MONETARY MODEL OF EXCHANGE RATE: EMPIRICAL EVIDENCE FROM MALAWI

Kisukyabo Simwaka

Research & Statistics Department
Reserve Bank of Malawi

Abstract

In this paper, we examine the monetary model of the Malawi Kwacha – U S dollar exchange rate during the current floating exchange rate system by applying several recent developments in the econometrics of unit roots and cointegration. Several interesting and important results are found. A single cointegration equation is identified whose coefficients conform to the restriction implied by the monetary model. The short run equation indicates the following results: First, the domestic interest rate has a negative sign, which indicates that increases in the domestic interest rate lead to an appreciation of the Malawi Kwacha. Domestic money supply has a positive sign, which implies that reductions in domestic money supply lead to an appreciation of the Malawi Kwacha.

These results have led to the following conclusions. First, we have demonstrated through the use of Johansen's multivariate cointegration technique that an unrestricted monetary model does provide a valid explanation of the long-run nominal Malawi Kwacha – US dollar exchange rate, thus lending support to the interpretation of the model as describing a long run equilibrium relationship. Second, money supply can be employed as a tool to influence the exchange rate. This arises because a reduction in the nominal money supply through open market operations raises domestic rate of interest rate for given money demand in the short run. The increase in domestic interest rate results in an incipient short-term capital inflow. This causes the exchange rate to appreciate. Finally, the correct sign and significance of the foreign country interest rate signify the role of currency market liberalization and it is a justification of our choice of RSA as Malawi's major trading partner in our model

Keywords: Monetary model, Exchange Rate, Co-integration

1.0 Introduction

The issue of exchange rate determination has been recently in the core of academic debates. Despite the fact that many exchange rate determination models and their modifications have been developed, economists still cannot agree on which model best describes behavior of exchange rate and because empirical tests of the models are often ambiguous and sometimes even contradictory. The empirical evidence defeating conventional monetary theories of exchange rate determination for developed world puzzled many economists and caused further theoretic development. At that, existing models have been tested mainly for developed and developing countries while transition countries have not received as much attention.

In this paper, we examine the monetary model of the Malawi Kwacha – U S dollar exchange rate during the recent float by applying several recent developments in the econometrics of unit roots and cointegration. First, we use Phillips Perron test for the presence of unit roots in the data. Second, we further analyze the stochastic properties of the data, testing for the presence of possible structural breaks by employing recursive tests. Third, we use Johansen multivariate cointegration technique to test for the existence of a long-run relationship underpinning the monetary equation, and we were able to identify one cointegration vector.

The paper is organized as follows: Section 2 outlines recent economic developments relevant to the study. Section 3 presents a brief on the evolution of the exchange rate policy in Malawi. The proposed analytical framework for the study is presented in Section 4. The empirical results are presented in Section 5 while Section 6 gives concluding remarks and policy implications.

2.0 Economic Developments

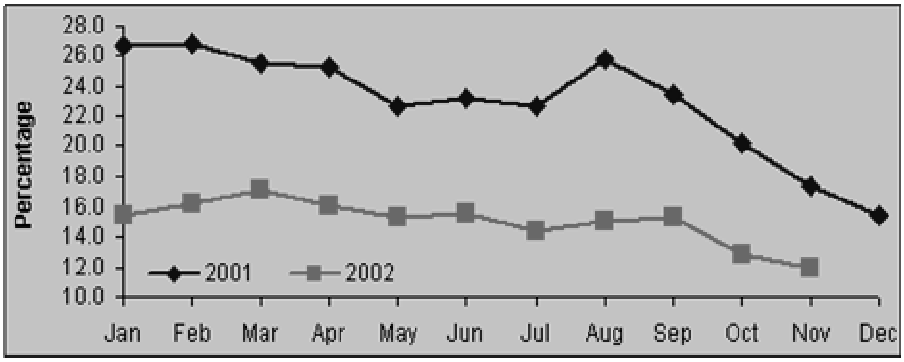
2.1 The Malawi Kwacha Exchange Rate

The Malawi Kwacha exchange rate against the United States Dollar (USD) remained relatively unstable recently. The domestic currency depreciated against the USD, changing from MK80.4912 per USD in October 2002 to Mk87.1625 at the close of the year.

The Kwacha continued to slide against the United States Dollar and other currencies of the country's major trading partners in February 2003, albeit marginally. During the month, the Kwacha lost MK1.16 against the USD compared to a MK2.24 loss in value against the USD in January. At the end of February 2003, the exchange rate was at MK90.6500 per USD compared to MK89.4887 per USD at the beginning of the month.

The slow down in the depreciation of the Malawi Kwacha is as a result of a number of factors. First, the local foreign exchange market has been well supported by the central bank, which has been selling foreign exchange to ADBs with the aim of keeping the value of the domestic currency from plunging. Secondly, it is due to seasonal reduction in demand for foreign exchange coupled with reduced speculative behaviour by market participants following the opening of tobacco auction floors early March 2003. Thirdly, the recent poor performance of the USD against other major trading currencies following threats of war on Iraq has played a significant role in keeping the Kwacha relatively strong.

Graph 1: Exchange Rate of the MWK Against the USD (2002)



Source: Authorised Dealer Banks

2.2 Money Market

2.2.1 Money Market Liquidity

Unlike in the second and third quarters, liquidity on the money market tightened in the fourth quarter of 2002 in line with contractionary monetary policy stance adopted by the Monetary Policy Committee. Pursuant to this policy RBM issued a total of MK14.91 billion Malawi Government Treasury and RBM Bills against maturities of MK15.46

billion. In addition, RBM sold MK4.1 billion equivalent of foreign exchange to Authorized Dealer Banks (ADBs). A further MK2.04 billion was withdrawn from the system through the RBM Open Market Operations Desk (besides the primary issues of Treasury and RBM Bills). The net impact was a withdrawal of MK5.59 billion from the money market.

Money market authorities continued tightening monetary policy in February 2003 in conformity with the tight monetary stance adopted by the Monetary Policy Committee. During the month, a total of MK5.37 billion Malawi Government Treasury and Reserve Bank of Malawi Bills matured against issues MK5.94 billion, resulting into a withdrawal of MK0.57 billion from the money market. In addition, the central Bank mopped the money market with a further net withdrawal of MK0.56 billion through foreign exchange sales to Authorized Dealer Banks (ADBs). Ultimately, a total of MK1.85 billion was withdrawn from the money market.

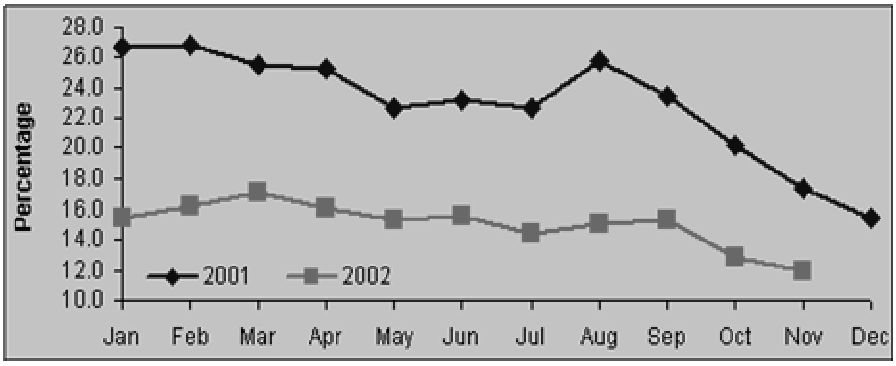
2.2.2 Money Market Rates

Average yields on both Malawi Government Treasury Bills and Reserve Bank of Malawi Bills have, on average, been going down through out the year 2002. Monthly average 91 day, 182 day and 273 day Treasury Bill (TB) yields have gone down from 39.16%, 41.21% and 41.68% at the end of the third quarter to 36.61%, 36.55% and 38.56% at the end of the fourth quarter while average 63 day and 91 day RBM Bill yields have gone down to 35.32% and 36.38% from 40.43% and 39.98% during the period the fourth quarter.

The month of February was characterized by uncertainty on the likely direction of money rates. Monthly average yields on Malawi Government Treasury and Reserve Bank of Malawi Bills went up during the month. Average 91 day and 182 day Treasury Bill (TB) yields went up from 37.17% and 37.63 in January 2003 to 37.34% and 38.07% in February 2003, respectively. The average 273 - day TB yield remained unchanged at 38.56%. The average 63 - day RBM yield also went up to 37.00% in February 2003 from 36.36% in the preceding month. The average 91- day RBM bill yield, on the other hand, went down from 36.94% in January 2003 to 36.87% in February 2003.

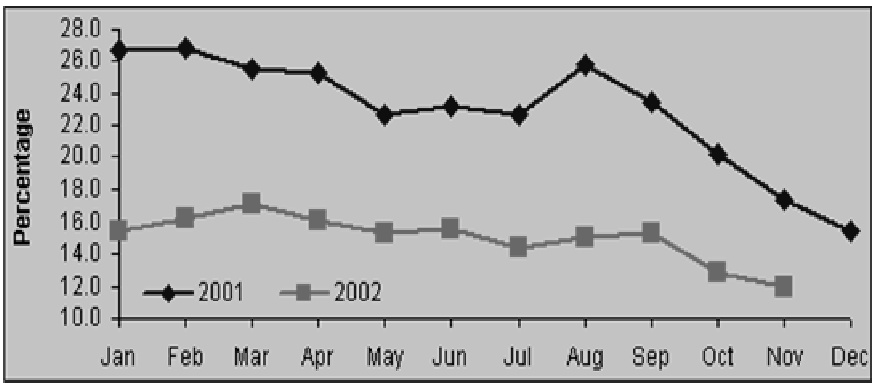
While monthly average yields generally went up in February, actual end-month figures indicate a downward movement. Average yields on 91 -, 182-, and 273-day TBs as at months-ends went down from 37.83%, 38.22% and 38.39% at the end of January to 37.14%, 38.02% and 38.16% at the end of February 2003, respectively. Similarly average 63 – day and 91 – day RBM Bill yields also declined from 37.01% and 37.04% at the end of January 2003 to 36.95% and 36.96% at the end of the February, in that order.

Graph 2: Malawi Government Treasury Bill Yields (2002)



Source: Reserve Bank of Malawi

Graph 3: Reserve Bank of Malawi Bill Yields (2002)



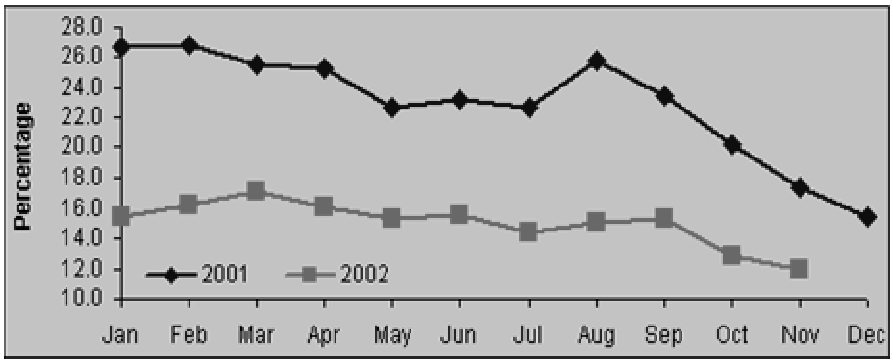
Source: Reserve Bank of Malawi

Monetary authorities have apparently been driving the Treasury and RBM Bill yields downwards, in a bid to bring down the cost of borrowing, encourage private sector investment and ultimately stimulate economic growth. Unfortunately, the yields have not gone down

sufficiently enough to trigger downward adjustments in the base lending rates and cause a noticeable improvement in the private sector investment.

Following the downward movement in the Treasury and RBM Bill yields, the bank rate was adjusted downwards from 43.0% to 40.0% effective 21st October 2002, sparking a round of downward adjustments in the base lending and deposit rates in commercial banks. The average savings, 7 day, 30 day, 60 day, 91 day, 182 day, 273 day and one year fixed deposit rates changed from 23.20 %, 22.0 %, 25.67 %, 28.29 %, 27.71 %, 24.92%, 21.50% and 19.50% to 20.0 %, 19.00 %, 23.67 %, 24.64 %, 24.43 %, 21.00 %, 16.60 %, and 16.00 % respectively, while the average base lending rate dropped to 41.43% from 44.71%.

Graph 4: Bank Rate



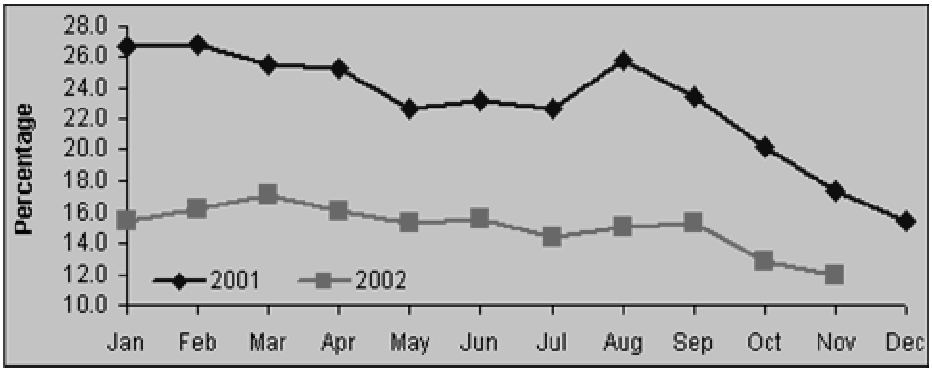
Source: Reserve Bank of Malawi

2.2.3 Inflation Rate

National headline inflation went down for the fifth consecutive month in February 2003. As measured by year-on-year percentage changes in the national composite consumer price index (CPI), national inflation dropped to 10.5% in February 2003 from 10.7%, 11.5%, 12.0%, 12.9% and 15.4% in January, December, November, October, and September 2002, respectively.

The downward movement in inflation rates during the fourth quarter of 2002 follows the slowdown in the price increases of pulses and nuts, milk and dairy products, oil and fat products, cereals and cereal products, fish and vegetables.

Graph 5: National Inflation



Source: National Statistical Office

The implementation of the surtax bill has had little effect on inflation so far. This is due particularly to the fact that most items that dominate the representative basket used for measuring price indices are surtax exempt and for those that are not, their impact to the CPI is insignificant.

Inflation continues to go down following the abundance of food supplies, particularly maize stocks, this year compared to a similar period in 2002. While maize prices went up in January 2003 by 6.8%, the increase was relatively small compared to a similar period in 2002 (7.2%) hence the continued slow down in the general price level increase.

2.3 Short Term Prospects

The likely direction of the country's headline inflation during the ensuing months is not certain. Food supplies may increase in March as we approach the crop harvesting season. This may lead to drop in the inflation rate, given that food has a major weight in the computation of CPI, the measure of inflation. On the other hand, there may be an upward pressure on inflation rate as the US - Iraq crisis gathers momentum, which may push up oil prices. In addition, the money market is expected to be awash with liquidity as farmers cash-in their foreign exchange proceeds from tobacco sales. This may increase money supply, which may also put upward pressure on the inflation rate. The expected increase in Government spending resulting from the continued slowdown in donor funding may also put additional pressure on inflation rates. The extent to which RBM may intervene on the money market through open market operations may also determine the direction of inflation rates as well as interest rates.

The slow and steady depreciation of the Malawi Kwacha vis-à-vis the USD will continue throughout the first quarter of 2003. RBM support of the local foreign exchange market is expected to continue in the earlier part of the tobacco selling season thereby keeping the Malawi Kwacha somehow stable. The timing of the donor inflows will also be crucial in the monetary authorities' process of stabilizing the local currency. As of now, it is not certain as to whether donors will start funding the government in the short term or not. However, government is doing all it can to convince donors to start providing the much needed support.

The likely direction of money market rates is uncertain as of now. Market fundamentals indicate that money market rates should necessarily be going up. However, the rates have been decreasing giving the impression that the authorities are mechanically suppressing the rates against the dictation of market forces. Furthermore, it is not clear when the Bretton Woods Institutions (World Bank and International Monetary Fund) will clear the country as being eligible for balance of payments support. In the absence of donor funding, government is under pressure to borrow from the open market. This will in turn put upward pressure on Treasury Bill rates, which also put similar pressure on money market rate, for example, commercial bank's deposit and lending rates.

3.0 A brief on Exchange Rate Policy in Malawi

From independence in 1964 to January 1971, Malawi operated within the Sterling zone with the Malawi Pound pegged at par to the British pound Sterling. The Malawi Kwacha was introduced in 1971 and it was pegged to the Pound Sterling at two to one. In November 1973, the currency was pegged to a weighted average of the Pound and the US Dollar. However, due to heavy fluctuations of the two currencies, the Kwacha was pegged to the SDR in June 1975. This allowed the Kwacha some measure of stability until early 1980s when the SDR started appreciating rapidly, forcing authorities to devalue the local currency against the SDR by 15 and 12 percent in April 1982 and September 1983, respectively.

Because of the continued appreciation of the SDR and the fact that the SDR did not properly represent the currencies of Malawi's trading partners, the authorities decided to add the South African Rand to the SDR basket in January 1984. Following this peg, the main thrust was to

maintain external competitiveness by ensuring that the real effective exchange rate (REER)[1] was not appreciating. This was achieved by periodic devaluations of the Kwacha, especially that the rate of inflation in Malawi remained higher than that of the trading partners. Towards the end of 1991, the Kwacha appreciated rapidly in real terms because of sharp devaluations in some trading partners' currencies such as South Africa, Zimbabwe and Zambia and also due to unfavourable movements in relative prices. That led to two devaluations in June 1992.

Progressively, it became apparent that the exchange rate was becoming heavily politicized with each devaluation becoming subject of intense speculation within the private sector. That led to lack of confidence in the exchange system, of which a major consequence was a marked slowdown in repatriation of export proceeds. The situation was worsened by the cut in non-humanitarian assistance by bilateral donors in 1992 because of governance issues. As a result, the foreign exchange situations became critical and external arrears began to accumulate. Consequently, the authorities decided to have a far-reaching overhaul of the exchange rate system by floating the Kwacha against other currencies on February 7, 1994.

Together with the exchange rate liberalization, all foreign exchange transactions were liberalized except for the capital account, which remained under exchange control regulations. Opening the capital account in the initial stages of a liberalizing process overexposes a country to external volatility. In order to support the foreign exchange liberalization effectively, the authorities encouraged new entrants into the foreign exchange market by licensing other authorized foreign exchange dealers (Bureau de Changes) in addition to the two commercial banks that existed then. Investment in the banking sector was encouraged so much that by the end of 1995 two new commercial banks had become operational. Reflecting the scarcity of foreign exchange reserves and overvaluation of the Kwacha before the floatation, the Kwacha depreciated from about MK4.5 to the US Dollar in January 1994 to MK7.3 to the Dollar by end June 1994 when the weekly auctions were abandoned. The Kwacha continued to depreciate and stabilized at around MK15.3 to the Dollar by the end of 1994.

[1] This is a trade weighted adjusted real exchange rate (RER). The RER is defined as the relative price of tradable to non-tradable goods.

Following the liberalization of the exchange rate system, all foreign exchange transactions to do with the private sector are dealt with by the dealer institutions at exchange rates privately determined. Following this move, the official exchange rate is determined by averaging the rates offered by the Authorized Dealer Banks (ADB).[2] Rates offered by the bureaus act as signals to the developments in the parallel markets. The central Bank however continues to intervene in the foreign exchange market by seasonally buying or selling foreign exchange to control fluctuations in foreign exchange supplies. The flow of foreign exchange in Malawi is seasonal because of its dependence on agriculture (mainly tobacco) as the main foreign exchange earner.

The ADBs are free to work out their own operating rate for the USD based on the available information. Ideally, the ADBs are supposed to be guided by demand and supply conditions in the market, their own trading positions that mainly constitutes the safeguarding of their profit margins, positions of the competitors, and the general outlook of the economy. The obvious advantage of the system is that it is transparent and easy, simply requiring the allocation of the rates from the banks and calculating the simple average.

Obviously the system assumes that ADBs are able to assess the market correctly. In the course of operating this system however, it has been noted that capacity to interpret information is lacking in most ADBs. Notably, smaller ADBs always ask for rates from the big ADBs before working out their rates. This is obviously a 'follow-the lender' market behavior and therefore, reduces competition that is essential in ensuring that the Kwacha is set at the right price.

4.0 Analytical Framework

The flexible monetary model (associated with Frenkel and Mussa) assumes that prices of goods are flexible, and that the purchasing power parity (PPP) always holds. The assumption about PPP implies that the real exchange rate is constant over time (Diamonds, Gorgoutsos, and Kouretas, 1996, p.85).

[2] National bank of Malawi, Commercial Bank of Malawi, Indebank Financial Services, Finance Bank of Malawi, First Merchant Bank and Loita Investment Bank

The sticky price monetary model (associated with Dornbusch's, 1976) on the other hand assumes that prices of the goods are sticky in the short run, and that Purchasing Power Parity (PPP) holds only in the long run but does not hold in the short run because goods prices adjust slowly to asset prices. Sticky price monetary models are often referred to as overshooting models. Overshooting refers to the tendency for the exchange rate to overshoot its new equilibrium level following some exogenous shock to the system. Assume for example a shock, which warrants depreciation of the exchange rate to a new long run level. Overshooting implies in short run, the exchange rate tend to over-depreciate before appreciating towards its new long run equilibrium value. The key result of overshooting arises from different speeds of adjustment in the goods and assets markets. In particular, it is assumed that following a disturbance, the assets markets moves rapidly to its new equilibrium level. The goods market, by contrast, is characterized by sticky prices and takes longer to adjust to new equilibrium.

Both models also assume stable domestic and foreign money demand functions, capital mobility, and uncovered interest parity (i.e expected rates of return are the same for two currencies). While the assumptions of the monetary model rarely hold in the real world (especially in the short run), this model shows theoretically well-grounded relationship between exchange rate, prices, money, real incomes, and interest rates.

4.1 Model Description

Absolute purchasing power parity (PPP) means "that exchange rates are equal to relative price levels" (Krugman, Obstfeld, 2000, p.397) and can be written as follows:

$$e = P/P^* \qquad (1)$$

Where e is the nominal exchange rate, P and P* are domestic and foreign price levels, respectively.
"While PPP concludes that the exchange rate is relative price of goods in the two countries, monetary theory suggests that the exchange rate is the relative price of two moneys" (Levich, 1983, p.32). So in the monetary approach exchange rate represented as relative demand for money of two countries.

Let us express the demand for the real money balances (M^d/P) as:

$$M^d/P = L(Y, i, K) \quad (2)$$

Where M denotes demand for money, P is the price level, L is some function of a real income (Y), the interest rate (i), and other factors (K) that determine money demand. Real money demand is positively related to income and negatively related to the interest rate.
The demand for real money balances in equilibrium is equal to real money supply.

$$M^d/P = M^s/P \quad (3)$$

Where M^s is money supply. (2) and (3) can be rewritten as

$$P = M^s / L(Y, i, K) \quad (4)$$

Since money supply is equal to money demand, prices can be expressed as

$$P = M/L\,(Y, i, K) \quad (5)$$

Where M is equilibrium quantity of money.

Price level of the foreign country can be presented in the same way

$$P = M^*/L^*\,(Y^*, {}^*i, K^*) \quad (6)$$

Where * denotes the foreign country.

According to Levich (1983, p.34) for the flexible price monetary model we can write money demand as

$$M^d/P = Y^{\gamma 1} e^{-\gamma 2 i} K \quad (7)$$

Where e is an exponent, $^{\gamma 1}$ and $^{-\gamma 21}$ are elasticities of income and interest respectively.
So, following the logic introduced above, price levels can be written as

$$P = M/\ Y^{\gamma 1}\ e^{-\gamma 2 i} K \quad (9)$$

$$P^* = M^*/\ Y^{*\gamma 1^*}\ e^{-\gamma 2^* i^*} K^* \quad (10)$$

If we introduce (9) and (10) into (2), we will get

$$e = (M/\ Y^{\gamma 1}\ e^{-\gamma 21}\ K)\ (M^*/\ Y^{*\gamma 1^*}\ e^{-\gamma 2^* i^*}\ K^*) \qquad (11)$$

$$e = (M/M^*)\ (Y^{*\gamma 1^*}/Y^{\gamma 1})\ (e^{-\gamma 2^* i^*}/\ e^{-\gamma 2 i})(K^*/K) \qquad (12)$$

Take logarithms of (12) (small letters denotes logarithms of capital letters)

$$e = m - m^* - \gamma_1 y + y^*_1 y^* + \gamma_2 i - \gamma_2^* i^* - k + k^* \qquad (13)$$

If there are no other factors determining money demand (i.e. k=k*=0), then

$$e = m - m^* - \gamma_1 y + \gamma^*_1 y^* + \gamma_2 i - \gamma^*_2 i^* \qquad (14)$$

Equation (14) is the fundamental equation of monetary model with flexible prices (Taylor, 1995, p.21). Accordingly, fundamental equation for the sticky price monetary model is

$$e = m - m^* - \gamma_1 y + \gamma^*_1 y^* - \gamma_2 i + \gamma^*_2 i^* \qquad (15)$$

The difference between the sticky and the flexible price monetary model is explained above (see pp. 4 – 5).

4.2 Econometric Specification of the Model

The following regression, based on (14) and (15), will be used as a benchmark one:

$$e_t = \delta_0 + \delta_1 m_t + \delta_2 m^*_t + \delta_3 y_t + \delta_4 y^* + \delta_5 i + \delta_6 i^* + \varepsilon \qquad (16)$$

where δ_0 is a constant term, ε is an error term. All small letters denote logarithms. Here, e is the nominal exchange rate, m is the money supply, y denotes real income and i is the nominal interest rate. An asterisk indicates a foreign country variable (the Republic of South Africa in our case)

According to equation (16), an increase in domestic (foreign) money supply will lead the domestic currency to depreciate (appreciate). An increase in domestic (foreign) real income will raise the money demand,

causing the domestic currency to appreciate (depreciate). Finally, an increase in the home (foreign) interest rates will result in an appreciation (depreciation) of the exchange rate. It is interesting to note that the last two effects are the opposites of the ones expected in the Mundell – Fleming fixed price model. This model generally regards an increase in domestic real income as leading to a worsening trade balance and therefore to a depreciation of the exchange rate. The Dornbusch's (1976) sticky price model accords, in the long run, with the implications of the monetary approach but has Keynesian features in the short run (Dornbusch's model assumes $\delta_5 < 0$ and $\delta_6 > 0$).

The empirical validity of the monetary model can only be tested in the long run, given the short run deviations of the exchange rate from its PPP. Therefore, we employ tests of cointegration, which provide evidence for the existence of long run relationship among the exchange rate, money supplies, real incomes and interest rates, even if individual variables are nonstationary. Therefore, under such a statistical specification, even Dornbusch's sticky price model can be consistent with the presence of a long-run equilibrium even though a temporary overshooting of exchange rate is implied.

5.0 Empirical results

5.1 Data

The study uses quarterly data from 1996 to 2001. The data used include nominal exchange, money supply, real income and interest rates.

5.2 Time Series Properties of the Data

We first conduct a descriptive analysis of the data for the first part of the study. Table 1 shows that the variables do not follow a normal distribution. The second step is to test for a unit root in the variables. The results of the unit root tests are shown in table 2.

Table 1: Data Distribution

Variable	Mean	SDV	Skewness	Kurtosis	Jaque-Bera
e	32.97138	18.43470	0.816733	2.963735	2.224604
m2	8780.435	3785.081	0.636268	2.317631	1.737480

m2*	197397.0	49624.84	-0.097718	1.647076	1.557164
y	3134.532	256.4011	-0.750359	3.899879	2.551612
y*	538288.4	124713.0	-1.448616	3.188903	7.024700
i	20.98200	10.36331	0.108496	1.337491	2.342520
i*	14.47300	3.811031	0.062715	2.188019	0.562538

Table 2: Phillips - Perron Unit (PP) Root Test (Trend and Intercept)

Variable	PP	Order of Integration
e	-2.142020 (-3.6746) 3.844974 (-3.6920)	I(1)
m2	-3.205953 (-3.6746) -5.139809 (-3.6920)	I(1)
m2*	-1.636989 (-3.6746) -3.6920 (-3.6920)	I(1)
y	-4.360930 (-3.6746)	I(0)
y*	-1.718646 (-3.6746) -4.604724 (-3.6920)	I(1)
i	-2.3036 (-3.6746) -3.734832 (-3.6920)	I(1)
i*	-1.75843 (-3.6746) 2.666788 (-3.6920) -4.25834 (-3.7119)	I(2)

The figures in brackets are Mackinnon critical values (in absolute terms) for rejection of unit root at the conventional 5 % level of significance. The results show that all variables (except domestic income and foreign interest rate) are non-stationary (integrated of order one) and thus become stationary after first difference. Domestic income is I(0) while foreign interest rate is I(2).

Co-integration analysis

The next stage is to determine the co-integrating vectors that span the variables in equation 16, that were found to be integrated of order one. That is we test whether nominal exchange rate, money supply, foreign income, and domestic interest rates are co-integrated. Our co-integration analysis employs the method developed by Johansen (1988) and Johansen and Juselius (1990). This method commences from a standard vector auto-regression (VAR) of the form:

$$X_t = \Pi_1 X_{t-1} + \ldots + \Pi_k X_{t-k} + \mu + \epsilon_t \qquad (17)$$

Where X is a $p \times 1$ vector of I(1) variables of interest, μ is a vector of constants $\epsilon_{1,\ldots,}\epsilon_t$ are IN $(0,\Lambda)$ error terms. Using the operator, Δ, equation 17 can be re-parameterized as:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1}\Delta X_{t-k-1} + \Pi X_{t-k} + \mu + \epsilon_t \qquad (18)$$

Where $\Gamma_1 = -(I - \Pi - \ldots - \Pi_i)$ $(I = 1, ., k-1)$, and $\Pi = -(I - \Pi_1 - \ldots - \Pi_k)$

Equation 18 is a stationary error correction (ECM) first differences vector auto-regression (VAR) where the term ΠX_{t-k} contains information on the long-run levels relationship between variables in the VAR. The ECM term will be consistent with the stationary VAR only if is stationary, and this will occur if the elements of X are co-integrated. The number of co-integrating vectors v, between the elements X (i.e., number of independent linear combinations spanning the I(1) vector space, determines the rank r of the vector Π. According to Dickey *et al* (1991) co-integrating vectors are obtained from the reduced form of a system where all variables are jointly endogenous.

Table 3: The Johansen Co-integration Test[3]

Eigen values	Likelihood ratio	5 % Critical value	1% Critical value	Hypothesized No. of CE(s)
0.979099	113.6095	68.52	76.07	None**
0.704968	43.98623	47.21	54.46	At most 1
0.538778	22.01416	29.68	35.65	At most 2
0.324834	8.084401	15.41	20.04	At most 3
0.054779	1.014066	3.76	6.65	At most 4

*(**) denote rejection of the hypothesis at 5%(1%) significance level.

The table shows the eigen values, the likelihood ratio for the significant eigen value and the probability values. The hypothesis that we have no co-integrating vector (none) is rejected. The results thus show that we have one significant co-integrating vector. It should be noted that in a system of N variables, we should expect N-1 co-integrating vectors. The method used here helps us to get the significant vector(s). The vector is identified and normalized with inflation rate consistent with the objectives of the study. The significant vector is formed as follows:

$$e - 1.97m2 + 0.334409\ m2^{*} + 0.719406y^{*} + 0.342882\ i + 0.112927 \quad (19)$$
$$(0.13819) \quad (0.20531) \qquad (0.06672) \qquad (0.03334)$$

The result implies that there is a monetary relationship describing long run movements of the Malawi Kwacha – US Dollar exchange rate. In addition, all coefficients have reasonable magnitude and have the expected signs based on theoretical postulates.

Granger causality

Having identified our co-integrating vector, now our ECM term, the next step is to determine how these variables drive each other. This is done through the Granger causality test. The results are shown in table 4. From these results, we see that nominal exchange rates predict domestic money supply and interest rate with no feedback effects. Likewise, exchange rates do predict domestic and foreign interest rates with no reverse causation.

[3] The Johansen Technique has the following advantages over the Engle Granger Two Step procedure: First, its results are invariant with respect to the direction of normalization, because it makes all the variables implicitly endogenous. Secondly, it fully captures underlying time series properties of the data. Thirdly, it allows direct hypothesis testing of the co-integrating vector.

Table 4: Granger causality test

m2 ⇒⇒ Δe	F (1,19) = 1.62840 [0.22014]
Δe⇒⇒m2	F (1,19) = 9.48483 [0.00718]
m2* ⇒⇒ Δe	F (1,19) = 5.50897 [0.03212]
Δe⇒⇒Δm2*	F (1,19) = 0.23275 [0.63602]
Δy ⇒⇒e	F (1,19) = 3.54326 [0.07810]
Δe⇒⇒Δy	F (1,19) = 1.33920 [0.26416]
Δy * ⇒⇒ Δe	F (1,19) = 2.46560 [0.13593]
Δe⇒⇒Δy *	F (1,19) = 0.02247 [0.88273]
Δi ⇒⇒ Δe	F (1,19) = 1.60640 [0.22314]
Δe⇒⇒Δi	F (1,19) = 12.7742 [0.00253]
Δi *⇒⇒ Δe	F (1,19) = 0.15964 [0.69477]
Δe⇒⇒Δi*	F (1,19) = 5.02169 [0.00391]

5.3 Developing an Error Correction Model of Exchange Rate

This section reports on the development of a single equation error correction model for exchange rate in Malawi. First a general model is estimated, and the general-to-specific modeling strategy is used to obtain an empirically constant parsimonious model. Then the economic and statistical properties of the preferred model are described.

The general model was estimated with four lags of each variable in differences and an error correction term. The reduction of the general model was carried out by removing the longest lag of each variable with low t-statistics, and then using F-statistics and the Schwartz criterion to check the validity of the simplification.

Table 5: The Short Run Model of Exchange Rate (Δe)

Variable	*Coefficient*	*S.E.*	*T-Statistic*	*Prob.*	
C	-7.598	1.643	-4.626	0.0009*	*
Δm2(-1)	0.767	0.386	-1.986	0.0751	

Δm2*	0.463	0.134	3.465	0.0061*
y(-2)	-1.089	0.204	5.345	0.0003**
Δy*	-0.716	0.242	2.966	0.0141*
Δi(-1)	0.509	0.136	3.73	0.0039**
ΔΔi*	-0.621	0.162	-3.83	0.0033**
ECM(-1)	-0.221	0.190	-1.16	0.272

R^2 = 0.886460
Adj. R^2 = 0.806981
D-W Stat =1.895343
F-Stat =11.15349 Prob =0.000518

Jarque Bera	F-Stat	=1.247203	Prob	=0.536011
White Heteroscedasticity	F-Stat	=3.8626	Prob	=0.695259
ARCH	F-Stat.	=0.750810	Prob	=0.399868
Brusche Godfrey	Obs*R sq	=2.028312	Prob	=0.362708
Ramsey Reset Test	F-Stat	=0.042934	Prob	=0.840468

** (*) Implies that the variables are significant at both 1% and 5% level of significance.

By following the general-to-specific approach, a parsimonious (preferred) short run model was obtained. Domestic money supply has a positive sign, which implies that, a reduction in domestic money supply lead to an appreciation of the Malawi Kwacha. The reduction in money supply raises the domestic rate of interest for a given money demand in the short run. This arises because a reduction in the nominal money supply reduces the real money supply since in short run, the price level is sticky. The reduction in domestic interest rate results in an incipient short-run capital inflow. This causes the exchange rate to appreciate. Domestic income variable has a negative sign, which is consistent with the sticky monetary model. The real income variable is negative because growth in real income increases the demand for money, since at a given level of prices, there is a larger value of transactions to be financed. This causes the exchange rate to appreciate.

The error correction term (ECM) is negative and significant confirming the validity of the co-integrating relationship established earlier. The

ECM at 22% indicates that the nominal exchange rate adjusts to its own equilibrium level relatively slowly. The goodness of fit is quite reasonable and statistically significant as measured by both the adjusted R^2 and F-statistics. This, in other words, means that parameters of the model are jointly statistically significant and the variables explain 81% of variation in exchange rate.

Graph 6 in the appendix 1 shows the extent of misalignment of the exchange rate (the difference between prevailing nominal exchange rate and the long-run equilibrium) under the floating exchange rate regime to give guidance to policy makers. The misalignment measures coincide with heavy devaluations like the one in August 1998 depicted in the graph during the fourth quarter of 1998. In periods of relative stability, the measures of misalignment may provide guidance to policy makers. However, in the case of Malawi the misalignment measures are coincident to crisis and do not serve as a good forecaster of the crisis

To evaluate the statistical properties of the model, a battery of tests was implemented. The diagnostic tests reveal that the model is free from statistical problems. The diagnostic tests are all insignificant at 5% level of significance. This implies that the model is well specified, that there are no problems of autocorrelation of the second order, that the errors are homoscedastic and that the errors are normally distributed.

6.0 Conclusion and Policy Implications

In this paper, we have examined the monetary model of the exchange rate for the Malawi Kwacha – U. S. dollar exchange rate over the recent period of floating exchange rates. Since the monetary model is viewed as a theory of long-run equilibrium, the concepts and tests of cointegration are suitable.

The results described in the previous section have led to the following conclusions. Firstly, money supply can be employed as a tool to influence the exchange rate. This arises because a reduction in the nominal money supply through open market operations raises domestic rate of interest rate for given money demand in the short run. This is due to the fact that a reduction in the nominal money supply reduces real money supply since in short run the price level is sticky. The increase in domestic interest rate results in an incipient short-term capital inflow. This causes the exchange rate to appreciate. Thus policy makers can use monetary policy to induce change in international trade

competitiveness by manipulating exchange rate. Though unobservable in practice, exchange rate (especially real exchange rate) does in fact exert a powerful influence on the direction and volume of international trade and capital flows. The only caution is that intervention cannot change market trends. Thus intervention must be very selective, and ultimately also well coordinated to reduce exchange rate volatility and risk of misalignment.

Secondly, exchange rate instability in this country has been largely due to limited foreign exchange reserves. Temporary stability is being achieved under the floating exchange rate regime because of foreign financial assistance largely in form of balance of payments support. The policy question therefore is whether the floating exchange regime would be sustainable in the absence of such support in the long run, given the narrow, undiversified and unstable export base. Thus this calls for greater investments in improving our many natural resources would enable us to generate high rates of growth in tourism revenue. It is an established fact that Malawi as primary producer (or natural resource-intensive exporter) is facing inelastic demand for its products (e.g. commodity products like tobacco, sugar, cotton). Several developing countries trying to diversify their export base into newly manufactured products do face stiff competition in export markets from other developing countries, as well as import competing sectors in developed countries. We therefore need to consciously follow a policy of developing our ecological assets to attract tourist from many countries and raise foreign exchange reserves.

Thirdly, periodic adjustments in the exchange rate have failed its competitiveness in the medium term and long term because of its subsequent increase in the domestic prices triggered by the very exchange rate adjustments. This casts doubt on the appropriateness of currency devaluations as a policy tool for expanding and diversifying exports

Fourthly, causal observations indicate that developments in the external sector of the economy (changes in terms of trade, flow of aid and other external shocks), which are not under the control of domestic authorities, contribute more to the weakening of the Malawi Kwacha-US dollar exchange rate. If indeed the above diagnosis is true, the policy implications are that the Reserve of Malawi's ability in influencing the behaviour of the exchange rate is limited. This is because the ability of a

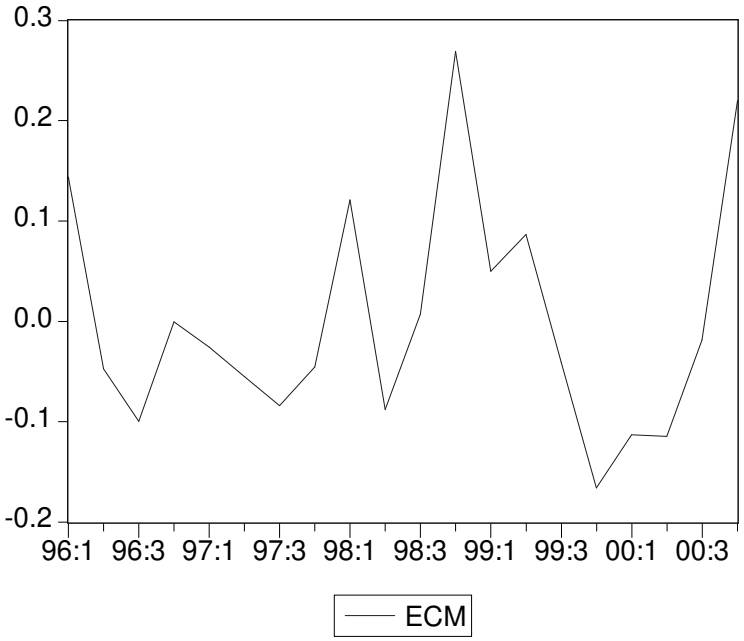
small economy like that of Malawi to fully insulate itself from external shocks is constrained. It will be mainly confined to limiting contributions of inconsistencies in domestic policy, implementing some confidence building measures at least in the short - to - medium term.

Our results suggest directions for future research. First, data limitations, notwithstanding, the study attempted to examine factors that influence the Malawi Kwacha – US dollar rate. While its coverage of economic fundamentals is adequate, a lot of relevant questions remain unanswered. For instance, to what extent do economic crises in traditional trading partners (Zimbabwe and South Africa for instance) contribute to the exchange rate instability in Malawi? Besides, it might be interesting to determine whether and how dollarization (calculated as the relation of deposits in foreign currency to the sum of all deposits) affect exchange rate. Stability and sustainability of exchange rate depend on the degree of dollarization. Reduction of dollarization and the factors that cause it (such as fragility of financial system, low public trust to the banking and financial institutions and government, high potential risk) would reduce the impact on destabilizing forces on the exchange rate. Thus exchange rate policy has to be selected taking into account the degree of dollarization and everything it entails.

It also would be interesting examine the effects of the estimated structural shocks on the variables in the system by computing impulse responses based on the Vector Error Correction Model (VECM) representation where the estimated long-run restrictions are taken into account. This would help in examining the impulse response of each of the variables to a unit positive change in each of the "fundamental"shocks.

Appendix 1

Graph 6: Misalignment of exchange rate



References

Balassa, Bella, 1978, "*The Monetary Approach to the Exchange Rate: Some Evidence*," IMF Staff Papers 25:503-28.

Diamonds P F, Georgoutsos D A, and Kouretas G P (Winter, 1996); "Cointegration Tests of the Monetary Exchange Rate Model" the Canadian – US dollar, 1970-1994," International Economic Journal, Volume 10, Number 4, pp.83-97.

Florentis, G., Gordon, D. V., Huber, P., "Monetary models of the Canadian – US Exchange Rate: A reexamination of empirical, 1971-1986," *Quarterly Journal of Business and Economics*, Summer 1994, 27-43.

Frenkel, J A, "*A Monetary approach to the exchange rate: Doctrinal aspects and empirical evidence*," Scandinavian Journal of Economics, March 1976, 200-234.

Macdonald, Ronald, and Mark Taylor, 1994, "The Monetary Model of the Exchange Rate: Long-Run Relationships, Short-Run Dynamics and How to Beat a Random Walk", Journal of International Money and Finance 13 (3): 276-290.

Rapach D E and Wohor M E (November, 2001); "Testing the Monetary Model of Exchange Rate Determination: New Evidence from a century of Data," *Journal of International Economics*.

Smith P N., Wickens M R (April, 1986); An Empirical Investigation into the Causes of Failure of the Monetary Model of the Exchange Rate' *Journal of Applied Econometrics*, Volume 1, Issue 2, p.143-162.