SECTORAL EFFECTS OF MONETARY POLICY IN MALAWI

MASTER OF ARTS (ECONOMICS) THESIS

By

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DECLARATION

I, the undersigned, hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes. Where other people's work has been used, acknowledgements have been made.

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Full Legal Name

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Signature

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Date

CERTIFICATE OF APPROVAL

The undersigned certifies that this thesis represents the student's own work and effort and that it has been submitted with his approval.

Signature:_____Date:_____

Exley B.D Silumbu, PhD (Senior Lecturer)

SUPERVISOR

DEDICATION

To Gray, Elyce, Linda, and Ju.

My thanks, My love.

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ABSTRACT

The sectoral effects of monetary policy in Malawi were analyzed in this study using the recursive VAR methodology. Specifically, the study sought to examine the differential effects of monetary policy on sectoral output and to examine the role of the exchange rate channel of monetary policy transmission in explaining these monetary policy effects. The analysis was carried out on annual time series data from 1980-2014. Sectors which are the key drivers of Malawi's GDP growth were analyzed. These include agriculture, manufacturing, and services. The analysis was based on pair wise granger causality tests and innovation accounting. The results indicate the presence of granger causality running from the exchange rate to agriculture output hence suggesting the importance of the exchange rate channel in agriculture. Furthermore, variance decomposition revealed that the exchange rate channel is the most effective monetary policy transmission channel in the agriculture sector whereas the interest rate channel was found to be most effective in the manufacturing and services sectors. It was hence concluded that the exchange rate does not better explain the sectoral effects of monetary policy in Malawi compared to the other channels. On the other hand, analysis of the impulse response functions showed that monetary policy shocks have differential impacts on output of all sectors. Thus, based on the findings, it is recommended that the RBM, in addition to encouraging entry and competition in the financial sector, must also leverage on its role as advisor to the government in order to positively affect sectoral output.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey Fuller
AEO	African Economic Outlook
AIC	Akaike Information Criterion
CPI	Consumer Price Index
FAO	Food and Agricultural Organization
GBP	British Pound Sterling
GDP	Gross Domestic Product
GoM	Government of Malawi
IMF	International Monetary Fund
LM	Langrange Multiplier
LR	Likelihood Ratio
LRR	Liquidity Reserve Requirement
MWK	Malawi Kwacha
NSO	National Statistical Office
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
OMO	Open Market Operations
RBM	Reserve Bank of Malawi
SC	Schwarz Information Criterion
SVAR	Structural Vector Auto regression
VAR	Vector Auto regression
WB	World Bank

WDI	World Development Indicator

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Economists have generally held different views regarding whether monetary policy has economically significant effects on real output. In recent times, however, there seems to be increasing agreement among monetary economists and policy-makers that monetary policy does have real effects, especially in the short run (Alam & Waheed, 2006). Consequently, focus of monetary policy analysis has shifted from a question of whether money matters, to emphasizing other aspects of monetary policy and its relations to real economic activity.

The 'sectoral effects of monetary policy shocks' is one of the aspects that has received considerable attention of late. Studies undertaken in various countries have found that different sectors or regions of the economy respond differently to monetary shocks (Pellenyi, 2011). This observation has major implications on macroeconomic management as the central bank will have to weigh the various consequences of its actions on different sectors or regions of the economy. For instance, the tightening of monetary policy might be considered mild from the aggregate perspective, yet it can be viewed as excessive for certain sectors. Accordingly, information on which sectors are more favourably or adversely affected by monetary easing (or tightening) provides

valuable information to monetary authorities in designing appropriate monetary policies (Alam & Waheed, 2006). Additionally, the results can contribute to our understanding of the underlying nature of the transmission mechanism. For these reasons, many economists have called for a disaggregated analysis of the monetary policy transmission mechanism (Crawford, 2007). This study, therefore, endeavours to investigate the effects of monetary policy on the output of various sectors in Malawi.

1.2 Problem Statement

For the most part, monetary research in Malawi has concentrated on the aggregate economy and has ignored important differences that can occur at the disaggregated level. Moreover, most studies in Malawi focus on impacts of monetary policy on prices. A few studies have looked at its impact on aggregate output. Studies by Ngalawa (2009), and Mwabutwa, Bittencourt and Viegi (2013), for example, found that aggregate output responds negatively to a monetary policy shock. There is need, therefore, to study the effects of monetary policy at a dissagregated level. If significant heterogeneity in responsiveness does exist among the various sectors in Malawi, monetary policy's capacity to effectively affect economic growth will depend on the relative size of the various sectors as a proportion of gross domestic product (GDP) (Crawford, 2007). We may expect then to find a link between output composition and the effectiveness of monetary policy which may be especially important for policy makers.

Furthermore, although the primary goal of monetary authorities in Malawi is to achieve a single digit inflation rate, over the course of the medium term, a secondary yet

nonetheless important goal is to keep output as close to its 'natural' level as possible (Reserve Bank of Malawi [RBM], 2015). In this sense, one of the principal objectives of the RBM is to improve economic growth. Evidently though, Malawi continues to experience high variability in real GDP growth and remains one of the least developed nations in the world (Mwanakatwe, 2014). This study therefore focuses on how particular sectors react to the RBM's policies so as to achieve this growth objective.

Additionally, Malawi is a net importer (Mwanakatwe, 2014). Export production is low and uncompetitive. This has led to low levels of foreign exchange over the years and has exacerbated the growth challenges. There is therefore a compelling need to correct the existing policy distortions that negatively impact output in the Malawian sectors and put the economy on the path of sustainable growth.

1.3 Objectives and Hypotheses

The main purpose of this study is to investigate the sectoral effects of monetary policy in Malawi. Consequently, the specific objectives are twofold:

- To investigate the differential effects of monetary policy on the output of various sectors (agriculture, manufacturing, and services)
- To examine the role of the exchange rate channel in explaining the sectoral effects of monetary policy in Malawi vis-à-vis the other channels (interest rate channel and credit channel).

The specific hypotheses are as follows:

- Monetary policy has no differential impact on the output of various sectors

- The exchange rate channel does not better explain the sectoral effects of monetary policy in Malawi as compared to the other channels.

The exchange rate channel is used as the benchmark transmission mechanism for comparison in this study because most studies in developing nations find that it is the dominant monetary policy transmission mechanism (Mangani, 2011).

1.4 Justification of the Study

There are several reasons why it is important to study the sectoral effects of monetary policy. According to Raddatz and Rigobon (2003), monetary policy will have a strong redistributive component if different sectors of the economy have different interest rate sensitivities. A government's goal of redistribution of wealth can therefore be made or broken depending on the monetary policy adopted.

Furthermore, a sectoral analysis of the impact of monetary policy may help clarify the aggregate transmission mechanism, as specific (and observable) sector characteristics will generate uneven output responses to a given change in monetary policy (Crawford, 2007). The variation in the responsiveness of output across sectors will be influenced by both demand and supply side factors. Notable factors that are suggested by economic theory include interest rate sensitivity of goods and services demand, and capital intensity of production, amongst others. Yet these differences in the responses to monetary policy, which have implications for policy effectiveness, are largely disguised at an aggregate

level – making disaggregated sectoral data more informative than aggregate data for the purposes of analyzing the transmission mechanism (Crawford, 2007).

1.5 Organization of the Study

The rest of the study is organized as follows: the next Chapter (Chapter two) presents an overview of the economy, an account of the key macroeconomic developments and the conduct of monetary policy in Malawi. Chapter three discusses the theoretical framework and empirical literature. The methodology is outlined in Chapter four, followed by results and discussions in Chapter five. Chapter six presents a summary as well as the policy implications and study limitations.

CHAPTER TWO

OVERVIEW OF THE ECONOMY, KEY MACROECONOMIC DEVELOPMENTS AND THE CONDUCT OF MONETARY POLICY IN MALAWI

2.1 Introduction

This Chapter focuses on the key macroeconomic developments and the conduct of monetary policy in the country. It is divided into three subsections. Section 2.2 presents an overview of the Malawian economy and introduces the agriculture, manufacturing, and services sectors. Section 2.3 highlights the key macroeconomic developments and Section 2.4 analyzes key developments in monetary policy over time.

2.2 Overview of the Malawian economy

Malawi is a small, Southern African land-locked country with a population estimated at 16.7 million and a population growth rate of 2.6 percent per annum (World Bank [WB], 2016a). The country's GDP was estimated at US$4.258 billion in 2014, and its gross national income per capita was US$250 only. The 2010/11 integrated household survey showed that over half of the population was poor and one quarter lived in extreme poverty (WB, 2016a). Other social indicators are similarly low, and the country ranked 153 of the 169 countries surveyed in the 2010 Human Development Index of the United Nations

Development Programme (African Economic Outlook [AEO], 2015). The economy is divided into three major sectors, viz.: agriculture, manufacturing, and services.

Agriculture is a key sector in the Malawian economy. It currently represents 33 percent of GDP. It accounts for over 80 percent of the labour force, and represents about 80 percent of all exports (AEO, 2015). The agriculture sector is divided into the smallholder and the estate subsectors (Government of Malawi [GoM], 2010a). The estate subsector mainly grows cash crops whereas the smallholder subsector is mainly engaged in mixed subsistence farming. About 80 percent of agricultural output is produced by the smallholder subsector, while the balance is from estates (Food and Agricultural Organisation [FAO], 2010). While it accounts for only about 20 percent of total national agricultural production, the estate subsector provides for over 80 percent of agricultural exports (GoM, 2010a). The following challenges are pertinent to the agriculture sector: heavy reliance on rainfall, low levels of adoption of modern farming technologies mainly due to financial constraints, and limited human capacity, among others (FAO, 2010).

Malawi's manufacturing sector currently contributes 11 percent to the national GDP. Its main industries are agro processing, construction, consumer goods, cement, fertilizer, ginning (cotton treatment), and furniture production. Manufacturing output is mostly derived from agro-processing (AEO, 2015; Malawi Investment and Trade Centre [MITC], 2016). Manufacturing has a high potential to improve economic growth especially because most opportunities present in the sector remain unexploited. For instance, most agricultural products are exported in a raw or semi-processed state. Huge opportunities therefore exist for investors to convert most of these products into high value finished

products (MITC, 2016). The major production constraints in manufacturing include: poor state of infrastructure, high transport costs, inadequate water and energy supply, and a high cost of capital (GoM, 2010b).

Services account for 56 percent of Malawi's national GDP. Notable industries are tourism, wholesale and retail, transport, education, health services, telecommunications, and the financial sector (AEO, 2015). Output from the services sector is dominated by wholesaling and retailing, which contributes 15 to 20 percent (Mangani, 2011). The sector is faced with a number of challenges affecting output including inadequate infrastructure, inadequate investment in the sector, and inadequate human resources (GoM, 2010b).

Figure 1 shows a comparison of the contributions of each sector to GDP for the years 1980 to 2014.

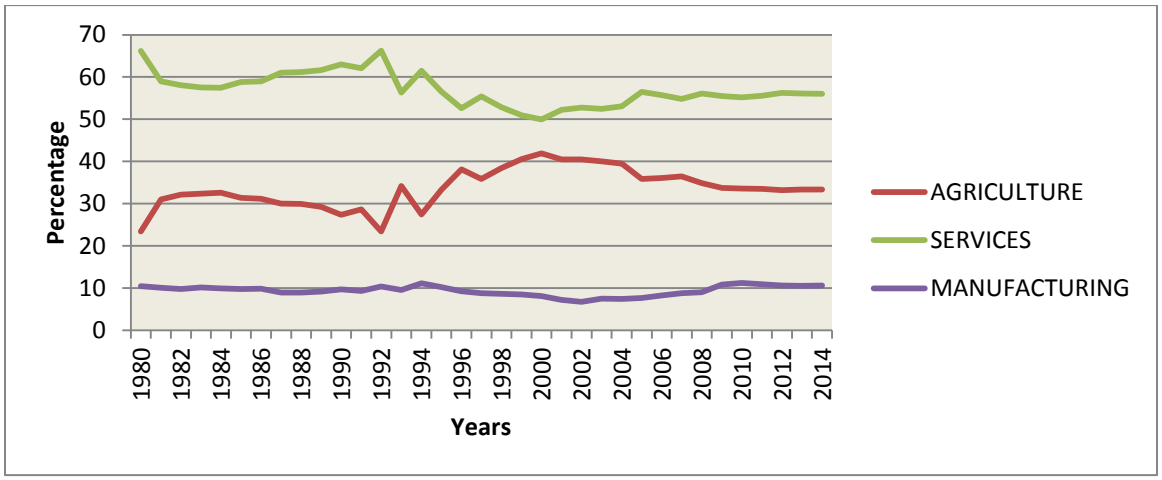


Figure 1: Sectoral Contributions to GDP

Source: compiled by author using data from NSO

The services sector contributes the most to GDP over the period, possibly because it is made up of numerous and relatively larger industries. The trends show that at peak, in

1992, the sector contributed 66.24 percent to GDP. On the other hand, the agriculture sector contributed 41.97 percent to GDP at its highest in 2000. As the figure shows, the contributions to GDP by the agriculture sector dropped in the years 1981, 1992, 2001 and 2005. According to FAO (2010) and Chalira (2009), each of these years had been characterized by drought. The low contributions to GDP can thus be attributed to this. It should be pointed out that following each drought, the Government tended to put in place interventions aimed at improving the agriculture output. The most notable intervention followed the 2004/2005 drought when Government introduced the Farm Input Subsidy Programme. Following this intervention, maize yields substantially rose, and this possibly explains the improvement in the agriculture sector's contribution to GDP in 2007 as shown in Figure 1.

Figure 1 also shows that the manufacturing sector's contribution to GDP has been relatively low over time. Even at its peak in 2010, it contributed only 11.23 percent to the GDP. This could be reflective of macroeconomic imbalances/ instability and policies that are not conducive to the sector. However, from around 2009, the sector's contribution to GDP started to show improvements, possibly due to initiatives such as the promotion of the public-private partnership arrangement championed by the Malawi government (GoM, 2010b). The Public Private Partnership initiative's primary task is to improve public goods and service delivery through transparent procurement of private sector partners for development (GoM, 2010b). Thus the private partners including manufacturers are given access to markets through this arrangement, thereby enabling them to expand.

2.3 Key Macroeconomic Developments

Malawi registered commendable rates of growth in GDP during the first fifteen years since independence in 1964, reaching a record high of 14.4 percent in 1971 (Ngalawa, 2009). However, this trend was not sustained from the early 1980s to the mid-1990s due to high costs of importation and exportation caused by the Mozambican war that disrupted the country's traditional transport route to Nacala Port. This was worsened by challenges arising from increasing inflation, declining tobacco prices on the international market, and drought incidences among others (Mangani, 2011). The downward trend continued and, as a result, the economy shrunk by about 5.2 percent in 1981 (Mangani, 2011).

The economy picked up sometime later, growing by 7.8 percent in 1991 on account of increased agricultural output. However, the withdrawal of foreign aid thereafter led to a growth reduction of 7.9 percent in 1992 (Mangani, 2011; Ngalawa, 2009). Following elections and adoption of multiparty democracy in 1994, donors resumed aid and the economy resurfaced. Significant growth, averaging 7.4 percent per annum, was recorded in the last part of the 1990s, despite shocks arising from the adoption of a floating exchange rate regime in 1994. Economic growth was reported to be 13.8 percent in 1995. However, this was followed by weak fiscal discipline, resulting into high fiscal deficits, high domestic borrowing, excess liquidity, high interest rates and the crowding out of private investment. This macroeconomic instability led to another decline in growth up to around 2004 (Mwabutwa et al., 2013).

Malawi's economic outlook since 2005 started showing signs of recovery from the sluggish performance (Mangani, 2011). Although the rate of annual real GDP growth has never reached the 14.4 percent peak recorded in 1971, the growth rate of 8.8 percent witnessed in 2008 represented a substantial improvement. Since 2006, annual economic growth averaged about 7.8 percent, significantly higher than the average of 3.3 percent over the period from 1996 to 2005 (Mwabutwa et al., 2013).

In 2009, however, Malawi started experiencing some setbacks including a general shortage of foreign exchange which damaged its ability to pay for imports, and fuel shortages that hindered transportation and productivity. This was followed by devaluation in 2012, but the country is yet to fully recover. Investment has continuously fallen overtime; the government struggles to address barriers to investment and productivity such as high interest rates, unreliable power, water shortages, poor telecommunications infrastructure, and the high costs of services (International Monetary Fund [IMF], 2016). Donors, who provided an average of 36 percent of government revenue in the past, suspended budget support for Malawi in 2011 due to a negative IMF review and governance issues (IMF, 2016). In 2014, Malawi's economy continued on the path to recovery in the aftermath of the economic crisis of 2012, which saw a contraction in real GDP growth to 2.1 percent. Real GDP growth in 2014 was around 5.7 percent, driven largely by agriculture but with significant contributions from manufacturing, and services (WB, 2016a). Growth in 2015 was projected to slow to 5.5 percent following the late arrival of rains and severe floods experienced in January 2015, which damaged crop and infrastructure. Growth momentum is expected to resume in 2016, with projected growth

of 5.7 percent assuming improved investor confidence, favourable weather conditions, higher agricultural exports, lower inflation and moderate interest rates (WB, 2016a).

2.4 Monetary policy in Malawi

2.4.1 Monetary policy framework

The conduct of monetary policy in Malawi since independence can be divided into three monetary policy regimes viz., period of financial repression (1964-86), period of financial reforms (1987-1994), and period of financial liberalization (post-1994) (Ngalawa, 2009; Sato, 2001). 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 impose unreasonably high charges on routine banking services (Ngalawa, 2009). To get rid of these distortions, direct controls on credit and interest rates were imposed. The agricultural sector, for example, was given preferential lending rates and quota credit allocations in line with the aim of promoting agricultural production. Government also adopted a fixed exchange rate system and imposed price ceilings on selected commodities as other forms of control.

In the late 1970s, a hostile external environment (the Mozambican war) forced the economy into a deep recession, which persisted through the 1980s. The failure of the economy to adjust to these shocks revealed structural weaknesses in the design of the country's macroeconomic framework. Government was forced, therefore, to implement a policy change from the mid-1980s to the 1990s, moving away from direct to indirect tools

of monetary control, among others (Chirwa, 2001). A phased financial liberalization 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 (Sato, 2001). This partial liberalization allowed commercial banks to determine their own lending and deposit rates but not to effect any adjustment without permission from the central bank. Credit ceilings were abolished in 1988 and in January 1990, the authorities abolished preferential lending rates to the agricultural sector. Complete liberalization occurred in May 1990.

The reform programme also revamped 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 1989 and December 1989 respectively. Basically, the Act stipulates that monetary policy in Malawi should aim at promoting economic growth, employment, stability in prices, and maintenance of a sustainable balance of payments position (Sato, 2001). The revised Banking Act extended the supervisory role of the RBM to include non-bank financial institutions, a function that was previously in the hands of the Treasury. In addition, inspection of the financial institutions was broadened to include 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 discount window facility. The discount window facility led to the introduction of the bank rate. 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 (Treasury bill yields) also follow the same direction (Mangani, 2011) –see figure 2.

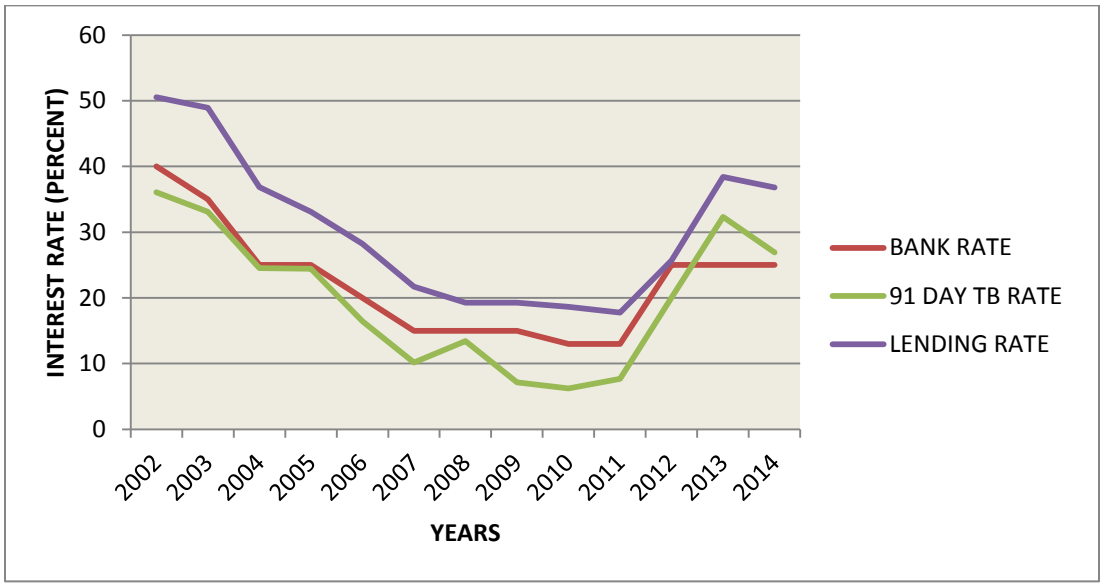


Figure 2: Interest Rates in Malawi (2002-2014)

Source: compiled by author using data from RBM

The country's financial reforms reached near-completion with the floatation of the Malawi Kwacha on February 7, 1994 (Ngalawa, 2009). Subsequently, the monetary authorities removed exchange control regulations, allowed for the establishment of foreign exchange bureaus, introduced foreign currency denominated accounts, established a forward foreign exchange market and started the trading of foreign exchange options and currency swaps. Eight new commercial banks entered the commercial banking sector since 1994, changing the structure of the market from a duopoly to a fairly competitive sector. The country's first discount house entered the financial sector in 1998 followed by a second one in 2002.

The official position of RBM is that monetary policy in the country utilizes a quantitative operating target known as reserve money, which is defined as the sum of currency in circulation, vault cash and bank deposits with the central bank (RBM, 2015). On the sources side, reserve money is defined as net domestic assets plus net foreign assets. In this framework, the foreign exchange market operates on the supply side of reserve money through the effect of foreign exchange transactions on net foreign assets.

As an instrument target of monetary policy, reserve money is used to reflect open market operations (OMO) and foreign exchange transactions (Ngalawa, 2009). In Malawi's OMO, the central bank undertakes weekly trading of RBM Bills and Malawi Government Treasury Bills in a competitive bidding system. The former are short-term financial instruments issued by the central bank for monetary policy purposes while the latter are short-term financial instruments issued by the Government through RBM to borrow funds from the general public for the financing of current fiscal deficits and maturing government debt.

In addition to the regular trading, RBM also sells extra securities on an ad hoc basis to discount houses and commercial banks which are referred to as 'tap sales'. While the monetary policy framework in Malawi is officially designated as reserve money targeting with OMO playing an important role, the system operates as if the central bank also targets short term interest rates through adjustments in the bank rate. So operationally, the RBM seeks to influence the reserve money and domestic interest rates to attain its

objectives. The main instruments available to the Bank remain the LRR, OMO, and the Bank rate (Sato, 2001).

2.4.2 Exchange Rate Policy

Various exchange rate regimes have been pursued in Malawi during its history (Mangani, 2011). The Malawi kwacha (MWK) was pegged to the British pound sterling (GBP) at one-to-one from 1964 to 1967, and at MWK2.00 = GBP1.00 between 1967 and 1973. Following the collapse of the Bretton Woods' fixed exchange rate system (due to problems arising from limited gold supply), the MWK was pegged to a trade-weighted average of the GBP and the United States dollar (US$) from November 1973 to June 1975. Since June 1975, the MWK was pegged to IMFs Special Drawing Rights (SDR). As the SDR began to appreciate, however, the MWK was also forced to appreciate to an extent that export development was constrained (RBM, n.d). In 1984 authorities delinked the MWK from the SDR and pegged it to a trade-weighted basket of seven currencies (US$, GBP, German deutschemark, South African rand, French franc, Japanese yen, and Dutch guilder). This period was characterized by frequent devaluations of the MWK, implemented in line with the IMFs structural adjustment programmes, in an attempt to improve the country's export competitiveness and balance of payments position.

Devaluations of 10, 20, 7, 15, and 22 percent against the US$ were effected between February 1986, and August 1992 (Mangani, 2011). In February 1994, the foreign exchange market was completely liberalized and the MWK was allowed free floatation. The immediate effect of the floatation was a 62 percent depreciation of the domestic

currency between February and December 1994 (Sato, 2001; Mangani, 2011; and RBM, n.d).

To operationalize the freely floating regime, an auctioning system was introduced at the time of floatation, allowing the highest bidder to purchase the available foreign exchange from the central bank (Sato, 2001). However, this system was found inappropriate given the limited number of players on the market. The Government then adopted a managed floating system in 1995, under which the authorities intervened to artificially influence the exchange rate through sales and purchases of foreign currency, hence managing it within a limited band. However, the band was removed in 1998 in favor of a free float, and then later reinstated in mid-2004.

During the latter part of 2011 and early 2012, however, Malawi found itself in a severe foreign exchange crisis. The country eventually introduced a series of reforms, including a 50 percent devaluation and subsequent floatation of the Kwacha in 2012 (Pauw, Dorosh, & Mazunda, 2013).

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter reviews the literature analyzed in determining the methodology used in the study. It discusses both the theoretical and empirical aspects of the relationship between monetary policy and sectoral output. Theoretical literature focuses on monetary policy transmission models and relates them to sectoral output. The empirical framework reviews a number of empirical studies undertaken, particularly focusing on their models, results, and how the current study differs from them.

3.2 Theoretical Literature

Monetary policy transmission mechanism is defined as the channel through which changes in money supply affects the decisions of firms, households, financial intermediaries, investors, and ultimately alters the level of economic activity and prices (Mishkin, 1996). This study employs the Keynesian approach of monetary policy transmission mechanism to real sector growth. The Keynesian approach suggests the following key transmission channels of monetary policy: the interest rate channel, the asset price channel, which is also known the wealth effect, the credit channel and the exchange rate channel (Bernanke & Gertler, 1995). In isolation, these broad channels do not fully indicate how monetary policy will affect the economic activity of specific sectors. However, if these channels are considered in the context of sector characteristics,

it is possible to draw inferences about which sectors are more interest rate sensitive (Crawford, 2007).

Under the interest rate channel, an increase in short-term interest rates due to the manipulation of a policy instrument increases the cost of capital, lowers demand for credit, depresses spending on durable goods and increases savings (Mangani, 2011). The interest rate channel therefore refers to the process through which changes in the stance of monetary policy alter the expenditure patterns of firms and individuals (Crawford, 2007). The presence of nominal rigidities, particularly in prices, means that a change in nominal interest rates translates into a change in real interest rates (Belanger, 2014). Real interest rates will reflect the opportunity cost of consumption for consumers and so contractionary monetary policy may induce them to postpone expenditure in favour of saving. The prospect of lower consumer expenditure may also reduce the incentive for firms to invest. However, more directly, this channel will increase the cost of capital for firms, which is also likely to discourage investment and output growth.

The extent to which these effects occur is difficult to observe because, among others, different investment projects will have different time horizons (Mangani, 2011). The interest rate channel is bench-marked on the conventional Taylor rule in equation 1, which reflects the actions of the monetary authority to adjust policy rates in relation to inflation and output movements (Nampewo, Munyambonera & Lwangwa, 2013).

$$r_t = \beta\pi_t + \delta y_t \qquad (1)$$

where;r_t is the short term interest rate, π_t is the inflation rate and y_t is the output.

Under this framework, a contractionary monetary policy reflected through a positive shock to the short term interest rate leads to a rise in the real interest rates. This increases the cost of capital and in turn constrains investment and eventually results in positive inflationary pressures, hence negative output growth (Mishkin, 1996).

Higher interest rates can also have wealth effects (Bernanke & Gertler, 1995). An increase in interest rates is typically associated with a fall in asset prices, which reduces the net worth of households and businesses. This may then reduce consumer confidence and subsequently dampen consumption and investment. However, this channel is not relevant in Malawi due to a small and underdeveloped capital market (Mangani, 2011).

The credit channel of monetary policy has recently received growing attention in empirical monetary policy literature. This channel relates to the impact of monetary policy on financial intermediation (Crawford, 2007). The channel postulates that financial market frictions amplify the effects of the interest rate and asset price/ wealth channels as banks are likely to increase their risk premia since the increase in interest rates depresses the value of debt-based asset portfolios and reduces the net worth and borrowing capacity of liquidity constrained agents (Crawford,2007; Angelopoulos& Gibson, 2009). Mishkin (1996) explains two ways in which this happens: the balance sheet channel and the bank lending channel. The balance sheet channel argues that tight monetary policy directly weakens borrowers' balance sheets, lowers their collateral for loans and credit-worthiness, and increases their external finance premium (Angelopoulou & Gibson, 2009). Lower net worth for borrowers increases both adverse selection and moral hazard

problems, leading to a decline in lending for investment spending. The bank lending channel has an indirect transmission effect from monetary policy upon growth. Through reducing bank reserves and bank deposits, a contractionary monetary policy stance decreases the quantity of bank loans available to borrowers (Bernanke & Gertler, 1995). This makes loan-dependent small and medium firms incur costs associated with finding new lenders (Mishkin, 1996). This directly increases their external finance premium, lowers the levels of their borrowing, and reduces real economic activity. While this effect is more relevant at a firm (and not industry) level, particular sectors may be on average less credit-worthy, which is likely to result in significant variation in the activity levels of sectors.

In a small open economy such as Malawi, the exchange rate channel is a particularly influential transmitter of monetary policy (Mangani, 2011; Nampewo et al., 2013). Assuming flexible exchange rates, a rise in domestic real interest rates reflective of tight monetary policy makes deposits denominated in domestic currency more attractive than those denominated in foreign currency. This results in an increase in net capital inflows thereby leading to domestic currency appreciation, and a fall in exports, export-oriented investment and output (Giovanni & Shambaugh, 2008). Additionally, the appreciation makes imports more competitive in the domestic economy.

Combined, these channels of monetary policy mean that sectors will not react uniformly to a monetary policy shock. Several studies have shown that the interest rate channel is more evident in sectors that produce durable goods as demand for these goods is more

interest elastic than demand for non-durable goods (Crawford, 2007; Mankiw, 1985). Sectors that are highly capital intensive are also more susceptible to the interest rate channel as higher interest rates will result in a higher overall cost of capital. On the other hand, sectors that have low levels of financial leverage and low overall interest coverage ratios are likely to be less interest rate sensitive.

The exchange rate channel has important implications for sectors that are more export oriented (Gruen & Shuetrim, 1994). The currency appreciation (or depreciation) perpetuated by contractionary (or expansionary) monetary policy will also affect import competing industries and those that heavily rely on imported inputs (Crawford, 2007).

3.3 Empirical Literature

This section discusses the empirical studies that have investigated the testable hypotheses presented in the foregoing sections. Most empirical studies use the Keynesian approach of monetary policy transmission described above. However, due to differences in the level of financial sophistication, intensity of Government regulations and macroeconomic conditions, monetary policy operates in varying ways across countries and regions.

A study by Ngalawa (2009) investigated the process through which monetary policy affects aggregate economic activity in Malawi. Using innovation accounting in a Structural Vector Autoregressive (SVAR) model, it was established that monetary authorities in Malawi employ hybrid operating procedures and pursue both price stability and high growth and employment objectives. The study uncovered that

monetary policy significantly impacts both aggregate prices and output. Specifically the study found that positive shocks to monetary policy reduce prices and output.

In a related study, Mwabutwa et al. (2013) investigated the evolution of monetary transmission mechanism in Malawi between 1981 and 2010 using a time varying parameter vector autoregressive (TVP- VAR) model with stochastic volatility. They found that the response of real output and prices to monetary shocks has been changing over time since adoption of financial sector reforms in the 1980s. Overall, both output and prices have been responding negatively to contractionary monetary policy.

Mangani (2011) studied the effects of monetary policy on aggregate prices in Malawi using a SVAR analysis. He examined the effects of monetary policy by tracing the channels of its transmission mechanism in the presence of market imperfections and fiscal dominance. Granger-causality, block exogeneity tests and innovation accounting analyses were conducted in order to describe the dynamic interrelationships among monetary policy, financial variables and prices. The study established that the exchange rate was the most important variable in predicting prices.

In another study, Alam and Waheed (2006) analyzed the relations between sectoral output and the monetary policy to find out whether monetary policy shocks have different sectoral effects in Pakistan. Their analysis considered the call money rate as a monetary policy indicator and seven different sectors of the economy and

estimated a Vector Auto regression (VAR) for each sector as well as for the aggregate production. Their results showed that some sectors are affected more by contractionary monetary policy than others. The manufacturing, wholesale and retail trade, and finance and insurance sectors tended to decline more in response to the interest rate shocks whereas agriculture, mining and quarrying, construction, and ownership of dwellings were found to be insensitive to interest rate changes.

Jansen, Kishan and Vacaflores (2013) wrote on the impact of monetary policy on net sales of publicly traded firms in various sectors of the United States (U.S.) economy. They found that monetary policy has a heterogeneous impact on firms in different industries, with the strongest effect being on firms in retail and wholesaling.

Radattz and Rigobon (2003) also studied the sectoral effects of monetary policy on the U.S. economy. Unlike Jansen et al. (2013), they focused on the role that monetary policy plays in the transmission of sectoral shocks using a SVAR analysis. They found significant differences in sectoral responses to monetary policy and also found that monetary policy is a significant source of sectoral transfers. In particular, they found that a shock to equipment and software investment induces a response by the monetary authority that generates a temporary boom in residential investment and durable consumption. Pellenyi (2011) used a structural factor model to analyze sectoral heterogeneity in the impact of monetary policy in Hungary. He found that the sectoral responses reveal significant heterogeneity. In particular, sectors more reliant on external finance showed larger output responses, whilst the rest showed

weaker price responses. The results therefore revealed that the credit channel of monetary transmission was in operation or operates in Hungary.

Nampewo et al. (2013) investigated the impact of monetary policy at the sectoral level in Uganda. Sectors which are the key drivers of Uganda's GDP growth were analyzed. These include agriculture, manufacturing, and service sectors. The analysis based on pair wise granger causality test and estimating a recursive VAR revealed that the exchange rate channel was the most effective monetary policy transmission channel to all the three sectors studied. Thus, based on the findings, they recommended that emphasis should be put on maintaining a stable exchange rate.

In summary, monetary policy effects vary at the sector level and across countries. Overall, studies that have looked at the sectoral effects of monetary policy are many but none focus on the Malawian economy. It is in this view that this study is conducted to determine the sectoral effects of Malawian monetary policy. Furthermore, some researchers do not apply an economy wide approach to studying the sectoral effects of monetary policy. Such studies (e.g. Jansen et al., 2013; Raddatz &Rigobon, 2003) only look at the effects of monetary policy within particular sectors of choice. The present study however takes into account all three major sectors of the Malawian economy. Additionally, most researchers focus on a particular transmission channel that is assumed to be more relevant for their countries (e.g. Crawford, 2007; Alam&Waheed, 2006). This study goes further and looks at three monetary policy transmission channels to uncover deeper insight into Malawi's transmission mechanism.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter discusses various analytical tools used in the study. A brief review of the modelling framework for estimation is presented before specifying the empirical econometric models. The chapter then describes variables and sources of data the study has used for estimation before finally discussing the relevant diagnostic tests and estimation techniques that were employed.

4.2 Modelling framework

Following Nampewo et al. (2013), the empirical approach employed in this study is theVAR framework. A VAR is an *n*-equation, *n*-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining *n*-1 variables. This framework provides a systematic way to capture rich dynamics in multiple time series, and the statistical toolkit it comes with is easy to use and interpret (Stock & Watson, 2001; Nampewo et al., 2013).

The simplest case of a VAR model, the reduced-form VAR model, expresses each variable as a linear function of its own past values and past values of all other variables (Nampewo et al, 2013). Each equation is estimated by ordinary least squares (OLS)

regression. The number of lagged values to include in each equation can be determined by a number of different methods (Stock & Watson, 2001). To illustrate this VAR using matrix notation, suppose that $x_t = (x_{1t}, x_{2t}, \dots\dots, x_{nt})$ is an $(n \times 1)$ vector each of whose elements, say x_{jt} (for all j=1,2,…,n) is a variable that can be included in the monetary policy transmission mechanism. A reduced-form VAR of order p in the levels of the variables is:

$$x_t = Ay_t + \Omega x_{t-1} + \cdots + \Omega_i x_{t-i} + \cdots + \Omega_p x_{t-p} + \varepsilon_t \qquad (2)$$

where $y_t$is a vector of deterministic variables such as constant, trend and seasonal terms, $\Omega_i$and A are matrices of coefficients to be estimated, and ε_t is an $(n \times 1)$ vector of error terms, ε_{jt}. The drawback with this VAR is that if the different variables are correlated with each other – as they typically are in macroeconomic applications – then the error terms in the reduced form model will also be correlated across equations (Kilian, 2011). Two main procedures are proposed to resolve this problem in a VAR framework. The first is to diagonalise the variance-covariance matrix of the VAR system using a triangular orthogonalisation process. This is achieved by estimating the reduced-form VAR model, then computing the Cholesky factorisation of the models' covariance matrix (Lutkepohl, 1993 as quoted in Mangani, 2011). This is called recursive VAR modeling. A recursive VAR constructs the error terms in each regression equation to be uncorrelated with the error in the preceding equations. This is done by including some contemporaneous values as regressors (Stock & Watson, 2001). The recursive VAR has the general disadvantage of being sensitive to the ordering of variables in the computation of the shocks. The approach adopted in the literature to mitigate this is to place policy variables first 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 delays in the availability of economic data, for instance (Crawford, 2007). This approach is quite reliable when the off-diagonal elements of the variance-covariance matrix are small (i.e., when the contemporaneous correlations among the relevant innovations are low).

The second approach to tackling the problem posed by the reduced form VAR involves imposing restrictions (identifying assumptions) on the matrix that governs the contemporaneous relations among the variables in the VAR, to reflect the structure of the economy (Stock & Watson, 2001). This is called the SVAR. Based on the assumptions made regarding the causal links among the variables; instruments are produced to facilitate the estimation of the contemporaneous links using instrumental variables techniques (Stock & Watson, 2001). Put simply, the SVAR uses economic theory to sort out the contemporaneous relationships between the variables (Mangani, 2011). A drawback of this SVAR modeling framework is that the estimation results are very sensitive to the identifying assumptions made. Any changes to the assumptions made result in substantial changes in the results (Stock & Watson, 2001). This study therefore adopts the recursive VAR framework.

4.3 Model specification

In line with this study's objectives (to investigate the differential effects of monetary policy on the output of various sectors and to investigate the role of various monetary transmission channels- the exchange rate channel, the interest rate channel, and the bank credit channel in explaining the sectoral effects of monetary policy); the study will estimate three VAR systems -for the three sectors (agriculture, manufacturing, and services) under study. Each system consists of six endogenous variables namely: 91- day Treasury bill interest rate (TB), used as a proxy to signal the monetary policy stance; the lending interest rate (LR), included to capture the interest rate channel; the natural log of nominal exchange rate (LEXC), included to capture the dynamics of the monetary policy transmission mechanism through the exchange rate channel; the natural log of domestic credit to private sector by banks (LPR), included to capture the bank credit channel; the natural log of Consumer Price Index (CPI) inflation (LCPI), included to capture inflation; and finally the natural logs of GDP value added for agriculture (LAGR), manufacturing (LMAN) and services (LSERMG), included to capture the sectoral outputs.

The VAR systems for this study are specified as follows:

$$Ax_t = B(L)Lx_t + \varepsilon_t \qquad (3)$$

where:

$x_t$is a $(k \times 1)$– dimensional vector of the endogenous variables (TB, LR, LPR, LEXC, LCPI, LAGR/ LMAN/ LSERMG), A is a $(k \times k)$- dimensional autoregressive coefficient matrices, L is the lag operator, that is;$Lx_t = x_{t-1}$and $B(L)$ is $B_0 + B_1L + B_2L^2 + \cdots + B_kL^k$ is the autoregressive lag order polynomial; while, ε_t is dimensional vector of the stochastic error term normally distributed with white noise properties $N(0, \sigma^2)$.

In order to capture the impact of shocks within the monetary policy variables upon sectoral output, a recursive VAR model is estimated from the reduced VAR form. Thus, from equation (3), the reduced form VAR is estimated in equation (4)

$$x_t = A^{-1}B(L)Lx_t + \mu_t \qquad (4)$$

Where $\mu_t$is $A^{-1}.\varepsilon_t$is a vector of reduced form residuals with$E(\mu_t\mu_t') = \Omega$.

Structural shocks are generated using Cholesky decomposition of the variance-covariance m**a**trix of the reduced form VAR residuals,Ω from equation (4). The relationship between the reduced form VAR residuals and the structural disturbances is presented in equation (5).

$$\begin{bmatrix} \varepsilon^{tb} \\ \varepsilon^{lr} \\ \varepsilon^{pr} \\ \varepsilon^{exc} \\ \varepsilon^{cpi} \\ \varepsilon^{gdp} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{tb} \\ \mu_t^{lr} \\ \mu_t^{pr} \\ \mu_t^{exc} \\ \mu_t^{cpi} \\ \mu_t^{gdp} \end{bmatrix} \qquad (5)$$

Whereμ_t^{tb} denotes monetary policy shocks,μ_t^{lr} interest rate shocks,μ_t^{pr}credit to the private sector shocks, μ_t^{exc} exchange rate shocks, μ_t^{cpi} sectoral output shocks and μ_t^{cpi} inflation shock. The structural model is identified because the $\frac{k(k-1)}{2}$restrictions are imposed on the matrix A as zero restrictions where k denotes the number of endogenous variables in the VAR system (Nampewo et al., 2013).

The resulting matrix implies that in the first equation, a monetary policy shock is not a reaction to changes in the other variables in the model. In the second equation, lending rates respond to monetary policy shocks only; in the third equation, private sector credit responds to the monetary policy and lending rate shocks only; in the fourth equation, the

nominal exchange rate responds to the monetary policy shocks, the lending rates shocks and shocks due to private sector credit only; in the fifth and sixth equations, inflation and sectoral outputs react to all the shocks due to other variables in the system.

4.4 Description and Justification of the Variables

This section gives the description and justification of the variables. It also explains the relationships among the variables.

Natural Log of GDP Value Added Agriculture, Manufacturing, and Services (LAGR, LMAN, LSERMG)

GDP Value added is the measure of the value of goods and services produced in an area, industry or sector of an economy (Miles & Scott, 2005). The units of measurement adopted for this variable for the purposes of this study are millions of Kwacha (2010 chained prices). GDP value added for the various sectors is used as a measure of the sectoral output in this study.

91 Day Treasury bill rate (TB)

In line with Crawford (2007) and Nampewo et al. (2013), this study uses the short term interest rate (annual average 91 day Treasury bill rate) as a proxy to signal the monetary policy stance because it remains variable over time. By definition, short term interest rates are the rates at which short term borrowings are effected between financial institutions or the rate at which short term government paper is issued or traded in the market (Organization for Economic Cooperation and Development [OECD], 2014). Their

typical standard names are “money market rate” and “treasury bill rate”. Long term interest rates on the other hand are interest rates on financial instruments with a maturity of longer than one year (OECD, 2014; Lewis & Mizen, 2000). In general, monetary policy actions are transmitted to the economy through their effect on market interest rates. According to this standard view, contractionary monetary policy by the central bank pushes up both short term and long term interest rates. However, causative observation suggests a close connection between central bank action and short-term interest rates (Wen, 2004). The relationship between policy and long term interest rates appears much looser and more variable. Short term interest rates are therefore generally used as an indicator of monetary policy action. This study uses the 91 day Treasury bill rate and not the call money rate that is used in some studies because of its data availability. Apriori, we expect a positive shock to this variable to lead to a decline in sectoral output.

Lending rates (LR)

Annual average lending rates are used in this study. A lending rate is the bank rate that usually meets the short and medium term financing needs of the private sector (WB, 2016b). Put simply, it is the amount that a bank charges on money that it lends out. A change in the monetary policy stance will lead to a change in the lending rate which will then affect economic activity (output). This reflects the interest rate channel of monetary policy. Lending rates are therefore used in this study to capture the interest rate channel. Apriori, we expect a positive shock to this variable to lead to a decline in sectoral output.

Natural Log of Nominal Exchange Rate (LEXC)

The nominal exchange rate is the rate at which the currency of one country is traded for the currency of another (Mankiw, n.d). The nominal exchange rate is used in this study to capture fluctuations in the exchange rate (and hence capture the exchange rate channel). Specifically, the study uses the MWK/ US$ bilateral exchange rate. Apriori, we expect a positive shock to the exchange rate (depreciation) to lead to an increase in output of export oriented sectors. Annual average nominal exchange rates are used in the study.

Natural Log of Domestic Credit to the Private Sector (LPR)

This variable enters the study as a percentage of total GDP. Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations (except central banks) such as through loans, purchases of non-equity securities, and trade credits and other accounts receivables that establish a claim for repayment (WB, 2016c). A change in the monetary policy stance will lead to a change in credit availability which will later affect economic activity. This reflects the credit channel of monetary policy. Domestic credit to the private sector is therefore used in this study to capture the credit channel of monetary policy transmission. Apriori, we expect a positive shock to credit to the private sector to improve sectoral output (especially for interest rate sensitive sectors).

Natural Log of CPI Inflation (LCPI)

The annual average consumer prices percentage change is used to measure inflation in this study. Inflation is the increase in the general level of prices (Mankiw, 2003). CPI

inflation (inflation measured by the consumer price index) is the standard measurement of inflation. CPI inflation is included in the model to capture the impact of its shocks to sectoral output. CPI inflation will impact output negatively (especially in the long run) because it entails an increase in the cost of production.

4.5 Data Sources

The analysis is based on annual data spanning from 1980 to 2014 (see Appendix 1). The major data sources include the RBM, NSO, and the EconStat World Development Indicators (WDI) website. Gross value added was obtained from NSO whereas CPI inflation, the nominal exchange rate, 91 day Treasury bill rate, and lending rates are taken from the RBM. The private sector credit was drawn from the Econstat WDI website. The study employs the E-views statistical package for data analysis.

4.6 Lag Length Determination in the Model

In a VAR model, lag length selection is critical. Long lag lengths consume degrees of freedom whereas a small lag length may render the model misspecified (Gujurati, 2004). The Akaike Information Criterion (AIC), the Schwartz Information Criterion (SC), and the Log Likelihood Ratio (LR) are alternative methods used to select lag length. For the AIC and SC, selection is based on the model that yields the smallest value of the criterion. In case of the LR, the null hypothesis is that the restriction is binding. If the calculated value of the statistic is less than the critical at a pre-specified significance level, we fail to reject the null hypothesis. The test continues until the appropriate lag is established (Enders, 2004 as quoted in Chalira, 2009).

4.7 Time Series Properties

4.7.1 Stationarity Definition

Estimation and hypothesis testing using time series data is based on the assumption that the variables are stationary or independent of time. A stationary series is a series with a time invariant mean, variance, and covariance (Gujurati, 2004). If the series is not stationary, the means, variances, and covariances of the time series will not be well defined. To rectify this, the series are differenced. The VAR models in this study are however estimated in levels in order to avoid losing information surrounding possible long-run relationships among the variables. This was confirmed by Sims, Stock and Watson, 1990 (Nampewo et al., 2013).

4.8 Diagnostic Tests

Since the VAR estimation analysis uses the OLS technique for each equation in the system, it is necessary to conduct the following tests to ensure that the OLS assumptions are met and the estimates are unbiased, efficient, and consistent.

4.8.1 Auto regression (AR) or Serial Correlation (LM) Test

A common problem in using time series regressions is that the estimated residuals tend to be correlated across time. Serial correlation makes OLS estimates to have small standard errors that yield inefficient, biased and inconsistent estimates especially when lagged dependent variables are included on the right hand side of the test equation.

The Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test is used to test for higher order autocorrelation among the errors and is applicable whether or not there are

lagged dependent variables (Wooldridge, 2006). The null hypothesis is that there is no serial correlation up to a pre-specified lag order against the alternative of the presence of serial correlation.

4.8.2 White's Test for Heteroskedasticity

This test undertakes an auxiliary regression analysis: it regresses the squared residuals from the original regression model onto a set of regressors that contain the original regressors along with their squares and cross-products (Wooldridge, 2006). One then inspects the R^2. The LM test statistic is the product of the R^2 value and sample size:

$$LM = n \times R^2 \qquad (6)$$

This follows a chi-squared distribution, with degrees of freedom equal to $k - 1$, where k is the number of estimated parameters (in the auxiliary regression). The null hypothesis is that there is homoskedasticity.

4.9 Granger Causality Tests

Granger causality tests are statistical hypothesis tests for determining whether one time series is useful in forecasting another (Gujurati, 2004). Granger causality implies a correlation between the current value of one variable and the past values of others; it does not mean changes in one variable cause changes in another. By using an F-test to jointly test for the significance of the lags on the explanatory variables, this in effect tests for 'Granger causality' between these variables. It is possible to have causality running from variable X to Y, but not Y to X; from Y to X, but not X to Y and from both Y to X and X to Y, although in this case interpretation of the relationship is difficult. Bivariate granger

causality tests are conducted in the study to show the direction of causation between the variables.

4.10 Innovation Accounting

Innovation accounting is a tool used for forecasting in VAR models (Stock & Watson, 2001). It is done through impulse response function and variance decomposition analysis. The impulse response function traces out the effects of a shock to an endogenous variable on the variables in the VAR system in the current, as well as future periods, whereas variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. In other words, variance decomposition shows the relative importance of each random innovation to the variables in the VAR. Variance decomposition is used in this study to determine the roles the various monetary policy transmission channels play in explaining the sectoral effects of monetary policy in Malawi.

CHAPTER FIVE

ECONOMETRIC ESTIMATION AND INTERPRETATION OF RESULTS

5.1 Introduction

The present chapter describes the empirical results of the study. Specifically, 5.2 and 5.3 present the lag length selection criteria and diagnostic tests respectively. Section 5.4 presents the results and discussion of the study with respect to the postulated hypotheses and existing knowledge on the subject under investigation.

5.2 Lag Length Selection Criteria

The appropriate lag length was selected based on the LR test and the AIC. Based on these criterions, a common lag length of 2 for each VAR model was adopted. The lag order of 3 was not opted for because of the small sample size at hand. The results of the lag selection criteria are presented in Table 1 to 3.

Table 1: Lag Selection Criteria (Agriculture)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-272.3917	NA	0.856479	16.87223	17.14432	16.96378
1	-88.85957	289.2022	0.000117	7.930883	9.835529*	8.571739*
2	-45.26467	52.84231*	9.27e-05*	7.470586*	11.00779	8.660746

* indicates lag order selected by the criterion

Table 2: Lag Selection Criteria (Manufacturing)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-280.2070	NA	1.375374	17.34588	17.61797	17.43743
1	-78.50294	317.8367	6.22e-05	7.303209	9.207854*	7.944064
2	-23.88502	66.20354*	2.54e-05*	6.174850*	9.712050	7.365010*

* indicates lag order selected by the criterion

Table 3: Lag Selection Criteria (Services)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-263.9640	NA	0.513916	16.36146	16.63355	16.45301
1	-70.76252	304.4387	3.89e-05	6.834092	8.738738*	7.474947
2	-19.87214	61.68531*	1.99e-05*	5.931645*	9.468844	7.121805*

* indicates lag order selected by the criterion

5.3 Diagnostic Test Results

5.3.1 Serial Correlation

In this analysis, the Breusch-Godfrey LM test was used to test for serial correlation of the residuals. The test found that there is no higher order serial correlation in all the VARs. This implies that the standard errors are valid and therefore, the test results are efficient and unbiased. See Appendix 2.

5.3.2 Heteroskedasticity

The white's test was conducted to check for heteroskedasticity of the residuals in the VAR models. The null hypothesis states that all the residuals have constant variance or are homoskedastic. The results in Appendix 3 reveal that the probability value remains

higher than the 5 percent level of confidence hence we fail to reject the null hypothesis that the residuals are homoskedastic.

5.4 Results and discussion

5.4.1 Pair wise granger causality

The pair-wise granger causality test was employed to identify possible relations between the monetary policy variable and the monetary policy transmission variables; and the monetary policy transmission variables and sectoral output variables. Hence, both hypotheses (monetary policy has no differential impact on output of various sectors; and the exchange rate channel does not better explain the sectoral effects of monetary policy as compared to the other channels) are tested using this test. The results in Appendix 4 reveal a bi-directional causation between the 91 day Treasury bill rate and the lending rates and a unidirectional causation from the 91 day Treasury bill rate to credit to the private sector. In addition, the tests reveal that the exchange rate granger causes agriculture output. This could imply that the exchange rate channel is dominant in the agriculture sector. However, since granger causality only implies correlation, the study proceeds to plot impulse response functions for better detail.

5.4.2 Impulse response functions

Impulse response analysis in this study was mainly conducted to test the hypothesis that monetary policy has no differential impact on the output of various sectors. The impulse responses also attempt to show how sectoral output reacts to inflation. The impulse response analysis was mainly based on the impact of a positive one standard deviation

shock from the monetary policy transmission variables and inflation upon agricultural, manufacturing, and services output. The response functions are plotted within 95 percent confidence interval bands. The confidence interval bands show the significance of the impulse response functions. Only the response graphs that fall within the confidence intervals and do not include zero are significant (Stock & Watson, 2001). Those that include zero and fall outside are insignificant. Since this study focuses on the sectoral effects of monetary policy, only the responses of sectoral output to the other variables are reported in Figures 3 to 5 below while responses of the other variables to shocks in each other are reported in Appendix 5. As shown in this Appendix; the exchange rate, credit to the private sector, and interest rates all respond significantly to the monetary policy variable (91 day TB rate). This confirms their use in the study as monetary policy transmission variables.

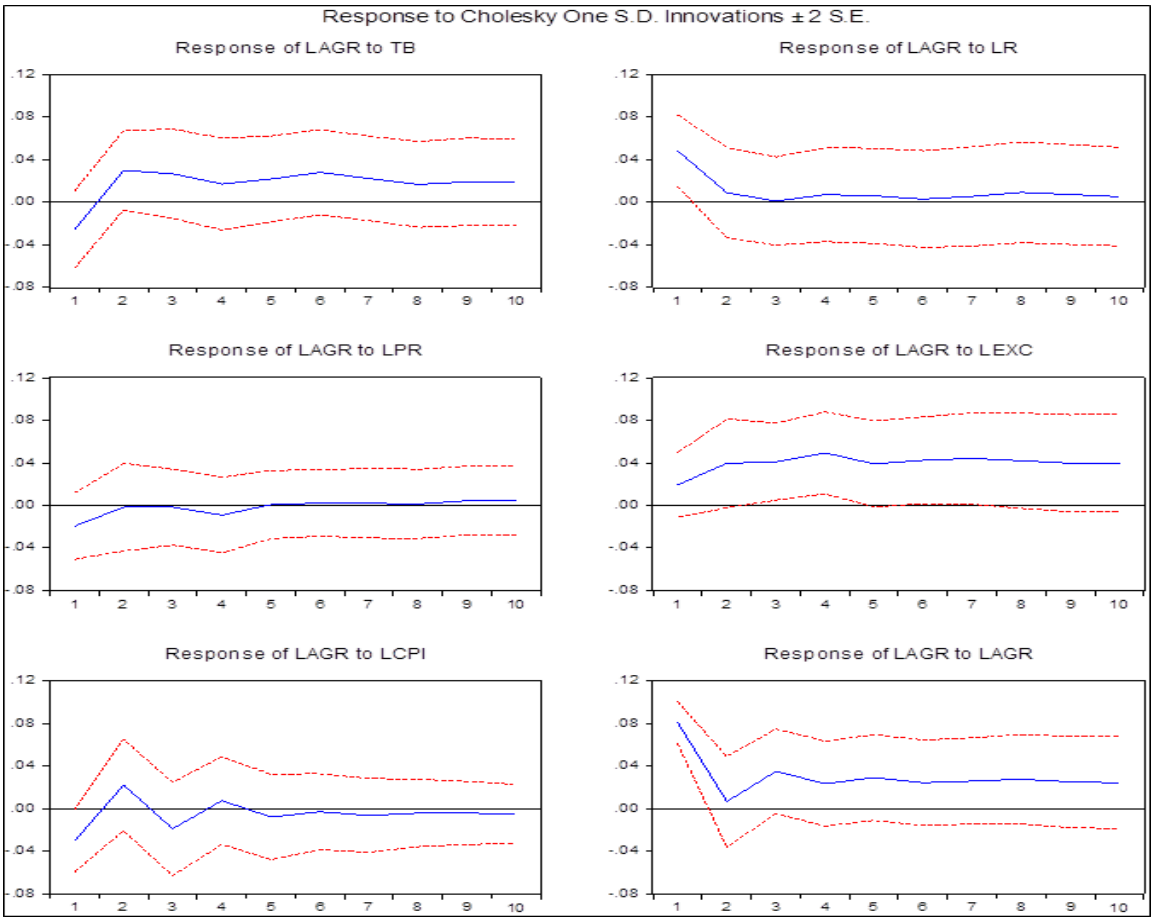


Figure 3: Impulse response functions for the Agriculture Sector

In the agricultural sector, the impulse response functions reveal that a one standard deviation positive shock to the exchange rate (exchange rate depreciation) results into a significant increase in the sector's output, up to about five years. This therefore means that agriculture outputs responds to a shock in monetary policy via the exchange rate channel and that exchange rate depreciation spurs growth in the sector. The rise in agriculture output may be on account of increased earnings from agriculture exports due to increased competitiveness arising from exchange rate depreciation. This result confirms the finding of the granger causality tests that there is a unidirectional causation between the exchange rate and agriculture output. The response also conforms to apriori

expectations and other study findings (e.g. Alam &Waheed, 2006; Crawford, 2007; and Nampewo et al., 2013).

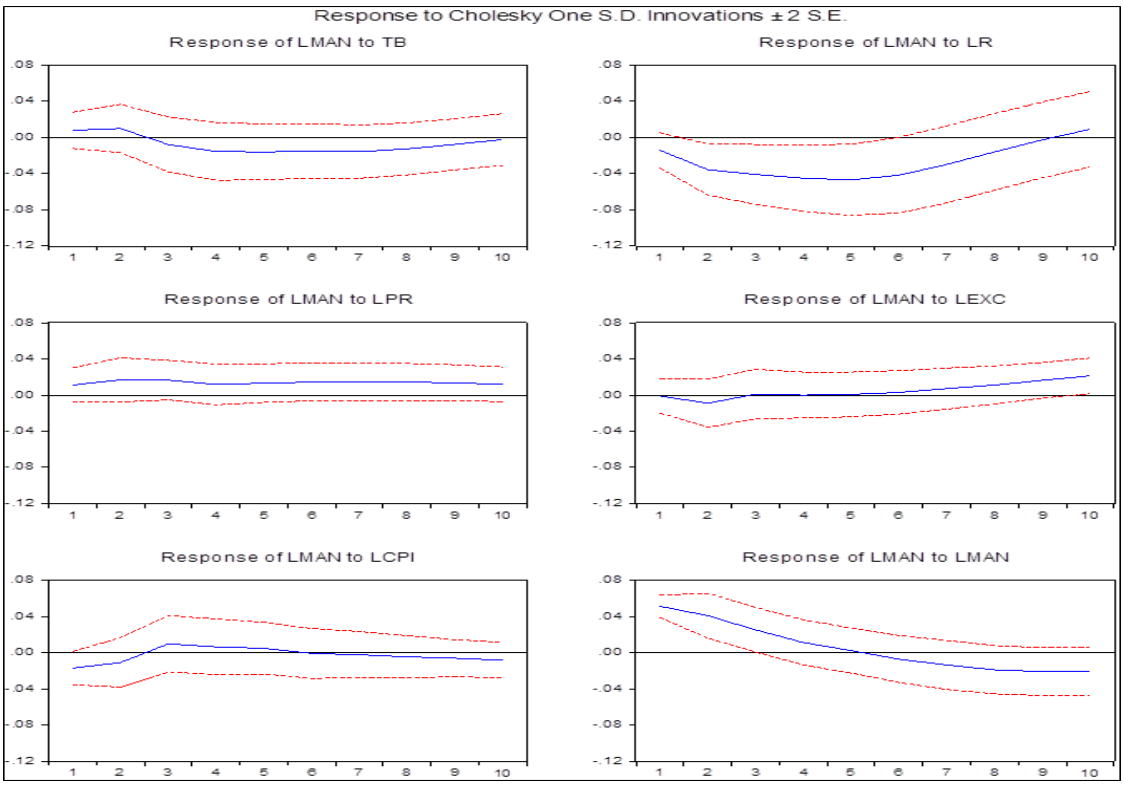


Figure 4: Impulse response functions for the Manufacturing sector

The manufacturing sector's impulse response functions show that the response of manufacturing to a shock in lending rates is significant and negative up to about six years. Manufacturing therefore responds to monetary policy via the traditional interest rate channel. This sector is comprised of a diverse range of production, but most components of the sector in Malawi are engaged in the production of durable goods (construction, cement production, furniture production, etc.), which potentially explains the significant decline in output- demand for durable goods is more interest rate sensitive than demand for non-durable goods since most consumers use debt to finance the

purchase of such items (high value/ expensive items) (AEO, 2015; Bernanke &Gentler, 1995). Furthermore, manufacturing tends to be highly capital intensive and as such responds more to interest rate changes and the cost of capital (Central Bank of Nigeria, 2014). This finding is in tandem with apriori expectations and study findings by Borys and Horvath (2007) and Pellenyi (2011) among others who also found that manufacturing negatively reacts to positive shocks in monetary policy through the interest rate channel.

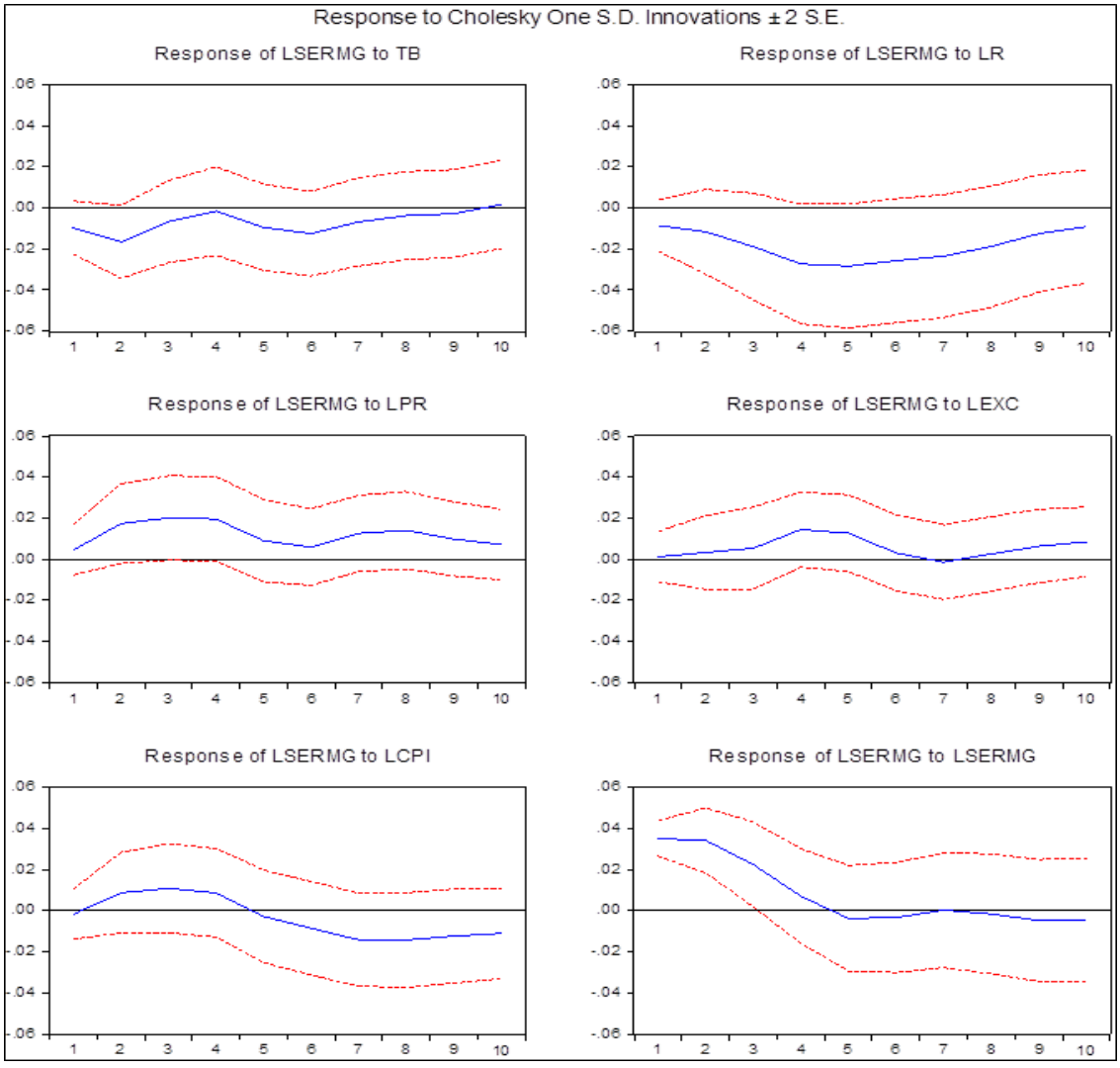


Figure 5: Impulse response functions for the Services sector

As shown in Figure 5, all impulse response functions in services are insignificant. The responses of output to positive shocks in private sector credit and the exchange rate (depreciation) are positive as expected but never significant. A positive shock to lending rates is never significant as well.

Analysis of the impulse response functions in this section has therefore shown that there are differences in the responses of various sectors to particular monetary policy transmission mechanism variables. The agriculture sector significantly reacts to shocks in the exchange rate while the manufacturing sector reacts significantly to shocks in lending rates. No transmission mechanism was found to be significant in services. Furthermore, the effects of the monetary policy shocks also die down after different periods in different sectors. The manufacturing responses persist up to about six years whereas the agriculture sector's response dies down after about five years. We can therefore conclude that various sectors of the economy do respond differently to monetary policy. A more detailed analysis of the transmission mechanisms is done in the next section.

5.4.3 Variance decomposition analysis

Variance decompositions were mainly conducted to test the study hypothesis that the exchange rate channel does not better explain the sectoral effects of monetary policy. Variance decompositions for all the variables in the system were generated over a forecasting horizon of 10 years. The effect of shocks from the monetary transmission variables on sectoral outputs was considered to examine the possible transmission

channels of monetary policy at the sectoral level. The results of the variance decomposition analysis across the three sectors are presented in Appendix 6.

The results reveal that the exchange rate channel dominates the agriculture sector. Specifically, the exchange rate, interest rate and credit channels explain 28.53, 11.15, and 1.95 percent of the variation in the agriculture sector respectively. On the other hand, the interest rate channel dominates in the manufacturing sector. It accounts for 41.05 percent of the variation in output followed by 6.95 percent from the credit channel, and 1.31 percent from the exchange rate channel. The interest rate channel also dominates in services. It accounts for 24.92 percent of the variation in output whereas the credit and exchange rate channels account for 13.51 and 3.37 percent respectively. These findings confirm the results of the impulse response analyses above where the exchange rate was found to significantly affect agriculture output and the lending rate was found to significantly affect manufacturing output. These findings are also in line with the theory that the exchange rate channel plays a greater role in export oriented sectors and that the interest rate channel is more dominant in capital intensive sectors and in sectors which have interest rate sensitive goods and/or services demand. It therefore makes sense that in agriculture, which accounts for over 80 percent of all exports in Malawi, the exchange rate channel dominates. It also makes sense that the interest rate channel is significant in manufacturing. These findings are however inconsistent with Nampewo et al. (2013) who found that monetary policy is mainly transmitted via the exchange rate channel in Uganda. Possible structural differences in the Ugandan and Malawian economy (such as variances in exchange rate regimes) could account for this difference in results. Uganda

overtime has adopted more flexible exchange regimes whereas Malawi has moved around fixed, free and managed regimes (Pauw et al., 2013; Nampewo et al., 2013). For the exchange rate channel to be dominant, flexible exchange rates must prevail.

The results in this section therefore reveal that the exchange rate channel does not better explain the sectoral effects of monetary policy in Malawi as compared to the other channels (it dominates in the agriculture sector only whereas the interest rate channel dominates in both manufacturing and services).

CHAPTER SIX

CONCLUSIONS

6.1 Summary

The study set out to analyse the relationship between sectoral output and monetary policy in Malawi over the period 1980 to 2014. It investigated firstly whether monetary policy has differential impacts on the output of various sectors and secondly the role the exchange rate channel plays in explaining the effects of monetary policy compared to the other channels. The analysis considered three different sectors of the economy and estimated a recursive VAR for each sector. From the estimated VARs, impulse response functions and variance decompositions were generated to investigate the first and second objectives respectively.

Analyzing the sectoral output responses, it is found that sectors are indeed affected differently by monetary policy in Malawi. The interest rate channel was found to be significant in manufacturing whereas the exchange rate channel was found to be significant in agriculture. No channel was found to be significant in services. Consistent with theoretical suggestions, the study also found that monetary policy effects persist longer in sectors which are more capital intensive- manufacturing in this case. Monetary policy effects were found to die down sooner in agriculture.

The variance decompositions conducted in the study revealed that the exchange rate channel dominates in the agriculture sector only, whereas the interest rate channel dominates in the manufacturing, and services sectors. Although this finding differed from some studies, it is consistent with the theory that the exchange rate channel is more dominant in export oriented sectors and that the interest rate channel is more dominant in capital intensive and interest rate sensitive sectors.

6.2 Policy Implications

The differential responses of various sectors to monetary shocks are important from a policy perspective. All potential sectoral effects of monetary shocks need to be taken into consideration to ensure effectiveness of future monetary stabilisation policies. In general, monetary policy authorities should ensure that they create an environment that spurs output growth in all sectors. However, RBM should not consider direct intervention into the sectors as this will result into diversion from their primary goal of achieving price stability resulting in price instability which will worsen output conditions in the long run. Instead, RBM must create an enabling environment by encouraging entry in the financial sector and laying foundations for more competitive markets with the aim of reducing lending rates.

The RBM should also leverage on its role as economic adviser to the Government to influence all other supply side policies that would promote real sector development in Malawi. The RBM can advise Government to improve particular infrastructure in favour of a particular sector, lower tariff barriers to enhance entry, and improve education

service delivery in a particular field so as to ensure growth of a particular sector. Infrastructure improvements will have a positive impact of reducing operating costs in the sectors thereby improving productivity. Additionally, the Government and the RBM must also put efforts in actively seeking export markets.

6.3 Study Limitations

Due to the unavailability of consistent data, the study has employed annual data dating only as early as 1980. Furthermore, this study does not explore the balance sheet channel of monetary policy transmission. The balance sheet channel requires a comprehensive analysis of how private sector balance sheet variables are affected by monetary policy/ interest rate changes. Such variables were not included because estimation of an over-parameterised model might lead to loss of degrees of freedom. Future research can therefore explore how to encompass this channel of monetary policy. Nonetheless, the three channels examined render this study useful.

REFERENCES

African Economic Outlook. (2015). *Malawi Economic Outlook.* Retrieved January 2, 2016, from HTTP:// www.afdb.org/en/countries/southern-africa/malawi/malawi-economic-outlook/

Alam, T., & Waheed, M. (2006). Sectoral Effects of Monetary Policy: Evidence from Pakistan. *Journal of Economic Perspectives, 9*(4), 27-48.

Angelopoulou, E., & Gibson, H. (2009). The Balance Sheet Channel of Monetary Policy Transmission: Evidence from the United Kingdom. *Economica, 76*(304), 675-703.

Belanger, G. (2014). *Interest Rates Rigidities and the Fischer Equation (MPRA Working Paper no 54705).* Retrieved June 24, 2016, from http://mpra.ub.uni.muenchen.de.54705

Bernanke, B., & Gertler, M. (1995). Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives*, 9(4), 27-48.

Borys, M., & Horvath, R. (2007). The Effects of Monetary Policy in the Czech Republic. *Journal of Monetary Economics, 45(1),* 561-580.

Central Bank of Nigeria. (2014). *Effects of Monetary Policy on the Real Economy of Nigeria*: *Dissagregated Analysis.* Nigeria, Abuja: Central Bank of Nigeria

Chalira, B. (2009). *The Role of Exchange Rate Misalignment in Sectoral Growth Determination: Evidence from Malawi*. (Master's Thesis). University of Malawi.

Chirwa, E. (2001). Financial Sector Reforms in Malawi: Are Days of Financial Repression Gone? *IMF Staff Papers*, 51(1), 96-122.

Crawford, C. (2007). *The Sectoral Impact of Monetary Policy, 110(5),* 247-261. (Master's Thesis). University of Sydney.

Ewubare, D. & Eyitope, A. (2015). The Impact of Monetary Policy on Agricultural Output in Nigeria. *Journal of Business Management and Economics, 3*(11), 4-16.

Food and Agricultural Organisation (2010). *Review of Food and Agricultural Policies in Malawi.* Retrieved January 10, 2016, from www.fao.org/3/a-i4675e.pdf

Food and Agricultural Organization (n.d). *Malawi.* Retrieved June 10, 2016, from Food and Agricultural organization of the United Nations: www.fao.org/countryprofiles/index/en/?iso3=mwi

Giovanni, J. D& Shambaugh, J. (2008). The Impact of Foreign Interest Rates on the Economy: The Role of the Exchange Rate Regime. *Journal of International Economics, 74*(2), 341-361.

Government of Malawi (2010a). *The Agriculture Sector Wide Approach (ASWAP): Malawi's Prioritised and Harmonised Development Agenda.* Retrieved January 10, 2016, from http://www.cisanetmw.gov/site/publications/ASWAPrevised.pdf

Government of Malawi (2010b). *Trade Policy Review Report.* Retrieved September 2, 2016, from https://www.wto.org/english/tratop_e/tpr_e/tp331.e.htm

Gruen, D. & Shuetrim, G. (1994). *Internationalisation and the Macroeconomy.* Retrieved February 10, 2016, from www.rba.gov.au/1994/gruen-shuetrim

Gujurati, D. (2004). *Basic Econometrics.* New York: McGraw Hill.

International Monetary Fund. (2016). *IMF Staff Completes Review Mission to Malawi.* Retrieved April 29, 2016, from https://www.imf.org/esternal/np/sec/pr/2016/pr16131.htm

Jansen, D., Kishan, R. & Vacaflores, D. (2013). Sectoral Effects of Monetary Policy: The Evidence from Publicly Traded firms. *Quarterly Journal of Economics, 109*(2), 309-340.

Kilian, L. (2011). *Structural Vector Autoregressions*. USA, Michigan: University of Michigan.

Lewis, M. & Mizen, P. (2000). *Monetary Economics.* Oxford: Oxford University Press.

Malawi Investment and Trade Centre. (2016). *Manufacturing.* Retrieved June 12, 2016, from MITC: http://www.mitc.mw/index.php?itemid=617

Mangani, R. (2011). *The Effects of Monetary Policy on Prices in Malawi.* Retrieved December 14, 2016, from www.csae.ox.ac.uk/854.mangani.pdf

Mankiw, G. (1985). Consumer Durables and the Real Interest Rate. *The Review of Economics and Statistics, 67*(3), 353-362.

Mankiw, G. (2003). *Principles of Macroeconomics.* London: Worth Publishers.

Mankiw, G. (n.d). *Open- Economy Macroeconomics: Basic Concepts.* Retrieved January 8, 2016, from www.swlearning.com/economics/mankiw/mankiw3e/ppt_lecture/open_economy.ppt

Miles, D. & Scott, A. (2005). *Macroeconomics: Understanding the Wealth of Nations.* West Sussex: John Wiley & Sons Ltd.

Mishkin, F. (1996). *The Channels of Monetary Transmission: Lessons for Monetary Policy.* Retrieved March 4, 2016, from www.nber.org/papers/w5464

Mwabutwa, C., Bittencourt, M. & Viegi, N. (2013). *Evolution of the Monetary Policy Transmission Mechanism in Malawi: A TVP-VAR with Stochastic Volatility Approach.* Retrieved September 3, 2016, from http://www.econrsa.org/system/files/publications/working_papers/working_paper_387.pdf

Mwanakatwe, P. (2014). *Malawi.* Retrieved February 7, 2016, from www.africaneconomicoutlook.org

Nampewo, D., Munyambonera, E., & Lwanga, M. M. (2013). Sectoral Effects of Monetary Policy in Uganda. *Journal of Statistical and Econometric Methods*, 17-40.

Ngalawa, H. (2009). Dynamic Effects of Monetary Policy Shocks in Malawi. *South African Journal of Economics*, 79(3), 224-250.

Organization for Economic Cooperation and Development(2014). *Interest Rates.* Retrieved March 12, 2016, from http://stats.oecd.org/mei/default.asp?lang=e&subject=15

Pauw, K., Dorosh, P. & Mazunda, J. (2013). *Exchange Rate Policy and Devaluation in Malawi.* Retrieved May 14, 2016, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.352.6161&rep=rep1&type=pdf

Pellenyi, G. (2011). *The Sectoral Effects of Monetary Policy in Hungary (Working Paper No.2012/01).* Retrieved February 15, 2016, from Magyar Nemzeti Bank: http://www.mnb.hu/working-papers

Raddatz, C. & Rigobon, R. (2003). *Monetary Policy and Sectoral Shocks: Did the FED React Properly to the High Tech Crisis.* Retrieved January 2, 2016, from http://www.nber.org/papers/w9835

Reserve Bank of Malawi. (2015). *Monthly Economic Review.* Retrieved January 13, 2016, from https://www.rbm.mw//

Reserve Bank of Malawi (n.d). *Evolution of Exchange Rate Determination in Malawi: Past and Present.* Retrieved February 12, 2016, from https://www.rbm.mw

Sato, L. (2001). Monetary Policy Frameworks in Africa: The Case of Malawi. Paper presented at the International Conference on *Monetary Policy in Africa* at the South African Reserve Bank.

Stock, J., & Watson, M. (2001). Vector Autoregressions. *Journal of Economic Perspectives*, 15(4), 101-115.

Wen, Z. (2004). *The Effectiveness of the Interest Rate Channel in the Conduct of Monetary Policy*. Retrieved 4th July 2016 from https://ruor.uottawa.ca/bitstream/10393/25221/1/2004_wen_zhu.pd

Wooldridge, J. (2006). *Introductory Econometrics: A Modern Approach* (6th ed.). Cambridge: MIT Press.

World Bank. (2016a). *Malawi Overview.* Retrieved March 2, 2016, from The World Bank: www.worldbank.org/en/country/malawi/overview

World Bank. (2016b). *Lending Interest Rate.* Retrieved April 10, 2016, from The World Bank: http://data.worldbank.org/indicator/FR.INR.LEND

World Bank. (2016c). *Domestic Credit to the Private Sector.* Retrieved March 10, 2016, from The World Bank: http://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS

APPENDICES

Appendix 1: DATA USED IN THE STUDY

YEAR	TB	LR	PR	EXC	CPI	AGR	MAN	SERMG
1980	9	16.66667	18.30902	0.76	19.19	71550.07	31895.52	168911.6
1981	9	18.5	17.30782	0.9	12	101382	33044.9	157481.3
1982	9	18.5	17.58438	1.06	9.524	107830.1	32937.15	157338.2
1983	11	18.33333	17.72359	1.17	13.77	112607.8	35271.84	160748.3
1984	11	16.5	13.37466	1.41	19.75	119055.9	36133.88	166498.4
1985	12.3125	18.375	10.93311	1.72	10.64	119638.5	37283.27	177828.4
1986	12.75	19	10.72677	1.86	14.18	120415.4	38109.4	177461
1987	14.25	19.5	7.84084	2.21	25.05	121347.7	36277.56	173529.8
1988	15.75	22.25	7.373019	2.56	33.84	123794.8	36924.09	174863.3
1989	15.75	23	8.730824	2.76	12.45	126863.5	39689.8	188508.8
1990	12.91667	21	10.07284	2.73	29.35	125659.3	44538.78	209356.8
1991	11.5	20	10.65235	2.8	8.215	141624.1	46011.44	224703.1
1992	15.62417	22	13.63895	3.6	23.07917	106820.1	47340.42	220781.3
1993	23.5375	29.5	8.390222	4.4	23.28083	163531.9	45544.5	203449.7
1994	27.6775	31	11.41005	8.74	34.03833	115598.8	46981.23	196409.2
1995	46.29917	47.33333	5.864911	15.28	83.4875	161409.6	49570.06	206876.2
1996	30.8325	45.33333	4.028828	15.31	40.775	202584.5	49275.87	213932.4
1997	18.30583	28.25	3.661004	16.44	9.216667	202833.8	49746.57	245870.9
1998	32.98	37.66667	6.395414	31.07	29.74167	223820	50511.45	238276.4
1999	42.85417	53.58333	4.747461	44.09	45.78333	246451.3	51452.84	238496.9
2000	39.51583	53.125	5.603748	59.54	29.35	259711	50158.42	237123.9
2001	42.41417	56.16667	5.207935	72.2	27.35833	239781.5	42824.41	240807.3
2002	41.74917	50.54167	3.602793	76.69	14.79083	245364.6	41021.06	251629.9
2003	39.31917	48.91667	4.152006	97.43	9.5525	254846.2	47961.26	262799.8
2004	28.5775	36.83333	4.871564	108.9	11.43333	262066	49408.27	283896.3
2005	24.36083	33.08333	5.364683	118.42	15.40333	241651.2	51521.7	305441.4
2006	19.27333	28.25	6.545151	136.01	14.03	242617.8	55540.4	315200.1
2007	13.94667	21.71528	6.657279	139.96	7.936667	269791	65037.81	347238.5
2008	11.3027	19.27778	11.33866	140.52	8.720833	279396.6	72209.83	389376.2
2009	10.12583	19.25	13.38341	141.17	8.410833	290550.9	93200.69	411649.5
2010	7.162464	18.625	17.82853	150.49	7.408333	310167.1	103789.4	437574
2011	6.660528	17.75	19.81466	156.52	7.621667	323463.8	105206.1	445283.3
2012	14.30675	25.69255	20.71947	249.11	21.37167	326761.2	104302.6	474061.8
2013	29.55771	38.41319	17.69705	364.41	28.58675	347178.5	110095.5	501036.7
2014	20.64375	36.78646	16.19693	424.9	23.77921	367964.8	116748.5	530094

Appendix 2: AUTOCORRELATION TEST RESULTS

Appendix 2.1: Testing for residual autocorrelation in the Agricultural Sector

VAR Residual Serial Correlation LM Te...
Null Hypothesis: no serial correlation at...
Date: 07/30/16 Time: 06:39
Sample: 1980 2014
Included observations: 33

Lags	LM-Stat	Prob
1	39.58498	0.3130
2	28.81525	0.7969
3	44.79891	0.1492

Probs from chi-square with 36 df.

Appendix 2.2: Testing for residual autocorrelation in the Manufacturing sector

VAR Residual Serial Correlation LM Te...
Null Hypothesis: no serial correlation at...
Date: 07/30/16 Time: 06:53
Sample: 1980 2014
Included observations: 33

Lags	LM-Stat	Prob
1	38.80731	0.3443
2	22.54118	0.9609
3	42.15540	0.2220

Probs from chi-square with 36 df.

Appendix 2.3: Testing for residual autocorrelation in the Services sector

VAR Residual Serial Correlation LM Te...
Null Hypothesis: no serial correlation at...
Date: 07/30/16 Time: 07:15
Sample: 1980 2014
Included observations: 33

Lags	LM-Stat	Prob
1	41.71174	0.2363
2	45.90937	0.1246
3	41.02548	0.2596

Probs from chi-square with 36 df.

Appendix 3: HETEROSKEDASTICITY TEST RESULTS

Appendix 3.1: Testing for heteroskedacity in Agriculture

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 07/30/16 Time: 06:41
Sample: 1980 2014
Included observations: 33

Joint test:

Chi-sq	df	Prob.
535.7340	504	0.1586

Individual components:

Dependent	R-squared	F(24,8)	Prob.	Chi-sq(24)	Prob.
res1*res1	0.900461	3.015430	0.0548	29.71521	0.1944
res2*res2	0.856034	1.982026	0.1591	28.24912	0.2497
res3*res3	0.591365	0.482391	0.9199	19.51505	0.7240
res4*res4	0.890629	2.714400	0.0729	29.39076	0.2058
res5*res5	0.903558	3.122976	0.0497	29.81741	0.1909
res6*res6	0.864099	2.119425	0.1362	28.51525	0.2389
res2*res1	0.886040	2.591670	0.0824	29.23932	0.2113
res3*res1	0.831344	1.643081	0.2383	27.43436	0.2846
res3*res2	0.782695	1.200612	0.4172	25.82895	0.3619
res4*res1	0.910396	3.386753	0.0394	30.04308	0.1833
res4*res2	0.848755	1.870590	0.1812	28.00890	0.2597
res4*res3	0.901797	3.060989	0.0525	29.75929	0.1929
res5*res1	0.855954	1.980743	0.1594	28.24648	0.2498
res5*res2	0.772118	1.129412	0.4571	25.47989	0.3801
res5*res3	0.633500	0.576170	0.8588	20.90549	0.6443
res5*res4	0.836535	1.705842	0.2207	27.60566	0.2770
res6*res1	0.948156	6.096259	0.0062	31.28916	0.1456
res6*res2	0.872629	2.283696	0.1137	28.79676	0.2279
res6*res3	0.829308	1.619503	0.2453	27.36717	0.2876
res6*res4	0.922022	3.941355	0.0251	30.42671	0.1710
res6*res5	0.890167	2.701574	0.0739	29.37551	0.2063

Appendix 3.2: Testing for heteroskedasticity in Manufacturing

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 07/30/16 Time: 06:58
Sample: 1980 2014
Included observations: 33

Joint test:

Chi-sq	df	Prob.
502.9021	504	0.5054

Individual components:

Dependent	R-squared	F(24,8)	Prob.	Chi-sq(24)	Prob.
res1*res1	0.907404	3.266537	0.0437	29.94433	0.1866
res2*res2	0.901219	3.041142	0.0535	29.74023	0.1935
res3*res3	0.769633	1.113634	0.4664	25.39789	0.3844
res4*res4	0.864321	2.123451	0.1356	28.52260	0.2386
res5*res5	0.547523	0.403353	0.9593	18.06827	0.7997
res6*res6	0.593724	0.487126	0.9172	19.59288	0.7197
res2*res1	0.917761	3.719901	0.0299	30.28612	0.1754
res3*res1	0.827607	1.600234	0.2513	27.31103	0.2902
res3*res2	0.836950	1.711029	0.2193	27.61935	0.2764
res4*res1	0.857680	2.008807	0.1543	28.30344	0.2474
res4*res2	0.943299	5.545419	0.0085	31.12885	0.1501
res4*res3	0.902241	3.076406	0.0518	29.77395	0.1924
res5*res1	0.849672	1.884038	0.1784	28.03917	0.2584
res5*res2	0.932860	4.631419	0.0152	30.78438	0.1601
res5*res3	0.676272	0.696339	0.7675	22.31699	0.5604
res5*res4	0.603579	0.507523	0.9049	19.91810	0.7014
res6*res1	0.927678	4.275660	0.0196	30.61336	0.1652
res6*res2	0.865295	2.141215	0.1329	28.55474	0.2373
res6*res3	0.646323	0.609146	0.8347	21.32866	0.6193
res6*res4	0.709000	0.812143	0.6762	23.39701	0.4965
res6*res5	0.575156	0.451269	0.9370	18.98015	0.7530

Appendix 3.3: Testing for heteroskedasticity in Services

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 07/30/16 Time: 07:16
Sample: 1980 2014
Included observations: 33

Joint test:

Chi-sq	df	Prob.
525.3747	504	0.2467

Individual components:

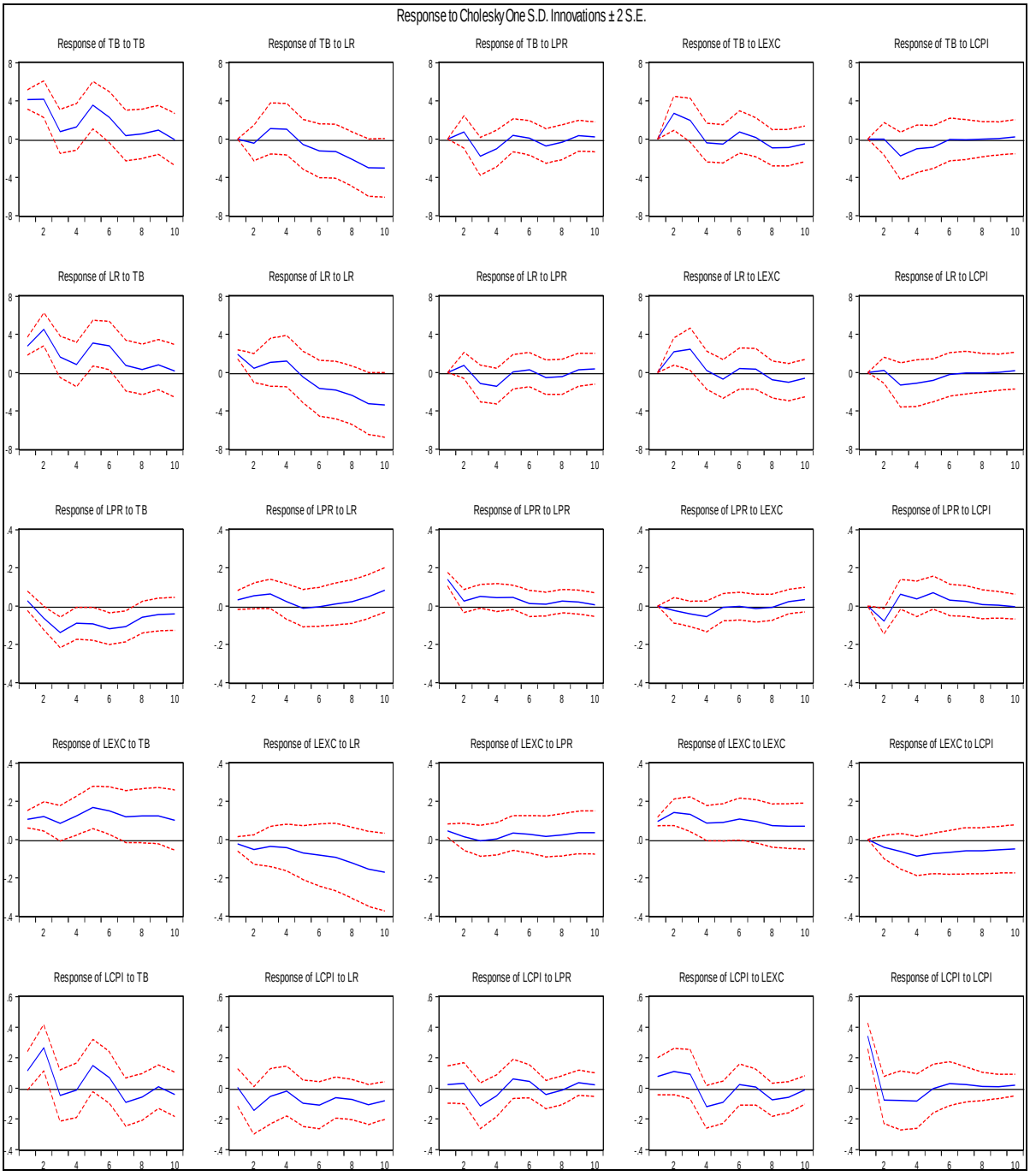
Dependent	R-squared	F(24,8)	Prob.	Chi-sq(24)	Prob.
res1*res1	0.869268	2.216407	0.1223	28.68584	0.2322
res2*res2	0.836552	1.706049	0.2207	27.60621	0.2770
res3*res3	0.725254	0.879909	0.6244	23.93338	0.4654
res4*res4	0.748599	0.992568	0.5438	24.70376	0.4220
res5*res5	0.780479	1.185128	0.4256	25.75582	0.3657
res6*res6	0.585534	0.470915	0.9264	19.32263	0.7346
res2*res1	0.857695	2.009060	0.1543	28.30395	0.2474
res3*res1	0.645944	0.608136	0.8355	21.31614	0.6200
res3*res2	0.740889	0.953116	0.5711	24.44934	0.4362
res4*res1	0.810777	1.428253	0.3117	26.75563	0.3160
res4*res2	0.780433	1.184804	0.4257	25.75428	0.3657
res4*res3	0.792949	1.276574	0.3784	26.16731	0.3447
res5*res1	0.858676	2.025319	0.1514	28.33632	0.2461
res5*res2	0.813974	1.458527	0.3000	26.86113	0.3110
res5*res3	0.611576	0.524836	0.8939	20.18201	0.6864
res5*res4	0.898913	2.964142	0.0574	29.66411	0.1961
res6*res1	0.898851	2.962147	0.0575	29.66209	0.1962
res6*res2	0.848652	1.869101	0.1815	28.00553	0.2598
res6*res3	0.752788	1.015039	0.5286	24.84201	0.4144
res6*res4	0.892201	2.758834	0.0698	29.44262	0.2039
res6*res5	0.613164	0.528359	0.8916	20.23442	0.6834

Appendix 4: PAIRWISE GRANGER CAUSALITY RESULTS

Pairwise Granger Causality Tests		
Sample: 1980 2014		
Lags: 2		
Null Hypothesis:	**F-Statistic**	**Prob.**
LR does not Granger Cause TB	3.34436	0.0498
TB does not Granger Cause LR	7.67555	0.0022
LPR does not Granger Cause TB	1.60434	0.219
TB does not Granger Cause LPR	7.44621	0.0026
LEXC does not Granger Cause TB	7.78987	0.002
TB does not Granger Cause LEXC	0.56519	0.5746
LAGR does not Granger Cause TB	3.59563	0.0407
TB does not Granger Cause LAGR	1.81111	0.1821
LMAN does not Granger Cause TB	3.7265	0.0367
TB does not Granger Cause LMAN	0.3175	0.7306
LSERMG does not Granger Cause TB	0.85035	0.438
TB does not Granger Cause LSERMG	1.29973	0.2886
LAGR does not Granger Cause LR	2.80889	0.0773
LR does not Granger Cause LAGR	1.6174	0.2164
LMAN does not Granger Cause LR	2.5008	0.1002
LR does not Granger Cause LMAN	0.92807	0.4071
LSERMG does not Granger Cause LR	0.88985	0.422
LR does not Granger Cause LSERMG	0.37065	0.6936
LAGR does not Granger Cause LPR	4.10203	0.0274
LPR does not Granger Cause LAGR	0.13236	0.8766
LMAN does not Granger Cause LPR	3.97329	0.0303
LPR does not Granger Cause LMAN	0.16727	0.8468
LSERMG does not Granger Cause LPR	4.13827	0.0266
LPR does not Granger Cause LSERMG	0.22047	0.8035

LAGR does not Granger Cause LEXC	2.64809	0.0884
LEXC does not Granger Cause LAGR	7.54429	0.0024
LMAN does not Granger Cause LEXC	3.11344	0.0601
LEXC does not Granger Cause LMAN	1.57356	0.2251
LSERMG does not Granger Cause LEXC	1.45119	0.2514
LEXC does not Granger Cause LSERMG	1.83922	0.1776
LAGR does not Granger Cause LCPI	0.8015	0.4587
LCPI does not Granger Cause LAGR	3.52889	0.043
LMAN does not Granger Cause LCPI	1.26048	0.2991
LCPI does not Granger Cause LMAN	0.8333	0.4451
LSERMG does not Granger Cause LCPI	0.92841	0.407
LCPI does not Granger Cause LSERMG	0.65202	0.5287

Appendix 5: IMPULSE RESPONSES OF THE MONETARY POLICY VARIABLES TO EACHOTHER



Appendix 6: VARIANCE DECOMPOSITIONS

Appendix 6.1: Variance Decomposition of Agriculture

Period	S.E.	TB	LR	LPR	LEXC	LCPI	LAGR
1	4.643612	5.924573	20.84117	3.412056	3.333389	8.341802	58.14701
2	8.059494	10.91127	16.91815	2.700549	13.53973	9.979154	45.95115
3	9.978343	12.42879	13.22878	2.128051	19.8037	9.805942	42.60474
4	11.36719	11.78358	11.34832	2.18049	27.85374	8.50052	38.33334
5	12.36365	12.30292	10.13422	1.9221	30.70268	7.739237	37.19885
6	13.23357	13.71406	9.000009	1.717567	33.64274	6.884392	35.04123
7	13.93994	13.90638	8.170863	1.552956	36.44483	6.314201	33.61076
8	14.2894	13.53297	7.719764	1.425652	38.5169	5.828408	32.9763
9	14.43052	13.55068	7.299982	1.375559	40.01383	5.455184	32.30476
10	14.52595	13.5682	6.880689	1.342711	41.40649	5.158343	31.64357

Cholesky Ordering: TB LR LPR LEXC LCPI LAGR

Appendix 6.2: Variance Decomposition of Manufacturing

Period	S.E.	TB	LR	LPR	LEXC	LCPI	LMAN
1	4.141746	1.807243	6.293916	3.683469	0.040697	8.830433	79.34424
2	6.621732	2.290567	21.73715	5.880027	1.2326	6.034807	62.82485
3	7.501804	2.279958	33.07839	7.01442	0.888668	5.29638	51.44218
4	8.153645	3.770577	42.81843	6.634319	0.700176	4.516804	41.5597
5	9.286762	4.8447	49.99906	6.602499	0.576664	3.866537	34.11054
6	9.856232	5.565687	53.64914	6.937873	0.548001	3.364076	29.93522
7	10.16306	6.438875	53.85735	7.435446	0.771549	3.104329	28.39245
8	10.67016	6.902989	52.09607	8.041382	1.33925	3.030083	28.59023
9	11.29686	6.864287	49.63824	8.542996	2.546276	3.067394	29.34081
10	11.75348	6.528283	47.3793	8.7242	4.450658	3.216779	29.70078

Cholesky Ordering: TB LR LPR LEXC LCPI LMAN

Appendix 6.3: Variance Decomposition of Services

Period	S.E.	TB	LR	LPR	LEXC	LCPI	LSERMG
1	4.553316	6.626541	5.216646	1.401929	0.098434	0.193224	86.46323
2	7.13131	10.87709	6.226705	9.425596	0.360615	2.336747	70.77324
3	8.232663	8.541226	11.71742	14.89485	0.851499	4.065924	59.92908
4	9.301836	6.602931	20.82488	17.48665	3.949377	4.310951	46.82522
5	10.90122	6.808321	28.37612	15.84714	5.476753	3.745818	39.74585
6	12.199	7.922426	33.04538	14.46925	4.970749	4.21042	35.38177
7	13.20191	7.616147	35.56433	14.66856	4.481264	5.911967	31.75772
8	14.12384	7.175465	36.31523	15.49706	4.201446	7.469061	29.34174
9	14.92394	6.928093	36.16004	15.7078	4.397964	8.567651	28.23846
10	15.50635	6.727676	35.75931	15.66385	4.91126	9.402316	27.53558

Cholesky Ordering: TB LR LPR LEXC LCPI LSERMG