A Monetary Policy Reaction Function for Malawi

Master of Arts (MA) in Economics Thesis

by

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Submitted to the Department of Economics at Chancellor College, University of Malawi, in partial fulfillment of the requirements for a Master of Arts Degree in Economics.

July 2007

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Abstract

The onset of financial sector liberalization in Malawi ushered in a new era in the conduct of monetary policy, which saw the abandonment of direct policy instruments and a corresponding introduction of indirect, more market-friendly instruments. Further, the Reserve Bank of Malawi was given a more direct mandate with respect to macroeconomic objectives of inflation, output and external balance.

This study specifies and estimates a monetary policy reaction function for the Reserve Bank of Malawi with the aim of reviewing the conduct of monetary policy in the post-liberalization period. The study tests whether the RBM reacts to inflation, output and exchange rate developments in the economy in a consistent and predictable way.

The Generalized Method of Moments technique is used to estimate the weights attached to inflation, output, and exchange rate in the RBM's policy operations. The study finds that inflation has been the most important variable in setting the monetary base, while results on the output gap have largely been insignificant and inconsistent with theoretical expectations. The RBM seems to have reacted to inflation developments more aggressively after the liberalization period than during the liberalization, as evidenced by the larger weights attached to inflation in the former period. Exchange rate developments also appear to moderately influence the setting of the monetary policy instruments. However, the discount rate setting seems to be more influenced by the central bank's desire to correct a previous disequilibrium than a direct reaction to economic developments.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

In monetary policy analysis, the debate as to whether monetary policy should be conducted by following rules or simply by discretion is usually cast under the umbrella topic of "rules versus discretion." Roughly speaking, discretion implies period-by-period reoptimization by the monetary authorities whereas a rule calls for a period-by-period implementation of a contingency formula that has been selected to be generally applicable for an indefinitely large number of periods (McCallum, 1997). The key distinction between discretion and rules thus concerns whether current commitments constrain the future direction of policy in any credible way.

One of the earliest advocates of the superiority of rules over discretion in the conduct of monetary policy was Milton Friedman (1959) in the context of a constant monetary growth rule that he propounded. However, it was the seminal paper by Kydland and Prescott (1977) which provided a strong theoretical foundation for the optimality of rules under rational expectations. They showed that, given the incentives faced by policymakers and the resulting inflationary bias that is inherent in discretionary monetary policies, commitment to a rule helps the monetary authorities to minimize the dynamic inconsistency problem, thereby bringing credibility to the conduct of monetary policy.

In recent years, there has been an upsurge in research interest on the use of monetary policy rules (or reaction functions) in monetary policy analysis, especially following the path-breaking paper by Taylor (1993). Taylor suggested a simple rule that he employed to evaluate the Federal Reserve System's conduct of monetary policy. Basically, a monetary policy reaction function is a relationship that describes how a central bank alters its monetary policy instrument in response to economic developments that can imperil the attainment of its policy objectives (e.g. price stability or attainment of full employment). There are several important ways in which knowledge of a central bank's reaction function plays a role in macroeconomic analysis. It can be helpful in predicting the central bank's policy actions, thereby serving as a benchmark for assessing the current stance and the future direction of monetary policy. Furthermore, in macro models, the reaction function is central in evaluating central bank's policy and determining effects of other macro policies (e.g. fiscal policy) or economic shocks (e.g. oil price shocks), implying that macroeconomic performance may itself depend upon the conduct of monetary policy. There is thus considerable interest in identifying the nature of actual policy pursued by the monetary authorities and determining whether the estimated reaction function fostered or hindered macroeconomic stability.

Despite this upsurge in the use of rules in monetary policy analysis, the bulk of the research has focused on the advanced economies, and little work has been done on the developing economies. Yet, given its centrality in macroeconomic management, an understanding of the conduct of monetary policy in these economies is essential. This is more so given that the conditions under which monetary policy is conducted in these countries are distinct from those in the developed countries. For example, it is a well-known fact that monetary authorities cannot effectively implement open market operations in an economy where the securities markets are undeveloped, which is the case in many developing countries (Kasekende and Atingi-Ego, 1998). Furthermore, issues of fiscal dominance, independence of the central bank from government, underdevelopment of the overall financial system, and the pursuit of other policy goals apart from the traditional output and price stabilization are some of the challenges facing the monetary authorities in developing countries. It is thus more worthwhile to study whether, in the midst of all these challenges, the monetary authorities in these countries have been able to pursue systematic monetary policy, which is the essence of estimating a monetary policy reaction function.

1.2. Problem Statement

That the long-run goal of monetary policy should be low and stable inflation is no longer a contested issue in the economics profession. This is due to the broad consensus among economists of different persuasions that, in the long-run, monetary policy can only affect nominal variables, but not real activity. However, in the short-to medium-term, there are a number of goals and objectives of monetary policy other than price stability, including economic growth, exchange rate and financial system stability, and a viable external balance, which make the conduct of monetary policy more complicated.

The Reserve Bank of Malawi (RBM), like any other central bank, has generally been targeting price stability and output stabilization as its major policy goals. The IMF-supported financial sector liberalization programmes that begun in the late 1980's saw the RBM shed off most of its repressive monetary policy tools (like quantitative controls on interest rates and credit, and restrictions on competition in the banking sector), and introduce more market-oriented tools of monetary operations .This both necessitated and facilitated the shift in the conduct of monetary policy from using direct policy instruments to the use of indirect ones. In principle, this was aimed at facilitating the conduct of monetary policy in line with the macroeconomic objectives of a manageable and stable inflation rate, economic growth, and a sustainable BOP position.

Despite these financial reforms, the major macroeconomic variables that were targeted have not significantly improved over time. Average inflation over the period has remained in double digits; the current account position has been worsening over the years, with rates of economic growth that have been far less than the required rate for poverty eradication and sustainable development. These outcomes beg a number of questions as to whether the central bank takes into account all its policy goals when setting its monetary policy instruments. Can the RBM credibly pursue its policy goals? Which goals significantly determine the RBM's monetary policy operations, and what weight is attached to each of the goals in the monetary policy decisions? Research on monetary policy in Malawi has not directly addressed these questions. No study has been undertaken to evaluate the conduct of monetary policy vis-à-vis the bank's legislated goals. Most studies have mainly focussed on the independence of the central bank (e.g. Sinoya, 2002; Tseka, 2000) or the interaction between the RBM and government (e.g. Phiri, 2002) and their implications on the effectiveness of monetary policy. The aim of this paper is therefore to analyse whether the RBM has been systematically pursuing its goals in the post-liberalization period, particularly between 1989 and 2006. Put differently, the paper would like to address the question as to whether, in setting its monetary policy instruments, the RBM has been systematically responding to developments in inflation, output and the exchange rate.

1.2. Objectives of the Study

The Reserve Bank of Malawi Act (RBM Act, 1989) clearly establishes the mandate of the RBM, which is, among others, to "implement measures designed to influence the money supply and availability of credit, interest rates and exchange rates with a view to promoting economic growth, employment, stability in prices and a sustainable balance of payments position and promote development in Malawi." Implementation of this kind of mandate makes monetary policy design and execution difficult and complex, as some of the objectives may be in conflict with each other in any given economic conditions. For example, in a bid to promote economic growth, the central bank may want to pursue an expansionary monetary policy, but this may result in inflationary pressure on the economy, hence conflicting with the price stabilization goal. The main objective of this study is therefore to evaluate whether the RBM has been systematic in conducting monetary policy, which goals have driven the RBM's conduct of monetary policy, the corresponding weight attached to each goal, and whether the weights have changed over time. Specifically, the paper aims to answer the following questions:

- In setting the monetary policy instrument (base money in this case), has the RBM acted as if it was following some rule-like behaviour?
- Do developments in output, inflation, and/or exchange rates really influence RBM's monetary policy actions?

The study also contributes to the ongoing debate in literature regarding the measurement of the output gap. Basically, we suggest that the standard measurement used in most specifications may be erroneous when considering the policy making environment in most developing countries.

1.3. Hypotheses

To achieve the above stated objectives, the following hypotheses will be tested:

- The setting of the monetary base and the discount rate by the RBM does not follow any rule-like behaviour;
- Inflation, output, and exchange rates are not important in the determination of the base money by the RBM.

1.4. Significance of the Study

The effectiveness of monetary policy on macroeconomic performance depends critically on private sector response to policy changes, which in turn depends on the private sector's expectations about present and expected future course of monetary policy. Knowledge of central bank behaviour in setting its monetary policy instruments is thus necessary for both the policymakers and the private sector, as it helps the latter to form correct expectations (especially price expectations) and thus helps in strengthening the effectiveness of monetary policy. The study will therefore contribute to the empirical literature on monetary policy reaction functions in developing countries, and in particular an understanding of the key drivers of the monetary policy conduct in the post-financial liberalization period in Malawi. This understanding is necessary for the policy makers to evaluate whether, and to what extent, they are acting in accordance with their legislated mandates. Further, the study contributes to the current debate about the appropriate measurement of the output gap by suggesting a measurement that is generally different from the ones used in standard policy reaction functions, and one that is particularly relevant for developing countries.

1.4. Organisation of the paper

The rest of the paper is organized as follows. The next chapter presents an overview of the monetary policy framework in Malawi. Chapter III reviews theoretical and empirical literature on monetary policy reaction functions. Chapter IV outlines the econometric methodology of the paper in estimating Malawi's policy reaction function. Chapter V presents the results of our econometric analysis, and chapter VI provides concluding remarks.

CHAPTER TWO

2.0 AN OVERVIEW OF THE MONETARY POLICY FRAMEWORK IN MALAWI

This chapter surveys three interrelated features that have shaped monetary policy in Malawi, namely, the legal and institutional framework, the historical development, and the design and operational framework of monetary policy in Malawi since 1964, but particularly focussing on the post-1989 developments.

2.1 The Legal and Institutional Framework

Monetary policy in Malawi is conducted by the Reserve Bank of Malawi (RBM), the country's central bank. The RBM was established by an Act of Parliament which was passed in July 1964 and became operational in 1965. At that time, the principal objectives of the RBM were limited to issuing legal tender in Malawi, maintaining external reserves so as to safeguard the external value of the Malawi Kwacha, promoting monetary stability, and developing a sound financial system, in addition to the traditional role of being a banker to government. Following the oil and debt crises of the late 1970s and early 1980s and the consequent IMF-backed economy-wide structural adjustment programmes, it was inevitable that the financial system also undergoes a major overhaul to place it in line with other structural changes. Financial sector reforms thus started in 1987, with the liberalization of lending rates, followed by the deregulation of deposit rates in 1988. These were followed by the enactment in 1989 of the Reserve Bank of Malawi Act and the Banking Act, replacing the old RBM Act (1965) and Banking Act (1965), respectively[1]. Enactment of these two laws broadened the mandate and powers of the RBM, granted it more monetary policy operational independence and more financial sector supervisory powers that had hitherto been in the hands of the Ministry of Finance, and led to the introduction of indirect monetary policy instruments. With respect to macroeconomic objectives, the RBM Act (1989) clearly stipulates that monetary

[1] For a comprehensive review of financial sector reforms in Malawi, see Chirwa and Mlachira (2002)

policy in Malawi should aim at promoting economic growth, employment, stability in prices, and maintenance of a sustainable balance of payments position.

Financial crises of the 1990's in Latin America and East Asia and their impact on monetary stability exposed important structural weaknesses in most developing countries' financial systems and highlighted the importance of financial system soundness for monetary policy effectiveness and macroeconomic stability. Thus, in line with current central banking practice, the added role of the RBM has been understood as that of promoting overall financial system soundness and monetary stability in the long-term interest of the national economy.

2.2 Monetary Policy Design and Operations

Monetary policy in Malawi is formulated by the Monetary Policy Committee (MPC), which meets once every month to review developments in the economy and decide the appropriate course for monetary policy. This is in line with current central banking practice in most countries, where monetary policy formulation is placed in the hands of a committee, rather than the single person of the Governor, in order to foster greater transparency, accommodate a diversity of views, and avoid personal and political pressures on the part of the Governor in policy decision-making. The MPC was instituted in February 2000. It is chaired by the Governor, and draws its membership from the Bank's senior management, the Secretary to the Treasury (Ministry of Finance), the Secretary for Economic Planning and Development, and an independent member from the academia. Policy decisions made during these meetings are made public through newspapers.

Operationally, the RBM seeks to influence the M2 (broad money stock, consisting of currency outside banks plus demand and time and savings deposits) money aggregate and domestic interest rates to attain its macroeconomic objectives. As with many other developing countries, the design and conduct of monetary policy in Malawi is strongly linked to the IMF's monetary programming model. Monetary policy has largely been conducted through *reserve money programming*, in which the RBM sets monthly and quarterly operational targets for reserve money, determined under the IMF's monetary programming. The first step in reserve money programming is to determine a target rate of growth in a broad monetary aggregate that is consistent with the set macroeconomic objectives of economic growth and price development. This requires that the velocity of broad money demand can be predicted. With assumptions about the money multiplier and seasonalities (e.g. reserve money targets for the tobacco harvest season in Malawi are expected to be higher than those for the tobacco growing season), the second step is then to calculate the desired base money levels. The reserve money programme can therefore be summarized as first setting an *intermediate* target for broad money and second relating this to an *operational* target for base money.

Through the use of different policy instruments, the RBM will then seek to influence movements in the components of the reserve money in order to influence the desired growth in the broad money stock (M2). Chart I below plots the trends in base money and the M2 in Malawi, and the resulting money multiplier (M2/base money). As can be seen from the chart, the money multiplier has been volatile, challenging a critical requirement in reserve money programming (i.e. a stable and/or predictable money multiplier), thereby posing problems for the conduct of monetary policy.

Chart I: Growth in base money vs. growth in M2

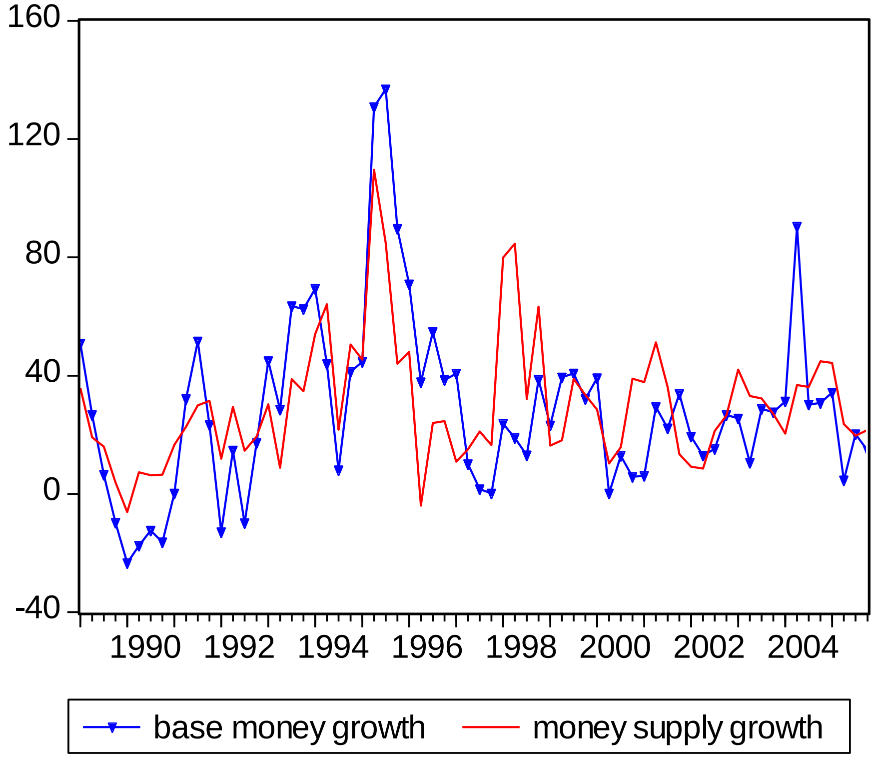
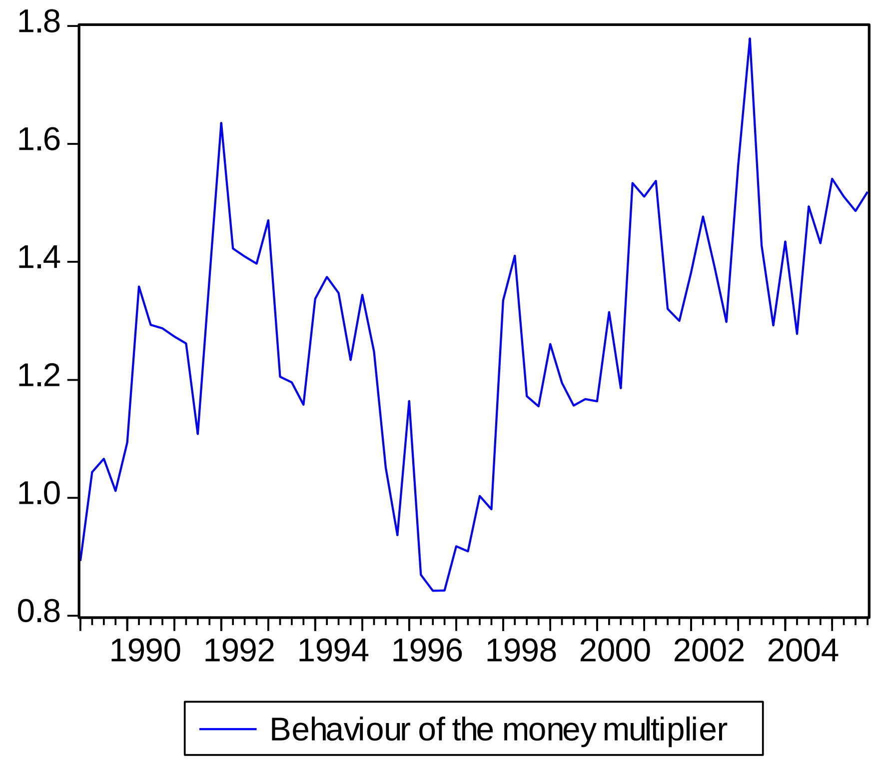


Chart III: Behaviour of the money multiplier (1989-2005)



In terms of monetary policy operating instruments, before the era of financial liberalization, monetary policy in Malawi was characterized by use of direct instruments such as direct credit, interest rate ceilings, and strict controls on foreign exchange and capital flows. Open market operations were limited due to the underdeveloped nature of the domestic securities market. Similarly, the use of the liquidity reserve requirement ratio was limited. Local Registered Stocks and Treasury Bills were floated principally for purposes of financing government budget deficit.

Although these instruments were available, the effectiveness of monetary policy was limited. This was partly due to the fact that Malawi, being a low income country, savings have been low consequently financial deepening has remained low. As such, the role of monetary policy in influencing macroeconomic performance has been minimal. The underdeveloped nature of the capital and financial markets meant a limited range of financial products offered by the commercial banks. Over and above these, the implementation of monetary policy was made more difficult by exogenous shocks like the declining terms of trade for Malawi's primary products, transport problems to/from the sea ports which increased landed cost of imports, rising government budget deficit whose financing crowded out the private sector, and increased external debt service payments.

The financial sector reforms that begun in 1987 brought about a new institutional and operational framework for monetary policy aimed at reducing direct government intervention in the economy, allowing market forces more latitude in decision-making, and generally re-orienting the conduct of monetary policy to reflect the objectives of a modern central bank. This necessitated the abandonment of the direct instruments of monetary policy and the consequent introduction of indirect instruments. Below, we discuss the different policy instruments available to the RBM for its monetary operations.

2.2.1 Liquidity Reserve Requirement (LRR)

Liquidity Reserve Requirement (LRR) refers to the amount of reserves, as a proportion of deposit liabilities, that a financial institution is required to hold with a central bank. They may be held in the form of cash in the vault or as deposits with the central bank. LRR is principally designed to protect depositors

LRR was introduced in Malawi as a monetary policy instrument in 1989. Its operation is governed through RBM Directives under which commercial banks and discount houses are subject to a liquidity reserve requirement of a given percentage (currently at 15.5 percent). For the banks, LRR is a given percentage of total local currency deposits, while for the discount houses, LRR is a given percent of non-collateralized deposits from the corporate sector. However, discount houses do not normally take deposits without collateral, and are therefore practically not subject to LRR. The reserve maintenance period is set at an average weekly basis, failure of which attracts a penalty charge of 0.25 percent of the amount of the violation multiplied by 7.

Ever since it was introduced, the LRR has not been actively used as a monetary policy instrument. When the LRR was first introduced in 1989, the rate was set at 20 per cent of commercial banks' deposit liabilities. It was increased to 35 percent in 1995 and remained there until in the second half of 2000 when the rate was adjusted down to 30 percent. The rate was further adjusted to 27.5 percent in June 2004, and further adjusting it downwards to 20 percent in February 2006. Currently (since February 2007), the LRR is at 15.5 percent. These rates are still high by international standards, and given that a high LRR acts as an implicit financial tax to the financial institutions (since the reserves earn little or no interest), it increases the cost of funds as banks transfer the tax to consumers by increasing the margin between lending and deposit rates. Chirwa and Mlachira (2002) found that the LRR in Malawi significantly affects the interest spreads, suggesting that commercial banks respond to the upward adjustment in LRR by widening the spread, thus shifting the cost of refinancing requirements to customers.

On the monetary policy front, a high LRR tends to constrain the extent to which a central bank can influence money supply through changes in reserve money. The high reserve ratio tends to cause the money multiplier to be relatively low, and therefore, requires a correspondingly large amount of security sales to absorb a given amount of liquidity and to effect changes in the rate of money growth Use of LRR is limited by the fact that it cannot be adjusted often to take into account daily fluctuations in liquidity estimates for fear of disrupting the financial planning process in the banking system (Sato, 2000).

2.2.2 Open Market Operations

Open Market Operations (OMO) are viewed as the primary tool for monetary policy operations. Basically, they involve the purchase and sales of securities to influence the levels of liquidity in the economy. However, they are also extensively used as a tool for financing government's budgetary deficit. The main instruments that are used for OMO are Treasury bills (TBs) auctions, RBM bills auctions, and Repurchase Agreements (repos) for both TBs and RBM bills. Whereas TBs are also used for financing the fiscal deficit, RBM bills are primarily a monetary policy instrument. Introduced in 1991, TB's are zero coupon government securities which originally had tenors of 30 days, 60 days and 91 days, but these were later adjusted to 91 days, 183 days and 271 days tenors, respectively. RBM bills were introduced in August 2000 to complement TBs in monetary operations, and are offered in two tenors-63 days and 91 days. Auctions for both TBs and RBM bills are held weekly.

Repo transactions are conducted in the secondary markets, and the instruments traded include TBs, RBM bills, banker's acceptances and commercial paper. It is the repo transactions in TBs and RBM bills that have a bearing on liquidity management. However, due to the underdevelopment of the secondary market and scanty information to (potential) market participants, there is limited participation in the market, with infrequent transactions.

2.2.3 The bank rate (discount rate)

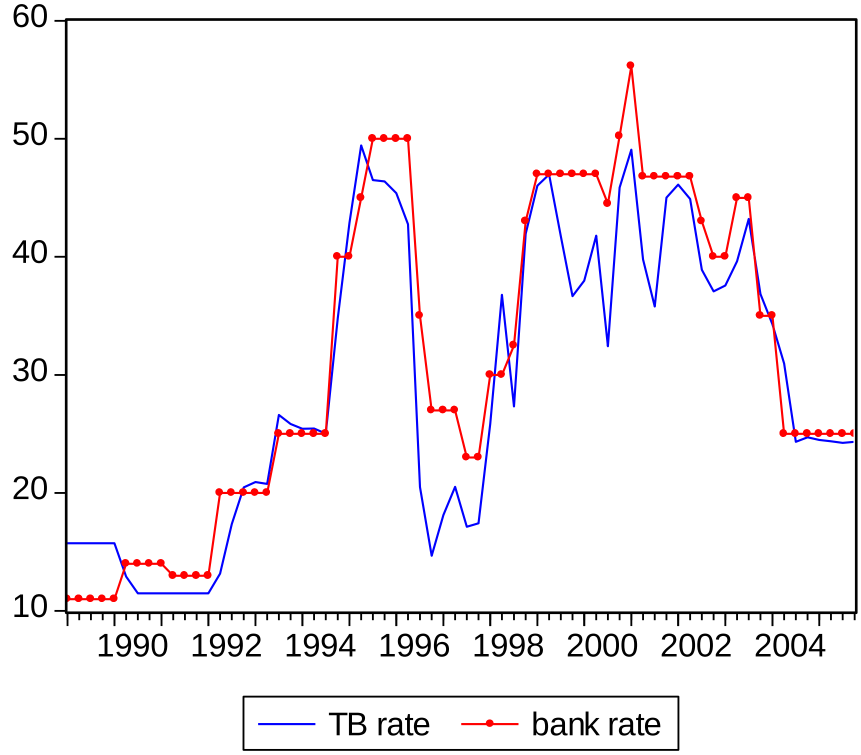
This is the rate of interest that the central bank charges commercial banks for credit. It is mainly used as an indicator for monetary policy stance i.e. whether the monetary authorities are tightening or relaxing monetary policy. It is set on the basis of interest rates on the TB market and inflation and is currently at 20 percent.

Interest rate policy in Malawi was for a long time under the administrative control of government. Government's main pre-occupation was to keep them low in order to promote private investment, and there was little attention paid to underlying economic conditions, especially inflation. As a result, rates were infrequently adjusted for the period up to 1987.

From January 1985 to May 1990 the discount and savings rates hovered around 10 percent with hardly any change. The minimum lending rates remained at about 15 percent. The full liberalization of interest rates in 1990 meant that commercial banks were free to set their own interest rates without consulting the central bank. However, in practice, during the period 1990-1992, the commercial banks moved their interest rates only after the central bank moved the discount rate. The discount rate was adjusted upwards at least seven times mainly to curb excessive inflationary pressures that were caused by fiscal indiscipline and the consequent excessive aggregate demand increases, especially during 1994-1995.

The setting of the bank rate largely followed movements in the TB yield. Indeed from 1994 the discount rate was loosely linked to the TB yield, adjusting it after every five consecutive auctions (see Chart III below). During the same period, commercial banks also started to actively adjust their lending rates on the basis of TBs, though their adjustment was often signalled first by adjustments in the discount rate.

Chart III: Movements in the Bank Rate vs. the TB rate (1989-2005)



2.3 Exchange Rate Policy

The importance of the exchange rate policy to a small open economy like Malawi cannot be overemphasized. Major sectors of the economy like agriculture and manufacturing rely on a significant amount of imported materials for their inputs, while at the same time agricultural produce form a huge component of the economy's total exports. Developments in the exchange rate therefore have a significant influence on price and output developments in Malawi.

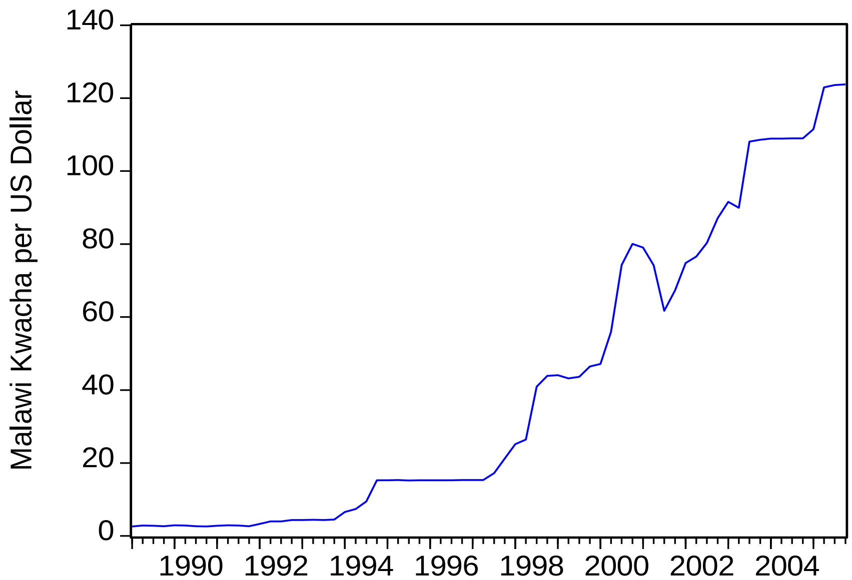
Since independence, Malawi has had a number of exchange rate regimes, mainly mirroring government's policy line on the external sector and international economic developments. The policy regime has over the years evolved from a hard peg to a single currency to a free-floating system, and everything else in between. Below, we summarise the evolution of the exchange rate regime since independence (1964)[2].

[2] For a comprehensive account of the evolution of Malawi's exchange rate policy, see Sato (2000), or Mkandawire and Simwaka (2006)

- 1964-January 1971: British pound/ Malawi pound par value system
- February 1971-November 1973: Malawi Kwacha pegged to the British pound at two to one.
- November 1973-May 1975: peg to a weighted average of the British pound and the US Dollar.
- June 1975-January 1984: peg to the SDR
- June 1975-January 1994: peg to a weighted basket of seven currencies
- February1994 to date: free floating (with intervals of a managed float)

The floatation of the Kwacha in February 1994, coupled with the opening of the current account in the same year, and the corresponding rise in inflation brought in new challenges to the conduct of monetary policy as the authorities had to deal with the impact of exchange rate fluctuations on the growth in the monetary aggregates. Consequently, in a bid to avoid excessive volatility in the foreign exchange market, the authorities have still maintained a flexible exchange rate policy, with some intervention in the market to smooth pressures related to seasonal supply factors like tobacco sales and inflows of donor assistance, and to ensure that the demand in the foreign exchange market is being met.

Chart IV: Developments in the MK/US Dollar exchange rate (1989-2005)



Two most important factors that have influenced the post-floatation intervention in the foreign exchange market are the desire to manage the level and volatility of inflation rates especially due to the growth in the volume of imports after the current account liberalization, and to stabilize the real effective exchange rate in order to support the international competitiveness of Malawi's exports.

As can be observed from the discussion above, the objective of monetary policy in Malawi has been price stability, implemented mainly through open market operations.

CHAPTER THREE

3.0 LITERATURE REVIEW

3.1 Theoretical Literature

3.1.1 A Conceptual Framework

A monetary policy rule is basically an operationalization of a central bank's objective function, given a particular macroeconomic model of the economy. Its essence is derived from the need to choose a time path for a monetary policy instrument (interest rate or some measure of a monetary aggregate) to engineer the time paths of the goal variables (e.g. output or inflation) that maximize the central bank's objective function, subject to the constraints on behaviour implied by the given macroeconomic model (Clarida et al, 1999). Thus, within the given macro model, the monetary policy design problem is to characterize how a given policy instrument should adjust to the current state of the economy.

The baseline macroeconomic framework that identifies the policy reaction function starts with the specification of the economy that signifies the constraints faced by the policy maker. Output is given by a Lucas-type aggregate supply function of the form:

$$y_t = y_n + a(p_t - p_t^e) + u_t \quad \ldots\ldots (1)$$

Where y_t is the level of output at time t; y_n is the economy's natural rate of output, p_t is the inflation rate, p^e is the expected rate of inflation, and u_t is a stochastic error term.
Equation (1) indicates that output can be expanded by a positive inflation surprise. This can be motivated as arising from the presence of one-period nominal wage contracts set at the beginning of each period based on the public's expectation of the rate of inflation. If actual inflation exceeds the expected rate, real wages will be eroded and firms expand employment. If actual inflation is less than the rate expected, realized real wages will

exceed the level expected and employment will be reduced. One can derive (1) from the assumption that output is produced according to a Cobb-Douglas production function in which output is a function of labour input, the nominal wage is set at the start of the period at a level consistent with the labour-market equilibrium (given expectations of inflation), and firms base actual employment levels on realized real wage (Walsh, 2003). Note that equation (1) can be reformulated to derive an expectations-augmented Phillips curve that relates the inflation rate to the output gap and expected inflation rate, a formulation which is used in other models as an alternative specification to (1).

Subject to the constraint imposed in equation (1), the central bank rationalizes its policy choice by specifying its social objective function which translates the behaviour of the target variables into a welfare measure. In this respect, a consistent policy by the central bank will seek to maximize this objective function, taking output as a "good" since an increase increases welfare, and inflation as a "bad" since a reduction increases welfare. However, the exact manner in which output is assumed to enter the objective function takes different forms. Following Barro and Gordon (1983), one formulation is to specify the central bank's objective as maximizing the expected value of a utility function:

$$U = \lambda(\dot{y}_t - y_n) - \frac{1}{2}(p_t - p^*)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (2)$$

Where λ is the parameter that governs the relative weight that the central bank places on output expansions relative to inflation stabilization, and *p** is the target rate of inflation. The critical point to note about the specification (2) is that, because of the standard specification of the aggregate supply function, the central bank can only increase output by creating inflation surprises.

The second specification of the objective function assumes that the central bank desires to minimize the expected value of a loss function that depends on output and inflation fluctuations:

$$V = \frac{1}{2}\lambda(\dot{y}_t - y_n - c)^2 + \frac{1}{2}(p_t - p^*)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

The key aspect of this loss function is the parameter *c*. Here the assumption is that the central bank desires to stabilize both output and inflation, inflation around the target and output around y_n+c, which exceeds the economy's equilibrium output of y_n by the constant *c*. Because the expected value of *V* involves the variance of output, the loss function (3) will generate a role for stabilization policy that is absent when the central bank cares only about the level of output, as in (2).

A number of interpretations have been given as to why the authorities would want to expand output beyond its potential level i.e. why $c>o$ in (3). Most often the appeal is made to the presence labour-market distortions (a wage tax, for example) that lead the economy's equilibrium rate of output to be inefficiently low. Attempting to use monetary policy to stabilize output around y_n+c then represents a second-best solution (the first best would involve eliminating the original distortion). Another interpretation is based on the notion that elected officials have a bias for economic expansions, since their effects tend to boost the probability of reelection of the incumbent politicians. They will therefore put pressure on the central bank for more economic expansion. Given the structural rigidities prevailing in most developing countries, specification (3), with $c>0$, would be more reflective of the policy making environment in these countries compared to (2).

Given that the central bank's policy design problem is intertemporal in nature, we maximize (3) over many periods to obtain:

$$V = \frac{1}{2}E_t\left[\sum_{i=0}^{\infty} B^i V_{t+i}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

Where V_t is defined as before, and B^i is the discount rate that the policymaker attaches to future values of the loss function.

Having specified its objective function, the central bank will then define its monetary policy rule (or reaction function) that specifies the exact period's setting of the policy instrument. Essentially, the reaction function will entail the response of policy instruments to deviations in key macroeconomic variables from the levels the monetary authorities deem optimal (Loayza and Schimdt, 2002). The settings are typically made in response to recent or predicted values of the target variables.

A number of monetary policy rules have been suggested in the literature, one of the earliest of which is Friedman's (1959) constant monetary growth rule, commonly referred to as the *k%* rule. This is a policy prescription for a fixed rate of monetary growth (combined with a floating exchange rate), in line with the trend/long-run growth rate of an economy. Friedman's rule is based on a number of arguments, including the informational constraints facing policy makers; problems associated with time lags and forecasting; uncertainty with respect to the size of fiscal and monetary policy multipliers; the inflationary consequences of reducing unemployment below the natural rate; and the basic distrust of the political process compared to market forces (Snowdon and Vane, 2005). However, the two major monetary policy reaction functions that have captured the interest of most researchers are the Taylor Rule (Taylor, 1993) and the McCallum Rule (McCallum, 1988). We discuss each of them in detail below.

3.1.2 The Taylor Rule

Taylor (1993) suggests a very specific and simple rule for monetary policy. The rule sets the level of the nominal federal funds rate as a linear function of the rate of inflation, an equilibrium real funds rate, plus an equally weighted sum of two gaps: the four-quarter moving average of actual inflation in the GDP deflator less a target rate, and the percent deviation of real GDP from an estimate of the potential level:

$$r_t = p_t + r^* + 0.5(p_t - p^*) + 0.5(y_t - y_n) \quad \ldots\ldots\ldots\ldots (5)$$

Where r_t is the short-term nominal interest rate that the central bank uses as its instrument or "operating target"; r^* is the long-run average real rate of interest; p_t is an average of recent inflation rates; and p^* is the central bank's target inflation rate. This rule has the feature that the federal funds rate rises if inflation increases above its target or if real GDP rises above trend GDP. Thus if both the inflation rate and real GDP are on target, then the federal funds rate would equal its equilibrium rate. What can be noticed from the original Taylor rule is that the weights given to the inflation and output deviations are assumed, not econometrically estimated. A more general specification of the formulation would be:

$$r_t = p_t + r^* + \delta_1(p_t - p^*) + \delta_2(y_t - y_n) \quad \ldots\ldots (6)$$

which states that the central bank will tighten/relax monetary policy (i.e. increase/decrease the nominal short-term interest rates at time t above the nominal equilibrium rate $(p_t + r^*)$) when inflation exceeds/is below the target and/or output is above/below potential.

A number of researchers have modified or extended the general formulation of the rule by adding more variables to the equation and/or by specifying whether policy responds to past, current or future expected values of the reaction variables. Current research using the Taylor rule has tended to focus on the reaction function in which the central bank responds to future expected values of inflation and real GDP (see, for example, Clarida et al, 1999; and Mehra, 2005). This formulation, referred to as the "Forward-looking Reaction Function," is justified on the basis that contemporary monetary policy making is forward looking by nature. Thus a forward-looking specification of equation (6) would be:

$$r_t = p_t + r^* + \delta_1(E[p_{t+n} \mid \Omega_t] - p^*) + \delta_2(E[y_{t+n} \mid \Omega_t] - y_n) \quad \ldots\ldots (7)$$

Where Ω_t is the information set available to the central bank at the time of adjusting the interest rate. Here, the reaction function hypothesizes that determination of the short-term interest rate each period is a function of the real interest rate, actual inflation and gaps between expected inflation and output and their respective target levels. This formulation is complemented by assumptions of rational expectations, and that the central bank smoothes short-run changes in interest rates, thus adjusting the actual federal funds rate gradually to the target implied by the economic fundamentals specified in (5).

3.1.3 The McCallum Rule

The McCallum rule, propounded by McCallum (1988), sets a monetary policy reaction function that uses the monetary base as the policy instrument, and thus expresses the growth of the monetary base (currency plus bank reserves) as a function of the nominal GDP gap:

$$\Delta b_t = \Delta x^* - \Delta v_t + \varphi(\Delta x^* - \Delta x_{t-1}) \quad (8)$$

Where Δb_t is the rate of growth of the monetary base; Δv_t is the rate of growth of base velocity, percent per year, averaged over previous four years; Δx_t is the rate of growth of nominal GDP; Δx^* is the target rate of growth of nominal GDP. In this rule, the target value Δx^* is taken to be the sum of p^*, the target inflation rate, and the long-run average rate of growth of real GDP (which is not affected by monetary policy). The term Δv_t is intended to reflect long-lasting changes in the demand for the monetary base that occur because of technological developments or regulatory changes (presumed to be permanent); it is not intended to reflect cyclical conditions. These are represented by the final term, $\Delta x^* - \Delta x_{t-1}$, which is positive when recent growth of output and the price level has been slow. A large resulting value for Δb_t is a signal for monetary ease, represented by a rapid rate of increase in the monetary base—which tends to generate or support a rapid rate of increase in monetary aggregates and thereby stimulate aggregate demand (McCallum, 2002). Note that the last term in the equation is the feedback term which allows for monetary policy to be tightened or loosened from a neutral stance according to the deviation of nominal income from the assumed target.

3.1.4 The Monetary Instrument problem.

The discussion above leads to one policy dilemma: suppose that the monetary authorities wish to choose some monetary instrument to serve as its monetary policy tool: which should they choose? The two most natural such intermediate targets are the nominal interest rate and the nominal money supply. If the authorities choose the former, they must be willing to allow the money supply to accommodate as necessary as possible so as to allow the interest rate to achieve its objective. If they choose the latter, the nominal interest rate will adjust endogenously in response to the stochastic disturbances impacting on the economy. This dilemma was first addressed by Poole (1970), who classified it as the “monetary instrument” problem.

Using a simple IS-LM model, Poole showed that the choice between pegging the nominal interest rate and pegging the nominal money supply, from the stand point of providing greater output stability, depends on the sources of risk impinging the on economy. If the shocks hitting the economy are primarily demand shocks (i.e. shocks to the IS curve), then pegging the money supply is better. This will allow the interest rate to bear some of the shocks and thereby insulate output from the full brunt of these disturbances. On the other hand, if the shocks are primarily monetary shocks (i.e. shocks to the LM curve), then the preferred policy is to peg the interest rate, allowing monetary shocks to be absorbed by an accommodating money supply, and insulating output.

Taylor (2000) also discusses the instrument choice problem in the context of using monetary policy rules for emerging economies. He points out that a monetary aggregate would be the preferred instrument if there is too much uncertainty in measuring the real interest rate; if there are relatively big shocks to investment or net exports, and if it is difficult to measure the equilibrium real interest rate. On the other hand, if velocity shocks are big then the interest rate is the better instrument, a point to which he attributes the preference for the interest rate instrument in most recent work on policy rules. He notes that, given the economic characteristics of emerging economies, such as high inflation rate and difficulties in measuring the equilibrium interest rate, an interest rate rule would translate into policy errors. He therefore concludes that policy makers in emerging market economies might want to give greater consideration to policy rules with monetary aggregates. Suffice to note that the structural characteristics of most developing countries resemble more of those of the emerging economies than those of the advanced economies. Therefore, the policy rules that may be relevant for the emerging economies may also do well for the developing countries.

To sum up the case for monetary targeting in emerging and developing economies, it is argued that where channels of finance are relatively underdeveloped (as is often the case with developing countries), credit availability is likely to be the most important channel of monetary policy transmission in developing countries, and monetary targets may serve as a proxy for the growth of overall credit.

3.2 Empirical Literature

Empirical evidence on monetary policy reaction functions is quite limited, as most studies mainly concentrate on the developed countries. It is also important to note that most of the studies are based on some variant of the Taylor rule, where interest rate is the policy instrument. Bearing this in mind, we review some of the empirical studies below.

Stuart (1996) assesses whether the conduct of monetary policy in the United Kingdom (UK) based strictly on rules could have helped prevent some of the policy errors that the monetary authorities made using quarterly data from 1985 and 1996. His analysis is based on a comparison between the settings of the instrument variables during the period against the values that would have been specified by the particular rules in response to the prevailing conditions. Applying both the Taylor rule and the McCallum rule in their basic formulations, he finds that the retrospective evidence provided by both rules provides useful information about the stance of monetary policy in particular episodes, and based on the ex-post judgments concerning the macroeconomic performance during the particular periods, he concludes that the policy rules might have helped identify past errors in the UK monetary policy design.

Judd and Rudebusch (1998) estimate a dynamic Taylor-type reaction function of the United States' Federal Reserve System for three separate subsamples over the period 1970-1998 delineated by the identity of the Federal Reserve Chairman. Their finding is that, overall, the estimated reaction functions provide a way to capture important elements of the policy regimes in place during these periods.

Clarida, Gali, and Gertler (2000) estimate a simple forward-looking reaction function for the United States before and after Volker's appointment as the chairman of the Federal Reserve System in 1979. They estimate the reaction function using the Generalised Method of Moments in order to take into account the interest-smoothing behaviour of the Federal Reserve and the effect of exogenous shocks on the Fed's policy actions. Their results show that interest rate policy in the Volker-Greenspan period appears to have been much more sensitive to changes in expected inflation than in the pre-Volker period. Their results imply that the pre-Volker rule permits larger fluctuations in inflation and real output than does the Volker Greenspan rule. Suffice to point out that this work by Clarida et al has been quite influential in the current empirical research on policy reaction functions.

De Brouwer and Gilbert (2005) examine and calibrate backward-looking and forward-looking reaction functions to assess the stability and consistency of interest rate setting for the Reserve Bank of Australia (RBA) in the post-float period (1984-2002). Using OLS for the backward-looking reaction function and instrumental variable estimation for the forward-looking function, they find that the RBA is forward-looking, focusing on outcomes one year ahead, and that the weight on inflation in the RBA reaction function has increased and that of output has decreased since the adoption of inflation targeting.

Using extended Taylor rules, Aron and Muellbauer (2000) estimate both forward and backward-looking functions for South Africa over the period 1987-96. They find that the South African Reserve Bank has over time been more responsive to inflation than output fluctuations. They also find weak evidence for structural breaks in policy setting over the period, attributing this to the competing Balance of Payments considerations in the monetary policy decisions of the SARB.

Setlhare (2004) uses OLS to estimate an empirical monetary policy reaction function for the Bank of Botswana (BoB) over the period 1977-2000 and finds that the policy actions of the BoB were predominantly countercyclical. He concludes that the estimated reaction function suggests that inflation is the ultimate variable of policy interest for the BoB.

All the above studies use interest rates as a policy instrument. One study that uses the monetary base as a policy instrument is the one by Sanchez-Fung (2002). He estimates a dynamic reaction function for the Dominican Republic (DR) during the period 1969-2000 using OLS. Results from the study reveal that the monetary authorities in the DR emphasized targeting the gap between the parallel and official exchange rates in their policy design, and that they started being more systematic after the mid-1980's, reflecting a rule-like behaviour on the part of the authorities as a result of the financial liberalization programmes that the DR undertook in the early years of the 1980's.

More generally, most of the current empirical research on monetary policy rules has tended to concentrate on forward-looking specifications of the rules. This is because this provides a good description of current central bank behaviour around the world (Clarida et al, 2000).

CHAPTER FOUR

4.0 METHODOLOGY

4.1 Model Development

This study adopts a hybrid model, derived from Clarida et al (2000), to estimate a dynamic reaction function for monetary policy in Malawi, using the monetary base as the policy instrument. The choice of the monetary base as the instrument of policy is based on two grounds. Firstly, and on practical considerations, this is the instrument that is used by the RBM as the operational target of monetary policy. The RBM's bank rate (the equivalent of the federal funds rate) is infrequently adjusted. Secondly, as discussed in the policy instrument choice dilemma in the previous chapter, in most developing countries, the presence of structural and economic factors such as an underdeveloped financial system, relatively high inflation rates, difficulties in measuring the equilibrium interest rate, and the persistence of shocks to the IS-curve (e.g. food availability and export shocks) necessitate the use of a monetary aggregate as compared to nominal interest rate as a policy instrument.

We therefore specify the base money reaction function for Malawi as follows:

$$\Delta b_t^* = \Delta b_t^{lr} + B_1(E[p_{t+n} \mid \Omega_t] - p^*) + B_2(E[y_{t+n} \mid \Omega_t] - y_n) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

Where Δb_t^{lr} is the equilibrium growth rate in the monetary base; and the rest of the variables are as previously defined. A number of modifications need to be made to the general framework (9) to suit the Malawian situation. A first modification concerns the inclusion of the exchange rate as one of the explanatory variables. A number of authors have highlighted the importance of the exchange rate in monetary policy rules, especially in the context of developing countries. Ball (1999) argues that the inclusion of the exchange rate variable in the reaction functions for small open economies is necessary and in line with the objectives of the central bank, since in these countries exchange rate stabilization is sometimes a precondition for output and inflation stabilization. Taylor (1999) also notes that policy rules that do not include the exchange rate may understate the exchange rate effects in small open economies and therefore tend to underestimate the effects of exchange rate fluctuations.

We therefore expect the monetary authorities to intervene in the foreign exchange market through purchases/sales of foreign exchange if an expected change in the exchange rate is seen by the central bank as destabilizing. For example, if a depreciation is expected to have destabilizing effects, the central bank will intervene by selling its foreign exchange reserves in order to smooth market supply. A study by Simwaka and Mkandawire (2006) finds evidence suggesting that the foreign exchange intervention by the RBM smoothes the Malawi Kwacha exchange rate fluctuations. Adding the exchange rate to equation (9) gives:

$$\Delta b_t^* = \Delta b_t^{lr} + B_1(E[p_{t+n} \mid \Omega_t] - p^*) + B_2(E[y_{t+n} \mid \Omega_t] - y_n) + B_3 E(ER_{t+n}) \ldots\ldots \quad (10)$$

Where ER_{t+n} is the Malawi Kwacha/US Dollar expected exchange rate for time $t+n$ as at time t. To estimate the long-run (static) relationship, we simply add a residual error term to equation (10) to capture the deviations from the rule, and then run an OLS regression. However, for such reasons as fear of disruption of financial markets or uncertainty about the effects of policy changes, central banks often appear to adjust their policy instruments more gradually-taking small, distinct steps towards the desired setting. Therefore to allow for such monetary base smoothing, we assume that the monetary base is adjusted only partially to its target level:

$$\Delta b_t = (1-\rho)\Delta b^*_t + \rho \Delta b_{t-1} + v_t \ldots\ldots \quad (11)$$

Where the parameter $0<\rho<1$ captures the degree of smoothing by the central bank. Equation (11) postulates a partial adjustment of the monetary base. It states that the growth in the monetary base at time t partially corrects the "error" between last period's setting and the current recommended level, as well as maintaining some of the "momentum" from last period's change in the monetary base. The exogenous random shock to the monetary base, v_t, is assumed to be *i.i.d (independently and identically distributed).*

We assume that central bank's expectations are rational and hence uncorrelated with the information known to the central bank at time *t-1* (thus eliminating the unobserved forecast variables), so that

$$p_{t+n} = E(p_{t+n}/\Omega_{t-1}) + vp_{t+n} \quad \text{12a}$$

$$GAP_{t+n} = E(y_{t+n}/\Omega_{t-1} - y^*) + vy_{t+n} \quad \text{12b}$$

$$EXR_{t+n} = E(EXR_{t+n}/\Omega_{t-1}) + vx_{t+n} \quad \text{12c}$$

Where vp_{t+n}, vy_{t+n} and vx_{t+n} are forecast errors that are uncorrelated with *t-1* dated information used by the central bank to forecast inflation, the output gap, and the exchange rate, respectively. Letting $\alpha = \Delta b^{lr} - B_1 p^*$, and incorporating equation (12) into equation (10), then combining equation (10) with the partial adjustment mechanism (11) and eliminating the unobserved forecast variables yields:

$$\begin{aligned}\Delta b_t = {} & (1-\rho)a + (1-\rho)B_1 p_{t+n} + (1-\rho)B_2(GAP_{t+n}) + \\ & (1-\rho)B_3 EXR_{t+n} + \rho\Delta b_{t-1} + \varepsilon_t\end{aligned} \quad \text{13}$$

where the error term ε_t is a linear combination of the forecast errors of inflation, output and exchange rate (eq. 12), and the exogenous disturbance υ_t., and is thus orthogonal to any variable in the information set Ω_t. The forecast inflation, output and exchange rate are correlated with the error term, rendering OLS estimates inconsistent. To overcome this problem, we use instrumental variables. In particular, The Generalized Method of Moments (GMM) estimator, which also takes care of the parameter non-linearities, is used to estimate the parameters.

Let u_t be set of instruments within the policymaker's information set (i.e., $u_t \in \Omega_t$) that are orthogonal to ε_t. These instruments are chosen on the basis that they are significantly correlated with the independent variables but are not correlated with the contemporaneous error term. Possible elements of u_t include any lagged variables that help forecast inflation, output, and exchange rate, as well as any contemporaneous variables that are uncorrelated with the current shock ε_t. Then equation (13) implies a set of orthogonality conditions:

$$E[\{\Delta b_t - (1-\rho)a - (1-\rho)B_1 p_{t+n} - (1-\rho)B_2(GAP_{t+n}) - (1-\rho)B_3 EXR_{t+n} - (1-\rho)\Delta b^*_t - \rho\Delta b_{t-1}\}|u_t] = 0 \quad \ldots\ldots\ldots 14$$

which provide the basis for the estimation of the parameter vector using the Generalised Method of Moments, with an optimal weighting matrix that accounts for possible serial correlation and heteroskedasticity of unknown form in ε_t[3]. Further, the use of the GMM technique also has the advantage that it requires no information about the exact distribution of the error term, which, in general, is assumed to be drawn from a normal distribution.

4.2 Variable definitions and expected signs of the coefficients

4.2.1 Monetary Base

The monetary base is sometimes called high-powered money, base money, or reserve money. Generally, it consists of currency in circulation, currency held in banks (as cash in their vaults), commercial bank deposits (bank reserves), and deposits of other domestic sectors to the monetary authorities. All these items are compiled on the liabilities side of the central bank's balance sheet. It includes required reserves held for Kwacha deposits, other domestic liabilities, and other demand and time deposits held with the RBM. The growth rate in the monetary base is the dependent variable in our model.

4.2.2 The exchange rate

This is the price of one unit of the US Dollar in terms of the Malawi Kwacha. We expect the sign of B_3 to negative. This is because an increase in the exchange rate (depreciation) would require foreign exchange intervention through sales of foreign exchange to the

[3] In estimating the equation in E-Views, we specify the GMM estimator to have Heteroskedasticity-and Autocorrelation-Consistent (HAC) standard errors i.e. the standard errors will be valid even if the error term is potentially heteroskedatsic and/or serially correlated over time.

market. This should also be paired with a reduction in domestic credit, as the central bank attempts to reduce liquidity; less liquidity in the streets means less demand for foreign exchange.

4.2.3 The output gap

As defined above, the output gap is the difference between actual and potential output. Estimation of the potential output is one of the contentious issues in the measurement of the output gap. Two types of measurement are used by researchers. The first one uses atheoretical methods, like the Hodrick-Prescott (HP) filter-which fits trend output over time, or a quadratic trend method as used by Clarida et al (1997). The second type uses theoretically based estimates of potential real GDP, like the Phillips-curve based estimation of the output gap. However, most studies use the HP filter because of its simplicity. In this paper, we measure the output gap using the HP filter.[4] We expect the RBM to have a *lean against the wind policy*. That is, it will engage in contractionary monetary policy to fight any inflationary pressures arising from GDP growth being above the potential (target) GDP growth. The sign for B_3 is therefore expected to be negative. We therefore expect the monetary authorities to decrease money supply when growth is above the target and increase it when growth is below the target. Since we will use quarterly data and Malawi GDP data is annual, we will interpolate the annual data to obtain the quarterly GDP estimates using indices from currency in circulation. (The correlation between GDP and currency in circulation was found to be 0.96, making the latter's indices a plausible instrument for interpolation).

4.2.4 The Inflation gap

This is the difference between actual and targeted inflation. Inflation rate is defined as the annual changes in the Consumer Price Index (CPI). The reaction of the RBM to inflation developments is expected to be a negative relationship. It is expected that when actual/expected inflation is higher than the target, the central bank will engage in

[4] Specifically we measure the output gap as $y - y^* = \frac{realGDP - t\arg etGDP}{t\arg etGDP} * 100$. See Appendix I for technical notes on how to obtain the HP filtered data

contractionary monetary policy in order to reduce the gap. This would thus entail decreasing the monetary base. Therefore, we expect the coefficient on the inflation gap, B_1, to be negative.

4.3 Estimation Technique

The study uses quarterly data to obtain estimates of the parameters using the Generalized Method of Moments (GMM) regression technique. Analysis was done using the E-Views software.

As in all instrumental variable estimation techniques, the reliability of the GMM coefficient estimates depends crucially on the validity of the instruments. The J-statistic is a commonly used test in IV estimation to check instrument exogeneity (Newey and West 1987), which is the crucial condition for instrument validity[5]. The J-statistic can be used to test the validity of over-identifying restrictions when there are more instruments than parameters to estimate. Under the null hypothesis that the over-identifying restrictions are satisfied, the J-statistic times the number of regression observations is asymptotically distributed as χ^2 with degrees of freedom equal to the number of over-identifying restrictions.

4.4 Data Sources

The data used in the study was collected from the various publications of the Reserve Bank of Malawi (RBM Financial and Economic Reviews), the National Statistical Office (Statistical Bulletin), and the International Monetary Fund (International Financial Statistics).

[5] The other condition is instrument relevance: an instrument is relevant if variation in the instrument is related to variation in the given regressor. In this paper, like in most papers on monetary policy reaction functions, this condition is taken care of by using lagged values of the regressors as instruments.

CHAPTER FIVE

5.0 MODEL ESTIMATION AND INTERPRETATION OF RESULTS

5.1 Exploratory Data Analysis

5.1.1 Descriptive Statistics

Table I below presents a summary of the descriptive statistics of the variables used in the study. Overall, base money has grown significantly over the sample period, ranging from an average of K536.2 million during the liberalization period to K7,615.3 million in the post-liberalization period. Comparing between the two subsamples, the data shows that the monetary base increased significantly in the post-liberalization period. It is also apparent from the data that not only are the average monetary base values higher in the period after reforms, but also its volatility as measured by the standard deviation increased significantly. This may point to the fact that liberalization brought in certain risks to monetary policy implementation that required the RBM to review and adjust the path of the operational target (base money) that would be consistent with programmed growth of the broader monetary aggregate in light of developments in the economy.

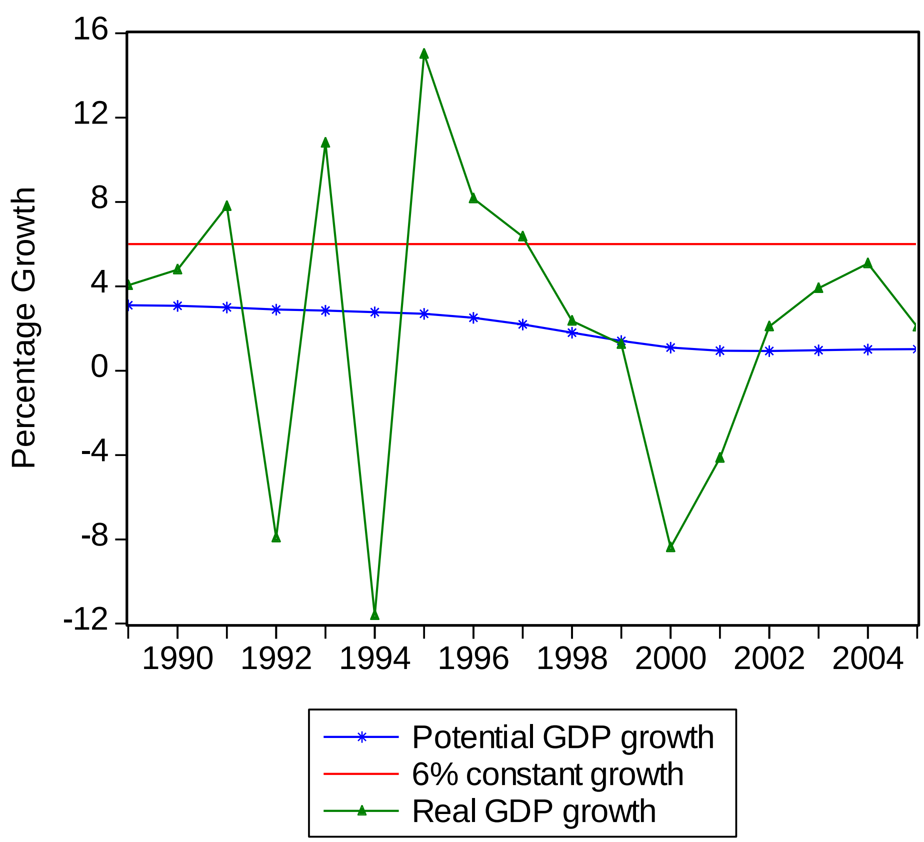
Table I: Descriptive Statistics

Variable	***Full Sample 1989:1 - 2005:4***		***During liberalization 1989:1-1994:1***		***After liberalization 1994:2-2005:4***		***Mean Change***
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Real GDP (K'mn)	24,866.9	29,751.8	1,583.7	509.3	35,270.1	30,513.9	33,686.4
Base Money (K'mn)	5,429.1	5,699.9	536.2	177.9	7,615.3	5,611.94	7,079.18
Inflation	25.33	20.02	17.13	8.11	28.99	22.60	11.85
MK/US Dollar	40.96	40.69	3.50	1.02	57.70	38.52	54.20

Over the sample period, inflation averaged 25.3 percent, high above the government's expressed target for a single-digit inflation rate. The average rate of inflation during the liberalization period was 17.1 percent, compared to the average of 29 percent after liberalization, with very high levels of volatility. The increase in the levels of inflation in the post-liberalization period reflect in part the impact of the floatation of the Malawi Kwacha in 1994 and the opening up of the current account, which led to very large depreciations and huge increases in imports, respectively.

The graphical analysis of developments in real and potential GDP reveals an important theoretical issue that requires adequate consideration in the specification and interpretation of the monetary policy reaction function (see Chart IV below).

Chart IV: Growth in real output (1989-2005)



As the graph shows, the growth rate in real output during the period of the study has been quite volatile, and for the most part below the required annual growth rate of at least 6 percent for poverty reduction and sustainable economic development, as propounded in most of Malawi's development strategies, like the Malawi Poverty Reduction Strategy Paper (MPRSP) and the Malawi Growth and Development Strategy (MGDS). Further, for the entire sample period, the annual growth rates in potential output have been below the 6 percent threshold. This has an important implication for the evaluation of monetary policy conduct: the RBM, like most central banks in developing countries, has a role to play in stabilization policy, and not just in maintaining price stability. This implies that the RBM may sometimes have to accommodate inflationary pressures arising from the aggregate demand side of the economy in order to allow economic expansion beyond the economy's potential, as long as the potential output growth is below the target growth for the economy. In this respect, the output gap measurement used in most standard specifications of the reaction function may be a misspecification when used for central banks that are involved in stabilization policies.

5.1.2 Time Series Properties

In order to avoid the problem of spurious regressions that can take place in time series regression analysis, we now investigate the data generating process of the variables used and, where necessary, the order of integration so as to establish meaningful economic relationships in our econometric analysis. The assumption of stationarity is very crucial in studies employing time series analysis, and the tests thereof have therefore become a necessary ingredient of time series analysis. If a variable contains a unit root then it is non-stationary and unless it is combined with other non-stationary series to form a cointegration relationship, then regressions involving the series may be spurious. Two most commonly used tests for stationarity are the (Augmented) Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. However, Perron (1989) showed that, in the presence of exogenous structural breaks in the series, the ADF tests tend to bias towards non-rejection of the null of unit root in the series. We therefore use the PP in this study. The unit root test results are reported in Table II below.

Table II: Unit Root Tests

Phillips-Perron Unit Root Tests in 1st Differences			
Variable	***PP Statistic***	***p-value***	***Decision***
Base money growth	-5.0198	0.0004*	Stationary
Output gap	-13.9721	0.0000*	Stationary
Inflation	-2.9045	0.0483**	Stationary
Depreciation	-4.0892	0.0016*	Stationary

*Note: *, **, and *** indicate 1 percent, 5 percent, and 10 percent significance level, respectively*

We thus establish that all the variables used in the econometric analysis are stationary, and can safely proceed to econometric estimation without fear of encountering spurious correlations.

5.2 Econometric Results

In this section we report the evidence as derived from the GMM estimates of the policy reaction function specified by the baseline equation (equation 13, excluding the exchange rate variable), and variants thereof.

Table II presents results of the baseline specification. We have divided the results into three samples, namely, the full sample (1989q1-2005q4), the sample during liberalization (1989q1-1994q1), and the post-liberalization sample (1994q2-2005q4).

Table III GMM Baseline Estimates of the RBM Reaction Function

Sample Period	***B_1***	***B_2***	ρ	***J-Statistic***	***R^2***
1989q1-2005q4	-1.1399	-0.1625	0.6219	5.2143	0.65
	(0.0528)	(0.4583)	(0.0000)	(0.7344)	
1989q1-1994q1	5.1229	0.5552	0.7130	5.3247	0.49
	(0.0000)	(0.0000)	(0.0007)	(0.7224)	
1994q2-2005q4	-1.3777	0.4904	0.5519	6.3889	0.45
	(0.0000)	(0.1259)	(0.0000)	(0.6038)	

Note: p-values for the coefficient estimates are in brackets. For both coefficients B_1 and B_2, we have reported the long-run coefficients. Short-run coefficients can be retrieved by multiplying the relevant coefficient by $(1-\rho)$ *. Full (short-run) GMM results are reported in Appendix II, Tables A, B and C.*

We first focus on the estimates of the full sample. The model has a modestly high explanatory power of 65 percent. The J-Statistic reported indicates that the null hypothesis that the overidentifying restrictions on the instruments are satisfied cannot be rejected, implying that the instruments used are valid; therefore the GMM estimates are consistent. The long-run inflation coefficient has the expected sign and is statistically significant at 10 percent significance level. The estimate indicates that the RBM engages in contractionary monetary policy if future (one-year ahead) inflation is expected to increase. Specifically, the estimated long-run coefficient on inflation is -1.14, indicating that a one percent increase in expected inflation leads the RBM to reduce the growth in the reserve money by -1.14 percentage points. The size of the coefficient is greater than 1, indicating that the RBM has been aggressive in reacting to developments in inflation.

However, the result on the output gap is very small and statistically insignificant. The estimated long-run coefficient is -0.16. In terms of policy implications, the result seems to suggest that, during the period under study, the RBM seems not to have pursued restrictive monetary policies in the face of inflationary pressures arising from excessive aggregate demand. In other words, the RBM seems not to have been too keen to *lean against the wind*, to avoid the inflationary pressures that are associated with an overheating economy.

The estimate of the smoothing parameter ρ also points to some interesting result on monetary policy conduct. The coefficient is large, positive, and highly significant. This suggests considerable policy inertia on the part of the monetary authorities: only about 38 percent of the growth in the monetary base is reflected in the changes in the economic fundamentals within the quarter of the change. That is, the RBM smoothes adjustments in the targeted growth in the monetary base.

Comparing between the two subsamples (during and after liberalization), notable differences lie in the weights attached to the inflation and output goals. The second and third rows in Table III report regression results of the two subsamples. Results for the liberalization period are largely paradoxical and inconsistent with theoretical expectations. This may be largely reflective of the fixed exchange rate regime that was in operation during this period, which made monetary policy endogenous since the authorities mainly acted to defend the Malawi Kwacha value. On the other hand, comparison of the magnitudes of the coefficients of the post-liberalization period against the full-sample results reveals that the conduct of monetary policy over time has been leaning more towards inflation stabilization, and away from output considerations. The magnitude of the inflation coefficient increased to 1.38 while the output coefficient is insignificant, with a wrong sign. This result does not have a straightforward interpretation since, as pointed out by De Breuwer and Gilbert (2005), a monetary policy reaction function is a reduced form embodying the interaction of the preferences of the central bank and the stochastic system of equations summarising the structure of the economy. The implication of this is that the increase in the weight on inflation can be taken as a reflection of a change in central bank preferences over inflation only if it is proven that the structure of the economy has been stable. However, as noted above, the post-liberalization period has been characterized by high and volatile inflation, partly reflecting the effects of the shift in the exchange rate regime to a free floating system, current account liberalization, and increased government's reliance on domestic borrowing to finance the budgetary deficit, which put pressure on the money supply growth. Though not econometrically established in this paper, this result could thus partly reflect a structural change in the monetary policy regime resulting from the financial liberalization programme. More generally, in both subsamples and in the full sample, inflation considerations tend to be more significant in terms of sign and statistical significance of the coefficients than the output gap.

We now look at variants of the baseline equation, including addition of the exchange rate as an explanatory variable, and a backward-looking specification of the reaction function. Table IV reports the GMM estimates when the US Dollar/Malawi Kwacha bilateral exchange rate is included as an explanatory variable.

Table IV GMM Estimates of the RBM Reaction Function (including the exchange rate)

Sample Period	B_1	B_2	B_3	ρ	***J-Statistic***	R^2
1989q1-2005q4	-1.96948	0.03206	-0.55149	0.501658	7.12098	0.73

	(0.0000)	(0.6727)	‘(0.0002)	(0.0000)	(0.8495)	
1989q1-1994q1	-1.56257 (0.0000)	0.21003 (0.0067)	-0.24291 (0.0000)	0.178542 (0.0009)	7.11302 (0.8500)	0.60
1994q2-2005q4	-0.82163 (0.0000)	-0.06772 (0.0632)	-0.27534 (0.0000)	0.33588 (0.0000)	7.9583 (0.78838)	0.67

Note: p-values for the coefficient estimates are in brackets. Full GMM results are reported in Appendix II, Tables D, E and F.

Addition of the exchange rate variable improves the fit of the model, with a one-quarter-ahead forecast of exchange rate movement bringing about significant changes in the other coefficients. In terms of expected versus actual signs of the coefficients, the results do not differ significantly from the baseline results. However, there is an improvement in the size of the inflation coefficient, while that of the output gap still remains either insignificant or incorrectly signed. The exchange rate itself is found to be a significant variable in explaining the behaviour of the RBM in the conduct of monetary policy.

Results from the estimation of a backward-looking policy reaction function (with lagged inflation, output gap, or exchange rate)-not reported here, generally do not improve the models. In fact in some cases, they worsen the fit of the model.

Although the bank rate is not the nominal anchor of monetary policy, we also estimated a Taylor-type reaction function for bank rate determination in Malawi to check whether interest rate setting was responsive to changes in economic fundamentals. For this exercise, we also estimated an equation of a form similar to equation (13), using the bank rate in place of the monetary base as the monetary policy instrument. Table V presents the results from the baseline estimates.

Table V GMM Baseline Estimates of the RBM Reaction Function-Bank Rate

Sample Period	***B_1***	***B_2***	ρ	***J-Statistic***	***R^2***
1989q1-2005q4	1.75224 (0.0000)	-0.19734 (0.0501)	0.95971 (0.0000)	7.90538 (0.5437)	0.92
1994q2-2005q4	1.10887 (0.0000)	-0.13708 (0.0672)	0.93303 (0.0000)	5.9443 (0.7455)	0.79

Note: p-values for the coefficient estimates are in brackets. Again, full GMM results are reported in Appendix II, Table G.

The results are largely qualitatively similar to the estimated reaction function for reserve money. Inflation is the key driver of the change in the bank rate. The coefficient of greater than 1 reveals that inflation considerations highly influence the RBM's decisions to change the bank rate than output considerations, with a 1 percent increase in expected inflation causing the RBM to adjust the bank rate by more than 1 percent. Note that the coefficient on the output gap has an incorrect sign. Another striking feature in the results is how highly autoregressive the bank rate is. ρ has a value of over 0.9 in both regressions, indicating deep policy inertia in the bank rate determination: less than 10 percent of the change in economic fundamentals is reflected in the change in the bank rate in the current period. However, interpretation of these results ought to be done with a lot of caution since, due to the infrequent adjustments of the bank rate, the series lacks adequate variability to enable the use of regression analysis. (This is one of the reasons why we were unable to obtain estimates for the 1989q1-1994q1 subsample).

CHAPTER SIX

6.0 CONCLUSION

Despite the current and growing literature on monetary policy reaction functions, little empirical work has been done on developing countries and specifically none on Malawi- at least to the knowledge of this author. However, there is no denying that monetary policy plays a crucial role in production, consumption and investment decisions of economic agents in an economy. Knowledge of the central bank's reaction function is therefore important for the agents to form appropriate expectations regarding the conduct of monetary policy.

In this paper, we estimated a forward-looking monetary policy reaction function for Malawi, using quarterly data between 1989 and 2005. The period was specifically chosen to study the behaviour of the central bank during and after financial reforms. Econometric results show that, over the period, price stabilization has taken an increasingly important role in the RBM's reaction function, particularly in the post-liberalization period which has been characterized by high and volatile inflation.

Results on the output gap are largely insignificant, with either small coefficient values or wrong signs. Raw interpretation of the positive sign on the output gap may imply that the RBM has been very accommodative of aggressive demand management policies that may result in inflationary pressures. However, a more analytical interpretation of this paradoxical result may point to the difficulties in defining and measuring the output gap that is relevant to the policy making environment in developing countries. Generally, measurement of the output gap has been one of the contentious issues in the analysis of monetary policy rules. All the empirical studies on monetary policy rules measure this as the gap between the actual output levels and the estimated potential output (y_t-y_n). Such a gap, adopted from the original Taylor rule, is intended to gauge the inflationary pressures in an economy, so that the further above the actual output is from the potential level, the higher is the probability of an "overheating" economy. However, this kind of output targeting is well placed for an advanced economy, with very high levels of production efficiencies. In a developing country like Malawi, where there are still so many economic and structural bottlenecks (like labour-market imperfections and low competition in some sectors), the level of potential output may be inefficiently low, and therefore not a good growth target for poverty reduction and sustainable development. Further, issues of political economy and the incentive for elected officials to expand beyond the potential still dominate the inflation stabilization goals of central banks. Central banks in developing countries are therefore more likely to have a role for stabilization policy that is absent in the standard formulations of policy reaction functions. The output gap that would likely be considered by policymakers would therefore be the one specified in equation (3). This is an important area of both theoretical and empirical research that has been highlighted in this paper, and one that can greatly contribute to the literature on policy reaction functions in developing countries if further explored.

Variations to the baseline specification included an addition of the exchange rate as an explanatory variable, use of lagged values of inflation, and use of the bank rate as a monetary policy instrument. The exchange rate variable was found to be highly significant and correctly signed. This seems to suggest that, apart from inflation and output considerations, the RBM also responds to exchange rate developments in its monetary policy conduct. This result also confirms the proposition by Ball (1999) and many other researchers that exchange rate may be an important factor in developing countries' monetary policy operations.

Results on the use of the bank rate as a monetary policy instrument show that though inflation has been factored in when setting the discount rate (again, the output gap is insignificant and wrongly signed), the RBM has largely concentrated adjustments to correct previous period disequilibrium, as reflected by a very large and highly significant coefficient on the lagged dependent variable. Caution has to be made, however, on the interpretation of these results. Since for the most part the interest rates were infrequently adjusted, this calls into question as to whether the bank rate has been variable enough to permit credible regression analysis.

6.1 Limitations of the study and direction for further research

Several issues have not been adequately addressed or considered in this paper. Firstly, the study has not attempted to test the stability and consistency of the model using alternative measures of the output gap (e.g. the adjusted Phillips-Curve-based measurement). A number of studies have found that estimates of the monetary policy reaction function may be significantly sensitive to the different measures of the output gap.

Secondly, the unavailability of quarterly data for GDP required interpolation of the annual GDP into quarterly series, a technique that may bring smoothness in the series and thus conceal the true behaviour of the variable. Further, whereas use of monthly data would have allowed more randomness, and therefore a better platform for getting more robust results, the same problem would have been encountered for output data, as further interpolation would have brought in more "noise" in the data.

7. REFERENCES

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APPENDIX I

The Hodrick-Prescott (HP) Filter

The HP filter, due to Hodrick and Prescott (1997), is a smoothing technique that is widely used among macroeconomists to obtain a smooth estimate of the long-run trend component of a series. The technique is used to decompose a series into a trend and a stationary component.

Technically, the HP filter is a two-sided linear filter that computes the smoothed series *s* of a given variable *y* by minimizing the variance of the variable around the series, subject to a penalty that constrains the second difference of *s*. Thus the objective is to select the trend component that minimizes the sum of the squared deviations from the observed series, subject to the constraint that changes in s_t vary gradually over time. In the case of the output variable, suppose we observe the values of real GDP, y_t, and want to decompose the series into a trend (s_t) and stationary component (y_t-s_t). The HP filter employs an adjustment rule whereby the trend component moves continuously and adjusts gradually. Formally, the (unobserved) trend component is minimized by solving the following minimization problem:

$$\sum_{t=1}^{T}\left(y_t - s_t\right)^2 + \lambda\sum_{t=2}^{T-1}\left[\left(s_{t+1} - s_t\right) - \left(y_t - s_{t-1}\right)\right]^2 \quad \text{……………………………………………..(A1)}$$

The Lagrange Multiplier λ is an arbitrary constant (positive number) that reflects the "cost" or penalty of incorporating fluctuations into the trend, thus controlling the smoothness of the series. The larger the value of λ, the smoother is the resulting trend series; if λ=0, the sum of squares is minimized when $(s_{t+1}-s_t)= (s_t-s_{t-1})$, but as $\lambda\rightarrow\infty$, the change in the trend is constant so that *s* approaches a linear trend. In many applications, λ is set to 100 for annual data, 1600 for quarterly data, and 14,400 for monthly data.

APPENDIX II

A. Baseline estimates for the full sample period (1989q1-2005q4)

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample (adjusted): 1989Q1 2004Q4
Included observations: 64 after adjustments

$$BMONEYR_t = (1-\rho)a + (1-\rho)B_1 INF_4 + (1-\rho)B_2(GAP1 + \rho\Delta BMONEYR_{-1} + \varepsilon_t$$

Instrument list: BMONEYR(-1 TO -4) INF(-1 TO -4) GAPR(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.91357	6.556285	2.732274	0.0083
INF(4)	-0.431032	0.218156	-1.975799	0.0528
GAP(1)	-0.061454	0.082321	-0.746520	0.4583
BMONEYR(-1)	0.621876	0.077908	7.982211	0.0000

R-squared	0.649300	Mean dependent var	29.21236
Adjusted R-squared	0.574095	S.D. dependent var	30.73006
S.E. of regression	24.31184	Sum squared resid	35463.92
Durbin-Watson stat	1.692904	J-statistic	0.131691

B. Baseline estimates for the liberalization period (1989q1-1994q1)

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample: 1989Q1 1994Q1
Included observations: 21
Instrument list: C BMONEYR(-1 TO -4) INF(-1 TO -4) GAPH(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.18007	5.783960	-3.316080	0.0041
INF(1)	1.470046	0.253634	5.795939	0.0000
GAP(1)	0.159311	0.038617	4.125437	0.0007
BMONEYR(-1)	0.713042	0.036349	19.61647	0.0000

R-squared	0.494879	Mean dependent var	18.59063
Adjusted R-squared	0.405740	S.D. dependent var	30.05792
S.E. of regression	23.17113	Sum squared resid	9127.319
Durbin-Watson stat	1.716558	J-statistic	0.253555

C. Baseline estimates for the post-liberalization period (1994q2-2005q4)

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample (adjusted): 1994Q2 2005Q3
Included observations: 46 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening
Instrument list: C BMONEYR(-1 TO -4) INF(-1 TO -4) GAPH(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.384021	4.390567	1.681792	0.1000
INF(1)	-0.617395	0.121060	-5.099921	0.0000
GAP	0.219779	0.140756	1.561413	0.1259
BMONEYR(-1)	0.551867	0.085935	6.421941	0.0000

R-squared	0.446602	Mean dependent var	33.44200
Adjusted R-squared	0.407074	S.D. dependent var	29.41830
S.E. of regression	22.65258	Sum squared resid	21551.86
Durbin-Watson stat	1.776006	J-statistic	0.138887

D. Full sample GMM estimates with exchange rate as an explanatory variable

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample: 1989Q1 2005Q1
Included observations: 65
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening
Instrument list: C INF(-1 TO -4) GAPR(-1 TO -4) EXRR(-1 TO -4)
BMONEYR(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.900795	5.106907	0.763827	0.4480
INF(1)	-0.981472	0.172064	-5.704115	0.0000
GAP(1)	0.015976	0.032724	0.488208	0.6272
EXRR(1)	-0.274830	0.068021	-4.040371	0.0002
BMONEYR(-1)	0.501658	0.092082	5.447957	0.0000

R-squared	0.728426	Mean dependent var	29.29088
Adjusted R-squared	0.656987	S.D. dependent var	30.49561
S.E. of regression	21.62852	Sum squared resid	28067.57
Durbin-Watson stat	1.538474	J-statistic	0.109554

E. Estimates for the liberalization period with exchange rate as an explanatory variable

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample: 1989Q1 1994Q1
Included observations: 21
Kernel: Bartlett, Bandwidth: Fixed (2), No prewhitening
Instrument list: C INF(-1 TO -4) GAPR(-1 TO -4) EXRR(-1 TO -4)
BMONEYR(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.996335	0.822990	-9.716205	0.0000
INF(4)	-1.283583	0.068804	-18.65559	0.0000
GAP(1)	0.172527	0.012541	13.75668	0.0000
EXRR(1)	-0.199538	0.055082	-3.622581	0.0023
BMONEYR(-1)	0.178542	0.044046	4.053537	0.0009

R-squared	0.595632	Mean dependent var	18.59063
Adjusted R-squared	0.494540	S.D. dependent var	30.05792
S.E. of regression	21.36990	Sum squared resid	7306.759
Durbin-Watson stat	1.851997	J-statistic	0.338715

F. Estimates for the post-liberalization period with exchange rate as an explanatory variable

Dependent Variable: BMONEYR
Method: Generalized Method of Moments
Sample (adjusted): 1994Q2 2005Q3
Included observations: 46 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening
Instrument list: C INF(-1 TO -4) GAPR(-1 TO -4) EXRR(-1 TO -4)
BMONEYR(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.84673	2.079792	6.176931	0.0000
INF(1)	-0.564191	0.061984	-9.102245	0.0000
GAP(1)	-0.046500	0.024347	-1.909903	0.0632
EXRR(1)	-0.189045	0.027833	-6.792100	0.0000
BMONEYR(-1)	0.313423	0.041736	7.509653	0.0000

R-squared	0.673783	Mean dependent var	33.44200
Adjusted R-squared	0.632201	S.D. dependent var	29.41830
S.E. of regression	20.12090	Sum squared resid	16598.87
Durbin-Watson stat	1.771610	J-statistic	0.173007

G. Baseline estimates for the Full Sample-Bank rate

Dependent Variable: BR
Method: Generalized Method of Moments
Sample (adjusted): 1989Q1 2005Q3
Included observations: 67 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening
Instrument list: C INF(-1 TO -4) GAPR(-1 TO -4) BR(-1 TO -4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.027758	0.339828	0.081681	0.9352
INF(1)	0.070596	0.014715	4.797571	0.0000
GAP(1)	-0.007951	0.003981	-1.997335	0.0501
BR(-1)	0.959711	0.017372	55.24453	0.0000

R-squared	0.917953	Mean dependent var	31.49836
Adjusted R-squared	0.914046	S.D. dependent var	13.63923
S.E. of regression	3.998725	Sum squared resid	1007.358
Durbin-Watson stat	2.028286	J-statistic	0.117991