BIDPA Working Paper 33

July 2012

Is the Botswana Pula Misaligned?

Haile Taye

BOTSWANA INSTITUTE FOR DEVELOPMENT POLICY ANALYSIS

BIDPA Working Paper 33

July 2012

Is the Botswana Pula Misaligned?

Haile Taye

BOTSWANA INSTITUTE FOR DEVELOPMENT POLICY ANALYSIS

BIDPA

The Botswana Institute for Development Policy Analysis (BIDPA) is an independent trust, which started operations in 1995 as a non-governmental policy research institution. BIDPA's mission is to inform policy and build capacity through research and consultancy services.

BIDPA is funded by the Botswana government and the African Capacity Building Foundation.

BIDPA Working Paper Series

The series comprises of papers which reflect work in progress or limited research efforts, which may be of interest to researchers and policy makers, or of a public education character. Working papers may already have been published elsewhere or may appear in other publications.

Haile Taye is a Senior Research Fellow at the Botswana Institute for Development Policy Analysis.

ISBN: 99912-65-44-9

TABLE OF CONTENTS

Acknowledgements

The author gratefully acknowledges comments of BIDPA staff on earlier versions of this paper. BIDPA is co-funded by the Botswana Government and the African Capacity Building Foundation, both of whom I thank for the financial support leading to this publication.

Abstract

The objective of this paper is to assess the extent to which the Botswana exchange rate (the Pula) has been consistent with economic fundamentals. To do so an equilibrium exchange rate is estimated and compared against the values of the effective exchange rate data from 1990Q:1 to 2011Q:4. Using an Auto Regressive Distributed Lag (ARDL) model, the estimation results showed that the Pula exhibited a stable movement and has been consistent with economic fundamentals during the estimation period. But forecasts for the four quarters of 2011 seem to suggest that the exchange rate has started to slightly deviate from its economic fundamentals relative to its recent history. Such a deviation (mainly a depreciation in this case) might be representing one of the following cases: (i) a temporary market adjustment and, hence in that case, should not be viewed as more than a temporary fluctuation; (ii) an indication of a shift from economic fundamentals such that the trend will encourage exports and discourage imports; this will be good news in principle but for a heavily import dependent economy, for its production and consumption needs, this will probably entail a huge import bill. This is partly because of what is called the J-curve effect and import dependence of the economy. If indeed this is the case, then it calls for an appropriate and timely adjustment before it entails serious economic distortions.

1. Introduction

The exchange rate is simply the price of a given currency in terms of another currency. A national currency is therefore simply the price of what a country exports relative to the price of what it imports. Put differently, it is the price of tradables as a ratio of non- tradables. As such, it affects both the supply of and the demand for both goods and services domestically produced and internationally traded. Therefore, its overvaluation (above its competitive value) hurts exports and encourages imports while its undervaluation (below what is its competitive value) does exactly the opposite. As *Maxwell (2003, P.2)* noted *"* the overriding objective of exchange rate policy should be to avoid persistence in exchange rate misalignment, which is a common feature in most developing countries. However, in order to manage misalignments it is necessary to successfully identify what constitutes the equilibrium real exchange rate (ERER), and this continues to pose a fundamental difficulty in the modern literature on the real exchange rate".

In broad terms, the exchange rate regime is either fixed or floating. A fixed exchange rate is administratively determined and its value only varies from time to time when monetary authorities decide to either revalue or devalue its rate against external currencies. While this was dominant from WWII to the early 1970s under the Bretton Woods system (1944-68), since then very few countries (mainly least developed ones) have a fixed exchange rate system regime.

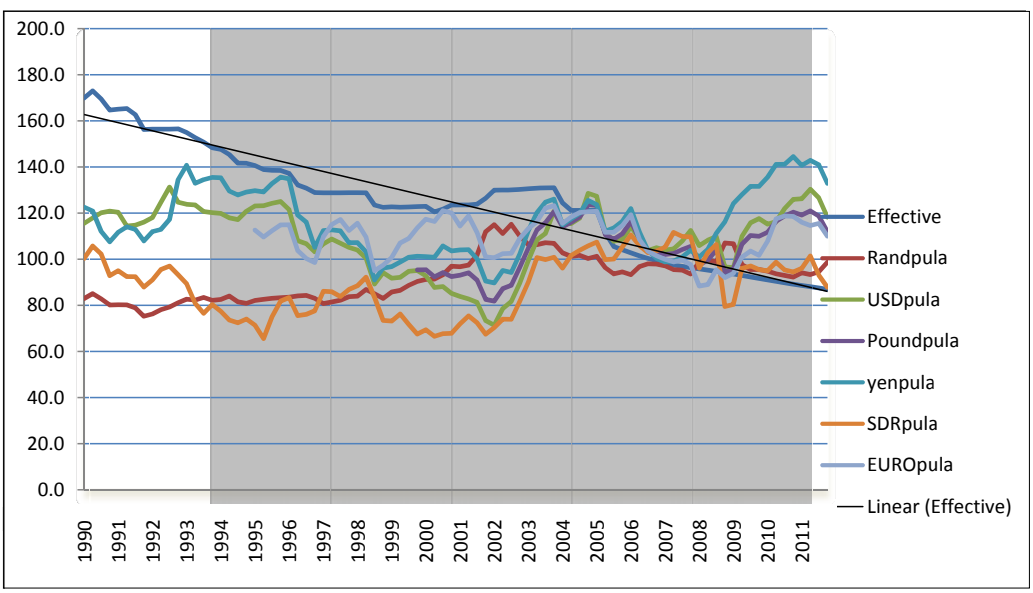
The floating exchange rate regime, on the other hand, is essentially determined by market forces. Even the movements of pegged float (in which monetary authorities keep changing its value from time to time to minimize deviation from it's true currency price) is influenced by movements of market forces. The floating exchange rate regime (either in its close to pure form or pegged) is the most widely used system at the moment. And clearly because it is market determined, the deviation between the actual exchange rate and what is termed an equilibrium exchange rate is, in most cases, minimal, that is, deviation is marginal.

The exchange rate regime in Botswana is categorised as what is called a crawling peg. This means that the exchange rate is pegged to its important trading partners. It is, therefore, tied to the South African Rand and the SDR which is constituted to reflect movements in the Pound Sterling, the US dollar, the Euro, and Japanese Yen. Hence the effective exchange rate index is calculated based on the weighted average of these currencies. The appreciation or depreciation of the local currency (the Pula) will then vary in tandem with the changes in these currencies.

The movements of these currencies against the Pula between the 1st quarter of 1990 to the 4th quarter of 2011 are depicted in Figure 1. The movement of individual

currencies from one quarter to another varied over the years, but the weighted average of the effective exchange rate of the five currencies relative to the Pula declined as shown by the trend line. This means, in historical terms the Pula on average declined or depreciated by about 20 percentage points between 1990 and 2011 as indicated by the trend line. To put it more clearly, every unit of Pula, on average, was buying less and less of a unit of foreign currency. In addition to the overall downward trend, the movements of the pula against all the currencies has moved up and down during the period in question. While the movements varied, all the currencies increased between 2002 and 2005 (indicating an appreciation of the Pula) which then declined between 2006 to 2008 following the devaluation in 2005. Between 2008 to date while the Pula started to slightly depreciate against the major currencies (the British Pound, the US dollar, the Euro and the Japanese Yen), it marginally appreciated or remained stagnant against the South African Rand and the SDR. It again started to slightly appreciate in the last quarter of 2011 even against the major currencies.

Figure 1: Movements of Exchange Rate Indices (1990Q1 2011Q4)



The important question is, then, what are the factors that determine its movements over time? More specifically, what are the macroeconomic fundamentals that economic agents (including monetary authorities) may influence or monitor that could lead to an exchange rate misalignment (or deviation between actual and equilibrium exchange rates)? Hence, even though such deviations are minimal in a floating exchange rate system relative to a fixed exchange rate regime, misalignment could happen as the exchange rate movements lag behind the dynamic movement of

economic fundamentals that influence it. This brings us to the fundamental question of what economic fundamentals influence the behaviour of the exchange rate?

The purpose of this paper is to answer this question by examining whether the Pula is misaligned or it is close to its equilibrium value as determined by macroeconomic fundamentals. To do so, the paper estimates what is called the equilibrium exchange rate and compares this value with the actual exchange rate to evaluate the extent to which the actual exchange rate is consistent with the equilibrium exchange rate.

Following this brief introduction, the second section of this paper outlines the various ways used to measure the equilibrium value of the exchange rate; it also examines the determinants of the equilibrium exchange rate and explains why these fundamental variables influence the behaviour of the equilibrium real exchange rate; section three presents the model and the estimation results of the exercise and discusses whether the Botswana Pula is misaligned or not; and finally section four presents brief conclusions and highlights the policy implications of the results.

2. Determinants of the Equilibrium Exchange Rate

Before explaining an equilibrium exchange rate it is instructive to define a real exchange rate. The real exchange rate could be measured as the nominal exchange rate weighted by the ratio of the foreign price of tradable goods to domestic goods. That is, it is simply the nominal exchange rate scaled by world and domestic price ratios.

That is, $REER = E.P^*/P$

Where:

REER = the Real Effective Exchange Rate;

E is the official nominal exchange rate measured as the amount of foreign currency (USD, RAND...., or a weighted average of trading partners' currencies) per unit of domestic currency (Pula);

P* is the foreign currency price of tradables and P is the domestic price of non-tradables.

In cases where the price of tradables (P*) is not available many researchers (Balassa -1990, Edwards -1990, 1989 and Ghura -1993, for instance), used the world or the

US whole sale price index as a proxy. And the domestic price index is measured by domestic CPI. But in the case of Botswana both prices are available.

It is worth noting that the way the real exchange rate is measured some times vary depending whether it is expressed in terms of foreign currency per unit of domestic currency or the other way round. This, of course, has no substantial difference except in our interpretation of upward or downward movements. In this exercise, we follow the Bank of Botswana's definition of expressing the value of foreign currencies per unit of the local currency. Hence, the nominal exchange rate is defined as the weighted average of trade partners' currencies per unit of the domestic currency (Pula). Therefore, an increase in the real exchange rate implies an appreciation of the Pula while a decrease indicates a depreciation. An increase in the ratio of price of tradables to the price of non-tradables will also, other things being equal, lead to an appreciation of the real exchange rate while an increase in the price of non-tradables will lead to a depreciation of the real exchange rate.

A commonly used alternative definition of the exchange rate is the bilateral exchange rate (RER); this is the same as above except the nominal exchange rate instead of being an index based on trading partners' currencies, it is calculated relative to a single currency (The Rand, Dollar, for instance). The advantage of the effective exchange rate measure is it reflects the value of the exchange of the countries which are close trade partners from which the country in question imports its goods and to which it exports its goods and services. This is usually a more comprehensive measure as it reflects the relevant trade transactions of the country.

Whether the above defined real exchange rates (RER or REER) are consistent with what the macroeconomic fundamentals of the country suggest or not are measures of the prevalence and the extent of distortion (or lack thereof) in the performance of the macro-economy. In short, they are measures of competitiveness of the economy with trading partners because it is the price by which foreign and domestically produced goods are scaled (or weighed). Hence, other things being equal, we will expect a depreciation of the domestic currency (Pula in this case) to encourage what is domestically produced (or exports) and discourage what is imported from abroad. Appreciation of the currency will have exactly the opposite effects (discourage exports and encourage imports).

An exchange rate that is not misaligned (not under- or overvalued) will therefore help competitiveness and ultimately a healthy current account and Balance of payment positions in addition to an appropriate resource allocation in the domestic market. The main purpose of all the various studies that were conducted has, therefore, been to assess the extent to which the actual real exchange rate is consistent with the equilibrium exchange rate that would ensure such a resource allocation.

Some studies, take the year in which the purchasing power parity (PPP) is believed to approximate the equilibrium value of the exchange rate and compare any changes taking place with that year as a point of reference. But of course, this ignores the dynamic movement of the economic fundamentals that might have taken place in the economy that would seriously impact on the behaviour of the exchange rate. Consequently, many prefer to estimate the equilibrium exchange rate based on some macroeconomic fundamentals. Following Edwards (1990), Cottani...et al (1990) and Ghura (1993), to name a few, the most common specifications to estimate the real exchange rate uses the following variables.

The terms of trade (TOT) (price of exports relative to the price of imports) is expected to increase the availability of foreign currency as the price of exports relative to that of imports increases. This would then have both income and substitution effects and depending which one dominates it would lead to either an appreciation or a depreciation of the real exchange rate, hence a priori the sign is ambiguous. Similarly, the degree of openness or closeness of the economy (CLOSE) to external trade (due to tariff and non-tariff barriers) is measured by the ratio of total income (GDP) to total exports and imports. This indicates the extent to which the economy is closed to external trade. The more closed the economy to external trade and hence less exposed to external shocks and hence the more likely that the real exchange rate will appreciate. Some studies use the inverse of this to measure openness.

Another important variable that is believed to affect the behaviour of the real exchange rate is the amount of capital flow (LRCAPFLOY) to the country. This is measured as the difference between net changes in the trade balance and foreign reserves, scaled by GDP. An increase in net flows helps the country accumulate more foreign currency and hence would lead to a depreciation of the domestic real exchange rate. Similarly, the growth in domestic credit (as measured by growth in total domestic credit) less the growth in GDP (LRXCRE) is supposed to indicate the excess in money supply relative to growth of the economy. Hence, this excess credit is expected to lead to an inflationary pressure and hence to depreciate the real exchange rate.

To account for the flow of capital which has implications on the exchange rate, an interest rate differential between competing countries is included. In this case, an interest rate differential between South Africa and Botswana is added to account for the movement of capital between the two countries and hence its impact on the value of the exchange rate. Hence, as the interest in Botswana exceeds that of South Africa, it is expected it will increase the demand for Pula while the opposite holds when that of South African real interest rate exceeds that of Botswana. Hence, the way it is defined, we expect the real interest rate differential and the exchange rate to have a negative relationship. Similarly, government consumption is included to capture its pressure on the exchange rate since it imports most of its goods from abroad. Hence,

an increase in government consumption is expected to lead to a depreciation of the domestic currency (Pula). An increase in FDI flows and an accumulation of foreign reserves will lead to, other things being equal, a depreciation of the Pula. And finally, devaluation of the nominal official exchange is measured by a dummy variables (D1) for periods when devaluation took place to capture exchange regime changes.

3. Estimation and Results

In principle the exchange rate equation could be estimated in many ways. But in this exercise we have used what is called Autoregressive Distributed Lag (ARDL) model. The main advantage of this modelling approach is as Persaran and Shin (1997, P.1) noted *"Monte Carlo experiments provide strong evidence in favour of a rehabilitation of the traditional ARDL approach to time series econometric modelling. The ARDL approach has the additional advantage of yielding consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(1) or I(0)".* Hence since in our case, few of the variables are I(0) while most are I(1) we chose this estimation technique.

$$LREER_t = \alpha_o + \alpha_1 LNREER_t + \alpha_2 LRINV_t + \alpha_3 LREXCRE_t + \alpha_4 RRID + \alpha_5 LRcapfloy_t + \alpha_6 LRTOT_t + \alpha_7 LRGFCONS_t + \alpha_8 LRCLOSE_t + \alpha_9 D1$$

Variables Name	**Definition**	**Expected sign & order of Integration**
REER	Real effective exchange Rate	I(1)
NEER	Nominal effective exchange rate	+ I(1)
LRINV	Investment flows	**- I(1)**
LREXCRE	Excess credit measured as growth of money supply less growth of GDP	**- I(1)**
RRID	Interest Rate differential between South Africa & Botswana	**- I(0)**
INFD	Inflation differential relative to that of South Africa	**- I(1)**
LRCAPFLOY	Capital flow measured by Net changes in trade balance	**- I(1)**
LRTOT	Terms of trade	**?** I(1)
LRGFCONS	Government final consumption	**- I(1)**
LRCLOSE	Closeness of the economy (GDP/exports+ imports)	**+ I(1)**
D1	Dummy for regime changes before and after 2005	**- I(1)**
α_o	A constant	---

Note: LR in front of any variable stands for natural log of the real values of the variable and the rationale for the expected signs was discussed earlier.

In brief, quarterly data from 1990 to 2010 for all the above variables was collected and used to estimate the equilibrium exchange rate; before actually subjecting the data to estimate the model, all the data were diagnosed for their statistical properties. For instance the data was tested for normality and stationarity. Further, as reported in Appendix 1, the variables were tested for the existence of co-integration among them and the results are acceptable. In particular, we cannot reject the hypothesis of "no co-integration' of these variables. Hence we can proceed to estimate a long-run and a short-run Auto Regressive Distributed Lag Model (ARDL).

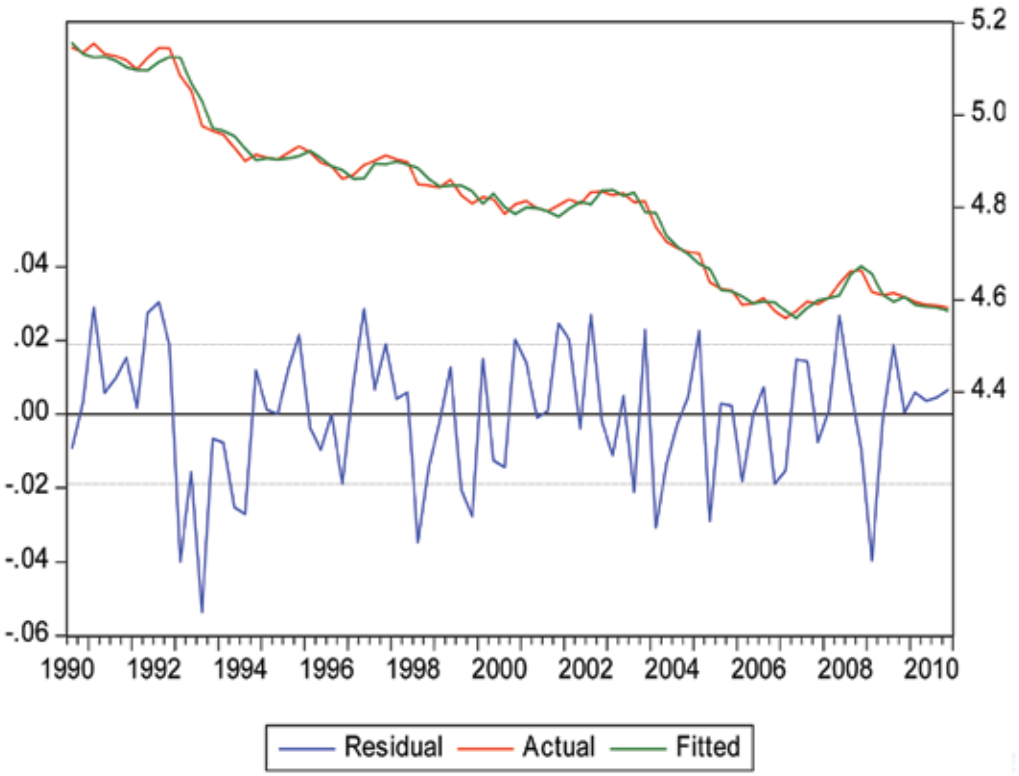
In addition to the above attributes of the data, various tests were also conducted to ensure the estimates are consistent and their validity is acceptable. On the whole, as could be seen from the results reported for the long-run and short-run models (Tables 1 and 2) and the within sample simulation of the models (Figs. 2 and 3), the fit of the model is acceptable. In what follows the plausibility, sign and the statistical attributes of the model will be briefly discussed, following the tables and figures. It is also worth highlighting that the fit of the equation is good and model seems well specified as shown by the Akaike information criterion and Schwarz criterion.

Table 1: Long-run Model of Effective Equilibrium Real Exchange Rate

Dependent Variable: LREER5
Method: Least Squares
Date: 05/01/12 Time: 11:38
Sample (adjusted): 1990Q3 2010Q4
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NEER1(-1)	0.006557	0.000399	16.43236	0.0000
LRTOT(-1)	0.674724	0.068220	9.890421	0.0000
LREXCRE	0.033201	0.011235	2.955243	0.0042
INFD(-1)	-0.002288	0.001038	-2.205288	0.0306
RIRD(-1)	-0.003897	0.000968	-4.026244	0.0001
LRINV	0.076009	0.025886	2.936283	0.0045
LRGFCONS(-1)	-0.043881	0.014288	-3.071235	0.0030
LRCLOSE(-1)	-0.029711	0.019521	-1.522038	0.1324
D1	-0.014877	0.009890	-1.504154	0.1369
C	0.756395	0.299529	2.525285	0.0138
R-squared	0.990614	Mean dependent var		4.821126
Adjusted R-squared	0.989441	S.D. dependent var		0.173107
S.E. of regression	0.017788	Akaike info criterion		-5.106725
Sum squared resid	0.022782	Schwarz criterion		-4.813223
Log likelihood	219.3757	Hannan-Quinn criter.		-4.988889
F-statistic	844.3354	Durbin-Watson stat		1.859009
Prob(F-statistic)	0.000000			

Fig. 2: Within Sample Forecasts: the Long Run Model



Without going into details, the results of the estimation of the model could be summarised as follows:

1. All the variables of interest have the theoretically expected signs Except (the excess money supply growth relative to GDP or 'lrexcre' in the long-run model);
2. Most of the variables have plausible parameter estimates relative to what is reported in the literature;
3. In particular, almost all the variables are significant (at least in the long-run) as shown in the table;
4. In addition to the theoretically expected signs, as the graphs in Fig. 2 and 3 for the within sample and the dynamic simulation in the Appendix show, the model mimics very well even the turning points which suggest that the model is well specified to account for the movements of the real exchange rate during the period of estimation;
5. Further, as the behaviour of the residuals indicates, the stationarity and hence the normality of the data cannot be rejected, even by visual inspection.

Table 2: Short-Run Model of Effective Equilibrium Real Exchange Rate

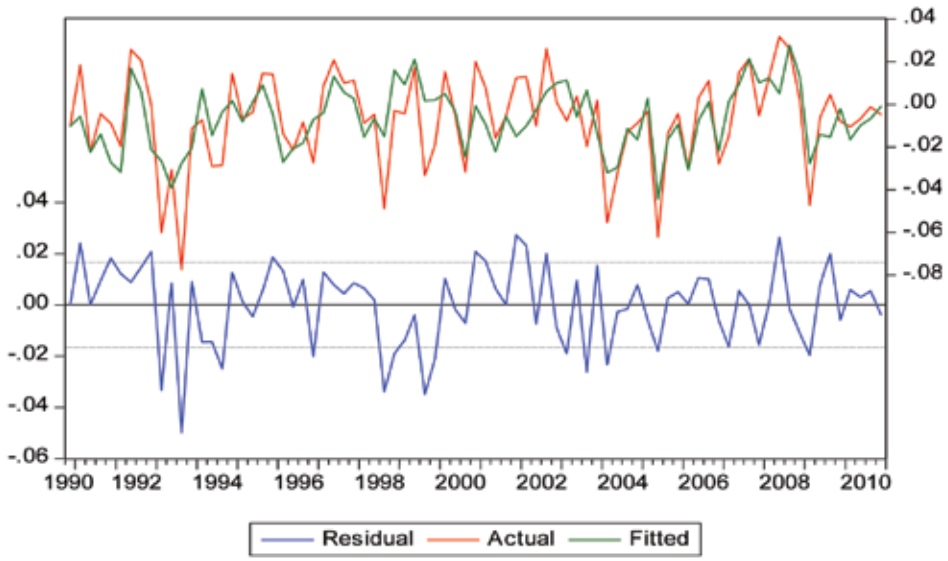
Dependent Variable: D(LREER5)
Method: Least Squares
Date: 05/01/12 Time: 11:44
Sample (adjusted): 1990Q4 2010Q4
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NEER1(-1))	0.009870	0.001588	6.213767	0.0000
D(LRTOT(-1))	0.966058	0.180732	5.345255	0.0000
D(LREXCRE)	0.056266	0.031681	1.775984	0.0801
D(INFD(-1))	-0.001311	0.001160	-1.130493	0.2621
D(RIRD(-1))	-0.002973	0.001299	-2.288876	0.0251
D(LRINV)	0.062601	0.021250	2.945904	0.0044
D(LRGFCONS(-1))	-0.066102	0.014673	-4.504889	0.0000
D(LRCLOSE(-1))	-0.050927	0.015603	-3.264021	0.0017
D1	-0.000578	0.004212	-0.137317	0.8912
C	0.002242	0.003127	0.717044	0.4757
ARDL_ECM(-1)	-1.305477	0.220680	-5.915704	0.0000
R-squared	0.481003	Mean dependent var		-0.006956
Adjusted R-squared	0.406861	S.D. dependent var		0.021584
S.E. of regression	0.016623	Akaike info criterion		-5.230386
Sum squared resid	0.019343	Schwarz criterion		-4.905214
Log likelihood	222.8306	Hannan-Quinn criter.		-5.099923
F-statistic	6.487554	Durbin-Watson stat		1.946633
Prob(F-statistic)	0.000001			

Note: All variables are as defined before and 'D" in the short run denotes first difference of the variable and ARDL_ECM is the lagged value of the ECM term.

6. As an additional test for the forecasting ability of the model, in addition to the within sample forecasts, outside sample forecasts for which actual data is available (2011Q:1 to Q:4) were undertaken (reported in Appendix 2.3). the forecasts show a slight depreciation of the pula relative to the effective exchange rate.
7. This is mainly because, while on average the Pula slightly appreciated against the South African rand in 2011, it depreciated against all the major currencies, hence an overall depreciation again the weighted average of the major currencies.

Fig. 3: Within Sample Forecasts: the Short-Run Model



4. Conclusions and Policy Implications

The main conclusions that could be drawn from the above preliminary exercise are that:

a. There seems to be no misalignment of the real exchange rate (the Pula) in Botswana in the last twenty years (1990 to 2010);

b. What is also worth noting is that, as the estimates suggest, any misalignment when it exists, adjusts to an equilibrium level in a short period of time (within few quarters);

c. Therefore, the crawling peg which the monetary authorities follow to conduct the exchange rate policy in Botswana seems to have worked until the last few quarters;

d. The policy implications of the above conclusion is that the policies that have been in place seem to be on the right track in conducting the exchange rate policy and should be pursued in tandem with the developments in the fundamentals. This is because, unlike many countries which either suffer from what is called the "Dutch Disease" which affects many countries with huge natural resource endowment, such distortions do not seem to reflect the movements of the Botswana Exchange rate (the Pula).

e. But of course, the above observation has disregarded the movement of the exchange rate in the last few quarters (for in instance, in the last year alone it moved from a low of 5.45 Pula per USD to a high of 7.78 Pula per USD, in

recent days - i.e. about 40% decline). If indeed such a deviation persists and is not a temporary fluctuation, there is every reason to be worried about such a deviation. The time is too short to make a judgement regarding the impact of such a deviation and has to be carefully monitored to ensure it does not develop into distortions in resource allocation and/or instability. In fact this is probably one of the best features of a crawling Peg exchange regime (to adjust as the need arises before any deviation entails any market distortion); and

f. Finally, the policy implications of the last point must be emphasised again. It should be clear that for an import dependent economy and with price inelastic exports and import structure, currency devaluation does not necessarily improve a trade balance due to what is called 'elasticity pessimism'. The depreciation of the Pula has to, therefore, be carefully monitored because it is likely that due to low elasticity of exports and imports ("elasticity pessimism"), depreciation will not significantly increase exports and decrease imports which both will lead to a deteriorating trade balance due to lack of significant increase in export revenue and increase in import bill.

REFERENCES

Arghyrou, M. (2003). "Debt Sustainability, Structural Breaks and Non-linear adjustment: A testing Application to Greek fiscal policy", Department of Economics and Finance, Brunel University.

Balassa, B. (1964). "The Purchasing Power Doctrine: A Reappraisal", *Journal of Political Economy,* 72, 584-596.

Cottani, J., et. al. (1990). "Real Exchange Rate Behaviour and Economic Performance in LDCs", *Economic Development and Cultural Change,* 39, 61-76.

Edwards, S. (1989*)*. Real Exchange Rates Devaluation and Adjustment, The MIT Press, Cambridge, MA.

Edwards, S. (1990). "Real Exchange Rate in Developing Countries: Concept and Measurement", in Greenes, T. J. ed., *International Financial Markets and Agricultural Trade,* 56-108. London: Westview Press, Boulder co.).

Elbadawi A. I. (1994). "Estimating Long-Run Equilibrium Real Exchange Rates", in John Williamson Ed., *Estimating Equilibrium Exchange Rates*, Washington, D.C: Institute for International Economics, 1994.

Ghura, D. and Greenes T. J. (1993). "The Real Exchange Rate and Macroeconomic Performance in Sub-Saharan Africa", *Journal of Development Economics,* 42, 155-174.

MacDondald, R. (1995). "Long-Run Exchange Rate Modeling: A Survey of the Recent Evidence", *IMF Staff Papers*, 42, 437-489.

MacDondald, R., and Ricci, L. (2003). "Estimation of the Equilibrium Real Effective Exchange Rate for South Africa", IMF Working Paper WP/03/44 (Washington: International Monetary Fund).

Maxwell, O., et. al. (2003). "Real Exchange Rate Response to Aid Inflows: A Dynamic Analysis for Ghana", School of Economics, University of Nottingham, Nottingham NG7 2RD.

Pesaran, H. and Shin, Y. (1997). "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis", Trinity College, Department of Economics, Cambridge England, January.

Razin, O. (1997). "Real Exchange Rate Misalignment and Growth", Doctoral Dissertation, George Town University.

Stock, J. and Watson. M. (1993). "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated System", *Econometrica*, 5, pp. 1035-1056.

APPENDICES

Appendix 1: Co-integration Tests

Date: 05/01/12 Time: 11:32
Series: LREER5 NEER1 LRTOT LREXCRE INFD RIRD LRINV LRGFCONS LRCLOSE
Sample (adjusted): 1990Q2 2010Q4
Included observations: 83 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=11)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
LREER5	-4.031229	0.6477	-30.25174	0.5202
NEER1	-4.335113	0.5005	-33.95611	0.3648
LRTOT	-6.025803	0.0295	-47.20759	0.0532
LREXCRE	-5.623277	0.0708	-45.75223	0.0691
INFD	-5.333818	0.1235	-42.63748	0.1163
RIRD	-4.346919	0.4942	-30.22298	0.5238
LRINV	-4.239290	0.5474	-36.50729	0.2720
LRGFCONS	-6.538702	0.0083	-56.62680	0.0074
LRCLOSE	-7.978433	0.0001	-71.13841	0.0001

*MacKinnon (1996) p-values.

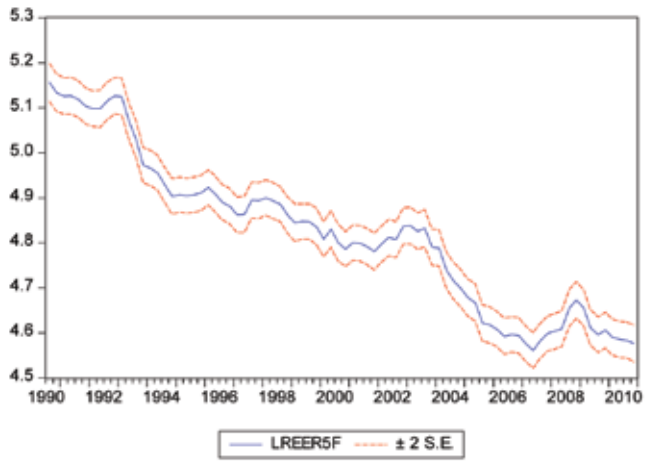
Intermediate Results:

	LREER5	NEER1	LRTOT	LREXCRE	INFD	RIRD	LRINV	LRGFCONS	LRCLOSE
Rho - 1	-0.465181	-0.499168	-0.575702	-0.557954	-0.519969	-0.368573	-0.573088	-0.690571	-0.867542
Rho S.E.	0.115394	0.115145	0.095540	0.099222	0.097485	0.084789	0.135185	0.105613	0.108736
Residual variance	5.36E-05	0.947203	7.49E-05	0.022644	3.087416	2.359951	0.004720	0.013892	0.008558
Long-run residual variance	3.45E-05	0.668059	7.49E-05	0.022644	3.087416	2.359951	0.002919	0.013892	0.008558
Number of lags	1	1	0	0	0	0	1	0	0
Number of observations	81	81	82	82	82	82	81	82	82
Number of stochastic trends**	9	9	9	9	9	9	9	9	9

**Number of stochastic trends in asymptotic distribution

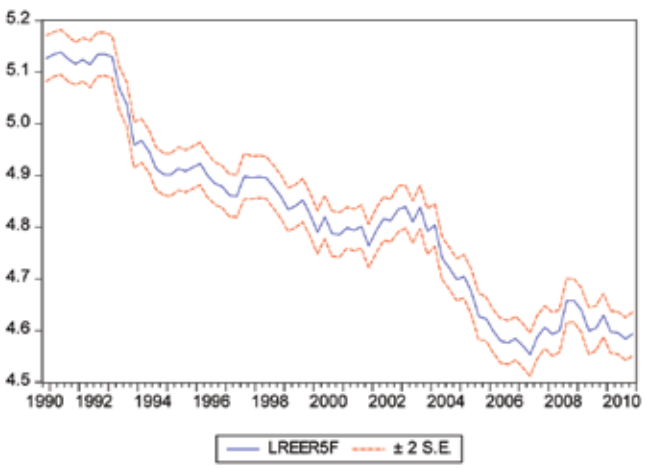
Appendix 2: Simulation

Appendix 2.1: Long-run model based dynamic Forecasts (± 2 standard Deviation)



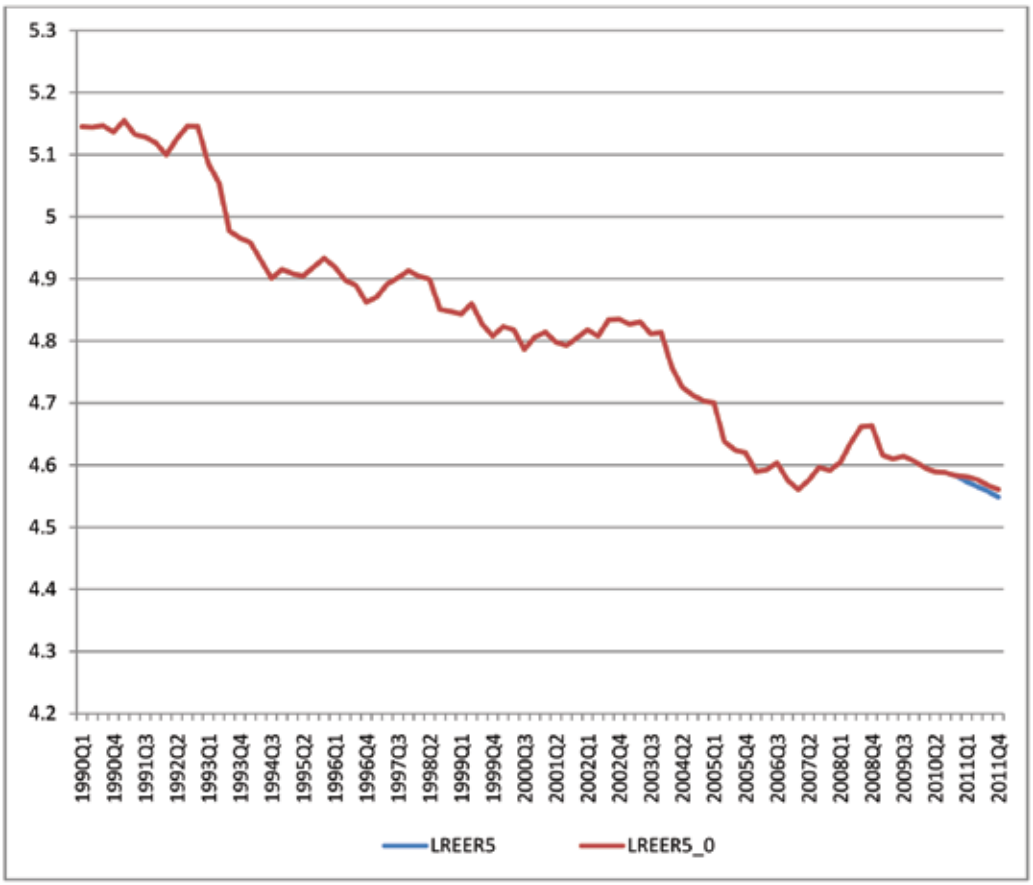
Forecast: LREER5F	
Actual: LREER5	
Forecast sample: 1990Q1 2011Q4	
Adjusted sample: 1990Q3 2010Q4	
Included observations: 82	
Root Mean Squared Error	0.017714
Mean Absolute Error	0.013832
Mean Abs. Percent Error	0.285742
Theil Inequality Coefficient	0.001836
Bias Proportion	0.000000
Variance Proportion	0.002664
Covariance Proportion	0.997336

Appendix 2.2: Sort-Run model based dynamic Forecasts (± 2 standard Deviation)



Forecast: LREER5F	
Actual: LREER5	
Forecast sample: 1990Q1 2011Q4	
Adjusted sample: 1990Q4 2010Q4	
Included observations: 81	
Root Mean Squared Error	0.018586
Mean Absolute Error	0.014466
Mean Abs. Percent Error	0.300241
Theil Inequality Coefficient	0.001928
Bias Proportion	0.000000
Variance Proportion	0.003723
Covariance Proportion	0.996277

Appendix 2.3: Outside Sample Forecasts (actual and Predicted)



Botswana Institute for Development Policy Analysis (BIDPA)
BIDPA House, International Finance Park
Plot 134, Tshwene Drive, Kgale View
Private Bag BR-29
Gaborone, Botswana
Tel. 267 3971750,Fax: 267 3971748
URL: http://www.bidpa.bw, e-mail: webmaster@bidpa.bw

Associated Printers