



ESSAYS ON FINANCIAL REFORMS AND MONETARY POLICY IN MALAWI

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Declaration

“I declare that the thesis, which I hereby submit for the degree of PhD (Economics) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at another university.”



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Abstract

Essays on Financial Reforms and Monetary Policy in Malawi

By

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The thesis contains three essays that investigate the effects of macroeconomic reforms on the Malawian economy between 1980 and 2010. Specifically, the thesis tries to answer three broad questions. First, what is the effect of financial reforms on consumption behavior in Malawi? Second, how did monetary transmission mechanism in Malawi change over time following the implementation of financial reforms? Last, how did the monetary policy respond to foreign aid increases following the implementation of financial reforms in the country? Although answers for these questions are available for other developing countries where abundant research has been conducted, this is not the case in Malawi. Existing research on Malawi has not accounted for the effects of the reforms on consumption behavior, the evolution of the transmission mechanism over time and the monetary policy impact of aid on the economy. Yet such information is very useful in the design and proper implementation of financial and monetary policies that contribute to price stability and economic growth.

The first essay assesses whether financial reforms has had a statistically significant effect on Malawi consumption behaviour. More specifically, the essay starts by examining the existence of Permanent Income Hypothesis (PIH) and then proceed to assess whether the reforms have affected consumption behaviour by reducing liquidity constraints. The essay presents a robust account of the financial reforms and constructs financial reform indices for the country. These indices are then used to exam the effects of the reforms on consumption. The essay finds that the



PIH does not hold in Malawi. Most consumers are current income consumers (rule-of-thumb). They consume from “hand to mouth” and very little is left to smooth consumption in their life time. The reforms did not shift current income consumers to permanent income consumers. Empirical evidence from the thesis shows that the main failure of the PIH hypothesis is due to liquidity constraint which is manifested in the under development of the financial market and unstable macroeconomic conditions in Malawi. Weak financial institutions, both structural and operational have impacted negatively on the accessibility of financial resources for most Malawians despite the reforms. This is a bigger lesson for policy makers to consider in the preparation of future broad based financial reforms.

The second essay provides an empirical analysis of the lag effect of implementing financial reforms on price stability and economic growth. We use the monetary transmission mechanism framework based on the time varying parameter vector autoregressive (TVP-VAR) model with stochastic volatility. It is becoming clear from literature that financial reforms can change the transmission mechanism by changing the overall impact of the policy or by altering the transmission channels overtime. Therefore, the impact of monetary policy on price stability and output growth can vary and portray delayed effects overtime. The essay finds that inflation, real output and exchange rate responses to monetary policy shocks vary over the period under review. Importantly, beginning mid-2000, the monetary policy transmission performed consistently with predictions of economic theory and there is no evidence of price puzzle as found in the previous literature on Malawi.

In the last essay, a Bayesian Dynamic Stochastic General Equilibrium (DSGE) model for Malawi is developed and estimated to account for the short-run monetary response to aid inflows in Malawi between 1980 and 2010. The model incorporated the rational expectations of economic agents based on micro foundations. The estimated model showed that monetary authorities reacted to foreign aid inflows. Based on how aid was spent and absorbed in Malawi, aid inflows appeared to be associated with depreciations of the exchange rate rather than the expected real appreciation. There is also evidence of limited impact of a positive aid shock on depreciation and inflation when RBM targets monetary aggregates compared to when the authorities use the Taylor rule and incomplete sterilisation. On the other hand, the thesis found that the implication of increased aid inflows became more prominent in an economy comprising of few economic

agents having access to financial assets. Furthermore, the monetary policy responses are much clear consistent with economic theory in a market with less controls over prices and open capital account.

The contribution of the thesis to the literature is that, firstly, this looks into the effects of macroeconomic reforms on economic activities in the context of a Sub-Saharan Africa country, Malawi. The thesis enhances the understanding of the effects of macroeconomic reforms on consumption, evolution of monetary policy overtime and the impact of aid inflows on the conduct of monetary policy in Malawi in ways that have not been done before. Secondly, the thesis takes advantages of multivariate econometric methodologies in an attempt to capture both the dynamics of time series data and the relationship among key macroeconomic variables. The thesis develops and estimates a DSGE model for Malawi which is derived from microeconomic foundations of optimisation problem, making it less susceptible to the Lucas critique and thus suitable for policy analysis. The results will help policy makers and development partners such as the IMF and the World Bank in the design of policies and programs that aim at improving the financial sector that is accommodative of achieving price stability and economic growth in Malawi.



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Chapter1

Introduction

1.1. Introduction

The thesis contains three essays that investigate the effects of macroeconomic reforms on the Malawian economy between 1980 and 2010. Specifically, the thesis tries to answer three broad questions. First, what is the effect of financial reforms on consumption behavior in Malawi? Second, how did the monetary transmission mechanism in Malawi change over time following the implementation of financial reforms? Last, how did the monetary policy respond to foreign aid increases following the implementation of financial reforms in the country? Although answers for these questions are available for other developing countries where abundant research has been conducted, this is not the case in Malawi. Existing research on Malawi have not accounted for the effects of the reforms on consumption behavior, the evolution of the transmission mechanism over time and the monetary policy impact of aid on the economy. Yet such information is very useful in the design and proper implementation of financial and monetary policies that contribute to price stability and economic growth.

1.2. Background

The 1970s and 1980s distortion of regulation coupled with the oil price shocks and escalating real interest for external debt servicing worsened the macroeconomic performance of many developing countries. Accordingly, a mix of economic measures under the Structural Adjustment Program (SAP) supported by the International Monetary Fund (IMF) and the World Bank designed to achieve internal and external balances at the minimum cost were adopted. Among many policy measures, SAP included macroeconomic reforms aimed at developing a well-functioning financial system that would contribute favourably to economic growth and price stability. Based on MacKinnon (1973) and Shaw (1973) paradigm, reforming the financial sector would encourage mobilization of savings and in turn increase investment and hence economic growth through their effect on availability and allocation of credit.



Macroeconomic reforms, particularly in the financial sector in Malawi included reform measures on interest rates, exchange rate, monetary policies, financial institutions and opening of the current and capital account. The reform measures summarised from Chirwa and Mlachila (2004) paper are highlighted in Table 1 and were introduced and implemented at different time period between 1987 and 1998. Hence, this study follows Aron and Muellbauer (2000), defining financial reform as a complete set of these reform measures that were implemented to improve financial intermediation between savers and investors in Malawi. The paper on Aron and Muellbauer (2000) constructed a financial reform index using a linear spline function with the process of accommodating the sequential institutional changes that occur due to different changes in the financial sector policy reforms.¹ It is argued that single indicators of financial reforms are not a comprehensive representation of financial sector development and do not consider institutional changes arising from implementing reform measures at different time period. In addition, the use of dummy numbers to represent financial reforms is mostly subjective and difficult in assigning arbitrary dummies (Groenewold, Peng, Li and Fan, 2008).

The effects of financial reforms on macroeconomic activities has been extensively studied in less developing countries but existing research has concentrated on the traditional way of testing the effects of financial reforms on macroeconomic variables such as savings, credit, investment and economic growth (Levine 2005). Very few if any especially in less developed countries have studied on the effects of these reforms on aggregate consumption which forms a large component of gross domestic product (GDP). Specifically, this work focuses on the effects of reforms on consumption behaviour which is lacking in most studies in less developed countries. In addition, the distinct feature of most less developed countries is the high degree of dependence on foreign aid (Hansen and Heady, 2009) and has become pronounced during the financial reform period. In addition, research on less developed countries has focussed on investigating the traditional way of monetary policy transmission mechanism as surveyed recently by Mishra and Montiel (2012). It is revealed that there is limited focus on the issue of how changes in the conduct of monetary policy affect macroeconomic performance following financial reforms.

¹ The construction of the financial reform indices are fully explained in Chapter 2.


Table 1: Financial Reforms Measures in Malawi between 1987 and 1998

Period	Policy Measures
July 1987 April 1988 August 1988 May 1990	1. Liberalisation of Interest Rates Commercial banks started setting their own lending interest rates Deposit rates were deregulated Preferential interest rates to the agricultural sector were abolished All interest rates became fully liberalized
1988 1990	2. Directed credit Credit ceilings and credit rationing were removed Preferential lending to Ministry of Agriculture was abolished
June 1989 December 1990 1997 August 1998	3. Cash Reserves and Liquid Assets Requirements LRR introduced at 10% of commercial bank liabilities with commercial banks earning interest rates on reserves LRR ceased to earn interest rates LRR was changed from daily to monthly average and RBM started paying interest rate on reserves LRR changed back to daily observance by commercial banks and RBM ceased paying interest rates on reserves
1989 March 1998	4. Competition in the financial markets Review of RBM Act and Bank Act leading to deregulation of entry into the banking sector Entry and incorporation of continental discount house and introduction of interbank market lending among commercial banks
1991 1990	5. Open Market Operations Treasury bills introduced RBM bills introduced
January 1971 February 1971 November 1973 June 1975 January 1984 1990 February 1994	6. Exchange Rate Liberalisation British pound/Malawi pound par value system Malawi Kwacha introduced and pegged to the pound at two to one Peg to a weighted average of the pound and the US Dollar Peg to the SDR Peg to a weighted basket of seven currencies Complete liberalisation of foreign exchange allocation Free floating (with intervals of managed float)
February 1995	7. Liberalisation of capital account Malawi stock exchange established (limited liberalisation of capital markets)

Source: A summary from a paper by Chirwa and Mlachila (2004)

In Malawi, financial sector was regulated by government prior to the financial reforms (Chirwa, 1999). Particularly, interest rates were controlled and credit ceilings were imposed on commercial banks, preferential lending rates to agriculture were set by Reserve Bank of Malawi, the country implemented a fixed exchange rate and operated a closed current and capital account impacting negatively on trade, monetary authorities used direct monetary instruments to influence inflation stability and economic growth. Coupled with exogenous shocks such as high import costs due to oil price shocks, disruption in the trade routes of Beira and Nacala, influx of refugees from Mozambique and incidences of droughts, considerable macroeconomic imbalances emerged. As highlighted in Table 2 the point of reference of most macroeconomic trends, the current account balance as proportion of GDP worsened significantly to around 21.8



percent. Real economic growth fell to an average of 1.6 percent far below the population growth of 3.7 percent in 1980-1987. Inflation increased to 15.5 percent and fiscal deficit after grants as proportion of GDP increased to 9.4 percent in 1980-1987 from 5.5 percent registered in 1970-1979.

With the introduction of SAP in 1980s and 1990s, financial reform measures were adopted including liberalisation of interest rates, liberalisation of exchange rate, adopting indirect monetary policies, deregulation of financial institutions and opening of the current and capital account. However, these reforms were implemented in unstable macroeconomic environment characterized by high inflation rates contributing negatively to real interest rates and very erratic economic growth. As reflected in the trends of nominal exchange rate, the local currency faced heavy devaluations during this period. On the understanding that the economy depends heavily on imports of raw materials, domestic inflation increased through pass-through effects. Most households were unable to save and invest as negative real interests became a disincentive to deposits and acquiring loans from financial institutions. The level of real interest rates and private credit as proportion of GDP declined to averages of 0.9 percent and 8.5 percent in 1988-1997 (during reforms) from 4.5 percent and 14.2 percent in 1980-1987, respectively. The outcomes were in contrast to the expected increases and resulted also in the reduction of savings and an increase in household consumption. On the other hand, the reforms enhanced large aid inflows aimed at supporting government operations. However, donors withdraw foreign aid in Malawi in 1992-1993 to force political change to multiparty dispensation and hence the situation induced economic contraction.

This pattern of trend of macroeconomic variables continued even after the reform period. Inflation rates continued to increase reaching 28.2 percent in 1988-1997 impacting negatively on real interest rates. Public sector as a share of credit increased to an average of 35.5 percent. Thus saving and private credit as a proportion of GDP declined further. During the reform period government implemented the Poverty Reduction Growth Facility (PRGF) arrangements with the IMF. Most donors aligned their aid disbursements based on the achievement of the IMF-PRGF arrangement in Malawi. However, the country went off-track with the IMF program and donors withdraw aid support in 2002-2004 due to mismanagement of public finances. Hence, government continued to depend on domestic resources through borrowing to finance its



budgetary requirements at the expense of crowding out private sector investment. Economic growth became erratic, with large declines after the reform period. Structural shocks such as drought conditions (2001, 2002) and political regime change in 2004 also contributed to the sluggish economic growth (Mangani, 2011).

Marginal improvements did start to occur in the latter years of the reforms in 2006 and 2010. Following government change in 2004 and the significant improvements in fiscal management, the government went back on track with the IMF programme. Donors resumed aid assistance and Malawi benefited from debt forgiveness under the Heavily Indebted Poor Countries (HIPC) initiatives and Multilateral Debt Relief Initiatives (MDRI) in 2006. Malawi achieved good macroeconomic performance as private credits as proportion of GDP increased and the Bank rate declined. Aggregate consumption also declined indicating a possible shift of economic agents being able to smooth consumption due to increased private credit. Inflation declined to single digits and economic growth hovered around 7 % which was above the standard requirement to achieve poverty reduction during this period. The improvement in economic growth is attributed to the good performance of the agricultural sector (large component of GDP) as a result of good rains and implementation of the farm input subsidy programme (IMF, 2010).

Table 2: Malawi Key Macroeconomic Variables 1970 - 2010

Description	1970-1979	1980-1987	1988-1997	1998-2005	2006-2010
Bank Rate %	6.50	10.75	23.40	39.00	15.60
Real Interest Rate %	-	4.52	0.86	16.74	13.48
Growth %	6.26	1.59	3.89	2.36	7.36
Inflation %	8.39	15.49	28.20	22.25	9.29
Credit % GDP	12.03	14.23	8.46	4.98	11.14
Consumption % GDP	70.53	69.87	78.21	84.12	75.15
Savings % GDP	14.45	13.23	4.77	1.95	8.47
Aid % GDP	9.74	13.35	26.63	21.88	19.89
Population growth (%)	3.18	3.68	2.38	2.72	3.00
Exchange rate MK/US\$	0.84	1.42	8.66	83.26	143.41
Fiscal Surplus/Deficit	-5.55	-9.39	-3.82	-3.36	-1.90
CAB % of GDP	-21.77	-9.98	-8.60	-8.43	-12.19
Public Sector Share of Credit	28.63	57.92	39.47	35.49	26.72

Source: Data obtained from IMF-IFS, World Bank Indicators and RBM Financial and Economic Reports.

Notes: Fiscal deficit/surplus is after grants and it is percent of GDP. CAB is current account balance.



1.3. Problem Statement and Motivation

According to the Permanent Income Hypothesis (PIH), aggregate consumption patterns respond to changes in permanent income (Friedman, 1957; Hall, 1978). However, studies by Flavin (1981) and Campbell and Mankiw (1989) found that aggregate consumption also responds to changes in current income. They argue that consumption expenditures seem to respond to predictable changes in income because some consumers encounter binding liquidity constraints in some period. Liquidity constrained consumers are unable or unwilling to use financial markets to smooth consumption. Therefore, reforming the financial sector will promote the financial system capable of influencing consumers to use the financial markets to smooth their consumption pattern in time of need.

The link between aggregate consumption and financial reforms has been extensively studied in developing and emerging economies (Blundell-Wignall, Browne and Cavaglia, 1991; Bayoumi, 1993; Girardin, Sarno and Taylor, 2000; Aron and Muellbauer, 2000; Barrell and Davis, 2007). These papers observe that financial reforms can make liquidity constraints for consumers (excess sensitivity) to decline and can enhance consumption to track current income closely. This is attributed to the fact that financial reforms facilitate the availability of liquidity options of households who have the ability to smooth consumption. Hence, relaxing the liquidity constraints on borrowers that used to be rationed out of the market may allow consumers to borrow to cover shortfalls in income and enhance the ability to consume out of wealth at the same time. On the other hand, uncertainty about future income emanating from unreformed financial sector can induce consumers engaging in precautionary savings and increasing this uncertainty will increase savings and reduce consumption relative to income (Blundell-Wignall *et al.*, 1991). Most of these assertions are empirically becoming clear in industrialised and emerging economies but very limited country specific studies have been conducted in sub-Saharan Africa.

Despite Malawi implementing financial reforms in 1980s, empirical studies have left out examining the effects on aggregate consumption. Consumption is so large and plays an important role in national welfare and business cycle fluctuations. Hence establishing the type of consumption pattern that exists in Malawi will provide clear indications to understand the



fluctuation of sound fiscal and financial policies. For instance, if this work will show that a significant proportion of consumers are unable to smooth consumption effectively because of liquidity constraints, then movements in current income may be an additional determinant of consumption. This would imply that changes in aggregate consumption expenditure will be more responsive to income changes induced by policy. Thus, government actions could be destabilizing if consumption patterns are closer to liquidity constrained consumers also called ‘rule-of-thumb’ consumers than to those who can smooth their consumption overtime following the permanent income hypothesis.

One main goal of financial reform is to establish a vibrant financial sector that is accommodative of improved monetary policy transmission mechanism. Abundant empirical work about monetary transmission mechanism focus on how the monetary policy shocks affect output, prices, exchange rates as well as other key economic variables (Christiano, Eichenbaum and Evans, 1999; Peersman and Smets, 2001, Mishra and Montiel, 2012). These models are based on the assumption of constant parameters and constant volatility. However, financial reform is a process and the effects may vary overtime. In addition, Franta, Horvath and Rusnak (2013) revealed that the reforms can affect the monetary transmission mechanism by changing the overall impact of the policy or by altering the transmission mechanism channels. Hence, the use of these models fails to evaluate how changes in the way macroeconomic economic variables respond to shocks and how the volatility of shocks hitting the economy evolves overtime. Consequently, the outcome of these models have been affected by omitted variable bias, identification problem, spurious dynamics in random coefficients and most importantly ‘price puzzles’ (Sims, 1992; Eichenbaum, 1992; Giordani, 2004; Bernanke, Boivin & Ehasz, 2005; Cogley & Sargent, 2005; Sims & Zha, 2006; Koop, Leon-Gonzalez & Strachan, 2009; Korobilis, 2013).

Nevertheless, several of these studies on monetary policy transmission mechanism have concentrated on developed countries and there is very limited evidence if any in Sub-Saharan Africa. A recent empirical survey by Mishra and Montiel (2012) documents studies on effective monetary transmission in Low-Income Countries and no study has considered including the stochastic volatility in their monetary policy transmission mechanism frameworks. Although not directly related to this study, the only existing studies are two recent papers by Peretti, Gupta and



Inglesi-Lotz (2012) and Aye, Gupta and Modise (forthcoming) included stochastic volatility in their models to quantify the impact of house and stock prices on consumption and interest rate in South Africa, respectively.

In Malawi's package of financial reforms have brought about new financial innovation with growing banking system, removal of interest rate and credit controls, opening current and capital account, adopting a managed and floating exchange rate regime, mushrooming of credit facilities and other non-financial institutions such as insurances. These policy changes have posed macroeconomic challenges for the Reserve Bank of Malawi (RBM). In tandem, we have seen an improvement of the evolution of various economic activities following these reforms. For instance, inflation declined to single digits in 2000s and the country managed to achieve a stable economic growth of about 6 percent on average until 2010 (Table 1). In addition, the country experienced interest rates and exchange rate stability with mushrooming of private sector credit. Therefore, using Nakajima (2011) approach, it would be interesting to investigate whether the monetary stabilisation policy had any effects on this hard earned economic stability and how the effects have evolved overtime, especially during the financial reform period.

Most of the countries in sub-Saharan Africa including Malawi hold a high degree of dependence on foreign aid. In addition, the adoption of financial reforms under SAP influenced an increase in foreign aid from development partners to assist in the implementation of the structural reforms in many less developed economies in sub-Saharan Africa. Abundant work has focused on investigating management of aid and impact on economic growth and development. However, Hansen and Heady (2009) argue that increases in foreign aid can bring about implications in the long-run institutional development and short-run macroeconomic management in small economies. Hence, the focus on this work is on the latter part and research work on this area is still in the infancy stage.

Several studies have been initiated in this area (Buffie, Adam, O'Connell and Pattillo, 2004; Tang & Vines, 2007; Adam, O'Connell, Buffie & Pattillo, 2009; Berg, Mirzoev, Portillo & Zanna, 2010). It is becoming clear from these studies that large aid inflows can indirectly cause macroeconomic problems that could limit the overall impact of foreign aid on economic growth and development. In particular, in small countries that depend heavily on the export sector to



generate enough foreign exchange to satisfy import demand, there is a possibility that aid inflows denominated foreign currencies may raise either nominal exchange rates or the prices of other critical resources that are in limited domestic supply. These effects known as “Dutch Disease” are often considered one of the main reasons for the apparent ineffectiveness of aid. Literature reveal that this “Dutch Disease” can be addressed by either absorbing the increased aid inflows through increased imports or delay absorption and aid spending by bolstering their foreign exchange (Hansen and Heady, 2009). Hence, the mix of spending and absorption of increased aid inflows begs the question of whether the aid inflows have short run negative impact on inflation and exchange rate policies that would impact on price stability and economic growth.²

In Malawi, foreign aid inflows provide 40 percent of resources to support the national budget (Malawi Government, 2006) and foreign aid as proportion of GDP increased after adopting financial reforms. The country also depends on agricultural exports (tobacco earning about 60 percent of total export proceeds) and raw materials imports for production. Country studies have revealed that aid inflows have been erratic due to slippages in the economic management, violations of rule of law and governance problems (Fagernas & Schurich, 2004; Lea & Hanmer, 2009, Munthali *et al.*, 2010). For these reasons, the country experienced episodes of aid withdrawal between 1980 and 2010. The withdrawal of foreign aid has coincided with the shortage of foreign exchange making the country failing to import essential commodities such as fuel, fertiliser and medicines (Munthali *et al.*, 2010; IMF, 2012). The big question now lies in understanding whether the positive aid shock may have short run negative macroeconomic consequences on inflation and exchange rate policies as explained by Buffie, Adam, O’Connell and Pattillo (2004). Specifically, we only isolate how RBM responded to aid increases depending upon government spending options.

1.4. Studies on Macroeconomic Reforms in Malawi

Generally, earlier studies in Malawi have also investigated the effects of financial reforms but only to the limited number of key macroeconomic activities such as savings, industries, informal markets and economic growth. Effects on aggregate consumption pattern and impact on

² Full details about absorption and spending are fully explained in Gupta, Powell and Yang (2005) and Hussain *et al.* (2009).



monetary policy response of increased aid inflows have not been included. Although, monetary policy transmission has also been a focus in Malawi, specific to changes in the monetary policy transmission has been limited.

For instance, Chirwa (1999) examined the effect of financial sector reforms on the market structure, financial intermediation and savings mobilisation in Malawian banking system. The results indicate that financial liberalisation has significantly reduced financial repression in Malawi with respect to the depth of the financial system, reduction in monopoly power, increase in savings mobilisation and relocation of credit to the neglected sectors. However, macroeconomic instability continued during the reform period, real interest rates remains low with very high intermediation cost margins and there was a relative fall in the share of loans and advances in total assets. These findings are in line with the earlier study by Aryeetey, Hettige, Nissanke and Steel (1997) and another study by Chirwa and Mlachila (2004).

The study by Chipeta and Mkandawire (1991) analysed the informal financial sector and macroeconomic adjustments in Malawi. This study demonstrates that the country has a large size of informal financial sector which drives economic activities despite the country implementing financial sector reforms. Specifically, the study found that informal financial sector complement formal financial sector in the mobilisation of savings (savings effects), in the use of resources to earn income (investment effects), and in obtaining loans (credit effects). However, the study argue that the use of official monetary statistics understate the volume of financial savings and credit in the economy. By implications, the monetary policy instruments are targeted at a small proportion of financial transactions and thus giving a false view of the degree of monetary control. These findings have also been echoed by Ngalawa and Viegli (2010) who have also reiterated that the larger the size of the informal financial sector the lower the likely impact of monetary policy on economic activity.

The work of Kabango and Paloni (2010) also investigated the effects of financial reforms on industrial development in Malawi. The study argues that financial reforms improve industrial development by removing the credit access constraint on firms. Although the study states that large firms tend to benefit from a liberal financial regime, the reforms have been found to be associated with a significant increase in industrial concentration and a significant drop in firm



entry especially the micro, small and medium enterprises. Ngalawa and Viegi (2011) also investigated the effects of monetary policy on inflation and output considering the implementation of macroeconomic reforms in Malawi. The impacts on economic activities were found to be weak during the financial reform period but became strong and consistent with theoretical expectations in the post reform period.

A recent study by Simwaka, Munthali, Chiumia and Kabango (2012) also focused on financial development and economic growth in Malawi. The paper found that faster economic growth leads to financial deepening. There is however little evidence of causality of financial deepening on economic growth. The study explains that the financial sector is still less developed and financial sectors tend to develop slowly to explain medium term variations in growth. This implies that the implementation of financial reforms have had little effects on the development of financial sector as well as little contribution to economic growth. In addition, the study also point that the results are sensitive to the measure of financial reforms. In particular, the study uses individual indicators of financial development and obtains different results on each indicator used in the relationship. Creating a representative index of financial development might help in analysing the actual effects of financial reforms on output and prices.

Despite these efforts, empirical work examining the effect of these reforms on aggregate consumption which forms a large component of GDP has not been investigated. The analysis of the effects of monetary policy on economic activities has not taken into consideration of the possibilities of changes in the evolution of macroeconomic policies faced by the economy during the reform period. Malawi also experienced large aid inflows and the inflows have been erratic over time. But there have been limited studies to demonstrate how the monetary response to aid inflows through exchange rate mechanism impacted price stability and economic growth in Malawi.

1.5. Objective of the Thesis

Between 1980 and 2010, the Malawian economy was characterized by macroeconomic reforms that led to price instability and a decline in economic growth. Although, the economy improved in the post reform period, the country remains poor, heavily dependent on foreign aid to finance



its national budget and in addition characterized by high current income consumers. In addition, the implementation of economic policies in Malawi happens in an environment with a lot of structural and institutional policy changes. As a result, there are still gaps which require redress in understanding the impact of macroeconomic reforms on economic activities in Malawi. In understanding these gaps, this thesis aims to achieve the following broad research objectives: a) evaluate the impact of financial reforms on consumption behaviour in Malawi; b) determine how the monetary policy transmission mechanism has evolved over time, following the implementation of financial reforms; and c) investigate the monetary policy response to increased foreign aid inflows in Malawi.

1.6. Contribution of the Thesis

The thesis contributes to the current state of knowledge on the effects of macroeconomic reforms on economic activities in the context of a Sub-Saharan African country, Malawi. Particularly, the thesis enhances the understanding of the effects of macroeconomic reforms on consumption, evolution of monetary policy overtime and the impact of aid inflows on monetary policy in Malawi. To the best of my knowledge this is the only thesis that examines how the consumption pattern and evolution of monetary transmission changed overtime following the implementation of financial reforms that occurred in Malawi. The thesis also examines how the monetary policy responded to foreign aid during and after adopting the reforms in Malawi. Furthermore, the research uses multivariate econometric models in an attempt to capture both the dynamics of time series data and the relationship between key macroeconomic variables. The thesis attempts to address issues such as inconsistent estimates, misspecifications and identification, and endogeneity problems that are inherent in previous empirical work on the effects of macroeconomic reforms on consumption, transmission mechanism and aid inflows.

This thesis includes the development and estimation of the Bayesian DSGE model for Malawi which is derived from microeconomic foundations of optimisation problem of the economic agents. The DSGE model is appropriate as it is less susceptible to the Lucas (1976) critique and is suitable for policy analysis (Teo, 2009). Despite the increasing awareness of the advantages of Bayesian DSGE models in recent years, no attempt has yet been made to explore the models for the Malawian economy. Most of the studies in the area of aid inflows in low-income countries



use calibrated DSGE model instead of estimations. Hence, the thesis fills this gap and contributes to the modelling of the country's macroeconomic fluctuations. The results will help the government or policy makers and other stakeholders understand the role of macroeconomic reforms in improving financial and monetary sector. In addition, it will help policy makers and development partners such as the IMF and the World Bank in the design of policies and programs aimed at improving the financial sector that is accommodative of achieving price stability and economic growth in Malawi.

1.7. Scope and Outline of the Thesis

Based on the above research objectives, the thesis consist of three essays presented in chapter 2 to 4. The first essay in chapter 2 examines the existence of the Permanent Income Hypothesis (PIH) and whether financial reforms implemented in 1980's and 1990's altered the pattern of aggregate consumption behavior in Malawi using Instrumental Variable and Two Stage Least Squares (IV-TSLS) approach. Empirical work shows that, in addition to other factors, macroeconomic reforms were supposed to expand liquidity options of households who have the ability to smooth consumption (Reinhart and Tokatlidis, 2003; Qi and Prime, 2009). However, reforms in Malawi aggravated the liquidity constraints on borrowers that used to be rationed out of the market and led to increase in household consumption and decline in savings.

Currently, aggregate consumption is estimated around 80 percent of GDP on average. Therefore, this essay tries to understand the effects of financial reforms on consumption behaviour and identify factors that contribute to the increase in household consumption. Our analysis is based on the Permanent Income Hypothesis (PIH) framework. But before that we present a robust account of the financial reforms and construct financial reform indices for the country based on Aron and Muellbauer (2000). This method accommodates the sequential institutional changes that occur due to different changes in the financial sector policy reforms. The new constructed indices are then used to examine whether financial reforms affected consumption behavior in Malawi. We compare the performance of this index with the one constructed under the PCA and a single indicator of financial reform in Malawi.³The key finding in the essay is that the PIH does not capture important characteristics of aggregate consumption behavior in Malawi and most

³The full details about the indices are discussed in chapter 2.



consumers follow the “rule-of-thumb” of consuming their current income partly due to liquidity constraint.

The second essay in chapter 3 investigates the monetary policy transmission mechanism in Malawi. As discussed earlier, the macroeconomic reform is a process and involves a combination of policies happening at different time period. It is becoming clear from literature that financial reforms can change the transmission mechanism by changing the overall impact of the policy or by altering the transmission channels over time (Franta, Horvath and Rusnik, 2013). Therefore, the impact of monetary policy on price stability and output growth can vary and portray delayed effects overtime. These assertions have not been investigated in Sub-Saharan Africa including Malawi.

It is therefore necessary to examine how and when changes in the monetary policy as a result of macroeconomic reforms have affected price stability and economic growth overtime in Malawi. We employ a time-varying vector autoregressive (TVP-VAR) model with stochastic volatility. The key results are that the responses of economic activities to monetary policy change over time and beginning 2000s, the transmission mechanism performed consistently with the predictions of economic theories. This means that the implementation of macroeconomic reforms together with structural changes in the economy might have influenced changes in Malawi transmission mechanisms over time.

The third essay in chapter four develops a dynamic stochastic general equilibrium (DSGE) model for Malawi that is capable of handling both the possibilities of structural events and the issue of nonlinearities. Particularly, the essay estimates the Bayesian DSGE model and analyses the monetary policy response to increased aid inflows in Malawi. Following macroeconomic reforms, foreign aid inflows from the development partners increased and are supporting about 40 percent of the national budget. However, large aid inflows induce exchange rate appreciation pressures which negatively affect the export sector (Berg *et al.*, 2010). On the other hand aid inflows have a similar effect as domestically-financed fiscal expansion which leads to increases in money supply and creates inflationary pressures. Thus, this essay can help to understand how the monetary policy response to aid inflows influence price stability and economic growth. The key results from this essay indicate that there is strong evidence of “Taylor rule” like response of



monetary policy to aid inflows in Malawi. Evidently, spending but not absorbing increased aid inflows induces demand pressures and result in an increase in real interest rates. The demand pressures are associative with high depreciation and inflation in Malawi. In addition, this chapter tests the performance of different monetary policy rules including the Taylor rule, incomplete sterilisation and money growth based on the central bank balance sheet approach.

The thesis combines three different essays, that all fall under the single theme of the effects of macroeconomic reforms on economic activities in Malawi. A number of key findings emanate from the empirical analysis. The results show that the effects of macroeconomic reforms contributed negatively to the consumption pattern of Malawians. The proportion of current income consumers have increased indicating that savings and investment have been declining due to liquidity constraint despite implementing macroeconomic reforms. Interestingly, the implementation of macroeconomic reforms fuelled increased aid inflows in Malawi, but the increased aid inflows induced depreciation of the exchange rate which contributed to inflation pressures. It is also partly evident that the contribution of the reforms portrayed delayed effects on price stability, exchange rate and output growth. It is quite clear that macroeconomic reforms have policy implications on achieving price stability and economic growth.



Chapter 2

Financial Reforms and Consumption Behaviour in Malawi

2.1 Introduction

Although, Malawi implemented financial reforms starting from 1987 under the structural adjustment programmes supported by the International Monetary Fund (IMF) and the World Bank, empirical work testing the effect of these reforms on aggregate consumption which forms 90% of gross domestic product (GDP) has not been investigated. The only studies well documented in the literature include the effects of financial liberalisation⁴ on savings, on the banking industry, other industries and firms, monetary policy and formal and informal financial markets (Chipeta & Mkandawire, 1991; United Nations Development Programme, 1999; Chirwa, 1999; Chirwa & Mlachila, 2004; Kabango & Paloni, 2010; Ngalawa & Viegli, 2010).

Studies on the effect of financial liberalisation on consumption behaviour have mainly followed the seminal work of Hall (1978) on the Permanent Income Hypothesis (PIH). The hypothesis based on the representative agent consumption model proposes that aggregate consumption patterns respond to changes in permanent income. However, empirical work done by Flavin (1981) and Campbell and Mankiw (1989) found that apart from responding to permanent income, aggregate consumption also responds to changes in current income. Thus consumers can be categorised as either permanent income consumers or current income consumers. They argue that consumption expenditures seem to respond to predictable changes in income because some consumers encounter binding liquidity constraints in some period. Specifically, the liquidity constrained consumers are unable or unwilling to use financial markets to smooth consumption.

Blundell-Wignall, Browne and Cavaglia (1991), Bayoumi (1993), Girardin, Sarno and Taylor (2000), Aron and Muellbaur (2000), Barrell and Davis (2007) have explained the link between excess sensitivity of current consumption to current income and liberalisation. They observed that liberalisation makes excess sensitivity (liquidity constraints) to decline and enhance

⁴Financial liberalization, financial reforms and financial deregulation mean the same in this study and are used interchangeably



consumption to track current income closely. However, in a situation of continued credit market imperfection despite liberalisation, the excess sensitivity of consumption to income may not decline and consumers will be forced to consume entirely out of current income. That is, consumers will be unable to borrow against future income and hence affect the consumption of significant fraction of consumers. Another reason why excess sensitivity may remain high during liberalisation is through rational expectation arguments. For instance, uncertainty about future income can induce consumers engaging in precautionary savings and increasing this uncertainty will increase savings and reduce consumption relative to income (Blundell-Wignall *et al.*, 1991). Most of these arguments are based on the empirical findings from industrialised and emerging economies and very limited country specific studies have been conducted in sub-Saharan Africa. Hence, one of the contributions of this paper is an empirical extension of Campbell and Mankiw's (1989) model on Malawi data and findings add to the empirical literature in Africa.

Attempts have also been made to explore factors behind the rejection of the PIH (Flavin, 1985; Shea, 1995; Drakos, 2002; Rao, 2005; Gomes and Paz, 2010). They have found that myopia, liquidity constraints and perverse asymmetry are important factors behind the failure of PIH. For instance, Shea (1995) explains that under myopia, aggregate consumption behaviour tracks current income and consequently consumption should increase and decrease in response to increases and decreases in the expected income, respectively. While under liquidity constraint, consumers are prevented from borrowing when income is temporarily very low. Accordingly, consumption is more correlated with predictable income increases than declines. Gomes and Paz (2010) in their study on Brazil have demonstrated that both factors can coexist. On the extreme side, Paz (2006) found that neither liquidity constraints nor myopia contributes to the failure of PIH but consumption is sensitive only to expected income declines which Shea (1995) called 'perverse asymmetry'.

Ang (2011) has argued further that liberalisation can reduce the response of current consumption to changes in current income in a country with stable macroeconomic background and good financial institutions. However, the current study only explains why liquidity constraints and myopic tendencies remain high despite implementing liberalisation in Malawi. Findings by Chipeta and Mkandawire (1991), United Nations Development Programme (1999), Chirwa (1999), and Malawi Financial Sector Assessment Programme (2007) show that Malawi



experienced macroeconomic instability and weak financial institutions during the liberalisation period. They further elaborate that the financial sector is characterised by weak imperfect financial information, lack of proper legal financial systems and supervision, undeveloped credit markets and reliance on collateral requirements which exclude many participants in the formal financial systems. Hence, the formal financial sector may have not changed credit availability which may have impacted negatively on liquidity constraints in Malawi during liberalisation.

Various measures have been deployed to model the direct and interactive effects of financial reforms on economic activities. However, single country empirical studies on the impact of financial liberalisation provide mixed evidence (Barrell & Davis, 2007). The disparities in results partly may also be attributed to differences in the methodological innovations in the measurement of the proxy defining liberalisation indices. Recently, common approaches employed are the principal component analysis (Demetriades & Luintel, 1997; Bandiera, Caprio, Honohan, & Schiantereli, 2000; Laeven, 2003; Shrestha & Chowdhury, 2006; Bittencourt, 2012) and the linear spline function (Aron and Muellbauer, 2000). Thus, another contribution of this study is an attempt to construct the financial reform index for Malawi using the principal component analysis and the linear spline function. Most studies in Malawi use single proxies such as the ratio of private credit to GDP and dummy variables prior and post period of liberalisation. Therefore, constructed indices may help to address issues of comprehensive representation and accommodate the sequential institutional changes due to changes in financial sector policy reforms.

In most of the studies mentioned above, the reform measures were expected to affect mobilisation of savings and investment through their effect on availability and allocation of credit. However, these studies demonstrate that savings as percent of GDP and private credit as percent of GDP declined while aggregate household consumption increased during the liberalisation period. In principal, liberalisation would have increased competition in the formal credit market and eased restrictions on borrowers. This would have expanded liquidity options of households who have the ability to smooth consumption. Hence relaxing the liquidity constraints on borrowers that used to be rationed out of the market may allow consumers to borrow to cover shortfalls in income and enhance the ability to consume of wealth at the same time (Reinhart and Tokatlidis, 2003; Qi and Prime, 2009). These researchers conclude that credit will increase



leading to increase in aggregate consumption and a decline in aggregate savings. Instead, the country experienced a decline in credit during liberalisation and shows very limited relationship with consumption pattern in Malawi. Therefore, these patterns of consumption and private credit provide motivation for further investigations of behavioural changes in aggregate consumption in Malawi.

In addition, establishing the type of consumption pattern that exists in Malawi will provide clear indications to understand the formulation of sound fiscal and financial policies. For instance, if this study will show that a significant proportion of consumers are unable to smooth consumption effectively because of liquidity constraints, then movements in current income may be an additional determinant of consumption. This would imply that changes in aggregate consumption expenditure will be more responsive to income changes induced by policy. Thus, government actions could be destabilising if consumption patterns are closer to liquidity constrained consumers also called ‘rule-of-thumb’ consumers than to those who can smooth their consumption overtime following the permanent income hypothesis.

Henceforth, the purpose of this chapter is to investigate the existence of Permanent Income Hypothesis (PIH) based on Flavin (1981) and Campbell and Mankiw (1989) following the implementation of financial reforms in Malawi in the 1980’s and 1990’s. More specifically, the study questions whether financial reforms contributed to the promotion of the financial system that is capable of influencing households to use the financial markets to smooth their consumption pattern in time of need. If it happens that PIH does not exist in Malawi, the chapter continues to explore further whether the failure is due to liquidity constraints or myopia as done by Gomez and Paz (2010) on Brazil. The study further attempts to examine whether the degree of excess sensitivity (liquidity constraint) of consumption declines during financial reforms by simply controlling for financial reforms represented by indicators of financial reforms. Explanations as to why liquidity constraint remains high despite implementing reform in Malawi are also provided. This chapter is unique from the rest in the sense that new constructed time series of financial reform indices based on Aron and Muellbauer (2000) are used. To the best of our knowledge, this is the first study to investigate these questions for a small country like Malawi.



The rest of this chapter is organised as follows: section 2.2 discusses a brief analysis of financial reforms and the construction of financial liberalisation indices in Malawi. Section 2.3 provides the empirical specification of the model to be used in the analysis. Data analysis and empirical results of the model are discussed in section 2.4 and 2.5, respectively. Section 2.6 concludes the study.

2.2 Brief Overview of Financial Liberalisation in Malawi

2.2.1 Financial Reforms

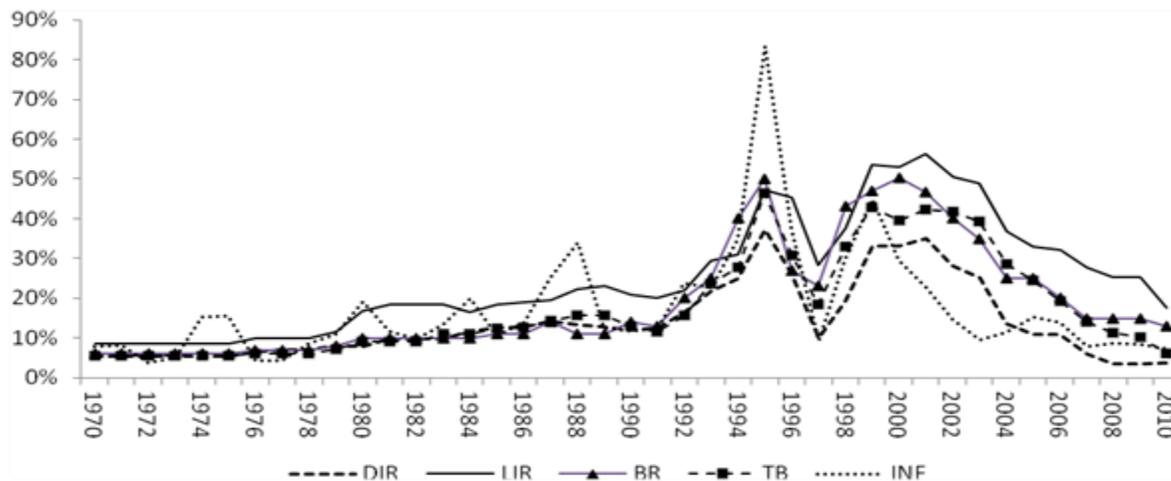
In Malawi, liberalisation of the financial sector started during the structural adjustment programmes supported by International Monetary Fund (IMF) and the World Bank (WB) in the 1980's. Liberalisation aimed at reducing direct government intervention while at the same time increasing the competition and efficiency in the operations of the financial sector. Measures of liberalisation included decontrolling interest rates, eliminating credit limits, reforming financial institutions, deregulating the financial sector, and adoption of indirect instruments of monetary policy (Chirwa, 1999; Chirwa & Mlachila, 2004). Accordingly, Malawi implemented many policy measures under liberalisation and we concentrate on those related to the study⁵.

Liberalisation of the financial sector started with the deregulation of interest rates in July 1987 (Chirwa, 1999). Prior to that the basic structure of interest rates was directly administered by the Reserve Bank of Malawi (RBM) with an aim of keeping the interest rates low in order to reduce government expenditures and promote private investment. In particular, commercial banks in Malawi were given the freedom to set their own lending interest rates starting in 1987. This was followed by the deregulation of the deposits rates in April 1988. By August 1988, preferential interest rates to the agriculture sector were abolished and full interest decontrol was done in May 1990. The significant objective of interest rate liberalisation was to influence and encourage borrowing and raise the cost of funds to all financial institutions. Consequently, as shown in Figure 1, there were upward trends of various nominal interest rates after the liberalisation but this happened on the background of high inflation and high income growth volatility. In addition, high interest rates in Malawi have generally been due to high levels of government borrowing of funds on the money market. The money market comprised of a high oligopolistic structure with

⁵ A brief historical aspect of financial reform is outlined in Table 1 summarised from Chirwa & Mlachila, 2004.

only two banks which accounted for 90% of bank credit in the economy during the liberalisation period.

Figure 1: Trend of Various Interest Rates and Inflation



Note: Data obtained from IMF-IFS, World Bank Indicators and RBM Financial and Economic Reports. INF, DIR, LIR, BR and TB stand for inflation, deposit interest rate, lending interest rate, bank rate and Treasury bill, respectively.

Malawi removed credit ceilings and rationing in 1989 (Chipeta & Mkandawire, 1991). By elimination of credit control, it was envisaged that further increase in private sector credit will be achieved. The removal of credit controls which constitute a liquidity constraint may imply that excess sensitivity will be reduced during liberalisation. Henceforth, the pattern of Malawi consumption will be smoothed during the liberalisation period and thereafter. However, RBM introduced the liquidity reserve requirement (LRR) ratio as the major monetary policy instrument in June 1989 (Sato, 2001). RBM started with 10 percent of LRR and thereafter it trended upwards until 2003. As in Chirwa and Mlachila (2001), banks in Malawi reacted to these high LRR by widening the interest rate spread and hence shifting the cost of refinancing requirements to the customers. Thus, the introduction of LRR can be seen as counter-productive as it might have restricted consumer credit absorption as the cost of borrowing increased. Simultaneously, government implemented open market operations (OMO) and the bank rate with Treasury bills, RBM bills, Local registered stock and repurchase agreements (repos) as main instruments of monetary policy (Sato 2001), due to inherently limited flexibility of the LRR. Despite some of these efforts, Figure 2 shows that private credit declined during the liberalisation period, but started improving in 2004.

Figure 2: Economic Growth and Private Credit as % GDP



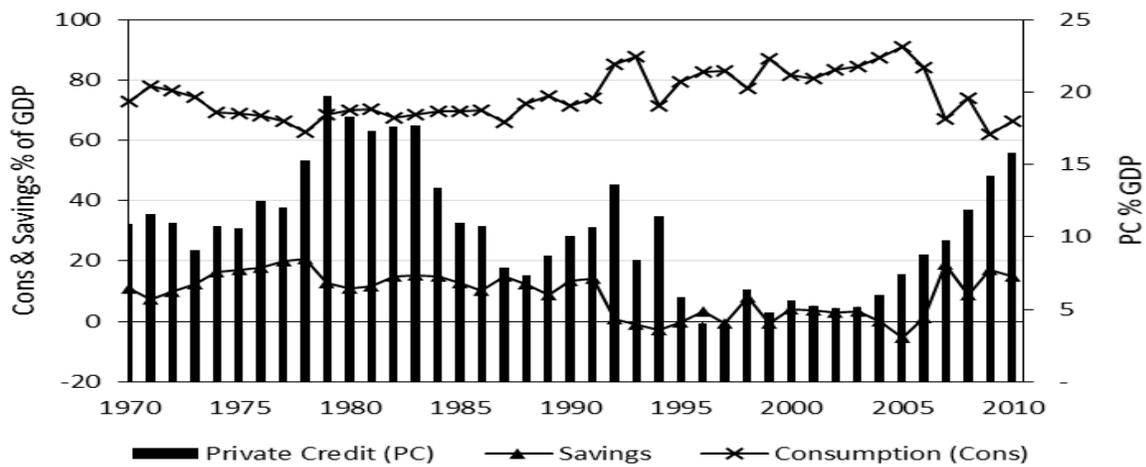
Source: Data used from IMF-IFS, World Bank Development Indicators and RBM Economic and Financial Review. Private credit is calculated as percentage of GDP and economic growth is percentage changes of real GDP.

Other reform policies involved the amendment of the RBM Act and Banking Act which were completed in 1989. After the revision of the Acts, privatisation and restructuring of banks and other financial institutions followed starting from 1990. This resulted in the expansion of banks from two in 1994 to nine in 2008 (Lea & Hanmer, 2009). In the foreign exchange market, Malawi adopted a floating exchange rate regime and removed exchange rate controls except for the capital account in 1994 (Sato, 2001). Due to potential volatility of foreign exchange experienced during the floating regime, Malawi adopted a managed floating exchange rate regime in 1995. The RBM was allowed to intervene to influence the exchange rate through sales and purchases of foreign currency, hence managing the exchange rate within a limited band. The band was removed later in 1998 in favour of a floating exchange rate regime (Mangani, 2011). The stock exchange officially opened in 1995 and listing of the first company took place in 1996. Despite this, capital markets are not fully developed and activities on the Malawi stock exchange remain limited

The important feature of financial reform on financial markets is the promotion of savings. Reinhart and Tokatlidis (2003) argue that the effect of real interest rates on consumption and savings depends upon the level of permanent income or wealth of the country. They contend that households first have to achieve subsistence consumption before other inter-temporal consumption choices are made. Hence, countries having high composition of subsistence

consumption, consumption and savings will be insensitive to changes in real interest rates, consumption will decline and savings increase after an increase in real interest rates. From Figure 3, savings and consumption as a percentage of GDP instead declined and increased, respectively during liberalisation period in Malawi. The decline in savings as proportion of GDP was largely experienced in the 1990's and reached negative 3 percent in 1994 from 14 percent in 1991; consumption on the other hand dropped in the 1980's and started increasing in the 1990's and thereafter.

Figure 3: Savings, Private Credit and Consumption as % of GDP



Source: Data used from IMF-IFS, World Bank Development Indicators and RBM Economic and Financial Review

Furthermore, liberalisation of the credit controls and ceilings indicate that not all households have access to credit. Hence, some consumers are not able to smooth their consumption overtime because they cannot afford to borrow from the formal financial sector. These liquidity constrained consumers determine their consumption and savings based on current income. Therefore, relaxing credit controls and improving credit availability may lead to consumption increases after the financial reforms (Reinhart & Tokatlidis, 2003). Accordingly, Figure 3 portray that Malawi experienced an increase in consumption as percent of GDP and a decline in savings as a percent of GDP which according to Bayoumi's (1993) arguments may be attributed to increased liquidity coming from increased credit as a result of liberalisation. Private credit as percent of GDP, however, declined during liberalisation. One important feature in Figure 1, 2 and 3 is the turnaround of the pattern of macroeconomic variables after 2006. In particular, we observe that inflation declined, private credit increased, economic growth increased, savings



increased and consumption declined. It would be interesting to investigate what caused the turnaround of economic events after 2006.

Moreover, empirical findings in Malawi generally indicate that liberalisation has little effect on improving credit availability in Malawi (United Nations Development Programme, 1999). More specifically, the study found that the demand for bank credit was adversely affected by unfavourable economic environment of high budget deficits, large government demands for bank credit, high rates of inflation, high nominal rate of interest rate and a depreciating currency. In addition, low credit has been attributed to structural issues which include unreliable power and water supplies, unsatisfactory state of internal road networks, and high transport costs. Other institutional set up problems observed include the fact that 90 percent of the Malawi population still remain unbanked and 85 percent of households are predominantly rural and employed in the agricultural sector (Malawi Financial Sector Assessment Programme, 2007). The banking system which forms a large share of the formal financial sector is still fragmented and repressed, mainly situated in urban areas and provide credit mostly to large-scale enterprises (Chipeta & Mkandawire 1991). Even where financial institutions have sufficient resources, lending to small-scale households is seen to be costly and considered a risky credit business.

The Malawi Financial Sector Assessment Programme (2007) has also provided additional factors that led to many Malawians having limited access to formal financial systems. Some of the operational factors include high cost of maintaining bank accounts because many Malawians cannot afford minimum balances due to low income levels, cash based payment systems and delays in loan processing and high cost of banking transfers. Other factors include the higher amount of securities that the banking system imposes on borrowers depending on their perception risks; weak microfinance sectors; limited export finance; existence of large informal sector and limited primary capital markets; and limited legal and regulatory frameworks. These factors have deprived many Malawians accessibility to formal financial systems and cause most household consumers to remain liquidity constrained even after financial reforms in the 1980's and 1990's.

This section has provided a few explanations as to why liquidity constrained consumers exist in Malawi. It is clear from existing literature that the liquidity constraint situation of consumers in



Malawi did not improve during the liberalisation era. As discussed above, liberalisation is a process and cannot be specifically defined. Therefore, the study attempts to construct proxies for liberalisation in order to quantify the true picture of financial reforms in Malawi as discussed in section 2.2.

2.2.2 Financial Liberalisation Index

In practice, single indicators of financial reforms such as ratio of liquidity liability (M2) to nominal GDP, ratio of debt to GDP and ratio of domestic private credit to nominal GDP have been used (Beck, Demirguc-Kunt and Levine, 2000). However, these indicators are not comprehensive representations of financial sector development and constructing a financial liberalisation measure with various aspects of the deregulatory and the institution-building process of financial development is very difficult (Bandiera *et al.*, 2000; Kelly & Mavrotas, 2008). In addition, others have used dummy variables to represent financial reforms but this has been found to be mostly subjective and difficult in assigning arbitrary dummies (Groenewold *et al.*, 2008). Recently, studies have suggested the use of a financial liberalisation index constructed from principal component analysis (Gries, Kraft, & Meierrieks, 2009). However, Aron and Muellbauer (2000) have argued that the principal component technique does not link institutional information with behavioural responses. Therefore, a paper by Aron and Muellbauer has constructed a financial reform index using a linear spline function accommodating the sequential institutional changes that occur due to changes in the financial sector policy reforms.

Given these considerations, this study attempts to construct a financial reform index for Malawi employing both the principal component and the linear spline function using quarterly data from 1980q1 to 2009q4. The indices are specifically helpful in monitoring the pace of liberalisation and evaluating the impact of the policy on various aspects of the economy. After constructing the two financial liberalisation indices, the study also attempts to estimate the impact of financial liberalisation on consumption behaviour using the constructed indicators of financial liberalisation. Apart from estimating a consumption function with financial liberalisation indices obtained from principal component analysis and the linear spline function, the study will also estimate the consumption function using the ratio of private domestic credit to nominal GDP as an index.



2.2.2.1 Financial Liberalisation Index from Principal Component Analysis

Demetriades and Luintel (1997), Bandiera *et al.* (2000), Laeven (2003), Shrestha and Chowdhury (2006) and more recently Bittencourt (2012) have attempted to construct financial liberalisation indices using the principal component analysis. Specifically, their approaches were based on assigning arbitrary dummies between 0 and 1 to construct a single index of liberalisation depending on the implementation status to each financial liberalisation policy variables. However, Groenewold *et al.* (2008) have argued that the process of choosing dummies will be plagued by certain arbitrariness in the assignment of numbers to events. Therefore, we depart from this practice and compute the weighted average of the principal components directly from the three standard measures of financial depth which include the ratio of liquidity liabilities (M2) to GDP, the ratio of domestic private credit (PC) to GDP, and ratio of commercial bank assets (CBA) to commercial bank assets plus central bank assets.⁶ This approach is similar to what was done by (Bittencourt, 2012).

Following Shrestha and Chowdhury (2006) but using indicators of financial depth as discussed above, the composition of financial liberalisation (FLI_t^{PC}) based on the principal component method can be expressed as follows:

$$FLI_t^{PC} = w_1 PC_t + w_2 M2_t + w_3 CBA_t \quad (1)$$

where w_i is the weight of the component given by the respective eigenvector of the selected principal components. These three standard measures are translated into natural logarithms. After computations, Table 3 reports the eigenvalues of the three possible components as well as the proportion and cumulative proportion of the variation in variables explained by each. The first principle component explains over 65 percent of total variation and the second principal component explains over 26 percent of total variation. Hence, the first financial liberalisation index (FLI_t^{PC}) is estimated using the eigenvectors of principal component 1.

⁶The choice of these ratios was done based on the availability data and the level of development of the financial sector in Malawi. For instance, the stock market is still in infancy stage hence we could not include it to represents financial liberalization



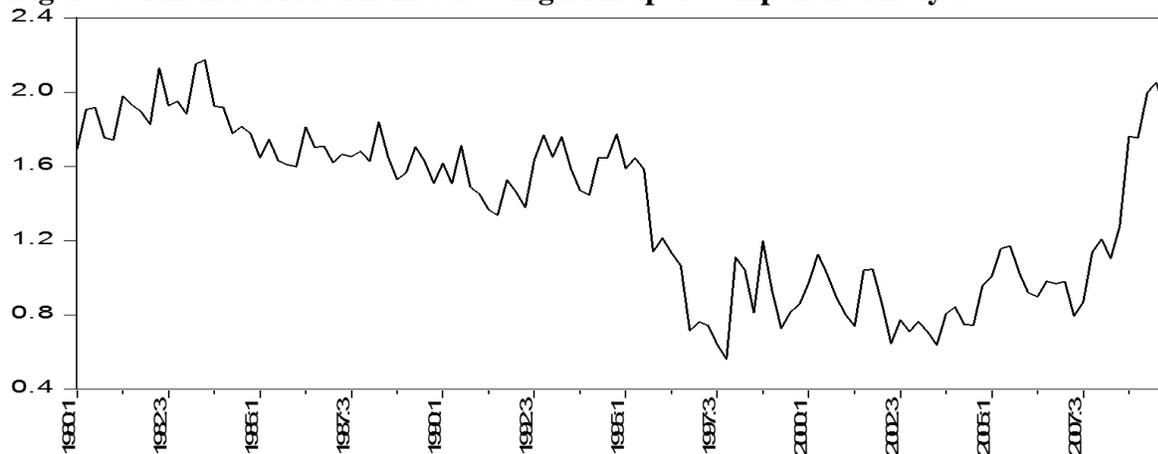
Table 3: Eigenvalue and Scores of Principal Components

Component/ Variable	Eigenvalue	% of Variance explained	Cumulative % of variance explained	Score principal component 1	Score principal component 2
1	1.939	65	65	0.633	0.329
2	0.777	26	91	0.638	0.291
3	0.284	9	100	-0.438	0.899

Note: variables in chronological order are 1) PC, 2) M2, and 3) CBA

The series are graphed in Figure 4 and it is evident that financial sector development deteriorated starting from 1980 and became slightly stable during the implementation of financial reforms in 1987. Although, interest rates were decontrolled and credit rationing was removed, episodes of ups and downs were observed during the reform period. Some policy measures introduced such as the introduction of liquidity reserve ratio and limited initial conditions of institutional environment were counter-productive to the reform programme (refer to section 2.1). Other factors contributing to unsuccessful financial reform programmes included political change regime in 1992 and 1994, withdrawal of donor funding, fiscal indiscipline and drought during the reform period (Mangani, 2011). Financial reforms showed signs of positive contribution starting from 2005 coinciding with the new government in power.

Figure 4: Financial Reform Index Using Principal Component Analysis



2.2.2.2 Financial Liberalisation Index from Linear Spline Function

Financial reform is also proxied by a linear spline function as done in Aron and Muellbauer (2000) study. To define the linear spline function, its coefficients are first estimated jointly from the consumption function. Theoretically and empirically, a macro-econometric consumption

function would include an income term, a wealth term and a real interest rate term (Cappelen *et al.*, 2006). However, the wealth term is excluded because data was not available for Malawi. In addition, Musila (2002) found insignificant impact of wealth and interest rate in describing consumption pattern in Malawi. Hence, the national disposable income is used as income in the household sector adjusted for inflation.

The estimated consumption function is as follows:

$$\Delta c_t = \mu + \lambda \Delta y_t + \alpha (y_{t-1} - c_{t-1}) + \omega_i d_{it} + \varepsilon_t, \quad (2)$$

where c_t is the natural logarithm of consumption and y_t is the natural logarithm of income. α is speed of adjustment, ω_i denotes a group of coefficients obtained from a group of dummy variables (d_{it}) at different time period of liberalisation that will be used to construct the index and ε_t is the white noise.

As observed from the review of financial reforms in Malawi in section 2.1, the financial liberalisation process has progressed in many stages and involved many policy reform measures⁷. Malawi implemented financial reforms sequentially between 1987 and 1998 and the set of reform measures were introduced at different time period starting with the liberalisation of lending rates in 1987 and then deposit rates in 1988. Other reform measures in the area of credit controls, financial institutions, monetary policy, exchange rate and current and capital account followed in the later years as highlighted in Table 1. Based on this history of financial reform in Malawi, dummies for the linear spline function are generated as follows. Financial reform started in 1987 and 0 is assigned prior to the liberalisation and 1 thereafter. By use of the quarterly data series, a 4 quarter moving average is created with predetermined moving average of dummies in 1987. d_{87} is defined as 0 prior to 1987 and 0.25 in the first quarter of 1987, 0.5 in the second quarter, 0.75 in the third quarter and 1 starting from fourth quarter and thereafter. d_{88} is defined as the 4 quarter lag of d_{1987} , d_{89} is the 8 quarter lag of d_{1987} , this continues until we obtain

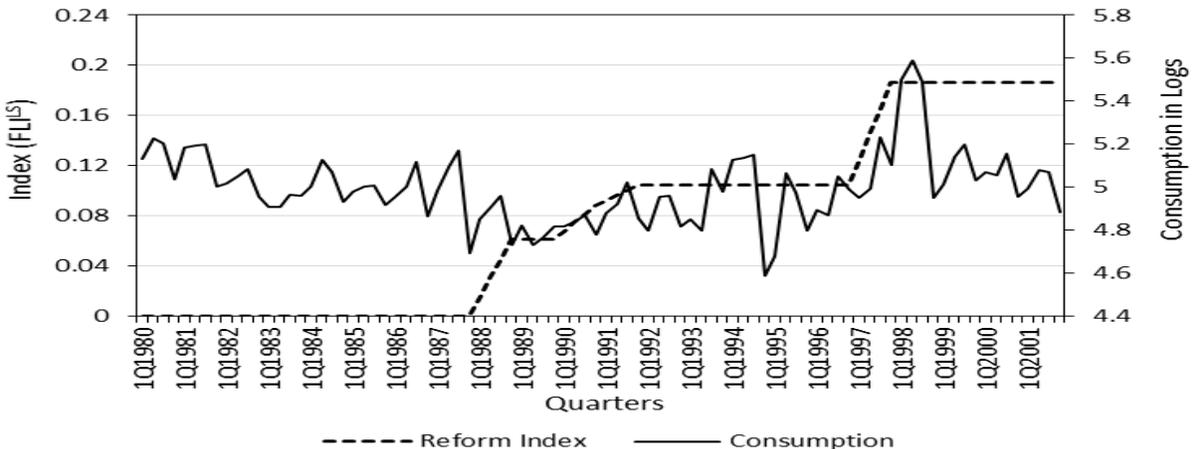
⁷A list of reform measures were summarized from Chirwa and Mlachila (2004) and these are included in Table 1 of chapter 1.

d98 which will be 44 quarter lag of d1987. Then the linear spline function (FLI_t^{LS}) is defined as follows:

$$FLI_t^{LS} = w_1 * d87 + w_2 * d88 + w_3 * d89 + w_4 * d90 + w_5 * d91 + w_6 * d92 + w_7 * d93 + w_8 * d94 + w_9 * d95 + w_{10} * d96 + w_{11} * d97 + w_{12} * d98 \quad (3)$$

The coefficients (w_i) in equation 3 are estimated from equation 2. Based on Aron and Muellbauer (2000) arguments, only positive coefficients are used in the estimation of equation 3. They argue that negative coefficients indicate policy reversal in the implementation of financial liberalisation. Positive effects of liberalisation are not realised in economies practicing policy reversal because most households and firms lose trust and coherence in adopting government policies. After estimations, 5 positive coefficients of dummies out of 12 were used in estimating FLI_t^{LS} in equation 3. The estimated FLI_t^{LS} is plotted together with consumption function as shown in Figure 5. The results show that consumption has moved along with financial reform index except in 1994 at the time of political change regime. It will be interesting to see how the coefficients will behave in a more sophisticated consumption function with wealth variables and interest rates variables. Additionally, joint estimation with household debt function should also be considered in future after obtaining reliable data on domestic debt. This is work in progress to improve on the formulation of the consumption function and debt function that can be jointly estimated to obtain reliable coefficients that can be used to construct a formal financial reform index for Malawi.

Figure 5: Consumption and Financial Liberalisation Index





We observe different performances between the principal component analysis and the spline function. The principal component shows that the actual implementation of liberalisation policies had negative effects on financial sector development which by implication may have led to non-effects of financial reforms on consumption. In section 2, we observed that some policy measures implemented were counter-productive to the reform programme. In addition, the financial reform programme was implemented under the background of unstable macroeconomic fundamentals such as high inflation, erratic economic growth and change in political regimes. However, we observe different scenario under the spline function. The changes in aggregate consumption pattern moved along with financial reforms. Consumption is trending at the lower level than before liberalisation. But episodes of upward movements in consumption when financial reform improved contradict the permanent income hypothesis and liquidity constraint. This may imply that changes in consumption pattern arose during liberalisation following changes in the current income.

Nevertheless, in both methodologies, the outcomes after financial liberalisation beginning 2007 show that financial sector development improved. From Figure 3, private credit increased, savings rejuvenated and consumption decreased in line with the theoretical expectations. Several questions can be asked from this. Is this an element of reduction in liquidity constraints? Is this an element of reduction in myopic tendencies of consumers? Did Malawi introduce other policies such as institutional policies apart from financial policies which had positive effects on changing consumption pattern during this period? For instance, government may have implemented policies in agriculture, education and health that likely may have influenced household consumption behaviour. In order to answer such questions, there is need for a more dynamic macroeconomic model which will be an important topic for the next study.

2.3 Empirical Specification of the Model

In this study, we adopt the Euler-equation approach based on the work of Hall (1978) to analyse the development of aggregate consumption function. The model follows the solved-out consumption function set out in Campbell and Mankiw (1989) in which we allow for the presence of liquidity constraints as follows:



$$\Delta c_t = \mu + \lambda \Delta y_t + \theta r_t + \varepsilon_t, \quad (4)$$

where Δc_t represent the change of the log of aggregate consumption, Δy_t is the change of the log of aggregate income while μ and ε_t represent the drift and the error term, respectively. θ is the elasticity of substitution parameter and r_t is the real lending rate. The parameter λ represents the degree of excess sensitivity. This equation simply states that the change in consumption is a weighted average of the change in current income and the unpredicted changes in permanent income. Hence, the analysis of changes in consumption pattern will be based on the degree of excess sensitivity. Therefore, we test the hypothesis that $\lambda = 0$. If λ is significant and positive, it entails rejection of the permanent income hypothesis, that is consumption behaviour in Malawi follows a rule-of-thumb.

In theory, real interest rates (r_t) would also be expected to influence savings, and therefore consumption, with lower interest rates leading to increased consumption. However, actual trends of savings declined during liberalisation in Malawi (Figure 3). The interest rate structure is still non-market determined due to high official oligopolistic financial structure and high government credit uptake. Hence, interest rate structure is likely to be controlled and consumer credits are likely to be low and lenders continue to use different criteria in credit rationing. Therefore, we assume constant elasticity of substitution but include it in our estimations to testify non-impact of interest rates on consumption in Malawi.

After examining the level of excess sensitivity, it is found that PIH did not exist in Malawi despite implementing financial reforms. We then extend our investigation to test whether this level of sensitivity declined during liberalisation period. We use indices of financial liberalisation constructed in section 3 because liberalisation involves many policy measures. On the understanding that we can obtain different outcomes using different indices, we allow for up to three separate parameters on the liberalisation indices to access different aspects of the

evolution of consumption behaviour following liberalisation. In this context, we modify equation 4 to allow for liquidity constraints and financial liberalisation as follows:⁸

$$\Delta c_t = \mu + \lambda \Delta y_t + \delta FLI_t^i + \varepsilon_t \quad (5)$$

where $FLI_t^i, i = C, PC, LS$ is a proxy for financial liberalisation. Three proxies are used which include the ratio of private credit to GDP (FLI_t^C), constructed series of financial liberalisation from the principal component (FLI_t^{PC}) and constructed series from the linear spline function (FLI_t^{LS}). It is anticipated that the size of excess sensitivity λ for Malawi will decline during the liberalisation period. As explained in the introduction, one reason for excess sensitivity is the existence of liquidity constraints. Therefore, a significant and reduced λ during the liberalisation period would show that financial liberalisation improved liquidity situation and hence changed the pattern of consumption in Malawi.

The hypothesis that excess sensitivity $\lambda = 0$ may be rejected and may not decline during the liberalisation period has prompted us to explore further factors behind the negative outcomes. Building from the work of Shea (1995) and others, we modify equation 4 further to isolate liquidity constraints effects in Malawi:

$$\Delta c_t = \mu + \lambda_1 DUM1 \Delta y_t + \lambda_2 DUM2 \Delta y_t + \varepsilon_t, \quad (6)$$

where $DUM1$ is a dummy variable for periods in which $\Delta y_t > 0$ and $DUM2$ is a dummy variable for periods in which $\Delta y_t < 0$. Under liquidity constraint λ_1 should be positive, significant and greater than λ_2 while under myopia λ_1 and λ_2 should be positive, significant and equal.

However, estimating excess sensitivity λ using ordinary least squares (OLS) in all the models will yield biased and inconsistent coefficient because we are using expected variables in the equations. More specifically, permanent income hypothesis involves predictable components of income growth and real interest rates which are unobservable quantities (Campbell & Mankiw,

⁸This formulation will require further improvements to allow the coefficient of indicators of financial reforms to vary with the excess sensitivity as done in Bayoumi (2000).



1990; Shea, 1995; Drakos, 2002; Wooldridge, 2009). Such simultaneous and error specifications can bring about the problem of endogeneity. Thus the explanatory variable Δy_t in equation 4 maybe correlated with ε_t . To address such endogeneity problem, the current study uses instrumental variables technique and two-stage least squares (IV –TSLS) employed by Campbell and Mankiw (1989).

In the IV-TSLS, we use the predetermined variables as instruments. Specifically, the lagged values of Δy_t are usually considered in the literature because the lagged variables are likely to be correlated with their current variables but not with the error term, since there were generated at an earlier point in time. In addition, instrumental variables are used to control for the possibility that changes in current income might signal changes in permanent income. The first lags are not used in this study because consumption and income data are time averaging and may induce serial correlation between the variable and its first lag (Campbell & Mankiw, 1989; Bayoumi, 1993; Shea, 1995; Drakos, 2002). Instead, we use lags starting from the second lag period in order to circumvent this problem. The only problem is that the degree of predictability is somehow lost in the first stage of regression (Agell & Berg, 1996).

2.4 Data and Description Statistics

The study uses quarterly data for the period 1987:1 to 2009:4 which was collected from International Financial Statistics (IFS) of IMF. Missing data was filled and consolidated from various in-country publications of the RBM, National Statistics Office (NSO) and from the Ministry of Economic Planning and Development (MEPD). Data series include real per capita national disposable income (total domestic consumption plus total national savings), real per capita household consumption, and bank lending interest rate. Real interest rates are calculated according to the formula $1+r_t = (1+i_t)/(1+\pi_t)$, where r_t is real interest rate, i_t is nominal interest rate and π_t is inflation (Chipeta & Mkandawire, 1991; Paz & Gomes, 2010). Household consumption (consumption) and national disposable income (income) are collected annually with monetary aggregates (M1) in Malawi (Table 4). According to Denton (1971) approach, indices of industrial production (IIP) as related series would have been appropriate data to interpolate the quarterly GDP but IIP were not correlated with consumption and income. In this regard, the



series were interpolated using annual data to obtain quarterly series estimated using indices of seasonally adjusted money series (M1). In particular, we calculated quarterly changes of M1 and use these changes to interpolate the annual consumption and income into quarterly series as done in Denton (1971).

Table 4: Test for Serial Correlation

	M1	Income	Consumption	IIP
M1	1.000			
Income	0.993	1.000		
Consumption	0.954	0.956	1.000	
IIP	0.434	0.438	0.401	1.000

Note: Test for serial correlation so that M1 can be used to calibrate the quarterly series of household consumption and national disposable income.

Consumption and income variables were converted into natural logarithms. This makes the model estimated as the log-linear approximation to the true model. As shown in Table 5, consumption and income series were tested using the Augmented Dickey-Fuller test for stationarity and the Johansen procedure for cointegration. The series were not stationary in levels and became stationary at first difference, that is they are integrated of order one $I(1)$.

Table 5: Testing for Stationarity and Cointegration

Testing for stationarity		Testing for Cointegration – Johansen Procedure		
Variables	Dickey-Fuller Test	Null hypothesis	Trace test	p-value
c_t	-1.197 (0.673)	$r=0, v r=1$	10.712	(0.230)
Δc_t	-6.133 (0.000)	$r=1, v r=2$	1.881	(0.170)
y_t	-0.907 (0.782)	Null hypothesis	Max-Eigen test	p-value
Δy_t	-4.957 (0.000)	$r=0, v r=1$	8.831	(0.301)
		$r=1, v r=2$	1.881	(0.170)

Note: The testing null hypothesis is that the variable has a unit root $I(1)$. The figures in parenthesis are p-values. In terms of cointegration, r is the number of cointegrating vector. Number of lags used is 1 in both cases.

Using Johansen procedure, the series are not cointegrated at the 5% critical value; hence the null hypothesis of non-cointegration cannot be rejected. Thus the model is proven to be properly specified and can model the series in difference without losing important information in the estimated equation. It is also observed that estimations should use consumption data of non-durables and services and total disposable income or disposable labour income but Campbell and Mankiw (1990) found that the distinction is not very important. They obtained similar results empirically.



2.5 Empirical Analysis

The estimated model on whether permanent income hypothesis exists in Malawi is represented in Table 6. First, we tested the quality of the instruments used in our estimations and results are reported in the first stage regressions. The test results show that each set of instruments has strong predicting power for both income growth and consumption changes. One noticing feature is that the absolute R^2 for consumption are smaller than R^2 for income, except when real interest rate is used as instrument. This provides evidence against the permanent income hypothesis in Malawi. Campbell and Mankiw (1990) have argued that such result is sometimes obtained because of the error in the measurement of the income growth. However, obtaining uncorrelated measurement error will not bias the IV estimates of λ but will reduce the predictability of income growth.

Second, we tested the validity of the instruments using the over-identifying restriction tests of the instruments and this method is equivalent to the Sargan test. The test is conducted across all models. The adjusted R^2 for a regression of IV residual on the instruments with p-values in brackets for a Wald test that all the coefficients are zero are reported in the last column of Table 6. In all the models, the test results show that there is no evidence against the restrictions in the models used for estimations. Hence, we can argue that the models are well specified.

Third, attempts have been made to address the issues of heteroskedasticity, serial correlation, stability of parameters, and testing for restriction in the use of instrumental variables to address the issue of over-identification in the Tables 7 and 8. Most of these tests show that all the standard errors and test statistics are heteroskedasticity, autocorrelation, and stability consistent.

Empirical results represented in Table 6 show that predictable movements in real income growth do exhibit significant explanatory power over consumption growth, evidence against the PIH in Malawi. That is, the excess sensitivity is much higher than what is generally observed in industrial countries as well as other less developed countries (Campbell & Mankiw, 1989 and 1990; Rao, 2005; Paz & Gomes, 2010). These findings show that almost 90% of households in Malawi are associated with liquidity constraints and cannot smooth their consumption pattern over time. Specifically, it implies that consumers in Malawi depend on current income for their



current consumption. The strong effects of current income are consistent with how the economic system prevailed in Malawi. As observed in the literature, the country experienced low liquidity options such as credit unavailability and low savings and most Malawians were unable to use savings and borrowing to smooth the path of consumption.

Table 6: Estimate of λ Model for Malawi 1987Q1 – 2009Q4

Instrument	First Stage Regressions		λ (s.e.)	estimate	Test restrictions	of
	Δc_t equation	Δy_t equation				
Model 1 (OLS)			0.922*** (0.066)			
Model 2 (IV)	0.182 (0.001)	0.227 (0.000)	0.870*** (0.170)	-0.025 (0.855)		
Model 3 (IV)	0.199 (0.000)	0.262 (0.000)	0.815*** (0.120)	-0.030 (0.942)		
Model 4 (IV)	0.222 (0.000)	0.187 (0.000)	1.125*** (0.158)	-0.033 (0.996)		
Model 5 (IV)	0.180 (0.001)	0.247 (0.000)	0.914*** (0.098)	-0.040 (0.830)		
Model 6 (IV)	0.278 (0.000)	0.280 (0.006)	0.983*** (0.110)	0.008 (0.428)		

Notes: Three asterisks indicate 1% significance level and the figures in brackets are standard errors. In the first column of the table, model 1 is estimated using OLS while models 2 to 6 are estimated using two stage least squares. Model 2 uses three lags of income growth as instruments and model 3 uses three lags of consumption growth as instruments. Model 4 instruments are three lags of real interest rate. Model 5 instruments are three lags of income growth, consumption growth and error correction model for consumption and income. Model 6 instruments are three lags of income growth, consumption growth, real interest rate and error correction model for consumption and income. In the first stage regression, we report the adjusted R^2 statistics for the OLS regression of change in consumption and change in income on the instruments with p-values in brackets for the Wald test of the hypothesis that all coefficients are zero except the intercept.

The intertemporal substitution of consumption with respect to the real interest rate has also been estimated and the results have not been included in Table 6. The coefficients found were very small and insignificant in all models. We also found that when using lagged real interest rate as instruments, the estimated coefficient λ is greater than 1 but significant. This may imply that model 4 suffers from specification problems (See Gomes & Paz, 2010). Thus, the predictive power of interest rates on consumption growth or income growth is not clear in Malawi. This confirms the explanation provided in the model specification in section 4.

The results in Table 7 show that the coefficients of the excess sensitivity remained high under all cases of financial liberalisation. In addition, the estimated coefficients under the three liberalisation proxies are insignificant, indicating that there has been very little contribution from financial liberalisation on the consumption behaviour in Malawi. The failure to find any evidence

of financial market liberalisation in Malawi is also in keeping with prior expectations. Despite liberalising interest rates and removing credit controls, financial regulation concerning the authorisation of various financial activities was not fully implemented. This can partly be seen in the oligopolistic tendencies that banks practices in Malawi and the high participation of government in credit uptake. In addition, financial reforms could not work in isolation with unstable macroeconomic environment and weak financial institutions. Therefore, the case of liquidity constraints remained strong despite efforts to decontrol interest rates and abolish credit allocations.

Table 7: Estimated Results of $\Delta c_t = \mu + \lambda \Delta y_t + \delta FLI_t^i + \varepsilon_t$

	Model 1 OLS	Model2: IV	Model 2: IV - FLI_t^{PC}	Model 3: IV - FLI_t^{PC}	Model 4: IV - FLI_t^{LS}
μ	-0.003 (0.008)	0.003 (0.008)	-0.037 (0.065)	-0.029 (0.045)	0.039 (0.058)
λ	0.933*** (0.067)	0.918*** (0.100)	0.932*** (0.097)	0.937*** (0.098)	0.927*** (0.104)
δ			0.018 (0.034)	0.020 (0.036)	-0.307 (0.425)
\bar{R}^2	0.795	0.794	0.786	0.787	0.786
D.W.	1.856	1.860	1.822	1.827	1.809
LM(1)	0.001 (0.970)	0.003 (0.957)	0.007 (0.933)	0.002 (0.963)	0.091 (0.763)
ARCH (1)	0.0.314 (0.575)	0.312 (0.596)	0.315 (0.575)	0.314 (0.580)	0.329 (0.566)
Ramsey's RESET	0.108 (0.915)	0.025 (0.980)	0.063 (0.950)	0.087 (0.931)	0.151 (0.881)
Test of Restriction	-	-0.040 (0.273)	-0.045 (0.878)	0.046 (0.886)	-0.053 (0.933)
H₀: $\lambda = 0$					
H_a: $\lambda \neq 0$					

Note: Three (two) asterisks indicate 1% (5%) significance level and the figures in brackets of λ and δ are t-statistics. LM (1) test for serial correlation and ARCH (1) test for heteroskedasticity coefficients are observed R-squared and in brackets are p-values. Test for parameter stability was done using Ramsey's RESET test and in testing for over-identification restrictions the adjusted R^2 for a regression of IV residual on the instruments with p-values in brackets for a Wald test that all the coefficients are zero was also conducted. Instruments for models 2 to 6 are lagged variables of consumption, lagged variables of income, and an error correction model.

Following the rejection of permanent income hypothesis even during the liberalisation period, we estimated equation 6 in an attempt to clarify the sources of this rejection. The results in Table 8 show that both liquidity constraints and myopic tendencies are important factors behind the rejection of the PIH in Malawi. One possible reason for existence of liquidity constraints is non-

effect of significant structural changes in the formal financial sector (particularly on the banking sector) which failed to improve on making credit available to most households. As explained in section 2.1, the financial sector was characterised by limited presence in rural areas and high cost of financial intermediation. In addition, apart from government taking up a lion's share of credit, the monetary authority implemented counter-productive monetary policy instruments such as the liquidity reserve requirement which controlled the accessibility of liquidity in the economy. This may have possibly hindered accessibility of finance for those household consumers capable of smoothing consumption. Malawians are also myopic in nature because they depend on current income for their daily living. A large population is located in the rural areas and characterised with low savings, very limited non-human assets and low income. This is the first time the estimation of such nature is found on Malawi though similar to what has been found by Gomes and Paz (2010) on Brazil. It is now evident that the reason for the failure of PIH in Malawi is either liquidity constraint or myopia.

Table 8: Estimated Results of $\Delta c_t = \mu + \lambda_1 DUM1_t \Delta y_t + \lambda_2 DUM2_t \Delta y_t + \varepsilon_t$

	Model 1 (OLS)	Model 2 (IV)	Model 3 (IV)	Model 4 (IV)	Model 5 (IV)
μ	-0.009 (0.013)	-0.030 (0.113)	-0.018 (0.020)	-0.017 (0.018)	-0.030 (0.023)
λ_1	0.999*** (0.106)	1.302 (1.488)	1.115*** (0.258)	1.105*** (0.243)	1.345*** (0.292)
λ_2	0.892*** (0.121)	0.850* (0.469)	0.861*** (0.167)	0.867*** (0.167)	0.0.897*** (0.158)
\bar{R}^2	0.793	0.774	0.791	0.791	0.765
D.W.	1.870	1.932	1.891	1.888	1.941
LM(2)	0.006 (0.938)	0.058 (0.810)	0.018 (0.894)	0.016 (0.901)	0.070 (0.792)
ARCH (1)	0.325 (0.569)	0.503 (0.478)	0.367 (0.545)	0.362 (0.548)	0.550 (0.458)
Ramsey's RESET	1.623 (0.108)	0.108 (0.914)	0.807 (0.422)	0.675 (0.501)	0.035 (0.972)
Test of Restriction	-	-0.142 (0.631)	0.002 (0.149)	-0.039 (0.361)	-0.015 (0.281)
F-Statistics	0.309	0.054	0.437	0.401	0.377
H₀: $\lambda_1 = \lambda_2$	(0.580)	(0.817)	(0.510)	(0.528)	(0.244)

Note: One, two, and three asterisks indicate 10%, 5%, and 1% significance level, respectively and the figures in brackets alongside the coefficients are t-statistics. In the diagnostic part, the figures in brackets are p-values. Other diagnostic estimates were conducted as included in the table. Under myopia, $H_0: \lambda_1 = \lambda_2$ and $\lambda_1 > 0, \lambda_2 > 0$ while under liquidity constraint $H_0: \lambda_1 > \lambda_2$ and $\lambda_1 > 0$.

In summary, a closer look at our data reveals drastic changes in some macroeconomic variables starting especially from 2005. The years after 2006 dramatically changed in the economic



variables with persistent high increase in economic growth, credit resurgence and decrease in aggregate consumption. Hence, it is quite conceivable that there were other uncertainties or factors that affected consumption apart from financial policy measures implemented during liberalisation. Following the new political dispensation in 2004, Malawi may have implemented other institutional policies apart from financial reforms. For instance, Malawi introduced the fertiliser subsidy programme which on record has contributed to bumper crop harvest in agriculture leading to high economic growth. Therefore, the households in Malawi may have responded to increased uncertainty or other factors which may have increased precautionary savings and hence reduced the level of current consumption in the economy and increased future consumption later. It would be interesting to analyse all these relationships using a dynamic macroeconomic model.

2.6 Conclusion

The study has found that PIH of aggregate consumption behaviour does not exist in Malawi. Most consumers are current income consumers (rule-of-thumb). They consume from “hand to mouth” and very little is left to smooth consumption in their life time. The magnitude of 90% of excess sensitivity implies that most consumers in Malawi are current income consumers and is much higher than what was found in US and UK but even higher than what was found in other Less-Developed countries like Fiji. Despite Malawi implementing financial reforms in the 1980’s and 1990’s, households in Malawi seem to link consumption to current income. It is further observed that there was no shift between the current income consumers and permanent income consumers. The excess sensitivity still remains high during the liberalisation period. The empirical findings have further argued that the main reason for the failure of the PIH is due to liquidity constraint which is manifested in the under development of the financial market and unstable macroeconomic conditions in Malawi. Weak financial institutions, both structural and operational have impacted negatively on the accessibility of financial resources for most Malawians. This is a bigger lesson for policy makers to consider in the preparation of the broad based financial reforms in future.



Chapter 3

Evolution of Monetary Policy Transmission Mechanism in Malawi: A TVP-VAR Approach

3.1 Introduction

The main objective of this chapter is to investigate whether the monetary transmission mechanism has changed since Malawi adopted the financial reforms in 1980s. We investigate how and when the changes in the exogenous shocks of the monetary policy instrument of bank rate have influenced changes in the stability of inflation and output growth. Based on the Bayesian Time Varying Parameter Vector Autoregressive (TVP-VAR) techniques by Primiceri (2005) and Nakajima (2011), we empirically examine how the transmission mechanism and the monetary shocks have been varying overtime. Particularly, we evaluate whether the responses of prices and output level to bank rate, exchange rate and credit growth have been changing during and after financial reforms.⁹

Prominent work by McKinnon (1973), Shaw (1973) and Levine (2005) provide good foundations in understanding how financial reforms impact economic activities. One main goal of financial reform is to establish a vibrant financial sector that is accommodative of improved monetary policy transmission mechanism. Malawi's package of financial reforms have brought about new financial innovation with growing banking system, removal of interest rate and credit controls, opening current and capital account, adopting a managed and floating exchange rate regime, mushrooming of credit facilities and other non-financial institutions such as insurances. These policy changes have posed macroeconomic challenges for the Reserve Bank of Malawi (RBM). In tandem, we have seen an improvement of the evolution of various economic activities following these reforms. For instance, inflation declined to single digits in 2000s and the country managed to achieve a stable economic growth of about 6 percent on average until 2010. In addition, the country experienced interest rates and exchange rate stability with mushrooming of private sector credit. Therefore, it would be interesting to investigate whether the monetary

⁹The transmission mechanism effects overtime are explained via interest, credit and exchange rate channels. The asset channel has been left out because its development is still at infancy stage.



stabilisation policy had any effects on this hard earned economic stability and how the effects have evolved overtime.

Abundant empirical work about monetary transmission mechanism focus on how the monetary policy shocks affect output, prices, exchange rates as well as other key economic variables. Most of these studies use Vector Auto-Regression (VAR) frameworks in their analysis following a breakthrough seminal work by Sims (1980). Some of the most prominent ones include an authoritative survey by Christiano, Eichenbaum and Evans (1999) on USA, Peersman and Smets (2001) on the euro area and a recent survey by Mishra and Montiel (2012) on low-income countries. These models are based on the assumption of constant parameters and constant volatility. However, financial reform is a process and the effects may vary overtime. In addition, Franta *et al.* (2013) revealed that the reforms can affect the monetary transmission mechanism by changing the overall impact of the policy or by altering the transmission mechanism channels. Hence, the use of these models fails to evaluate how changes in the way macroeconomic economic variables respond to shocks and how the volatility of shocks hitting the economy evolves overtime. Consequently, the outcome of these models have been affected by omitted variable bias, identification problem, spurious dynamics in random coefficients and most importantly ‘price puzzles’ (Sims, 1992; Eichenbaum, 1992; Giordani, 2004; Bernanke, Boivin & Ehasz, 2005; Cogley & Sargent, 2005; Sims & Zha, 2006; Koop, Leon-Gonzalez & Strachan, 2009; Korobilis, 2013).

Accordingly in recent times, empirical researchers have developed the TVP-VAR models to address the issue of time varying parameter problems in the estimation of the monetary policy transmission. For instance, work by Canova (1993) followed by Cogley and Sargent (2001) considered the estimation of the TVP-VAR based on the assumption of constant volatility. However, Koop *et al.* (2009) and Cogley and Sargent (2005) argue that the transmission mechanism may not be constant overtime and the way the exogenous shocks are generated can change overtime. Primiceri (2005) confirmed the existence of both in USA. Nakajima (2011) also found the same results on Japanese economy. Another important study employing a Bayesian TVP-VAR model with stochastic volatility on transmission mechanism is by Franta *et al.* (2013) on Czech Republic.



Nevertheless, several recent studies on monetary policy transmission mechanism using the TVP-VAR with stochastic volatility framework have concentrated on developed countries. There is very limited evidence if any in Sub-Saharan Africa using the Bayesian TVP-VAR model to measure quantitatively the country's monetary transmission mechanism. A recent empirical survey by Mishra and Montiel (2012) documents studies on effective monetary transmission in Low-Income Countries and no study using the TVP-VAR framework with stochastic volatility has been included on Sub-Saharan Africa. Although not directly related to this study, the only existing studies are two recent papers by Peretti, Gupta and Inglesi-Lotz (2012) and Aye, Gupta and Modise (forthcoming) who have used a TVP-VAR model with stochastic volatility to quantify the impact of house and stock prices on consumption and interest rate in South Africa, respectively. Thus, our paper contributes to the literature by filling this gap. The model will assist not only in analysing the effects of monetary policy transmission but also observe how the shocks and estimated parameters have evolved overtime depending on the underlying macroeconomic structure of the Malawi economy.

Previous work on Malawi monetary policy transmission mechanism has primarily focused on the estimation of aggregate money demand relations in single equation framework (Phiri, 2001), using VAR estimations (Mangani, 2010), using SVAR (Ngalawa and Viegli, 2011) and using the VECM (Lungu, Simwaka, Chiumia, Palamuleni and Jombo, 2012). From these studies, issues of parameter instability and 'price puzzle' are commonly found. However, the models are based on the assumption of constant volatility of the exogenous monetary policy shocks and estimated parameters. By employing a TVP-VAR model with stochastic volatility, this paper accommodates the possibility of the changes in the transmission mechanism and the changes in the variances of the exogenous shocks. Our preliminary findings show that the transmission mechanism in Malawi changed markedly following the financial reforms. First, the change in the monetary transmission mechanism is not clear and provides more puzzles than answers before the financial reforms. Second, the transmission mechanism changes became volatile during the financial reform. Third, the changes in the transmission became clear during the post period of financial reform. Importantly, we found clear variety of shocks to bank rate and exchange rate with weak transmission mechanism through the credit channel.



The rest of the chapter is structured as follows. In section 3.2, we provide a brief review of the monetary policy and other stylized facts about the transmission mechanism in Malawi. In section 3.3, we propose a benchmark Bayesian TVP-VAR with stochastic volatility model in order to estimate whether the transmission mechanism changed overtime and whether the generated shocks are also changing overtime. In section 3.4, we discuss the empirical results and section 3.5 concludes.

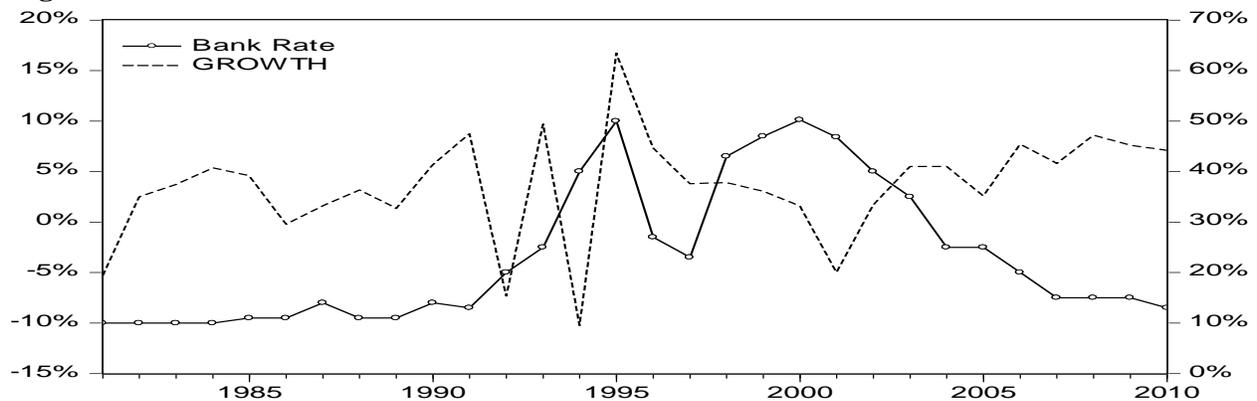
3.2 Brief Overview of Monetary Policy and Stylized Facts in Malawi

Ngalawa and Viegi (2011) provide a thorough overview of monetary policy in Malawi over the last two decades. The monetary policy analysis is also properly explained through the demand for money function by Munthali *et al.* (2010). Thus, we only provide an overview of monetary policy in Malawi. In general, the monetary framework can be categorised under three broad regimes: the repression period (1964-1986), the financial and liberalisation reform period (1987-1998) and post period of financial reform (1999-2010). Several monetary policy reforms emerged during these periods which included: changing the fixed exchange rate regime to the managed and floating one, removing direct controls on credit and deregulation of market interest rates, moving away from direct to indirect tools of monetary control, reviewing the legal and regulatory framework of the banking system, and removing the capital controls to the liberalisation of the stock market and other external flows. All these policy changes and implementation happened at different time periods.

Officially, the Reserve Bank of Malawi (RBM) uses reserve money and the bank rate as monetary policy targets. Recently, Ngalawa and Viegi (2011) have evidently evaluated the performance between these two targets and the bank rate has been found to be more effective tool of monetary policy than reserve money. The study also demonstrates that the bank lending, exchange rates and aggregate money supply contain important addition information in the transmission mechanism process of monetary policy shocks in Malawi. The study also found that the effects of transmission mechanism became strong and unambiguous during the post period of financial reforms. In particular, the role of exchange rate, interest rate and credit channels in transmitting monetary policy impulses was enhanced in the post period of financial reforms.

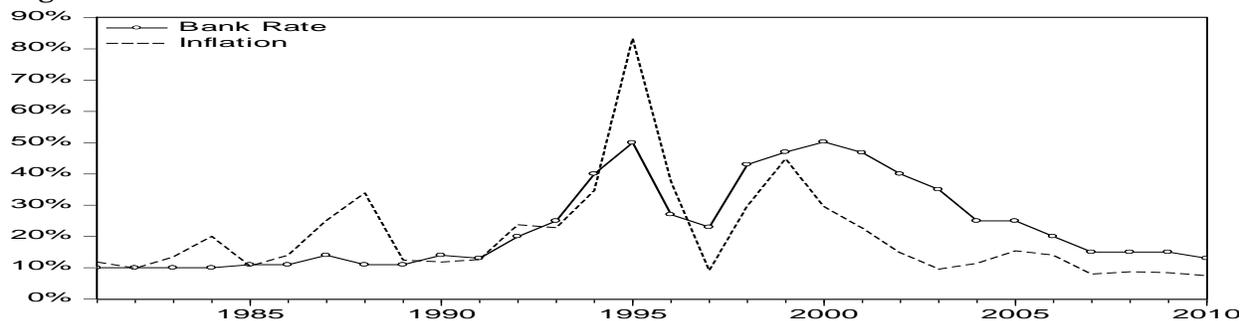
In addition, with changes in Government in 2004, both fiscal and monetary policy changed direction coupled with resumption of donor assistance. Adherence to international monetary fund programme also helped Malawi achieve fiscal and monetary consolidation after 2006 until 2010. As shown in Figure 6 and 7, inflation rates historically declined to single digits and economic growth hovered around 6 percent on average. Specifically, Figure 6 shows that episode of high and low bank interest rate are associated with stagnation and robust economic growth, respectively. However, the relationship between bank rate and growth is not clear during the financial reform period because the period was mild with volatility in growth emanating from high inflation, drought and shift in government policies. On the other hand, movements of inflation seem to have followed the bank rate (see Figure 7). The relationship between the bank rate, economic growth and inflation seems to be very clear during the post era of financial reforms. The IMF country reports have shown that macroeconomic and all other financial and fiscal targets were almost kept on target as programmed with the IMF based on the economic fundamentals during this period (IMF, 2010).

Figure 6: Trend of Bank Rate and Growth



Source: International Monetary Fund-International Financial Statistics from Quantec Easydata

Figure 7: Bank Rate and Inflation in Malawi

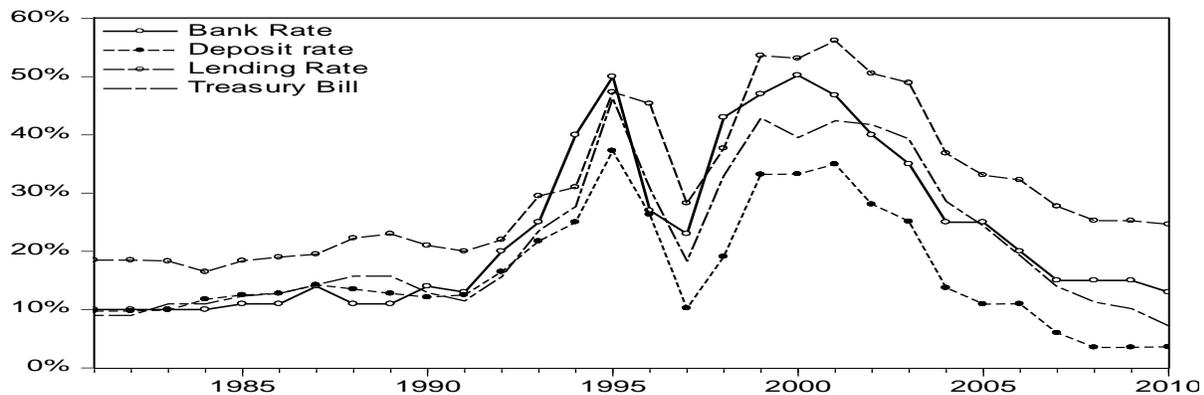


Source: International Monetary Fund-International Financial Statistics from Quantec Easy Data



According to the interest channel, the monetary transmission mechanism is based on the innovations in the bank rate. The RBM bank rate is administratively set and signals to the market the expected movements in the market interest rates (Simwaka, Ligoya, Kabango & Chikonda, 2012). In particular, movements in the bank rates are only effective to the extent they influence the Treasury bills, deposit and lending rates and thereby possibly economic activity. This is well demonstrated in the co-movements of market interest rates with the bank rate as shown in Figure 8. The weak link of transmission of interest rates is also affected by the possibility of having large informal credit markets in Africa which is the case for Malawi (Chipeta & Mkandawire, 1991; Ngalawa & Viegi, 2010). For instance, Christensen (2011) argue that tighter monetary policy divert demand to large informal credit sector and so lead to the sharp rise in cost of credit. Therefore, tighter monetary policy is associated with short-run rise in inflation because of considerable lag in demand effects in the large informal sector leading to ineffectiveness of monetary policy in stabilising the economy.

Figure 8: Bank Rate and Key Market Rates in Malawi



Source: International Monetary Fund-International Financial Statistics from Quantec Easy Data

Prior to financial reforms, RBM used instruments such as priority sector lending targets, especially to the agriculture sector¹⁰. In addition, the government introduced cash reserve ratios in the initial stage of financial reforms which trended upwards until 2003. The Malawi economy is agricultural based and government saw it fit to target agriculture to achieve development goal

¹⁰The details of the financial reforms in Malawi are documented by Chirwa & Mlachila (2004) and Ngalawa & Viegi (2011).

of price stability and economic growth. With the introduction of financial reforms, RBM started phasing out credit ceilings in 1988 but counter effect with the introduction of upward trending of liquidity reserve requirement. However, we have seen rapid expansion of lending to the private sector in the post period of financial reforms as shown in Figure 9. Quantitatively, annual credit growth reached an extent of 106 percent in September 2008- April 2009 from 38 percent realised in January 2005 – September 2008 and was one of the highest in Africa (Christensen, 2011). The BIS study by Christensen (2011) also explains that growth fuelled in part by large capital flows and monetary policy that in case was too accommodative to stem rising inflation. The big question now arises whether this buoyant credit growth had any transmission effects in achieving economic growth and price stability.

Figure 9: Trend of Bank Rate and Private Credit

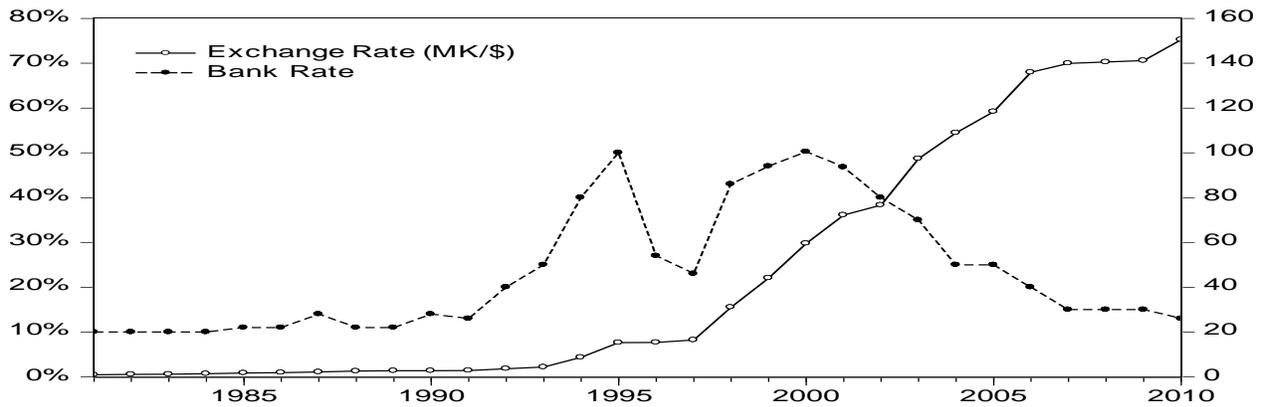


Source: International Monetary Fund-International Financial Statistics from Quantec Easy Data

In Figure 10, movement in the Malawi Kwacha per US dollar seems to have followed the bank rate until 2004. However, low interest rate tends to be followed by a depreciation of the local currency since 2003 and this runs against the theoretical understanding of positive relationship between interest rate and exchange rate. Researchers have argued that the local currency was deemed overvalued to the exchange rate as explained by Munthali *et al.* (2010). Empirically, it has been found that exchange rate channel is particularly important in a flexible exchange rate (Christensen, 2011). For instance, the paper argue that monetary expansion would tend to reduce the real interest rate and lead to the devaluation of the currency, which would increase exports , reduce imports and thereby boost aggregate demand. Compounded with limited timely statistics and information about the health of the economy, devaluation has been shown to be an early

indicator of monetary conditions and inflation pressures. This condition seems to exist when Malawi devalued its currency more than 50 percent in 2012, inflation has been skyrocketing from single digits in 2006 – 2010 to around 30 percent in 2012. This recent outcome shows that exchange rate shocks can have a strong effect on inflation in Malawi and volatility in the shocks may likely change overtime. Therefore, expansion of broad money in line with nominal GDP and exchange rate stability are significant factors to curb inflation in Malawi.

Figure 10: Bank Rate and Exchange Rate in Malawi



Source: International Monetary Fund-International Financial Statistics from Quantec Easy Data

3.3 Econometric Methodology

A survey by Mishra and Montiel (2012) reveals that the VAR methods have commonly been used to investigate the monetary transmission mechanism in low-income countries including Malawi. Thus, we start by presenting the basic structural VAR model that describes the Malawi economy as follows:

$$Ay_t = Q_1y_{t-1} + \dots + Q_p y_{t-p} + u_t, t = p + 1, \dots, T. \quad (1)$$

In Equation 1, y_t presents a $n \times 1$ vector of observed Malawian variables, A and Q_1, \dots, Q_p are $n \times n$ matrices of parameters, and $u_t \sim N(0, \Sigma_u)$ is a $n \times 1$ vector of structural shocks whereby



$$\Sigma = \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \sigma_2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_n \end{bmatrix} \quad (2)$$

We specify the simulations relation of the structural shock by recursive identification, assuming that A is a lower triangular matrix with the diagonal elements equal to one:

$$A = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \alpha_{2,1} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{n,1} & \cdots & \alpha_{n,n-1} & 1 \end{bmatrix} \quad (3)$$

Literature reveals that Equation 1 has problem of uniquely determining the value of the parameters in the model because the coefficients are unknown and the variables may have contemporaneous effects on each other (Bredin & O'Reilly (2004)). To allow estimation of the parameters, we re-specify Equation 1 as the reduced form VAR model as follows:

$$y_t = B_1 y_{t-1} + \dots + B_p y_{t-p} + A^{-1} \Sigma_t \varepsilon_t, \quad \varepsilon_t \sim N(0, I_n) \quad (4)$$

In Equation 4, $B_i = A^{-1} Q_i$ for, $i = 1, \dots, p$. Further, we define B as a stacked row of B_1, \dots, B_n to obtain a reduced form representation:

$$y_t = X_t B + A^{-1} \Sigma \varepsilon_t \quad (5)$$

where $X_t = I_n \otimes [1, y'_{t-1}, \dots, y'_{t-p}]$ and \otimes is the Kronecker product. All parameters do not vary overtime.

Following Primiceri (2005), Koop *et al.* (2009) and Nakajima (2011) and discussions in section 1 and 2, we now assume that all parameters (B, A, Σ) change overtime. Then, we re-specify Equation 4 and 5 as follows:

$$y_t = B_{1t} y_{t-1} + \dots + B_{pt} y_{t-p} + e_t, \quad e_t \sim N(0, \Phi_t) \quad (6)$$



$$y_t = X_t B_t + e_t, \quad t = p+1, \dots, n \quad (7)$$

where y_t is a $(k \times 1)$ vector of observed variables. B_{1t}, \dots, B_{pt} are $(k \times k)$ time varying coefficients. Φ_t is $(k \times k)$ time varying covariance matrix. Assuming a recursive identification and a decomposition of a $\Phi_t = A_t^{-1} \Sigma_t \Sigma_t A_t'^{-1}$ where A_t is the lower triangular matrix with diagonal elements equal to 1 and Σ_t is a diagonal matrix containing standard deviations of the structural shocks. X_t remains as defined in equation 5. All parameters do not vary overtime. B_t is also defined as a stacked row vector of B_{1t}, \dots, B_{pt} , a_t is a stacked row vector of the free lower-triangular elements in A_t and define elements $x_{jt} = \log \sigma_{jt}$ for $j = 1, \dots, n$ in a stacked vector of $x_t = (x_{1t}, \dots, x_{nt})$. The time-varying parameters are assumed to follow a random walk process (Nakajima, 2011; Primiceri, 2005):

$$\begin{aligned} B_t &= B_{t-1} + v_t \\ \alpha_t &= \alpha_{t-1} + \xi_t \\ x_t &= x_{t-1} + \eta_t \end{aligned} \quad \sim N \left(0, \begin{pmatrix} I_n & 0 & 0 & 0 \\ 0 & \Sigma_B & 0 & 0 \\ 0 & 0 & \Sigma_\alpha & 0 \\ 0 & 0 & 0 & \Sigma_x \end{pmatrix} \right) \quad (8)$$

for $t = p+1, \dots, n$, with $e_t = A_t^{-1} \Sigma_t \varepsilon_t$ where I_n is the identity matrix of n dimensions, while Σ_B , Σ_α and Σ_x are positive definite matrices. In this matrix, the shocks are uncorrelated among the time-varying parameters. The covariance matrices Σ_α and Σ_x are assumed to be diagonal. We treat the time-varying parameters as latent variables and Equations 7 and 8 form a state space specification. As in Nakajima, Kasiya and Watanabe (2009), we assume that the initial states for the time-varying parameters are $B_{p+1} \sim N(v_{\beta_0}, \Sigma_{\beta_0})$, $\alpha_{p+1} \sim N(v_{\alpha_0}, \Sigma_{\alpha_0})$ and $x_{p+1} \sim N(v_{x_0}, \Sigma_{x_0})$.

As you can see from the model, the estimation of the TVP-VAR model with stochastic volatility will involve estimating a number of parameters. In addition, the inclusion of the stochastic volatility in the model makes the estimation difficult due to the intractability of the likelihood function (Peretti *et al.*, 2012). As discussed in Koop and Korobilis (2010) the concern about over-parameterisation makes it difficult to obtain precise estimates of the parameters and impulse

responses. To circumvent this problem, we estimate this TVP-VAR model using the Bayesian inference methodology via the Markov Chain Monte Carlo (MCMC) methods. As argued in many studies, the Bayesian inference methodology allows the splitting of the original estimation problem into smaller ones in order to deal efficiently with high dimension of the parameter space and the nonlinearities of the model (Primiceri, 2005; Nakajima, 2011; Banerjee & Malik, 2012). By incorporating the MCMC algorithm, we are able to assess the joint posterior distributions of the parameters that are of interest under certain priors that are set in advance. Banerjee and Malik (2012) also explains that the use of MCMC avoids the issue of dimensionality because it essentially deals with recursively sampling from lower dimensional objects and helps to mitigate problems associated with parameter explosion.¹¹ We use the same priors as the one in Nakajima (2011), $\Sigma_{\beta} \sim IW(25, 0.01I)$, $(\Sigma_a)_i^{-2} \sim Gamma(4, 0.02)$ and $(\Sigma_h)_i^{-2} \sim Gamma(4, 0.02)$ where IW denotes the invert Wishart distribution, $(\Sigma_a)_i^{-2}$ and $(\Sigma_h)_i^{-2}$ represents the $i = th$ diagonal elements of the matrices. Finally the initial set of the time-varying parameters, we use the flat priors such that $u_{\beta 0} = u_{a0} = u_{h0} = 0$ and $\Sigma_{\beta 0} = \Sigma_{a0} = \Sigma_{h0} = 10 \times I$.

3.4 Data

Data used in this study were obtained from International Financial Statistics of the International Monetary Fund (IFS-IMF) under Quantec Easy Data website. Gaps in the data were filled by domestic official publication of the Reserve Bank of Malawi (RBM) and the Government of Malawi. The dataset consists of quarterly observations and the sample spans from 1981:1 to 2010:4. Data used include GDP which measures the economic activities, CPI measures the price level, the bank rate which measures the short term interest rate. Other variables include exchange rate defined as Malawi Kwacha per US dollar and private credit which measures the financial development activity. Real gross domestic product data is annually recorded hence we generated quarterly data using quarterly data on money. We take the natural logarithms of all variables except bank rate and data is seasonally adjusted using the TRAMO and SEATS as done in Ngalawa and Viegi (2011). We also factored out price effects to come up with real interest rate. List of the data and their sources are provided in Table 9.

¹¹For full derivation of the model, the conduct of the MCMC algorithm and the choice of priors, see Nakajima (2011), Koop and Kolobilis (2010) and Primiceri (2005).


Table 9: Key Variables Used in the Analysis

Variable	Details	Source
BR	Bank Rate	IMF-IFS, Quantec Easy Data
LP	Log consumer price index	IMF-IFS, Quantec Easy Data
LEX	Log exchange rate	IMF-IFS, Quantec Easy Data
LPC	Log private credit	IMF-IFS, Quantec Easy Data
RY	Log gross domestic product constant price	World Bank, Quantec Easy Data

As indicated in Table 10, all macroeconomic variables used in the estimation are tested for the stationarity using the Augmented Dickey- Fuller (ADF) test (1981), Phillips-Perron test (1988) and Kwiatkowski (KPSS) test (1992). The stable TVP-VAR is estimated based on 1 lag resulting from the popular lag length tests which include the sequential modified LR test statistic, the Akaike information criterion, the Schwarz information criterion, applied to the constant parameter VAR.

Table 10: Testing for Stationarity

Variables	ADF		PP		KPSS	
	Level	Differenced	Level	Differenced	Level	Differenced
Bank Rate (BR)	-1.882	-12.954***	-1.882	-12.945***	1.293	0.155***
Prices (P)	-1.036	-3.679***	-0.651	-8.632***	1.293	0.214***
Real Output (Y)	0.699	-3.169***	1.871	-3.893***	1.287	0.330***
Private Credit (PC)	-0.904	-10.947***	-0.646	-11.239***	0.285	0.050***
Exchange Rate (EX)	-0.757	-7.622***	-0.756	-7.665***	1.280	0.188***

Note: To test for unit root test, we use the intercept on bank rate, exchange rate, prices and real output with the critical value for the KPSS LM-Stat at 5% equal to 0.463 and use trend and intercept on private credit with the critical value of the KPSS LM-Stat at 5% equal to 0.146. The symbols *** denote significance at 1 % level, respectively.

All tests in Table 10 show that the variables are non-stationary in levels. After taking the first difference, the variables become stationary, indicating integration of order one $I(1)$. In the standard VAR, we used the variables in levels as argued by Sims *et al.* (1990). However, estimation of the TVP-VAR model uses annual growth rates of all variables except the bank rate. The VAR satisfy the stability conditions as no root lies outside the unit circle. To be consistent between the standard VAR model and the TVP-VAR model, one lag VAR estimation is used based on the stability of the two models. Based on Bernanke and Blinder (1992) and Christian and Eichenbaum (1992), we order the variables in the Y vector of the VAR as $Y = (Y, P, EX, BR)$. Private credit is also augmented in the Y vector as $Y = (Y, P, PC, EX, BR)$. We place real output and prices before the policy variables in a VAR because this standard identification structure has strong theoretical foundation that real output and prices are unlikely to react immediately to bank

rate shocks (Christiano et al., 1999; Hoppner, Melzer and Neumann, 2008). The bank rate changes will only affect real output and prices with a lag. This ordering was also employed by Ngalawa and Viegi (2011) in their study on the dynamic effects of monetary policy shocks in Malawi.

3.5 Empirical Results

This section discusses the responses to monetary policy, exchange rate shocks and effects of credit shocks. In each case, we compare the results of the TVP-VAR with stochastic volatility with the standard VAR model. First, four variables including real output (Y), prices (P), exchange rate (EX) and bank rate (BR) are estimated in a standard VAR and TVP-VAR model. Then, we augment the model with the private credit (PC) and compare the performances of these monetary transmission channels during and after the financial reform period.¹²

3.5.1 Posterior Estimates for Stochastic Volatility of the Structural Shocks and Simultaneous Relationship

Table 11 shows the estimated results for the posterior means, standard deviations, the 95 per cent credible intervals, the convergence diagnostics of Geweke and the inefficiency factors which are estimated using MCMC sample. Note that in this paper we do not use confidence intervals as in the frequentist approach. We use 95 per cent credible intervals for Bayesian inferences to describe the uncertainty of the parameters. In our estimation, we draw $M = 10,000$ samples with the initial 1000 samples discarded. In the estimated results the null hypothesis for the convergence of the posterior distributions is not rejected as all the Geweke results are greater than 5 per cent level of significance. The results also indicate an efficient sampling as the inefficiency factors are below 100.

Table 11: Estimation of Selected Parameters in the TVP-VAR Model

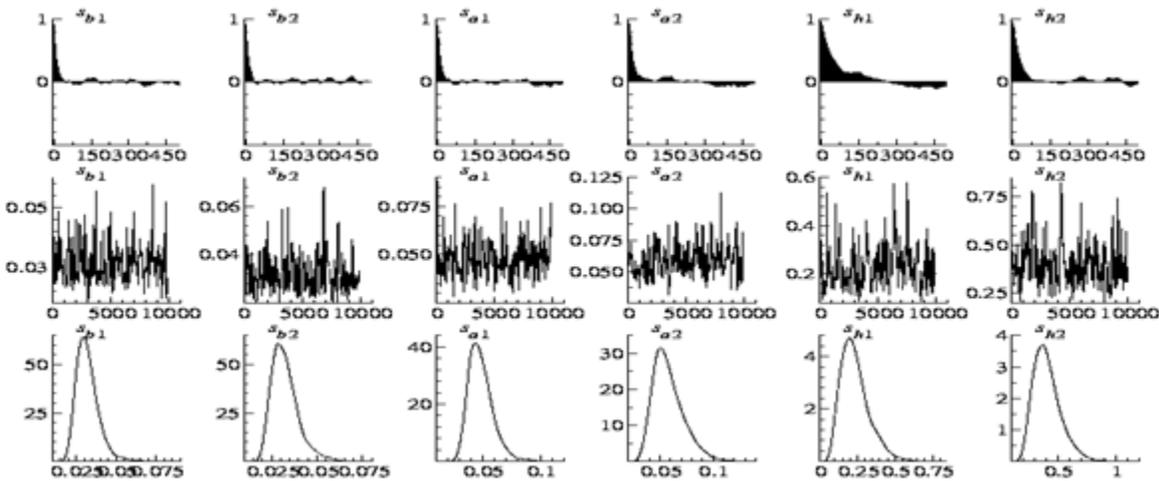
¹² The results of the posterior estimates for stochastic volatility of the structural shocks when credit is augmented in the baseline are shown in Annex 1 and 2.



Parameter	Mean	Stdev	95% Interval		Geweke	Inefficiency
sb1	0.0324	0.0073	0.0212	0.0491	0.065	24.97
sb2	0.0285	0.0055	0.0202	0.0417	0.266	11.78
sa1	0.0821	0.0312	0.0432	0.1619	0.169	39.34
sa2	0.0742	0.0231	0.0416	0.1290	0.157	35.78
sh1	0.5582	0.1469	0.3224	0.8864	0.248	28.29
sh2	0.5108	0.1167	0.3199	0.7751	0.945	37.75

Figure 11 shows the sample autocorrelation represented by the first panel, sample paths represented by the second panel and posterior densities for selected parameters. Discarding 1000 samples in the burn-in period, the sample paths appear stable as the sample autocorrelations drop steadily. As in Nakajima (2011), this shows that our sampling method efficiently produces samples with minimal autocorrelation.

Figure 11: Sample Autocorrelation, Sample Paths and Posterior Densities for Selected Parameters



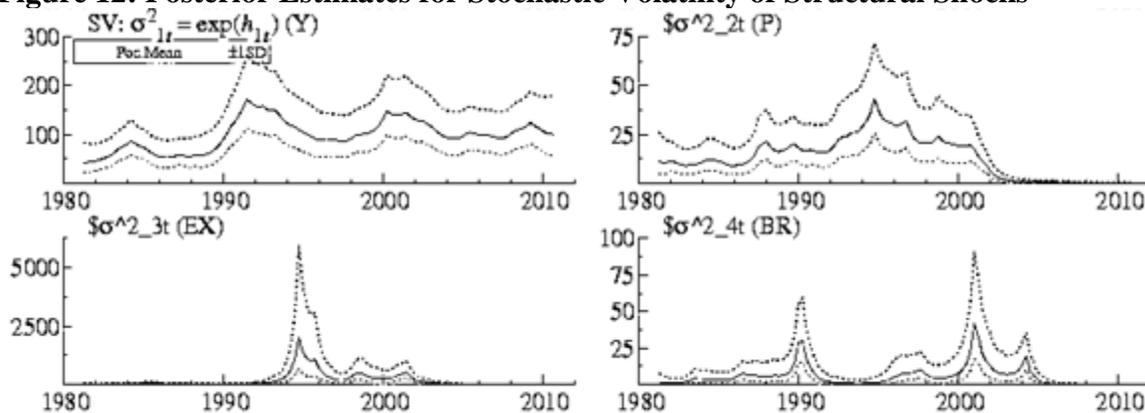
Note: Sample autocorrelation (top), sample paths (middle), and posterior densities (bottom). The estimates of the Σ_β and Σ_α are multiplied by 100.

The posterior means of stochastic volatility of real output (Y), prices (P), exchange rate (EX) and bank rate (BR) changes are shown in Figure 12. The panel depicts the dynamic of the volatility over time, which differs across variables. The stochastic volatility of bank rate shows a relatively higher volatility in 1990 which started towards the end of 1980. Beginning 1987, Malawi liberalised the market interest rates which trended upwards until 1994 and 1995. In addition, between 1992 and 1994 Malawi adopted multiparty system of government which brought about

changes in economic policies, such as the adoption of free floating exchange rate regime in 1994. High spike in bank rate changes were experienced after 2000, while high spikes in inflation and economic growth started much earlier. By implication, the monetary authorities reacted to the continued volatility in the inflation and sluggish economic growth.

The stochastic volatility of all variables remains stable between 2005 and 2010, coinciding with the new elected government in 2004. As discussed in section 2, the stability of the transmission might be explained by government successfully implementing disciplined monetary and fiscal policies. In particular, good performance in the agricultural sector emanating from good rains and the implementation of the fertiliser subsidy programme boosted economic growth and price stability. Achieving meaningful growth and stable inflation rates led to downward trends and stable bank and market interest rates. The movement of exchange rates also exhibit a spike in 1990s due to changes in exchange rate policies. Government adopted the floating exchange rate regime in 1994 and this was followed by many devaluations bringing about much exchange rate instability. Therefore, the use of time-varying stochastic volatility will contribute to the VAR estimation and the identification of the structural shock with the appropriate variance of the shock (Nakajima *et al.*, 2009).

Figure 12: Posterior Estimates for Stochastic Volatility of Structural Shocks



Note: Graphs are the posterior mean (solid) line and 95 percent credible intervals (dotted line) for stochastic volatility. The changes in the variables were multiplied by 100 during estimation.



3.5.2 Responses to Monetary Policy Shocks

In Figures 13, 14 and 15, we use the impulse responses to explain the macroeconomic dynamics captured by the estimated VAR system. In these figures, Chart 1 presents impulse responses from a standard VAR model whose parameters are all time invariant drawn for each set of two variables. While Chart 2 and 3 captures the impulse responses from the TVP-VAR model computed at points in time using the estimated time-varying parameters.¹³ Specifically, chart 2 presents the accumulated impulse responses at several horizons of particular variables to a specific shock. The responses are drawn in a time series manner by showing the size of the impulses for 1 to 3 year horizons over time. Chart 3 on the other hand demonstrates how the responses have behaved in different periods which are chosen arbitrary to capture important episodes of economic and political events in the Malawi economy. The 1987 and 1995 captures the time when Malawi abandoned repressive monetary policies and experienced frequent devaluations following the adoption of flexible exchange rate regime in 1994, respectively. A period between 1995 and 2010 captures the post era of financial reforms and the time when new governments came into power.

Figure 13 shows that the impulse responses of output to a one standard deviation of positive bank rate shock is statistically insignificant at 95 percent confidence interval within the first 5 quarters using a constant parameter VAR model. However, estimates from the TVP-VAR model with stochastic volatility shows that the impulse responses vary over time. A one percentage point positive bank rate shock leads to non-effect in real output until 2000. However, we observe positive response of output to real bank rate changes after the post period of financial reforms. Basic economic theory, based on the standard interest rate transmission mechanism (Mishkin, 1995), tightening of monetary policy leads to a rise in market interest rates which in turn raises the cost of capital, implying a decline in aggregate demand through decline in investment expenditures and hence a fall in output. Empirically, however, the basic standard of interest rate transmission mechanism has yielded different results (Mishra and Montiel, 2012).

¹³ In Chart 2 and 3, all the shocks are normalised to one standard deviation band to enable us compare responses across periods.

The positive effects on output after 2000 is supported by a decline in interest rates during this period as reflected in the response of bank rate to its own shock. However, other factors such as changes in the institutional policies (fertiliser subsidy programme) influenced a positive increase in real output. From these, we can ascertain that the effects of positive interest shock on output is not immediate as it becomes significant almost after 5 quarters, indicating that the monetary policy does not have any contemporaneous effect on output as argued by Christiano *et al.*, (1999), Bernanke and Blinder (1992) and Bredin and O'Reilly (2004).

In terms of the effects of monetary policy shock on general price, according to the traditional Keynesian theory, an increase in interest rates will increase the cost of borrowing for consumers and investors leading to the reduction in both consumption and investment. This will result into lower aggregate demand leading to lower output and lower prices and inflation. However, we observe the 'price puzzle' using a constant parameter VAR model as generally found in many studies documented on Low-Income countries over the past two decades by Mishra and Montiel (2012). In particular, results from the TVP-VAR with stochastic volatility estimations (Chart 1 and 2) reveal that response of price to bank rate shock varies overtime and the 'price puzzle' disappears in the post period of financial reforms. As argued by Ngalawa and Viegi (2011), monetary factors may not be determinants of inflation in Malawi. Generally, food costs (above 50 percent) account for a large proportion in the Consumer Price Index (CPI) and hence fluctuations in food production (maize in this case) may have determined the movements in inflation other than monetary factors. As discussed in section 2, Malawi achieved high output growth emanating from agriculture (high increase in stable food maize) attributed to good rains and implementation of fertiliser subsidy programme. This would have increased the supply of food and hence a reduction of prices on market.

Mishkin, 1995 states that "when domestic real interest rates rise, domestic dollar deposits become more attractive relative to deposit denominated in foreign currencies, leading to an increase in the value of dollar deposits relative to other deposits, that is, an appreciation of the dollar". In this case, the value of domestic currency will increase and induce a high cost of domestic goods relative to the foreign goods. However, the constant parameter VAR model shows that an increase in the bank rate in Malawi has short lived limited effect on exchange rate. The exchange rate appreciation is not clear and the response is insignificant. Empirically, the

constant parameter VAR results are consistent with the evidence found in Lungu (2008) using a VAR model and Ngalawa and Viegi (2011) employing the SVAR model to analyse the dynamic effects of monetary shocks in Malawi. Regarding responses of exchange rate as a result of bank rate shock using the TVP-VAR model with stochastic volatility, exchange rate movements behaved differently over time period. We observe an appreciation of the exchange rate consistent with economic theory during the post period of financial reforms. More explanation about the exchange rate effects are further discussed under section 3.5.3.

Figure 13: Standard VAR and TVP-VAR Impulse Responses to a Positive Bank Rate Shock

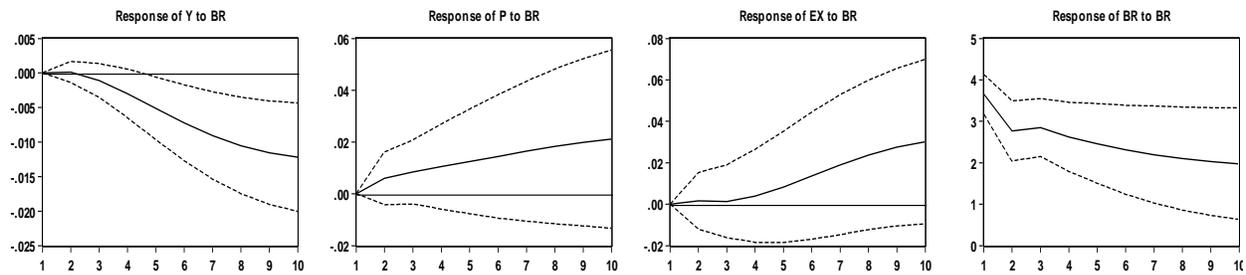


Chart 1: Unrestricted standard VAR impulses with dotted lines indicating 95% confidence intervals

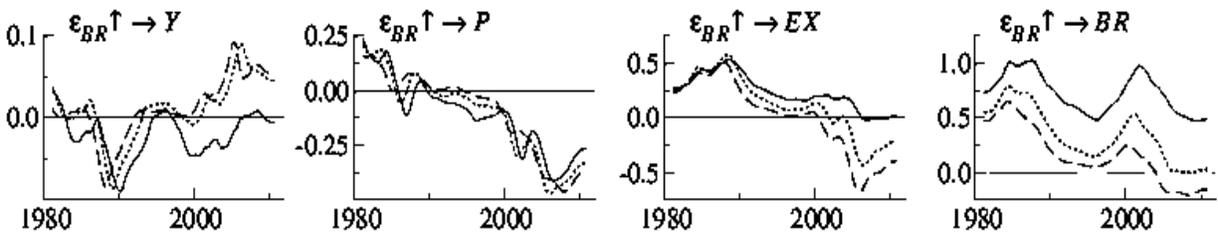


Chart 2: TVP-VAR impulses after 1 year (—), 2 years (-----) and 3 years (- - -) ahead

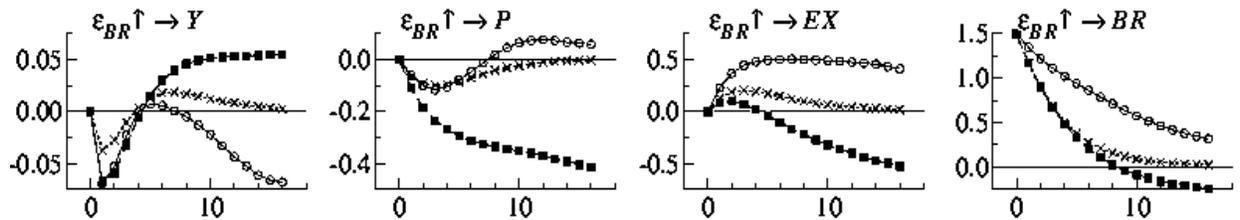


Chart 3: TVP-VAR impulses in 1987:Q1 (—○—), 1995:Q1 (—×—) and 2010:Q1 (—■—) one standard-deviation bands

Thus, the existence of price puzzle and non-effects on exchange rate cast doubts on the relevance of findings from the VAR model. Based on section 2, the economy behaved differently before and after the financial reforms. Thus, changes in the structural macroeconomic relationships and the behaviour of policy makers could have influenced transmission mechanism overtime (Catik



and Martin, 2012). Accordingly, the TVP-VAR model demonstrates that interest transmission mechanism on prices and exchange rate performed differently overtime. Although the paper finds that transmission mechanism improves with the implementation of financial reforms, the financial environment is still characterised with weak legal systems, poor governance, and insufficient financial infrastructure (RBM, 2012). These factors have contributed to high interest rate spread (Chirwa & Mlachila, 2004), inadequate financial intermediation and a large informal financial market (Chipeta & Mkandawire, 1991; Ngalawa & Vieg, 2010).

3.5.3 Responses to Exchange Rate Shocks

On the supply side, exchange rate shocks tend to feed directly into domestic prices of imported goods and services and indirectly through to the prices of goods and services that uses the imported goods. While on the demand side, exchange rate movements influences demand for domestically produced goods and services and hence affects the net exports. In turn, aggregate demand is affected and this impact the uptake of production inputs such as wages. Hence through this channel, exchange rate movements affect inflation. As argued by Franta *et al.* (2013), exchange rate movements affects output through expenditure switching which affects net exports and also through real interest rate changes which affects investment expenditure and hence real output. However, the importance of this exchange rate channel in the monetary transmission mechanism depends on the nature of exchange rate regime, the market structure and product substitutability (Vinh and Fujita, 2007; Aleem, 2010). Therefore, empirical investigations have revealed mixed reaction of inflation and output following exchange rate shocks. A paper by Vinh and Fujita (2007) provide a well-documented empirical literature about these effects. Accordingly, for the case of Malawi where the exchange rate regime has remained de facto coupled with capital controls and the monetary authorities have some room of intervention, we expect high mixed responses of output and inflation following a positive exchange rate shock.

The standard VAR model results in Figure 14, Chart 1 show that output increases significantly following a depreciation of the exchange rate and the effects on prices are significant. The results of the TVP-VAR model with stochastic volatility presented in Figure 14, Chart 2 and 3 show that the effects of positive exchange rate shock on output and inflation varied overtime.

Although the responses of output still remain unclear as the impulses oscillate around zero line overtime in Chart 2, Chart 3 indicates that output increases following a depreciation of exchange rate in Malawi. Depreciation is also inflationary and there is high exchange rate pass through to prices and is more persistent in the post period of financial reforms. Malawi depends heavily on imports mainly fertiliser and oil used in the production process and as a landlocked country transport costs are also very high. Thus, depreciation shocks on exchange rate will immediately feed into the prices of goods and services that use imported inputs. Most interestingly, the effects on prices are prominent in all horizons after the reform period.

Figure 14: Standard VAR and TVP-VAR Impulse Response to a Positive Exchange Rate Shock

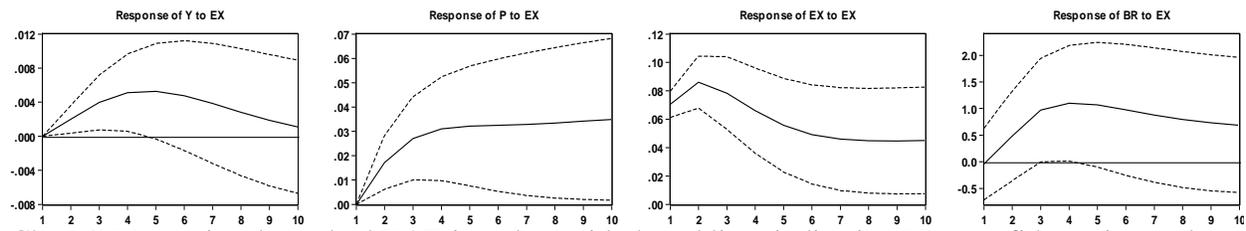


Chart 1: Unrestricted standard VAR impulses with dotted lines indicating 95% confidence intervals

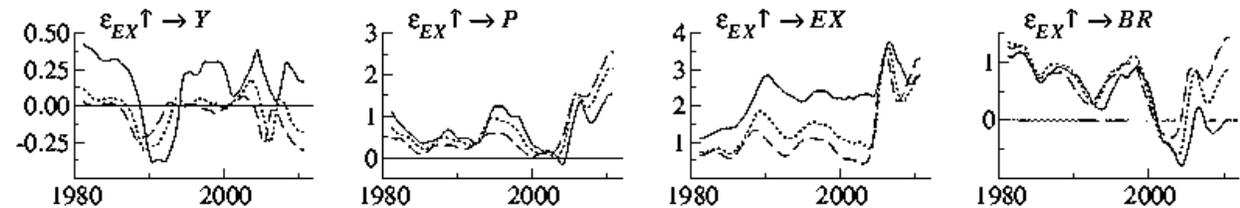


Chart 2: TVP-VAR impulses after 1 year (——), 2 years (-----) and 3 years (-.-.-) ahead

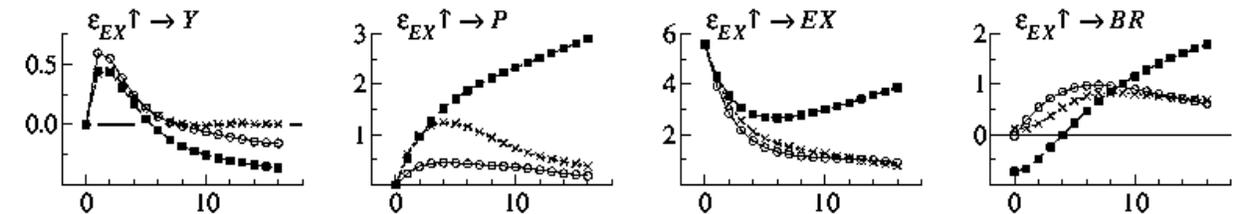


Chart 3: TVP-VAR impulses in 1987:Q1 (—○—), 1995:Q1 (—×—) and 2010:Q1 (—■—) one standard-deviation bands

Chart 3, also shows that the transmission mechanism through the exchange rate channel was more pronounced during the financial reform. Malawi adopted the free floating exchange rate regime which was followed by many episodes of devaluations especially after 1994 which led to government reverting to the fixed exchange rate. However fixed exchange rate did not last long



and government adopted a floating exchange rate again in 1998. It is also observed that depreciation had short lived positive effect on output and inflation pressures contrary to the good macroeconomic condition in the country during the later years of post-financial reform period (2004Q1-2010Q1). The country experienced high economic growth and stable nominal exchange rate fluctuations. Researchers have argued that the disparity comes about because of the overvaluation and management of the exchange rate (see IMF, 2012; Munthali *et al.*, 2010). Nevertheless, the result shows that the exchange rate pass-through is relatively strong and quick in Malawi agreeing with findings by Ngalawa and Viegi (2011), Simwaka *et al.* (2012), and Lungu *et al.* (2012).

3.5.4 Responses to Private Credit Shocks

The dynamic responses of bank rate, exchange rate, output and prices to unexpected positive credit shock are discussed based on the bank lending channel mechanism, working through the conditions of supply of banks loans as fully explained by Bernanke and Gertler (1995), Mishkin (1995) and Ireland (2005). Specifically, they argue that a monetary policy that induces an increase in bank deposits will enhance an increase in banks loans and investors will be able to borrow. Therefore, the increase in investment will lead to an increase in output. However, they have noted that credit channel does not matter currently because banks plays less important role in credit markets due to evolution of other players in credit allocation. However, our study uses the lending channel because Malawi is still bank dependant and the financial system is still shallow with high cost of financial intermediation (Chirwa and Mlachila, 2004).

In the standard VAR model in Figure 15, Chart 1, a positive shock on credit does not lead to immediate positive reactions on output and prices. The responses on output are positive after 3 quarters and prices respond negatively to credit shock. However, the responses are not significant and the negative response on prices to one standard positive credit shock contradicts what was found by Ngalawa and Viegi (2011). In addition, a positive shock on credit induces exchange rate depreciation. As pointed out by Ngalawa and Viegi, 2011, Malawi depends heavily on fertiliser and fuel imports in the production process. Hence, the increased credit might have increased demand for imports which might have influenced exchange rate depreciation.

Nevertheless, Chart 2 and 3 of the TVP-VAR model estimation results tell us much variation of responses following a one standard positive private credit shock. In Chart 2, response of output is positive in one year ahead as expected but the effects diminish with time. The effects picks up in the latter part of the sample with minor positive effects on output in the long run period. A positive private sector credit shock is inflationary but the effects vary over time. The effects on prices dampen in the later years of the sample. However, positive credit shock leads to the exchange rate appreciation in the post period of financial reforms. The results in Chart 3 also demonstrate that responses varied over time. For instance, the responses of output was positive prior and during the financial reforms but became negative in the post period of the reforms. In addition, the a positive shock on bank rate leads to decline in credit to the private sector in the post period of financial reforms.

Moreover, results show that the private loan supply effect remains weak in Malawi. As explained in section 2, the importance of the credit channel for monetary transmission has been negatively affected by the upward trend in liquidity reserve requirements during the financial reform period. In addition, the economy is characterised with large informal credit markets (Chipeta and Mkandawire, 1991; Ngalawa and Viegli, 2010). Hence tighter monetary policies might divert demand to the large informal credit sector and so lead to a sharp rise on the cost of credit. Other important issue to note is the beneficiaries of credit. The results show that private sector credit drives demand other than production because the effects on real output are limited. In addition changes in the financial structure are still limited. For instance, the banks are still not offering facilities such as credit cards. Thus, the effects of credit shocks seems to be less persistent overtime and this calls for more financial reforms targeting the credit market which can contribute to monetary transmission and promote further economic growth in Malawi.

Figure 15: Standard VAR and TVP-VAR Impulse Responses to a Positive Private Credit Shock

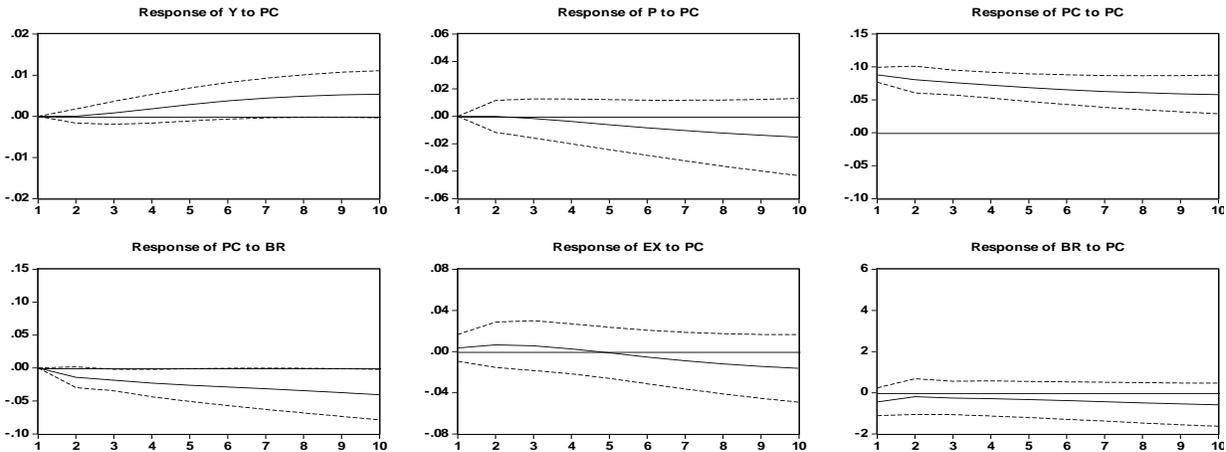


Chart 1: Unrestricted standard VAR impulses with dotted lines indicating 95% confidence intervals

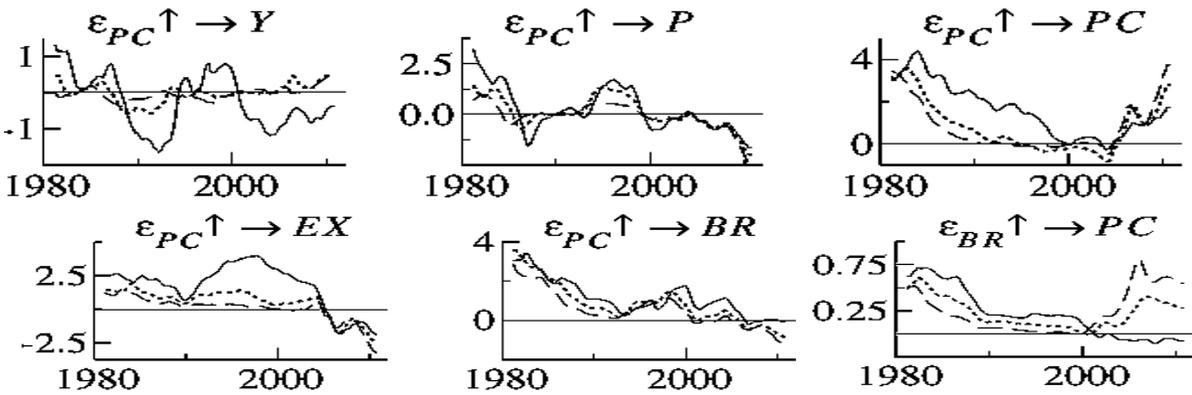


Chart 2: TVP-VAR impulses after 1 year (—), 2 years (-----) and 3 years (- - -) ahead

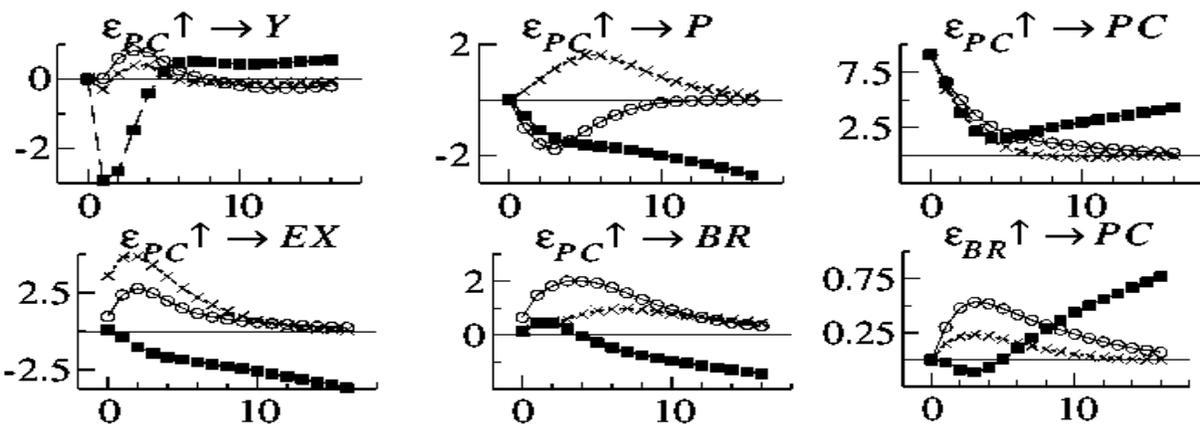


Chart 3: TVP-VAR impulses in 1987:Q1 (○), 1995:Q1 (x) and 2010:Q1 (■) one standard-deviation bands



5.6 Conclusion

This chapter has estimated an empirical macroeconomic model of Malawi that generates changes in output and price level in response to bank rate, exchange rate and private credit shocks. On the understanding that Malawi implemented financial reforms between 1988 and 1994 and continued efforts in improving the financial sector until 2010, we estimated a TVP-VAR model with stochastic volatility that allowed us to capture the variation of macroeconomic structure and the changes in the transmission mechanism overtime. Combined with Bayesian econometric techniques enabled us to estimate whether, where, when and how the transmission mechanism has been changing over time. In particular, this model is used to estimate and calculate the impulse responses of output and price level to financial and monetary policy shocks overtime.

Using the TVP-VAR model results, the chapter demonstrates that the transmission mechanism changed markedly following the financial reforms. In particular, our empirical results of the impulse response show that in the prior years of the financial reforms, the transmission mechanisms are not clear and provide more puzzles than answers. The changes in the transmission mechanism were volatile during the financial reforms as this period was also faced with high inflation, natural shocks and political changes. However, the changes in the transmission mechanism became clear starting from 2000. Specifically, the monetary policy transmission performed consistently with predictions of economic theory and there is no evidence of price puzzle as found in the previous literature on Malawi. On the other hand, the transmission mechanism through the credit channel remains weak and this calls for more financial innovation, especially in improving the credit market system that is viable for economic growth.

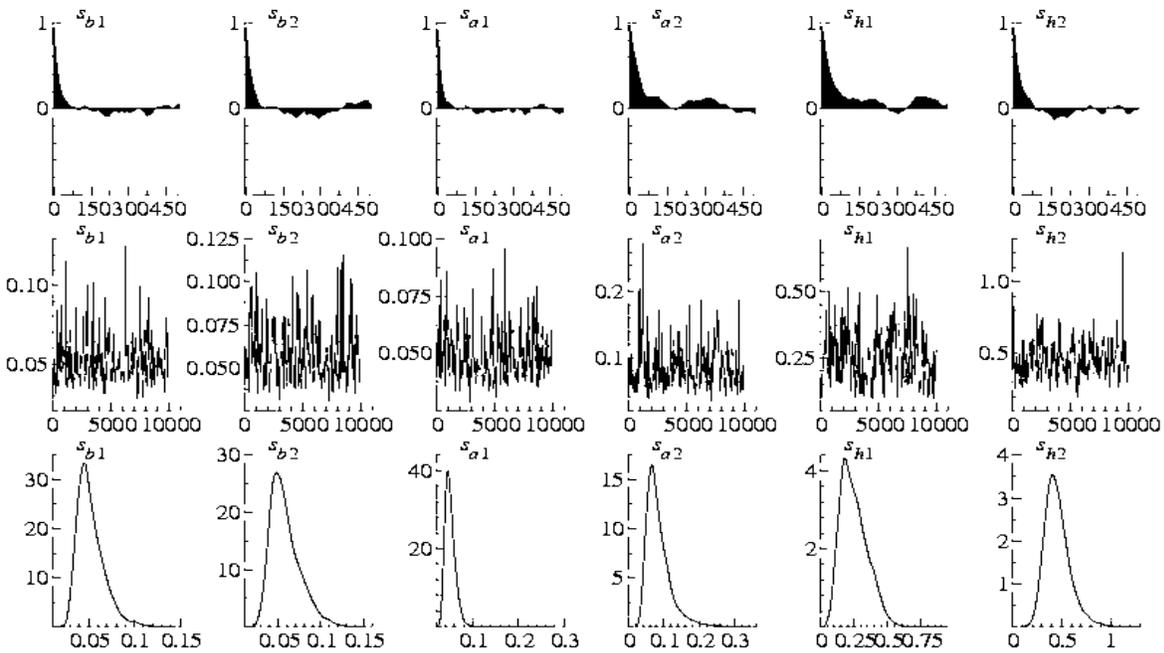


5.7 Appendix

Annex 1: Estimation of selected parameters in the TVP-VAR model including private credit

Parameter	Mean	Stdev	95% Interval		Geweke	Inefficiency
sb1	0.0522	0.0148	0.0313	0.0886	0.491	33.09
sb2	0.0582	0.0175	0.0330	0.1003	0.460	34.17
sa1	0.0506	0.0128	0.0335	0.0766	0.051	23.68
sa2	0.0845	0.0343	0.0420	0.1773	0.286	81.44
sh1	0.2506	0.1001	0.0990	0.4678	0.470	86.61
sh2	0.4562	0.1276	0.2560	0.7620	0.655	36.12

Annex 2: Sample autocorrelation, sample paths and posterior densities for selected parameters including private credit



Note: Sample autocorrelation (top), sample paths (middle), and posterior densities (bottom). The estimates of the Σ_β and Σ_α are multiplied by 100.



Chapter 4

Monetary Policy Response to Foreign Aid in an Estimated DSGE Model of Malawi

4.1 Introduction

The main objective of this chapter is to estimate a Bayesian Dynamic Stochastic General Equilibrium (DSGE) model of Malawi and use the model to analyse the monetary policy response to increased aid inflows¹⁴. Specifically, a Bayesian DSGE model is estimated based on the standard Taylor rule to explain how increased aid inflows causes real appreciation and other key macroeconomic variables. Most studies in this area on low income countries use a calibrated DSGE model instead of estimations (Tang & Vines, 2007; Adam, O’Connell, Buffie & Pattillo, 2009; Berg, Mirzoev, Portillo & Zanna, 2010). To the best of our knowledge, the only well-known paper that estimates the monetary policy response to an aid shock using an estimated DSGE model on low income countries is by Peiris and Saxegaard (2007) on Mozambique. Thus, we extend the calibrated model developed by Berg *et al.* (2010) to estimate a DSGE model using Bayesian techniques borrowing from Peiris and Saxegaard (2007) and Smets and Wouters (2007) on Malawi. This model is able to capture economic features and policy issues of interest in low income countries. Specifically, the model allows for deeper analysis of the effects of aid shock on exchange rate appreciation which is detrimental to the export sector and reserve accumulation. After estimating the model, this chapter experiments what would happen to the responses following the use of the different monetary policy rules such as incomplete sterilisation and money growth based on the central bank balance sheet.

Countries in the sub-Saharan Africa including Malawi received high aid inflows following the Structural Adjustment Program (SAP) introduced by the International Monetary Fund (IMF) and the World Bank in 1980s. However, recent research in this area has revealed that increases in foreign aid can bring about implications in the long-run institutional development and short-run

¹⁴Official aid inflows mean all grants and loans received by the government through the national budget. All grants and loans recorded as actual disbursement. To avoid complications, we also disregard whether loans borrowed under concession terms as well as budget support or sector support.



macroeconomic management in small economies (Buffie, Adam, O’Connell and Pattillo, 2004; Tang & Vines, 2007; Adam, O’Connell, Buffie & Pattillo, 2009; Hansen and Heady, 2009; Berg, Mirzoev, Portillo & Zanna, 2010). Concentrating on the latter, it has become clear from these studies that in small countries that depend heavily on the export sector to generate enough exchange rate to satisfy import demand, there is a possibility that aid inflows denominated foreign currencies may raise either nominal exchange rates or the prices of other critical resources that are in limited domestic supply. As argued by Hansen and Heady (2009), these effects known as “Dutch Disease” are often considered one of the main reasons for the apparent ineffectiveness of aid.

Literature reveal that the “Dutch Disease” can be addressed by either absorbing the increased aid inflows through increased imports or delay absorption and aid spending by bolstering their foreign exchange reserves. In this study the definition and explanation about absorption and spending is based on the IMF (2005) and has been well discussed in Gupta *et al.* (2005), Aiyer *et al.* (2005) and Berg *et al.* (2007). Absorption is defined as the extent to which a country’s non-aid current account deficit (excluding aid) widens in response to an increase in aid flows. Particularly, absorption captures direct government purchase of imports and indirect increases in net imports resulting from aid driven increases in government or private expenditure. Thus, the monetary authorities can make decisions about how much foreign exchange associated with aid to sell and through interest rule policy influences the demand for private imports through aggregate demand. On the other hand, spending is defined as widening in the government fiscal deficit net of aid (fiscal deficit excluding grants) that accompanies an increase in aid. It captures the extent to which government uses aid to finance an increase in expenditure which could be used for imports or domestically produced goods and services.

Consequently, absorption and spending have become policy choices and the mix of these two is likely to differ. For instance, if government spend all the aid received on imports or receive aid in kind such as drugs then spending and absorption are equivalent and this implies that there is no direct impact on macroeconomic variables such as exchange rate, the price level, or interest rate. On the other hand, if the government receives foreign exchange resources and immediately sells them to the central bank, the government might decide how much of the local currency counterpart to spent domestically and the central bank has to decide how much of aids-related



foreign exchange to sell on the market. Hence, the mix of absorption and spending decisions may have positive or negative consequences on exchange rate, interest rate and general prices.

The short run effects of aid flows is based on the “transfer problem” literature. According to this literature, government can spend received aid on domestic goods or on imports and the increase in spending reflected in the increase of absorption (Buffie *et al.*, 2004; Hussain, Berg & Aiyar, 2009; Berg *et al.*, 2010; Fielding and Gibson, 2012). These papers argue that the exchange rate will have to appreciate to shift demand towards imports and supply towards domestic goods so that there is internal balance in the domestic market and external balance in the external market (improvements in the balance of payment). Theoretically, if government chooses to spend aid directly on imports, there will be no initial impact on the exchange rate, price level, or interest rate. But, if government spends more on domestic goods which characterises most low income countries (Gupta, Powell and Yang, 2005), there will be short-run real appreciation of the exchange rate and a shift of resources from the traded to non-traded goods sector (Fielding and Gibson, 2012). Specifically, the authorities will be required to sell the foreign exchange by removing from circulation the local currency spent by government to complete the real transfer of resources to the recipient country which is called sterilisation. However, empirical evidence has shown that aid inflows can be associated with a depreciation of the exchange rate especially in low income countries (Ogun, 1995; Nyoni, 1998, Sackey, 2001; Ouattara & Stobl, 2003).

On the other hand, aid-recipient countries in less developing economies have used aid inflows to finance government spending but the current account deficit excluding aid did not increase. Most of these countries have used additional aid-related resources to increase their reserves. For instance Berg *et al* (2007) found that some African countries with large aid surges experienced a fiscal expansion, large accumulation of reserves and real depreciation of exchange rate. This has a similar effect as domestically-financed fiscal expansion which leads to increases in money supply and creates inflationary pressures. Thus, monetary authorities are faced with the challenges of either controlling inflation or dealing with the crowding out of the private sector that arises from the sale of treasury bills due to increased aid.

Traditionally, foreign exchange from aid inflows accrues to the government. The government then sells the foreign exchange to the monetary authorities in exchange for local counter-part



fund to finance government operations. In turn, the monetary authorities decides independently whether to accumulate aid-related foreign exchange as reserves or whether to sterilise the accumulation through sells of securities to the public. If the monetary authorities chooses not sell aid related foreign exchange, the recipient country may experience a larger supply of domestic currency thus pushing up the prices of foreign currency. This leads to increases in import demand and lowers export supply, hence inducing exchange rate depreciation. On the other hand, if government chooses to sell the aid-related foreign exchange to the public, interest rates increases and crowd out private investment (Hussain *et al.*, 2009). In this case, there is no real transfer of resources from donors to recipient countries but it induces reallocation of resources from private to the public sector through interest rate increases. The impact of the latter will depend upon the level of financial development and the opening of the capital account of the recipient country. Therefore, the monetary policy response to foreign aid inflows will depend upon the combination of absorption and spending options¹⁵.

Methodologically, this chapter improves technically on previous work in the area by estimating the DSGE model using Bayesian method as opposed to the usual method of calibrating parameters. In addition, despite the increasing awareness of the advantages of Bayesian DSGE models in recent years, no attempt has yet been made to explore the models for the Malawian economy. The DSGE models are less susceptible to the Lucas critique and suitable for policy analysis (Teo, 2009). Borrowing from Teo (2009) explanation, the equations in the DSGE model are derived from the optimisation problems of the economic agents. Hence, the model can capture the effects of policy changes on the expectations of economic agents. As discussed earlier, aid flows involves interactions of various economic agents, namely households, firms, government and the monetary authorities. The structure of the DSGE model accommodates such interactions and allows us to understand theoretical issues and provide some explanations to some macroeconomic outcomes. The DSGE models have also been found to perform well empirically than the traditional autoregressive models (Smets & Wouters, 2003; Adolfson, Laseen, Linde & Villani, 2007).

¹⁵For more details about the impact of absorption and spending options of aid see Gupta, Powell and Yang (2005) and Hussain *et al.* (2009).



Furthermore, the choices of Bayesian method of estimating this model are well explained by An and Schorfheide (2007) and Fernandez-Villarde (2009). One factor worth mentioning includes the possible use of prior distributions that incorporate additional information into the parameter estimation. The approach also accommodates the possible examination of the robustness of the results with respect to model misspecification and identification that may distort the parameter estimates in the DSGE model. The paper also takes advantage of the model developed by Ireland (2004) to introduce many shocks to capture additional stochastic dynamics that can be found in the data. This work also contributes to the proper modelling of the country's macroeconomic fluctuations. Thus, the study will help to inform policy makers of the appropriate monetary and exchange rate policy for Malawi at the time when it is anticipating aid increases in FY 2012/13.

In Malawi, foreign aid inflows provide 40 percent of resources to support the national budget (Malawi Government, 2006) and foreign aid as proportion of GDP increased after adopting financial reforms. The country also depends on agricultural exports (tobacco earning about 60 percent of total export proceeds) and raw materials imports for production. Country studies have revealed that aid inflows have been erratic due to slippages in the economic management, violations of rule of law and governance problems (Fagernas & Schurich, 2004; Lea & Hanmer, 2009, Munthali *et al.*, 2010). For these reasons, the country experienced episodes of aid withdrawal between 1980 and 2010. The withdrawal of foreign aid has coincided with the shortage of foreign exchange making the country failing to import essential commodities such as fuel, fertiliser and medicines (Munthali *et al.*, 2010; IMF, 2012). Based on Hussain *et al.* (2009) framework as discussed in section 4.2, fiscal deficit excluding grants as proportion of GDP increased from 5.63 percent in 2004-2006 to about 7.88 percent in 2007-2009. On the other hand, current account balance excluding grants as a proportion of GDP remained almost constant from 18.28 percent to about 18.32 percent. The big question now lies in understanding whether the positive aid shock may have short run negative macroeconomic consequences on inflation and exchange rate policies as explained by Buffie, Adam, O'Connell and Pattillo (2004). Specifically, we only isolate how RBM responded to aid increases depending upon government spending options.

This chapter finds that RBM reacted to increased foreign aid in Malawi between 1980 and 2010. In particular, we find strong evidence of the Taylor rule of monetary policy response based on



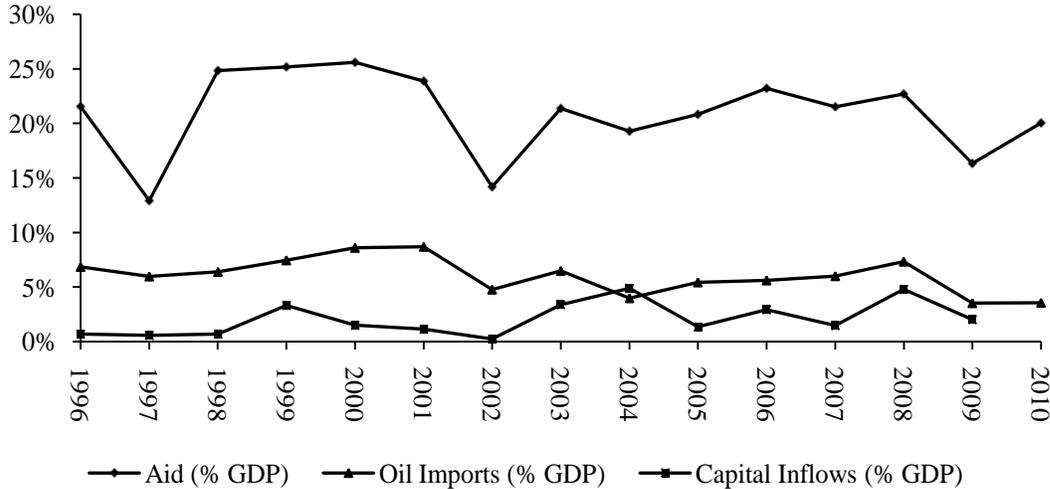
the results of the estimated DSGE model. Most importantly, spending but not absorbing increased aid inflows induces demand pressures and result in an increase in real interest rates. The demand pressures are associated with high depreciation in Malawi in contrast to what was found in Mozambique by Peiris and Saxegaard (2007) because aid inflows were found to be associated with depreciation other than the expected real appreciation. Furthermore, the impulse responses reveal that an impact of a positive aid shock on depreciation and inflation is much less when the monetary authorities engage in the target of monetary aggregates than when the authorities use the Taylor rule and incomplete sterilisation. This implies that the choice of appropriate and effective monetary policy instruments by monetary authorities following foreign aid increase is necessary condition to achieve inflation stability and sustained economic growth in Malawi.

The rest of the chapter is organised as follows. Section 4.2 provides a brief overview of macroeconomic developments and foreign aid in Malawi. Model specification is discussed in section 4.3. Section 4.4 discusses the calibration and estimation of the model using Bayesian DSGE model based on the Malawi economic structure. Section 4.5 and 4.6 highlights in details model simulation and policy response options of managing foreign aid and sensitivity analysis, respectively. Conclusion and policy implications are presented in section 4.7.

4.2 Macroeconomic Development and Foreign Aid in Malawi

Malawi as a low-income and land-locked country in the Sub-Saharan Africa depends on substantial inflows of foreign aid from the International Monetary Fund (IMF), the World Bank and other individual donor nations to support about 40 percent of resources to run the national budget (Malawi Government, 2006). Figure 16 shows the trend of foreign aid and other inflows for the past three decades. It is observed that aid inflows accounts for a lion's share as a percentage of GDP and have varied between 1980 and 2010. As explained by Buffie *et al.* (2004), the erratic flows of aid inflows have economic implications on achieving broader macroeconomic objective of stable exchange rate, price stability and sustainable economic growth. The big question now lies in understanding whether these shocks have short run macroeconomic consequences on inflation and exchange rate policies.

Figure 16: External Inflows in Malawi as % of GDP



Source: IMF, World Bank and OECD Data.

Note: All the variables are based on calendarised data.

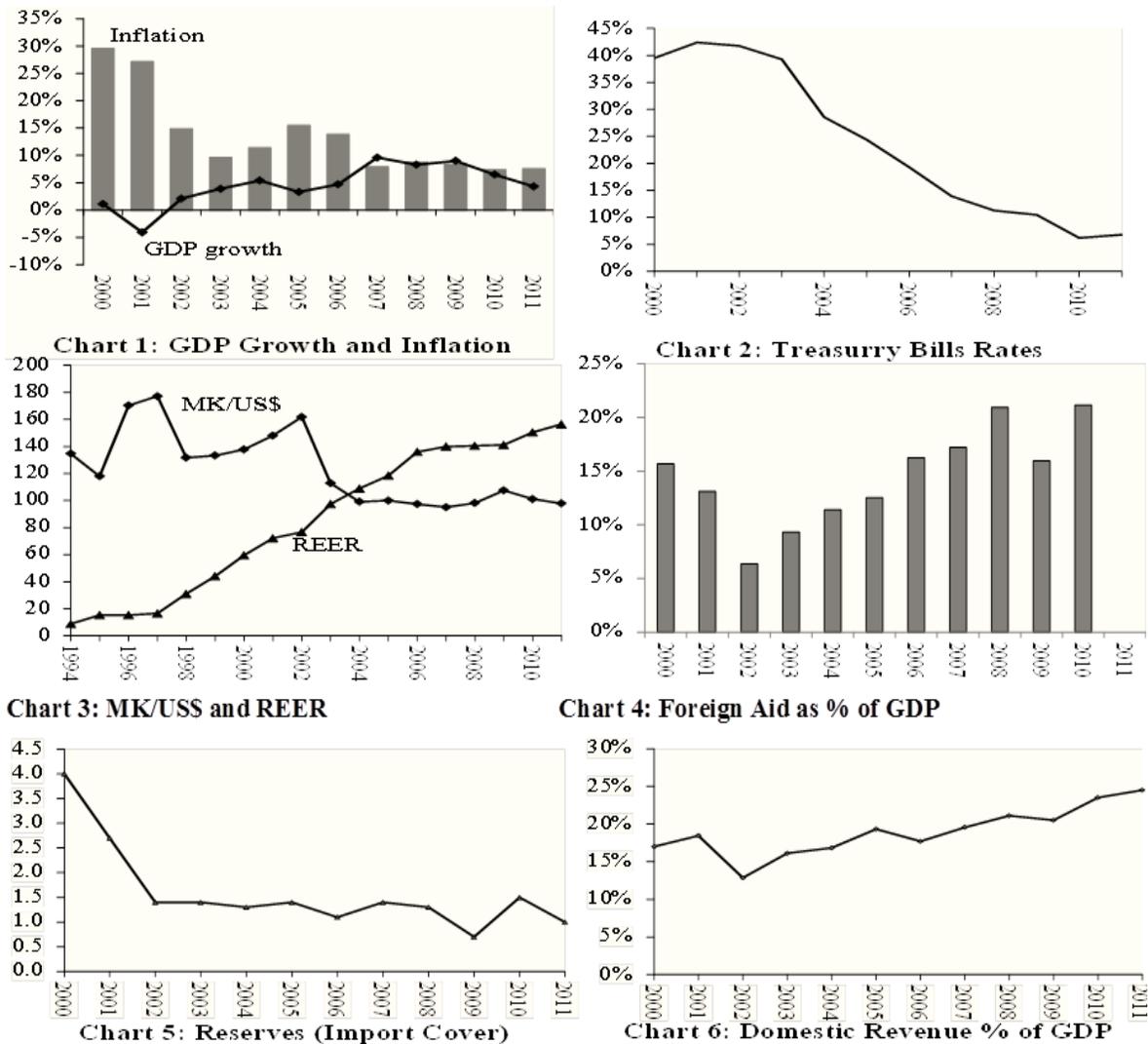
In addition, an ODI study by Fagernas and Schurich (2004) found that aid inflows to Malawi were volatile due to slippages in the economic management. Specifically, the study observed that slippages in aid flows was due to donor withdrawal of budget support in early 1990s which resumed in 1996 and another which happened 2001 and resumed in 2006. Malawi also benefited from debt forgiveness under the Heavily Indebted Poor Countries (HIPC) initiative in 2006. The resumption of budget support has followed an increase in aid inflows to Malawi as observed from Figure 16. However, Hussain *et al.* (2009) argue that the increase in foreign aid can bring about negative macroeconomic consequences when policy reactions between the fiscal and monetary authorities are not properly coordinated. In particular, these studies argue that macroeconomic imbalances comes about when there is no coordinated response between the fiscal authorities focusing on spending and the monetary authorities indulging in absorption.

Over the same period, the evolution of economic indicators has also varied as shown in Figure 17. For the past 7 years, there has been an increase in economic growth of around 6 percent on average and an achievement of historical single digit inflation due to high performance of the agricultural sector. Interest rates have been declining and exchange rate per US dollar has been stable with real effective exchange rate depreciation. These movements in the exchange rates have also been documented by Munthali *et al.* (2010). The country also experienced increased domestic revenue and foreign aid but international reserves in terms of import cover have



remained low over this period. The variation of economic indicators moves in tandem with trends in aid inflows. These imbalances between domestic revenue, foreign aid and reserves raise some important questions for further investigation. To understand the economic implication, we isolate the monetary policy response to official foreign aid increases in Malawi.

Figure 17: Some Key Macroeconomic Indicators



Source: IMF Country Reports and World Bank Development Indicators.

Note: Aid % of GDP data were obtained from the fiscal year using the IMF Country Reports. The fiscal year in Malawi is from July to June.

In terms of the conduct of monetary policy, Mangani (2011) provides evidence that Malawi target broad money instead of interest rate rule and Reserve Bank of Malawi (RBM) reacts to



inflation and moderate exchange rate in setting the monetary base but it does not react to output gap. In addition, the study found that the bank rate determination is largely influenced by the desire to correct disequilibria rather than economic developments. Furthermore, the conduct of monetary policy is complicated by fiscal dominance as foreign aid is taken as a source of government revenue. Therefore, this monetisation of foreign aid done through expenditure on non-tradable goods may induce inflationary effects and becomes more compounded if fiscal indiscipline is paramount. Hence, monetary policy decisions on the combination of changes in inflation, exchange rate and interest rates will respond differently to aid inflows when compared to a normal simple Taylor rule.

We illustrate in Table 12 how the increase in aid performed in collaboration with key macroeconomic variables. We split the performance of key macroeconomic indicators into two periods, when the country experienced low aid inflows and the period after receiving debt relief and scaled up aid in terms of budget support. Using Hussain *et al.* (2009) methodology, aid inflows increased by 4.3 percentage points of GDP. Aid inflows through budget support also slightly increased by 0.04 percentage points of GDP indicating more flexibility for Malawi in spending aid. During the same period, real effective exchange rate depreciated during aid increase instead of the expected appreciation. However, the nominal exchange rate strengthened because the RBM managed the exchange rate peg against the US dollar. This shows that Malawi gained competitiveness which is evident in the improvement of the terms of trade and strong export performance (Table 12). These findings are in line with what Munthali *et al.* (2010) found in their study on the real exchange rate and growth in Malawi. The study also points out that Malawi managed a crawling peg to the US dollar and exchange rate was deemed overvalued during this period. Thus by implication, Table 12 provides evidence that the exchange rate depreciated instead of the expected appreciation.



Table 12: Some Key Macroeconomic Indicators

	Pre aid increase-average 2004-2006	Aid increase-average 2007-2009	Difference
Official exchange rate (MK/US\$, period average - change)	11.79	1.25	
REER index (2005-100) - change	-4.65	3.48	
Treasury bill rate (%)	24.08	11.91	
Terms of trade	-4.65	3.97	
Export (% of GDP)	23.88	28.57	
Of which tobacco	9.75	11.85	
Import (% of GDP)	47.5	45.31	
Of which oil	4.67	4.81	
Net aid inflows (% of GDP-Fiscal)	13.75	16.49	2.74
Net aid inflows (% of GDP-BoP)	12.89	17.18	4.3
Budget support (% of GDP)	3.25	3.42	0.17
Current account balance (excluding grants - % of GDP)	-18.28	-18.32	-0.04
Change in reserves (increase -)	-1.11	0.55	1.66
Tax revenue (% of GDP)	16.05	18.19	2.14
Domestic revenue (% of GDP)	17.94	20.6	2.66
Public Spending excl. interest payment (% of GDP)	23.57	28.48	4.91
Overall fiscal balance excl. grants (% of GDP)	-5.63	-7.88	-2.25

Source: IMF country reports, World Bank Economic Indicators and RBM Financial and Economic reports:

Note: Change in reserves (increase -) is calculated as changes in the official reserves as a percent of GDP and a minus sign indicates that the official reserves increased during that period.

According to Berg *et al.* (2010), it is assumed that once the aid is received the fiscal authorities spend all the increased aid while the monetary authority absorbs the foreign exchange proceeds realised from aid to finance imports, hence accumulating part of the aid flows in form of international reserves. With such ideal situation, total spending should match total absorption. However, empirical literature has revealed that four combinations are possible when foreign aid is received: all is a) spent and absorbed; b) neither spent nor absorbed; 3) absorbed but not spent; and 4) spent but not absorbed (Hussain *et al.*, 2009). In Malawi, once foreign aid is received, the government immediately sells to the RBM and the local currency realised is spent on domestic goods. Then, RBM decides how much of the realised aid-related foreign exchange to sell on the market and this may yield discrepancy between spending and absorption, posing great policy challenges. However, as explained by Aiyer, Berg and Hussain (2005), there will be limited policy changes in the case that government could receive aid in kind or spend direct on imports. Thus, following Hussain *et al.* (2009) procedure, the study will determine what type of combinations of absorption and spending options Malawi implemented.

Hussain *et al.* (2009) defines absorption as the extent to which the current account deficit excluding aid as percent of GDP widens in response to an increase in aid. According to Table 12,



current account deficits excluding aid as percent of GDP widened by 0.04 percentage points and aid inflows as percent of GDP increased by 4.3 percentage points. Truncating the current account deficits excluding aid as a percentage of increased aid inflows between 0 and 100, incremental aid absorption in Malawi was almost 0.9 percent indicating that Malawi failed to absorb the increased aid during 2007 and 2009. These results are almost similar to what Hussain *et al.* (2009) found in Ghana and Tanzania.¹⁶ However, the evidence of no absorption in Malawi contradicts what Lea and Hanmer (2009) found of full absorption of aid in Malawi. One of the factors leading to differences may maybe due to the period of the review. The data used was provisional and this time actual flows are obtained. On the other hand, international reserves deteriorated during aid increase period in support of the exchange rate peg against the US dollar. Thus, the monetary authority had control on the operation of absorption through the determination of how much of the foreign exchange is associated with aid sell and keep control over the overvalued exchange rate against the US dollar.

In the same study by Hussain *et al.* 2009, spending is defined as the widening in the government fiscal deficit excluding aid accompanying an increment in foreign aid. Calculating the spending of increased aid shows that 88 percent of the increased aid was spent in Malawi.¹⁷ This evidence shows that Malawi spent almost all the aid it received during 2007 and 2009. The results in terms of spending are similar to what Lea and Hanmer (2009) found on Malawi. However, Malawi experienced an increase in taxation and domestic revenue by 2.14 percent and 2.66 percent, respectively clouding out the evidence of whether the increased aid was fully spent. Although theory and empirical studies propose that aid can indirectly be spent by lowering taxes (Hussain *et al.*, 2009), Malawi's situation was different because domestic revenue and expenditure increased during the period of increased foreign aid. The increased expenditures could be on imports or domestically produced goods and services and this condition could create tension between fiscal policy response through budget and broader macroeconomic objective of maintaining stable exchange rate and inflation.

¹⁶ Increased aid absorbed (0.9 percent) calculated as change of current account deficit excluding grant (-0.04) divided by the change of aid inflows (4.3) times 100 (see Table 12).

¹⁷ Increased aid spent (88.2 percent) calculated as change in fiscal balance excluding grants deterioration (-2.25) divided by the change of aid inflows (2.74) times 100 (see table 12).



Henceforth, Malawi fully spent and partly absorbed the increased aid the same way it was observed by Hussain *et al.* (2009) in Tanzania, Mozambique and Uganda. Hence, these patterns of absorption and spending provide enough challenges for monetary policy in response to the aid increases. The task is to find out now whether increased aid inflows affected exchange rate appreciation or depreciation, inflation, and economic growth. The important question is how the monetary authority responded to these aid increases in Malawi. It will provide immediate suggestions of how to manage the anticipated aid increases following the resumption of budget support expected in FY2012/13.

4.3 The Model

The structure of the model and much of its notations are taken from Berg *et al.* (2010) and Dagher, Gottschalk and Portillo (2010). It is assumed that the economy comprises of the households, firms, government and Reserve Bank of Malawi (RBM) managing monetary policy. We have a small open economy with traded good (T) and a non-traded good (N) and relax the assumption of cashless economy in order to accommodate the conduct of monetary policy using money targets in low income countries. The household is categorised as either an optimising forward looking consumer who have access to capital markets or current income consumer who have no financial assets and consume their labour income (Campbell & Mankiw, 1989; Gali, Lopez-Salido & Valles, 2004). In this study, the source of uncertainty in the model is a structural shock to foreign capital inflows in form of official foreign aid. In order to estimate the model, we derived the log-linear approximation around steady states based on the method developed by Gali, Lopez-Salido and Valles (2007) and most of these solutions were also used by Berg *et al.* (2010). Most importantly, we incorporate shocks on key endogenous variables in the log-linear equations to capture the dynamic behaviour of the estimated model based on Ireland (2004) paper. However, we only present the structural model while the full version of the derived log-linear model is provided in Annex 3.

4.3.1 The Household

4.3.1.1 Optimising Households



The optimising household derives utility from consumption c_t^* , real money balances $m_t^* = \frac{m_t^*}{P_t}$, and l_t^* is the amount of labour supplied to the firm. A fraction λ of total households who are optimising consumers are represented by superscript “*”. These households have access to financial markets to smooth their consumption pattern. The representative agent of this group chooses consumption, labour, money, domestic and foreign bonds to maximise life-time utility as follows:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{*1-\frac{1}{\eta}}}{1-\frac{1}{\eta}} + \frac{m_t^{*1-\frac{1}{\eta}}}{1-\frac{1}{\eta}} - \frac{h l_t^{*1+\psi}}{1+\psi} \right) \quad (1)$$

subject to the following budget constraint deflated by domestic CPI:

$$c_t^* + m_t^* + b_t^{p*} + s_t f_t^* = w_t l_t^* + \frac{m_{t-1}^*}{\pi_t} + i_{t-1} \frac{b_{t-1}^{p*}}{\pi_t} + s_t i^f f_{t-1}^* - s_t \Psi f_t^* + \Pi_t^{*N} - \tau \quad (2)$$

where E_0 is the expectations operation. $\beta \in (0,1)$ is the discount factor. η is the inter-temporal elasticity of substitution. h and ψ determines disutility of participating in labour market and is the inverse of the labour supply elasticity. b_t^{p*} is the household's real holding of government bonds earning interest rate i_t . The household also holds foreign assets f_t^* deflated by foreign price index earning interest rate i^f and are subject to portfolio adjustment Ψf_t^* (risk premium tax). $s_t = \frac{E_t P_t^f}{P_t}$ is real exchange rate where E_t is the nominal exchange rate. w_t is the real wage

and domestic inflation is defined as $\pi_t = \frac{P_t}{P_{t-1}}$, while foreign inflation is assumed constant and equal to one. Π_t^{*N} represents household's profits from domestic firms in the non-traded sector and τ is lump sum tax collected by government.



Using the first order conditions calculated from the objective function equation 1 and the budget constraint equation 2, the following solutions are obtained for an optimising household:

$$c_t^{*\frac{1}{\eta}} = \beta E_t \frac{i_t}{\pi_{t+1}} c_{t+1}^{*\frac{1}{\eta}} \quad (3)$$

$$c_t^{*\frac{1}{\eta}} = \beta E_t \left\{ c_{t+1}^{*\frac{1}{\eta}} \left(\frac{s_{t+1}}{s_t} \right) \left[\frac{i^f}{1 + \Psi' f_t^*} \right] \right\} \quad (4)$$

$$m_t^{*\frac{1}{\eta}} = \beta E_t \frac{i_t - 1}{i_t} c_t^{*\frac{1}{\eta}} \quad (5)$$

$$h l_t^{*\psi} = w_t c_t^{*\frac{1}{\eta}} \quad (6)$$

In order to accommodate international capital mobility as explained by Berg *et al.* (2010), the portfolio adjustment cost is assumed $\Psi f_t^* = \frac{v^*}{2} \left(f_t^* - \bar{f}^* \right)^2$ where f^* is the steady state value of the foreign assets. This accommodates a closed capital account where $v^* = \infty$ and partial capital account where $0 < v^* < \infty$. In both cases, sterilised exchange rate interventions will influence the exchange rate. As explained by Dagher *et al.* (2010), if the private sector's holding of foreign assets is reduced, a purchase of foreign exchange with domestic bonds will increase expected returns on foreign assets net of adjustment costs and cause depreciation.

4.3.1.2 Rule-of-Thumb Households

The rule-of-thumb consumers represented by a fraction $1 - \lambda$ indexed by “**” superscript have no access to capital markets and do not invest in financial assets and therefore depend on their current income received from non-interest activities (wages and salaries) net of lump sum tax. Hence, these household will maximise the same lifetime utility of equation 1 but subject to the following budget constraint:

$$c_t^{**} = w_t l_t^{**} - \tau^{**} \quad (7)$$

For the rule of thumb consumers, we obtain a single first order condition

$$hl_t^{**\psi} = w_t c_t^{**\frac{1}{\eta}} \quad (8)$$

4.3.2 Aggregation, Consumption Basket, Price Indices and Demand Function

The aggregates related to the consumer variables can be defined using $N_t = \lambda N_t^* + (1 - \lambda)N_t^{**}$, where $N_t = (c_t, c_t^N, c_t^T, l_t, b_t^c, m_t, \Pi_t^N)$, $f_t^{**} = b_t^{**p} = 0$. Individual household $j \in [0, 1]$ consume from traded and non-traded goods and the structure of consumption basket follows a constant elasticity of substitution (CES). The consumer price index of this basket also follows a CES structure.

$$c_t^j = \left[\varphi^{\frac{1}{x}} (c_t^{jN})^{\frac{x-1}{x}} + (1 - \varphi)^{\frac{1}{x}} (c_t^{jT})^{\frac{x-1}{x}} \right]^{\frac{x}{x-1}} \quad (9)$$

$$P_t = \left[\varphi (P_t^N)^{1-x} + (1 - \varphi) (P_t^T)^{1-x} \right]^{\frac{1}{1-x}} \quad (10)$$

where φ is the degree of home bias in consumption and x represents the elasticity of substitution between traded goods and non-traded goods. P_t^N and P_t^T represent prices for non-traded goods and traded goods, respectively.

Government also consumes traded goods and non-traded goods, its consumption basket and prices expressed in terms of the CPI will be as follows:

$$g_t = \left[\varphi_g^{\frac{1}{x}} (g_t^N)^{\frac{x-1}{x}} + (1 - \varphi_g)^{\frac{1}{x}} (g_t^T)^{\frac{x-1}{x}} \right]^{\frac{x}{x-1}} \quad (11)$$

$$p_t^G = \left[\varphi_g (p_t^N)^{1-x} + (1 - \varphi_g) (p_t^T)^{1-x} \right]^{\frac{1}{1-x}} \quad (12)$$

where φ_g represents the degree of home bias in government consumption. Therefore, the demands for the consumer and government in traded goods and non-traded goods are:

$$c_t^{jN} = \varphi(p_t^N)^{-x} c_t^j; \quad c_t^{jT} = (1-\varphi)(s_t)^{-x} c_t^j \quad (13)$$

$$g_t^N = \delta(p_t^N)^{-x} g_t; \quad g_t^T = (1-\delta)(s_t)^{-x} g_t \quad (14)$$

where $p_t^N = \frac{P_t^N}{P_t}$ and $s_t = \frac{s_t P_t^{TF}}{P_t}$.

4.3.3 Firm

In this model, supply is determined from output of non-traded and traded good producers.

4.3.3.1 Non-Traded Good Producers

In the non-traded goods producer (N), the firm faces the monopolistic competition and price setting behaviour based on a Calvo pricing. Its production technology is expressed as

$$y_t^N = \left(\int_0^1 y_{it}^N \frac{\theta-1}{\theta} di \right)^{\frac{\theta}{\theta-1}}, \text{ where } \theta \text{ is the elasticity of substitution between varieties indexed } i \in [0,1].$$

Assuming that most firms in Malawi are labour intensive, a simple production technology with only labour as input is adopted. Hence demand and production are represented as follows:

$$y_{it}^N = \left(\frac{p_{it}^N}{p_t^N} \right)^{-\theta} y_t^N \quad (15)$$

$$y_{it}^N = z^N (l_{it}^N) \alpha \quad (16)$$

where α is the production share of labour and z^N is the productivity coefficient in non-traded sector. And as in Rotemberg (1982), the firm faces price adjustment costs of

$$F(p_t^N, y_t^N, \pi_{it}^N) = p_t^N \frac{\zeta}{2} (\pi_{it}^N - 1)^2, \text{ where the non-traded goods inflation } \pi_{it}^N, \text{ price and } p_{it}^N \text{ are:}$$



$$\pi_{it}^N = \pi_t \frac{p_{it}^N}{p_{it-1}^N} \text{ and } p_{it}^N = \frac{p_{it}^N}{p_t} \quad (17)$$

The firm in the non-traded good chooses price p_{it}^N to maximise profits as follows:

$$E_0 \sum_{t=0}^{\infty} \beta \frac{c_t^*}{c_{t+1}^*} \left[p_{it}^N \left(\frac{p_{it}^N}{p_t^N} \right)^{-\theta} y_t^N (1+\iota) - w_t^N \left(\frac{p_{it}^N}{p_t^N} \right)^{\frac{-\theta}{\alpha}} \left(\frac{y_t^N}{z_t^N} \right)^{\frac{1}{\alpha}} - F(p_t^N, y_t^N, \pi_{it}^N) - \varphi_t^N y_t^N \right] \quad (18)$$

where ι denotes a subsidy from government financed by a tax common to the sector and this addresses the issue of distortions created by monopolistic competition (Berg *et al.*, 2010). Therefore, the first order condition with respect to inflation in non-traded sector is:

$$\pi_t^N (\pi_t^N - 1) = \beta E_t \left[\frac{c_t^*}{c_{t+1}^*} \pi_{t+1}^N (\pi_{t+1}^N - 1) \right] + \frac{1}{\zeta} \left[\frac{\theta}{(1+\iota)(\theta-1)} \left(\frac{w_t^N}{p_t^N} \right) \left(\frac{y_t^N}{z_t^N} \right)^{\frac{1-\alpha}{\alpha}} - 1 \right] \quad (19)$$

4.3.3.2 Traded Good Producers

The traded good producer (T) is assumed to operate in a perfectly competitive market and the law of one price holds. Production in the traded sector is represented as follows:

$$y_{it}^T = z^T (l_{it}^T)^\alpha \quad (20)$$

where l_{it}^T is the amount of labour inputs used in production, α is the labour share and z^T is productivity coefficient. Thus, the firm will choose labour l_{it}^T to maximise its real profits as follows:

$$E_0 \sum_{t=0}^{\infty} J_t \left[s_t z^T (l_{it}^T)^\alpha \right] - w_t^T l_{it}^T \quad (21)$$

Therefore, the first order condition in the traded sector is:



$$\frac{w_t^T}{s_t} = \frac{(y_t^T)^{\frac{1-\alpha}{\alpha}}}{(z^T)^{\frac{1}{\alpha}}} \quad (22)$$

4.3.4 The Public Sector

The public sector is constrained with the following budget:

$$p_t^G g_t = \tau + s_t A_t - \left(d_t - \frac{d_{t-1}}{\pi_t} \right) + \left(b_t - \frac{b_{t-1}}{\pi_t} \right) - \frac{(i_{t-1}) b_{t-1}^p}{\pi_t} \quad (23)$$

where public expenditure is financed by taxes τ_t , direct proceeds earned from foreign aid $s_t A_t$, changes in deposits held at RBM $-\left(d_t - \frac{d_{t-1}}{\pi_t} \right)$ or issuing domestic debt $\left(b_t - \frac{b_{t-1}}{\pi_t} \right)$.

Government also pay interest rates on its past debt held by the private sector b_{t-1}^p . Total debt is a composite of RBM debt and debt to the private sector $b_t = b_t^{RBM} + b_t^p$. Furthermore, the fiscal policy is determined by rules for deposits and gross debt.

$$d_t = \rho_d d_{t-1} + (1 - \rho_d) \bar{d} + (1 - \gamma) s_t (A_t - \bar{A}) \quad (24)$$

where the steady state aid spent is \bar{A} and steady state deposits are \bar{d} . The government decision to spend on increased aid is represented by a fraction γ and ρ_d is a rate at which aid related deposits are drawn down. Thus, the initial increased aid can either be spent or accumulated as deposits depending on the policy parameter γ . The accumulation of government debt is represented as follows:

$$b_t = b_{t-1} - \varsigma \left(b_{t-1}^p - \bar{b}^p \right) \quad (24)$$

where ς is assumed small and positive, so that transaction effects on debt held by the private sector do not influence steady interest payments.

4.3.5 The Reserve Bank of Malawi

4.3.5.1 The Balance Sheet

We assume a simple RBM balance sheet as in Berg *et al.* (2010).

$$m_t - \frac{m_{t-1}}{\pi_t} = b_t^{RBM} - \frac{b_{t-1}^{RBM}}{\pi_t} + \left(d_t - \frac{d_{t-1}}{\pi_t} \right) + s_t (R_t - R_{t-1}) \quad (26)$$

The bond transactions are influenced by changes in the deposits and changes in the reserves which may affect the changes in the monetary injection. This open market operation is adjusted to incorporate the monetary transmission when investigating the effects of absorbing aid through sterilisation. The reserve policy rule R_t is:

$$R_t = \rho_R R_{t-1} + (1 - \rho_R) \bar{R} + (1 - \omega)(A_t - \bar{A}) \quad (27)$$

where, \bar{R} and \bar{A} are steady state levels of reserves and aid, respectively. The parameter ω measures the rate at which additional aid revenues are absorbed by RBM especially in the closed capital account to aid-financed spending. From equation 27, if ω is close to 1, then RBM immediately sells the received aid related foreign currency to obtain equivalent local currency to finance the aid induced spending. But if the parameter ω is less than 1, it indicates that RBM can accumulate some of aid received revenues as reserves. The accumulated reserves are then drawn at the rate of ρ_R . The accumulation of reserves is mainly induced by RBM being concerned with persistent reserve deviation from long run equilibrium hence targeting a particular long-run value of reserves \bar{R} .

4.3.5.2 The Monetary Policy

RBM follows a simple Taylor rule and targets non-traded sector:

$$i_t = \frac{1}{\beta} (\pi_t^N)^{\phi_\pi} \quad (28)$$

4.3.6 The Market Equilibrium

The labour market equilibrium is:



$$l_t = l_t^N + l_t^T = \lambda l_t^* + (1 - \lambda) l_t^{**} \quad (29)$$

Equilibrium condition in the two sectors, non-traded goods N and traded goods T is:

$$Y_t = p_t^N y_t^N + s_t y_t^T \quad (30)$$

Equilibrium condition in the non-traded goods sector:

$$y_t^N = c_t^N + g_t^N + F(p_t^N, y_t^N, \pi_{it}^N) \quad (31)$$

Equilibrium condition in the external sector defined by the balance of payment in terms of the use of aid is:

$$A_t = [c_t^T + g_t^T - y_t^T + \lambda \Psi(f_t^*) - (i_{t-1}^f - 1) f_{t-1}] + (f_t - f_{t-1}) + (R_t - R_{t-1}) \quad (32)$$

Equation 32 states that aid can either be used to finance the current account deficit represented by terms in the square brackets or finance the capital account represented by terms in the second brackets or used to accumulate international reserves represented by terms in the last bracket.

We also assume that Aid A_t is officially received to carter for government spending and follows an autoregressive (AR) stochastic process:

$$A_t = \bar{A} + \rho_A (A_{t-1} - \bar{A}) + \varepsilon_t^A \quad (33)$$

where \bar{A} denotes the steady level of aid, ρ_A represents the degree of persistent in aid increase, and ε_t^A is an i.i.d. shock.

4.3.7 The Estimated Model

The estimated model is a solution of the structural model from section 4.3.1 to 4.3.6 represented as a log-linear approximation around steady states as in Annex 4. The estimated log-linear equations also incorporate shocks on key endogenous variables to capture the dynamic behaviour of the estimated model based on Ireland (2004) paper. The full explanations about having many shocks are briefly discussed in section 4.3.8. We only discuss how the combination of spending

and absorption aid impact an appreciation and depreciation of exchange rate in the model using the log-linear internal and external balance equations from Annex 4. In particular, the impact of spending aid on exchange rate can be explained by the internal balance,

$$\hat{s}_t = -z_w \hat{w}_t - z_c \hat{c}_t - z_A \hat{A}_t - z_\pi \hat{\pi}_t - z_d \hat{d}_{t-1} + z_b \hat{b}_{t-1}^p - z_u \hat{u}_t \quad (16A)$$

where $z_w = z_u = \frac{\alpha \delta}{(1-\alpha)z}$; $z_c = \frac{\phi k_c}{z}$; $z_A = \frac{\gamma \phi_g k_A}{z}$; $z_\pi = \frac{k_m}{z}$; $z_d = \frac{\phi_g (1-\rho_d)}{z}$;

$$z_b = \frac{\phi_g}{z} \left(\frac{1}{\beta} - 1 + \zeta \right) \text{ and } z = (1-\phi)k_c \chi + \phi_g \phi + \delta \zeta \left(\frac{\alpha}{1-\alpha} \right)$$

In Equation 16A, an increase in aid \hat{A}_t will lead to an appreciation of the exchange rate \hat{s}_t . Specifically, the coefficient z_A entails that when the degree of initial aid spent γ increases combined with positive share of government spending of non-traded goods ϕ_g and share of aid in GDP k_A , the exchange rate appreciates while a decline leads to the depreciation of the exchange rate.

The impact of absorption of aid inflows on exchange rate can be explained through the following external balance equation:

$$\hat{s}_t = x_w \hat{w}_t + \hat{x}_c \hat{c}_t + x_d \hat{d}_{t-1} - x_f \left(\hat{f}_t - \frac{1}{\beta} f_{t-1} \right) - x_A \hat{A}_t - x_R \hat{R}_{t-1} - x_b \hat{b}_{t-1}^p \quad (17A)$$

where $x_w = \frac{\alpha(1-\delta)}{(1-\alpha)H}$; $x_c = \frac{(1-\phi)k_c}{H}$; $x_A = \frac{k_A \{ \omega - (1-\phi_g) \chi \}}{H}$; $x_R = \frac{1-\rho_R}{H}$; $x_f = \frac{1}{H}$;

$$x_d = \varepsilon_d \frac{E}{H}; x_b = \varepsilon_b \frac{E}{H}; H = (1-\phi)k_c \chi - (1-\phi_g) \phi + \frac{\alpha(1-\delta)}{1-\alpha}.$$

In equation 17A, an increase in the degree of absorbing revenues realised from aid increment ω will lead to an increase in the parameter x_A , assuming a positive share of aid in GDP k_A , positive degree of initial aid spent γ and positive share of government spending of non-traded goods ϕ_g . This implies that the exchange rate \hat{s}_t will decline, assuming other things remain



constant in the model. Therefore, increasing the degree of absorbing the revenue realised from increased aid will lead to exchange rate appreciation while a decline will lead to depreciation.

4.3.8 Stochastic Shocks

As in Ireland (2004), the study attempts to augment the log-linear- DSGE model in Annex 3 with the flexibility of the vector autoregressive (AR) time series. In particular, the model includes many shocks to estimate the model and ensure that it is not stochastically singular. This will allow the model to capture the movements in the actual data used in the estimations that cannot be explained by the theory. In addition, by incorporating only the aid shock as a driver of all business cycle fluctuation, most endogenous variables becomes deterministic and this makes it difficult to estimate the model (see Ireland, 2004; Peiris and Saxegaard, 2007). Accordingly, we assume that all exogenous shocks included in the UIP e_t^s , consumption Euler equation e_t^c , non-traded inflation e_t^π , government spending e_t^g , Taylor rule e_t^i , reserves e_t^R , and open market operations e_t^b follow a first order AR stochastic process (see Annex 3). The actual estimation of this model system is based on the policy requirements to be made to accommodate the interaction of spending and absorption policy mix and various monetary policy instruments.

4.4 Calibration and Estimation of the Model

In estimating our DSGE model, we adopt the Bayesian procedure which depends on specifications of priors (beliefs) as in Smets and Waters (2007), Peiris and Saxegaard (2007) and DeJong, Ingram and Whiteman (2000). Before estimations, the study discusses the sources and treatment of actual data, the calibration of the parameters and choice of the priors to be included in the estimation. The study attempts to include many shocks to ensure non-singularity and the number of shocks is assumed at least as large as the number of observations to enable us estimates the model using Bayesian techniques. The section ends with sensitivity analysis of the estimations.

4.4.1 Data

The estimation of the model is based on the quarterly data for Malawi between 1980:1 and 2010:4. The period was chosen to align with the implementation of the financial reforms under

the support of the Bretton wood institutions. The key macroeconomic variables used included consumption, output, government expenditures, aid flows, real exchange rate, real interest rate and CPI inflation. Other endogenous variables included in the model are assumed to be unobservable in the estimations. Data collected annually such as GDP, consumption and aid inflows were transformed into quarterly data estimated using indices of seasonally adjusted money series (M1). The data series were transformed into real variables by deflating with CPI deflators except the real interest rate data which was calculated according to the formula $1 + r_t = (1 + i_t) / (1 + \pi_t)$, where r_t is real interest rate, i_t is nominal interest rate and π_t is inflation (Chipeta and Mkandawire, 1991). The Hodrick-Prescott filter was applied to remove the trend in the observations¹⁸. In addition, data with evidence of seasonality were transformed using the X12 arima filter as in Peiris and Saxegaard (2007) paper on Mozambique.

4.4.2 Calibration and Choice of Priors

Calibration is presented in Table 13, but the values used are tentative and work will continue to obtain proper parameters. The structural parameters of the model are based either on the structure of Malawi economy or chosen in line with the literature. The calibrated key steady state parameters were based on the annual data taken from IMF-IFS and WDI over the period of 2000 to 2009. These include non-traded sector, government spending, consumption, money and aid prior to the aid increases from 2004 to 2006. The value of the discounting factor β is a standard measure from Gali and Monacelli (2005). Malawi is agricultural based and agriculture accounts for over 38 percent of GDP and employs about 85 percent of the labour force and contributes about 82 percent of foreign exchange earnings (Regional Programme on Enterprise Development, 2006). Accordingly, labour share is calibrated based on the labour involved in agricultural production as provided in the Malawi Investment Climate Assessment of 2006. The elasticity of substitution of traded and non-traded goods is estimated using a simple OLS import demand function as in Aydm, Ciplack and Yucel (2004)¹⁹. The country operates a closed capital account and hence the value of νb is set very large as in Berg *et al.* (2010). Aggregate interest

¹⁸As discussed in Baum (2006), despite some criticisms, the HP filter is a standard method for removing trend in time series data. The HP filter is applied mainly to non-stationary variables and our interest was only to use stationary variables. Other methods such as Baxter-King, Christian-Fitzgerald, and butterworth filters suppresses the frequency component in time series further and becomes complicated in estimations.

¹⁹For the simple import demand function see Annex 4



semi-elasticity of money demand was estimated using the money demand function defined in Annex 5.

Table 13: Calibration of Model Parameters

Parameters	Description	Value	Source
β	Discounting factor	0.99	Gali & Monacelli (2005)
ψ	Inverse elasticity of labour supply	2	Berg <i>et al.</i> (2010)
χ	Elasticity of substitution of traded and non-traded goods	0.83	Malawi Data
α	Labour share	0.74	MICA 2006
φ	Degree of home bias in consumption	0.60	National Accounts
δ	Non-traded sector's share of employment and GDP	0.75	National Accounts
λ	Access to financial markets	0.45	FinScope Malawi (2008)
κ	Aggregate interest semi-elasticity of money demand	0.07	Malawi Data
η	Elasticity of substitution	2	Adam <i>et al.</i> (2007)
ν_b	Measures international capital mobility	100000000	Berg <i>et al.</i> (2010)
κ_c	Share of consumption in GDP	0.80	Ngalawa <i>et al.</i> (2010)
κ_g	Share of government spending in GDP	0.24	IMF-Country Report
κ_A	Share of Aid in GDP	0.12	IMF-County Report
κ_m	Share of money in GDP (13.91%)	0.15	IMF-Country Report

Peiris and Saxegaard (2007) argue that Bayesian estimation technique allows the incorporation of prior based on theoretical or empirical knowledge through the specifications of prior distribution for the parameters to be estimated. Thus, some priors are chosen based on the convention of the main theoretical and empirical restrictions imposed on some parameters. Where there is little theoretical and empirical evidence, diffuse priors are employed. Specifically, for positive parameters, gamma distribution is assumed, beta distribution is chosen for parameters which vary between one and zero, all shocks carry an inverse gamma distribution with a mean of 0.10 and the rest have a normal distribution. For instance, empirical investigations show that most African countries do not set targets on interest rates (Berg *et al.* 2010). Thus, a simple Taylor rule is included with a standard ϕ_π equal to 1.5 as in Gali and Monacelli (2005). Assuming the prices are sticky for almost 4 quarters, we adopt the standard measure of nominal rigidities ζ as in Dagher *et al.* (2010). The choice of the rate of spending on aid and rate of drawing down accumulated reserves is based on the Uganda study which assumed persistent accumulation of reserves and an increase in aid having a short term life of less than six months. Access to financial markets represented by λ is based on FinScope Malawi (2008)



survey. The survey found that about 55% of the adult population of Malawi manage their lives without using any formal and informal financial products.

4.4.3 Estimation Results

Table 14 and plots in annex 8-10 provide visual representation of priors and estimations which were conducted in Dynare software Package using Matlab (Juillard, 2004). The estimates are only obtained from the baseline scenarios and are discussed in line with key findings by Bert *et al.* (2010), Peiris and Saxegaard (2007) and Tang and Vines (2007). The mode, means and the 5 and 95 percentiles of the posterior distribution of the parameters were obtained by the Metropolis-Hastings algorithm in Dynare. According to the plots, the data used is informative about the parameter estimates for the model. The Bayesian estimation method appears to deliver reasonable parameter estimates.

Table 14 also shows that the behaviour of the main parameters of the mean of the posterior distributions is typically relatively close to the mean of the prior assumption. However, there are few discrepancies that are worth discussing. The rate of drawing down reserves is estimated about 1.01 a bit higher than 1.00. These higher drawings are an indication in support of maintaining the fixed or managed exchange rate regime. This is also evident that the coefficient of fixed price is about 12.37 higher than the prior estimates. On the monetary policy reaction function, the estimated coefficient of the mean of the long-run coefficient to inflation 2.2 is relatively higher than the standard of 1.5. This implies that monetary authorities reacted to inflation pressures. The rate of spending is estimated at 0.95 and the coefficient of drawing down aid related deposits is about 0.59 lower than what was expected. In terms of exogenous shocks, data appears to provide informative data. The Taylor rule and government spending processes are estimated to be the most persistent with an AR (1) coefficient of 0.87 and 0.67, respectively. The mean of the standard error of the shock to the aid process is 0.12 less persistent than ones on government debt and reserves. This implies that most of the forecast error variances of the real variables are explained by government debt and reserves.


Table 14: Estimated Parameters of the Model

Parameters	Prior distribution			Posterior distribution			
	Density	Mean	Stdev	Mode	Mean	5 %	95 %
Structural Parameters							
ζ	gamma	12.000	1.000	12.317	12.374	10.872	13.889
λ	Beta	0.450	0.100	0.445	0.443	0.278	0.601
ε	gamma	0.900	0.100	0.889	0.896	0.727	1.062
ω	gamma	1.000	0.100	0.985	1.008	0.849	1.159
γ	gamma	1.000	0.100	0.941	0.950	0.798	1.105
φ_g	Beta	0.700	0.100	0.722	0.700	0.543	0.871
ϕ_π	normal	1.500	0.500	2.154	2.163	1.912	2.420
ρ_R	gamma	0.900	0.010	0.923	0.923	0.914	0.932
ρ_d	gamma	0.900	0.500	0.571	0.591	0.273	0.999
Shocks							
ρ_A	gamma	0.900	0.100	0.664	0.667	0.579	0.754
Rho1	Beta	0.500	0.100	0.500	0.499	0.332	0.670
Rho2	Beta	0.500	0.100	0.445	0.439	0.345	0.533
Rho3	Beta	0.500	0.100	0.889	0.873	0.815	0.933
Rho4	Beta	0.500	0.100	0.352	0.352	0.297	0.404
Rho5	Beta	0.500	0.100	0.286	0.296	0.194	0.394
Rho6	Beta	0.500	0.100	0.670	0.666	0.586	0.740
Rho7	Beta	0.500	0.100	0.356	0.357	0.300	0.418
Standard deviation of shocks							
eA	Invg	0.150	0.150	0.119	0.121	0.108	0.134
eS	Invg	0.150	0.150	0.086	0.149	0.045	0.258
eINFL	Invg	0.150	0.150	0.026	0.027	0.024	0.030
eI	Invg	0.150	0.150	0.095	0.097	0.083	0.111
eB	Invg	0.150	0.150	2.304	2.329	2.103	2.558
eC	Invg	0.150	0.150	0.144	0.149	0.124	0.173
eG	Invg	0.150	0.150	0.123	0.124	0.111	0.137
eR	Invg	0.150	0.150	1.642	1.662	1.500	1.834

4.5 Monetary Policy Response Options

After estimating the model, this section analyses the dynamic effects of positive aid shock on key macroeconomic variables under different monetary policy reactions including the Taylor rule, incomplete sterilisation and money growth based on the central bank balance sheet approach. The discussions are based on two main policy scenarios. The first scenario is when aid is fully spent and absorbed and the second is when aid is fully spent but not fully absorbed in a closed capital account. The section also examines the responses when all households are assumed optimising agents, under flexible prices, open capital account and government spend what the monetary authorities can absorb.



4.5.1 A Scenario When Aid is Completely Spent and Completely Absorbed

The baseline response of the shocks in the model variables when aid is completely spent and fully absorbed are summarised in Figure 18.²⁰ Under closed capital account with nominal rigidities, increased aid leads to increased government expenditures. The increased government expenditure especially on domestic goods induces demand on non-traded goods fuelling inflation pressures. Accordingly, the real exchange rate appreciates and creates a reallocation of resources from traded goods sector to domestic goods sector. The latter happens only when the foreign exchange realised from aid induces an increase in net imports also called absorption. This implies that consumption expands for a given output level. However, the increase in the overall output will depend upon the net effect of appreciation in the traded and non-traded sector. In this situation, the increase in non-traded inflation is minimal and thus the effects on output are almost negative. The deflation in the traded sector leads to CPI inflation decreases and real interest rates remain unchanged.

The study also modifies the Taylor rule in the baseline as in Berg *et al.* (2010) to accommodate the incomplete sterilisation mechanism. Sterilisation in this case means that the monetary authorities are not selling the aid-related foreign exchange through open market operations but accumulating reserves. By accumulating reserves with foreign exchange means that the reserves are financed by money stock and on the assumption that an increase in reserves do not lead to an increase in government debt outstanding. Based on these assumptions the modified Taylor rule becomes $\hat{r}_t = \phi_\pi \hat{\pi}_t^N - \frac{1-E}{k_m \vartheta} (\hat{R}_t - \hat{R}_{t-1})$ where E is the degree of sterilisation and is between zero and one. However, the level of E depends on the share of base money k_m and the coefficient of nominal interest rate ϑ in the estimated demand function.²¹ In addition, Mangani (2011) observed that the implementation of monetary policy in Malawi is based on setting operational targets on monetary aggregates. Following this pertinent observation, the study also modify the simple Taylor rule as was done in Berg *et al.* (2010) on Uganda study.²² The variant Taylor rule used is $\hat{r}_t = \frac{1+\phi_m^m}{\vartheta} \hat{\pi}_t + \frac{1}{\vartheta} (\hat{c}_t - \hat{c}_{t-1}) + \hat{r}_{t-1}$. In simple terms, interest rates increases when consumption

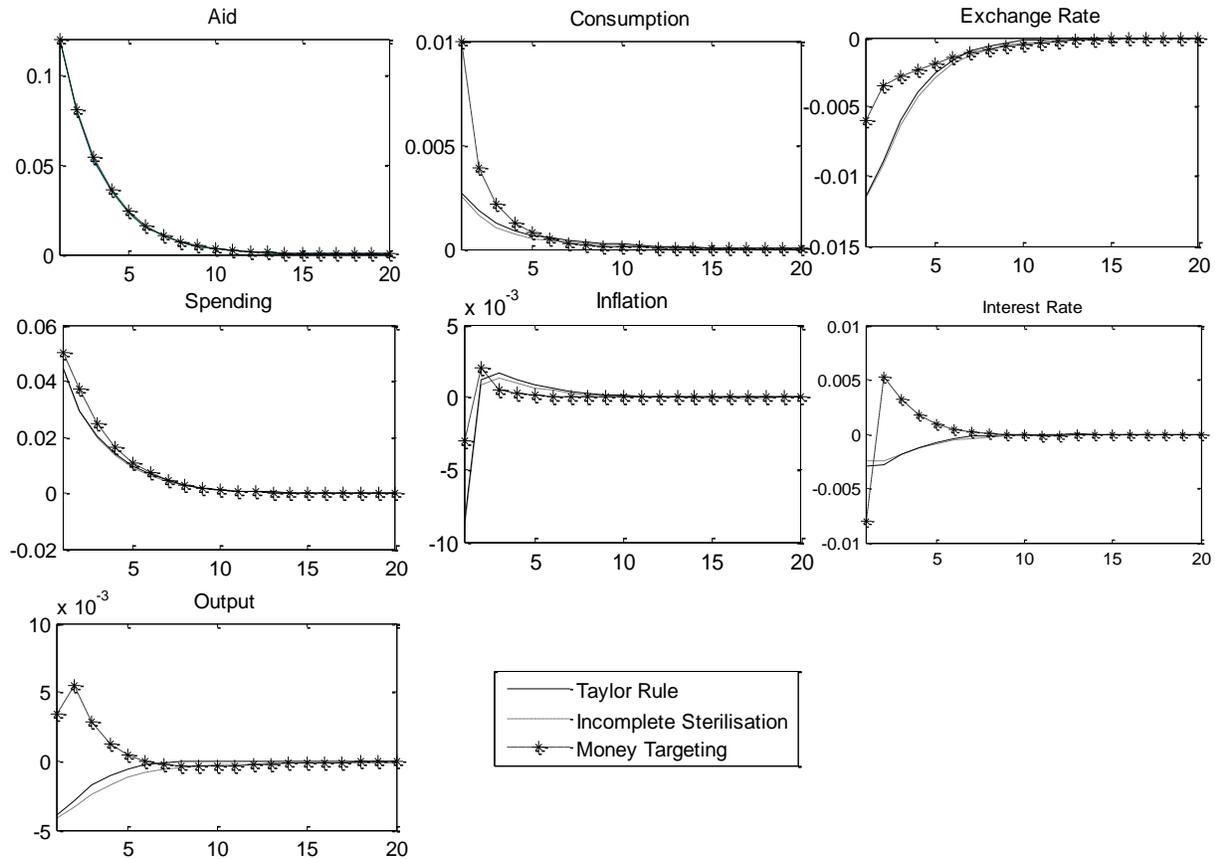
²⁰The current account deficit equation $\widehat{ca}_t = k_A \left((1 + \phi) \hat{s}_t + \hat{A}_t - \hat{y}_t \right) - (\hat{R}_t - \hat{R}_{t-1})$ is also included in the estimations (Berg *et al.*, 2010).

²¹ See Berg *et al.* (2010) for derivation of the parameters of this modified Taylor rule.

²² See Berg *et al.* (2010) for full derivation of the modified Taylor rule.

growth increases with coefficient of past interest rates equal one. When the two variant Taylor rules are compared with the base line in Figure 18, the monetary policy response between the simple Taylor rule and incomplete sterilisation are almost similar. However, responses under money targeting results in minimal appreciation of the exchange rate. Real interests are slightly higher because of domestic inflation pressures.

Figure 18: Response to Aid Shock - Aid Fully Spent and Fully Absorbed



4.5.2 A Scenario When Aid is Completely Spent but Not Absorbed

Based on the discussions from section 4.2, impulse responses to aid shock presented in Figure 19 describes a situation whereby Malawi completely spent aid but failed to absorb the increased aid in a closed capital account. Specifically, the government increased expenditures but the RBM did not sell the foreign exchange required to finance additional net imports. In this scenario, the real exchange rate depreciates in the short run resulting from the larger supply of local currency pushing up the prices of foreign exchange. The lack of sales of foreign exchange to mop up the

increased liquidity also leads to increases in money supply which fuels inflation pressures. In order to counter inflation pressures, the monetary authorities react through sterilisation and inducing more private sector participation in the purchase of domestic bonds leading to real interest rate increase.

Figure 19: Response to Aid Shock - Aid Fully Spent and Not Absorbed

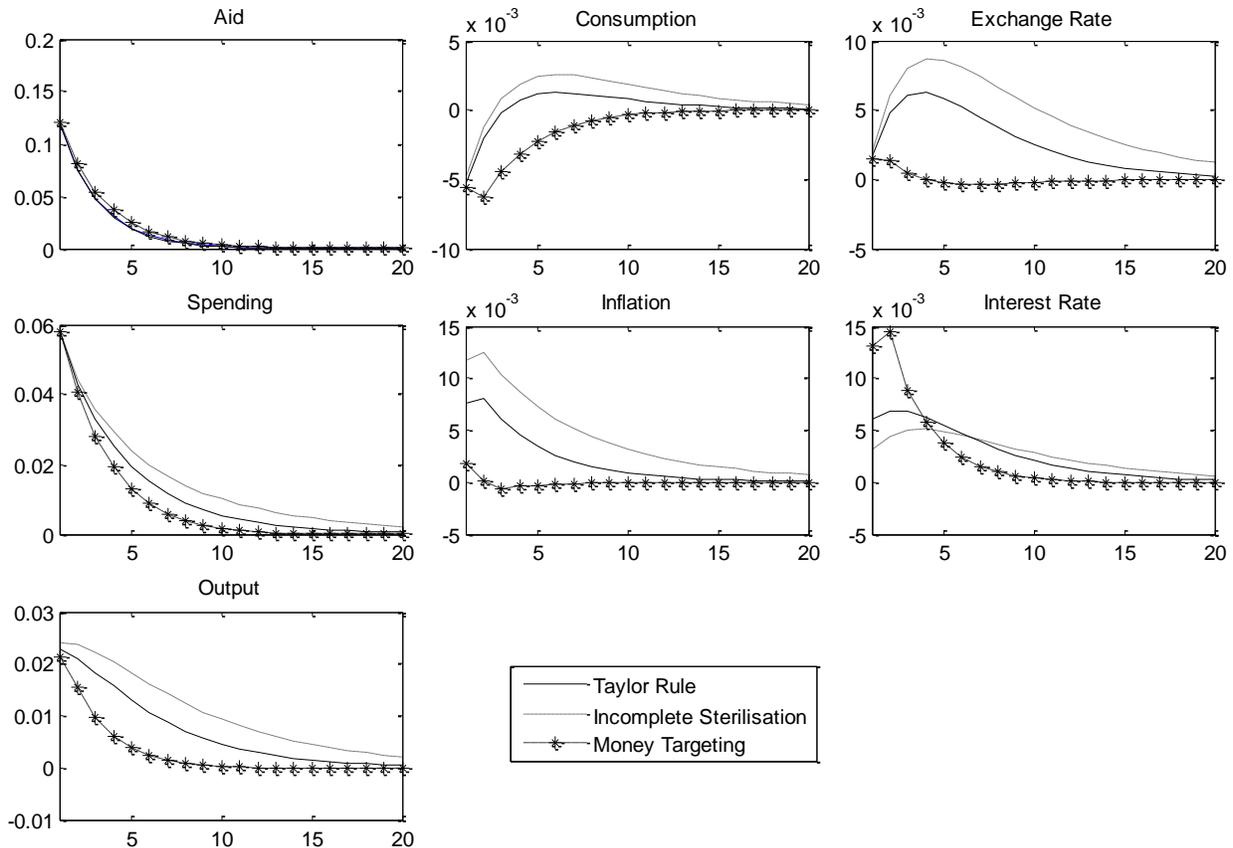


Figure 19 also illustrates the performance among the three monetary policy rules including Taylor rule, incomplete sterilisation and money targeting. We compare monetary policy alternative rules in terms of their implications for inflation, real exchange rate and real output. Larger depreciation of the exchange rate and output are observed under the incomplete sterilisation rule emanating from increased demand pressures. In particular, significant private consumption is crowded out which comes at the cost of using increased aid resources twice. The realised foreign exchange value of increased aid resources are used to accumulate reserves and at the same time the equivalent domestic currency counterpart are used to increase government spending. Real interest rates also increase responding to CPI higher inflation. The impact on



inflation is smaller under money targeting with lower real output when compared with other policy rules because the inflation remains well fixed by the presence of the lagged interest rate in the policy rule (when increased aid is fully spent and not absorbed). Berg *et al.* (2010), however, argue that this does not mean the superiority of money targeting policy to the simple interest rate rule. Arguments are based on what Woodford (1999) found that fixing the role of lagged interest rate is not specific to money targeting but is instead a general property of optimal rules. Furthermore, these studies argue that money targeting is subject to the instability and volatility of money demand.

4.6 Sensitivity Analysis

The model is also cross examined in Annex 6 and 7 by relaxing different assumptions. Specifically, this section analyses how several features of the model affect the impact of aid inflows and how these effects vary. The results from the standard Taylor rule case are compared with four variations including only excluding non-asset holders, using flexible prices, open capital account and spending what can be absorbed assumptions.

First, the study assumes that the non-asset holders fall from 55 percent to 0 percent. The monetary policy response varies when aid received is fully absorbed or not. In the situation whereby the aid is fully absorbed, the results are almost similar to the baseline (Taylor rule) despite having different magnitudes. However, the results changes when the aid is not fully absorbed. The demand pressures become smaller and the real exchange rate slightly appreciates when compared with bigger depreciation in the Malawi scenario. This entails that the presence of non-asset holders amplifies demand pressures and the effects are larger than when we have many households who are non-optimising agents.

Second, simulations under sticky prices are similar to the flexible price counter-part of no reserve accumulation. However, the performance under flexible price is different from the fixed price scenario when aid is fully spent and not absorbed (see Annex 7). It is observed that output and inflation increases with small exchange rate appreciation under flexible price but lower than the baseline scenario. The outcome contradicts with what Bert *et al.* (2010) found on Uganda and is consistent with the reality whereby the exchange rate was believed to be overvalued and



deliberately kept stable against macroeconomic conditions prevailing in the country (Munthali *et al.*, 2010).

Third, in the case of open capital account, a small value of capital mobility ($v_b = 0.0125$) is assumed. When all aid is fully absorbed, adjustments entails significantly more increase in domestic relative prices, while the annualised interest rate increases. However, appreciation of exchange rate is smaller when compared with the baseline scenario. Other impacts on inflation and real interest rate are smaller under less aid absorption. With open account, the private sector's consumption is less pro-cyclical as it can now smooth more efficiently over temporary aid flow by indirectly accumulating net foreign assets via bond market. In case of reserve accumulation, opening the capital account will allow capital inflows when the private sector borrows from the rest of the world.

Last, attempts have also been made to cross check the impulse response in terms of spending only what the monetary authorities can manage to absorb. In this case, we assume that 0.5 of increased aid is initially spent and the same 0.5 is fully absorbed by RBM. Annex 7 shows that minimal exchange rate appreciation which remains flatter over time can be observed. There are also minimal changes in inflation and interest with high consumption and income under this scenario. However, the interpretation of these results should be taken cautiously because variations of the coefficients also depend upon the combination of other variables. In addition, the choice of this option is in violation with donor agreements and government who would like to see that aid is immediately and fully spent for accountability purposes.

4.7 Conclusion

Generally the estimation results are robust in the numerical posterior kernel maximisation and the convergence of the MH algorithm. Information about many parameters seems to be well explained by the actual data. Specifically, the parameter estimates of interest are mostly in line with what is found in the literature and trends in most macroeconomic variables in Malawi. However, worth noting is the estimated coefficient of inflation in the Phillips curve which is higher than what was found by Peiris and Saxegaard (2007) on Mozambique. This finding provides evidence that monetary authorities reacts to aid inflows in Malawi as most of the



foreign exchange realised were not immediately fully sterilised. In addition, the study reveals that other exogenous shocks such as exchange rate and government spending are driving the Malawi business economic fluctuations.

Results of the simulations demonstrate that the monetary policy intervention arises depending upon the impact of aid on domestic financing requirement. According to the findings in the baselines, fully spending and fully absorbing aid received produces smooth adjustments with a modest impact on macroeconomic variables. Specifically, spending all the received aid and aligning foreign exchange sales with the fiscal absorption of aid yields less impacts on interest rate and inflation. This is an ideal situation that government and donors would like to implement. However, the aids fully spend and fully absorbed scenario is associated with real appreciation of exchange rate, threatening the competitiveness of the export sector that may be critical to the long-run economic growth.

Nevertheless, the Malawi scenario fully spending and not absorbing aid received shows that aid inflows appear to be associated with depreciations of the exchange rate than the expected real appreciation in contrast to what Peiris and Saxegaard (2007) found in Mozambique. In particular, it is observed that the impact of increased aid inflows produces inflation and interest rate pressure on the economy. When we compare the performance of various monetary instruments, the impact of aid inflows on depreciation and inflation are much smaller when monetary authorities indulge in money targeting other than following the Taylor rule and incomplete sterilisation on the expense of lower real output growth. The result of depreciated exchange rate is similar to what was found in Uganda by Berg *et al.* (2010), in Ghana by Sackey 2001 and in Tanzania by Nyoni (1998), though the latter two used different methodologies.

Based on Berg *et al.* (2010) observations, this paper would have concluded that RBM deliberately limited the absorption of the increased aid because of the fear of real appreciation of the exchange rate and monetary authorities were accumulating foreign reserves. However, the country experienced a decline in the already low level of international reserves. As discussed in several IMF country reviews, the management of exchange rate was not in tandem with the prevailing macroeconomic conditions experienced during the aid surge. This may have



contributed to the puzzle of short-run monetary policy effects coming out from the management of aid increases.

Simulations also show that scaling up of foreign aid requires strong absorption capacity on the part of RBM but in support with proper fiscal policy decisions. Though with caution, it would be suggestive for RBM to only convert the aid related foreign exchange in line with what government is supposed to spend at a particular time. The unsterilized aid should be kept in the foreign denominated account as a buffer until government needs arises. This will cushion pressure on the part of RBM from sterilisation so that the private sector is not crowded out. In essence, this will require heavy lobbying and commitment on the part of government with development partners.

The paper also shows that the implications of increased aid inflows become more prominent in an economy comprising of few economic agents having access to financial assets. This calls for a need to refocus on improving or developing a vibrant financial sector that will allow households having more access to financial assets. In addition, other facilities such as opening the capital account and non-interference in prices will cement the proper conduct of monetary policy in Malawi. The study particularly shows that the impacts are dampened when the economy is open with minimal controls over prices.

4.8 Appendix

Annex 3: The Log-Linear Model

Following the methodology by Gali *et al.* (2007) and full version derived in Berg *et al.* (2010), the solutions of the general model is represented as a log-linear approximation around the steady state. The lower cases with hats represent log-deviations from the steady state ($\hat{x}_t \equiv \log X_t / X$), otherwise indicates changes in % of steady states. The derived solutions of some log-linear versions are a combination of set of equations and only key equations are included in this section.

In steady state as in Berg *et al.* (2010), stock variables b^c, d^g, R , and f are set equal to zero. The productivity parameter in the non-traded good Z^N and traded good sector Z^T and the labour disutility h are set as follows:

$$Z^N = \delta^{1-\alpha}; Z^T = (1-\delta)^{1-\alpha}; h = \frac{\alpha}{k_c}.$$

δ is the share of non-traded good sector in GDP and k_i is the share of variable i in GDP. Other constraints regarding solving problems of distortions in monopolistic completion, non-traded equilibrium and the balance of payments are set as follows:

$$\iota = \frac{1}{\theta-1}; \delta = \varphi k_c + \varphi_g k_g; 1 - \delta = (1 - \varphi)k_c + (1 - \varphi_g)k_g - k_A$$

Home bias in consumption ξ and home bias in production relative to consumption ϕ are set as:

$$\xi = \frac{1-\varphi}{\varphi} > 0; \text{ and } \phi = \delta\xi - (1 - \delta) = k_A + \xi k_g \left[\varphi_g - (1 - \varphi_g) \frac{1}{\xi} \right] > 0$$

where ξ measures home bias in consumption. The share of aid is related to ϕ and the share of government spending on non-traded good φ_g . This study is limited to where $\phi > 0$ so that home bias in production is larger than home bias in consumption.

The Consumer Price Index (CPI) is derived from equation 10:



$$\hat{p}_t^N = -\xi \hat{s}_t; \quad \text{where } \xi = \frac{1-\varphi}{\varphi} \quad (\text{A1})$$

The real GDP is derived by combining the log-linear equations 16 and 20:

$$\hat{y}_t = \alpha \hat{l}_t \quad (\text{A2})$$

The labour supply is obtained by combining the log-linear equations 6 and 8:

$$\hat{y}_t = \frac{\alpha}{\psi} \left(\hat{w}_t - \frac{1}{\eta} \hat{c}_t \right) \quad (\text{A3})$$

The interest rate parity is derived by combining the log-linear equations of 3 and 4:

$$\hat{i}_t = E_t(\hat{s}_{t+1}) - \hat{s}_t + \hat{\pi}_{t+1} - v_f \hat{f}_t + e_t^s \quad (\text{A4})$$

where $v_f = \frac{v}{\lambda}$ is the coefficient of portfolio adjustment costs as in Berg et al. (2010).

The consumption Euler equation is obtained by combining the log-linear equations of 3, 7, and 8:

$$\hat{c}_t = E_t(\hat{c}_{t+1}) - b_2(\hat{i}_t - \pi_{t+1}) + b_3\{\hat{y}_t - E_t(\hat{y}_{t+1})\} + e_t^c \quad (\text{A5})$$

where $b_2 = \frac{\lambda\eta(k_c\psi - \alpha\eta^{-1})}{k_c\psi + \alpha - (1-\lambda)\alpha(1-\psi)}$; $b_3 = \frac{(1-\lambda)\alpha\psi(1+\psi)}{k_c\psi + \alpha - (1-\lambda)\alpha(1-\psi)}$; k_c is the share of consumption in GDP at the steady state.

The new-Keynesian Phillips curve is derived from equation 19:

$$\hat{\pi}_t^N = \beta E_t(\hat{\pi}_{t+1}^N) - \frac{1}{\xi} \hat{u}_t^N + e_t^\pi \quad (\text{A6})$$

where $\hat{u}_t^N = -\left(\frac{1-\alpha}{\alpha}\right)\hat{y}_t^N - \hat{w}_t - \xi \hat{s}_t$ is % change in the mark-up in the non-traded sector.

CPI inflation is obtained by deriving equation 17:

$$\hat{\pi}_t^N = \hat{\pi}_t - \xi(\hat{s}_t - \hat{s}_{t-1}) \quad (\text{A7})$$

The supply of traded goods is obtained from equation 22:

$$\hat{y}_t^T = -\frac{\alpha}{1-\alpha}(\hat{w}_t - \hat{s}_t) \quad (\text{A8})$$

Government total spending is obtained by combining log-linear equations of 12, 23, 24 and 25:

$$k_g \hat{g}_t = \phi \hat{s}_t + \gamma k_A \hat{A}_t + (1 - \rho_d) \hat{d}_{t-1} - \left(\frac{1}{\beta} - 1 + \varsigma\right) b_{t-1}^p + e_t^g \quad (A9)$$

The government deposit is obtained by taking log-linear equations 24:

$$\hat{d}_t = \rho_d \hat{d}_{t-1} + (1 - \gamma) k_A \hat{A}_t \quad (A10)$$

The simple Taylor rule is obtained by taking the log-linear of equation 28:

$$\hat{i}_t = \phi_\pi \hat{\pi}_t^N + e_t^i \quad (A11)$$

The reserve accumulation rule is derived from 27:

$$\hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \omega) \hat{A}_t + e_t^R \quad (A12)$$

The government debt is derived from equation 24 and 26:

$$\hat{b}_t^p = -km(m_t - m_{t-1} + \pi_t) + (\hat{R}_t - \hat{R}_{t-1}) - (\hat{d}_t - \hat{d}_{t-1}) + (1 - \varsigma) \hat{b}_{t-1}^p + e_t^b \quad (A13)$$

The labour market equilibrium is derived from equation 31 and labour demands in each sector and labour supply.

$$\hat{w}_t = \frac{1-\alpha}{\eta(1-\alpha+\psi)} \hat{c}_t - \frac{\psi\phi}{1-\alpha+\psi} \hat{s}_t - \frac{\delta\psi}{(1-\alpha+\psi)} \hat{u}_t^N \quad (A14)$$

The output level consistent with the equilibrium labour market is:

$$\hat{y}_t = -\left(\frac{1-\alpha+\psi}{\alpha}\right) \left(\frac{1}{\eta} \hat{c}_t + \phi \hat{s}_t + \delta \hat{u}_t^N\right) \quad (A15)$$

Internal balance explaining behaviour of exchange rate is derived by combining demand for non-traded goods $\hat{c}_t^N = \hat{c}_t + (1 - \varphi)\chi \hat{s}_t$, government spending on non-traded goods $\hat{g}_t^N = \hat{g}_t$ and supply into equation 31.

$$\hat{s}_t = -\varepsilon_w \hat{w}_t - \varepsilon_c \hat{c}_t - \varepsilon_A \hat{A}_t - \varepsilon_d \hat{d}_{t-1} + \varepsilon_b \hat{b}_{t-1}^c - \varepsilon_u \hat{u}_t \quad (A16)$$

where $z_w = z_u = \frac{\alpha\delta}{(1-\alpha)E}$, $z_c = \frac{\varphi k_c}{E}$, $z_A = \frac{\gamma\varphi g k_A}{E}$, $z_d = \frac{\varphi g(1-\rho d)}{E}$, $z_b = \frac{\varphi g}{E} \left(\frac{1}{\beta} - 1 + \varsigma \right)$, and $z = (1 - \varphi)k_c\chi + \varphi_g\phi + \delta\xi\left(\frac{\alpha}{1-\alpha}\right)$.

External balance explaining the behaviour of exchange rate is derived by combining demand for traded goods $\hat{c}_t^T = \hat{c}_t + (1 - \varphi)\chi\hat{s}_t$, government spending on traded goods $\hat{g}_t^T = \hat{g}_t$ and supply into equation 32.

$$\hat{s}_t = x_w\hat{w}_t + x_c\hat{c}_t + x_d\hat{d}_{t-1} - x_f\left(\hat{f}_t - \frac{1}{\beta}f_{t-1}\right) - x_A\hat{A}_t - x_R\hat{R}_{t-1} - x_b\hat{b}_{t-1}^c \quad (A17)$$

where $x_w = \frac{\alpha(1-\delta)}{(1-\alpha)\mathcal{H}}$, $x_c = \frac{(1-\varphi)k_c}{\mathcal{H}}$, $x_A = \frac{k_A\{\omega - (1-\varphi_g)\gamma\}}{\mathcal{H}}$, $x_R = \frac{1-\rho R}{\mathcal{H}}$, $x_f = \frac{1}{\mathcal{H}}$, $x_d = \varepsilon_{d\mathcal{H}}^E$, $x_b = \varepsilon_{b\mathcal{H}}^E$, and $\mathcal{H} = (1 - \varphi)k_c\chi - (1 - \varphi_g)\phi + \frac{\alpha(1-\delta)}{1-\alpha}$.

Annex 4: The Import Demand Function Based on Aydem et al. (2004)

The elasticity of substitution is estimated using the following import demand function:

$$\ln Z_t = a_1 + a_2 \ln Y_t + a_3 \ln \left(\frac{PZ}{PD} \right)_t + \mu_t$$

Where Z_t is the quantity of imports, PZ is the import price, PD is the domestic price level, Y_t is GDP and μ_t is the error term. The parameter representing the elasticity of import demand is a_3 .

Annex 5: The Money Demand Function

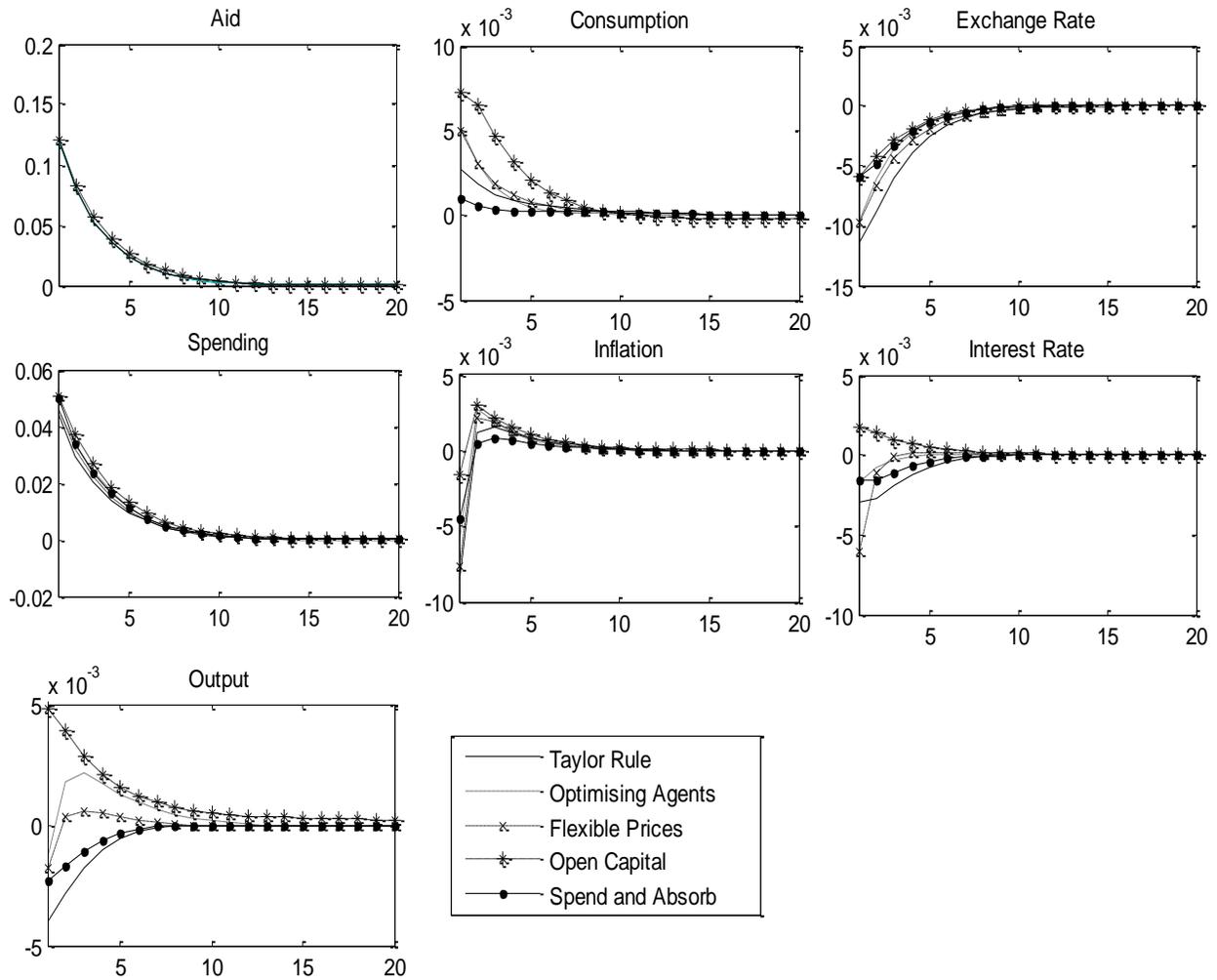
The calibration of the aggregate interest semi-elasticity of money demand is based on an OLS regression of nominal money balances on nominal interest rates and nominal output.

$$\ln M_t = b_1 + b_2 \ln i_t + b_3 \ln Y_t + \mu_t$$

Where M_t is the nominal money balances (M2), i_t is nominal interest rates, Y_t is the nominal output (GDP). b_2 represents the aggregate interest semi-elasticity of money demand.

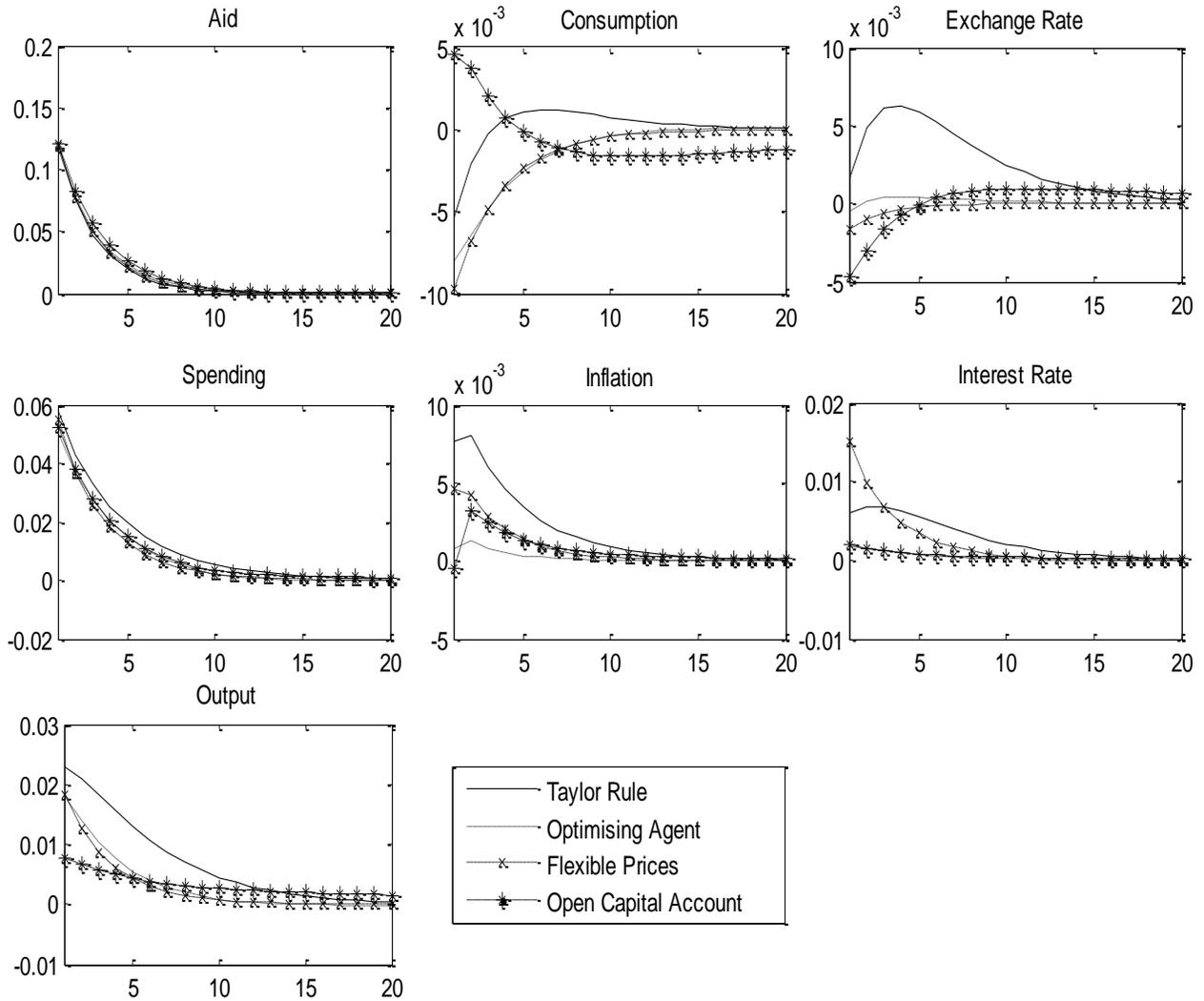


Annex 6: Robust Check Response to Aid Shock - Aid Fully Spent and Absorbed



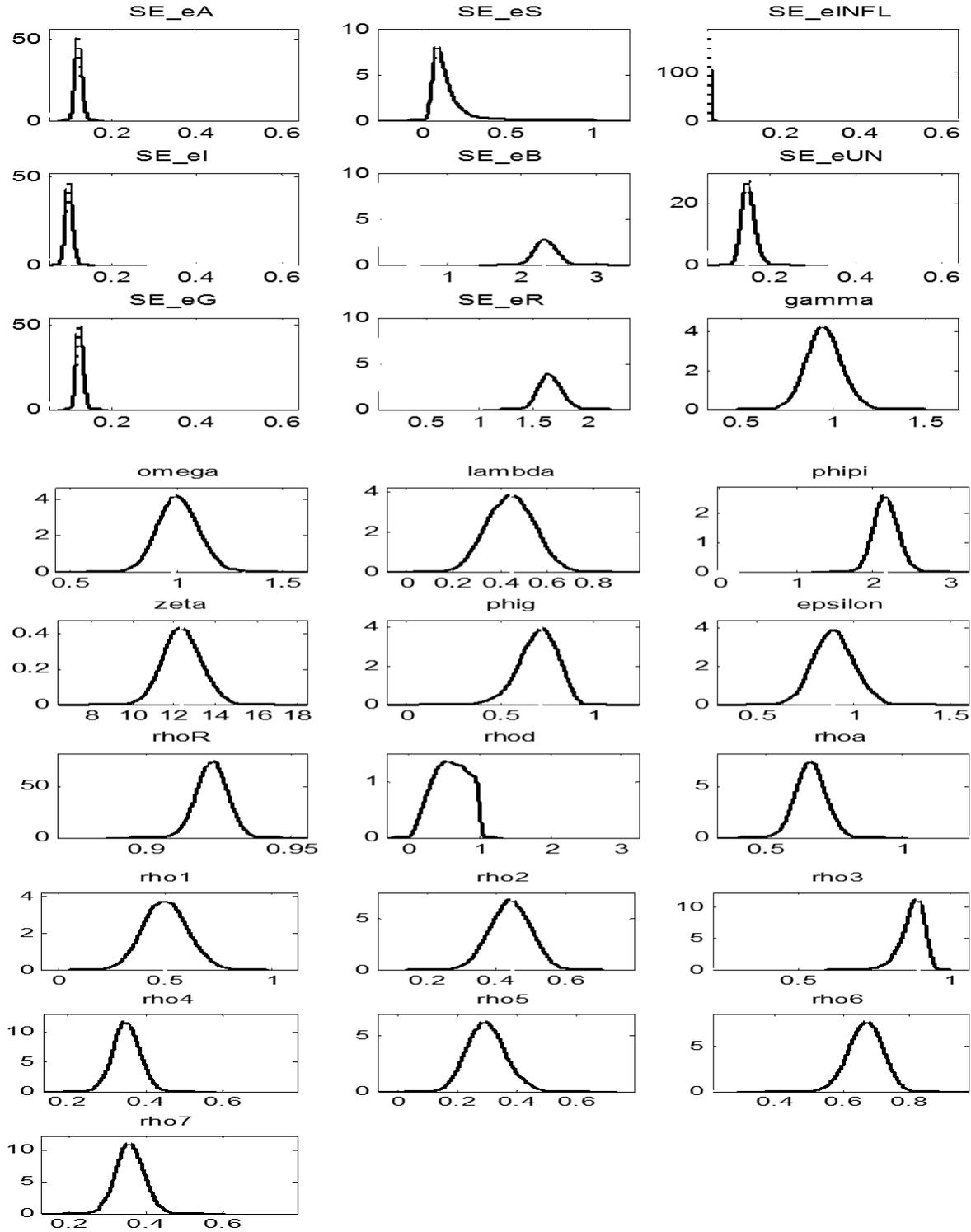


Annex 7: Robust Check Response to Aid Shock - Aid Fully Spent and Fully Absorbed



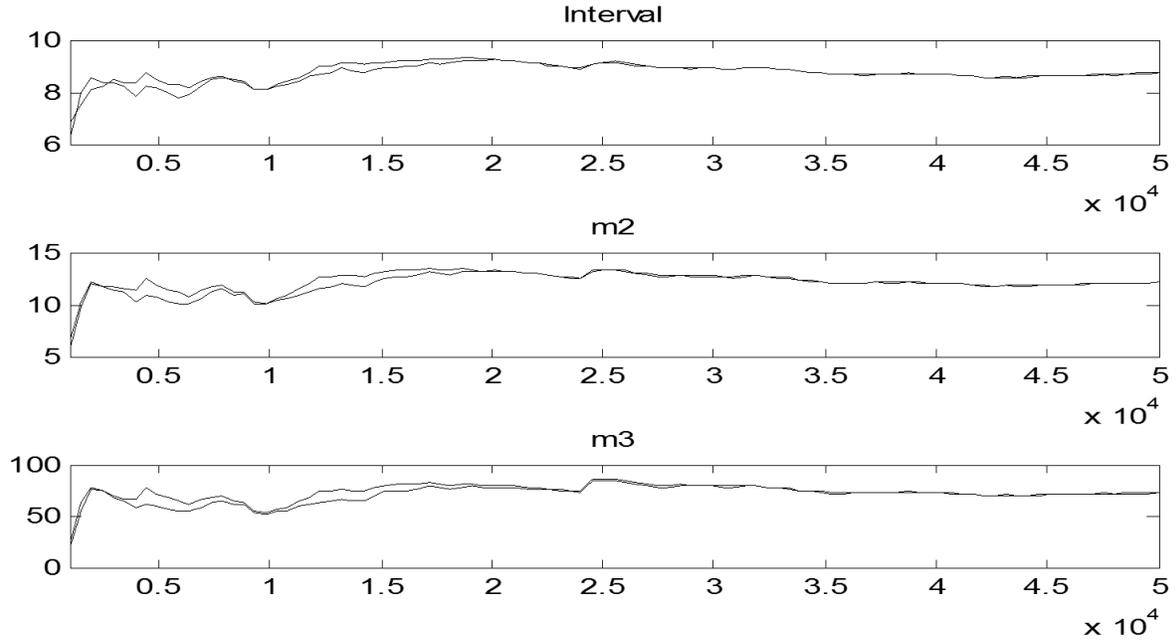


Annex 8: Prior and Posterior Distributions

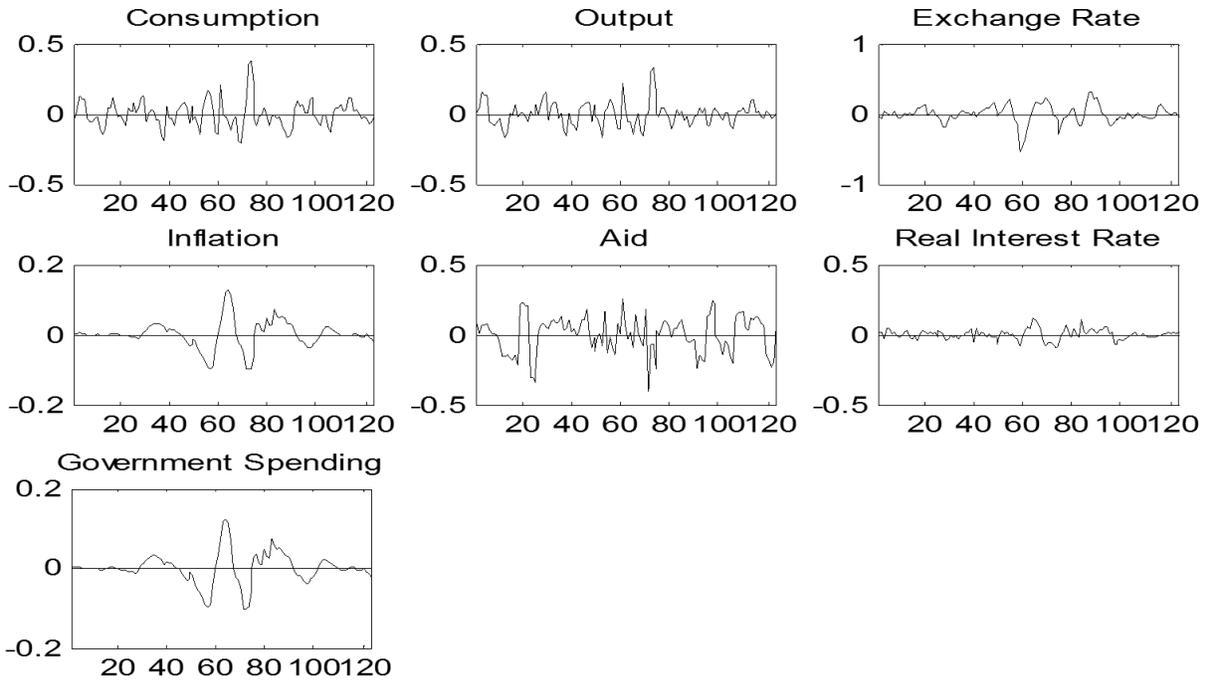




Annex 9: Multivariate MH Convergence Diagnosis



Annex 10: HP Filtered Actual Data





Chapter 5

Conclusion

Macroeconomic reforms in 1980s and 1990s, particularly in the financial sector made tremendous changes in Malawi's key macroeconomic variables. The level of real interest rates and credit to the private sector declined during the liberalization period inconsistent with the expected increases. This culminated in reduction of savings and an increase in household consumption. Despite these reforms, the financial sector still remains underdeveloped with high cost of intermediation. The country also experienced high inflation rates which contributed negatively to interest rates returns. On the other hand, the reforms enhanced large aid inflows aimed at supporting government operations. All these changes in the macroeconomic variables had significant influence in the conduct of fiscal and monetary policy and impacted on price stability and economic growth in Malawi.

Therefore, the thesis investigated the effects of macroeconomic reforms on consumption behavior, monetary policy and aid inflows on the Malawian economy. To carry out this investigation the thesis looked at three questions. The first question was to found out whether the reforms affected the consumption pattern in Malawi. The second question looked at how the effects of the reforms on economic activities can change over time. The third question investigated how monetary policy responds to changes in the economic activities. To answer these questions, household consumption and foreign aid were chosen as measures of economic activities because consumption forms a large share of GDP and Malawi depends heavily on aid inflows which increased during the reform period. Large aid inflows have implications on appreciation and depreciation of exchange rate which are detrimental to economic growth and price stability. In order to assess the changes in the effects of the reforms, we use the monetary transmission mechanism because it is now becoming clear that the reforms can alter both the transmission and the channels overtime.



Using the IV-TSLS approach, the PIH does not hold in Malawi. Most consumers are current income consumers (rule-of-thumb). They consume from “hand to mouth” and very little is left to smooth consumption in their life time. The reforms did not shift current income consumers to permanent income consumers. Empirical evidence from the thesis shows that the main failure of the PIH hypothesis is due to liquidity constraint which is manifested in the under development of the financial market and unstable macroeconomic conditions in Malawi. Weak financial institutions, both structural and operational have impacted negatively on the accessibility of financial resources for most Malawians despite the reforms. This is a bigger lesson for policy makers to consider in the preparation of future broad based financial reforms.

Changes in the effects of the reforms and their delayed impacts on economic activities were investigated using the Bayesian TVP-VAR model with stochastic volatility. This method was chosen because it accommodates issues of heteroskedasticity of the parameters and variances of shocks. The method also shows visually exactly when the reforms had impact on the economic activities. Using the monetary transmission mechanism, it was found that changes in monetary policy changed the transmission mechanism markedly and the impact on prices and output varied over time. Importantly, beginning mid-2000, the monetary transmission performed consistently with prediction of economic theory and there is no evidence of price puzzles as found in the previous literature on Malawi. During this period, there were positive developments in the financial sector characterised by low cost of intermediation with stable inflation and exchange rate. Coupled with good rains and input subsidy programme, economic growth also improved.

The reaction of monetary authorities to foreign aid inflows was analysed using the Bayesian DSGE model. In this analysis, the Bayesian DSGE model was developed and estimated to account for the short-run monetary response to aid inflows in Malawi between 1980 and 2010. The model incorporated the rational expectations of economic agents based on micro foundations. The estimated model showed that monetary authorities reacted to foreign aid inflows. Based on how aid was spent and absorbed in Malawi, aid inflows appeared to be associated with depreciations of the exchange rate rather than the expected real appreciation. On the other hand, the thesis found that the implication of increased aid inflows became more prominent in an economy comprising of few economic agents having access to financial assets.



Furthermore, the monetary policy responses are much clear consistent with economic theory in a market with less controls over prices and open capital account.

The thesis contributes to the current state of knowledge on the effects of macroeconomic reforms on economic activities in Sub-Saharan Africa in general and Malawi in particular. Particularly, the thesis enhances the understanding of the effects of macroeconomic reforms on consumption, evolution of monetary policy overtime and the impact of aid inflows on the conduct of monetary policy in Malawi in ways that have not been done before. First, to the best of our knowledge this is the only thesis that looks into how the consumption pattern and evolution of monetary transmission changed overtime following the implementation of financial reforms. The thesis also examines how the monetary policy responded to foreign aid during and after adopting the reforms in Malawi. Furthermore, the research uses multivariate econometric models in an attempt to capture both the dynamics of time series data and the relationship among key macroeconomic variables. The thesis attempts to address issues such as inconsistent estimates, misspecifications and identification, and endogeneity problems that may have affected previous empirical work on the macroeconomic effects on consumption, transmission mechanism and aid inflows.

Nevertheless, there were some limitations encountered in this study. Real data such as GDP and consumption are compiled annually in Malawi. However, the models in this thesis use quarterly data. Hence GDP, aid and household consumption data were interpolated using annual data to obtain quarterly series estimated using indices of seasonally adjusted money series (M1). This may have implications on the dynamics of time series data and may not be reflective of the changes in the particular interpolated variable. Furthermore, the Bayesian methods in the TVP-VAR model and DSGE models required choice of priors that reflected the model economy of Malawi. Due to limited research in this study on Malawi, the thesis used some priors from the literature from other African countries which might not be reflective of different experiences of Malawi business cycle.

The thesis has set as an eye opener for new avenue of research in Malawi. The thesis shows that there were dramatic turnarounds of economic events with increased economic growth, credit resurgence, decreased aggregate consumption and increased savings after 2006. It would be



interesting to model the uncertainties or factors that affected consumption and savings apart from the delayed effects of financial reforms. In addition, the developed Bayesian DSGE model for Malawi can be extended to consider the impact of increased aid on the real sector (e.g. investment) and incorporate the full behaviour of the labour market. It would also be interesting to estimate the effects of other inflows including private capital inflows, remittances, commodity earnings from tobacco and proceeds realised from new uranium mining on Malawi economy. Depending on the data availability, issues of heterogeneity of aid whether loans and grants, budget support and project support are also important for future research. Lastly, the thesis concentrated on the monetary policy responses. It would be relevant to incorporate the fiscal policy responses in future work.



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