

A CLOSE LOOK AT BOTSWANA'S MANAGEMENT OF MONETARY POLICY: THE REACTION FUNCTION APPROACH

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1.0 Introduction

The importance of macroeconomic management of an economy by the monetary authorities cannot be overemphasized. This paper looks at how monetary policy was actually conducted in Botswana, by specifying and estimating a monetary reaction function for the Bank of Botswana. Basically, a monetary reaction function (MRF) for a central bank is an equation which is intended to establish the goals that have actually been influencing the actions of the central bank. A MRF would exist if the monetary authorities (or Bank of Botswana in particular) have been purposeful and reasonably consistent in the policy-making process. Thus, a study of a MRF provides a test on whether the monetary policy-making process has been characterized by systematic (if it exists) or random (if it does not exist) changes in the policy instrument(s).

Studying how monetary policy was conducted in Botswana is of interest for another reason. Knowledge of the monetary policy of Botswana may be of great value to other African countries or developing countries in general. This is particularly so in view of the economic circumstances that prevailed in Botswana during the period under study. For about a decade in the 1980s, the economy experienced an unparalleled boom. But in spite of this, policymakers managed to avoid chronic inflation (see section 2 for details). Other developing countries that also enjoyed a commodity boom, or natural resource boom, had difficulties managing the boom situation without serious macroeconomic imbalances. For example, in Kenya, the management of the commodity export boom of the 1970s is partly blamed for the economic difficulties (such as appreciation of the real exchange rate, increase in both the level of external debt and fiscal deficit) that followed the boom (see Durevall and Ndung'u, 1999).² The other example is that of Zambia, a

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² The problem of rising external debt and fiscal deficit started during the boom (see Durevall and Ndung'u, 1999).

country which, at independence in 1964, was one of Africa's richest nations. Due to the economic mis-management of the mineral-led boom the country has had an inflation problem (Nankani, 1979) and is now facing a serious economic crisis (see MacWilliam, 1996). In general, Nankani (1979) observes that mineral-exporting countries are characterized by high demand-pull type of inflation rates. Unless accompanied by nominal depreciation of the exchange rate, high inflation rates lead to real currency appreciation and the Dutch disease. Botswana has managed to avoid the Dutch disease.

Monetary reaction functions have been estimated in both developed and underdeveloped countries – see Wood (1967), Fair (1984), Clarida, Gali and Gertler (1998), and Shen, Hakes and Brown (1999) for the former; and Porzecanski (1979), Joyce (1991), and Bleaney and Lisenda (2001) for the latter. It is important to note that in general, in developed countries, several MRF studies have been conducted for each country. The justification has been to establish a robust reaction function. For Botswana, only two MRF studies have been conducted – the study by Bleaney and Lisenda (2001) estimates a reaction function for the period 1990-99,³ and the other by Setlhare (2002) estimates a reaction function for the period 1977-95. Thus, it is crucial that a reliable Bank of Botswana MRF equation be established. This study will make contributions to this end (i) by offering a modified MRF specification and (ii) by estimating the MRF equation on different samples of data.

The paper is organized as follows. In section 2 we provide a review of the macroeconomic history of the economy of Botswana over the period of study. After specifying the Bank's MRF equation in section 3, section 4 investigates the stochastic properties of the variables of the model. The estimation results are presented in section 5 and then analyzed in section 6. Section 7 then offers conclusions and suggestions for future research.

2.0 Macroeconomic History of Botswana

For much of the 25 years after independence, Botswana was the fastest growing economy in the world – attaining the status of an upper middle income country by 1993. It is important to note that the economy of Botswana experienced this “diamonds boom”

³ Bleaney and Lisenda also estimated their MRF equation over the sub-sample 1992-99.

over an extended period of time. The continuous unabated boom lasted for the whole period of 1982-90; where Gross Domestic Product, in real terms, grew by an average of 12 percent per annum.

Diamond exports have resulted in a rapid increase in foreign exchange reserves. When combined with exchange controls on the capital account (that restricted capital outflows)⁴ and limited absorption capacity, the rapid increase in foreign exchange reserves led to a situation of excess liquidity in the banking system.

Two major regimes could be identified in the monetary history of Botswana. The first period (1976-88) is characterized by financial repression, and the second period (1989 to present) is characterized by financial liberalization.

Prior to 1989, the monetary authorities followed the forced saving approach of the Keynesian school. This approach maintains that since investment, not saving, is the constraint on growth, a low or even negative real interest rate is a prerequisite for economic growth. Thus, the monetary authorities can autonomously increase investment without prior savings through monetary expansion; such an investment will then generate its own savings (see Hossain and Chowdhury, 1996). This can work through several channels. For example, under conditions of supply rigidities, as in Botswana, expansionary monetary policy will be inflationary. The effect will be a fall in the real rate of return on financial investment, which will cause a portfolio shift in favour of physical capital. Other aspects of the financial repression included the imposition of floors on deposit rates, refusal to license additional commercial banks and exchange controls.

By 1989 the failure of the financial repressive policy (to promote productive investment) had become apparent. The problem of excess liquidity remained unabated. The market for loanable funds remained thin;⁵ since the low real interest rates discouraged private saving, while the Bank's protective policy essentially perpetuated a duopoly comprising two commercial banks, and thus the range of instruments from which borrowers could choose to save or lend was limited. When the market is thin, the transmission of monetary policy is hindered and hence, monetary policy becomes ineffective.

⁴ While exchange controls on non-residents were very liberal, they were less so towards domestic residents.

⁵ A thin market is one in which there are relatively few buyers and sellers.

On account of these problems, the monetary authorities became weary with the strategy and started on the process of financial liberalization in 1989. This entailed removal of controls on interest rates, increase in bank competition (by allowing entry of new commercial banks) and progressive liberalization of exchange controls. In the case of interest rates, the BoB began issuing its own paper, the Bank of Botswana Certificates (BoBCs), in May 1991 in order to mop excess liquidity and to achieve positive real interest rates (comparable to those prevailing in major international capital markets). The issuance of the BoBCs marked the transition from a monetary framework in which monetary policy was implemented by direct controls (on interest rates) to one that is market-oriented and in which monetary control was effected through indirect instruments. And in respect of the liberalization of exchange controls, the process entailed the complete removal of controls on current account transactions and a substantial reduction of controls on the capital account. All remaining capital account controls were eliminated in 1999 (Masalila, 2001).

The exchange rate policy also underwent a major shift.⁶ Before 1989, the Rand/Pula exchange rate was managed so as to control imported inflation from South Africa and, to ensure the competitiveness of exports other than minerals in the South African market on the other hand. Obviously, there is a conflict between these two goals. Appreciation of the exchange rate to curb imported inflation makes exports uncompetitive. In view of this conflict, and the realization that domestic prices were not that sensitive to changes in the exchange rate, the use of the exchange rate to fight inflation was discontinued in 1989.

As already mentioned in section 1, an interesting feature to note is that in spite of the dramatic events discussed above, the economy of Botswana did not experience the problem of chronic inflation since annual inflation in Botswana has never exceeded 20 percent throughout the period under study. A comparison of the inflation performance of Botswana with that of other developing countries in general, as has been done in Cowan (1998) for the 1976-95 period, shows that Botswana is better than a broad range of African countries. He finds that within SACU, Botswana has had one of the lowest

⁶ Botswana operates a fixed exchange rate system; where the Pula (Botswana's currency) is pegged to a basket of currencies that comprise 50 percent Special Drawing Right and 50 percent South Africa's currency, the Rand.

average Consumer Price Index (CPI) inflation during 1976-85. Cowan also finds that Botswana has had the lowest average CPI inflation during 1986-95 and the lowest average inflation in the whole period. In addition, Botswana has had the most stable average CPI inflation, compared to the rest of the SACU countries (see Cowan, 1998).

In the following section, we specify an equation that models the behavior of the BoB.

3.0 Monetary Reaction Function Specification

MRF equations are specified with the variable that serves as the indicator of the stance of monetary policy (i.e., the instrument of policy) as the dependent variable and the variables that serve as policy target variables as explanatory variables (these are variables that reflect the state of the economy. The other set of variables used as explanatory variables comprise intermediate variables – the importance of these variables emanates from their ability to affect or predict policy target variables.

Using the three categories of variables just described, most of the empirical studies on the MRF specified an equation of the form:

$$x_t = a + \alpha x_{t-1} + \sum w_i y_{it} + e_t \quad (1)$$

where, x_t represents an indicator of monetary policy, y_{it} represents “target variables” which usually also included intermediate variables, e_t is classical error term and a, α, w_i are parameters to be estimated. This study will follow suit by specifying and estimating a version of (1).

3.1 Specification of the Bank of Botswana MRF Equation

To formulate a MRF equation for BoB we adapt equation (1) to the context of monetary policy in Botswana.

Any study of monetary policy must first determine a variable that seems to be a plausible indicator of the stance of policy. Throughout its history, BoB has used the Bank rate as a policy instrument. However, the fact is that the Bank rate gained preeminence in signaling the desired direction and level of interest rates after 1991. Before then, the

Bank's call loan rate had a greater influence on interest rates – commercial banks did not borrow much from the BoB on account of excess liquidity.⁷ This situation seems to suggest using a spliced series of the Bank's call rate and the Bank rate. Unfortunately, the data on the Bank's call rate are not published, and hence unavailable to us. Consequently, we use the Bank rate as the policy instrument for the whole period, which is somewhat justifiable since interest rates in Botswana have tended to move together (see Setlhare, 2002).

In respect of goal variables, one plausible variable is inflation. Inflation is a plausible goal of monetary policy on the basis of the consensus that has emerged among many economists and practitioners that the primary goal of monetary policy should be to attain and maintain price stability (see Kadioglu, Ozdemir and Yilmaz, 2000). In fact, in Botswana, both the government and the Bank have repeatedly stated that the main objective of monetary policy is price stability.

Another variable is the real exchange rate, which became a policy variable in 1989. This variable essentially captures the response of monetary policy to inflation differential between Botswana and its trading partners, particularly South Africa (see section 5 for explanation).

And the third policy variable we consider is output, which could be seen as a theoretically and historically plausible goal of monetary policy in Botswana. On theoretical grounds, we can argue that watching income is useful even when inflation is the main objective of monetary policy since the level and/or growth of real income relative to capacity has implications for inflation. On historical grounds, we observe that the government has stated that monetary and fiscal policies will be used to foster economic growth (National Development Plan, 1985-91). The government has also indicated that monetary policy will be used to avoid sharp shifts in real aggregate demand (for elaboration, see Setlhare, 2002).

And in respect of intermediate variables, we use M1, M2, and domestic private credit and total revenue from diamond sales.

⁷ The Bank introduced a call account facility for commercial banks in 1976 to permit commercial banks to earn some interest on the excess liquidity in the banking system. This worked as an ordinary interest-earning account in which the commercial banks could make deposits and earn some interest (Bell, 1987). The call account facility was discontinued in 1991.

Financial aggregates will be included in the BoB's MRF because the BoB has been using them (particularly domestic credit) as information variables. An information variable is an intermediate variable that is used as an early indicator of the effect of monetary policy on economic activity – aggregate output or inflation in our case.

As for the revenue from diamond sales, it seems reasonable to view it as an intermediate variable given that diamond exports are the main source of foreign exchange and government revenues. We make a conjecture to the effect that the BoB may have been concerned with upward changes in the diamond sales revenue since an increase in diamond revenues, by increasing liquidity in the economy, is inflationary. That is, changes in diamond sales could be seen as serving the role of a leading indicator of later changes in the other information variables. Consequently, the Bank could have engaged in a preemptive countercyclical monetary policy strategy in response to the growth of diamond sales.

And lastly, we have a variable that does not fall into any of the three categories, the South African Treasury bill rate. It seems plausible that the monetary authorities in Botswana may consider the effect of the foreign interest rates of South Africa important. The South African interest rates may have an influence on monetary policy in Botswana since in the demand for money studies of Anyangah (1995) and Setlhare (2002), the Treasury bill rate of South Africa was found to determine the demand for money in Botswana. This effect could be anticipated even for the pre-liberalization period given that, although capital controls were strict towards citizens, they were liberal towards non-citizens. Therefore, in spite of the existence of capital controls (during most of our sample period), Botswana has had the potential to experience substantial capital flows. In fact, the Bank's own accounts show that it has been concerned about the interest rate differential between Botswana and South Africa (see BoB Annual Report, 1982).

We now turn to the actual specification of the MRF equation for the BoB. We specify two MRF equations. One equation will assume that the Bank followed an integral rule in reacting to inflation; so inflation enters in level form. The other equation will assume that the Bank followed a proportional rule in reacting to inflation; hence, inflation enters in growth form. Either of these two feedback rules seems equally likely concerning the BoB's response to inflation, in the period we are modeling.

Under the integral rule, the policy instrument is changed until the goal variable (inflation) is back on target. This rule is plausible when the goal is inflation stabilization and monetary authorities have adopted an anti-inflation stance, as has been the case with BoB, which made repeated statements the Bank has made about its concern with inflation. Although the BoB did not declare a target value for inflation until just recently, it is plausible that to think that the central bank could have tried to maintain tight control over inflation – by adopting a strategy of raising the Bank rate until inflation is (virtually) back to the target level.

Under the proportional rule, the policy instrument is changed only once, in response to a deviation of the goal variable from target. This rule is not consistent with a tight control over inflation. The one-time change in the instrument may not be enough to remove the deviation (see Cameron, 2001). This rule also seems plausible since in spite of BoB's great concern with inflation, other tools (such as the exchange rate and incomes policy) have also been used to fight inflation.

Supposing that BoB focuses on the growth of real GDP as a measure of aggregate demand, our first MRF equation is specified as follows:

$$DBr_t = a + \sum_{i=1}^5 \alpha_i Inf_{t-i} + \sum_{i=2}^3 \phi_i Drgdp_{t-i} + \sum_{i=1}^2 \theta_i DrFA_{t-i}^* + bDdvl_t + cDTbSA_{t-1} + e_t \quad (2)$$

where DBr_t , Inf_t are as defined above; $Drgdp_t$ is growth of real GDP; $DrFA_t^*$ is the growth of a real financial aggregate, purged of the effect of South African interest rates – financial aggregates are real M1, real M2 and real private domestic credit; $Ddvl_t$ is the growth of revenue from diamond sales and $DTbSA_t$ is the growth of the South African Treasury bill rate. When policy is assumed to have followed a proportional rule towards inflation, we replace the level of inflation term in (2) with a first-difference (of inflation) term.

The reader will note the following about equation (2). First, the maximum lag length for the output variable has been made shorter than that for the inflation variable since GDP is a leading indicator of inflation. Thus beyond three quarters, the Bank would

likely pay more attention to the trend of inflation than the trend of real GDP. That is, they will likely act quicker on changes in real GDP, so they wait less time, even though growth in real GDP is revealed only slowly. Similarly, the lag length for the financial aggregates is shorter than that for goal variables.

Second, the income variable enters with the lowest lag set to two quarters. This is intended to make the MRF equation consistent with the fact that BoB does not have access to GDP data until in the second quarter.

Third, when the proportional rule is assumed, the MRF will include a one period lagged term for the growth of the Bank rate as an explanatory variable. This is based on the idea that in general central banks avoid sharp and sudden changes in setting short-term interest rates (Svensson, 1999). Interest-rate smoothing is compatible with the proportional rule – where the policy instrument is not changed vigorously, in response to deviations of the goal variable. The idea is incompatible with the integral rule.

And fourth, our assumption about the final target values of the rate of inflation and output is that they remain constant over the sample period under study and therefore can be captured in the intercept.¹⁶ This is an expedient simplifying assumption in view our lack of knowledge of the target values of these variables. For most of the period, neither the government nor the BoB spelled out in public their target values. It is only recently that the Bank has been making statements that point towards a possible target value for inflation.

In the next session we investigate the time series properties of the variables that enter the MRF equation.

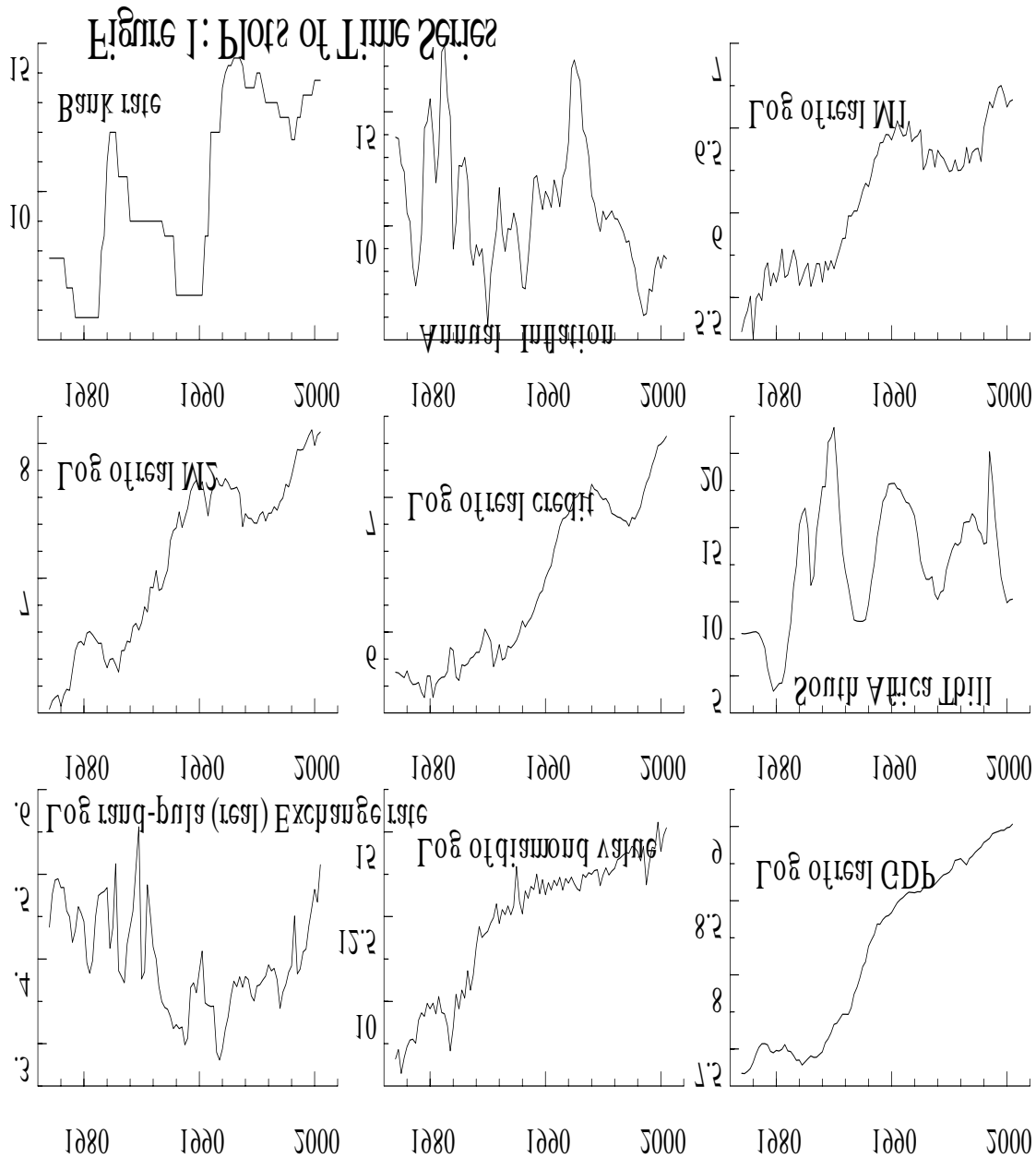
4.0 Time Series Properties of the Data

Prior to carrying out estimations of the MRF equation specified in section 3, we need to examine the time series behavior of the variables included in it. Examination of the stochastic properties of the data will help us to know whether or not our results are subject to the spurious correlation problem.

To study the stochastic properties of data, we shall conduct a unit root test, using the Phillips-Perron test. Our preference for the PP test rests on the empirical evidence that has shown that it has more power of test against the null of non-stationarity. In this

regard, we should note that of the three tests that are used in Setlhare (2002), the integration test results led the author to prefer the PP test.

Readers not familiar with Botswana will find the Phillips-Perron test statistics easier to appreciate after seeing actual time paths of the variables being tested. These time paths are shown in Figure 1. A detailed description of the data and their respective sources is provided in appendix 1.



The PP test statistic, determines how many unit roots each series has, and is implemented by testing the null hypothesis that a series has a stochastic trend (unit root) against the alternative of either a deterministic linear trend (for trended series) or a constant (for series without trends). The lag-length was automatically truncated at the third quarter as preset by the Newey-West procedure built into the Eviews Econometrics program. Using different lag-lengths did not change the results substantially. Table 1 presents integration test results for variables in their level form.

The results support the null hypothesis that all the variables are non-stationary in levels (i.e., not $I(0)$), except for the inflation variable. This suggests that inflation is stationary around its mean.

TABLE 1: UNIT ROOT TEST - LEVELS OF VARIABLES

VARIABLE	TREND	PP(τ)	LAG
Inflation	no	-2.94*	3
Bank rate	yes	-2.21	3
Log of Real GDP	yes	-1.42	3
South Africa Tbill rate	no	-2.30	3
Log of Real M1	yes	-2.47	3
Log of real M2	yes	-2.20	3
Log of Real Private credit	yes	-1.80	3
Log of Diamond Value	yes	-2.05	3
Log of Real Exchange rate	no	-2.60	3

Notes:

1. MacKinnon Critical Values in Eviews:
5% = -3.46; 1% = -4.06 for model with intercept and trend.
5% = -2.89; 1% = -3.50 for model with intercept only.
2. * means significance at the 5 percent level.

We now address the question of whether the non-stationary series are $I(1)$, i.e., first-difference stationary, or $I(2)$, i.e., second-difference stationary. This entails performing the same test on the first-differences of variables. The results are reported in Table 2.

TABLE 2: UNIT ROOT TEST - FIRST-DIFFERENCES OF VARIABLES

VARIABLE	PP(τ)	LAG
Bank Rate	-8.52**	3
Log of Real GDP	-4.54**	3
South Africa Tbill rate	-6.09**	3
Log of Real M1	-12.63**	3
Log of Real M2	-9.34**	3
Log of Real Private Credit	-7.96**	3
Log of Diamond value	-14.50**	3
Log of Real Exchange rate	-11.12**	3

Notes:

1. MacKinnon Critical Values in Eviews:
5% = -1.94; 1% = -2.59
2. ** means significance at the 1 percent level

When the variables are transformed to their first-differences, the PP test rejects the null hypothesis for all the variables, even at the 1 percent level of significance. Thus all the variables are first-difference stationary.

Overall, we note that all the variables in the MRF equation (2), including the level of inflation, can be treated as I (0). Thus, the use of the integral feedback rule will not lead to spurious results. In the next section, we go right ahead to the estimation of the MRF equation.

5.0 Estimation Results

Results will be presented as follows. For each financial aggregate, we shall estimate two versions of the MRF equation. One version assumes a proportional feedback rule for inflation; and the other assumes an integral feedback rule (see section 3 for explanation).

Another consideration that our MRF estimation takes into account is the major policy regime shift that occurred in 1989. This entails re-estimating the equation over the post-financial liberalization period. However, given that the more powerful market-based policy instruments were only introduced in 1991, we re-estimate the equation over the 1991-2000 period. Bleamey and Lisenda (2001) also argue that although the BoB gained some autonomy over its monetary policy in the late 1980s, the Bank really gained operational control over monetary policy in 1991.

We start by estimating the MRF equation over the whole period: 1977-2000.

5.1 MRF Estimation over the 1977-2000 Period

Given the large amount of output, we only present the ‘best’ results in the text; the rest of the output is placed in appendix 2. The best results occur when we assume that the Bank focused on real M1 as the most important information variable

5.1.1 Results: Growth of real M1 is the most Important Information Variable

Our specification for the estimated MRF equation becomes:

$$DBr_t = \alpha + \sum_{i=1}^5 \alpha_i Inf_{t-i} + \sum_{i=2}^3 \phi_i Drgdp_{t-i} + \sum_{i=2}^2 \theta_i Drm1_{t-i} + bDdvl_t + cDTb_{t-1} + e_t \quad (3a)$$

where, *Drml* is growth of real M1, and the rest of the variables are defined as above.

The reader will notice that *Drml* has not been adjusted for the effect of the South African Tbill rate (hereafter called Tbill rate); hence its name is as is, instead of *DrmlSA*. This emanates from the fact that none of the Tbill rate terms remained significant in the equation used to detect the influence of the Tbill rate on *Drml*.

The results of the estimating (3a) are presented in panel A of Table 3. Panel A presents the final parsimonious (estimated) version of equation (3a), after subjecting it to the general-to-specific reduction procedure. The reduction process was evaluated using the F-test for omission of a variable.

The results show that the central bank changed the growth of the Bank rate in response to changes in the one period lag of the level of inflation. The positive sign of the coefficient of the variable suggests that the bank followed a countercyclical policy with respect to inflation.

The last piece of information in this section of the table shows the temporal stability tests due to Hansen (1992). There is no evidence of individual coefficient instability since none of the statistics for parameter instability tests (shown in the last column entitled “Instab”) is significant at the 5 percent level.⁸ The model also passes the variance instability test, indicated by σ^2 .

⁸ These are within-sample parameter constancy tests.

Under mis-specification tests, we present two types of tests to check the specification of the equation: the residual tests (testing the properties of the equation's residuals) and the specification test (testing the correctness of the equation).⁹ Except for the normality test, none of the mis-specification tests indicates problems. The normality test result suggests possible mis-specification of the functional form; a suggestion that is heavily discounted by the finding that the RESET test suggests not a problem. So we ignore the rejection by the normality test.

Table 3: MRF with Growth of real M1 as Information Variable and Target Variables as the Level of Inflation or Growth of Inflation and Growth in Real Income

Modelling DBr by OLS - Sample is: 1978(2) - 2000(3)							
PANEL A				PANEL B			
Variable	Coeff	t-value	Instab	Variable	Coeff	t-value	Instab
Const	-0.55	-1.88*	0.12	Const	0.07	0.97	0.09
Inf_1	0.06	2.18*	0.07	Dinf_4	0.09	1.75*	0.07
R ² = 0.05; F(1, 88) = 4.75 [0.03]; $\sigma = 0.70$; Instability ($\sigma^2 = 0.12$)				R ² = 0.03; F(1, 88) = 3.05 [0.08]; $\sigma = 0.71$; Instability ($\sigma^2 = 0.14$)			
Mis-specification Tests				Mis-specification Tests			
AR 1- 5 F(5, 83) = 1.32[0.26]				AR 1- 5 F(5, 83) = 1.51[0.20]			
ARCH 4 F(4, 80) = 1.04[0.39]				ARCH 4 F(4, 80) = 1.32[0.27]			
Normality Chi ² (2)= 29.3[0.00]**				Normality Chi ² (2)= 29.4[0.00]**			
Xi ² F(2, 85) = 0.80[0.45]				Xi ² F(2, 85) = 0.64[0.53]			
Xi*Xj F(2, 85) = 0.80[0.45]				Xi*Xj F(2, 85) = 0.64[0.53]			
RESET F(1, 87) = 1.34[0.25]				RESET F(1, 87) = 0.00[0.99]			

Notes:

1. * and ** denote the 5 and 1 percent level of significance respectively

In the second version of the reaction function equation, we use all the variables entered in (3a), but now the rate of inflation is entered in growth form.

The results are presented in panel B of Table 3. They suggest that the Banks's monetary policy decisions were influenced by the four period lag of growth of inflation.

⁹ The properties of the model residuals are tested using five residual tests : (i) Lagrange Multiplier (LM) test for autocorrelated residuals (denoted as AR 1-5); (ii) LM test for autocorrelated squared residuals – this is the autoregressive conditional heteroscedasticity (denoted ARCH) test ; (iii) the normality test, for testing whether the skewness and kurtosis of the residuals correspond to that of a normal distribution ; (iv) the test for heteroscedasticity using squares of the regressors (denoted Xi²) ; and (v) the test for heteroscedasticity using squares and cross- products of the regressors (denoted XiXj). Ramsey's specification test (denoted RESET), tests to see if the original functional form is incorrect

As in the case of integral rule, policy reacted in a countercyclical fashion to the rate of inflation.

An important point to note is that for both versions of the MRF equation, the real M1 aggregate has dropped out of the equation during the reduction process, suggesting absence of its role as information variable.

The estimation results, when the growth of real M2 is taken as the most important information variable are presented in appendix 2. The results still suggest that inflation has had an important influence on monetary policy. However, the adjustment in policy to changes in inflation seems to have been temporary, and not permanent – since the sum of the coefficients of the inflation terms is zero. Both of these equations do not fit the data so well, particularly the integral rule equation which fails not just the heteroscedasticity test, but also the RESET test.

When the credit aggregate is taken as the key information variable, the resultant estimation results (not shown) are exactly the same as those obtained when the real M1 aggregate is assumed the most important information variable. That is, the parameter values, tests statistics, summary statistics, etc, are exactly the same.

In the following sub-section, we estimate the MRF over the 1991-2000 period.

5.2 MRF Estimation over the 1991-2000 Period

The MRF specification of this sub-section will differ from that estimated for the whole period in one important respect. The equation for the 1991-2002 period will include the growth of the rand-pula real exchange rate as one of explanatory variables. The reader will recall that with effect from 1989, the authorities terminated the use of the (rand-pula) exchange rate as policy instrument. The objective of the policymakers has since been to maintain a stable real exchange rate (see Monetary Policy Statement 1999). Thus since 1989, the exchange rate ceased from being a policy instrument and became a policy variable.

$$\begin{aligned}
 DBr_t = a + \sum_{i=1}^5 \alpha_i Inf_{t-i} + \sum_{i=2}^3 \phi_i Drgdp_{t-i} + \sum_{i=1}^2 \theta_i DrFA_{t-i} + bDdvl_t \\
 + cDTb_{t-1} + dDrxr_{t-1} + e_t
 \end{aligned} \tag{3b}$$

Where $Drxr$ is growth of the real rand-pula exchange rate.¹⁰

We need to determine the expected sign for the coefficient of the exchange rate variable. On the basis of the relative purchasing power parity (PPP) hypothesis, and if the exchange rate is flexible, we expect the rate of domestic currency depreciation or appreciation to be equal to the inflation differential between two countries in order to leave the real exchange rate constant. This implies that for Botswana, where the exchange rate is pegged, one way policy makers could maintain the PPP between the domestic and foreign currency is by changing the peg to mirror the differential between Botswana's inflation rate and that of trading partners. However, the central Bank has made it clear that it wants "to avoid having to devalue the nominal exchange rate in order to maintain a stable real exchange rate" (Monetary Policy Statement 1999). So, since international competitiveness is important to the monetary authorities in Botswana,¹¹ we expect BoB to maintain a stable real exchange rate by using its policy instrument to react to domestic inflationary pressures that differ from those in the country's trading partners. That is, in terms of (3b), the Bank would increase the growth of the Bank rate in response to an appreciation of the real exchange rate (indicated by an increase in $Drxr$) resulting from a domestic inflation shock. This suggests a positive relationship between $Drxr$ and DBr .

As in sub-section 5.1, the first set of regressions entail the assumption that real M1 is the most important information variable.

5.2.1 Results: Growth of Real M1 is the most Important Information Variable

The results for the integral rule version of the equation are presented in panel A, while the results for the proportional rule version are presented in panel B of Table 4.

As can be seen, both versions of the MRF show that in the 1991-2000 period, the monetary authorities were mainly concerned with the stability of the rand-pula real exchange rate.¹² This implies that the authorities have been concerned with the differential between domestic inflation rate and that of South Africa (and other trading partners). This is consistent with statements made by the BoB in its Monetary Policy

¹⁰ If adjusted for Tbill rate, $DrFA$ becomes $DrFA^*$.

¹¹ The level and stability of the real exchange rate plays a major role in the competitiveness of Botswana's non-traditional exports (IMF, 1998).

¹² Although the real income variable in the integral rule version is insignificant, it could not be deleted. Deleting it caused the RESET statistic to become significant at the 5 percent level.

Statements; where the Bank indicates that it would avoid changing the peg of the nominal exchange rate for purposes of maintaining a stable real exchange rate, rather, the Bank would target an inflation rate comparable to the average inflation rate of Botswana’s major trading partners. Given that Botswana’s non-traditional trade is dominated by South Africa, we expect Botswana’s monetary policy to be mainly influenced by the inflation differential with South Africa, more than with any other trading partner.

Table 4: MRF with growth of real M1 as Information Variable and Target Variables as the Level of Inflation or Growth of Inflation and Growth in real Income

Modelling DBr by OLS - Sample is: 1992(2) - 2000(3)							
PANEL A				PANEL B			
Variable	Coeff	t-value	Instab	Variable	Coeff	t-value	Instab
Const	-0.02	-0.32	0.15	Const	-0.02	-0.32	0.15
Drxr_1	4.84	2.18*	0.07	Drxr_1	4.84	1.76*	0.04
R ² = 0.09; F(1, 32) = 3.09 [0.09]; $\sigma = 0.33$; Instability ($\sigma^2 = 0.07$)				R ² = 0.09; F(1, 32) = 3.08 [0.09]; $\sigma = 0.33$; Instability ($\sigma^2 = 0.07$)			
Mis-specification Tests				Mis-specification Tests			
AR 1- 3	F(3, 29)	= 1.57	[0.22]	AR 1- 3	F(3, 29)	= 1.57	[0.22]
ARCH 3	F(3, 26)	= 0.56	[0.64]	ARCH 3	F(3, 26)	= 0.56	[0.64]
Normality	Chi ² (2)	= 2.60	[0.27]	Normality	Chi ² (2)	= 2.60	[0.27]
Xi ²	F(2, 29)	= 0.02	[0.98]	Xi ²	F(2, 29)	= 0.02	[0.98]
Xi*Xj	F(2, 29)	= 0.02	[0.98]	Xi*Xj	F(2, 29)	= 0.02	[0.98]
RESET	F(1, 31)	= 3.93	[0.06]	RESET	F(1, 31)	= 3.93	[0.06]

Notes:

1.*denotes the 5 percent level of significance

The results, when real M2 and real domestic credit are taken (alternatively) as the key information variables, are presented in Table A2.2 and Table A2.3 respectively in appendix 2. In the case of M2, the significance of the M2 term suggests that the central bank followed a countercyclical policy with respect to policy goals (especially inflation) – a “reaction to an information variable” actually means a reaction to the expected movement of the policy goal variable(s). As in the case of M1 (see Table 4), the significance of the real exchange rate term suggests that the Bank tried to use policy to avoid differential between domestic inflation and that of South Africa.

Turning to the MRF using the credit variable, we find that in both versions of the MRF equation, changes in the growth of the Bank rate are explained only by the one period lag of the growth of real credit. This implies that the Bank reacted to what it considered impending changes in the policy goal(s) solely on the basis of information presented by changes in the growth of private credit.

6.0 Analysis of Results

In this section, we look at the results more closely with three objectives in mind: (i) to highlight the main variable(s) that have influenced monetary policy decisions over the period of study, (ii) to see whether policy was mainly countercyclical or accommodative, and (iii) to see which feedback rule outperforms the other.

As to the main variable(s) that influenced monetary policy, it is apparent that the monetary authorities were mainly concerned with inflation. The inflation variable turns out to be statistically significant at standard levels in all the versions of MRF in the whole sample regressions. This is true irrespective of the financial variable used as an information variable. Similarly, when we focus on the 1991-2000 period, empirical results seem to still point to the dominating influence of inflation on monetary policy. The statistical significance of the real exchange rate variable, given the Bank's decision to avoid changing the nominal exchange rate for purposes of maintaining a stable real exchange rate, could also be associated with policy reacting to inflation- in terms of inflation differential with South Africa. These results suggest that the monetary authorities were not much concerned with reacting to changes in the growth of real output – the variable is statistically insignificant in all the equations. This means that the monetary authorities were more concerned with stabilization of inflation, and not much concerned with stabilization of output

These findings (i.e., inflation, whether explicitly or via the real exchange rate, having a predominate influence on policy) are consistent with the monetary policy history of Botswana. As already indicated, the Bank has stated, in both its annual reports and Monetary Policy Statements, that its ultimate variable of policy interest is inflation. Therefore, we could argue that in general, the postulated empirical reaction function is able to explain the past history of the conduct of monetary policy in Botswana.

An interesting empirical evidence that needs highlighting is predominance of the private domestic credit variable in influencing monetary policy decisions in the 1990s. When real private credit is taken as the most important information variable, the final parsimonious MRF equation shows that the policy decisions of the Bank concerning the growth of the Bank rate are influenced solely by the growth of the credit variable. This probably reflects the fact that in the current monetary policy framework the central bank treats the growth of real private credit not just as an information variable but as its “key intermediate target variable” (see Monetary Policy Statement, 2001). In theory, an intermediate target variable is taken as a proxy for an ultimate target variable; so that the policymakers react to the intermediate target and not to the ultimate target variable(s).

Although the literature suggests that the monetary authorities have been concerned with interest rate differentials with South Africa, particularly in the pre-liberalization period, empirical evidence for this is rather weak. Only one regression equation detects influence from South African interest rates.

Turning to the policy stance, we notice that the monetary authorities followed a policy of ‘leaning against the wind’ (i.e., countercyclical policy) in respect of inflation. That is, when inflation rate rose relative to desired level, in the case of the integral rule, the central bank responded by increasing the growth of the Bank rate for purposes of dampening inflationary pressures. Similarly, in the case of proportional rule, the results suggest that the central bank responded to increases in the growth of inflation relative to desired growth rate by increasing the growth of the Bank rate.

Lastly we compare the performance of the two feedback rules to determine which, if any, outperforms the other. Such a comparison is only possible in the case of regressions for the whole sample;¹³ where we observe the following pattern. The integral rule tends to suggest that policy reacted to immediate past inflation – specifically, policy reacted to inflation of the previous quarter. In contrast, the proportional rule suggests that monetary policy reacted to the growth of inflation of up to four quarters in the past. It is not apparent why monetary policy would tend to react to inflation of long periods in the past. Hence, we are inclined to conclude that the integral rule-based MRF performs better

¹³ For the 1991-2000 period, none of the explicit inflation terms (whether in the integral rule or proportional rule equations) is significant. Hence, the final parsimonious equations do not permit comparison of the rules.

than the proportional rule-based MRF in the whole-sample results. However, in the sub-sample results (1991-2000), both versions of MRF equation perform equally well. This makes it difficult to rule one way or the other. Perhaps this outcome suggests that there has been regime-switching. In this case, both rules are a valid characterization of the historical pattern of monetary policy. That is, it is possible that on some occasions, monetary policy followed an integral feedback rule, while on other occasions, policy followed a proportional feedback rule.

7.0 Conclusion and Suggestions for Further Work

This paper intended to study how monetary policy was conducted in Botswana. We accomplish this task by specifying and estimating an empirical monetary policy reaction function for the Bank of Botswana (BoB) over the period of study, 1977-2000 and also over the post- liberalization period, 1991-2000. In both periods, we have identified a predominantly countercyclical policy reaction function. The reaction function suggests that inflation (directly and indirectly via the real exchange rate) is the ultimate variable of policy interest.

Our results are broadly similar to those found in Bleaney and Lisenda (2001). The authors find a countercyclical response of the BoB's Bank rate to both the real private sector credit and inflation. A contrast in results arise in that whereas Bleaney and Lisenda find that the monetary authorities' decisions are not influenced by changes in international competitiveness (via the real exchange rate) and South African interest rates, we do find some influence from these variables.

The existence of the reaction function suggests that the monetary authorities have been systematic in conducting policy. That is, as stated in Bleaney and Lisenda (2001), the existence of the MRF implies that Botswana has had a stable policy regime. This probably explains why Botswana, a country that has enjoyed a mineral boom that caused it to experience the highest economic growth rate for much of the 25 years after independence, has not experienced chronic inflation. Of course, monetary policy should be seen as a complementary policy within the broad package of macroeconomic policies. In fact, the success story of Botswana, both in terms of achieving impressive growth rates and macroeconomic stability has been attributed partly to sound macroeconomic

policies by both domestic researchers (c.f. Harvey and Lewis, 1990) and international observers (c.f. IMF, 2002)

Although the empirical reaction function in this paper generates results that are consistent with what the monetary authorities claim to be doing, we have assumed a homogenous type of response by the central bank to target variables. That is, by using a fixed-parameter-model to represent the Bank's MRF, we have implicitly assumed that the Bank responds to, say inflation, "with the same vigor regardless of whether the level of inflation is unusually high or low" (Shen, Hakes and Brown, 1999). This may not be the case, as confirmed in Shen et. al. (1999) for the Fed Reserve Bank of U.S. and Shen (2000) for the central bank of China. Thus, future work may consider testing this hypothesis in the case of the BoB.

Appendix 1: Data Description

m1 denotes log of nominal M1.¹⁴ M1 is Narrow money = currency outside banks plus current (i.e., demand) deposits at the commercial banks (in millions of Pula), labeled “money” in the IMF’s International Financial Statistics (IFS) publications. These are end-of-quarter values for quarterly data.

m2 denotes log of nominal M2. M2 is Broad money = M1 plus Quasi-money values (reported in the IFS publications); these are end-of-quarter values like M1. Quasi – money consists of call, savings and time deposits at commercial banks.

cr denotes log of nominal domestic credit (in millions of pula) from commercial banks to the non-financial private sector. These are end-of-quarter values, labeled “Claims on Private Sector” in IMF’s IFS publications.

rm1 denotes real m1; where real m1 is in constant (1991) pula

rm2 denotes real m2; where real m2 is in constant (1991) pula

rcr denotes real credit; where real cr is in constant (1991) pula.

Br denotes the Bank rate. The values are in percent per annum. These are end-of-quarter data, as reported in the IFS publications.

rgdp denotes log of real GDP. The quarterly values were interpolated by the author from annual values (using Friedman’s method, the procedure is described in chapter 3 of the author’s dissertation).

Xr is Botswana’s Rand/ Pula nominal exchange rate. These are averages of the end-of-month values. The monthly values were obtained from the Bank of Botswana’s computer.

¹⁴ All logs refer to natural logarithms.

rxr is the log of rand-pula real exchange rate; calculated using the CPI of Botswana and CPI of South Africa. Real exchange rate (rXr) was calculated as follows:

$rXr = (\text{rand/pula}) * (\text{BOTprice} / \text{SAprice})$ where BOTprice denotes Botswana prices and SAprice denotes South Africa prices (with base in 1991: 4)

dvl denotes the log of the value of diamond exports (in millions of Pula). The data are averages of end-of-month values obtainable from CSO bulletins in Table 3.3A which is entitled “EXTERNAL TRADE – EXPORTS B PRINCIPAL COMMODITIES” (c.f. CSO bulletin for September 1992 or March 1996).

Tb denotes South Africa’s Treasury bill rate in percent per annum (as noted in the IFS publications). This is the 91-day rate. Monthly data are averages of each Friday of the month.

Inflation (inf) was calculated from the CPI using the formula:

$$((\text{CPI}_t / \text{CPI}_{t-4}) - 1) * 100.$$

Notes:

1. All variables (except the Consumer Price Index, inflation, the Bank rate, the exchange rate, and South Africa’s Treasury bill rate) are measured in millions of Pula.
2. Pula is the name of Botswana’s currency.
3. The monetary aggregates and credit values (from Botswana Financial Statistics and IFS bulletins) were expressed in units of 1 million pula in order to make them comparable in size to the GDP values.
4. All variables are seasonally unadjusted.

Appendix 2: Estimation Results

Table A2.1 MRF with Growth of Real M2 as Information Variable and Target Variables as the Level of Inflation or Growth of Inflation and Growth in Real Income

Modelling DBr by OLS; Sample is:1978(2)-2000(3)							
PANEL A				PANEL B			
Variable	Coeff	t-value	Instab	Variable	Coeff	t-value	Instab
Const	0.300	0.742	0.06	Const	0.168	2.216*	0.06
Inf_1	0.052	1.878*	0.06	DInf_2	0.083	1.696*	0.02
Inf_5	-0.064	-2.050*	0.06	DInf_4	0.092	1.890*	0.06
Drm2_1	-2.410	-2.480**	0.15	Drm2_1	-2.172	-2.405**	0.18
Drm2_2	-2.461	-2.532**	0.11	Drm2_2	-2.154	-2.384**	0.11
DTb_1	0.088	1.669*	0.30				
R ² = 0.17; F(5,84)= 3.52[0.01]; σ = 0.67; Instability (σ^2 =0.11)				R ² = 0.16; F(4,85) = 4.10[0.00]; σ = 0.67; Instability (σ^2 =0.11)			
Mis-specification Tests				Mis-specification Tests			
AR 1- 5 F(5, 79) = 1.09[0.37]				AR 1- 5 F(5, 80) = 1.03[0.40]			
ARCH 4 F(4, 76) = 1.81[0.14]				ARCH 4 F(4, 77) = 1.80[0.14]			
Normality Chi ² (2)= 18.1[0.00]**				Normality Chi ² (2)= 20.2[0.00]**			
Xi ² F(10, 73) = 1.93[0.06]				Xi ² F(8, 76) = 3.02[0.01]**			
Xi*Xj F(20, 63) = 2.84[0.00]**				Xi*Xj F(14, 70) = 5.53[0.00]**			
RESET F(1, 83) = 9.77[0.00]**				RESET F(1, 84) = 3.45[0.07]			

Notes:

- * and ** denote the 5 and 1 percent level of significance respectively.

Table A2.2 MRF with Growth of Real M2 as Information Variable and Target Variables as the Level of Inflation or Growth of Inflation and Growth in Real Income

Modelling DBr by OLS; Sample is:1992(3)-2000(3)							
PANEL A				PANEL B			
Variable	Coeff	t-value	Instab	Variable	Coeff	t-value	Instab
Const	-0.050	-0.880	0.12	Const	-0.048	-0.846	0.07
Drm2_1	1.629	2.067*	0.09	DBr_1	0.223	1.768*	0.26
Drxr_1	4.541	1.757*	0.05	Drm2_1	1.668	2.135*	0.13
				Drxr_1	4.597	1.797*	0.07
R ² = 0.20; F(2,30) = 3.72[0.04] σ = 0.31; Instability (σ ² = 0.13)				R ² = 0.26; F(3,30) = 3.58[0.03] σ = 0.31; Instability (σ ² = 0.17)			
Mis-specification Tests				Mis-specification Tests			
AR 1- 3 F(3, 27) = 2.16[0.12]				AR 1- 3 F(3, 27) = 0.99[0.41]			
ARCH 3 F(3, 24) = 0.26[0.85]				ARCH 3 F(3, 24) = 0.37[0.78]			
Normality Chi ² (2)= 5.60[0.06]				Normality Chi ² (2)= 6.20[0.05]*			
Xi ² F(4, 25) = 0.23[0.92]				Xi ² F(6, 23) = 0.36[0.89]			
Xi*Xj F(5, 24) = 0.29[0.91]				Xi*Xj F(9, 20) = 0.29[0.97]			
RESET F(1, 29) = 0.00[0.99]				RESET F(1, 29) = 0.04[0.84]			

Notes:

1. * and ** denote the 5 and 1 percent level of significance respectively.

Table A2.3 MRF with Growth of Real Private Credit as Information Variable and Target Variables as the Level of Inflation or Growth of Inflation and Growth in Real Income

Modelling DBr by OLS; Sample is:1992(3)-2000(3)							
PANEL A				PANEL B			
Variable	Coeff	t-value	Instab	Variable	Coeff	t-value	Instab
Const	-0.050	-0.837	0.05	Const	-0.037	-0.607	0.05
Drcr_1	2.580	2.089*	0.22	Drcr_1	2.633	2.094*	0.15
R ² = 0.12; F(1,31) = 4.37[0.05] σ = 0.32; Instability (σ^2 = 0.06)				R ² = 0.12; F(1,32) = 4.38[0.04]; σ = 0.33; Instability (σ^2 = 0.33)			
Mis-specification Tests				Mis-specification Tests			
AR 1- 3	F(3, 28) = 1.11[0.36]			AR 1- 3	F(3, 29) = 0.90[0.45]		
ARCH 3	F(3, 25) = 1.44[0.25]			ARCH 3	F(3, 26) = 1.32[0.29]		
Normality	Chi ² (2) = 2.15[0.34]			Normality	Chi ² (2) = 1.29[0.53]		
Xi ²	F(2, 28) = 0.07[0.94]			Xi ²	F(2, 29) = 0.10[0.91]		
Xi*Xj	F(2, 28) = 0.07[0.94]			Xi*Xj	F(2, 29) = 0.10[0.91]		
RESET	F(1, 30) = 0.53[0.47]			RESET	F(1, 31) = 0.20[0.66]		

Notes:

1. * denotes the 5 percent level of significance.

References

- Adam, C. S.(1992). “On the dynamic specification of money demand in Kenya”, *Journal of African Economies*, 1, 233-270.
- Anyangah, J. O. (1995). *The Demand for Money in Botswana: An Error-Correction Approach*, Unpublished thesis, University of Botswana.
- Bank of Botswana, Annual Report (various years).
- Bank of Botswana (1999). Monetary policy statement. Gaborone: Bank of Botswana.
- Bank of Botswana (2000).Monetary policy statement. Gaborone: Bank of Botswana.
- Bank of Botswana (2001). Monetary policy Statement Gaborone: Bank of Botswana.
- Bell, S. C. (1987). Financial development in Botswana. In M. N. Bhuiyan (eds), *Selected Papers on the Botswana Economy*, Gaborone: Bank of Botswana.
- Bleaney, M. and L. Lisenda (2001). “Monetary Policy After Financial Liberalization: A Central Bank Reaction Function for Botswana”, Working paper.
- Blejer, M.I. and L. Leiderman (1981). “A monetary Approach to the Crawling-peg System: Theory and evidence”, *Journal of Political Economy*, 89, (1), 132-151.
- Cameron, N. E. (2001). “Integral rule vs. Proportional Monetary Rules”, Working Paper, University of Manitoba.
- Clarida, R., Gali, J., and M. Gertler (1998). “Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory”, NBER Working Paper No. 6442.
- Courchene, T. J. and A.K. Kelly (1971). Money Supply and Money Demand, *Journal of Money, Credit and Banking*, 3, (2), 219-244.
- Cowan, D. (1998). Inflation in Southern Africa. In Bank of Botswana, *The Research Bulletin*, 16, (1), 3-13.
- Dean, J.W. (1974). “Problems in the Specification and Interpretation of the Central Bank Reaction Functions”, *Economic and social Review*, 5, 431- 451.
- DeRosa, P.H. and S. Gary (1977). “Monetary Control and the Federal Funds Rate”, *Journal of Monetary Economics*, 3, (2), 217-230.

Dickey, D.A. and W.A. Fuller (1979). "Distribution of the estimators for autocorrelation regressive time series with a unit root", *Journal of the American Statistical Association*, 75, 427-431.

Durevall, D. and N. Ndung'u (1999). "A Dynamic Model of Inflation for Kenya, 1974-1996", IMF Working paper no. 97.

Fair, R.C. (1984). *Specification, Estimation and Analysis of Macroeconometric models*, Cambridge: Harvard University Press.

Harvey, C. (1985). The Use of Monetary Policy in Botswana, in Good Times and Bad. Institute of Development Studies Working Paper, University of Sussex.

Harvey C. and S.R. Lewis, Jr. (1990). *Policy Choice and the Development Performance in Botswana*, Macmillan in Association with the OECD Development Centre.

Hossain, A. and A. Chowdhury (1996). *Monetary and Financial Policies in Developing Countries: Growth and Stabilisation*, London: Routledge.

IMF (1998). *Botswana: Selected Issues and Statistical Appendix*. IMF Staff Country Report No. 39.

IMF (2002). Public Information Notice: IMF concludes 2002 article IV consultation with Botswana. Public Information Notice No. 126.

Johnson, K., Small, D. and T. Tryon (1999). "Monetary Policy and Price Stability, Board of Governors of the Federal Reserve System", International Finance Discussion Paper No. 641.

Joyce, J.P. (1986). "On the Specification and Estimation of Macroeconomic Policy Functions", *Quartely Journal of Business and Economics*, 25, 16-37.

Joyce, J.P. (1991). "An Examination of the Objectives of Monetary Policy in Four Developing Countries", *World Development*, 19, 705-709.

Judd, J.P. and G.D. Rudebusch (1998). "Taylor's Rule and the Fed: 1970-1997", *Federal Reserve Bank of San Francisco*, (3), 3-16.

Khoury, S.S (1990). The Federal Reserve Reaction Function: A Specification Search. In T Mayer (ed.), *The Political Economy of American Monetary Policy*, pp. 27-41, England: Cambridge University Press.

MacWilliam, D .C. (1996). *Foreign exchange market liberalization and the demand for money in the presence of currency substitution*, Unpublished dissertation, Vanderbilt University, Nashville, Tennessee.

- Mankiw, G. N. (1994). *Macroeconomics* (2nd ed.), New York: Worth.
- Masalila , K.S. (2001). Financial Liberalization and Monetary Policy Effectiveness: A Comparison of Botswana, Malawi and Zimbabwe, In Bank of Botswana, *The Research Bulletin*, 19, (1), 9-26.
- Ministry of Finance and Development Planning (1985). *National Development plan 6: 1985-1991*, Gaborone: Government Printer.
- Phillips, P.C.B. and P. Perron (1988). “Testing for a Unit Root in Time Series Regression”, *Biometrika*, 75, 335-346.
- Porzecanski, A .C. (1979). “Patterns of Monetary Policy in Latin America”, *Journal of Money, Credit and Banking*, 11, (1), 427-437.
- Setlhare, L. (2002). *Empirical foundations of monetary policy in Botswana*, Unpublished Dissertation, University of Manitoba.
- Shen, C.H. (2000). “Estimation of a Taiwan Monetary Reaction Function With Time Varying Parameters”, *Applied Economics*, 32, 459-466.
- Shen C.H., Hakes, D.R. and K. Brown (1999). “Time-varying Response of Monetary Policy to Macroeconomic Conditions”, *Southern Economic Journal*, 65 (3), 584-593.
- Svenssons, L. E. O. (1999). “How Should Monetary Policy be Conducted in an era of Price Stability?”, In *Achieving price stability*, The Federal Reserve Bank of Kansas City.
- Wood, J. H. (1967). A Model of the Federal Reserve Behavior. In G. Horwich (ed.), *Monetary Process and Policy: A Symposium*, Richard Irwin.
- Zha, T. (1997). “Identifying Monetary Policy: A Primer”, *Federal Reserve Bank of Atlanta Economic Review*, 82, 26-43.