswana operated an adjustable peg exchange rate system, where the domestic currency is pegged to a trade-weighted basket of currencies consisting of the South African rand and special drawing rights (SDR). The SDR is the International Monetary Fund's unit of account comprising of the US dollar, the euro, the British pound and the Japanese yen. The benefit of this exchange rate arrangement was to mitigate the danger of domestic currency appreciation, especially during periods of unusually high export earnings from the diamonds sector, which might have eroded competitiveness in the other sectors (Bank of Botswana Annual Report, 2008). The arrangement also allowed Botswana to import and benefit from credible policies of these large countries. Alterations in the rate were determined by policymakers and took the form of discrete changes to the composition of the basket as well as devaluation and revaluation in order to achieve the objective of a stable real effective exchange rate (Masalila and Phetwe, 2001 and Motlaleng 2004). Since the early 1990s the adjustments were dominated by the need to maintain competitiveness, as measured in terms of movements in the real effective exchange rate (Masalila and Phetwe, 2001). Table 1 summarizes the exchange rate alterations over the study period and reasons for the changes.

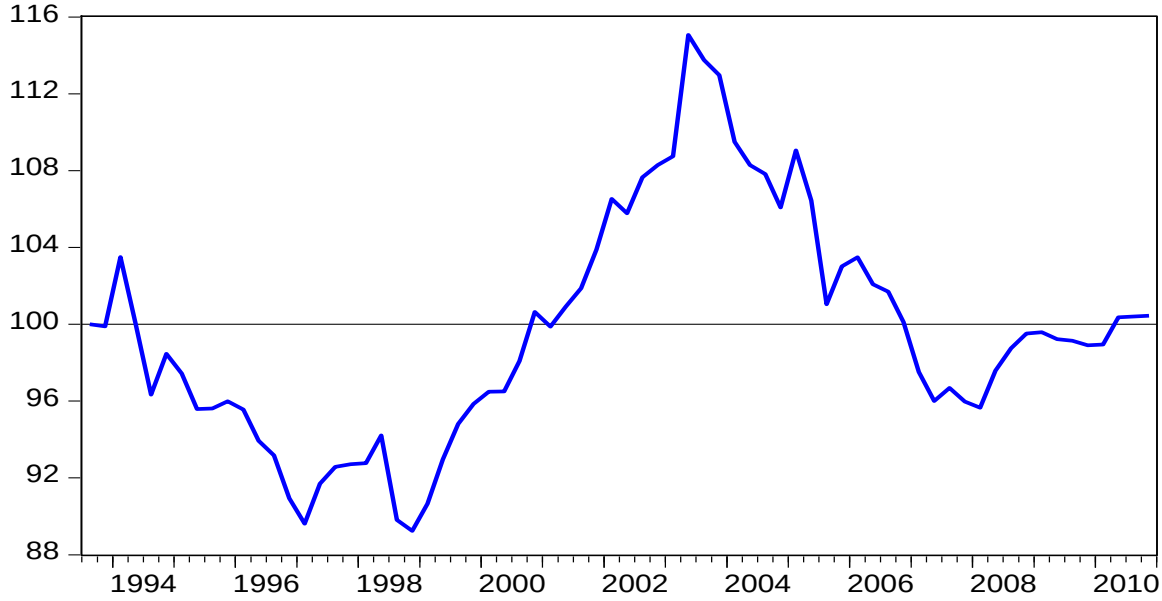
Table 1 Chronology of exchange rate adjustments.

Date	*Action*	*Reason*
August 1990	5 percent devaluation	Competitiveness measure
August 1991	5 percent devaluation	Competitiveness reason
June 1994	Technical adjustment	Competitiveness and exchange rate stability
February 2004	7.5 percent devaluation	Competitiveness reason
May 2005	12 percent devaluation	Competitiveness reason
May 2005	Adoption of crawling peg mechanism	Avoid discrete adjustments to the exchange rate

Source: Bank of Botswana Annual Report, 2007

In May 2005 Botswana switched to a crawling peg exchange rate system. The objective of the exchange rate policy remained the maintenance of real effective exchange rate stability. However, in this new system the exchange rate is adjusted continuously in a forward-looking manner based on the differential between the Bank's inflation objective and the forecast inflation for trading partner countries, rather than in huge discrete changes as was previously the case. The crawling peg mechanism allows for a ±0.5 percent margin around the central parity. It is clear from Figure 1 below that the introduction of the crawling peg system brought some degree of stability to the real effective exchange rate movements.

Figure 1 Real effective exchange rate index (1993q3=100)



Source: Authors' calculations based on data from Bank of Botswana

3. Recent empirical research

A survey of the literature revealed that several modeling strategies have been employed to analyze the impact of currency devaluation on economic activity.[17] This section presents a summary of some recent literature on exchange rate-output nexus in developing and emerging market economies. Kalyoncu et al (2008) use error-correction model to regress real GDP of 23 Organization of Economic and Cooperation Development (OECD) countries on the real exchange rate. They found that devaluations tended to reduce output in six countries, raised output in three and had no effect on output in fourteen countries. However, by considering only the exchange rate as the independent variable, the study did not adequately control for the many variables that might simultaneously induce devaluation and economic contraction, such as terms of trade, monetary policy response and government spending. Bahmani-Oskooee and Kutan (2008) regresses real GDP of nine emerging market economies of Eastern Europe on real exchange rate, real money supply and real government expenditure in an error-correction model. They found that real devaluations boost output in four countries, dampens it in four and has no effect on one country. The impact was found to be the same in both the short-run and long run.

El-Ramly and Abdel-Haleim (2008) use VAR to analyze the effect of real exchange rate depreciation on Egyptian output. They found that depreciations were contractionary in the short-run, but expansionary in the long run. However, VAR studies have two main weaknesses. First, is the issue of identification and interpretation of the exchange rate shocks. This is because what might be regarded as shocks could be the effects of some omitted important variables. Second, it is difficult to interpret whether shocks represent short or long-term effects. Table 2 below presents a summary of some of the studies that have been carried out in the area.

[17] See Kalyoncu et al (2008) for a discussion of the most commonly used approaches.

Table 2: Summary of Selected Previous Studies

Author/year	*Country/region*	*Main findings*
Wijnbergen (1986)	LDCs	Contractionary
Edwards (1986)	LDCs	Contractionary
Nunnenkamp and Schweickert (1990)	LDCs	Contractionary in the short-run; expansionary in the long run
Bahmani-Oskooee and Rhee (1997	Korea	Expansionary in the long run
Bahmani-Oskooee (1998)	Fiji	Expansionary
Taye, H. (1999)	Ethiopia	Contractionary
Acar, M. (2000)	LDCs	Contractionary in the short-run; expansionary in the long run
Upadhyaya, K. & M. Upadhyay (1999)	6 Asian countries	Neutral
Upadhyaya, K. et al. (2000)	Latin America	Contractionary
Upadhyaya, K. et al. (2004)	Greece & Cyprus	Expansionary in the short run
Miteza (2006)	5 Emerging economies	Contractionary in the long run
Yiheyis (2006)	20 African Countries	Contractionary in the short-run; expansionary in the long run
El-Ramly and Abdel-Haleim (2008)	Turkey	Contractionary in the short-to-medium term; expansionary in the long run
Kalyoncu, H. et al. (2008)	OECD	Expansionary for some and contractionary for others
Bahmani-Oskooee and Kutan (2008)	Eastern Europe	Expansionary in 3 countries and contractionary in 6 countries and neutral in others
Apadhyaya, K. et al. (2009)	Kenya, Tanzania & Uganda	Neutral in the short-run and expansionary in the long run

Source: Compiled by Authors

4. Analytical framework and estimation methodology

The empirical model used in this study is formulated along the lines of Edwards (1986), Yiheyis (2006) and Kalyoncu et al. (2008), among others. The baseline estimating equation is given in Eq. (1) below.

$$logY_t = \alpha_0 + \alpha_1 logrer_t + \sum_{i=2}^{k} \alpha_i X_i + \varepsilon_t \quad (1)$$

Eq. (1) is a reduced form model in which Y is a measure of real output; rer is the real effective exchange rate, X is a vector of two sets of important control variables, representing domestic and external shocks and ε is a random error term. The first set of controls comprises proxies for domestic monetary (i) and fiscal (G) policies that might be correlated with changes in exchange rates. These are common control variables in econometric models that study the relationship between the exchange rate and output (see, e.g., Edwards, 1986; Kamin and Klau, 1998; Yiheyis, 2006; Bahmani-Oskooee and Kutan, 2008 and Upadhyaya et al., 2009). The second set of controls is included to capture the effects of shocks to foreign interest rates (i*)

and foreign output (Y*). An increase in foreign interest rates may induce capital outflows resulting in devaluations and economic contraction. Similarly, a decline in a major trading partner's GDP may simultaneously dampen economic activity and force monetary authorities to devalue. Kamin and Klau (1998) argue that if these effects are not controlled for they may lead to a spurious correlation between exchange rate and GDP. Therefore the fully extended model is specified as:

$$logY_t = \alpha_0 + \alpha_1 logrer_t + \alpha_2 i_t + \alpha_3 logG_t + \alpha_4 i_t^* + \alpha_5 logY_t^* + \varepsilon_t \quad (2)$$

According to Eq. (2), the long run effect of the exchange rate on output effect will be reflected in α_1. A positive and statistically significant α_1 implies that output increases with currency appreciation, suggesting that devaluations are contractionary. However, if this coefficient is negative and statistically significant it would mean that devaluations are expansionary. Although this study is not explicitly interested in the conditioning variables, it is useful to discuss their expected signs. An increase in the interest rate or a contractionary monetary policy is expected to dampen aggregate demand and output; hence we expect α_2 to be negative. α_3 can take either a positive or negative sign depending on the extent to which government expenditure crowd-in or crowd-out private investment. If government expenditure crowds-out private sector spending, the coefficient will be negative and statistically significant. An increase in the interest rate in major trading partner(s) is expected to dampen domestic economic activity through the interest rate channel. Finally, an increase in base country output is expected to lead to an increase in domestic economic activity through the export channel; hence we expect α_5 to be positive.

The empirical counterparts of the variables specified in Eq. 2 above are as follows: y is log of real non-mining private GDP. Real non-mining private GDP is considered because Botswana's exchange rate policy has always been directed at promoting non-mining exports; e is log of real, end-of-period multilateral exchange rate (up means appreciation); i is the bank rate, which is the interest rate at which the Bank of Botswana lends to financial institutions to finance their overnight liquidity needs, and is a proxy for monetary policy. A central bank concerned with the control of inflation is expected to adjust its policy instrument to control the inflation effects of devaluations. The bank rate is measured in annual percentages; g is log of government consumption expenditure, which proxies for fiscal policy; i_t^* is the real South African three-month Treasury bill interest rate and is in annual percentage; y_t^* is log of the South African GDP.

5. Data and estimation results

The data for the statistical analysis are quarterly data for the period 1993Q3 to 2010Q4 and are obtained from Bank of Botswana Annual Reports, Botswana's Central Statistics Office and the IMF's International Financial Statistics website. A practical problem in characterizing relationships between output and the exchange rate concerns the stationarity properties of the data and the model specification to use. The tests for data-stationarity were performed using the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests and the results are presented in Table 3 and Table 4 below. Both tests fail to reject the null hypothesis of non-stationary of all the variables except government expenditure. While ADF rejects the null hypothesis of non-stationary of government expenditure, the PP fails to reject it. In view of the weaknesses of the ADF in small samples, we take the results of the PP test and conclude that all the variables are non-stationary in their log levels, but integrated of order one, I (1).

Table 3: Unit Root and Stationarity Tests: Levels of variables

	ADF(τ)				PP(τ)			
Series	Trend	lag	constant	lag	trend	lag	constant	lag
y	-1.790	1	-1.294	1	-3.090	3	-0.864	13
*y**	-2.521	1	-0.250	1	-1.799	5	-0.105	4
g	-3.595	0	-2.358	0	-3.466	1	-2.084	4
i	-0.799	1	-0.883	0	-0.674	3	-0.754	4
*i**	-3.181	1	-1.612	1	-2.252	0	-1.337	1
e	-1.484	0	-1.328	0	-1.586	3	-1.427	3

Notes: ADF stands for the Augmented Dickey-Fuller and PP the Phillips-Perron tests. All tests include a constant. Trend implies test with both trend and a constant. For both ADF and PP tests with a trend and constant, the critical values are: -4.156, -3.504 and -3.182 for the 1%, 5% and 10 % significance level, respectively. For the tests with just a constant the critical values are -3.571, -2.922 and -2.599, respectively.

Table 4: Unit root tests: First difference of variables

	ADF(τ)		PP(τ)	
Series	constant	lag	constant	lag
y	-10.830	3	-13.139	11
*y**	-3.511	0	-3.511	3
i	-5.750	0	-5.841	3
*i**	-6.360	0	-6.312	3
e	-7.545	0	-7.538	3

For both ADF and PP tests the critical values are -3.571, -2.922 and -2.599 for the1%, 5% and 10 % significance level, respectively.

Estimating models in which non-stationary variables enter in their levels might lead to spurious results. However, if there are cointegrating relationships, achieving stationary through differencing throws away valuable information about the long-run relationships among the variables (Favero, 2001). The appropriate specification in this case would be an error-correction model (ECM). A major strength of ECM is its ability to capture both the short- and long-run effects of one (or more) series on another. This paper employs a two-step procedure suggested by Engle and Granger (1987) cointegration test to test for the existence of long-run relationships. In the first step, the long-run equilibrium output model, Eq. (2), is estimated by ordinary least squares, and the results are given in Eq. (3) below.

$$y = -15.61 + 0.53e + 0.16g + 1.39y^* + 0.001r^* - 0.02r \qquad (3)$$
$$(3.46)\quad (1.83)\quad (11.99)\quad (2.80)\quad (4.28)$$

The figures in parenthesis are the respective t-values. We then calculated the residuals from Eq. (3) and tested them for stationarity using the ADF and PP tests. The ADF test statistic is -3.49 with a MacKinnon (1996) p-value of 0.011. The PP test statistic is -3.33 with a MacKinnon (1996) p-value of 0.016. This means that the null hypothesis of non-stationarity of the residuals is rejected - confirming existence of contegrating relationships among the model variables.

In the second step the calculated residuals from estimation of the equilibrium model are used in an error-correction model (ECM), which specifies the system's short-term dynamics. The ECM takes the following general form:

$$\Delta lnY_t = \beta_0 + \sum_{i=1}^{n} \alpha_i \Delta lnY_{t-i} + \sum_{i=0}^{n} \beta_i \Delta lnrer_{t-i} + \sum_{i=0}^{n} \delta_i \Delta r_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta lnG_{t-i} + \sum_{i=1}^{n} \tau_i \Delta lnY^*_{t-i} + \sum_{i=1}^{n} \beta_i \Delta r^*_{t-i} + \lambda EC_{t-1} + \varepsilon_t \qquad (3)$$

where, EC_{t-1} is the equilibrium error component lagged one period, and it measures the speed at which output returns to equilibrium after a deviation has occurred, Δ is the difference operator and all other variables are as defined before. Following Henry's (1995) general-to-specific modeling approach, the model was first estimated with four lags of each of the

explanatory variables and then the insignificant variables were gradually pared down. The results of the remaining parsimonious model are presented in Table 5.

Table 5 Error-correction model results: Dependent variable - Δy

Estimated coefficient on	**Eq. 3.1**
constant	0.03 (6.61)
Δe_t	0.39 (2.45)**
Δe_{t-4}	-0.53 (-3.61)***
Δg_{t-1}	-0.09 (-3.06)***
Δg_{t-3}	-0.18 (-4.78)***
Δg_{t-4}	-0.16 (-4.29)***
Δy^*_{t-3}	-1.51(-3.18)***
Δi^*_{t-2}	0.01 (2.19)**
Δi_{t-4}	0.01 (1.90)*
ECM_{t-1}	-0.31 (-4.92)***
Adj. R^2	0.64
F-statistic	11.71 [0.00]
SEE	0.02
N	65
Residual Diagnostics	
D-W	1.80
B-G LM test{4} F-Stat	2.18 [0.08]
ARCH{1} F-Stat	0.15 [0.69]
ARCH{4} F-Stat	1.18 [0.32]
J-B {Normality}	0.22 [0.89]
Stability Diagnostics	
CUSUM test	Stable

Notes: *, **, *** denotes significance at the 10%, 5% and 1% level, respectively. The numbers in round brackets are the absolute values of the t-statistics, while those in square brackets are the probability values.

The estimation results presented in Table 5 look reasonable in terms of the coefficient of determination, the F-statistics and the direction of the coefficients. Residual diagnostics for serial correlation, heteroskedasticity, normality, serial correlation and stability diagnostics are also examined. The CUSUM and CUSUM of Squares tests support stability of the estimates (Table B1 and Table B2 in the Appendices). The Lagrange Multiplier (LM) test indicates no autocorrelation in the residuals at the 10 % level of significance. Results of the Jarque-Bera test show that all series are jointly normal. The model is therefore accepted as adequate and reliable for the analysis of the contractionary devaluation thesis.

The results above indicate that the explanatory variables of the model are jointly significant and explain over 64 percent of the variations in the output growth. The sum of the coefficients on the change in the real exchange rate is negative and statistically significant, indicating that appreciations of the real exchange rate lower output growth. The finding that devaluations are expansionary in the short-run is consistent with those of Upadhyaya, K. et al. (2004) for Greece and Cyprus. However, it contradicts much of the empirical literature on developing and emerging market countries (see, e.g., Edwards (1986) for 12 developing countries, Kamin and Klau (1998) for 27 industrial and non-African developing countries and Yiheyis (2006) for 20 African countries). The latter found devaluations to have contractionary output effects in the short-run. This result is not unexpected for Botswana because non-mining production is

done mainly by small and medium enterprises who are likely to respond quickly to changes in relative prices. The coefficient on government expenditure is negatively associated with growth in non-miming private output. This could be because of inefficiencies in the government expenditure due to implementation capacity. Growth in base-country output is also negatively associated with domestic output growth. One possible explanation for this rather puzzling result could be that the resultant inflationary pressures in the South Africa raise the prices of imported intermediate inputs. In the short-run domestic producers may not be able to switch input suppliers and given their import dependence, they may reduce production. The coefficient on the error-correction term is low indicating that deviations from equilibrium are corrected at about 31 percent per quarter.

Results from the long run model indicate that an appreciation of the exchange rate is associated with output expansion, indicating that devaluations are contractionary in Botswana. This finding runs against the grain of the textbook characterization of the effects of devaluation. However, it is consistent with some recent developing country empirical literature (see, e.g., Miteza (2006) and Upadhyaya, K. et al. (2000)). This effect is not entirely unexpected for Botswana for the following reasons. First, most of the goods and services traded in Botswana are imported and therefore devaluation is likely to be inflationary, which in turn can harm economic growth. Second, since most of the intermediate inputs are imported, devaluation increases the cost of imported intermediate inputs which in turn dampens aggregate supply (see McCallum and Nelson, 1999; 2001 and Miller et al (2006)). This supply-side effect is more likely to be strong where most of the products are for final consumption in the domestic economy as is the case in Botswana's non-mining sector.

The coefficients on most control variables are of the expected signs and are statistically significant. The coefficient on government expenditure is positive and significant at the 10 percent level, which is consistent with our priors: much of private consumption and investment expenditure in Botswana is believed to be driven by government expenditure. Increase in domestic interest rate has a negative and statistically significant output effect as expected. This suggests that monetary policy has a role to play in output stabilization. South African output has a large positive and statistically significant effect on non-mining private output in Botswana. As the base economy from which most non-mining imports and investment originate and exports are destined, South African output is expected to be the most important determinant of economic activity in Botswana. The positive influence of South African interest rates on Botswana output is difficult to explain.

6. Conclusion

The purpose of this study was to test the contractionary devaluation thesis in Botswana. The study adopted a two-step Engle and Granger (1987) error-correction model that controls for domestic and foreign monetary policy, fiscal policy and base country output. The results indicate that devaluations are expansionary in the short-run and contractionary in the long run. The other findings of the study are that government expenditure dampens economic growth in the short run and promote it in the long run. As expected, contractionary monetary policy dampens economic activity in the long run. South African output is found to be the main driver of Botswana's non-mining private output in the long run.

These results have important policy implications for Botswana and other import-dependent economies. First, because devaluation has a contrationary output effect in the long run; it means that care should be excised when attempting to use currency devaluation to promote

economic activity. In fact, the results suggest that currency devaluation is not a policy option for this purpose. Second, government expenditure is still an important driver of economic activity in Botswana, suggesting that reduction in government activity needs to be gradual so as not to destabilize the economy. The large impact of South African output also suggests a need to diversify the economy to reduce reliance on that country.

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Appendices

A. Data: Descriptions, sources and statistics

Table A1: Description of data used

Variable	*Description & transformations*	*Source*
y	Log of real non-mining private GDP (sa)	BoB
i	Bank rate	BoB
g	Log of government expenditure (sa)	BoB
*y**	Log of real South African GDP (sa)	IFS
*i**	3-month South African Treasury Bill rate	IFS
e	Log of real effective exchange rate	BoB

Notes: BoB is Bank of Botswana; IFS - IMF's International Financial Statistics and sa – seasonally adjusted. Adjusting for seasonality was performed using Census – X12 method.

B. Stability tests

Table B1: CUSUM Test results

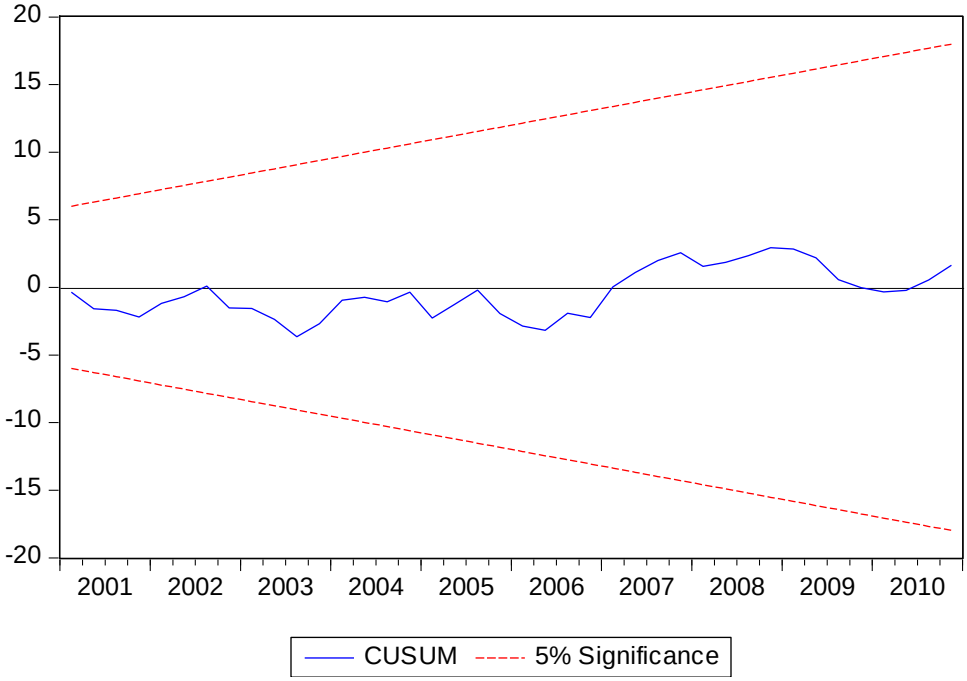

Table B2: CUSUM of Squares Test Results