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Determinants of foreign exchange reserves in Eswatini: An ARDL approach

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Abstract

Using the autoregressive distributed lag (ARDL) bounds testing cointegration method, the paper models the behaviour of Eswatini's foreign exchange reserves over the period 1990-2014. An augmented buffer stock model is applied and the results indicate that foreign exchange reserves in Eswatini are driven by GDP per capita, developments in the current account, government expenditure and movements in the exchange rate. With the growth in Eswatini's foreign exchange reserves lagging behind the growth rates observed in other emerging economies, the findings from the study imply that monetary authorities should increase efforts to build reserves in order to boost confidence in the currency peg to the South African rand and enhance financial stability in Eswatini.

Keywords: ARDL; Cointegration; Foreign exchange reserves; Eswatini.

1. Introduction

The past two decades saw an unprecedented rise in the holdings of foreign exchange reserves by emerging market economies. The main explanation for the accumulation of reserves has been the self-insurance or precautionary argument since adequate holdings of foreign exchange reserves allow a country to protect itself against external shocks that could undermine economic performance (Park and Estrada, 2009). International reserves are important for countries like Eswatini that operate in a "quasi-currency board" since such countries give up active monetary policy and adopt a currency peg linked to a credible reference currency. Under such a policy arrangement, central bank liabilities, including currency in circulation, must be fully backed by foreign exchange reserves (Jurgilas, 2007). According to the Common Monetary Area (CMA) agreement, the lilangeni[1] is pegged at par to the South African rand, implying that maintaining the exchange rate peg serves as an intermediate goal for monetary policy for the Central Bank of Eswatini (CBE, 2017). In order to achieve this intermediate goal and maintain the currency peg, Eswatini has to keep and maintain an adequate level of reserves since low reserves levels could undermine the Bank's policy credibility and ability to support the peg. Given the observed accumulation of reserves by other countries over recent years, it is unclear whether Eswatini has sufficient foreign exchange reserves to sustain the currency peg, support macroeconomic and financial stability and ensure the central bank meets its policy objectives.

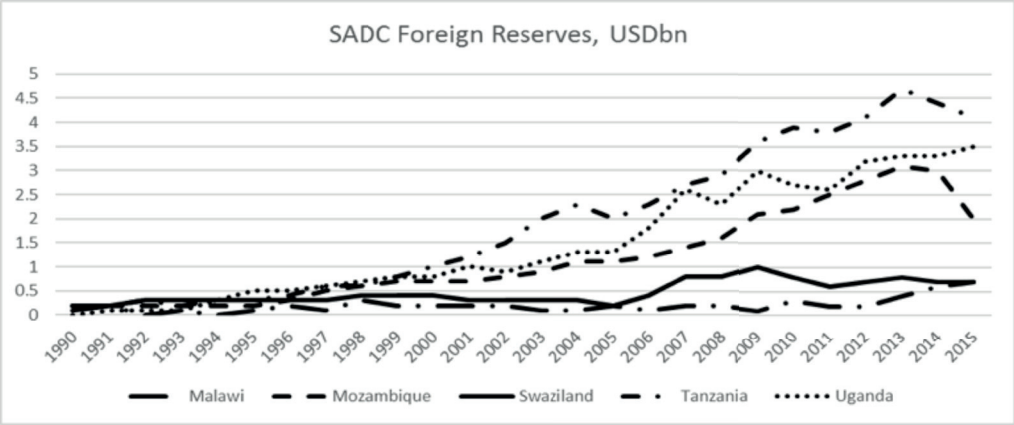
This paper therefore investigates the determinants of foreign exchange reserves in Eswatini. Such a study is motivated by the observed growth in reserves holdings seen in developing countries especially after the East Asian crisis of 1997. As indicated in Figure 1, foreign exchange reserves for most countries (including Southern African Development Community (SADC) economies) have grown tremendously in the last few years. This has seen many countries accumulating reserves sometimes well beyond levels that would be deemed adequate by the simple import-cover based International Monetary Fund (IMF) yardstick. Eswatini's reserves have also grown but not to a great extent that they would be deemed excessive.

The study hence presents an attempt to measure the determinants or drivers of foreign exchange reserves in Eswatini, a subject that has been largely ignored in the literature. Understanding the drivers of reserves is important since adequate

[1] Lilangeni (SZL) is the currency of Eswatini.

reserves allow a country to manage its currency and defend itself against a financial crisis should it occur. The study makes a contribution to the literature by identifying the macroeconomic variables that affect the levels of reserves such that the central bank could pay attention to such in an effort to build reserves. The paper is split into five sections. In section 2, a brief empirical literature on reserve determinants is presented. In section three, the theoretical and empirical model is specified, together with the data used in the study. Section 4 presents the results whilst section 5 concludes.

Figure 1: SADC Foreign Exchange Reserves



Source: BMI Research

2. Literature Review

The foreign exchange reserves of a country can be defined as its external stock of official public sector assets and these can include gold, foreign currency investments and IMF Special Drawing Rights. Such reserves are valuable to the country as they enable monetary authorities to mitigate balance of payments challenges as well as allow the central bank to intervene in the foreign exchange market in times of pressure on the exchange rate. The IMF (2003) guidelines for foreign reserves management defines reserve management as a process that ensures that adequate official public sector foreign assets are readily available for meeting a certain range of a country's objectives. To ensure that reserves are available at the times when they are needed most, liquidity usually receives the highest priority in reserves management operations.

Several studies can be identified in the literature that seek to answer the question as to what determines the level of foreign exchange reserves in emerging

markets? The studies mentioned in this paper are not meant to be exhaustive but merely to highlight what the literature has identified as key drivers of reserves holdings in developing countries. Amongst these is Gosselin and Parent (2005) who used panel cointegration tests as the basis for their assessment of a long-run reserve demand function in a sample of eight Asian emerging-market economies. Using data from 1980 to 2003, Gosselin and Parent, (2005) find that the reserves were explained by variables that include Gross Domestic Product (GDP), ratio of imports to GDP, M3[2] to GDP and the volatility of exports receipts. In analyzing the behaviour of Asian central banks in the aftermath of the 1997-98 financial crisis, the authors discovered that while there is evidence of a positive structural break in these country's demand for international reserves, the actual level of reserves accumulated in 2003–04 was still in excess relative to that predicted by their model.

Using data from Tunisia, Abdourahmane, Ludvig, Domenico and Taline (2004), seek to determine the drivers of foreign exchange reserves in the country and the extent to which reserves were adequate. Their study concludes that reserves are positively influenced by the size of the economy, current account vulnerability and negatively influenced by the exchange rate volatility and the opportunity cost of holding reserves (represented by the short-term interest rate differential). In a similar context, Suvojit, Ram and Benito (2008), use the Buffer Stock Model to analyse the optimal level of foreign exchange reserves holdings for India. Using an ARDL framework, they find that the scale variable, opportunity cost and exchange rate volatility all have significant effects on the demand for foreign reserves.

Popovska-Kamnar, Miso and Artan (2017), noting that an adequate level of international reserves is an indicator of the stability of a country focus on identifying the determinants of the foreign exchange reserves in the Republic of Macedonia. The authors used the Ordinary Least Squares (OLS) estimation technique based on quarterly data for the period 2004-2016 from the state statistical system of the country to indicate that there is a statistically significant relationship among foreign exchange reserve as a dependent variable and the policy interest rate, nominal GDP and the exchange rate as independent variables. Romero (2005) used a multiple linear regression model to undertake a study over the period 1980-2003 that determines whether the current account

[2] M3 measures money supply. This includes M2 (a measure of the money supply that incorporates cash and checking deposits as well as near money), large time deposits, institutional money market funds and short-term repurchase agreements.

balance, exchange rate regime and marginal propensity to import were strong predictors of China and India's levels of international reserves. The results from the study revealed that for India, all the variables were significant predictors of the level of international reserves whilst for China, for the most part, the results were unsatisfactory. However, Romero (2005) notes that for both countries, the current account variable was very significant.

Cheung and Ito (2009) tested a number of variables using a multiple linear regression model over the period of 1975-2004 to observe if they influence reserve holdings across segmented time periods for both developed economies and emerging market economies. The authors grouped the variables into three categories which were: traditional macro variables (propensity to import, export receipts volatility, reserve volatility, opportunity cost of holding reserves, real GDP per capita and population), financial variables (money supply, external debt, and capital flows) and institutional variables (corruption, political stability, trade openness and capital controls). The results from the study revealed that determinants of international reserves for emerging market economies were different to those of developing market economies, with fluctuations observed over the segmented time periods as well. For developing economies, the propensity to import was found to be the only consistent determinant throughout the entire period. For both developed and emerging market economies, the significance of macroeconomic variables moderated over the period, contrasting the increase in significance of financial variables over the time period. An Autoregressive Distributive Lag (ARDL) model is used by Nor, Azali, and Law (2011) to investigate the existence of a long run relationship between international reserve holdings and the current account balance for five Southeast Asian economies (Indonesia, Malaysia, the Philippines, Singapore, and Thailand). Their results revealed that the current account is a key determinant of international reserve holdings in Indonesia, Malaysia and Singapore for the period studied (1970-2005) such that current account surpluses can be used by countries as a way to boost their international reserves holdings.

3. Theoretical Framework

Huang and Shen (1999) correctly note that two theories have been used to explain the demand for international reserves in the literature. The first approach is the demand for international reserves or buffer stock model which states that reserves are there to finance international transactions and thus serve as a buffer stock against fluctuations in international accounts. The accumulation of

reserves by emerging market countries observed after the Asian crisis of 1997 has been mainly attributed to the need for emerging market countries to insure themselves against potential balance of payments crisis since countries that had more foreign exchange reserves were able to them to defend their currencies. The alternative theory attributes reserves holdings of a country to the monetary approach of the balance of payments such that reserves will rise if there is an excess demand for money (M3) and conversely decline if there is an excess supply of money; and hence represent a residual holding by the country, Huang and Seng (1999).

This study applies an extended version of the buffer stock model to analyse the demand for Eswatini's foreign exchange reserves in line with previous studies (e.g. Ra, 2007; Nor *et al*, 2011) due to its practical applicability to emerging economies. Reserves holdings under this model are a function of variations in a number of variables linked to the balance of payments, the scale (size) of the economy, the opportunity cost of holding reserves, trade openness and external vulnerability (Khan, Ahmed and Kazmi, 2005).

Prabheesh, Malathy and Madhumathi (2007) note that the fundamental variables that enter the long-run foreign exchange reserves demand equation have been well identified in the literature and these can be classified into five categories: namely the economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility and the opportunity cost of holding reserves (Table 1 below). The choice or potential of variables entering the model for each country would however be different based on the underlying economic structure, exchange rate policy and external sector.

Table 1: Empirical determinants of FX Reserves

Reserves determinant factors	**Variables**
Economic Size	GDP per capita; Population
Current Account vulnerability	Imports/GDP; Trade/GDP; Current account deficit/GDP
Capital account vulnerability	Capital account deficit/GDP; external debt/ GDP; money supply/GDP
Exchange rate flexibility	Exchange rate volatility
Opportunity cost	Interest rate differential

Source: Prabheesh *et al*, (2007)

Given the above categories, the empirical foreign exchange reserves function could therefore be specified as follows;

$$InRes_t = \beta_0 + \beta_1 InY_t + \beta_2 Cur\_Ac_t + \beta_3 InDebt_t + \beta_4 Cap\_Ac_t + \beta_5 InFX + u_t \quad (1)$$

where β_0 is a constant, $InRes_t$ represents the logarithm of the ratio of international reserves to GDP, InY_t is the log of real GDP per capita, Cur_Ac_t, the current account balance, Cap_Ac_t the capital account indicator, $lnDebt_t$ is the ratio of total external debt to GDP (log of), $InFX_t$ the nominal exchange rate and u_t the disturbance term. There is a general expectation that reserves will rise with the size of the economy such that β_1 would be positive. From a demand perspective, with reserves serving as a buffer for variations in the balance of payments, theoretically it is expected that β_2 and β_4 be positive as well since vulnerability of the balance of payments would require high holdings of reserves. High external debt is also associated with greater external vulnerability hence β_3 should be positive. Instead of exchange rate volatility, the study considered the level of the exchange rate since our reserves figures (dependent variable) are expressed in local currency (SZL) terms. A depreciation in local currency leads to higher reserves when stated in local currency terms thus the coefficient β_5 should be positive. Endogeneity in the relationship between construction and growth has not been given much thought in the literature. Does growth give birth to more construction works or it is the construction sector that initiate's growth? Additionally, the role of institutions is not properly interrogated. For a sector like construction, institutional factors are very likely to play a critical role in the tendering and contract award process, design, implementation and execution of projects.

The coefficient for the opportunity cost is expected to be negative since higher returns from alternative uses of reserves is expected to lead to a decline in reserves holdings. Given Eswatini's pegged exchange rate policy to the South African rand, we also considered broad money supply (M3) as another variable that introduces capital account vulnerability since all SZL in circulation has to be fully backed by foreign exchange reserves. Lastly, Eswatini Government expenditure is another key factor influencing reserves holdings due to Eswatini's participation in the Southern African Customs Union (SACU). Inflows from SACU normally feed into FX reserves and as government expenditure rises, this causes FX reserves to decline such that the relationship between reserves and government expenditure is theoretically expected to be negative.

4. Methodology

The study applies the autoregressive distributed lag (ARDL) bounds testing cointegration method of Shin *et al* (2001) to model the determinants of foreign exchange reserves in Eswatini. This model is an error-correction specification that allows for investigating a short-run and long-run relationship amongst the variables of interest through cointegration techniques. According to Odhiambo (2008), the ADRL approach uses lags of the dependent variable and the lagged and contemporaneous values of the independent variables such that the short-run effects in the model can be directly estimated and the long-run equilibrium relationship indirectly inferred.

This model is chosen for the study due to its relative attractiveness when testing for cointegration as compared to other methods, e.g. those suggested by Engle and Granger (1987); Johansen and Juselius (1990). The ARDL approach can be applied regardless of whether the variables in the model are stationary, I(1) or fractionally integrated (although not I(2); the model allows for simultaneous estimation of both short-run and long-run parameters, is good for small sample sizes and lastly the ARDL model is valid even if the explanatory variables are endogenous (Kumar, 2010).

The ARDL bounds testing procedure follows two steps; the first being testing for the presence of a long-run relationship among the variables. The F-test for the joint significance of the coefficients of the lagged levels of the variables is applied to test for the presence of a long-run relationship. Since equation (1) above only yields the long-run effects of the associated variables, the ARDL specification of the foreign exchange reserves function is therefore represented as follows;

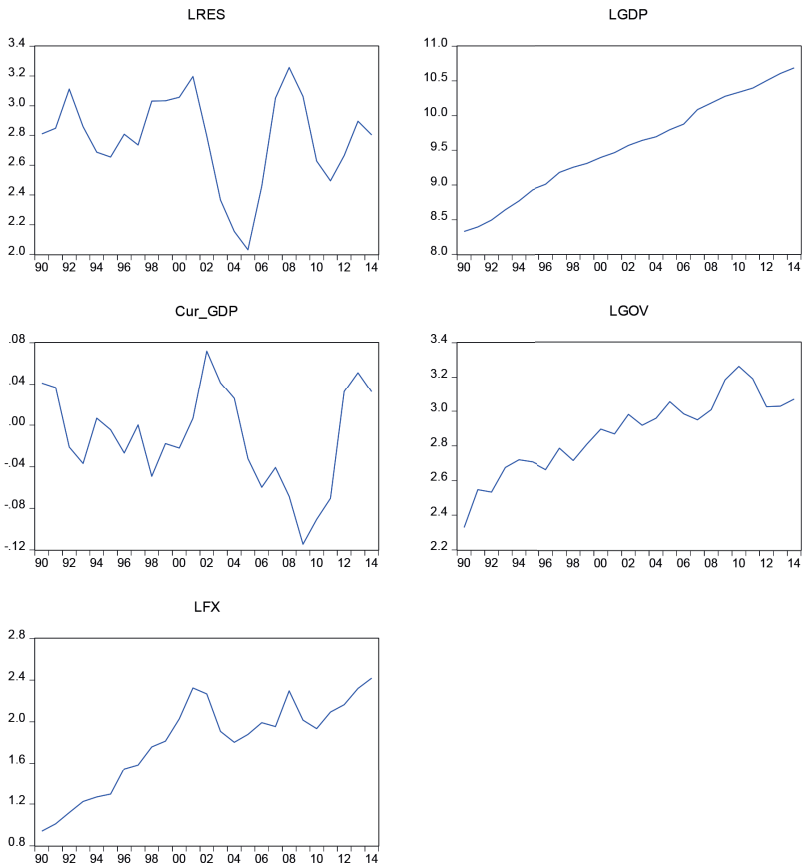
$$\Delta InRes_t = \alpha_0 + \alpha_1 InRes_{t-1} + \alpha_2 LY_{t-1} + \alpha_3 Cur\_Ac_{t-1} + \alpha_4 InDebt_{t-1} + \alpha_5 Cap\_Ac_{t-1} + \alpha_6 InFX_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta In\mathrm{Re}s_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta InY_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta Cur\_Ac_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta InDebt_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta Cap\_Ac_{t-i} \sum_{i=1}^{n} \beta_6 \Delta InFX_{t-i} + u_t \quad (2)$$

Equation (2) therefore is an error-correction specification whereby short-run effects are inferred from the first-differenced variables (Bahmani-Oskooee and Mohammadian, 2016). In order to test for cointregration in Equation (2), the null hypothesis of H_0: $\alpha1 = \alpha2 = \alpha3 = \alpha4 = \alpha5 = \alpha6 = 0$ is tested (against the alternative H_1: $\alpha1 \neq \alpha2 \neq \alpha3 \neq \alpha4 \neq \alpha5 \neq \alpha6 \neq 0$) using the bounds test (F test) per Pesaran *et al* (2001). The bounds test uses two critical values; the upper and

lower bounds such that if the computed value of the F test statistic exceeds the upper bounds, one can conclude that a long-run equilibrium relationship exists; and if the critical statistic is below the lower bound, no evidence of cointegration is confirmed; a critical value that lies between the lower and upper bounds gives inconclusive results (Athanasenas and Katrakilidis, 2014). Eviews 9.5 was used in the study to estimate the ARDL model.

Annual data obtained from the Central Bank of Eswatini covering the period 1990 to 2014 is used in the paper (Descriptive statistics are shown in Appendix 1). The dependent variable is reserves in local currency terms divided by GDP. All other variables that enter the reserves equation are expressed as a proportion of GDP, with the exception of the GDP per capita and the exchange rate which is expressed in nominal terms. The time series plot of the variables (reserves, GDP per Capita, current account, government expenditure and the exchange rate) that enter the cointegration equation are presented in Figure 2 below.

FIGURE 2: VARIABLES USED



5. Empirical Results

Prior to conducting the bounds cointegration test, unit root tests were performed on the variables to understand their order of integration. Although the ARDL method does not necessitate all variables to be integrated of order 1 (i.e. I(1)), it is important that the variables are not I(2) as the F-test would provide spurious results (Odhiambo, 2008). The Augmented Dickey Fuller (ADF) and Breakpoint Unit Root tests were applied to test for stationarity of the series and the results are presented in Table 2 below. Both test statistics confirm that the order of integration of the variables to enter the reserves demand model are mixed, and hence validate the suitability of the ARDL model. The only variable that is stationary is the log of reserves, with the other variables Lgdp_cap, Cur_acc, Cap_acc, Lgov and Lfx stationary after first differences, i.e. I(1). Given the unit root test results and confirmation that none of the variables is I(2), we proceeded to test for cointegration and the results are stated in Table 3 below.

Table 2: Unit root test results

Augmented Dickey-Fuller					
	Level		**First Difference**		**Conclusion**
Variable	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
Lres	-4.371***	-4.438***	-3.929***	-3.845**	I(0)
Lgdp_cap	-0.946	-1.919	-4.625***	-4.782***	I(1)
Cur_acc	-2.206	-3.344*	-4.242***	-4.288**	I(1)
Cap_acc	-2.815*	-2.941	-4.025***	-3.914**	I(1)
Lgov	-2.623	-3.286*	-5.544***	-5.559***	I(1)
Lfx	-1.492	-2.022	-4.390***	-4.339*	I(1)
Breakpoint Unit Root Test					
	Level		**First Difference**		**Conclusion**
Variable	Intercept	Intercept & trend	Intercept	Intercept & Trend	
Lres	-5.494***	-5.743***	-4.437*	-5.158**	I(0)
Lgdp_cap	-5.172***	-3.674	-5.433***	-6.271***	I(1)
Cur_acc	-4.558**	-4.002	-4.666**	-5.453***	I(1)
Cap_acc	-4.186	-5.907***	-4.682**	-5.668***	I(1)
Lgov	-3.501	-5.245**	-6.240***	-5.500***	I(1)
Lfx	-2.382	-4.078	-5.730***	-5.745***	I(1)

Notes: *; **; *** denote significance at 10%, 5% and 1% respectively

Table 3: ARDL Bounds Test for Cointegration[3]

ARDL (1,2,1,0,0)		
F-Statistic	23.30***	
Asymptotic Critical values		
	I(0)	**I(1)**
10%	2.20	3.09
5%	2.56	3.49
1%	3.29	4.37

Notes: *; **; *** denote significance at 10%, 5% and 1% respectively

The results in Table 2 reveal that the variables *Lres*, *Lgdp_cap*, *Cur_acc*, *Lgov* and *Lfx* are cointegrated since the bounds test F statistic of 23.30 exceeds the upper bound critical values at a 1% confidence level based on Pesaran *et al* (2001). The implication of the result is that the null hypothesis of no cointegration is rejected and we conclude that a long-run relationship exists between Eswatini's foreign exchange reserves and its determinants (GDP per capita, current account, capital account, government expenditure and the FX rate). Having established cointegration, the next step was to estimate the long-run and the short-run error correction coefficients of the ARDL model with the results presented below (Table 4).

Table 4: ARDL Model Results: Long-run Coefficients

Long-run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LGDP	1.078078	0.473695	2.275892	0.0391
CUR_GDP	-11.70852	2.412638	-4.852995	0.0003
LGOV	-7.602404	2.107293	-3.607665	0.0029
LFX	1.643770	0.270477	6.077291	0.0000
C	11.13695	2.074973	5.367276	0.0001
Diagnostic Tests				
Adjusted R2	0.896			
Serial Correlation Test	1.157 (0.347)			
Heteroscedasticity (BPG)	0.750 (0.670)			
Normality Test	0.866 (0.648)			

[3] We used the Akaike Information Criterion (AIC) to obtain the order of lags for the model chosen.

Table 5: ARDL Model Results: Short-run Error Correction Model Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP)	1.719090	0.362348	4.744307	0.0003
D(LGDP(-1))	-0.886091	0.357099	-2.481362	0.0264
D(CUR_GDP)	-3.315235	0.512031	-6.474679	0.0000
CointEq(-1)	-0.378694	0.027492	-13.77479	0.0000

The long-run coefficients of the ARDL model based on equation (2) are presented in Table 4. The coefficient for GDP per capita is positive and statistically significant, confirming that economic growth in general is positively associated with the level of international reserves in Eswatini. This is as per a priori theoretical expectations. The results indicate that government expenditure is negatively related to the level of reserves since a 1% increase in government expenditure induces a 0.88% decline in international reserves. The results also indicate that the relationship between the level of reserves and the exchange rate is positive as expected since a depreciation in the local currency leads to a rise in reserves when expressed in local currency terms. Surprisingly, the measure of current account vulnerability (current account deficit as a proportion of GDP) is found to have a negative relationship with international reserves. This could be a reflection of the fact that trade is not a key driver of the demand for reserves but probably capital account vulnerability. This is indeed expected since capital flight vulnerability is key for Eswatini which maintains a pegged exchange rate to the South African rand.

Table 5 shows that the lagged error term of the cointegration equation is negative and statistically significant (-0.378), indicating that about 38% of disequilibrium in the long-run reserves equation is corrected every year, implying a moderate adjustment process back to equilibrium. The diagnostic tests (see Table 4) indicate that the model is free from serial correlation, heteroscedasticity and non-normality. Figures 3 and 4 show plots of the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMQ). The reported statistics (CUSUM and CUSUMQ) are within the boundaries, confirming stability of the model.

FIGURE 3: CUMULATIVE SUM OF RECURSIVE RESIDUALS

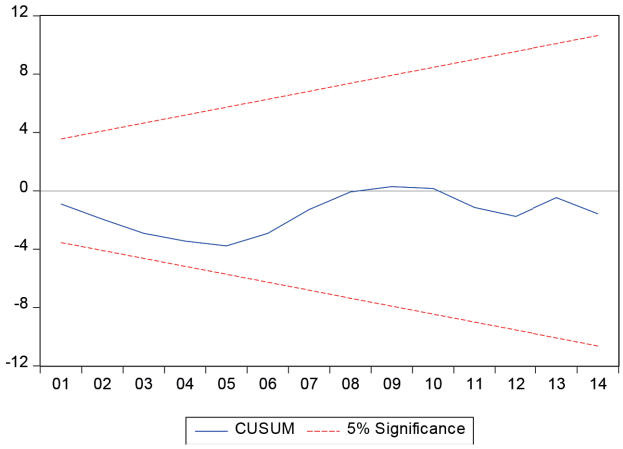
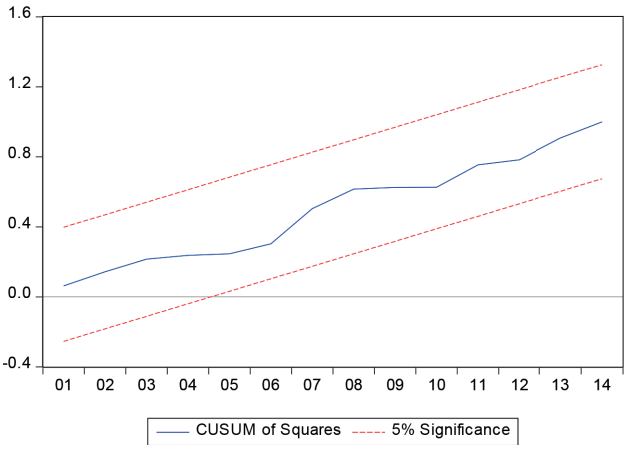


FIGURE 4: CUMULATIVE SUM OF SQUARES OF RECURSIVE RESIDUALS



6. Conclusion

This study investigates the demand for foreign exchange reserves in Eswatini. Applying the autoregressive distributed lag (ARDL) bounds testing cointegration method of Pesaran, Shin and Smith (2001), the paper models the behaviour of Eswatini's foreign exchange reserves over the period 1990-2014. An augmented buffer stock model is applied to indicate that foreign exchange reserves in Eswatini are driven by GDP per capita, developments in the current account, government expenditure and movements in the exchange rate. With the growth in Eswatini's foreign exchange reserves lagging behind the growth seen in other emerging economies, authorities should increase efforts to build

reserves in order to support confidence in the currency peg and hence maintain financial stability. The findings from the study suggest the central bank could be more aggressive towards building reserves for the country, having noted the key drivers for reserves. Finally, the study finds that the Buffer Stock model remains appropriate as a measure for foreign exchange reserve when applied in Eswatini in line with what has been seen in other countries (see e.g. Suvojit *et.al.,* 2008); Cheung and Ito (2009). A worthy addition to the literature could be modelling reserves adequacy in Eswatini; i.e. a determination of how much foreign exchange reserves could be deemed adequate for Eswatini economic and monetary policy structure.

Biographical Notes

Dr Melvin Khomo is Head of the Financial Markets Department of the Central Bank of Eswatini where his areas of responsibility include reserves management, government debt issuance, monetary policy implementation and treasury operations. He holds an MCom degree in Financial Markets from Rhodes University and PhD in Development Finance for the University of Stellenbosch. His research interests are interest rate markets, exchange rates, investment management and development finance. Mamba and Matsebula and Portfolio Manager and Risk Analyst respectively within the Financial Markets Department at the Central Bank of Eswatini.

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Appendix

Table 1a: Descriptive Statistics

	LRES	LGDP	CUR_ACC	LGOV	LFX
Mean	2.779805	9.551767	-299.8153	2.876185	1.796970
Median	2.807670	9.567024	-86.17902	2.920939	1.906981
Maximum	3.257184	10.68692	2248.122	3.260524	2.417166
Minimum	2.030391	8.329376	-3477.522	2.328955	0.940320
Std. Dev.	0.307316	0.718931	1333.698	0.225169	0.438490
Skewness	-0.710972	-0.101768	-0.623914	-0.477517	-0.532588
Kurtosis	3.097092	1.900669	3.367137	2.796094	2.156087
Jarque-Bera	2.115990	1.302037	1.762359	0.993405	1.923737
Probability	0.347151	0.521514	0.414294	0.608534	0.382178
Sum	69.49512	238.7942	-7495.383	71.90462	44.92425
Sum Sq. Dev.	2.266641	12.40470	42690033	1.216826	4.614569
Observations	25	25	25	25	25

Table 1b: Correlation Matrix

	LRES	LGDP	CUR_ACC	LGOV	LFX
LRES	1.000000	-0.128885	-0.073890	-0.240620	0.045813
LGDP	-0.128885	1.000000	-0.148930	0.919170	0.882536
CUR_ACC	-0.073890	-0.148930	1.000000	-0.338808	-0.006406
LGOV	-0.240620	0.919170	-0.338808	1.000000	0.829950
LFX	0.045813	0.882536	-0.006406	0.829950	1.000000