EFFECTIVENESS OF MONETARY POLICY IN MALAWI: EVIDENCE FROM A FACTOR AUGMENTED VECTOR AUTOREGRESSIVE MODEL (FAVAR)

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ABSTRACT

Despite immense research on the subject, most researchers and policy makers still remain agnostic on effectiveness of monetary policy and the appropriate choice of monetary policy instruments. This follows enormous divide in empirical findings on the subject in both developed as well as Low Income Countries (LICs). This problem is more pronounced in LICs which not only have underdeveloped financial markets but also lack appropriate tool to model their economies. This study sought to complement existing literature by further examining effectiveness of monetary policy in Malawi Using a Factor Augmented Vector Autoregressive Model (FAVAR) using quarterly data from 1990 to 2013. This helped to control for little information problem inherent in other modelling frameworks. After controlling for structural breaks and broadening the information set using the Principal Component Analysis, the price puzzle results disappears making inflation responsive to changes in money supply and policy rate innovations. This finding is consistent with (Muhanji et al, 2013) and (Mwabutwa et al, 2013). We also show that policy reversal could be responsible for price and liquidity puzzle results in other literature. It takes less time for inflation and GDP to stabilise under interest rate shock than it does under money supply shock. Based on these findings and persistent supply shock together with limitations in data, we conclude that monetary targeting is still useful for Malawi. However, elimination of fiscal dominance and broadening of foreign exchange sources would provide solid base to augment the framework with IT features and deal with the policy signalling challenge inherent in the Monetary targeting framework and also quick stabilisation of the economy after shocks.
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<thead>
<tr>
<th>ACRONYM</th>
<th>DESCRIPTION</th>
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<tr>
<td>VAR</td>
<td>Vector Autoregressive Model</td>
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<td>FAVAR</td>
<td>Factor Augmented Vector Autoregressive Model</td>
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<tr>
<td>DSGE</td>
<td>Dynamic Stochastic General Equilibrium Models</td>
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<td>MAT</td>
<td>Monetary Aggregate Targeting</td>
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<td>RBM</td>
<td>Reserve Bank of Malawi</td>
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<td>IMF</td>
<td>International Monetary Fund</td>
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<td>QTM</td>
<td>Quantity Theory of Money</td>
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<td>NFA</td>
<td>Net Foreign Assets</td>
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<td>REO</td>
<td>Regional Economic Outlook</td>
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SECTION 1.0 INTRODUCTION

Malawi started to actively use Monetary Aggregate Targeting (MAT) as a monetary policy framework in the early 1990s when the structural and political adjustments were being implemented and a flexible exchange rate system was finally commissioned (1994). Monetary aggregate targeting involves the use of an inflation target consistent reserve money growth as operational target to influence money supply. Major assumptions in the implementation of the MAT framework are the stability of money demand and money multiplier. These conditions enable the pass-through of changes in reserve money aggregates to monetary aggregates and target variables (price and GDP). In their absence, the framework becomes inconsequential.

After decades, Malawi still remains in the grip of severe macroeconomic instability. Inflation has high inertia and remains volatile averaging around 20 percent since 1990. Real GDP growth has equally been volatile and low averaging around 4.3 percent over the same period. This has resulted in the interrogation of the framework and its instruments on whether they are capable of delivering on central bank’s price stability mandate. Using Auto Regressive frameworks, (Ngalawa and Viegi, 2011), (Mangani, 2012) and (Mangani, 2014 unpublished) find evidence of price puzzles thereby dispelling the relevance of the MAT framework.

Due to these perceived challenges, several SSA countries including Malawi are therefore attempting to modernise their monetary policy frameworks. The modernisation process has tended to either completely abandon MAT in favour of Inflation Targeting (Ghana 2006), South Africa (2007), or augment the framework with some IT features, (Kenya 2012) and Uganda (2011).

Literature available on monetary policy effectiveness still lacks synchrony. For example while (Mangani, 2012) finds evidence of Price puzzle, (Mwabutwa et al, 2013) dispels this. (Sims, 1992) argues that the counterintuitive price puzzle results can be blemished on methodological issues which arise from imperfectly controlling for some factors in the models. Some specific factors pertaining to low income countries are
agriculture dependence, fiscal dominance and policy reversals. This leaves a knowledge and policy gap for African central banks which results in ineffective engagements with fiscal authorities, general public and the International Monetary Fund. This has resulted in ineffective deliberations, communication and choices on the subject.

Motivated by the foregoing, this study extends the line of thinking by (Mangani, 2012) and uses a Factor Augmented VAR model following (Bernanke et al, 2005) to provide further evidence on effectiveness of monetary policy in Malawi by particularly examining the role of money, exchange rate and the policy rate in the inflation and real sector dynamics. The major result is that after controlling for the perceived structural breaks and broadening the information set available to monetary authorities, we find that inflation is quite responsive to innovations in policy rate and money supply, a finding that is consistent with (Muhanji et al, 2013) and (Mwabutwa et al, 2013). We also demonstrate that interest rate is superior to money as an economic stabilisation policy.

The paper is organised as follows: The rest of Section 1 expands on the research question by discussing the problem, highlighting the major objectives as well as stating the significance of the study. Section 2 provides background of the Malawi economy, discusses the stylised facts and provides a brief discussion on the monetary policy framework and instruments in Malawi. Section 3 discusses theoretical as well as empirical literature. Section 4, lays out the VAR, the Principal Component Analysis and the FAVAR framework. In Section 5, we present and discuss results, while section 6 summaries the paper, provides recommendations and further research direction.

1.1 PROBLEM STATEMENT

(Gali, 2008) observes that central banks do not change policy instruments in an arbitrary or whimsical manner. Their decisions are meant to be purposeful, i.e., they seek to attain certain objectives, while taking as given constraints arising from the optimisation behaviour of firms and households. Therefore, understanding what should be the objectives of monetary policy and how the latter should be conducted in order to attain those objectives constitutes an important problem of modern monetary policy.
The finding by (Mwabutwa etal, 2013) that transmission mechanism has evolved calls for period assessment of policy effectiveness.

Inflation inertia remain high, partly compounded by the floatation of the exchange rate (May 2012) amidst intermittent donor inflows (September 2013 latest withdrawal). Aside these, sources of inflation in LICs are largely supply rather than demand driven. The rapid economic transformation, and peculiar characteristics that Malawi shares with other Low income countries calls for a continuous review of effectiveness of monetary policy instruments.

These factors have been compounded by diverse findings on the subject which are coming at a time when a wave of monetary policy regime change is cutting across the continent of Africa and hence the need for a better understanding of policy transmission and effectiveness.

1.2 STUDY OBJECTIVES AND SIGNIFICANCE

This research work intends to contribute to the current monetary policy debate on appropriateness of money or interest rate based monetary policy anchors by examining using a Factor Augmented VAR the effectiveness of monetary policy. The study also seeks to highlight policy reversals and how they related to inflation developments. Specifically the study sets out to:

i) Determine the impact of interest rate innovations on price stability and GDP.

ii) Determine the relationship between money supply, price stability and GDP.

The available literature is divided between money and interest rate instruments, suggesting that the instrument choice should depend on the economic fundamentals of a particular country (Poole, 1970). It is therefore important to empirically validate effectiveness of policy instruments in order to enhance public expectations and success of the central bank’s monetary policy innovations. The findings will also inform contemporary question on the choice of monetary policy frameworks and instruments, a debate that is currently sweeping across several sub-Saharan African central banks.
SECTION 2.0 THE MALAWI ECONOMY: CARDINAL FEATURES

Malawi is a small open land locked economy with gross domestic product estimated at US$5.8 billion, equivalent to per capita income of US$376.7. Agriculture is the most important sector, employing about 85 percent of the labour force and generating over 80 percent of the country’s foreign exchange. Main exports are raw materials with Tobacco alone generating over 60 percent of the foreign exchange. Other exports include Tea, Coffee and Sugar (processed). The bulk of the country’s imports include fertilizer, fuel and Pharmaceuticals. The international trading system inherited from the colonial times has remained largely unchanged. About 72 percent of the agricultural output is produced by the smallholder sector, while the balance is from estates. Manufacturing output is mostly derived from agro-processing (see appendix VII). Up to 40 percent of the country’s total revenue, mostly going into development expenditures, is financed by donors leaving the country susceptible to changing donor approaches to budget support. Recently, prudent fiscal, monetary and exchange rate policies have helped to stabilize the economy and laid out solid foundation for economic growth.

Table 1: Selected Economic Indicators

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<td>10.3</td>
<td>18.1</td>
<td>11.9</td>
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<td>167.6</td>
<td>240.8</td>
<td>4.8</td>
<td>1.1</td>
<td>62.4</td>
<td>11.3</td>
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<td>2012</td>
<td>17.8</td>
<td>33.8</td>
<td>14.3</td>
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<td>2013</td>
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<td>Jan-May 2014</td>
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<td>14.1</td>
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Source: Reserve Bank of Malawi Economic Reviews

2.1 SOME STYLISED FACTS

The major source of economic growth is agriculture. It is also a major source of economic fluctuations due to dependence on nature and international commodity markets. Although still remaining the largest, the contribution of
agriculture to overall GDP has however shrunk from 35 percent in 2002 to around 28 percent in 2010. On the contrary, the share of vending economy measured by the size of the wholesale and retail sector which is the second largest sector by economic activity has grown from 15.5% in 2002 to around 20.7% in 2010 (See appendix vii). Real GDP growth rates have been low and volatile, with 7 negative ones and only 18 above the 6% conventional benchmark since independence. The remarkable growth rate did not occur back to back meaning that their implication for human welfare development was disjointed and subjected to reversals.

CHART 1: REAL GDP GROWTH RATES

Source: National Statistics Office

Inflation inertia is high. In the past 34 years only 3 years out of the 34 years has inflation averaged single digit. These low digit rates are associated with periods when the exchange rate was in principle pegged to the United States dollar despite being a de jure managed float. Chart 2 further shows that inflation variability has trended downwards since 1994. One major characteristic of the period after 1994 is the initial introduction of seed starter pack programme which was later, in 2004, scaled up to a full input subsidy programme. This helped to raise food production and reduce food inflation which together with a de facto exchange rate peg contributed to substantially lower inflation rates. From 2013, the weight of food inflation in the overall Consumer Price Index Basket was reduced from 58.1 percent to 50.1 percent. The non-food inflation weight was raised from 41.9 percent to 49.9 percent. This revision in part reflects rising pattern in consumption of non-food items.
Exchange rate behaviour displays large seasonal patterns appreciating during harvest period and depreciating during lean period and reflects the country’s persistent excess demand over supply of foreign exchange. The major sources of foreign exchange are Tobacco exports and donor inflows, both of which are intermittent. With the growing wholesale and retail sectors, it is expected that demand will continue surpassing supply in the near term. Donor budgetary and project support provide additional foreign exchange inflows. While buoying the reserves position, the resulting liquidity injections alongside those created from the fiscal sector breed excess liquidity in the banking system. This international trade pattern alongside dependence on donor inflows have led to several exchange rate policy reversals (see appendix Vi).

The importance of the exchange rate policy warrants a deeper review. Pressure on the exchange rate strengthened after its flotation in February 1994, leading to persistent depreciation (chart 3). Due to inflationary concerns, authorities opted to fix it at about MK139/US$ in May 2006. Responding to persistent and growing pressure on reserves, it was later adjusted and was selling at K151.5/US$ from January 2010 to August 2011 before it was devalued by 10 percent. The 2011 global decline in tobacco prices together with withdrawal of budgetary support due to disagreement over economic management policies resulted in substantially low reserves of around 0.5 months official import cover by early 2012. The country could no longer import to sustain previous levels of consumption and production. Capacity utilisation reduced to
as low as 54 percent\textsuperscript{1}. The Kwacha traded at a premium of over 80% on the parallel market. Critical shortages of products ensued and parallel markets for all products were growing. As a result, the authorities devalued the currency by 49 percent in early May 2012 and immediately floated it. Following this, inflation which was “artificially” held low for a long period increased from 12.4 percent in April 2012 to 29.7 percent in December 2012 due to the high pass-through effect.

\textbf{CHART 3: EXCHANGE RATE AND INFLATION}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart3.png}
\caption{Exchange Rate and Inflation}
\end{figure}

Source: Reserve Bank of Malawi

\textbf{There have been several monetary and exchange rate policy reversals since 1990.} These reversals are reflected in chart 4 where the positive correlation between money supply observed between 1990 and 2003 disappears between 2004 and 2011 but re-appears between 2012 and 2014 (see also appendix VI). This break down could be owed to a defacto exchange rate system and the virtual insubordination of monetary policy to fiscal policy. Modelling monetary policy as will be explained latter must recognise such breaks in data generating processes for meaningful policy analysis.

\textsuperscript{1}This information is contained in the first Reserve Bank of Malawi Inflation Expectations Survey conducted in July 2012. The Document is available on request from the Director, Research and Statistics Department.
Annual private sector expansion (Pvt growth) has averaged around 20 percent but no discernible correlation appears with policy rate (PR) as credit expansion is noticed to be even higher at policy rate of between 40 percent and 50 percent (see Chart 5). This casts initial doubts as to whether private sector borrowing is indeed influenced by interest rate changes.
Domestic debt stock is high arising mostly from persistent fiscal deficits. These have contributed to continued monetary expansion (see table 1). This, initially occurred alongside high external debt which was reduced in August 2006 following HIPC debt relief which saw US$3.2 billion worth of external debt written off. Fiscal deficits translate to fiscal dominance as government relies on the domestic financial market for financing (see table 1). Treasury and open market operations compete in similar sections of the yield curve, thereby bidding interest rates up. (Sims, 1980) notes that a fiscal authority that controls every component of the budget eventually control seigniorage, and in doing so would effectively determine monetary policy. Authorities that control seigniorage and interest rates do not control taxes and expenditures, but impose a long term relation between the two.

Until 2012, Malawi had enjoyed a decade of declining inflation and hence interest rates. As long as inflation was declining, monetary authorities kept reducing interest rates to aid the growth process. However, sources of growth were not from exports and hence not sustainable for an import dependent country.

CHART 6: INFLATION AND INTEREST RATE DEVELOPMENTS

Source: Reserve Bank of Malawi.

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2Recently though there have been noticeable strides from both the Treasury and monetary authorities to deal with this. These include closure of the automatic conversion of Ways and Means Advances among other measures.
The growth was largely driven by peasant agriculture, in particular maize production (a situation that still persists) which though draining foreign exchange, has no meaningful feedback on foreign exchange generation. The interest rate levels were therefore not sustainable and were reversed in May 2012 to deal with the ensuing macroeconomic imbalances.

2.2 MONETARY POLICY

After independence in 1964, the conduct of monetary policy was through direct instruments. The RBM was then subordinated to the Treasury. By 1989 there was evident failure of an activist monetary policy as evidenced by widening domestic and external imbalances. Financial reforms through Structural Adjustment programmes therefore commenced. Financial market including interest rates were decontrolled, foreign exchange market was liberalised and more robust fiscal frameworks (often in the context of IMF-supported stabilization programmes) were instituted. These opened up space for indirect monetary policy. The RBM Act was thus repealed in 1989, in a way giving the RBM legal independence. In 1994, the exchange was floated and the country started to actively pursue monetary aggregate targeting.

The mandate of the monetary authorities is to influence money supply, credit, interest rates and the exchange rate in order to promote price stability, economic growth and a sustainable balance of payments position (Part III (1) (d) of the Reserve Bank of Malawi Act 1989). (Kwalinga, 2007) observes that implementing such a broad mandate could be practically challenging. Meeting all objectives requires multidisciplinary approach. The RBM therefore set price stability as its measurable objective whose achievement would lead to sustainable BOP and GDP positions.

2.3 POLICY FRAMEWORK AND INSTRUMENTS

A monetary policy framework represents institutional arrangement within which monetary policy is formulated and implemented. There are four major types of frameworks; namely, direct targeting of interest rates, credit or prices; monetary
aggregates targeting; exchange rate targeting, and inflation targeting. Theory and evidence show that the choice of any for particular economy is a function of diverse factors. (Kasekende, 2010 Unpublished) observes that in Africa, there are 18 countries pursuing monetary aggregate targeting (MAT), 23 countries pursuing exchange rate targeting while about 6 are either actively pursuing or seriously considering migrating to inflation targeting.

The pursuit of MAT with reserve money (RM) as an operational target is based on Fischer’s quantity theory of money (QTM). The QTM directly links price developments to changes in monetary aggregates given stability of the money multiplier and velocity. In classical sense, controlling growth of monetary aggregates should ideally lead to controlling inflation. QTM is expressed as follows:

$$ M_t, v_t = P_t Y_t $$

Where $M_t$ is nominal money supply, $v_t$ is velocity of circulation, $P_t$ is general price level and $Y_t$ is real GDP growth. This equation states that the rate of inflation is approximately equal to the rate of growth of money in excess of the growth rate of real output given constancy in velocity.

To operationalise the QTM, first real GDP and inflation projections are made by government. These are combined with the assumed velocity of circulation, i.e. demand for money and money multiplier to derive money supply growth which is consistent with arriving at the projected inflation. Since the central bank cannot directly control money supply growth, it uses its balance sheet items namely Net Domestic Assets (NDA) and Net Foreign Assets (NFA) to alter liquidity conditions of the banking system. A ceiling on NDA as well as a floor on NIR is set consistent with desired growth in reserve money which is eventually set to influence money supply growth on to an inflation consistent path. These targets are mostly set within the confines of the country’s economic programme with the IMF programme.

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3 These four types of frameworks are implemented within several variations. For detailed discussion of various policy framework see Mishkin (1998).
Other than the Open Market Operations which include foreign exchange operations, the central bank actively uses the policy rate and the Liquidity Reserve Requirements as monetary policy instruments. The central bank also accords a lender of last resort to commercial banks through the Lombard Facility.

SECTION 3.0 LITERATURE REVIEW

3.1 THEORETICAL REVIEW

There are contending theories regarding the impact of monetary policy on nominal and real variable. Recent major views have been put forward by the real business cycle (RBC) and new-Keynesians school (NKE).

The RBC by (Kydland and Prescott, 1982) and (Prescott, 1986) contend that there is no role for monetary policy as the business cycle are a reflection of rational decisions by economic agents. Attempt to change this would in fact result in suboptimal outcomes. Disruptions to the business cycle are real and the economy’s position at any point in time reflect the equilibrium arising from optimising agents’ adjustments to the economic disruptions. In effect this mean that there is no role for monetary policy in the short run and that no attempts should be made by monetary authorities to use monetary policy because this will throw the economy out of the self-achieved equilibrium. The basic result from the this classical school is that real economic magnitudes are self-adjusting so that their equilibrium path is independent of monetary policy—a phenomenon known as neutrality of money.

Contrary to this view, the new-Keynesians find a significant role of monetary policy in the short-run arising from Calvo pricing. They argue that nominal rigidities in price and wage adjustments would result in monetary authorities exploiting dividends from monetary policy (Mankiw, 1985). In the new-Keynesian analysis monetary policy affects real variables in short-run.

The modern design of monetary policy is tilting towards the use of NK economics to exploit the Phillips and IS curves which are designed with nominal rigidities embedded in them. The trade-off between output and inflation in the short-run implies
that disinflation would result in temporary output loss and/or increased unemployment. In the long-run, however, the vertical Phillips curve based on rational expectations and continuous market clearing, suggests that monetary policy can only influence prices and not real variables. Thus, monetary policy should aim exclusively at price-stability. We use the graphical exposition in figure 1 to summarise the transmission mechanism of monetary policy.

**FIGURE 1: THEORETICAL EXPOSITION OF MONETARY POLICY TRANSMISSION**

In this exposition, the economy is characterized by three interrelated entities; households, firms, and monetary authorities. Each of these entities react to shocks based on the need to maximise utility given their budget constraints. The demand block determines the real sector activity $Y_t$ as a function of the expected future real activity $Y^e (+)$ and the real interest rate $i - \pi^e (-)$. The supply block relates inflation to real economic activity $Y_t (+)$. Monetary policy is prescribed by a central bank, by either setting the short-term nominal interest rate according to the Taylor-type policy rule

Source: Sbordone *etal* 2010
Taylor, 1993) or following some money growth rule as in (McCallum, 1988) in response to developments in inflation and real activity.

The effectiveness of policy innovations depends on the transmission mechanism. Several theories exist on the transmission process of monetary policy. These include credit channel, interest rate channel, exchange rate channel, asset price channels and expectations channel. These channels have mainly been discussed within the variants of IS-LM-framework proposed by Keynes and formalised by (Tobin, 1969)\(^4\).

### 3.1.1 The interest rate channel

Under the conventional Keynesian interest rate channel, an increase in short-term interest rates following changes in monetary policy increases the cost of capital, and hence depresses spending and hence inflation. Evidence of effectiveness of this channel in Africa has been documented by (Al-Mashat et al., 2007) and (Cheng, 2006) for Egypt and Kenya, respectively. This channel is not without critics. For example, (Bernanke and Gertler, 1995) argue that monetary policy has large effects on purchases of long-lived assets which should be more responsive to real long-term rates than real short-term rates.

### 3.1.2 The money supply channel

Contrary to the interest rate view of monetary policy transmission, (Friedman and Schwartz, 1963) show that the level of prices in the economy reflects money market conditions arguing for exogeneity of money. Beginning from equilibrium, a reduction in money balances which can be effected by monetary authorities will reduce aggregate demand and hence prices and vice-versa. Evidence in support of this channel is documented for both developed economies, (Friedman and Schwartz, 1963) and less developed economies, (Chimobi, E and Igwe, O, 2010) for Nigeria; this school too is not

\(^4\) Recently, the transmission mechanism has been discussed using the DSGE models which takes account of expectations see for example Gali and Monacelli (2005).
without controversy with recent criticism coming from the NKE that money is a veil and has no impact of real variables, strictly arguing for the potency of interest rates.

3.1.3 The credit channel
The credit channel explores financial market imperfections, particularly a wedge between externally and internally raised investment funds—external financing premium, (Bernanke and Gertler, 1995). The size of this premium is a reflection of market imperfections, and a change in market interest rates due to monetary policy is positively related to a change in the premium, hence credit conditions, money supply, prices and output. The credit channel is embedded under the balance sheet and the bank lending channels. In the former, as monetary policy tightens, borrowers’ balance sheets weaken, lowering their collateral value and raising external finance premium. This eventually raises adverse selection and moral hazard problems, leading to curtailment in lending and investment spending. The bank lending channel posits that a disruption in the supply of bank loans resulting from tight monetary policy makes loan-dependent producers incur costs associated with finding new lenders. This directly increases their external finance premium, lowers the levels of borrowing, and reduces real economic activity.

3.1.4 The exchange rate channel
With flexible exchange rates, a rise in domestic real interest rates resulting from tighter monetary policy stance results in net capital inflows due to interest rate differentials. This leads to domestic currency appreciation, as well as a fall in exports and hence output. Additionally, the appreciation makes imports more cheap, a leakage in the national income identity which lowers aggregate output. Changes in the exchange rate, therefore, have implications for individual spending, and firms’ investment behaviour, price stability and employment. Viability of the exchange rate channel is documented for Ghana by (Ocran, 2007) and for Malawi by (Mangani, 2012).
3.1.5 Expectations Channels

Under this channels, changes in policy rates change economic agent’s expectations of future interest rate path, growth and inflation. These expectations often affect decisions of firms and households about current saving and investment choices which then affect price of labour, goods, services and assets.

In summary, the Keynesian advocate that short-term real interest rates changes are more effective, while monetarists view changes in money supply as more potent. Meanwhile, the International Monetary Fund (IMF) lends support to the monetarists by extensively using the financial programming framework for its policy advice to the majority of the sub-Saharan African countries, including Malawi. Although, it remains a research issue, literature converges on the fact that long-run effects of monetary policy fall almost entirely on prices, with no discernible impact on the real variables but nominal rigidities help to exploit the dividends in the short-run, (Walsh, 2010).

2.2 EMPIRICAL REVIEW

In its regional economic outlook (IMF REO SSA, 2010) the IMF uses single equation and panel VAR frameworks to study effects of monetary policy on Sub-Saharan African countries. They find that a shock to reserve money increases output, inflation, and monetary aggregates, and leads to exchange rate depreciation in floating exchange rate regimes. This implies that money is a strong determinant of inflation in Sub-Saharan-African countries contrary to the weak links observed in advanced countries\(^5\). The study also finds strong evidence of price puzzle. An increase in the discount rate depresses growth, but, somewhat anomalously increases inflation and depreciates the exchange rate. These findings cast doubt on use of interest rates as an active monetary policy instrument in Africa. Rather, the evidence renders credence to monetary aggregate targeting in the region. They however point out that the influence of monetary policy on growth is weakened by supply shocks and changes in risk premiums at times of global turbulence, a feature that warrants further analysis.

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\(^5\) See Castelnouvo (2012)
Studies specific on Malawi remain unsynchronised. (Mangani, 2012) uses a VAR framework and demonstrates that that the Policy rate does not transmit to changes in inflation. The study further finds evidence that reserve money and broad money had no discernible impact on prices contradicting (IMF REO SSA, 2010). The exchange rate is found to have significant impact on prices, a finding which is consistent with small open economies whose production and consumption systems are import dependent. The study however did not income real GDP and this may have influenced observed results.

(Simwaka et al., 2012) uses an error correction model and finds that inflation in Malawi is driven by demand and supply factors. They find that money supply growth is positively related to prices with a lag of three to six months. These findings stand in contrast with (Mangani, 2012) but consensus emerges on the potency of exchange rate.

(Shawa, 2012) finds that money demand is stable, positively responds to changes in GDP. He also finds significant but low response of money to changes in interest rates. The stability of the money demand points to the fact that monetary aggregate targeting remains relevant for Malawi.

(Ngalawa and Viegi, 2011) argues that Monetary Authorities have employed hybrid operating procedures using the Policy rate as well as Reserve money. The study also finds that after the 1994 floatation of the Kwacha, the role of the exchange rate became conspicuous while the role of money and bank lending in the monetary policy transmission process became enhanced. He notes that monetary policy transmission evolved to become clearer after the 1994 floatation of the Kwacha. The finding that the transmission process became enhanced after adoption of the flexible exchange rate is revealing to monetary authorities especially in light of a recent (May 2012) re-launch of the floating exchange rate.

(Lungu et al., 2012) find that money demand is insensitive to changes in interest rates in the short run but weakly significant in the long-run. This insensitivity brings difficulties in the implementation of the reserve money programming framework.
(Mwabutwa et al., 2013) do not find evidence of the existence of the price puzzle and argue that from 2000, after financial policy reforms, monetary policy transmission has performed consistently with predictions of economic theory. He finds evidence that transmission mechanism is not observed prior to reforms; is blurred during the reforms and gets clearer after reforms.

**FIGURE 2: SUMMARY OF RESEARCHED TRANSMISSION CHANNELS ON MALAWI**

![Diagram](image)

Source: Authors’ Summary

In summary, further research on effectiveness of monetary policy in Malawi is necessary based on the following observations: Firstly, some studies e.g. (Shawa, 2012) use low frequency series in contrast to high frequency analysis required by monetary authorities. Other studies e.g. (Ngalawa and Viegi, 2011) use tobacco as a related series to interpolate GDP. Significant strides have been made to the extent that other sectors are now becoming more prominent (see appendix VII). (Simwaka et al., 2012) use the index of industrial production to proxy real GDP activity, a subject that still lacks unanimity for countries with low industrialisation.

Secondly, several fundamentals have changed in Malawi. There has been a shift from administered pricing to automatic pricing for fuel and automatic adjustment of electricity and water tariffs (May 2012). In terms of economic structure, there has been

---

6 Uses Chen (2006)
a modest increase in the share of vending (see appendix VII). The exchange rate is also not without controversy, having been on stop, reverse and go path. Inability to control for these changes in the data generation process in most studies and proceeding to the application of standard econometric techniques reduces the credence of findings.

Finally, most studies have used error correction techniques in the VAR framework. *(Sims, 1992)* argues that price puzzles may result from imperfectly controlling for information used by researchers in their models, a fact that *(Soares, 2011)* empirically demonstrates.

In view of the diverse findings and the divide in modelling approaches on the subject, this study contributes to the policy debate by digressing from the conventional VAR to a Factor Augmented VAR (FAVAR) approach after controlling for potential breaks and using the Principal Component Analysis. Including factors in the VAR widens the information set and exposes a coherent picture of the effects of monetary policy innovations by improving precision of the impulse responses. Since the pioneering work of *(Bernanke and Boivin, 2003)* and *(Bernanke et al, 2005)*, several studies have used the FAVAR; among others; *(Zuniga, 2011)* on Mexico and Brazil and *(Kabundi and Ngwenya, 2011)* on South Africa. The findings from these studies have disproved price puzzles and have been more informative than those derived from conventional VAR.

**SECTION 4.0 METHODOLOGY**

**4.1 THE VECTOR AUTO Regressive FRAMEWORK**

Correlation of macroeconomic variables is a fact. Making distinction between endogenous and exogenous policy shocks therefore becomes difficult, *(Stock and Watson, 1989)*. To deal with these, the VAR, commonly used for forecasting systems of interrelated time series and analysing the dynamic impact of random disturbances on the system of variables becomes handy. The VAR was introduced by *(Sims, 1980)*. This paper sidesteps structural modelling but harnesses the dynamic impact of random disturbances by treating every endogenous variable in the system as a function of the
lagged values of all of the endogenous variables in the system and an exogenous shock. The mathematical representation of a VAR is:

\[ y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \beta x_t + \epsilon_t \]

Where \( y_t \) is a \( k \) vector of endogenous variables, and \( x_t \) is a vector of exogenous variables, and \( A \) and \( B \) are matrices of coefficients to be estimated while \( \epsilon_t \) is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all explanatory variables. Since only lagged values of the endogenous variables appear on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates. Moreover, even though the innovations may be contemporaneously correlated, OLS is efficient and equivalent to Generalised Least Squares (GLS) since all equations have identical regressors.

Considering the shortcoming of the VAR, precisely inability to control for all the information, we augment the model with a factor computed from as many series as available and estimate a Factor Augmented Vector Autoregressive model.

### 4.2 Factor Augmented VAR

The model detailed below and much of its notation follows (Bernanke et al, 2005). Let \( Y_t \) be an \( MX1 \) vector of observable economic variables. Contained in \( Y_t \) are policy variables and observable measures of real activity and prices. The conventional approach of estimating VAR is to use vector \( Y_t \) alone. In practice, however, vast information is not in this vector and could be extremely relevant to policy dynamics.

Let this unobserved information set be condensed in a second vector, \( KX1 \) denoted as \( F_t \). \( K \) is expected to be relatively small as the FAVAR is a data reduction technique. (Bernanke et al, 2005), observes that \( F_t \) can be construed as reflecting theoretically motivated concepts such as unobserved economic activity, price pressures, or credit conditions that cannot easily be represented by one or two series but rather are reflected in a wide range of economic variables. We model the joint dynamics of the two vectors \( Y_t \) and \( F_t \) as:

20
\[
\begin{bmatrix}
F_t \\
Y_t
\end{bmatrix} = \phi(L) \begin{bmatrix}
F_{t-1} \\
Y_{t-1}
\end{bmatrix} + \varepsilon_t
\]

Where \( \phi(L) \) is a lag polynomial of finite order \( d \). The error term \( \varepsilon_t \) is orthogonal. If the terms in \( \phi(L) \) which relate \( Y_t \) and \( F_t \) are all zeros, the system degenerates to a standard VAR. If not then equation 2 becomes a factor augmented vector auto regression (FAVAR). Because the FAVAR model nests standard VAR, estimation of equation 2 allows for easy comparison and provides a way of assessing the marginal contribution of the additional information contained in \( F_t \).

(Bernanke et al, 2005) note that if the true system is a FAVAR, estimating a standard VAR system in \( Y_t \) excluding \( F_t \) will lead to biased estimates. In fact, it may be the case that the most realistic description of the information structure is that the central bank and the econometrician truly observe only the policy instrument (the nominal interest rate), as well as a large set of noisy macroeconomic including GDP, inflation and other indicators. If the size of the information set is small enough, it can be directly included in \( Y_t \). But practically it will be large and the VAR would suffer from over-parameterisation.

Equation 2 however cannot be estimated directly because the factors are unobservable. Let \( X_t \) be the \( Nx1 \) matrix of the informational set, such that \( N > K + M \). We can assume that the information time series \( X_t \) is related to the factor and the actual series by the following equation:

\[
X_t = \Gamma^f F_t + \Gamma^y Y_t + \nu_t
\]

where \( \Gamma^f \) is an \( NxK \) loading matrix of the factor while \( \Gamma^y \) is an \( NxK \) loading matrix of the observable variables. \( \nu_t \) is an \( Nx1 \) vector of error terms which are marginally cross correlated. Equation 3 states that \( Y_t \) and \( F_t \) characterize common forces that drive the dynamics of \( X_t \). Although \( X_t \) in equation has contemporaneous relationship with
independent variables, the equation can be modified without loss of generality and meaning by including lags of the factors.

Just like the unrestricted VAR, the FAVAR does not impose prior restriction on the relation among $X_t$, $F_t$, and $Y_t$. (Sims, 1980) argues that imposing prior structural constraints in modelling the behaviour of the economy may result in potential gains but these gains must be weighed against biases that may result if those restrictions are wrong (which often is the case). The implication of this is that most structural models including SVAR and the recent DSGEs if wrongly specified might be ill-suited to study monetary policy dynamics.

We use the triangular orthogonalization of the variance-covariance matrix to identify our FAVAR system. This is achieved by estimating the reduced form FAVAR model, then computing the Cholesky factorization of the covariance matrix of the model (Lutkepohl, 1993). This ensures that shocks to the VAR system can be identified as shocks to the endogenous variables in each equation. The approach adopted in the literature is to place policy variables last in the ordering. The basis for this is the assumption that policy variables can influence non-policy variables contemporaneously as well as with a lag, while the non-policy variables themselves can only be influenced by the policy variables after a time-lag due. To account for the uncertainty of the "generated regressor" in the second step we implement a bootstrap procedure, based on (Killian, 1998) when computing impulse response functions.

The factor can be estimated using two procedures. The first is to use the Principal Component Analysis (PCA) which is not parametric to recover a common space spanned by the factors in $X_t$ to extract the factors. The other approach is to use a single step Bayesian likelihood approach. (Bernanke and Boivin, 2003) use both procedures and find similar results and conclude that use of both methods in one analysis is redundant. We therefore use the two step process because of its superiority in handling data irregularities as it can take series of different frequencies and its computational
simplicity. In the first step, the factors are estimated using the PCA methodology while the second steps involves incorporating the estimated principal components in the VAR model to generate the FAVAR model.

4.3 THE PRINCIPAL COMPONENT ANALYSIS (PCA)

The PCA owed to (Hotelling, 1993), is a data reduction methodology that performs ordinary correlations and extracts common components driving a group of series. Given $N \times P$ matrix of data $X$ of rank order $r$, $X = UDV'$ where $U$ and $V$ are modelled as orthonormal matrices of the left and right singular vectors and D as a diagonal matrix containing the singular values. Vector $X$ can be modelled as $X = AB'$, where $A$ is an $n \times r$ matrix, and $B$ is a $p \times r$ matrix. Both matrices are of rank $r$. Matrix $A$ are principal component score and $B$ is a loading matrix. Let $\Sigma$ be a dispersion matrix of $X$ and performing Eigen Decomposition

$$\Sigma = LL'$$

Where $L$ is the PXP matrix of eigenvectors and $\Lambda$ is the diagonal matrix with eigenvalues on the diagonal. These eigenvectors are by construction orthogonal such that $LL = LL' = I_m$. We can write, $A = n^{b/2}L\Lambda^{1-\alpha}$ and $B = n^{-b/2}L\Lambda^\alpha$. If we set $U = YLD^{-1}$, $V = L$ and $D = (n\Lambda)^{1/2}$ then,

$$A = n^{b/2}YLD^{-\alpha},$$

$$B = n^{-b/2}LD^\alpha,$$

Where $0 \leq \alpha \leq 1$, is a factor which adjusts relative weighting of $L$ and $L'$ vectors and the terms involving $\beta$ are scaling factors where $\beta \in (0, \alpha)$. Our interest is matrix $A$ which is interpreted containing the weighted principal components scores which will be used in our second stage of estimation (FAVAR); and $B$ is the weighted principal components loadings.
However, Principal components A have in them influence from policy variables, e.g. policy rate because they were jointly estimated. It will be improper to use these in the FAVAR model without extracting the influence of the policy variables. Since the influence of these policy variables is unknown upfront we follow (Bernanke et al., 2005) and estimate their coefficients by running a multiple regression of the following format:

$$ A = \psi_1 \hat{SM} + \psi_i \sum_{i=1}^{3} PV + \varepsilon_i $$

Where $\hat{SM}$ is constructed by taking principal components for the slow moving variables which are not contemporaneously affected by the policy variables; and PV are our policy variables. The final principal components to be included in the FAVAR is computed as:

$$ \hat{F}_t = A - \psi_i \sum_{i=1}^{3} PV $$

The number of principal components can be as many as the information set. Inclusion in the FAVAR will depend on whether additional components add value to the results. We now proceed to estimate a VAR in $\hat{F}_t$ and $Y_t$ which we denote as FAVAR.

### 4.4 DATA AND ESTIMATION

In line with our theoretical expose, the observed variables are presented in Table 8. Details of variable definition is provided in appendix I. The model is estimated using E-views using Quarterly data from 1990 to 2013.

Malawi does not capture quarterly GDP statistics. We therefore follow several studies that have used univariate filters to interpolate and generate quarterly GDP using the Constant match average method which assign the same value to all quarterly observations arising from a particular low frequency data point. In this case the value

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1. Literature does not place emphasis on diagnostic tests for this equation, see Bernanke et al. (2005).
of the lower converted series is chosen so that the sum of the high frequency observations for a particular period matches the low frequency observation is divided by the number of observations.

<table>
<thead>
<tr>
<th>Table 2: Model Variables</th>
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<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Policy Instruments</td>
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<tr>
<td>Policy Rate (PR)</td>
</tr>
<tr>
<td>Exchange Rate (ER)</td>
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<tr>
<td>Intermediate Variables</td>
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<tr>
<td>Broad Money (M2)</td>
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<tr>
<td>Exchange rate (ER)</td>
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<tr>
<td>Goal variables</td>
</tr>
<tr>
<td>Real GDP (GDP)</td>
</tr>
<tr>
<td>Other (1)</td>
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<tr>
<td>Other (2)</td>
</tr>
</tbody>
</table>

Choosing information to include in $X_t$ is not a haphazard issue. Although (Stock and Watson, 2002) argue that more data is always good, (Boivin and Ng, 2005) demonstrate that in practice this may mean using more of the same data since most series are related. They also investigate this in the context of a forecasting exercise and find that it is possible to forecast equally well, and perhaps marginally better, by using factors from fewer screened series. (Bernanke et al, 2005) shows that the pre-screening of series is largely an ad hoc process.
Malawi has undergone several structural changes. Since the VAR model cannot capture dummy variables directly, we follow (Filmer and Pritchett, 2001) to extract this information through the principal component analysis. However, to locate dummy variables, we follow (Bai and Perron, 2003) Multiple Break Point Test.

Tests for structural parameter instability and structural change date back to (Chow, 1960) who tested for regime change at a priori known dates using an F-statistic. More recently, (Bai and Perron, 2003) provide theoretical and computational results that further extend the Quandt-Andrews framework by allowing for multiple unknown breakpoints and relax the assumption of knowing the break apriori. Following (Bai and Perron, 2003) we use least squares to regress selected number of data extracted from our information set on a constant as a dependent variable. The test allows for a maximum number of breaks, employs a trimming percentage of 15% and uses the 0.05 significance level for the sequential breaks.

The joint results for the suggested breaks are presented in Appendix III. From the results, three structural breaks are determined namely 1993(Q3), 1997(Q1) and 2009(Q1). Using the “Know thy economy” principle we also include 2012(Q2) as another potential break to capture significant changes in monetary and exchange rate policies that took place following change in the political regime. We follow (Filmer and Pritchett, 2001) and proceed to construct four dummy variables related to these period.

These dummy variables, together with our information set of 15 variables are used to construct principal components. While developed countries use a large volume of information set e.g. (Bernanke et al, 2005), literature does not provide specific guidance for Low Income Countries in terms of how many variables can be included in the information set. This issue in LICs is further complicated by challenges of data.

9These variables are Narrow money, Nonfood inflation, Food inflation, Treasury bill rate, Lending rates, and Private sector credit, Index of industrial production, Deposit rates and Commercial bank holdings of net foreign assets.

10Greenacre, Michael and Blasius, (2006) use Multiple Correspondence Analysis to extract common components where dummy variables need to be considered.
availability. The variables in our information set have been chosen based on their economic links to the monetary policy instruments\textsuperscript{11}.

A graphical exposition of FAVAR variables in Appendix II suggests that some of the variables could be trend stationary. Despite this, the models were estimated in levels using the ordinary least squares (OLS) method. The benefit in estimating the models in levels arises from the fact that the data would retain the desirable statistical properties and causal interrelationships that could be lost in the process of differencing. Indeed, (Bacchetta and Ballabriga, 2000) and (Braun and Shioji., 2004) adopt the same procedure.

We specify FAVAR using recursive ordering which imposes the identifying assumption that the unobserved factors do not respond to monetary policy innovations within the period, in our case quarterly. (Bernanke et al., 2005) argue that we need not impose that assumption on the idiosyncratic components of the information variables. We instead define two categories of information variables: “slow-moving” and “fast-moving.” Slow-moving variables are assumed not to respond contemporaneously to unanticipated changes in monetary policy e.g. Index of Industrial Production. In contrast, fast-moving variables are allowed to respond contemporaneously to policy shocks e.g. Private sector credit. Slow moving variables are therefore placed at the top while fast moving and policy variables are ordered last in the model.

SECTION 5.0 RESULTS

5.1 VAR Results

In order to infer the value added by the FAVAR to VAR analysis we first present impulse response results from an ordinary VAR\textsuperscript{12}. All models are estimated at lag 1 chosen based on Schwarz Information Criteria (see appendix V).

\textsuperscript{11}In this case we considered the economic links between the exchange rate, policy rate and money supply to each of the variables. For want of space and as standard practice with other FAVAR studies, we do not present these for all variables as is done with those that have been used to construct our FAVAR in Appendix 1.

\textsuperscript{12}All diagnostics pertaining to the validity of the estimated VAR are presented in appendix iv. The impulse responses are based on Kilian (1998).
Results from the VAR impulse response functions are consistent with the ones reported by (IMF REO SSA, 2010) for sub-Saharan African countries which show that GDP counter-intuitively rises as policy rate is raised. Most of the results are also consistent with (Mangani, 2012).

Two critical results motivate us to take the discussion further using the FAVAR. First, is the price puzzle finding i.e. that prices respond positively to an interest rate hike though not statistically significant. Furthermore, that GDP also counterintuitively rises when the policy rate is hiked. Second, is the liquidity puzzle i.e. the finding that money supply increases when policy rate is increased. These, it has been argued in literature
may result from inability for the econometric models to capture precisely the whole set of information that the central bank takes into account when setting the policy rate\textsuperscript{13}.

5.2 \hspace{3pt} FACTOR AUGMENTED VAR RESULTS

5.2.1 \hspace{3pt} IMPULSE RESPONSES

Impulse response for the FAVAR take account of only one factor. Although the number of components generated was equal to the number of variables in the information set i.e. 18, successive addition of subsequent factors neither improved nor worsened results. Therefore all the information excluded in the conventional VAR was deemed to have been captured by the first factor.

Strikingly different from the VAR results, the price puzzle completely disappears as the response of inflation turns out to be negative following one standard deviation innovation to policy rate. This finding which is in contrast to (Mangani, 2012) and (IMF REO SSA, 2010) corroborates (Mwabutwa et al, 2013)\textsuperscript{14} and (Muhanji et al, 2013) who use Time Varying Parameter VAR and Dynamic Stochastic General equilibrium frameworks, respectively, and disprove the existence of price puzzle in Malawi. (Bernanke et al, 2005) using US data found a similar result. The decline in inflation picks after 4 quarters and reverts to the steady state after 13 quarters.

GDP negatively responds to an interest rate shock in the short-run, a finding that is consistent with New Keynesian thinking that with nominal rigidities as described in (Gali, 2008), monetary policy is indeed able to influence real variable like GDP in the short-run. This finding contradicts (IMF REO SSA, 2010) on sub-Saharan Africa and is not revealed using the conventional VAR estimation above. The response of GDP to inflation returns to steady state and dies off after 13 quarters signifying the applicability of the classical long run neutrality of Money.

\textsuperscript{13} See Sims, 1992
\textsuperscript{14} The author goes further to argue that it is the transmission mechanism that has evolved and that after the adoption of the flexible exchange rate in 1994, transmission mechanism became much more clear, a finding that is corroborated by Ngalawa et al (2011)
Furthermore, another pronounced counterintuitive result where money supply is positively correlated with a rise in policy rate, (IMF REO SSA, 2010), disappears in the FAVAR simply leaving money supply non responsive to changes in policy rate. The implication of this finding is that money supply creation could be fiscal driven.

Results further show that there is a trade off in the use of either policy rate or money supply innovations in terms of stabilising inflation and output. It takes longer for the two variables to stabilise after a shock to money supply process than it does when policy is implemented using the interest rate tool. Precisely, inflation and GDP return to steady state values after 16 and 19 quarters, respectively following a one standard deviation shock to money supply process. It, however, takes only 13 quarter for both, inflation and GDP to fall back to the equilibrium path after a one standard deviation shock to the policy rate.

**FIGURE 4: FAVAR IMPULSE RESPONSES**

![Graphs showing impulse responses](image-url)
We also find significant response of inflation arising from money innovations in both conventional VAR and FAVAR. When money supply expands, inflation picks up. A natural policy extension to this is that controlling the growth of money would reduce inflation. But money supply does not respond to changes in interest rate. Put differently, money supply is significant but the credit channel is impotent. This finding alludes to the role of fiscal dominance in Malawi and is reflected in low correlation of private sector credit and policy in chart 5.

The study further confirms the finding by (Mangani, 2012) and (Simwaka et al., 2012) that a depreciating exchange rate raises inflation and that an increase in real incomes eventually leads to a decline in inflation.

Another issue relevant for policy is the apparent non-responsiveness of the exchange rate to changes in the policy rate. Theoretically, a rise in policy rate, through the uncovered interest parity phenomenon is expected to lead to a surge in foreign inflows and hence exchange rate appreciation. However, portfolio inflows are largely non-responsive to interest rate changes in Malawi.

The significant response of inflation to the “underlying factor” is reminiscent of a significantly large volume of information that is left out when other factors are not included in explaining the inflation dynamics.

In summary, our result completely eliminate the price puzzle and partially resolves the liquidity puzzle leaving overall money supply non-responsive to changes in interest rate. The latter could result from cancelling off effects between private sector credit reduction and expansion in credit to government. Policy rate increases coincide with heightened fiscal financing requirements. Therefore as private sector credit contracts\(^{15}\), following a rise in interest rate, the government financing requirements increase through higher interest rate payments thereby necessitating further recourse

\(^{15}\)This finding is confirmed in IMF REO (2010) where private sector credit is included in the model. It is found that private sector credit declines when interest rates are hiked. A part from private sector credit expansion another source of monetary expansion is from fiscal injections which have the potency to overshadow the response of overall Money supply to policy rate changes.
to domestic borrowing which eventually expands money supply. This may exert a netting off effect leaving the overall impact of policy rate innovations on money supply negligible. In this case, effectiveness of the policy rate as a monetary policy instrument will be pronounced when fiscal borrowing significantly reduces. The findings also confirm the authorities’ drive to keep the policy rate tight as long as money supply and inflation are rising and exchange rate is depreciating.

For robustness check and to demonstrate that conventional VAR without modifications applied over a sample period that had structural breaks can generate price puzzle, we re-estimate the conventional VAR but change the sample period from to 2004-2011, a period when the country pursued a defacto exchange rate peg alongside huge agricultural input subsidy programme. We use the same variables as in full sample VAR. Resulting impulse responses are presented in figure 5. There is no evidence of price puzzle. Instead the response of inflation to exchange and money supply is strengthened.

We furthermore control for food inflation by estimating another VAR and replacing overall inflation with non-food inflation only for the sample period 2004-2011\(^{16}\), results still show that both money supply and policy rate are significant with

\(^{16}\) This period is chosen because of its relative economic stability
respect to inflation and conform to theory. These results are reflected in Table 3 where a negative relationship between money supply and inflation is depicted for the period 2004 to 2011, which if not controlled for in the estimation processes, has tended to contribute to price puzzle findings. One can therefore observe that the transmission of monetary policy may not necessarily be divorced from the monetary and exchange rate policy frameworks within which the policies are implemented.

**FIGURE 6: IMPULSE RESPONSES FOR VAR WITH NONFOOD INFLATION**

![Impulse responses for VAR with nonfood inflation](image)

5.2.2 FORECAST ERROR VARIANCE DECOMPOSITION

The variance decomposition reported in Tables 3 and 4 pertain to the FAVAR structure as the main model. They show the forecast error of inflation at a given horizon that is attributable to a given shock.

**Table 3: Summary of Forecast Error Variance Decomposition**

<table>
<thead>
<tr>
<th>Endogenous Variables</th>
<th>Percentage of Forecast Error Variance attributed to each shock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>86.51</td>
</tr>
<tr>
<td>GDP</td>
<td>4.28</td>
</tr>
<tr>
<td>INF</td>
<td>61.55</td>
</tr>
<tr>
<td>M2</td>
<td>38.44</td>
</tr>
<tr>
<td>EXR</td>
<td>13.47</td>
</tr>
<tr>
<td>PR</td>
<td>66.75</td>
</tr>
</tbody>
</table>
A standard result of the VAR literature is that a monetary policy shock explains a relatively small fraction of the forecast error of real activity measures or inflation. This finding is reflected in the table 3. For a forecast period of 20 quarters, money supply and policy rate only explain 3.6 percent and 2.3 percent of the variations in GDP, respectively. Similarly, only 8.2 percent and 3.8 percent of the variations in inflation are explained by money and policy rate innovations, respectively. This fact alludes to the long-run monetary policy neutrality. From Table 4, the factor shows high inertia and explains about 60 percent of the variation in inflation while inflation explain about 15 percent of its own variation.

### Table 4: Variance Decomposition for Inflation

<table>
<thead>
<tr>
<th>Period</th>
<th>F</th>
<th>GDP</th>
<th>INF</th>
<th>M2</th>
<th>LNXR</th>
<th>PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61.59</td>
<td>0.06</td>
<td>38.35</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>2</td>
<td>66.60</td>
<td>3.17</td>
<td>27.48</td>
<td>1.32</td>
<td>0.14</td>
<td>1.30</td>
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<tr>
<td>3</td>
<td>66.75</td>
<td>6.43</td>
<td>20.85</td>
<td>3.21</td>
<td>0.29</td>
<td>2.47</td>
</tr>
<tr>
<td>4</td>
<td>65.49</td>
<td>8.93</td>
<td>16.89</td>
<td>5.01</td>
<td>0.42</td>
<td>3.25</td>
</tr>
<tr>
<td>5</td>
<td>64.05</td>
<td>10.67</td>
<td>14.50</td>
<td>6.53</td>
<td>0.53</td>
<td>3.73</td>
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<tr>
<td>6</td>
<td>62.80</td>
<td>11.80</td>
<td>13.05</td>
<td>7.71</td>
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<tr>
<td>7</td>
<td>61.84</td>
<td>12.49</td>
<td>12.18</td>
<td>8.60</td>
<td>0.71</td>
<td>4.19</td>
</tr>
<tr>
<td>8</td>
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<td>11.66</td>
<td>9.23</td>
<td>0.79</td>
<td>4.29</td>
</tr>
<tr>
<td>9</td>
<td>60.69</td>
<td>13.08</td>
<td>11.37</td>
<td>9.66</td>
<td>0.86</td>
<td>4.34</td>
</tr>
<tr>
<td>10</td>
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<td>13.16</td>
<td>11.21</td>
<td>9.94</td>
<td>0.92</td>
<td>4.37</td>
</tr>
<tr>
<td>11</td>
<td>60.22</td>
<td>13.18</td>
<td>11.13</td>
<td>10.12</td>
<td>0.98</td>
<td>4.38</td>
</tr>
<tr>
<td>12</td>
<td>60.11</td>
<td>13.17</td>
<td>11.08</td>
<td>10.22</td>
<td>1.03</td>
<td>4.38</td>
</tr>
<tr>
<td>13</td>
<td>60.04</td>
<td>13.15</td>
<td>11.06</td>
<td>10.28</td>
<td>1.08</td>
<td>4.38</td>
</tr>
<tr>
<td>14</td>
<td>59.99</td>
<td>13.14</td>
<td>11.05</td>
<td>10.31</td>
<td>1.13</td>
<td>4.38</td>
</tr>
<tr>
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<td>59.96</td>
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<td>11.04</td>
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<td>1.17</td>
<td>4.38</td>
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<tr>
<td>16</td>
<td>59.92</td>
<td>13.13</td>
<td>11.03</td>
<td>10.33</td>
<td>1.21</td>
<td>4.38</td>
</tr>
<tr>
<td>17</td>
<td>59.89</td>
<td>13.13</td>
<td>11.03</td>
<td>10.33</td>
<td>1.25</td>
<td>4.38</td>
</tr>
<tr>
<td>18</td>
<td>59.85</td>
<td>13.14</td>
<td>11.02</td>
<td>10.32</td>
<td>1.29</td>
<td>4.38</td>
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<tr>
<td>19</td>
<td>59.81</td>
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<td>11.01</td>
<td>10.32</td>
<td>1.33</td>
<td>4.37</td>
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<tr>
<td>20</td>
<td>59.78</td>
<td>13.17</td>
<td>11.01</td>
<td>10.31</td>
<td>1.36</td>
<td>4.37</td>
</tr>
</tbody>
</table>

### SECTION 6.0 SUMMARY, CONCLUSION AND POLICY DIRECTIONS

This paper examines the effectiveness of monetary policy in Malawi using a two-step Factor Augmented Vector Autoregression Model where the first step uses Principal Component Analysis and second step estimates a FAVAR. Results show that both, money supply and interest rate innovations have potency to affect inflation. However,
interest rate policy is found to be superior to monetary targeting as a stabilisation tool for both inflation and real GDP.

It is also observed that monetary and exchange rate policy reversals amplify business cycles and have contributed to divergent results on the subject. Policy reversals arise from poor institutions. Therefore it is important to improve institutions, such as central bank independence, goods and money market infrastructure e.g. credit reference bureaus and legal enforcement of contracts. These will reduce nominal rigidities and price stickness without necessarily eliminating them thereby enhancing policy effectiveness.

The significance of exchange rate in the inflation process means that foreign exchange generation is vital for inflation management. While in the short-term central bank accumulation of reserves is helpful, in the long-run an increase in exports must take charge. This will ensure that economic gains are not periodically reversed.

The finding that inflation strongly responds to money supply but money supply responds weakly to interest rate means that restoring fiscal sustainability and leaving monetary policy to perform stabilization function rather than financing fiscal deficits would enhance policy effectiveness.

Meanwhile Monetary Authorities must rely on a vast number of instruments to implement monetary policy due to data deficiencies\textsuperscript{17}. In this case, precise analysis of the trade-offs associated with deployment of multiple instrument is vital\textsuperscript{18}.

\textsuperscript{17}This is evidenced by a recent move (September-October 2014) by the central bank where it deployed a mix of policy instruments which included changes in the LRR directives, Policy rate increase, changes in foreign exchange trading rules, rebalancing of the domestic and foreign debt portfolios among others to avert the depreciation of the kwacha. These unconventional monetary tools may also complicate the analysis of the effectiveness of the major policy tools

\textsuperscript{18}Technical capacitation is one of the key interventions in process.
SECTION 7.0   REFERENCE

REFERENCES


Mangani, R. (2014). Effectiveness of Monetary Policy in Malawi, Evidence from an Autoregressive Distributed Lag model.


## APPENDIX I: VARIABLE DEFINITION

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Rate (PR)</td>
<td>This a monetary policy instrument set by the Reserve Bank of Malawi. It is an indicator of monetary policy stance and is set based on developments in inflation, money market rate and prospects for real GDP growth.</td>
</tr>
<tr>
<td>Inflation (Inf)</td>
<td>Is the rate of change in overall level of domestic prices. It is made up of 50.8% food inflation and 49.2% non-food inflation.</td>
</tr>
<tr>
<td>Exchange Rate (ER)</td>
<td>It is the official nominal Malawi kwacha per USD</td>
</tr>
<tr>
<td>Reserve Money (RM)</td>
<td>It calculated as the sum of currency in circulation, Vault cash and Commercial bank deposits with the Reserve bank of Malawi</td>
</tr>
<tr>
<td>Broad Money (M2)</td>
<td>It is the sum of currency outside banks, demand deposits, time and savings deposits</td>
</tr>
<tr>
<td>Read GDP</td>
<td>This is the real growth rate of the economy</td>
</tr>
<tr>
<td>Lending Rate (LR)</td>
<td>Average of maximum and minimum commercial banks’ lending rates</td>
</tr>
<tr>
<td>Factor $X_t$</td>
<td>Constructed through PCA analysis from the following variables: Index of industrial production (IIP)<em>, Food Inflation (FINF), Nonfood Inflation (XINF), 91 day Treasury bill rate (TBR), Deposit Rate (DR), Liquidity Reserve Requirement (LRR), Fiscal Deficit (Fisc), Narrow money (M1), Private sector credit (PSC), Net Credit to Government (NCG), Net Domestic Credit (NDC), Commercial Banks’ Net Foreign Assets (CBNFA), Crude Oil Price (OILP)</em>, Commodity Price Index (COMPI)* and Agriculture Commodity Price Index (AGCOMPI)*; Dum1(1997Q1), Dum2(1993Q3), Dum3(2009Q3) and Dum4 (2012Q2).</td>
</tr>
</tbody>
</table>

*Denotes Slow-moving variables, otherwise fast-moving
APPENDIX II: GRAPHICAL PRESENTATION OF THE MODEL VARIABLES

APPENDIX III: BAI PERRON MULTIPLE BREAK POINT TEST

Bai-Perron tests of L+1 vs. L sequentially determined breaks
Sample: 1990Q4 2013Q4
Sequential F-statistic determined breaks:

<table>
<thead>
<tr>
<th>Break Test</th>
<th>F-statistic</th>
<th>Scaled F-statistic</th>
<th>Critical Value**</th>
</tr>
</thead>
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<tr>
<td>0 vs. 1 *</td>
<td>13.11715</td>
<td>118.0544</td>
<td>25.65</td>
</tr>
<tr>
<td>1 vs. 2 *</td>
<td>4.699240</td>
<td>42.29316</td>
<td>27.66</td>
</tr>
<tr>
<td>2 vs. 3 *</td>
<td>8.651752</td>
<td>77.86577</td>
<td>28.91</td>
</tr>
<tr>
<td>3 vs. 4</td>
<td>3.186299</td>
<td>26.49069</td>
<td>29.67</td>
</tr>
</tbody>
</table>

* Significant at the 0.05 level.
** Bai-Perron (2003) critical values.

Break dates:

<table>
<thead>
<tr>
<th>Sequential</th>
<th>Repartition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1997Q1</td>
</tr>
<tr>
<td>2</td>
<td>1993Q3</td>
</tr>
<tr>
<td>3</td>
<td>2009Q1</td>
</tr>
</tbody>
</table>

Suggested Causes of Breaks
There was a big drought in 1992. In 1993, Malawi was undergoing political reforms from single party to plural political and the referendum was held in this year and this could be responsible for the structural break. In 2009, the country started experienced economic hardship following imprudent economic policies which included maintenance of an overvalued exchange rate.
APPENDIX IV: VAR DIAGNOSTICS

Jarque-Bera: VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null: Residual are Multivariate normal

<table>
<thead>
<tr>
<th>Component</th>
<th>Jarque-Bera</th>
<th>df</th>
<th>Prob.</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>61.97646</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>2</td>
<td>112.3804</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>3</td>
<td>0.328787</td>
<td>2</td>
<td>0.8484</td>
</tr>
<tr>
<td>4</td>
<td>32.08639</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>5</td>
<td>11.44858</td>
<td>2</td>
<td>0.0033</td>
</tr>
<tr>
<td>6</td>
<td>9.453745</td>
<td>2</td>
<td>0.0089</td>
</tr>
<tr>
<td>Joint</td>
<td>227.6744</td>
<td>12</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Inverse Roots of AR Characteristic Polynomial

Period | GDP      | INF       | M2         | LNXR      | LR         | PR          |
-------|----------|-----------|------------|-----------|------------|-------------|
1       | 2.117839 | 97.88216  | 0.000000   | 0.000000  | 0.000000   | 0.000000    |
2       | 3.314364 | 91.86097  | 1.474871   | 2.622484  | 0.562948   | 0.164362    |
3       | 6.367363 | 85.12153  | 3.789548   | 3.854011  | 0.436706   | 0.430839    |
4       | 10.59313 | 77.98423  | 6.618087   | 3.851466  | 0.332088   | 0.621000    |
5       | 14.11698 | 71.52013  | 9.909431   | 3.418035  | 0.319430   | 0.715993    |
6       | 16.00231 | 66.36442  | 13.33541   | 3.157269  | 0.365019   | 0.775565    |
7       | 16.45421 | 62.79013  | 16.18927   | 3.279332  | 0.439714   | 0.847353    |
8       | 16.17464 | 60.65137  | 17.99829   | 3.691101  | 0.526560   | 0.958050    |
9       | 15.76391 | 59.52451  | 18.79527   | 4.196522  | 0.609796   | 1.109992    |
10      | 15.51714 | 58.94992  | 18.92872   | 4.647110  | 0.675313   | 1.281800    |
11      | 15.48956 | 58.59544  | 18.77352   | 4.980254  | 0.716566   | 1.444664    |
12      | 15.61702 | 58.29475  | 18.57749   | 5.195464  | 0.736167   | 1.579103    |
13      | 15.80610 | 58.00466  | 18.44781   | 5.320430  | 0.741779   | 1.679227    |
14      | 15.98346 | 57.74114  | 18.39850   | 5.387602  | 0.740980   | 1.748310    |
15      | 16.11266 | 57.52989  | 18.40246   | 5.423048  | 0.738613   | 1.793320    |
16      | 16.18893 | 57.38216  | 18.42685   | 5.443820  | 0.736696   | 1.821538    |
17      | 16.22475 | 57.29142  | 18.44956   | 5.459736  | 0.735498   | 1.839032    |
18      | 16.23641 | 57.24058  | 18.46179   | 5.476327  | 0.734672   | 1.850226    |
19      | 16.23654 | 57.21083  | 18.46361   | 5.497043  | 0.733949   | 1.858021    |
20      | 16.23237 | 57.18741  | 18.45846   | 5.524210  | 0.733374   | 1.864175    |
APPENDIX V: FACTOR AUGMENTED VAR DIAGNOSTICS

FAVAR Lag Order Selection Criteria
Sample: 1990Q1 2014Q4
Included observations: 88

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
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<tbody>
<tr>
<td>0</td>
<td>-1518.918</td>
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<tr>
<td>1</td>
<td>-1006.271</td>
<td>943.7363</td>
<td>897.0385</td>
<td>23.82434</td>
<td>25.0061*</td>
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<tr>
<td>2</td>
<td>-957.7100</td>
<td>82.77438</td>
<td>681.7536</td>
<td>23.53886</td>
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<td>3</td>
<td>-911.3279</td>
<td>72.73560</td>
<td>553.9468</td>
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<tr>
<td>4</td>
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<td>83.16474</td>
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<td>54.07118</td>
<td>110.1200</td>
<td>20.87214*</td>
<td>29.14869</td>
<td>24.20655</td>
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## APPENDIX VI: EVOLUTION OF EXCHANGER RATE POLICIES

<table>
<thead>
<tr>
<th>Exchange rate regime</th>
<th>Period</th>
<th>Devaluation</th>
</tr>
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<tbody>
<tr>
<td>British pound sterling (GBP)</td>
<td>16 Nov 1965-18 Nov 1973</td>
<td>14% 20 Nov 1967</td>
</tr>
<tr>
<td>Basket of BFS and USD</td>
<td>19 Nov 1973-8 June 1975</td>
<td></td>
</tr>
<tr>
<td>IMF Special Drawing Right (SDR)</td>
<td>9 June 1975-16 Jan 1984</td>
<td>15% 24 Apr 1982</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12% 17 Sep 1983</td>
</tr>
<tr>
<td>Managed Float (Dutch Auction)</td>
<td>7 Feb 1994–End 1994</td>
<td></td>
</tr>
<tr>
<td>Fixed band</td>
<td>End 1994-1st quarter 1997</td>
<td></td>
</tr>
<tr>
<td>Free float</td>
<td>End 1998-mid 2003</td>
<td></td>
</tr>
<tr>
<td>Managed float</td>
<td>Aug 2003-End 2006</td>
<td></td>
</tr>
<tr>
<td>Fixed in USD</td>
<td>2007-April 2012</td>
<td>10% Aug 2011</td>
</tr>
<tr>
<td>Free Float</td>
<td>May 2012-to date (June 2014)</td>
<td>50% 7 May 2012</td>
</tr>
</tbody>
</table>

*These currencies were: USD (27%), GBP (27%), Germany Deutschmark (7%), South African Rand (ZAR, 18%), French Franc (7), Japanese yen (7) and the Dutch guilder (7). Figures in parentheses are basket weights.

## APPENDIX VII: GDP BY ECONOMIC ACTIVITY

<table>
<thead>
<tr>
<th>Item Description</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008*</th>
<th>2009*</th>
<th>2010*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Agriculture, forestry and fishing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01 Crop and animal production, hunting and related service activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02 Forestry and logging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03 Fishing and aquaculture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2 Mining and quarrying</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Manufacturing</td>
<td></td>
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Source: National Statistics Office

*Mean Preliminary