Dynamic Effects of Monetary Policy Shocks in Malawi

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Abstract

This paper sets out to investigate the process through which monetary policy affects economic activity in Malawi. Using innovation accounting in a structural vector autoregressive model, it is established that monetary authorities in Malawi employ hybrid operating procedures and pursue both price stability and high growth and employment objectives. Two operating targets of monetary policy are identified, viz., bank rate and reserve money, and it is demonstrated that the former is a more effective measure of monetary policy than the latter. The study also illustrates that bank lending, exchange rates and aggregate money supply contain important additional information in the transmission process of monetary policy shocks in Malawi. Furthermore, it is shown that the floatation of the Malawi Kwacha in February 1994 had considerable effects on the country's monetary transmission process. In the post-1994 period, the role of exchange rates became more conspicuous than before although its impact was weakened; and the importance of aggregate money supply and bank lending in transmitting monetary policy impulses was enhanced. Overall, the monetary transmission process evolved from a weak, blurred process to a somewhat strong, less ambiguous mechanism.

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1 Introduction

While it is generally agreed that monetary policy can affect economic activity and prices significantly in the short run and only prices in the long run, considerable debate remains about how monetary policy shocks are transmitted. Views differ with regard to the emphasis placed on money, credit, interest rates, exchange rates, asset prices and the role of commercial banks and other financial institutions (Taylor, 1995). The differences are prevalent even in industrialised countries where the topic has been a subject of research for many years (Kamin, Turner and Van't dack, 1998); and in low-income countries such as Malawi, the process is even more uncertain (see Montiel, 1991).

In Malawi, monetary policy plays a prominent role in the management of the country's economy. The Reserve Bank of Malawi (RBM) Act of 1989 outlines the principal objective of the country's central bank as "to implement measures designed to influence the money supply and the availability of credit, interest rates and exchange rates with the view to promoting economic growth, employment (and) stability in prices" (GoM, 1989, pp. 5). Achieving this objective clearly requires an understanding of the process through which monetary policy affects economic activity. There is, however, no study that the authors are aware of that has measured the country's monetary transmission process quantitatively. This paper contributes to the literature by filling this gap. The paper isolates autonomous monetary policy disturbances from other shocks, quantifies their dynamic behaviour and measures the consequent macroeconomic implications in the Malawian economy using a

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structural vector autoregressive model (SVAR) with short-run restrictions. Within the same framework, the study also assesses how the country's monetary transmission process was altered by the RBM's migration from direct to indirect tools of monetary control in the late 1980s and the 1990s.

Since Sims' (1980) pioneering work, VARs and SVARs are considered benchmarks in econometric modelling of monetary policy transmission (Borys and Hovarth, 2007). Among the few studies undertaken on low-income countries, Mutoti (2006) employed a cointegrated SVAR to model the monetary transmission process of post-liberalisation Zambia; Maturu (2007) used an SVAR to argue that interest rate and exchange rate channels are unambiguously important channels of monetary policy transmission in Kenya; and Cheng (2006) also used an SVAR to examine the impact of monetary policy shocks on output, prices and the nominal effective exchange rate for Kenya during the period 1977-2005.

In the case of Malawi, there are two theoretical studies, one by Bolnick (1991) and another by Phiri (2002), and no empirical analysis on the country's monetary transmission process. The Bolnick (1991) study was carried out at the time the RBM was converting from direct to indirect tools of monetary management. The study investigated how the changing conditions would weaken or alter links in the country's monetary transmission process. Unfortunately, Bolnick was unable to predict the emergence of a reasonably competitive financial sector within the foreseeable future and consequently concluded erroneously that after the RBM's implementation of indirect monetary controls, the transmission of monetary policy shocks in Malawi would be stage-managed by the central bank through informal consultations with commercial bank managers. Phiri's (2002) study, on the other hand, does not go beyond a theoretical exposition of textbook transmission channels of monetary policy, which it incorrectly relates to Malawi. For instance, he presents the other asset price effects channel operating through an efficient stock market as one of Malawi's monetary transmission channels. However, with only eight listed companies at the time of the study, it is clear that the Malawi Stock Exchange (MSE) was still in its infancy to act as a conduit of monetary transmission. As at January 2010, the MSE had 15 listed companies and was still classified as an infant industry.

Following this introduction, the rest of the paper is organised as follows: Section 2 is an overview of monetary policy in Malawi since independence in 1964. A methodological framework characterising SVARs, identification of the structural shocks, data sources, variable definitions and measurement of variables is presented in Section 3. Estimation results and inferences are discussed in Section 4. Section 5 presents a summary and conclusions.

2 Overview of Monetary Policy in Malawi since 1964

Monetary policy in Malawi since independence can be outlined in three broadly distinct monetary policy regimes. This includes a period of financial repression (1964-86), a period of financial reforms (1987-1994) and a period of financial liberalisation (post-1994). At independence in 1964, the formal banking system which the country adopted from the colonial government was perceived to be primarily interested in serving the needs of an expatriate community, to have little interest in direct lending to local entrepreneurs, and to be imposing unreasonably high charges on routine banking services (Gondwe, 2001). To get rid of these distortions, direct controls on credit and interest rates were imposed. The agricultural sector, in particular, was accorded preferential lending rates and quota credit allocations in line with the government's policy of promoting agricultural production. Besides these controls, the government also adopted a fixed exchange rate system and imposed price ceilings on selected commodities.

In the late 1970s, a hostile external environment forced the Malawian economy into a deep recession, which persisted through the 1980s. Intensification of civil war in neighbouring Mozambique, the subsequent flooding of refugees into the country and disruption of a cost-effective rail route to the Mozambican sea ports of Beira and Nacala, the oil crisis in 1979, and drought in 1980, were some of the factors that triggered the recession. Failure of the economy to adjust to these shocks exposed structural weaknesses in the design of the country's macroeconomic framework. The government was forced, therefore, to adjust their policy from the mid 1980s, moving away from direct to indirect tools of monetary control, among others. A phased financial liberalisation program targeted at enhancing competition and efficiency in the financial sector was adopted.

The reforms commenced with partial deregulation of lending rates in July 1987 and deposit rates in April 1988. The partial deregulation allowed commercial banks to determine their own lending and deposit rates but not to effect any adjustment without prior consultation with the central bank. Credit ceilings were abolished in 1988. In January 1990, the authorities announced the abolition of preferential lending rates to the agricultural sector. Complete deregulation of interest rates was effected in May 1990.

The reform program also overhauled the legal and regulatory framework of the banking system, which involved revision of the RBM Act of 1964 and Banking Act of 1965 in May and December 1989, respectively. While the central bank previously supervised commercial banks only, the revised Banking Act extended its coverage to include non-bank financial institutions (NBFIs), a function that was previously in the hands of the Treasury. In addition, inspection of financial institutions was broadened to include monitoring of adherence to prudential requirements besides compliance to exchange control regulations.

In line with the revised RBM Act, the central bank introduced two new instruments of monetary policy, namely liquidity reserve requirement (LRR) and a discount window facility. The discount window facility led to the introduction of the bank rate, which has since become a very powerful indicator of the stance of monetary policy. A change in the bank rate is usually followed by near instantaneous corresponding changes in both lending and deposit rates. Average yields on government securities also follow the same direction.

The country's financial reforms reached near-completion with the floatation of the Malawian Kwacha on February 7, 1994. Thereafter, the monetary authorities removed exchange control regulations, allowed for the establishment of foreign exchange bureaux, introduced foreign currency denominated accounts, established a forward foreign exchange market and started the trading of foreign exchange options and currency swaps. Ten new commercial banks (one of which has since been liquidated) entered the commercial banking sector between 1994 and January 2010, changing the structure of the market from a duopoly to a fairly competitive sector. The country's first discount house started operations in 1998, followed by a second one in 2002.

The official position of the RBM is that monetary policy in the country utilises a quantitative operating target, reserve money, for monetary policy (Banda, 2004). The rationale for reserve money targeting by the central bank is to balance supply and demand conditions of the monetary aggregate in the money market so as to achieve price stability (Banda, 2004). While the country's monetary policy framework is officially designated as reserve money targeting, the system operates as if the central bank also targets short-term interest rates through adjustments in the bank rate. To avoid prejudgement, this study assumes the central bank targets both the bank rate and reserve money, and goes on to determine empirically if it is correct that the country employs hybrid operating procedures.

3 Methodology

3.1 *SVAR Framework*

Suppose Malawi's monetary transmission process is described by a dynamic system whose structural form equation is given by:

$$Ay_t = \Omega + \Phi_1 y_{t-1} + \Phi_{2y} y_{t-2} + \cdots + \Phi_p y_{t-p} + B\mu_t \qquad (1)$$

where A is an invertible matrix (n x n) describing contemporaneous relations among the variables; y_t is an (n x 1) vector of endogenous variables such that $y_t = (y_{1t}, y_{2t}, ...y_{nt})$; Ω is a vector of constants; Φ_i is an (n x n) matrix of coefficients of lagged endogenous variables ($\Phi_i = 1, 2, 3, ..., p$); B is an (n x n) matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and μ_t are uncorrelated or orthogonal white-noise structural disturbances

The SVAR presented in the primitive system of equations (1) cannot be estimated directly due to the feedback inherent in a VAR process (Enders, 2004). Nonetheless, the information in the system can be recovered by estimating a reduced-form VAR implicit in the two equations. Pre-multiplying equation (1) by A^{-1} yields a reduced-form VAR of order p, which in standard matrix form is written as:

$$y_t = \Psi_0 + \sum\nolimits_{i=1}^{p} \Psi_i y_{t-i} + \varepsilon_t \tag{2}$$

where $\Psi_0 = A^{-1}\Omega$; $\Psi_i = A^{-1}\Phi_i$; and $\varepsilon_t = A^{-1}B\mu_t$ is an (n x 1) vector of error terms assumed to have zero means, constant variances and to be serially uncorrelated with all the right-hand-side variables as well as their own lagged values, though they may be contemporaneously correlated across equations. Given the estimates of the reduced-form VAR in equation (2), the structural economic shocks are separated from the estimated reduced-form residuals by imposing restrictions on the parameters of matrices$A$ and B in equation (3):

$$A\varepsilon_t = B\mu_t \tag{3}$$

which derives from equation (2). The orthogonality assumption of the structural innovations i.e. $E(\mu_t, \mu_t^{'})$ =1, and the constant variance-covariance matrix of the reduced-form equation residuals i.e. $\sum = E(\varepsilon_t, \varepsilon_t^{'})$ impose identifying restrictions on A and B as presented in equation (4):

$$A \sum A^{'} = BB^{'} \tag{4}$$

Since matrices A and B are both (n x n), a total of $2n^2$ unknown elements can be identified upon which $n(n+1)/2$ restrictions are imposed by equation (4). To identify A and B, therefore, at least $2n^2 - n(n+1)/2$ or $n(3n-1)/n$ additional restrictions are required. These restrictions can be imposed in a number of ways. One approach is to use Sims' (1980) recursive factorisation based on Cholesky decomposition of matrix A. The implication of this relationship is that identification of the structural shocks is dependent on the ordering of variables, with the most endogenous variable ordered last (Favero, 2001). In this framework, the system is just (exactly) identified.

While there are many models that are consistent with the recursiveness assumption, the approach is nonetheless controversial (Christiano et al., 1998). The assumptions rationalising the ordering of variables are often different in different studies using the same variables, and since estimation results in a VAR identified by Cholesky factorisation differ with ordering of variables, these studies tend to be incomparable. Changing the order changes the VAR equations, coefficients and residuals, and there are $n!$ recursive VARs, representing all possible orderings (Stock and Watson, 2001). The validity of Cholesky factorisation is also questioned in cases where a simultaneity problem among monetary or macroeconomic variables exists. Following the apparent shortfalls in the approach, many authors have adopted alternative approaches to the identification of structural shocks (see, for example Sims and Zha, 2006; Bernanke and Mihov, 1998; Leeper, Sims and Zha, 1996; Sims, 1986; Bernanke, 1986).

More recent literature has used structural factorisation, an approach which uses relevant economic theory to impose restrictions on the elements of matrices A and B (Sims and Zha, 2006; Bernanke and Mihov, 1998; Sims, 1986; Bernanke, 1986). This study adopts a similar approach. The underlying structural model is identified by assuming orthogonality of the structural disturbances, μ_t; imposing that macroeconomic variables do not contemporaneously react to monetary variables, while the contemporaneous feedback in the reverse direction is allowed for; and imposing restrictions on the monetary block of the model reflecting the operational procedures implemented by the monetary policy-maker (Favero, 2001, p.166).

Seven variables are included in our SVAR namely, output (GY_t), consumer price level (CP_t), commercial bank loans (BL_t), exchange rates (XR_t), aggregate money supply ($M2_t$), bank rate (BR_t) and reserve money (RM_t). Output and consumer prices enter the SVAR as policy goals; bank rate and reserve money as operating targets; and commercial bank lending, exchange rates and monetary aggregates as intermediate targets of monetary policy. The structural shocks in equation (3) are identified according to the following scheme:

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} & a_{36} & a_{37} \\ a_{41} & a_{42} & 0 & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & 0 & 0 & 1 & a_{56} & 0 \\ 0 & 0 & 0 & a_{64} & 0 & 1 & 0 \\ 0 & 0 & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{pmatrix} \qquad \varepsilon_t = \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{BL} \\ \varepsilon_t^{XR} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix} \tag{5}$$

The first two equations suggest that output and consumer prices are sluggish in responding to shocks to monetary variables in the economy. This scheme is based on the observation that most types of real economic activity may respond only with a lag to monetary variables because of inherent inertia and planning delays (Bernanke and Mihov, 1997; Karame and Olmedo, 2002; Becklemans, 2005; Vonnak, 2005; Cheng, 2006).

Commercial bank lending is postulated to be contemporaneously affected by all variables in the system. Blundell-Wignall and Gizycki (1992) argue that expectations of future activity form an important determinant of credit demand. Assuming current output, price level, exchange rates, interest rates, and money supply give some indication of what is expected in the future (Becklemans, 2005) and because economic agents are indeed forward looking, bank lending may respond contemporaneously to all variables in the system.

Modelling contemporaneous responses of exchange rates to other variables in an SVAR is relatively standard across studies. Since the exchange rate is a forward-looking asset price, most studies assume that all variables have contemporaneous effects on the exchange rate (Kim and Roubini, 2000). Becklemans (2005) uses a real trade-weighted exchange rate index in a study of Australia and assumes that the index responds instantaneously to all variables in the system. In a study of Kenya, Cheng (2006) employs a nominal effective exchange rate and maintains that the exchange rate responds contemporaneously to all variables in the SVAR. Similarly, Borys and Hovarth (2007) in a study of the Czech Republic and Piffanelli (2001) in a study of Germany assume all variables in the system affect exchange rates instantaneously.

In Malawi, however, the instantaneous response of exchange rates to all macroeconomic variables cannot be justified. The financial sector in the country lacks depth and is weakly integrated into global markets. It is safe, therefore, to assume that information delays will be prevalent, forcing players in the foreign exchange market to respond with a lag to changes in interest rates, bank lending and monetary aggregates. This study, therefore, departs from the previous studies and postulates that exchange rates respond contemporaneously to changes in the level of output and consumer prices only and with a lag to movements in interest rates, bank lending and monetary aggregates.

Given the large dimensionality of the problem, the study avoids the temptation to add more variables to the SVAR to capture external factors. The complete SVAR analysed in this study has seven variables, which is already large by SVAR standards and increasing the number of variables without proper justification would only decrease the power of the model without making meaningful additions to the output. The study maintains, nonetheless, that exchange rates, besides being an asset price, should also account for movements in external factors such as oil prices and interest rates on the international market. Accordingly, the study does not expect a loss of information on developments in the external sector.

The fifth equation is a standard money demand function. The equation postulates that demand for money in the country makes aggregate money supply respond contemporaneously to changes in consumer prices, output and interest rates but not to changes to other variables in the system, akin to Sims and Zha (1998). The last two equations constitute the monetary policy feedback rule, which draws on the assumption that the country employs hybrid operating procedures, with the bank rate and reserve money as operating targets of monetary policy. In this framework, both interest rates and reserves are expected to contain information about monetary policy (Bernanke and Mihov, 1997). The country's effective operating target, accordingly, is determined empirically.

The monetary policy feedback rule is drawn on the assumption that information delays impede policymakers' ability to react immediately to economic activity and price level developments (Karame and Olmedo, 2002). Both the bank rate and reserve money, therefore, do not respond immediately to output and consumer prices. The bank rate, specifically, responds contemporaneously to changes in the exchange rates only. While exchange rate data is available real-time, data on other variables including bank lending and monetary aggregates is usually available to the monetary authorities with a lag. Reserve money, on the other hand, is assumed to respond contemporaneously to all monetary variables because by its definition, this information is inherent in the monetary aggregate.

3.2 *Analysis*

Analysis of the SVAR is carried out in three modular experiments. First, a generic model comprising the country's monetary policy goals and operating targets is estimated. Output and price level enter the model as policy goals while bank rate and reserve money go in as operating targets. The rationale for estimating the generic model is to establish how the two monetary policy goals respond to each of the operating targets and to find out if monetary authorities react to changes in the policy goals. In addition, the estimated generic model is used to identify which of the two monetary policy operating targets has a greater impact on the policy goals.

At the second level of analysis, bank lending, exchange rates and M2, representing three different transmission processes, are separately appended to the generic model and estimated. Following Disyatat and Vongsinsirikul (2003) and Morsink and Bayoumi (2001), two sets of impulse responses are calculated in each case: one with the variable of interest endogenised and the other with the variable exogenised. The latter procedure generates an SVAR identical to the former, except that it blocks off any responses within the SVAR that pass through the variable of interest (Disyatat and Vongsinsirikul, 2003). The two sets of impulse responses are later compared. The size of the difference in the impulse responses is an indicator of the level of information contained in the variable of interest associated with a particular transmission channel. Large differences denote more information in the variable of interest and suggest greater importance of the related transmission channel.

At the third and final level of analysis, all variables found to hold important information in the country's monetary transmission process are pooled and a composite SVAR is estimated. A general identification scheme based on short-run restrictions developed in system of equations (5) is used for identifying structural shocks in each of the models.

3.3 *Data, Data Sources and Measurement of Variables*

The study employs monthly time series data for the period 1988:1 to 2005:12. The starting date has been chosen to capture the period when monetary authorities in Malawi migrated from using direct measures of monetary control to using indirect measures. Major sources of data include the

RBM, the National Statistical Office (NSO) of Malawi, the Malawi Meteorological Department and the University of Malawi.

Bank rate (BR_t) is defined as the rate at which the central bank provides short-term loans to commercial banks and discount houses in its function as a lender of last resort. The variable enters the SVAR as an instrument target of monetary policy. Reserve money (RM_t) is also employed as an instrument target of monetary policy in the SVAR. Components of RM_t are identified as total cash reserves held by the central bank, vault cash in commercial banks and currency held by the non-bank public. The variable BL_t captures commercial bank lending and advances and it enters the SVAR as an intermediate target of monetary policy. Similarly, exchange rate (XR_t) enters the SVAR as an intermediate target of monetary policy. Middle nominal exchange rates of the Malawian Kwacha vis-à-vis the United States Dollar (USD) are used as a proxy for XR_t. Aggregate money supply (M2) is measured by the sum of currency in circulation, demand deposits and time deposits. The variable also enters the SVAR as an intermediate target of monetary policy.

Consumer prices (CP_t) are measured by the all items national composite consumer price index with base year 2000. The variable enters the SVAR as a monetary policy goal. A measure of output (GY_t) enters the SVAR as a monetary policy goal as well. GDP data (used as a proxy for GY_t) for Malawi is, however, only available in annual frequency. This presents a case for interpolation. Several studies have used interpolated monthly GDP series in SVARs (see, for example, Cheng, 2006; Borys and Hovarth, 2007). This study employs the Friedman method of interpolating time series by related series to compute the required monthly GDP series from annual data.

The Friedman method of interpolating time series by related series employs log-linear interpolations of a vector of variables X_t, which are available in both annual and monthly frequency, that explain the variable of interest Y_t, to compute actual errors in the trend interpolation for the elements of X_t. These errors are then used to adjust the linear trend interpolation for Y_t by the weighted individual error in trend interpolation for each regressor, where the weights are given by the respective coefficients on the X_{jt} variable in the annual regression of X_t on Y_t (see Friedman, 1962).

All variables, with the exception of interest rates, are expressed in natural logarithms. They are also seasonally adjusted using TRAMO (Time Series Regression with Autoregressive Moving Average (ARIMA) Noise, Missing Observations, and Outliers) and SEATS (Signal Extraction in ARIMA Time Series) with a forecast horizon of 12 months. The variables are further subjected to a test for stationarity, which reveals that they are all I(1). The study, however, proceeds with estimation of the SVAR in levels consistent with standard practice anchored on the canonical paper of Sims, Stock and Watson (1990). The Sims et al. (1990) paper demonstrates in part that the common practice of attempting to transform models to stationary form by difference or cointegration operators whenever it appears likely that the data are integrated is unnecessary because statistics of interest often have distributions that are unaffected by nonstationarity, which suggests that hypotheses can be tested without first transforming to stationary regressors.

The findings of Sims et al. (1990) have been generally accepted and widely adopted in the SVAR literature. Some studies that have adopted the approach include Bernanke and Mihov (1996), Piffanelli (2001), Dungey and Pagan (2000), Kim (1999), Brichetto and Voss (1999), Bernanke and Mihov (1998), Ramaswamy and Sloek (1998), and Sims (1992), among many others. The preference of SVARs in levels, according to Kim and Roubini (2000) and Becklelmans (2005), can be explained, at least in part, by a reluctance to impose possibly incorrect restrictions on the model. Kim and Roubini (2000) stress that if false restrictions are imposed, the resulting inferences will be incorrect as well. In addition, Bernanke and Mihov (1996) point out that the levels specification yields consistent estimates whether cointegration exists or not, whereas a differences specification is inconsistent if some variables are cointegrated.

4 Estimates and Inferences

4.1 *Generic Model*

Investigation of the monetary transmission process commences with a simple four-variable generic model. The vector of endogenous variables included in the model is presented as:

$$y_t^{'} = [GY_t, CP_t, BR_t, RM_t] \tag{6}$$

Following the identification scheme in system of equations (5), the equation separating structural economic shocks from the estimated reduced-form residuals for the generic model is presented as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & a_{43} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{pmatrix} \begin{pmatrix} \mu_t^{GY} \\ \mu_t^{CP} \\ \mu_t^{BR} \\ \mu_t^{RM} \end{pmatrix} \tag{7}$$

Selection of the optimal lag length is guided by established criteria (Akaike, Hannan-Quinn and Schwartz Information Criteria), which suggest a lag length of two (this approach is applied in all subsequent models). At the chosen lag length (of order two), all eight inverse roots of the characteristic autoregressive (AR) polynomial have modulus less than one and lie inside the unit circle, indicating that the estimated VAR is stationary or stable. A VAR lag exclusion Wald test further reveals that all endogenous variables in the model are jointly significant at each of the lag lengths for all equations collectively. Separately, at lag length of order one, all the endogenous variables are jointly significant in all equations, while at lag length of order two, the endogenous variables are jointly significant in all equations except in the consumer price equation.

Before making inferences on the structural shocks in the model, the study analyses correlations between movements in the bank rate and reserve money and their corresponding recovered structural shocks to ascertain if the monetary policy shocks are reasonable. It is observed that there is some correlation in the movements of the recovered bank rate and reserve money structural innovations, on the one hand, and the month-on-month growth rates of the bank rate and reserve money, respectively, on the other (plots not presented here but available on request). The correlations are, however, more pronounced between the bank rate and its recovered structural shocks compared to reserve money and its recovered structural shocks. Reliability of the structural shocks is also ascertained by assessing the efficiency of the structural coefficients estimated in the SVAR. All structural estimates of the coefficients in matrices A and B of the generic model show up with standard errors that are less than one, implying that the coefficients are efficient.

Next the study analyses the response of the central bank to shocks in the policy goals. Figure 1 presents impulse responses of the bank rate and reserve money to structural one standard deviation innovations in output and consumer prices over a five-year horizon. Impulse responses of output and consumer prices to own shocks are also presented in the same figure. The time scale measured on the primary horizontal axis is in months and the dashed lines represent analytic confidence intervals obtained from variance-covariance matrices after the final iteration. Both an output shock corresponding to an unanticipated 11 percent increase in output and a supply shock equivalent to an unexpected 2.2 percent rise in consumer prices trigger significant responses by the central bank, illustrating that monetary authorities in Malawi are concerned with both inflation and economic growth in line with the RBM Act of 1989. The bank responds to the output shock by loosening monetary policy through a decrease in the bank rate to buoy the output growth further. In response to the supply shock, monetary policy is tightened by raising the bank rate to arrest the increase in the consumer prices. The central bank's response with regard to reserve money, however, is surprising. Following the sudden increase in output, reserve money declines while the unexpected rise in consumer prices triggers an increase in reserve money.

Economic theory posits that an increase in output is associated with a corresponding increase in income, aggregate demand, and money supply. However, the monetary authorities may have been reducing reserve money (following an economic expansion) to keep money supply and hence inflation under control. The theory also suggests that monetary authorities normally respond to an increase in consumer prices with contractionary monetary policy. In the case of Malawi, however, the monetary authorities may have been increasing money supply following higher consumer prices as a way of validating the condition.

To analyse how monetary policy goals are affected by shocks to the operating targets, impulse responses of output and consumer prices to structural one standard deviation shocks in the bank rate and reserve money are plotted. Figure 2 reveals that a monetary policy shock corresponding to an unanticipated increase in the bank rate of about 2.2 percent leads to a decline in output, which bottoms out after 5 months at 1.4 percent below baseline. The price level, however, responds to monetary tightening by increasing, although insignificantly, which is maintained even after five years. This finding, referred to as the "price puzzle", is common in the literature. Some of the studies that have reported this finding include Weitong (2007), Kugler, Jordan, Lenz and Savios (2004), Disyatat and Vongsinsirikul (2003), Piffanelli (2001), Mihira and Sugihara (2000), Clarida and Gertler (1996), Bernanke and Mihov (1997) and Sims (1992).

Several explanations to the price puzzle have been suggested. Disyatat and Vongsinsirikul (2003) argue that failure to include a rich enough specification of the information available to policy makers is what causes the puzzle to show up. They maintain that if policy makers are able to observe variables that contain useful information about future prices, but those variables are left out of the model, a monetary tightening may be associated with higher prices because they partly reflect systematic policy responses to information indicating that inflation is on the way. Empirical evidence, however, does not support the Disyatat and Vongsinsirikul (2003) hypothesis. In a study of this phenomenon in Germany, Sims (1992) added a number of variables, including commodity prices and exchange rates in his system of equations to control for unanticipated future inflation after he had encountered the price puzzle. However, the perverse price response persisted. Piffanelli (2001) argues that the price puzzle may occur if an incorrect operating target is used in the analysis. In her study of Germany, Piffanelli (2001) showed that the price puzzle appears when the call rate is used and it disappears when the Lombard rate is used. A similar finding is reported by Bernanke and Mihov (1997).

Figure 2 also shows that an expansionary monetary shock equivalent to a sudden 7.6 percent increase in reserve money causes an increase in output, peaking at 1.4 percent above baseline after 15 months. The price puzzle persists even with reserve money as an operating target. Consumer prices respond to the unexpected increase in reserve money with an increase which peaks at 0.4 percent above baseline after 10 months.

Overall, shocks to either of the monetary policy operating targets attract significant output responses and insignificant consumer price responses, suggesting that monetary factors may not be primary determinants of inflation in Malawi. This finding is supported by the preponderant weight of food costs (58.1 percent) in the representative basket of commodities used for measuring national consumer price indices, which indicates that structural rigidities in food production may be a more important cause of inflation than monetary variables. To determine the relative importance of each structural innovation in explaining fluctuations of the variables in the generic model, Table 1 presents variance decompositions for each variable in the model over a five-year forecast horizon. Given the two policy goals, fluctuations in both the bank rate and reserve money are dominated by a shock in consumer prices, reflecting that the principal objective of monetary policy in the country is price stability. While shocks to consumer prices account for 13.1 percent of the bank rate fluctuations after 6 months, 18.6 percent after a year and 21.9 percent after 2 years, output shocks account for 8.2 percent of the bank rate fluctuations after 6 months, 14.7 percent after a year and 17.4 percent after 2 years. Shocks to consumer prices also account for 3.4 percent of the reserve money fluctuations after 6 months, 10.7 percent after a year and 25.5 percent after 2 years while shocks to output account for 4.8 percent of the reserve money fluctuations after 6 months, 9.8 percent after a year and 16.3 percent after two years.

Table 1 also reveals that the difference in the proportion of fluctuations in output attributed separately to the bank rate and reserve money is not pronounced. The bank rate, however, accounts for a notably larger proportion of the fluctuations in consumer prices than reserve money. On the whole, the preliminary indication is that the bank rate is a more effective tool of monetary policy than reserve money. While bank rate shocks account for 4.8 percent of the fluctuations in output after 6 months, 7.8 percent after a year, 5.8 percent after 2 years and 6 percent after five years, reserve money shocks account for 0.6 percent of the output fluctuations after 6 months, 3.5 percent after a year, 8 percent after 2 years and 4.1 percent after 5 years. This shows that interest rate shocks account for a larger proportion of the fluctuations in output up to a year and, thereafter, reserve money shocks are responsible for most of the variations in output. Reserve money shocks account for only 0.9 percent of the fluctuations in consumer prices after 6 months, 1.1 percent after two years and 0.5 percent after 4 years, while bank rate shocks account for 0.7 percent of the fluctuations in consumer prices after 6 months, 3.7 percent after 2 years and 7.7 percent after 4 years, illustrating that the bank rate accounts for most of the consumer price variations given the two operating targets.

4.2 *Channels of Monetary Transmission*

In order to unfold the monetary transmission process, analysis moves away from the generic model to an examination of more specific transmission channels. Three channels are investigated: the bank lending channel, the exchange rate channel and the money effect channel. In the course of identifying major monetary transmission channels for Malawi, the study concentrates on measuring the importance of each channel in the transmission process.

4.3 *The Bank Lending Model*

The bank lending model is a component of the credit channel of monetary transmission, where the underlying argument is that asymmetric information and costly enforcement of contracts create agency problems in financial markets (Bernanke and Gertler, 1995). Of the two mechanisms that explain this approach, the balance sheet model (not pursued further in this study due to data constraints) describes monetary transmission through either equity prices or interest rates and firms' cash-flows operating via the net worth of business firms (Mishkin, 1995)

The bank lending model, on the other hand, operates through quantity rather than price of credit. A monetary policy shock is assumed to be transmitted through changes in bank reserves, the total amount of available bank credit, and bank lending. The channel presumes that firms facing informational frictions in financial markets rely on bank lending for external finance because it is prohibitively expensive for them to issue securities in the open market (Disyatat and Vongsinsirikul, 2003). A decline in available bank credit, therefore, adversely affects investments and output. Appending commercial bank lending to equation (6) transforms the generic model to a bank lending model and the corresponding vector of endogenous variables becomes:

$$y_t^{'} = [GY_t, CP_t, BL_t, BR_t, RM_t]$$

The SVAR under investigation in equation (8) comprises five variables, which include output, consumer prices, bank lending, bank rate and reserve money. In line with the identification scheme in system of equations (5), the bank lending model is identified according to the following scheme:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & a_{55} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{BL} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{pmatrix} \begin{pmatrix} \mu_t^{GY} \\ \mu_t^{CP} \\ \mu_t^{BL} \\ \mu_t^{BR} \\ \mu_t^{RM} \end{pmatrix} \quad (8)$$

Figure 3 presents impulse responses of output, consumer prices and bank lending to innovations in the bank rate, reserve money and bank lending. The figure shows that a bank rate shock equivalent to an unexpected 2.2 percent increase in the bank rate causes bank lending to decline, bottoming out at 2 percent below baseline after 18 months. This response is significant between 6 and 24 months. A reserve money shock, on the other hand, corresponding to a 7.2 percent sudden increase in reserve money, leads to an increase in bank lending, peaking at 1.5 percent above baseline after 3 years. This response, however, is not significant. An unexpected 5.5 percent rise in bank lending, on the other hand, leads to an increase in both output and consumer prices. To determine the importance of the bank lending channel, impulse responses of consumer prices and output to bank rate and reserve money shocks are plotted in each case with two scenarios: endogenous and exogenous bank lending. The case of exogenous bank lending blocks off responses that pass through bank lending, while the case of endogenous bank lending allows bank lending to transmit the monetary policy shocks.

Figure 4 shows that in all four instances, there is a considerable difference in the size of impulse responses when bank lending is exogenous and when it is endogenous. This provides preliminary evidence that bank lending contains important additional information in the country's monetary transmission process.

In line with theoretical expectations, output decreases following a sudden increase in the bank rate and increases following an unexpected increase in reserve money, while consumer prices go up in response to an unanticipated increase in reserve money. The response of consumer prices to an unexpected rise in the bank rate continues to show the price puzzle, dissipating faster, though, when bank lending is endogenous.

4.4 *Exchange Rate Model*

Taylor (1995), Obstefield and Gertler (1995) and others have drawn attention to monetary policy operating through exchange rates and net exports. Monetary policy can influence the exchange rate through interest rates, direct intervention in the foreign exchange market or inflationary expectations. The changes in the exchange rate, in turn, affect aggregate demand through the cost of imported goods, the cost of production and investment, international competitiveness and firms' balance sheets in the case of high liability dollarisation (Dabla-Norris and Floerkemeier, 2006).

Summarising the channel, Ireland (2005) states that when domestic nominal interest rates increase above their foreign counterparts, equilibrium in the foreign exchange market requires that the domestic currency gradually depreciate at a rate that serves to equate the risk-adjusted returns on various debt instruments denominated in each of the two currencies. This expected future depreciation requires an initial appreciation of the domestic currency that, when prices are slow to adjust, makes domestically produced goods more expensive than foreign-produced goods, leading to a fall in net exports, domestic output and employment (Ireland, 2005).

The exchange rate channel is expected to have important effects on output and inflation in Malawi due to the relatively large proportion of imports in the country's GDP, estimated at 44 percent in 2006 (see Reserve Bank of Malawi, 2007). On the other hand, the channel may be weakened by the fact that the country's holdings of foreign reserves is usually low (about 2.7 months of import cover on average in 2005) and may not be enhanced by higher domestic interest rates due to a low interest elasticity of foreign capital flows. The study investigates the importance of the channel in Malawi's monetary transmission process by appending the exchange rate variable , to the generic model. The vector of endogenous variables in the exchange rate model is, accordingly, presented as follows:

$$y_t^{'} = [GY_t, CP_t, XR_t, BR_t, RM_t] \tag{9}$$

The five variables in the model are output, consumer prices, exchange rates, bank rate and reserve money. In line with the system of equations (5), the model is identified according to the following scheme:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ 0 & 0 & a_{43} & 1 & 0 \\ 0 & 0 & a_{55} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{XR} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{pmatrix} \begin{pmatrix} \mu_t^{GY} \\ \mu_t^{CP} \\ \mu_t^{XR} \\ \mu_t^{BR} \\ \mu_t^{RM} \end{pmatrix} \tag{10}$$

Figure 5 presents impulse responses of exchange rates to own, bank rate and reserve money shocks and responses of output and consumer prices to innovations in exchange rates. A monetary tightening corresponding to an unexpected 2.2 percent increase in the bank rate causes the domestic currency to appreciate, moving 1.5 percent below baseline after 3 years. The response, however, is insignificant. Contrary to theoretical expectations, the exchange rate responds to a reserve money shock equivalent to a 7.6 percent sudden increase in reserve money with an appreciation, moving 1 percent below baseline after a year. This response is also insignificant.

An exchange rate shock equivalent to a depreciation of the domestic currency by 5.5 percent, however, attracts significant responses in both consumer prices and output. Consumer prices rise, peaking at 4 percent above baseline after 3 years, while output declines in the first 4 months and rises thereafter, peaking at 4.3 percent above baseline after 4 years.

In spite of the weak responses of exchange rates to innovations in monetary policy operating targets, Figure 6 demonstrates that impulse responses of output and consumer prices to bank rate and reserve money shocks are different when exchange rates are exogenous, compared to when they are endogenous, indicating that inclusion of the exchange rate provides important additional information to the monetary transmission process.

4.5 *The Money Effect Model*

An alternative channel of monetary transmission is the monetarist view. The channel downplays the role of interest rates and liquid asset adjustment in the transmission mechanism, reducing the process to a direct link between changes in aggregate money supply and absorption (Bolnick, 1991). According to this view, prices and output respond to monetary impulses because households and businesses fail to anticipate or perceive correctly all of the future implications of past and current actions (Meltzer, 1995). These misperceptions occur primarily because of the existence of a time lag between observing the impulses and being able to distinguish between permanent and transitory impulses and real and nominal shocks. A monetary shock, therefore, drives a wedge between money supply and money demand, which triggers adjustments in portfolio holdings that in turn alter spending decisions. The study uses aggregate money supply (M2) as an indicator of the money effect. Appending to the generic model, the vector of endogenous variables in the money effect model is presented as:

$$y_t^{'} = [GY_t, CP_t, M2_t, BR_t, RM_t] \tag{11}$$

where the five variables in the model are output, consumer prices, M2, bank rate and reserve money. Following the identification scheme in system of equations (5), the model is identified as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & a_{55} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{GY} \\ \varepsilon_t^{CP} \\ \varepsilon_t^{MA} \\ \varepsilon_t^{BR} \\ \varepsilon_t^{RM} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{pmatrix} \begin{pmatrix} \mu_t^{GY} \\ \mu_t^{CP} \\ \mu_t^{M2} \\ \mu_t^{BR} \\ \mu_t^{RM} \end{pmatrix} \qquad (12)$$

Figure 7 presents impulse responses of M2 to own, bank rate and reserve money shocks and responses of output and consumer prices to M2 shocks. A monetary tightening equivalent to an unexpected 2.2 percent increase in the bank rate leads to a significant increase in M2. A reserve money shock corresponding to a sudden 7.2 percent increase in reserve money, however, triggers no response in M2. A possible explanation for this occurrence is the dominance of commercial banks in the trading of government securities. A sudden change in reserve money arising from open market operations (OMO) transactions changes bank reserves proportionately without significantly affecting currency and term and demand deposits, except for the interest component in maturing securities. Accordingly, aggregate money supply is insignificantly affected by the reserve money shock.

Both output and consumer prices respond significantly to unexpected changes in M2. An unanticipated 6.1 percent increase in M2 is followed by a rise in output, which peaks at 2.4 percent above baseline after 10 months and is significant up to 2 years. Consumer prices respond to the monetary expansion with an initial price increase, peaking at 0.6 percent above baseline after 8 months. The response is significant up to five months.

To determine the importance of the money effect model, Figure 8 presents impulse responses of consumer prices and output to bank rate and reserve money shocks in two scenarios: endogenous and exogenous M2. The figure confirms that M2 contains important additional information in the monetary transmission process, which is more pronounced in the responses of output to bank rate shocks and consumer prices to reserve money shocks.

4.6 *The Composite Model: Full Sample*

Preliminary indications from the preceding section suggest that bank lending, exchange rate and money effect channels contain important additional information for the monetary transmission process in Malawi. Putting everything together, a composite model of monetary transmission in Malawi can be drawn with the following vector of endogenous variables:

$$y_t' = [GY_t, CP_t, BL_t, XR_t, M2_t, BR_t, RM_t] \qquad (13)$$

which is identified according to system of equations (5). Impulse responses for the consolidated model over a five-year period are presented in Figure 9. The figure illustrates that the bank lending and money effect channels are important channels of monetary transmission in Malawi but that the transmission process is somewhat weak. Among the three intermediate policy targets, none responds significantly to reserve money shocks. However, bank lending and M2 respond significantly to bank rate shocks, although the M2 response is only marginally significant. Bank lending responds to a sudden 2.2 percent increase in the bank rate with a decline, bottoming at 1.7 percent below baseline after 2 years. The response is significant between 12 and 30 months. M2 responds to the shock with an instantaneous decline of 0.8 percent, before rising in the next 6 months and declining thereafter. The response is marginally significant between 16 and 24 months.

Output responds significantly to unexpected changes in both bank lending and M2. An unanticipated 5.7 percent increase in bank lending causes output to rise, peaking at 1.3 percent above baseline after 15 months. A sudden 5.8 percent increase in M2 also causes output to rise, peaking at 1.6 percent above baseline after 5 months. Consumer prices, however, respond insignificantly to shocks emanating from both bank lending and M2, consistent with the earlier findings.

The money effect channel is confirmed by significant responses of M2 to bank lending and exchange rate shocks. In contrast, the exchange rate channel is not well established. Exchange rates respond insignificantly to all monetary variables in the model but they prompt significant responses in both output and consumer prices. Thus, while there is no evidence that they are driven by monetary policy shocks, exchange rates are an important determinant of output and consumer prices. On this basis, it is probable that exchange rates are exogenously determined in the model. To confirm this claim, the composite model is re-estimated with the exchange rate treated as an exogenous variable and similar results are obtained.

4.7 *The Composite Model: Truncated Sample*

Historical events in Malawi suggest that financial sector operations during the pre-1994 period were considerably different to the post-1994 period. The country had credit ceilings until 1988, direct interest rate controls until May 1990 and a fixed exchange rate peg until February 1994. In the post-1994 period, numerous financial innovations emerged, the number of commercial banks increased considerably (from two in 1993 to 11 in January 2010) and the financial sector became reasonably competitive. Assuming that the impact of financial sector operations on economic activity may have also changed in the post-1994 period, the composite model (with endogenous exchange rates) is re-estimated with the sample period truncated, starting instead from 1994:03. The truncation date is chosen to separate the periods of fixed exchange rate peg (pre-1994:03) and floating exchange rates (post-1994:02). Impulse responses for the model with a truncated sample are presented in Figure 10. While the patterns are broadly similar to the full sample patterns, there are notable differences as well.

First, the response of exchange rates to unexpected changes in the bank rate is significant in the truncated sample. This is not surprising since the exchange rate was flexible during the entire post-1994 period, which allowed the Malawian Kwacha to respond freely to monetary variables. The response of output to exchange rate shocks, while still significant, is now less pronounced compared to the full sample. Thus, the impact of exchange rate shocks on policy goals is weaker in the truncated model although the exchange rate as a monetary policy transmission channel is now apparent. Second, the significant response of M2 to bank rate shocks is more pronounced in the truncated sample. This underlines the importance of monetary policy in the flexible exchange rate regime. Third, the significant output response to unexpected changes in bank lending is more pronounced in the truncated model, highlighting the importance of bank lending as a standalone channel of monetary transmission.

To determine the proportion of fluctuations in a given variable caused by different shocks, variance decompositions of each variable in the composite model with a truncated sample are computed at forecast horizons of 1 to 5 years (see Table 2). The table shows that, besides own shocks, output fluctuations are largely attributed to M2 up to about a year, exchange rates at about 2 years and bank lending from about 3 years and beyond. Collectively, bank lending, exchange rates and M2 account for 8.12 percent of the fluctuations in output after a year, 19.4 percent after 2 years, 28 percent after three years and 36.9 percent after 5 years.

Excluding own shocks, variations in consumer prices are mostly accounted for by exchange rates up to about 3 years and by bank lending thereafter. M2 accounts for less than 1 percent of the fluctuations in consumer prices across the forecast horizon, implying that shocks in aggregate money supply are not responsible for inflation in Malawi. Consistent with earlier findings, consumer prices account for a larger proportion of the fluctuations in both bank rate and reserve money fluctuations, given the two policy goals, reconfirming that the primary goal of monetary policy in Malawi is price stability, though the output goal is also pursued.

4.8 *Robustness Check*

While all models are subjected to robustness checks, only results of the estimated composite model from the truncated sample are reported. Structural estimates of the coefficients in matrices A and B of the model show that 12 of the 17 structural coefficients have expected signs. In addition, nearly all coefficients in the model have standard errors with values of less than one, implying that they are efficient and hence form a solid basis for measuring monetary policy shocks. Inverse roots of the characteristic AR polynomial for the determination of stability (stationarity) of the model show that all inverse roots of the characteristic AR polynomial have modulus less than one and they lie inside the unit circle, indicating that at the chosen lag length (of order three), the estimated model is stationary or stable. Finally, serial correlation test results show no evidence of serious serial correlation in the model. Gujarati (2003) points out that as a rule of thumb, if the pairwise or zero order correlation coefficient between two regressors is in excess of 0.8, then multicollinearity is a problem. Thus, the composite model with a truncated sample is robust and its inferences can be relied upon.

While the debate concerning whether or not to transform models to stationary form by difference or cointegration operators when dealing with I(1) variables appears to lean towards the Sims et al. (1990) conclusion, some authors maintain support for the traditional approach of transforming the data to stationary regressors prior to estimation regardless of whether the point of focus is long-run or short-run relationships (see, for example Enders, 2004). To illustrate that results obtained from the two methodologies are not diametrically opposed to each other, the study also estimates the composite model using a cointegrated SVAR, which demonstrates that while there may be some differences, as expected, the estimation results are on the whole similar to what was obtained from estimation in levels. Understandably, a number of differences also show up. Among the differences, impulse responses from the cointegrated SVAR die off very quickly compared to those from the estimation in levels. In order to retain clear visual images, the forecast horizon is reduced from 60 months in the levels estimation to 12-month in the cointegrated SVAR.

The cointegrated SVAR confirms the finding in the levels estimation that monetary policy in Malawi employs hybrid operating procedures, with the bank rate and reserve money as operating tools. Both the bank rate and reserve money respond significantly to shocks in the three intermediate targets of monetary policy, namely exchange rates, aggregate money supply and bank lending, revealing that the central bank is concerned with movements in the three targets and to achieve desired levels in these targets, the two policy tools are used. Consistent with the levels estimation, the cointegrated SVAR also shows that the exchange rate and money effect are important channels of monetary transmission in the country, though the impact is not as pronounced as in the levels estimation. The effect of bank lending in the monetary transmission process, however, is insignificant in the cointegrated SVAR, which contradicts the finding in the levels estimation.

The observed differences from the two estimation approaches are not unexpected. An important source of these differences is the imposition of what may be possibly incorrect cointegrating restrictions in the process of estimating the cointegrated SVAR. Kim and Roubini (2000) and Becklelmans (2005) argue that this is usually the case in cointegrated SVARs with the implication that the resulting inferences are often incorrect as well. In an attempt to circumvent the problem, some studies opt for a simple differences specification (see, for example, Weitong, 2007; Boivin & Giannoni, 2002; Kasa & Popper, 1997; Kugler et al, 2004; Karame & Olmedo, 2002; Mihira & Sugihara, 2000). The approach, however, is not persuasive as it yields inconsistent estimates if some variables are cointegrated (Bernanke & Mihov, 1997).

5 Summary and Conclusions

This paper set out to investigate the process through which monetary policy affects consumer prices and output in Malawi. Using innovation accounting in a structural vector autoregressive model, it is established that contrary to the official position that monetary policy in the country targets reserve money only, monetary authorities in Malawi also target short-term interest rates. Effectively, the country employs hybrid operating procedures and it is demonstrated that the bank rate is a more effective measure of monetary policy than reserve money. In line with Part III, Section 4(d) of the RBM Act of 1989, it is also established that monetary authorities in the country pursue both price stability and high growth and employment objectives. It is further shown that price stability is the principal objective of monetary policy in the country. With the exception of exchange rate shocks, however, consumer prices respond weakly to monetary impulses, suggesting that inflation in Malawi may not be dominated by monetary factors. The fact that food costs have a preponderant weight (58.1 percent) in the all items national composite consumer price index, reveals that structural rigidities in food production may be more important determinants of inflation than monetary considerations.

The study also illustrates that bank lending, exchange rates and aggregate money supply contain important additional information on the transmission process of monetary policy shocks in Malawi. Besides own shocks, output fluctuations are largely attributed to M2 up to about a year, exchange rates at about 2 years and bank lending from about 3 years and beyond. Excluding own shocks, variations in consumer prices are mostly accounted for by exchange rates up to about 3 years and bank lending thereafter. M2 accounts for less than 1 percent of the consumer price fluctuations across the five-year forecast horizon.

Truncating the study period to include only the flexible exchange rate period (post-1994) reveals two interesting issues. First, the role of the exchange rate becomes more conspicuous although its impact on economic activity is weakened. Second, the importance of aggregate money supply and bank lending in transmitting monetary policy impulses is enhanced. It is concluded, therefore, that with the floatation of the Malawian Kwacha in 1994, the monetary transmission process evolved from a weak, blurred process to a somewhat strong, less ambiguous mechanism, consistent with theoretical expectations.

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Figure 1: Impulse Responses of Bank Rate and Reserve Money: The Generic Model

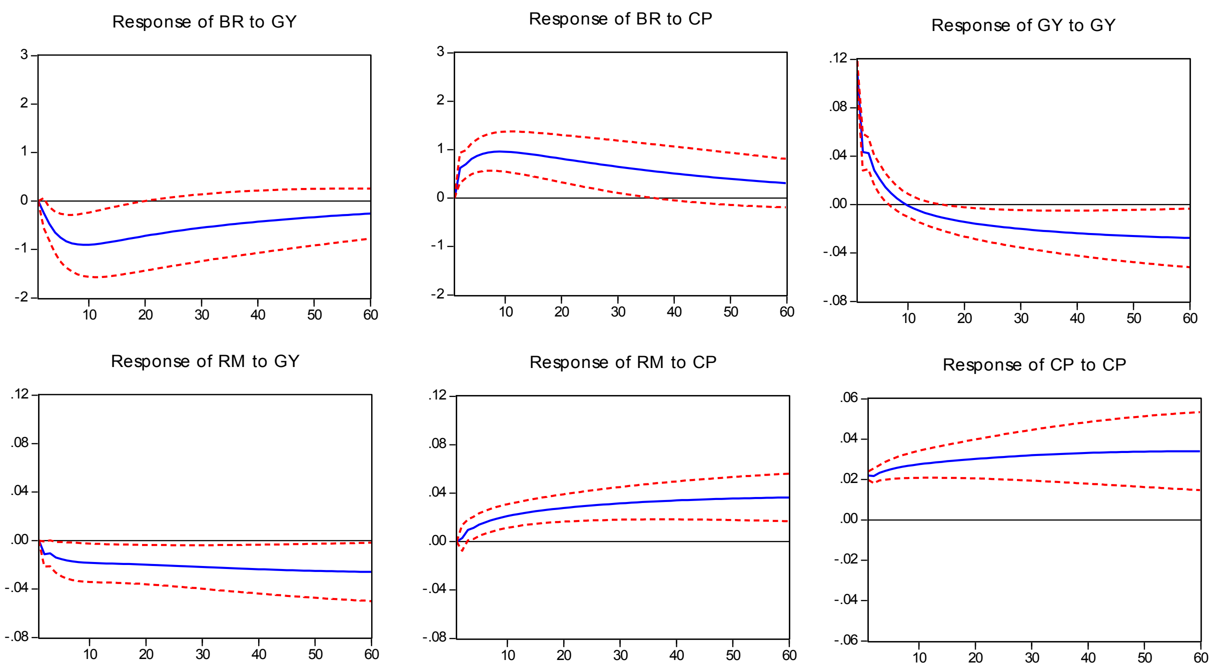

Figure 2: Impulse Responses of Output and Consumer Prices: The Generic Model

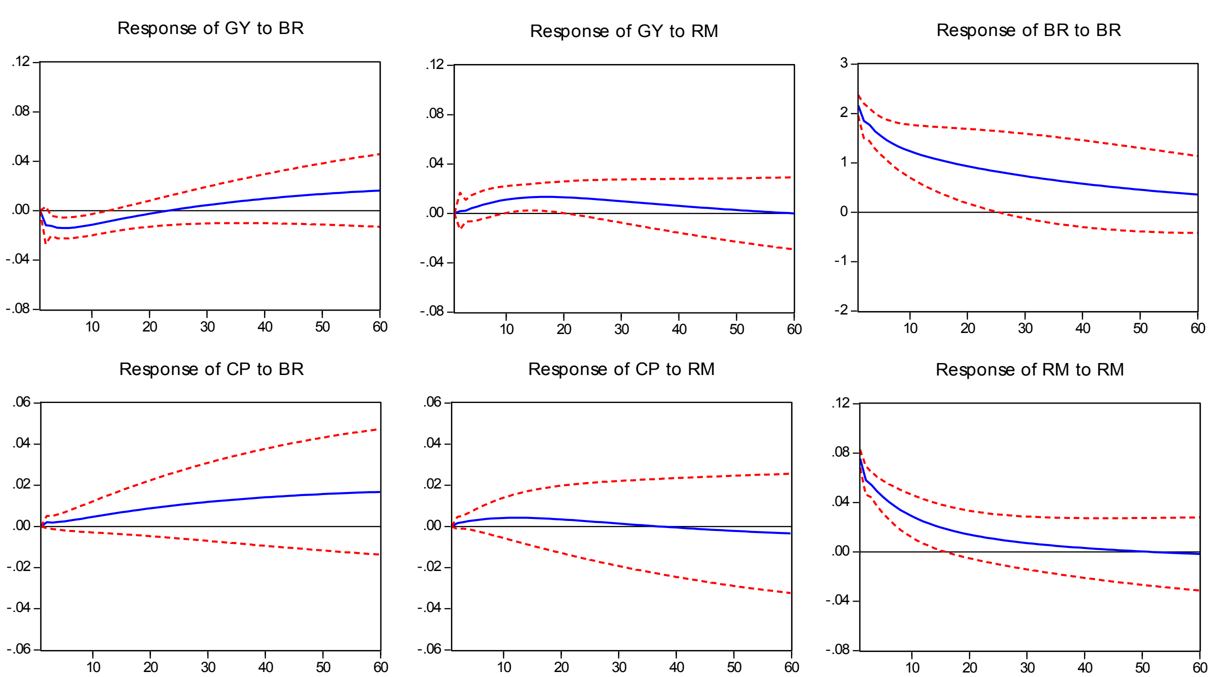

Figure 3: Impulse Responses for the Bank Lending Model

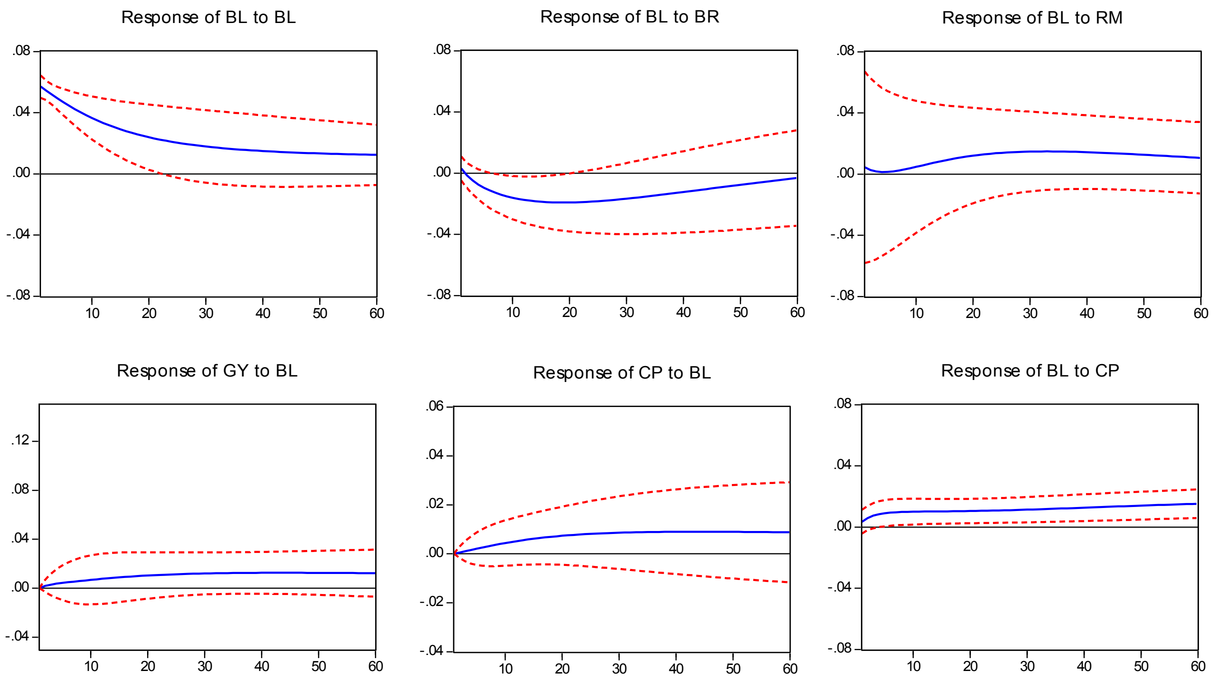

Figure 4: Impulse Responses of Output and Consumer prices to Bank Rate and Reserve Money Shocks with Endogenous and Exogenous Bank Lending

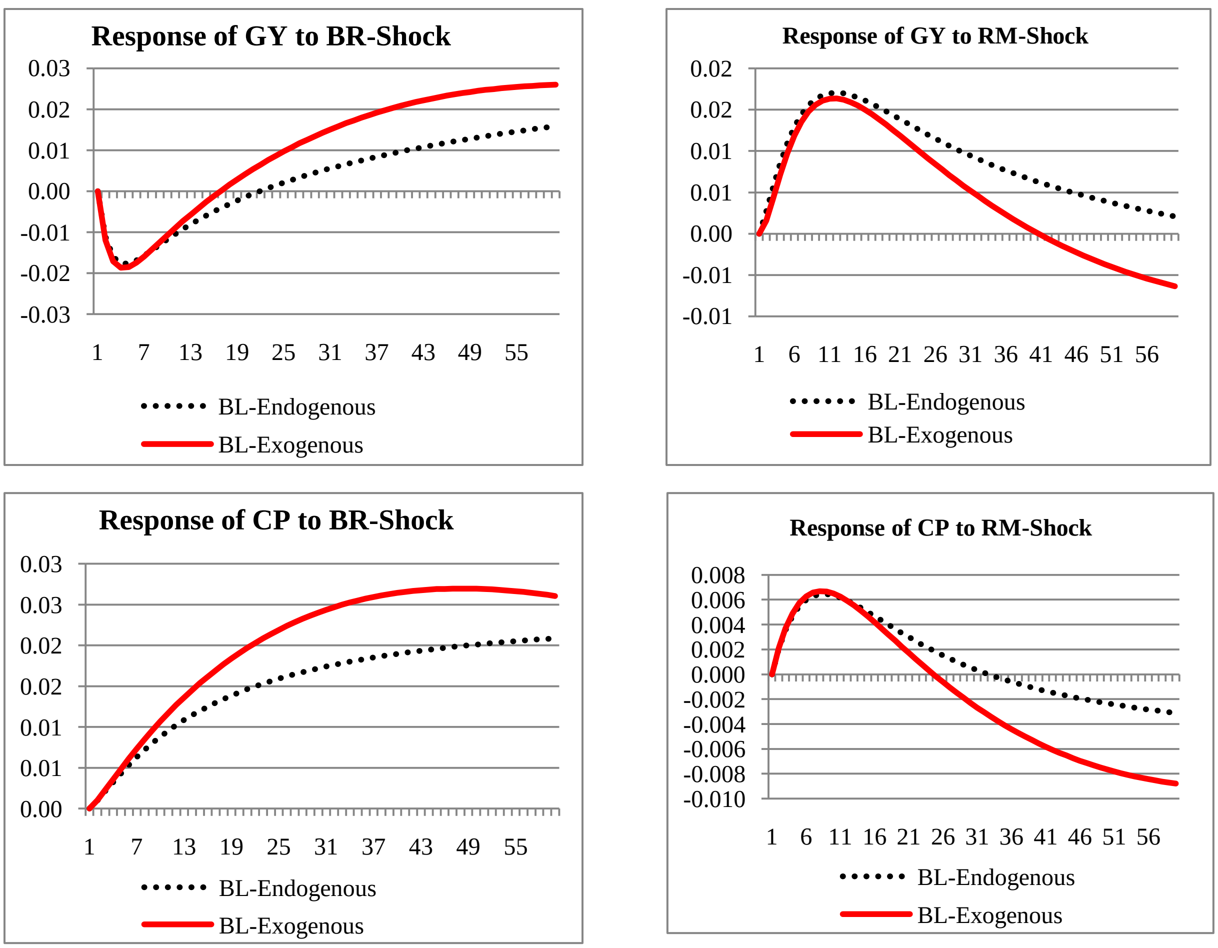

Figure 5: Impulse Responses for the Exchange Rate Model

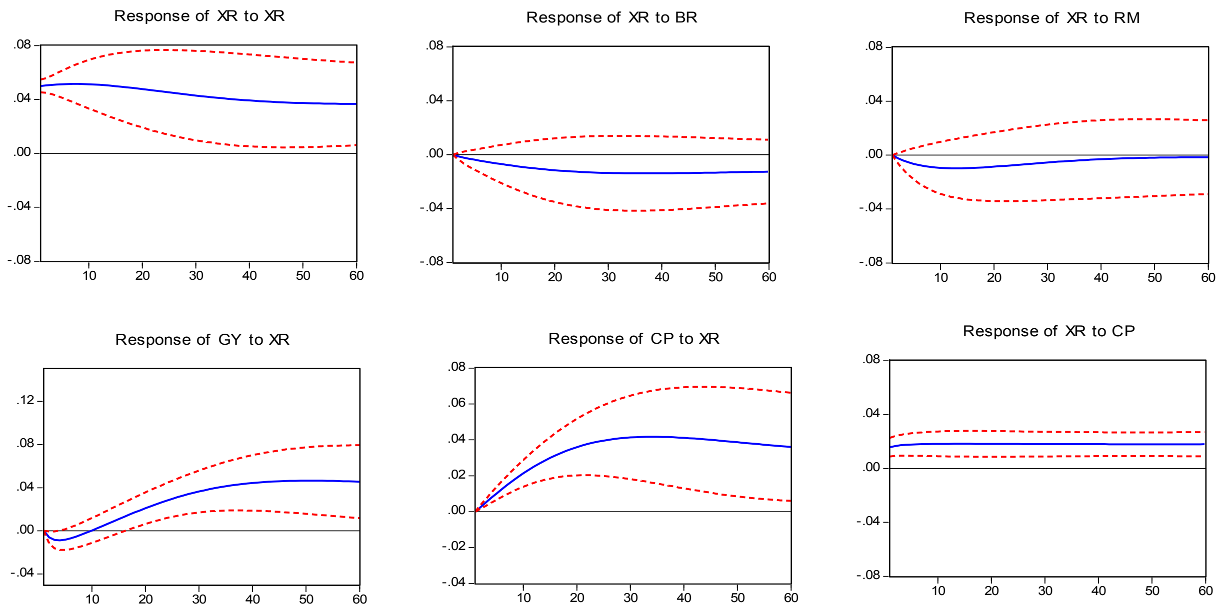

Figure 6: Impulse Responses of Output and Consumer prices to Bank Rate and Reserve Money Shocks with Endogenous and Exogenous Exchange Rates

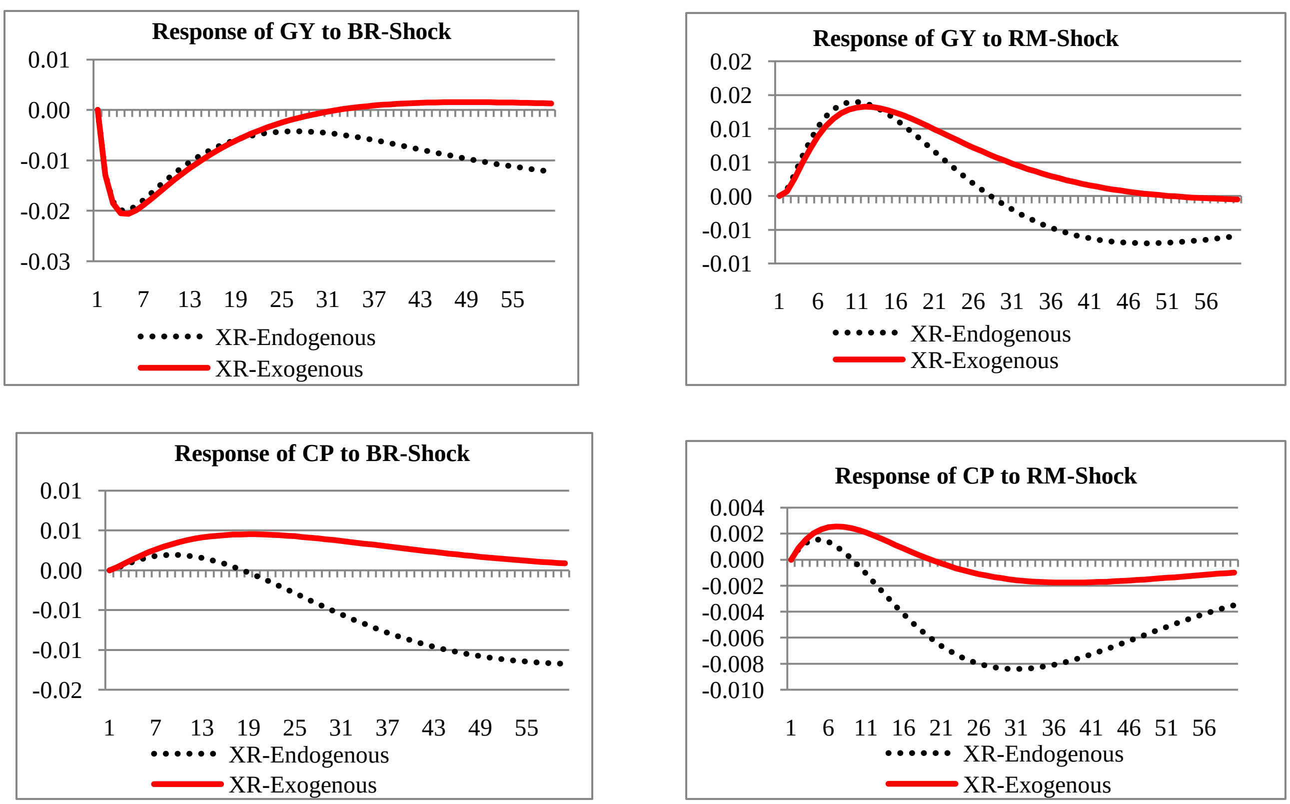

Figure 7: Impulse Responses for the Money Effect Model

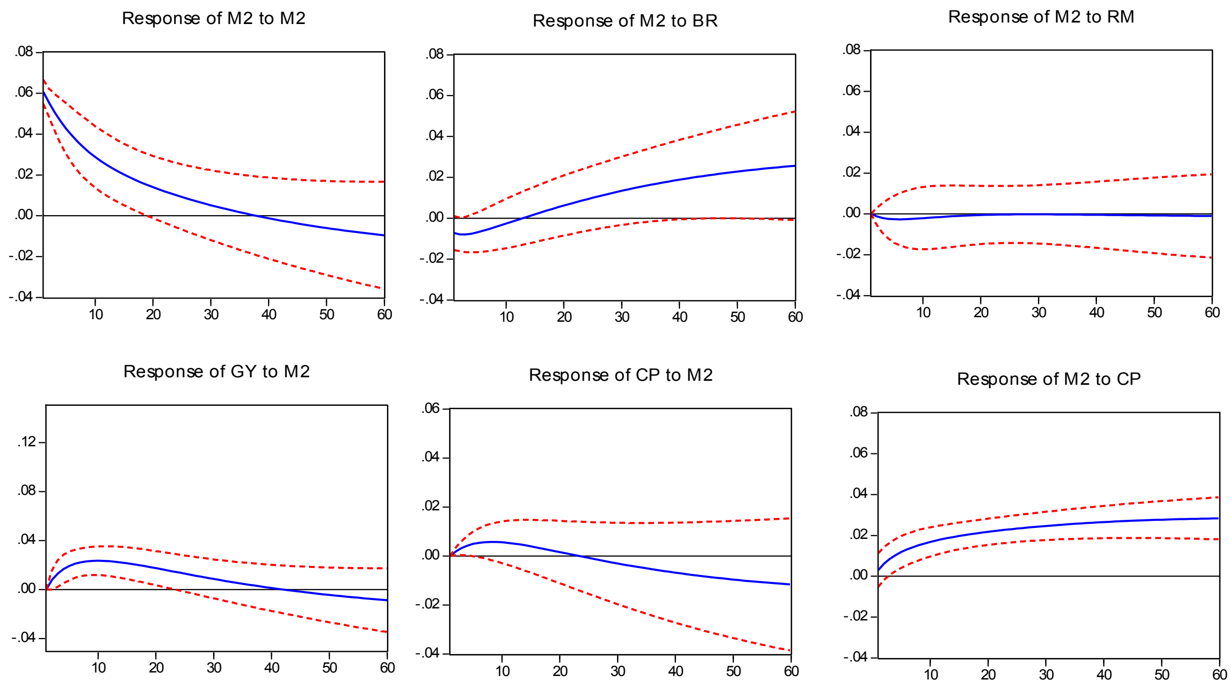

Figure 8: Impulse Responses of Output and Consumer prices to Bank Rate and Reserve Money Shocks with Endogenous and Exogenous M2

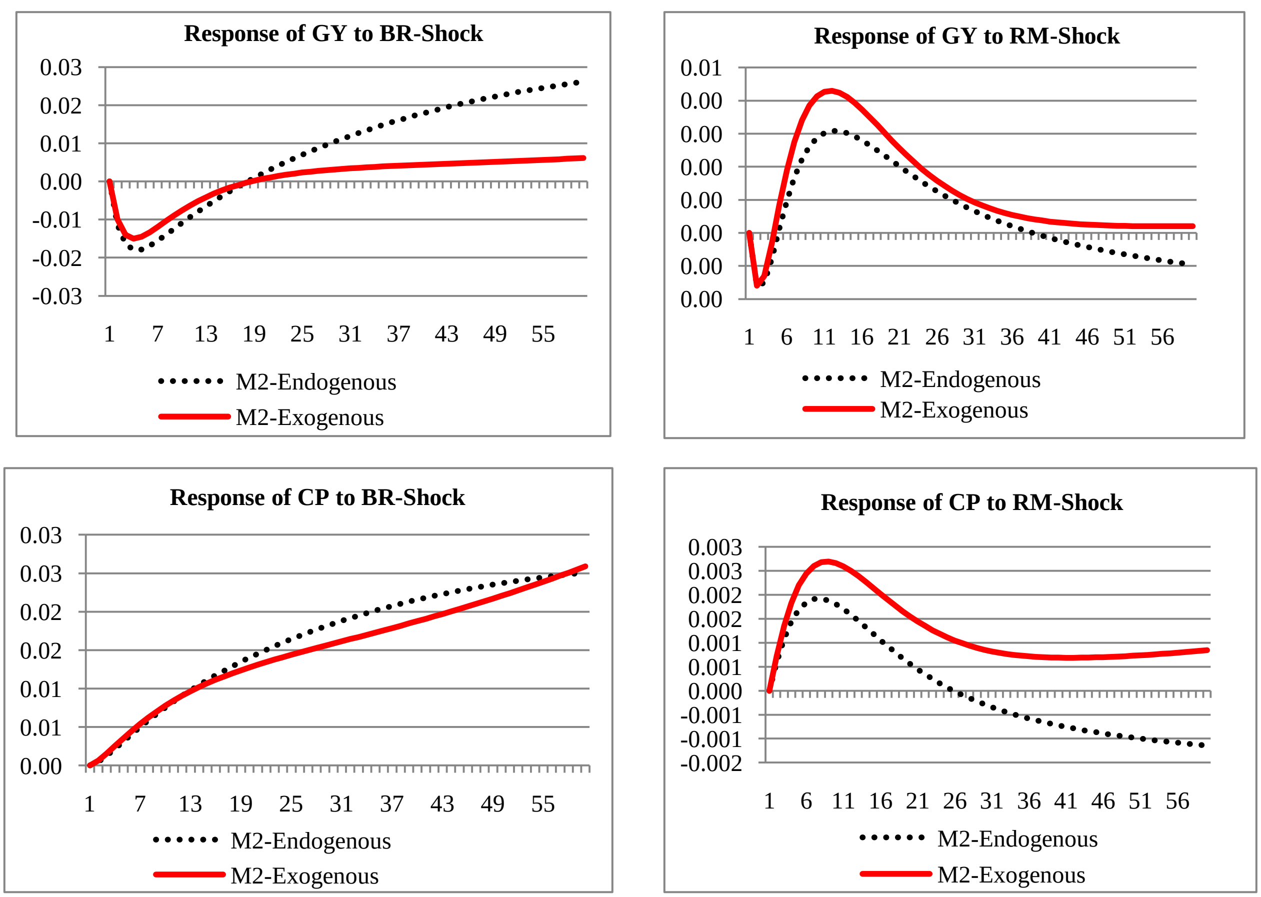

Figure 9: Impulse Responses for the Composite Model (Full Sample) with Endogenous Exchange rates

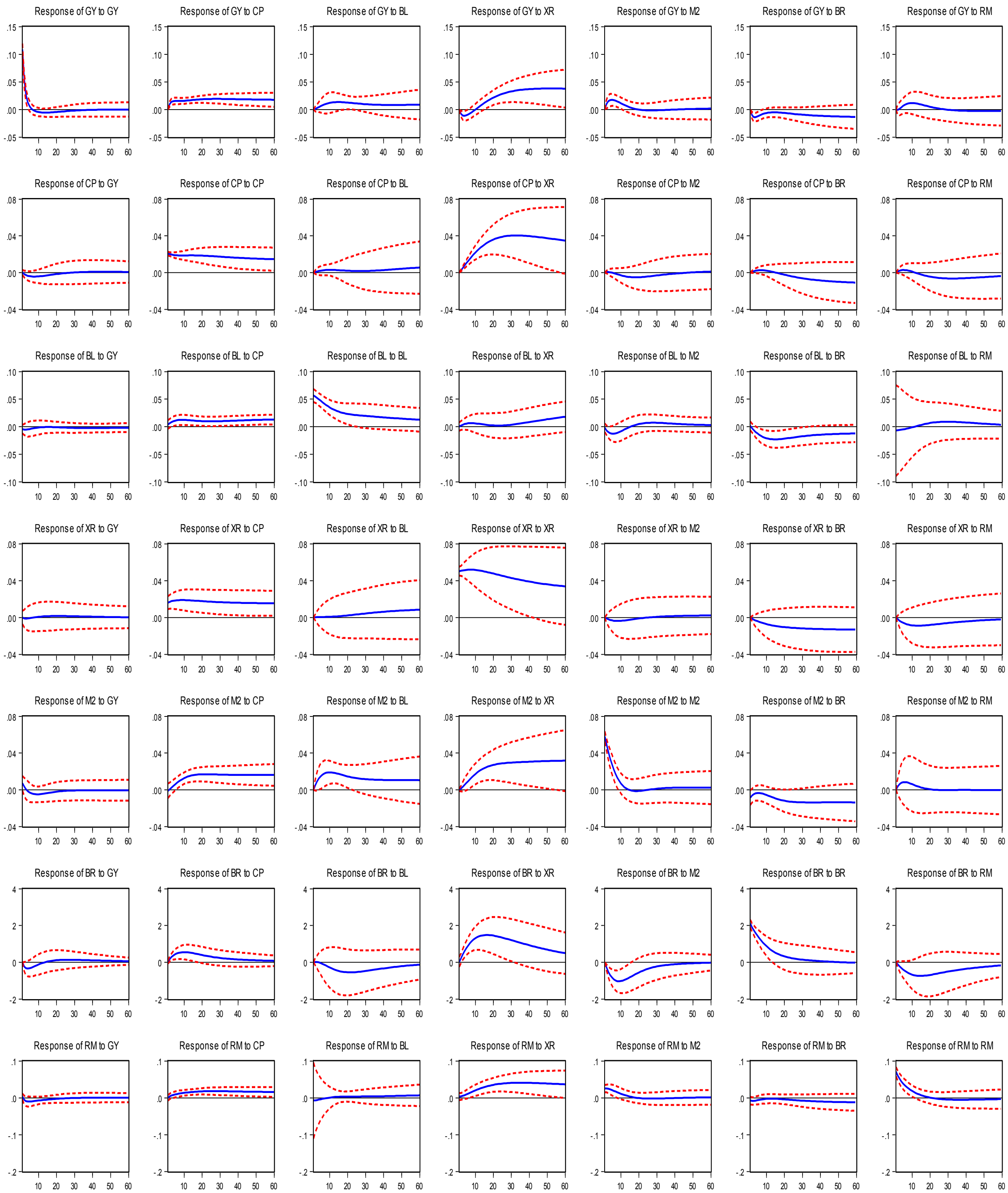

Figure 10: Impulse Responses for the Composite Model with a Truncated Sample

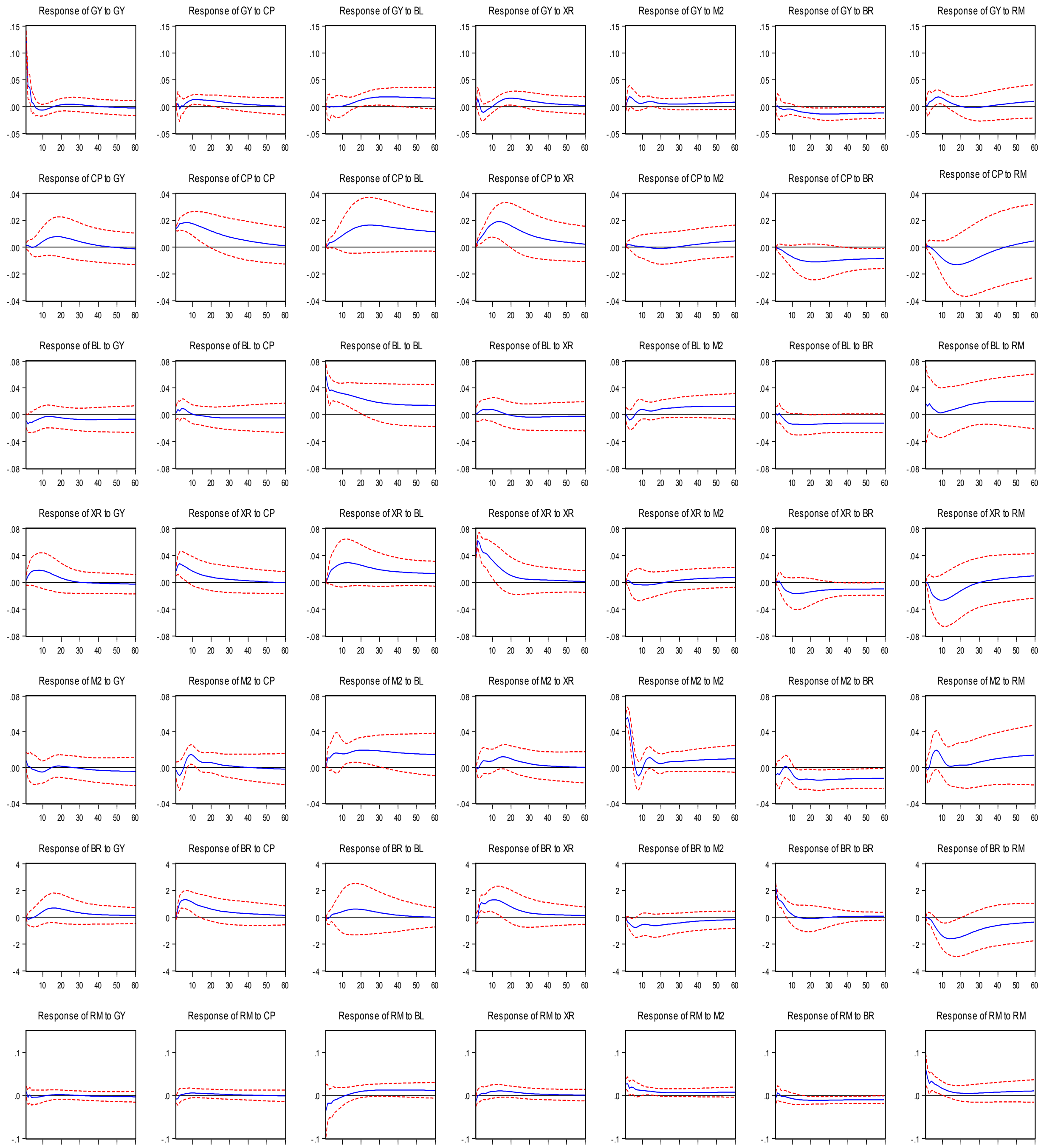

Table 1. Variance Decomposition for the Generic Model

Variance Decomposition of GY				
Month	GY	CP	BR	RM
1	100	0	0	0
6	92.3109	2.26977	4.85201	0.56728
12	76.8961	11.7495	7.83193	3.52248
24	55.1723	30.9392	5.84306	8.04545
36	45.2397	42.9679	4.38645	7.40598
48	40.2602	49.4123	4.79446	5.53305
60	37.3931	52.581	5.96782	4.0581
Variance Decomposition of CP				
Month	GY	CP	BR	RM
1	0.00429	99.9957	0	0
6	8.83843	89.5588	0.70214	0.90065
12	17.2802	79.9114	1.4836	1.32472
24	23.9426	71.2309	3.73211	1.09445
36	26.3566	67.0872	5.87991	0.67633
48	27.408	64.4648	7.65085	0.47635
60	27.9006	62.5823	9.06388	0.45322
Variance Decomposition of BR				
Month	GY	CP	BR	RM
1	0	0	100	0
6	8.22009	13.0522	76.6691	2.05862
12	14.6781	18.6407	60.9944	5.6867
24	17.4205	21.865	50.6677	10.0468
36	17.7836	22.7513	47.3985	12.0666
48	17.8461	23.0723	46.0195	13.0622
60	17.8509	23.1937	45.3665	13.5889
Variance Decomposition of RM				
Month	GY	CP	BR	RM
1	0	0	0.62107	99.3789
6	4.82833	3.42472	0.25099	91.496
12	9.83185	10.6703	0.17049	79.3273
24	16.3189	25.4689	0.50491	57.7074
36	20.3133	36.1984	1.78088	41.7074
48	22.8209	42.7248	3.50981	30.9445
	24.3806	46.4778	5.22628	23.9154

Table 2: Variance Decomposition for the Composite Model with a Truncated Sample

Response of GY							
Month	GY	CP	BL	XR	M2	BR	RM
1	100	0	0	0	0	0	0
6	88.9972	0.40382	0.01772	2.39005	4.9986	0.40715	2.78549
12	78.4499	3.68215	0.05778	2.5118	5.55366	1.20002	8.54472
24	59.7092	7.7282	4.33016	9.01098	6.05287	5.96018	7.20847
36	47.5531	7.56146	12.5306	10.5965	5.46594	10.5178	5.77465
48	40.6831	6.76495	18.4448	9.79906	5.58786	13.3136	5.40667
60	35.8408	5.97162	21.9176	8.78839	6.14028	15.0565	6.28477
Response of CP							
Month	GY	CP	BL	XR	M2	BR	RM
1	0.4792	99.5208	0	0	0	0	0
6	0.12692	78.5446	3.14765	15.6286	0.50971	1.46601	0.57655
12	1.4681	51.49	7.17394	29.3745	0.17985	4.62699	5.6866
24	3.96805	29.8407	16.7095	28.74	0.10506	8.76834	11.8684
36	3.71715	24.468	23.9787	25.109	0.10531	11.3679	11.2539
48	3.26477	21.9025	28.5072	22.8361	0.37441	13.2559	9.85916
60	2.97764	19.9325	31.0985	20.9767	0.97151	14.6828	9.36032
Response of BL							
Month	GY	CP	BL	XR	M2	BR	RM
1	2.25829	0.19857	90.2722	0.01399	0.03068	0.09299	7.1333
6	5.52293	2.53294	80.576	1.51271	1.13583	0.84956	7.87006
12	4.10393	1.78157	78.8282	2.4896	2.00075	5.57694	5.21904
24	3.19664	1.44509	72.3613	1.79589	3.34287	10.8788	6.97945
36	3.62075	1.64873	61.5861	1.62123	5.65369	12.488	13.3816
48	3.91385	1.78059	53.247	1.45903	7.60075	13.209	18.7898
60	4.03579	1.85327	47.5869	1.31464	8.99576	13.7526	22.4611
Response of XR							
Month	GY	CP	BL	XR	M2	BR	RM
1	0.41431	14.0718	0	85.5139	0	0	0
6	4.96644	15.4216	6.55759	66.815	0.13971	0.89385	5.20574
12	6.5994	12.2794	13.7981	51.0453	0.27603	3.86841	12.1333
24	6.18497	10.1437	22.9385	39.6472	0.31664	7.09144	13.6776
36	5.62408	9.50432	26.9406	36.2663	0.45737	8.68215	12.5252
48	5.29833	8.92229	28.815	33.9814	0.92018	9.88385	12.179
60	5.07369	8.37084	29.7261	31.9085	1.56142	10.8526	12.5069

Table 2: Variance Decomposition for the Composite Model with a Truncated Sample (continued)

Response of M2							
Month	GY	CP	BL	XR	M2	BR	RM
1	1.92636	0.28743	0	0.00352	95.4028	2.3799	0
6	0.6548	1.81596	7.52457	1.21604	81.1561	1.71303	5.91948
12	1.19103	7.08723	14.4188	3.06702	60.4949	3.13342	10.6076
24	0.85575	6.11429	25.9479	6.9906	42.1039	10.7904	7.19716
36	0.73459	4.81951	32.2545	6.07727	34.0857	15.022	7.00647
48	0.93304	3.92695	34.1127	5.01824	29.888	16.9727	9.14839
60	1.21924	3.33834	34.0998	4.20601	27.2372	17.9386	11.9608
Response of BR							
Month	GY	CP	BL	XR	M2	BR	RM
1	0.00072	0.02431	0	0.14773	0	99.8273	0
6	0.16952	25.4735	0.62922	15.7219	7.20235	47.9679	2.83565
12	1.80112	24.6725	2.04384	23.2621	6.99854	22.3638	18.8581
24	5.09523	17.5419	4.5163	20.9502	7.25953	11.4689	33.168
36	5.39437	16.3351	4.95889	19.036	7.83212	9.84913	36.5944
48	5.42576	16.0741	4.86045	18.4364	8.1086	9.40063	37.694
60	5.45687	15.9262	4.75147	18.1548	8.26378	9.21899	38.2279
Response of RM							
Month	GY	CP	BL	XR	M2	BR	RM
1	1.19511	1.22385	20.7566	3.12052	11.4659	0.84125	61.3968
6	1.09737	1.12111	17.1994	1.78105	18.0151	0.76545	60.0205
12	1.06856	1.80043	14.4123	3.72633	18.6833	2.18612	58.123
24	0.97493	2.30316	14.8494	7.21981	18.143	7.90619	48.6036
36	0.84538	2.10466	19.0743	6.91603	16.9618	11.9046	42.1932
48	0.89279	1.81678	22.1946	6.09373	16.2624	14.1667	38.573
60	1.05659	1.59219	24.002	5.32603	15.8866	15.5339	36.6028