RELATIVE EFFECTIVENESS OF MONETARY AND FISCAL POLICIES IN MACROECONOMIC STABILIZATION IN A DEVELOPING AND POST CONFLICT ECONOMY: THE CASE OF RWANDA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

To mémé

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LIST OF ABBREVIATIONS

AD	Aggregate Demand
ADF	Augmented Dickey-Fuller
AFPT	Armed Forces Personnel Total
AIC	Akaike Information Criterion
AMIS	African Union Mission in Sudan
ATMs	Automatic Teller Machines
AU	African Union
BCB	Basel Committee Benchmark
BCPS	Bank credit to private sector
BNPL	Banks Non-Performing Loans
BNR	National Bank of Rwanda
BVAR	Bayesian Vector Auto-Regression
CAC	Central American Countries
CAR	Capital Adequacy Ratio
CB	Central Bank
CBK	Central Bank of Kenya
CEE	Central Eastern Europe
CET	Common External Tariff
CIP	Crop Intensification Programme
CPI	Consumer Price Index
DGE	Dynamic General Equilibrium
DLM	Distributed Lag Model
DMFS	Debt Management Facility Strategy
DRC	Democratic Republic of Congo
DSA	Debt Sustainability Analysis

DSGE	Dynamic Stochastic General Equilibrium
DT	Direct Tax
DUN	Dummy variable for United Nations payment to Rwanda
EAC	East African Community
EDPRS2	Second Economic Development and Poverty Reduction Strategy
ERGR	Exchange Rate Growth
ETR	Electronic Tax Registers
FARG	Genocide Survivors Assistance Fund
FPE	Final Prediction Error
FTEI	Fast Track Education Initiative
GBC	Government Budget Constraint
GDP	Gross Domestic Product
GEXP	Government Expenditure (or Government spending)
GFCFPS	Gross Fixed Capital Formation for Private Sector
GNP	Gross National Product
GoR	Government of Rwanda
HQ	Hannan-Quin
IDP	Internally Displaced Persons
IMF	International Monetary Fund
INTBR	Interbank interest rate
IRF	Impulse response function
IS-LM	Investment-Saving and Liquidity preference-Money supply
KPSS	Kwiatkowski-Philips-Schmidt-Shin
KRR	Key Repo Rate
LDC	Least Developing Countries
LIC	Low Income Country
M3	Broad money (M3)

M3	Money Stock
MINECOFIN	Ministry of Finance and Economic Planning
MINUSTAH	United Nations Stabilization Mission in Haiti
MONUC	United Nations Organization Mission in the Democratic Republic of Congo
MPC	Monetary Policy Committee
MPTM	Monetary Policy Transmission Mechanism
MTM	Monetary Transmission Mechanism
NEC	New Economic Consensus
NEER	Nominal Effective Exchange Rate
NGDP	Nominal Gross Domestic Product
NK	New Keynesian
NODA	Net Official Development Assistance
NPLs	Non-performing loans
NTR	Net Tax Revenues
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
OMO	Open Market Operations
PCONS	Private Consumption
PFM	Public Financial Management
PP	Philips-Perron
PSI	Policy Support Instrument
QMS	Quadratic Match Sum
RDB	Rwanda Development Board
RET	Ricardian Equivalence Theorem
RGDP	Real Gross Domestic Product
RIPA	Rwanda Investment Promotion Agency

RMA	Rwanda Meteorology Agency
RR	Republic of Rwanda
RRA	Rwanda Revenue Authority
RWF	Rwandan Franc
SACCOs	Savings and Credit Co-operatives
SAP	Structural Adjustment Programme
SC	Schwarz Bayesian Criterion
SDGE	Stochastic Dynamic General Equilibrium
SEE	South Eastern Europe
SSA	Sub-Saharan Africa
SVAR	Structural Vector Auto Regression
T/PCC	Troop and Police Contributing Country
Tax Rev	Tax Revenue
TB	Treasury Bills
TGL	Total Gross Loans
TGR	Total Grant
TGS	Taxes on Goods and Services
TIT	Taxes on International Trade
TTR	Total Tax Revenue
U.S.	United States
UN	United Nations
UNDP	United Nations Development Programme
UNIOGBIS	United Nations Integrated Peace-building Office in Guinea-Bissau
UNISFA	United Nations Interim Security Force in Abyei
UNMIL	United Nations Mission in Liberia
UNMISS	United Nations Mission in South Sudan
UNOCI	United Nations Operation in Côte d'Ivoire

UNP	United Nations Programme
USATB	USA 90-Day Treasury Bills interest rate
USD	United States Dollar
USIPI	United States Industrial Production Index
VARs	Vector Auto Regressions
VAT	Value Added Tax
VECM	Vector Error Correction Model
WB	World Bank
WOILP	World Oil Price

ABSTRACT

This study set out to determine the relative effectiveness of monetary and fiscal policies in macroeconomic stabilization with a focus on output and inflation in Rwanda as a developing and post-conflict economy. It aimed at identifying the relative effectiveness of both monetary and fiscal policy by comparing their effects in explaining changes in output; and the channels of transmission in a correctly specified VAR. This was motivated by the fact that variables like rainfall, aid, and war have an impact on economic activity in developing countries and should hence be included in models that explain the effects of monetary and fiscal policies on economic activity. Disregarding such factors, as has been the case in several studies would imply incorrect specification.

This study contributes to the body of knowledge by including domestic exogenous variables (rainfall, foreign aid, war, and UN payments) when examining monetary and fiscal policies' effect on economic activity. The sample data covers the period from the 1st quarter of 1996 to the 4th quarter of 2014. The findings show that unexpected changes in monetary policy affect domestic output growth and the price level. Money stock and bank credit to the private sector are the best channels of monetary policy transmission in Rwanda. The study also examined the channels of fiscal policy transmission, and test for the presence of the crowding out/in effect of government spending on private investment. The study findings are mixed. The structural VAR approach reveals that government spending negatively affects prices but does not affect real output. The recursive approach shows that both prices and output do not respond to shocks in government spending. In a different specification, where output is divided into its components, government spending is shown to affect private investment through a crowding in effect, but raises inflation.

The study further investigates the relative contribution of monetary and fiscal policies to changes in nominal output, and possible interaction between these policies. The findings suggest that monetary policy is more effective than fiscal policy, and that there is interaction between both economic policies in Rwanda. Finally, two other specifications are examined, where foreign shocks are first controlled for, then both domestic and foreign shocks are ignored. The findings

indicate an improvement in the results as monetary policy only influences output in the benchmark model. While the study suggests that policy makers should rely more on monetary than fiscal policy, the use of both policies has the potential to achieving higher levels of output within an environment of stable prices.

This study has therefore made a significant contribution in the field of the monetary and fiscal policy transmission mechanism. The domestic exogenous variables are therefore relevant in the specification of the monetary and fiscal policy transmission mechanism. Given the Rwanda government objective of achieving an average growth rate of 11.5 percent up to 2020, it is suggested that more emphasis be placed on monetary policy than fiscal policy. However, given that government spending helps to explain private investment in the cost of rising inflation, careful coordination is required between monetary and fiscal policy in order to boost growth and control inflation. This would also help to avoid the joint inflationary effect of monetary and fiscal policies.

Future studies on monetary/fiscal policy transmission mechanisms should include all relevant domestic variables within a Bayesian VAR, or panel framework in order to circumvent the issue of data limitations.

CHAPTER ONE
INTRODUCTION

1.1 Background

Rwanda is a low income country (LIC) whose economy has been influenced by exogenous factors like the weather as well as foreign aid. Real Gross Domestic Product (RGDP) growth fell from 7.3 percent in 2012 to 4.6percent in 2013 partly as a result of lower than expected performance in agriculture. Delays in the disbursement of official development assistance also affected strategic public investments, following the suspension of budget support disbursements in 2012 (AfDB, 2014). Weather is generally seen as an important factor in explaining changes in output and prices for developing countries where economic growth mainly depends on growth in agricultural output and where there is still limited use of irrigation mechanisms (Barrios et al., 2008, Exenberger and Pondorfer, 2011 and Exenberger et al., 2014). Weather shocks impact GDP growth in economies that largely rely on rain fed agriculture, that is, neither have extensive irrigation systems, nor are heavily industrialized (Miguel et al., 2004, Paxson, 1992 and Miguel, 2005). Previous studies on the determinants of agricultural output have included weather variables (including precipitation, and temperature, and soil moisture deficit) that were not traditionally included in the production function because they were assumed constant and outside farmers' control. However, this should not be the case if climate change is present (Nastis et al., 2012).

The significant role played by weather implies that studies that seek to explain the influence of economic policies on aggregate demand in developing countries, should take into consideration the supply side of output due to rainfall. Weather shocks (beyond economic policies) in low

income countries (LIC) could be associated with changes in income and affect demand for goods and services in these economies. Rain can also directly affect the supply of goods as well as the equilibrium between supply and demand and consequently prices.

Montiel et al. (2012) showed that if real GDP is driven to a large extent or even primarily by temporary supply shocks, innovations in de-trended real GDP reflect a combination of supply and demand shocks. If the monetary authority reacts asymmetrically to these two types of shocks, the Vector Auto Regression (VAR) coefficients will be inaccurately estimated and the impulse responses will equally be insignificant. This study took into consideration the supply side of GDP driven by weather shocks by controlling for rain fall variable in VAR specification.

As in other developing countries, agriculture in Rwanda depends heavily on rainfall. However, climate change is "clearly visible" in Rwanda as reflected by the rise in minimum temperatures over the past 30 years of up to two degrees[1]. The agricultural sector is crucial for Rwanda's growth and is the backbone of the economy, accounting for 39 percent of GDP, 80 percent of employment, 63 percent of foreign exchange earnings and 90 percent of the country's food needs (World Bank, 2013).When the rains fail, agriculture suffers and hence economic growth and rise in price level. For instance, GDP in real terms registered a moderate growth rate of 3.4 percent in 2003 against 9.4 percent in 2002. This slowdown was due to the moderate performance of the primary sector dominated by agriculture which was affected by climatic vagaries (BNR, 2003). In 2006 rainfall was significantly below its seasonal averages, most crops did not reach their 2005 levels and the overall volume of crops fell by 2.1 percent. This dependency on rainfall is

[1] Red Cross/Red 2007, cited by Global Greenhouse Warming, available on www.global-greenhouse-warming.com/Rwanda.html

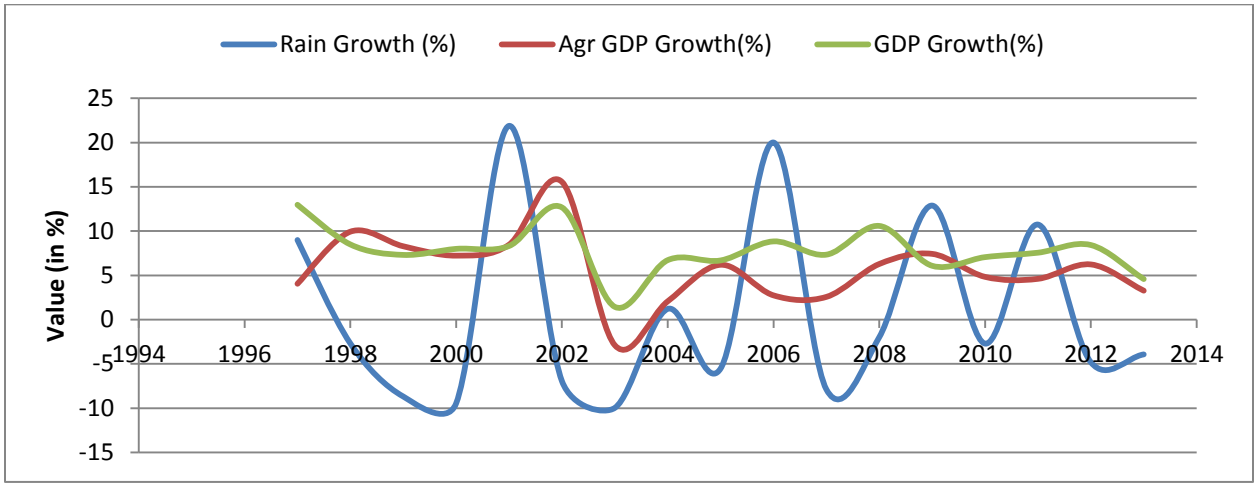
one of the primary causes of hunger and food insecurity in Rwanda. Establishing a country wide irrigation system is essential if hunger and poverty are to be reduced (Ensign and Bertrand, 2011). Real GDP growth was estimated at 4.9 percent in 2007, down from 5.3 percent in 2006. This reflected the 1.3 percent drop in agricultural production in 2007 induced by poor farming conditions resulting from delayed rainfall between March and June 2007, causing low harvests in numerous areas of the country (AfDB, 2008). ‘’Compared to 2006, coffee exports fell by about 50 percent in 2007, primarily due to poor precipitation at the end of 2006 and the beginning of 2007’’ (Kanimba, 2008, 11).

Moreover, while the BNR aimed at restricting inflation to 5 percent in 2007, the first quarter was marked by high inflation pressures with an accumulated average of 6.7 percent, while only slight price fluctuations were observed for the rest of the year. ‘’During the second quarter, disinflation reached 2.2 percent, induced by a significant fall in food prices, also resulting from seasonal effects (2007 B) and prices of domestically produced food stuffs’’ (Kanimba, 2008, 14). As a result of the long dry season during the period April to September 2013, growth in the agriculture sector dropped from 6 percent in 2012 to 3 percent in 2013 (AfDB, 2014).

During the period 1996-2014, annual rainfall fluctuated between 977 and 1279 mm, with an average of 1146 mm[2]. This reflects inconsistency in the weather that affects farmers’ decisions on the type of crop to grow and the quantities to produce. Figure 1.1 depicts the spelling and association of rain and both agricultural and total GDP growth from 1996 to 2013.

[2] Author’s calculations based on data provided by Rwanda Meteorology Agency.

Figure 1.1 Average temperature and rainfall fluctuation in Rwanda from 1996 to 2014



Source: Rwanda Metheorology Office, 2015.

World development indicators, World Bank (2015),

In terms of the relationship between rainfall, agricultural output and total output, Figure 1.1 reveals a lagged relationship between rainfall and both GDP and agricultural GDP, as well as a strong positive association between the growth rates of GDP and agricultural GDP aggregates, reflecting agriculture's significant contribution to GDP over the study period.

While LICs' economies depend heavily on the weather, it is also important to note the significant contribution foreign aid makes to these economies, especially during the post conflict periods. Following violent conflict, countries generally experience unusual constraints as they urgently need to mobilize resources for assistance, recovery and economic reconstruction. Such countries often have to simultaneously deal with several other major challenges. They must maintain peace and security, resettle domestically displaced persons (DDP) and re-integrate ex-combatants, rehabilitate essential infrastructure and important public institutions, restore the public finance regime and regain control of key national assets, create employment opportunities and restore

private investors' confidence, and establish the rule of law and transitional justice mechanisms (UNDP, 2005).

Aid from donors plays a significant role in achieving these objectives. As a country emerging from civil war[3] of 1990-1994 (and the 1994 genocide against Tutsi that caused loss of 15 percent of total population over a period of three months), Rwanda attracted both foreign aid and policy advice from different international institutions in support of its programs. Foreign aid and aid forgiveness might have positively affected aggregate demand in Rwanda. As indicated by Charry et al. (2014), judicious economic policies, coupled with ample donor support, have allowed Rwanda's economy to sustain real annual growth of around 8 percent over the past decade. This is consistent with Hoeffler et al. (2011), Collier and Hoeffler (2004) and (2002), who indicate that foreign aid, may induce a moderate but positive growth effect in economies emerging from war. Rwanda still depends heavily on foreign aid and has benefited from substantial financial aid from donor countries compared to most of its neighbours. For much of the period following the genocide, donor aid has made up a significant share of government spending. However, the percentage of aid to government spending fell over time from 85 percent in 2000, to 65 percent in 2009 and 45 percent in 2010 (Action aid, 2012). In 2011/12 aid inflows, which were nearly evenly divided between direct budget support and project grants, amounted to about 10 percent of Rwanda's GDP and 40 percent of public expenditure (Clark and Arnason, 2014).

[3] In their list of countries affected by civil war, Collier and Hoeffler (2002a), and Miguel et al. (2004), included Rwanda from October 1990 to July 1994. This was based on the conventional academic definition of civil war that requires: a domestic conflict between a government and an identified rebel group that provokes at least 1000 combat-related deaths, of which at least 5% must be incurred on each side.

While the government of Rwanda has effectively used aid for development, the country remains vulnerable to fluctuations in aid flows[4]. In mid-2012, Rwanda experienced an unexpected, sharp decline in aid. High growth and stability were maintained in 2012 as a result of suitable fiscal and monetary policies and the economy grew by 8.8 percent with an inflation rate of 6.3 percent. However, in mid-2013, the economy experienced the lagged effect of the reduction in aid, causing the economic growth rate to fall to 4.7 percent[5] from 7.3 percent in 2012. This shows the country's vulnerability to aid dependency.

Abbott and Rwirahira (2012) identify two issues in relation to the predictability of aid in Rwanda; the long-term commitment of aid to allow for planning, and the difference between the amounts promised in any particular year and what is disbursed. Consequently, both long-term and short-term planning has become difficult. It was observed that there are considerable divergences between estimates by Organization for Economic Co-operation and Development (OECD) staff of the amount that Rwanda receives, the information given to the OECD by official development partners (ODPs), and the information provided to the government. For instance, while forward spending information availed to the Rwandan Government for 2014 came to just over Rwanda franc (Frw) 100 billion, the information availed to OECD was for Frw 250 billion and the OECD estimate was nearly Frw400 billion. The lack of comprehensive information on budgetary aid resources makes it difficult for the GoR to decide on priorities and

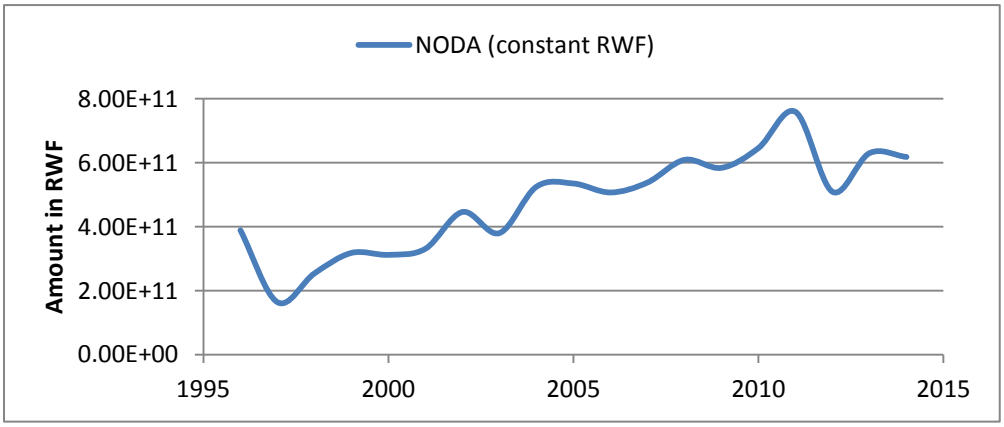
[4]Several studies have documented the cost of aid volatility and the channels through which this operates.At a macroeconomic level, aid volatility has been shown to cause volatility in some aggregate variables such as inflation (Fielding and Mavrotas, 2005), real exchange rates (Schnabel, 2007), or fiscal policy (Fatas and Mihov, 2008). In turn, volatility in these variables affects economic activity.

[5]http://www.worldbank.org/en/country/rwanda/overview visited on 10th Dec 2014

hence effective allocation of resources. It also hinders the government's ability to make consistent economic forecasts that impinges on macroeconomic stability and weakens national ownership (Baingana, 2011).

Figure 1.2 depicts the large drop in net official development assistance (NODA) to Rwanda in 2012 while Figure 1.3 shows the amount of aid per capita made available to Rwanda together with some of the other Great Lakes countries.

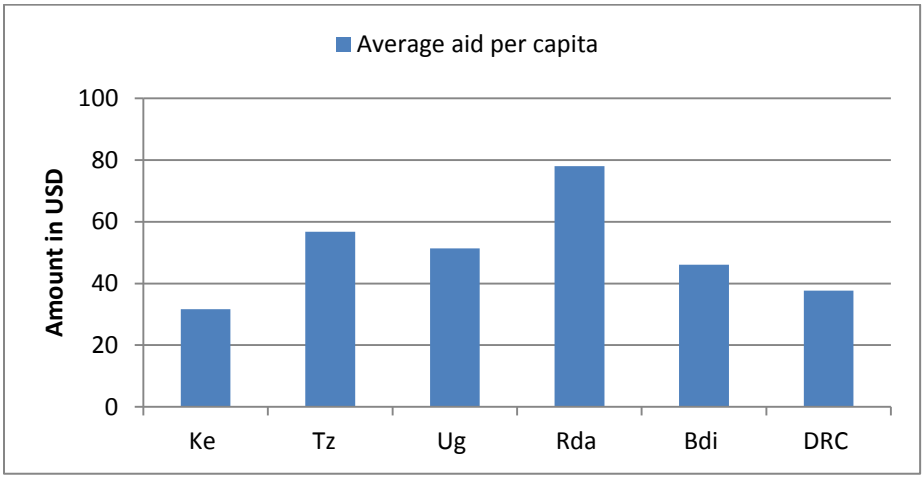
Figure 1.2 Net Official Development Assistance, 1996-2014 (in current USD)



Source: World development indicators, World Bank (2015),

From Figure 1.2, it is clear that aid for Rwanda has increased over time except 2012, implying a big role played by foreign aid in Rwandan economy.

Figure 1.3 Official foreign aid per capita in the Great Lakes countries (Average[6] of NODA for period 1996 to 2012)



Source: World development indicators, World Bank (2015),

Figure 1.3 shows that on average, for the period 1996-2012, Rwanda received a larger amount of aid per capita than other country in the region. While this amount is almost twice the amount of aid per capita received by the Democratic Republic of Congo (DRC), it is also more than twice the amount that Kenya received, and equals the sum of amount of Burundi and Kenya's aid per capita, supporting the significant contribution of foreign aid in Rwanda's economy.

Consistent with AfDB (2014), Abott and Rwirahira (2012), and Baingana (2011), this study considered foreign aid as an exogenous variable for its unpredictability .Ezemenari et al. (2008) argued that the flow in foreign aid, following the 1994 crisis, resulted in increases in M2 (broad money) and large changes in nominal GDP and inflation in Rwanda

[6] Average values were calculated using constant values in USD for Aid and GDP

The period following a civil war is generally characterized by two main challenges, economic recovery and avoiding renewed conflict. Nonetheless, nearly 40 percent of post-war countries return to civil war within a decade (Collier et al., 2008; 2003). After the 1990-1994 war and the 1994 Genocide against Tutsi, Rwanda was involved in the first and second war against the DRC between 1996-1997 and 1998-2002[7], respectively. In 2002, the United Nations Organization Mission in the Democratic Republic of the Congo (MONUC) announced the departure of over 20000 Rwandan soldiers from DRC. This represented a quarter of the armed forces personnel of 80,000[8], the highest number of Rwandan armed forces personnel during the period 1996 to 2014. There were 6000 armed forces personnel during 1989 to 1990. This number increased and stabilized to 30,000 in the period 1991 to 1994 due to the Rwandan war that took place from October 1990 to July 1994. The number increased from 47,000 in 1995 and reached its highest level of 80,000 in 2002, then started decreasing and stabilized at 35,000 between 2007 and 2012.This study considers the first and second wars against the DRC (during 1996-2002) an important factor that affected the government's expenditure, and ultimately inflation and output.

In addition, during the period 1996-2001 the organized insurgency based in the DRC confined its operations to the northern region (former Gisenyi and Ruhengeri provinces) bordering the DRC and to a lesser extent, to the western and central areas (for instance the provinces of Gitarama, Kibuye and Kigali Ngali) which border these regions. Gisenyi and Ruhengeri used to be the breadbasket of Rwanda, with farming the major economic activity. The consequences were

[7] In this study, 5 October 2002 is considered the end of Rwanda's presence in the DRC. On this date, Rwanda announced the completion of the withdrawal of its soldiers from DRC, an announcement that was confirmed by MONUC.

[8]World Bank (2015) World development indicators.

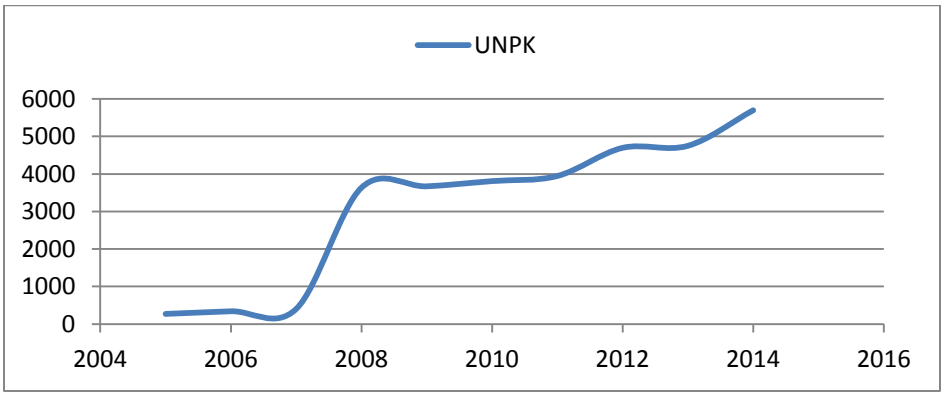
severe economic suffering and an increase in the price of food products. This study considers this situation in addition to the 1996-2002 war against the DRC as an exogenous shock to the economy.

United Nations (UN) payments to the Rwandan Government also heavily influenced the country's economy. In the past ten years, Rwanda has become an important contributor to UN, and AU peace keeping operations, contributing the highest percentage of troops per capita to UN peacekeeping missions. In 2014, Rwanda was the sixth largest major Troop and Police Contributing Country (T/PCC) in the UN, with over 4000 troops, more than 400 police officers, and 13 Military Observers in seven UN Missions, including the AU-UN Hybrid Operation in Darfur (UNAMID); the UN Mission in South Sudan (UNMISS); the UN Operation in Côte d'Ivoire (UNOCI); the UN Mission in Liberia (UNMIL); the UN Stabilization Mission in Haiti (MINUSTAH); the UN Interim Security Force in Abyei (UNISFA); and the UN Integrated Peace-building Office in Guinea-Bissau (UNIOGBIS) (Beswick and Jowell, 2014).

Rwanda's defense expenditure remained relatively steady at around USD73 million per year between 2010 and 2013. Defense expenses fell as a proportion of GDP from 1.34 percent in 2010 to 1.06 percent in 2013 largely as a result of economic growth. Nevertheless, the Rwanda Defense Force (RDF) continues to draw significant financial and peacekeeping contributions (Beswick and Jowell, 2014). Reimbursements from the UN to the country for peacekeeping contributions account for a significant proportion of Rwanda's defense budget. However, "delays have caused frustration and impacted Rwanda's performance against wider fiscal targets" (Beswick and Jowell, 2014, 3). Rwandan representatives at the UN have cited the slow rate of

UN reimbursements as a factor hampering sustained commitment. This study considers UN reimbursements as an exogenous factor in the Rwandan economy in two ways. The first is the fact that the country's contribution to UN peacekeeping operations depends on a rise in new conflict which is generally not easily predictable; and the second is that delays in UN reimbursements (that are beyond monetary and fiscal authorities' control) affect government expenditure, and the exchange rate, and could hence lead to price changes, thus should be controlled for, in evaluating the effectiveness of economic policies in Rwanda's economy. Figure 1.4 shows a significant increase in contributions to UN peace keeping operations, with a considerable shift from 2008.

Figure 1.4 Contribution of Rwanda to UN peacekeeping operations[9] from 2005 to 2014



Source: United Nations peacekeeping, troop and police contributors, available at

http://www.un.org/en/peacekeeping/resources/statistics/contributors.shtml

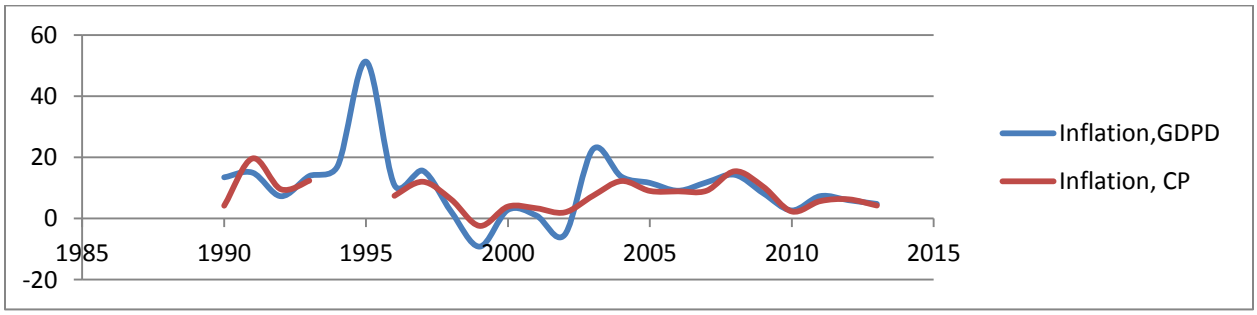
[9]Due to the lack of data on UN reimbursements for Rwanda's contribution to UN peacekeeping operations, the study uses the number of troops and police participating in UN missions for the period 2005-2014 as a proxy for UN reimbursement.

Rwanda remains fragile vis-à-vis exogenous shocks, which could increase inflation and reduce prospects for economic growth. The rise in global prices for petroleum and international food products are problems for inflation and potentially for growth. In 2007, the growing cost of fuel imports led to increases in transportation prices. Average inflation for 2008 was revised from 7 percent to 8.5 percent in order to contain the first round effects of the supply shocks, which were beyond the authorities' control. Nominal GDP and the macro economic framework were also revised accordingly (IMF, 2008). This link between domestic inflation and rise in price of foreign products (fuel and food) implies the importance of controlling for international prices when identifying the effectiveness of monetary and fiscal policies on economic growth and inflation.

During the past decade, the monetary policy objective was to maintain headline inflation at stable levels. Improved productive capacity due to structural reforms, mainly in agriculture, were expected to contribute to a fall in food prices and maintain headline inflation at below the BNR's medium-term target of 5.0 percent (AfDB, 2014). In order to contain inflationary pressures, in October 2011 the BNR reduced the monetary easing that had been in place since November 2010. The key repo rate (KRR) was raised from 6 percent in November 2010 and 6.5 percent in October 2011, to 7 percent in November 2011. In June2013, the KRR was reduced to 7.0 percent from 7.5 percent (applied since June 2012). It was kept at 7 percent at the December 2013 monetary policy committee (MPC) meeting with the aim of diminishing inflationary pressures and supporting growth in private sector credit. Headline inflation dropped from 5.7 percent in January 2013 to 3.6 percent in December 2013.

Enhanced productive capacity, mainly in the agricultural sector, and a stable exchange rate, in addition to sound macroeconomic management contributed to single digit inflation in 2011. Nevertheless, the rise in underlying inflation from 0.2 percent in 2010 to 8.3 percent year-on-year in December 2011 implies that internal factors, mainly the rapid growth in credit to the private sector, could explain rising headline inflation (AfDB, 2012). Since June 2013, low and stable inflation has been registered due to sustained and well-coordinated fiscal and monetary policies, easing inflationary pressures from trading partners and deceleration in global oil prices, and sound economic performance (BNR, 2014). Headline inflation fell from 3.7 percent in June 2013 to 1.4 percent in June 2014, mainly due to the slowdown in food inflation from 4.4 percent to 1.9 percent. Since February 2014, headline inflation has consistently trended downwards partly reflecting weak aggregate demand (BNR, 2014). Imported inflation fell from 1.9 percent, to -0.4 percent, energy prices decreased to 0.2 percent from 0.9 percent, and the price of fresh products fell from 6.3 percent to -0.5 percent during the same period. Inflation developments have been dominated by prices for food and non-alcoholic beverages as well as transport costs which together account for 46 percent of the CPI basket (i.e. 28 percent and 18 percent, respectively).

Figure 1.5 GDP deflator and consumer prices (annual percentage) from 1990 to 2013

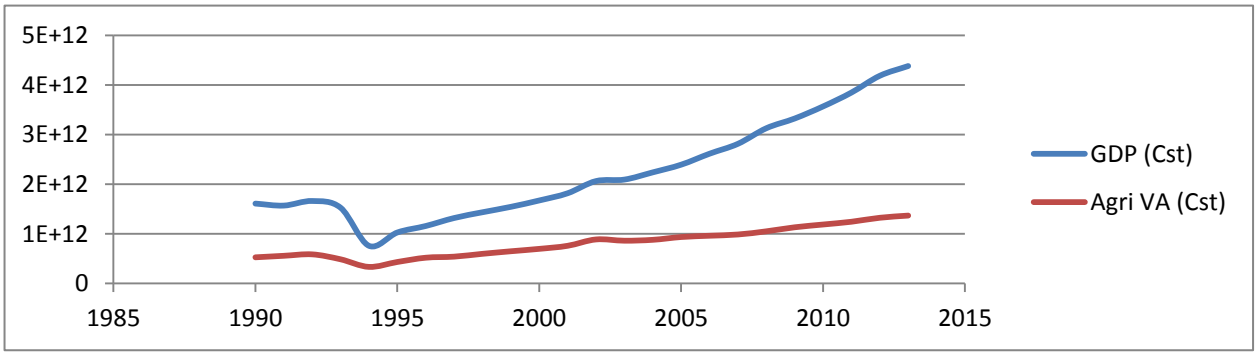


Source: World development indicators, World Bank (2015),

Figure 1.5 shows that the CPI inflation has fluctuated in a small range, with a constant trend from 1996 to 2013.

The economic structure is dominated by services. On average, they accounted for 35.3 percent of GDP during 1996-1998, and 49.1 percent between 1999 and 2003. This increased from 50.7 percent during 2004-2008 to 53.1 percent during 2009-2013. Expansion in trade, transport and telecoms, as well as finance and insurance are the major factors that led to the growth in services. While the share of services continued to grow, industry and agriculture has been declining. During the same period, the share of industry was 18.5 percent, 13.8 percent, 12.4 percent and 13.8 percent, respectively, while agriculture represented on average 46.2 percent, 37.2 percent, 36.8 percent, and 33.1 percent, respectively. Agriculture's declining GDP is explained by reduced productivity and low value added.

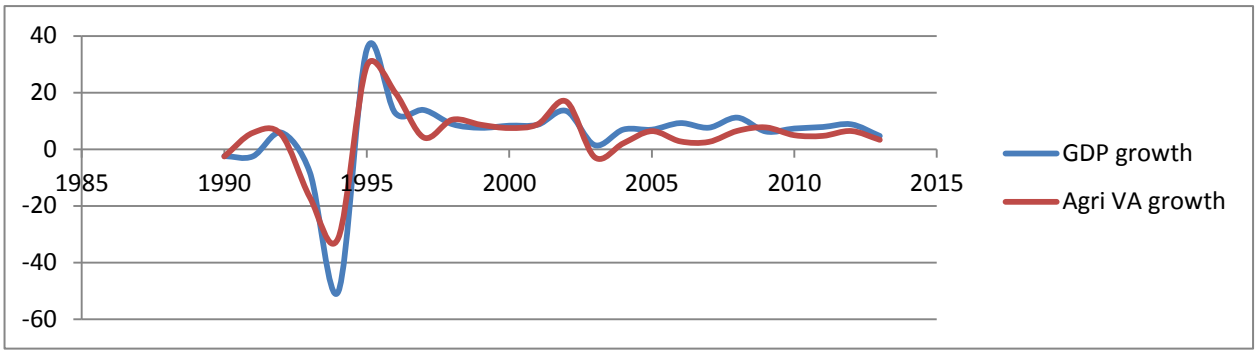
Figure 1.6 Total output and Agricultural development in Rwanda from 1990 to 2013 (in billion Constant Frw)



Source: World development indicators, World Bank (2015),

Figure 1.6 shows that although the proportion of agricultural products to total products has decreased over time, it shows that the degree of correlation between real GDP and agricultural GDP in Rwanda remains high. The high degree of association between agricultural and total GDP is revealed in Figure 1.7 whereby the growth rates for both aggregates fluctuate together in same direction, implying a possibility of agricultural output effect on total output.

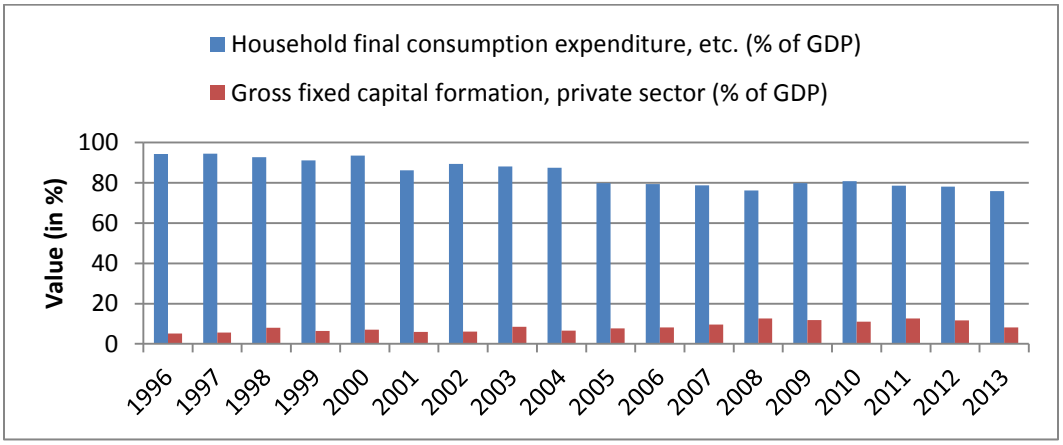
Figure 1.7 GDP and Agricultural GDP growth, 1990 to 2013



Source: World development indicators, World Bank (2015),

Consumption spending account for large portion in total expenditure with an average of 84.7 percent of GDP, followed by investment spending at 8.5 percent. Figure 1.8 shows that over the years, the consumption spending portion has been declining in contrast to private investment.

Figure 1.8 Household final consumption and private investment expenditure (as percentage of GDP) 1996-2013



Source: World development indicators, World Bank (2015),

Monetary and fiscal policies are the main tools used by policy makers to influence the level of economic activities. For example, if the economy experiences a recession, policy makers can employ two sets of principles to influence aggregate economic activity: monetary policy, to manage interest rates and the money supply, and fiscal policy, to manage government expenditure and taxes (Mishkin, 2012). Empirical studies have documented contrasting findings depending on which models they employed. For example, monetarists suggest that monetary actions have a greater impact on economic activities in developed countries, while studies employing structural models show that fiscal actions have a greater impact on economic activity in these countries. The divergence in the results of different studies suggests that none of these economic policies should be considered as superior to the other, while their relative effectiveness in a specific economy is dependent on the prevailing economic and political conditions at any point in time (Rakić and Radenović, 2013).

The objectives of monetary and fiscal policies in Rwanda are wide-ranging. They include sustained economic growth, price stability, reduced unemployment, an improved balance of payments, and preserving the value of the national currency. However, challenges exist that hinder the effectiveness of both monetary and fiscal policies in the country. As pointed out by the Central Bank of Rwanda [*Banque Nationale du Rwanda* (BNR)], ‘’excess liquidity hinders the development of the money markets since the majority of banks have been sitting on abundant funds and not making full use of money markets, resulting in very narrow money markets’’ (BNR, 2013 b, 26-27). BNR is facing the challenge of an interest rate pass-through that is ineffective as a policy transmission channel, mainly due to structural challenges and the lack of competition between banks. ‘’The signal transmitted by the BNR through a change in the interest rate does not translate into equivalent changes in banks’ lending rates’’ (BNR 2013 b, 27). This is consistent with Saxegaard’s (2006) research on sub-Saharan African countries that found that excess liquidity in the region weakens the mechanism of monetary transmission and hence the ability of monetary policy makers to influence demand in the economy.

The two studies conducted on the monetary policy transmission mechanism (MPTM) in Rwanda not only used a narrow set of methodologies but also produced conflicting results. Davoodi et al.’s (2013) study found that monetary policy seems to affect output but not prices, while Rusuhuzwa et al. (2008) concluded that monetary policy significantly affects prices but not output. Furthermore, Davoodi et al. (2013) used a short period (2000-2010) constrained by the fact that the year 2000 was when the treaty establishing the East African Community (EAC) came into force, though the study focused on Rwanda together with other EAC member countries. On the other hand, Rusuhuzwa et al. (2008) used the sample period of 1994 to 2006.

This partially overlaps with the Rwandan civil war from 1990 to mid-1994 that had severe effects on the country's level of macroeconomic activity. During the period 1994-1995, economic growth and inflation rates reached their lowest and highest levels, respectively in 50 years. Furthermore, both studies did not take into account the effects that the weather has on total output and prices through agricultural production, nor did they explore the role of other factors like foreign aid and UN payments.

The government's fiscal policy has focused on accomplishing fiscal consolidation and on steady withdrawal of the fiscal stimulus while sustaining expansion in economic activity (AfDB, 2012). However, despite efforts to control public finance since 1995, the size of the persistent budget deficit in Rwanda prevails with limited progress being made in the mobilization of domestic revenues and, on controlling expenditure. Public expenditure continues to increase faster than revenue which is limited by a small tax base and the buoyancy of economic activities in the private sector (RoR, 2003-2011).

Moreover, a number of studies have shown that increased spending resulting from an expansionary fiscal policy crowds out private sector investment spending, because of the rise in banking lending interest rates induced by higher domestic financing of persistent fiscal deficits. The banking sector in Rwanda appears to be the most important source of domestic debt; its share increased from 22.8 percent in 2009 to 40.4 percent in 2010. However, due to Government budget constraints, the private sector has been crowded out as a result of the increased credit extended to the government (BNR, 2011). It is therefore important to investigate whether fiscal policy actions have an adverse effect on economic growth.

1.2 Statement of the problem

The overarching goal of the Rwanda Economic Development Poverty Reduction Strategy 2 is "Accelerating progress to middle income status and better quality of life for all Rwandans through sustained average GDP growth of 11.5 percent …" (Republic of Rwanda, 2013, 2). The targeted middle income status set out in the revised targets of the Vision 2020 adopted in May 2012 corresponds to GDP per capita of $1240 from $644 in 2012.

After the 1994 genocide against Tutsi, the country experienced a high growth rate relative to other African economies. However, for the past decade, the growth rate has trending down. Following the economic recovery, Rwanda recorded an average annual growth rate of 9.2 percent between 1996 and 2000. During the period 2001-2005, the average growth rate was 7.2 percent, while it averaged 8.2 percent between 2006 and 2009 and, during 2010-2013; the annual growth rate was 6.9 percent[10].This illustrates the economy's vulnerability to structural limitations, including resource scarcity, and the fact that it is as small, landlocked country with limited export possibilities. Consequently, the new government's target per capita income of $1240 by 2020 which requires an average GDP growth rate of 11.5 percent could be difficult to achieve given the downward trend in economic growth observed between 1995 and2014.

Regarding the MPTM, the presence of excess liquidity in the Rwandan banking system weakens this mechanism and thus the monetary authorities' ability to influence demand conditions in the economy as banks' lending rates tend to be sticky and not responsive to changes in policy. The

[10]World development indicators, World Bank (2014).

lack of interest rate pass-through, as a policy transmission channel, remains a major challenge for monetary policy conduct.

Although fiscal policy in Rwanda has improved over time, challenges remain that impede economic activities. ‘’Due to Government budget constraints and the consequent increase in credit extended to the government, the Private Sector has been crowded out’’ (BNR, 2011, 41). Public expenditure has continued to increase at a faster rate than revenue. Revenue mobilization is hampered by the small tax base, which is reflected by the primary balance which changed from 1.1 percent in 2005 to -2 percent of GDP in 2011 and an estimated -4.5 percent of GDP for 2013 (AfDB, 2014). A noticeable challenge emanates from the fact that government expenditure includes a significant portion of exceptional expenditure related to the consequences of war and genocide, reducing government’s ability to allocate resources to productive activities. Given these challenges, it is interesting to evaluate the effectiveness of fiscal policy in Rwanda.

Monetary and fiscal policies are useful for macroeconomic stabilization (Mishkin, 2012). However, evidence on country specific impact of both monetary and fiscal policy transmission mechanisms remains mixed. The strength of these effects and the channels through which they operate remains unresolved. In addition, most studies that have assessed the effectiveness of monetary and fiscal policies have focused on developed countries and their findings cannot be generalized to developing economies (see for example Christiano et al., 2005; Kim and Roubini, 2000; and Bernanke and Gertler, 1995). Furthermore, the majority of studies on developing economies mainly focused on foreign rather than domestic shocks (see for example Maturu 2014, Cheng 2006, and Davoodi et al., 2013). Taking rainfall, aid and war into account could be

useful given that low income economies have experienced such shocks for many years. This thesis addresses these gaps.

In line with the research problem this study raises the following research questions:

1. What are the channels of monetary policy transmission in Rwanda?
2. What are the channels of fiscal policy transmission in Rwanda?
3. What is the relative effectiveness of monetary and fiscal policy in output stabilization in Rwanda?
4. What is the relationship between monetary and fiscal policy in Rwanda?

1.3 Objectives of the study

The main objective of this study is to examine the relative effectiveness of monetary and fiscal policies in macroeconomic stabilization, measured in terms of national income and inflation, in Rwanda.

More specifically, the study seeks:

1. To establish the channels of monetary policy transmission in Rwanda;
2. To establish the channels of fiscal policy transmission in Rwanda;
3. To establish the relative effectiveness of monetary and fiscal policy; and
4. To determine the type of relationship that exists between monetary and fiscal policy in Rwanda.

1.4 Significance of the study

This study makes a threefold contribution to policy and the existing literature. Several studies on monetary policy transmission mechanism (MPTM) in low-income economies have been based on research findings in industrialized economies. Given that the economic structure of LICs

differs markedly from that in industrialized countries, one cannot expect that findings on monetary transmission in industrialized countries would necessarily hold for LICs. This study adds to the existing literature by assessing the transmission mechanism of monetary and fiscal policy taking into account the systematic drivers of the economic structure of a poor and post-conflict country, that is, an economy that mainly depends on weather conditions and foreign aid.

Little is known about the MPTM in Rwanda; the two existing studies by Davoodi et al. (2013) and Rusuhuzwa et al. (2008) used a narrow set of methodologies. Using a large and relatively recent data, the study findings will inform policy makers about the current relationship between these two economic policies. For instance, the findings could help the monetary policy makers understand which monetary policy transmission channel impacts on economic activity, how fast the effects are transmitted and how long they remain relevant, as well as identify the tradeoffs between output stabilization and price stability in the Rwandan economy.

The study's findings could also help policy makers to understand which channel of fiscal policy transmission is more effective, and hence focus on this mechanism in order to boost economic activity, and/or ensure price stability. This is because, despite the Rwandan Government's efforts to reconstruct the economic and social fabric destroyed by the 1990-1994 war, relatively little analytical work has been done on the transmission mechanism of fiscal policy, which is essential to the appropriate design, management, and implementation of fiscal policy.

1.5 Scope of the thesis

The focus of this thesis was to determine the relative effectiveness of monetary and fiscal policy in macroeconomic stabilization in Rwanda. The study considers Rwanda as a developing and post conflict economy. Some exogenous variables were considered to have an effect on economic growth and prices for a developing and post conflict economy, and were taken into consideration in the analysis. The study covered the period from 1996 to 2014. Though a large data sample size is acknowledged for econometric analysis, data before 1996 could not be used in order to avoid outliers, given that this is a period where economic growth and prices were affected by war that took place between 1990 and 1994. In addition, the period after 1996, corresponds with fully liberalization of economic activity through implementation of structural adjustment programme (SAP). Quarterly data were used for the analysis, and theories about their usefulness were provided.

1.6 Organization of the thesis

This thesis is structured as follows:

The following chapter examines the channels of monetary policy transmission in Rwanda. The analysis focuses on the relative effectiveness of each monetary transmission channel on the economy, how fast they are transmitted and how long their effects last. Chapter three analyzes the channels of fiscal policy transmission in Rwanda. It shows the effects of changes in government expenditure and taxation on aggregate economic activity in a hypothesized crowding out effect situation; how fast the effects are transmitted; and whether the effectiveness of fiscal policy depends more on government expenditure or taxation. Chapter four discusses the relative effectiveness of fiscal and monetary policy on national income and interaction between these policies, and chapter five concludes the thesis.

CHAPTER TWO
MONETARY POLICY TRANSMISSION MECHANISM

2.1 Introduction

The practice in relation to monetary policy in Rwanda has focused attention on the efficacy of monetary policy transmission channels. A more accommodative monetary stance has been adopted to support growth. However, a pass-through has been observed from policy rates to lending rates (BNR, 2013). Furthermore, given that only two studies have been conducted on MPTM, this implies that there is a paucity of research on the MPTM in Rwanda. Many questions therefore remain unanswered. In particular, the following pressing issue requires more attention: Which transmission channel of monetary policy is likely to be most effective in transmitting monetary policy changes to output and prices in Rwanda?

Most studies on this subject have confined their attention to the experience in developed countries and their findings cannot be generalized to developing economies. Taking into account the economic structure of a LIC like Rwanda where agriculture accounts for an important proportion of total output, but depends heavily on rainfall because of a lack of sufficient irrigation systems, and given that a number of other shocks are likely to affect economic activity because they are often uncontrollable in these particular economies, this study introduces new exogenous variables that were not employed in the literature on the MPTM such as rainfall, aid, war, and UN payments (in the case of Rwanda) to best capture the evidence related to the effectiveness of monetary policy innovation. This chapter sets out to determine the best channels for monetary policy transmission in Rwanda, based on timing and magnitude of the effects of policy changes on output and prices.

2.2 Monetary policy development

2.2.1 Introduction

The monetary policy framework adopted by the Central Bank of Rwanda [the Banque Nationale du Rwanda (BNR)] from 1964 can be grouped into three distinct time periods: the period of financial authoritarianism (1964-1990) that was characterized by the use of direct monetary instruments, followed by the period of transition from financial control to financial liberalization (1990-1995) and finally, the fully-fledged financial liberalization period (post-1995). Financial liberalization involved the removal of interest rate controls, and requirements that banks lend to specific sectors, as well as credit ceilings. The financial sector has expanded considerably, with an increase in the number of banking and non-banking financial institutions. Competition has also intensified, improving banks' efficiency and keeping interest rate spreads low (BNR, 2013 a).

The goal of monetary policy is set out in the BNR Law which requires the BNR to implement monetary policy that ensures price stability and low inflation. Law N° 55/2007 of 30/11/2007 enables the BNR to focus on price stability while considering the implications of monetary policy for economic growth[11]. The BNR's monetary policy is operated through a monetary aggregate targeting (MAT) regime, whereby broad money (M3) and reserve money are intermediate, and operating target respectively[12]. ''The framework assumes a stable demand for money and money multiplier'' (BNR 2013 b, 14). In the MAT practice, the monetary transmission mechanism (MTM) begins with a change in broad money due to a corresponding change in reserve money, which also influences domestic inflation. The M3 is determined

[11] http://www.bnr.rw/index.php?id=180.

[12] M3 is defined as currency in circulation outside banks plus demand, time deposits and foreign currency deposits at the commercial banks. Deposits include both Rwanda franc and foreign-currency denominated.

following the desired level of inflation, economic growth, the government's expected fiscal operations, and the balance of payments, in the perspective of a stable money velocity. The reserve money target is defined in line with the estimated M3 assuming that the money multiplier is stable (BNR, 2013 b).

2.2.2 Monetary policy instruments

The indirect instruments of monetary policy that are used include the reserve requirements, the refinancing rate and money market operations. The main policy instruments being Treasury bills (TB) and open market operations (OMO) conducted using Repo operations (BNR, 2013 b).

Furthermore, in order to improve the MPTM and increase the effectiveness of its monetary policy, the BNR introduced a more flexible monetary targeting framework in October 2012, by initiating a reserve money band of ± 2 percent around a central reserve money target.

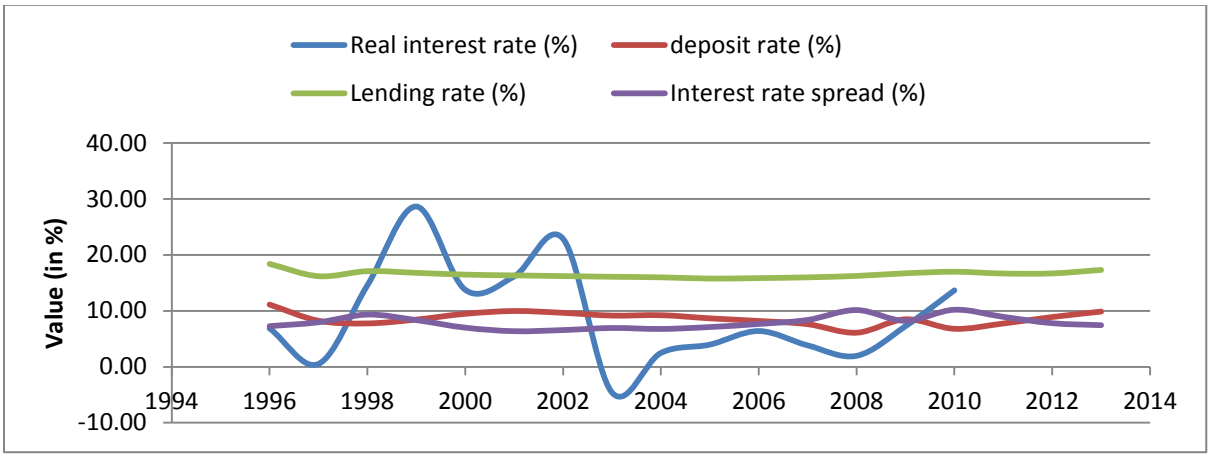
2.2.3 Transmission channels of monetary policy

Interest rate and money aggregate

Indirect control instruments were adopted to conduct monetary policy comprising of the required reserve ratio, the discount rate and the open market operations, and the BNR's policy rate was introduced in 2005. The central bank introduced repo operations in August 2008 to manage liquidity smoothly, while ensuring the collateralization of traded instruments in order to minimize the risk initially associated with former operations. However, partly due to lack of competition, the banking system has experienced excess liquidity, similar to 2007. While both the rate on OMO and the TB rates decreased by 2.1 percent between December 2006 and December 2007, and the discount rate fell from 8.1 percent to 7.4 percent during the same

period, banks' lending rates remained unchanged, fluctuating at around 16 percent. The BNR had to frequently intervene to reduce excess liquidity, in order to match the bank's liquidity with monetary indicators. This led to an increase of 16.2 percent in the BNR's domestic debt to commercial banks during the period 2006- 2007 (BNR, 2013). Figure 2.1 depicts the development of real interest rate, deposit, and lending rates as well as the interest rate spread.

Figure 2.1 Trends in key money market variables, 1996 to 2013



Source: World development indicators, World Bank (2015),

It shows that the lending and the deposit interest rates remained relatively unchanged for the period 1996-2013, supporting the possibility of a lack of competition in the banking sector. This could also be underscored by the behaviour of the interest rate spread that was relatively constant during the same period.

Exchange rate

Following the structural adjustment program (SAP), a flexible exchange rate system was introduced in 1995, and new exchange control regulations were put in place. The main features

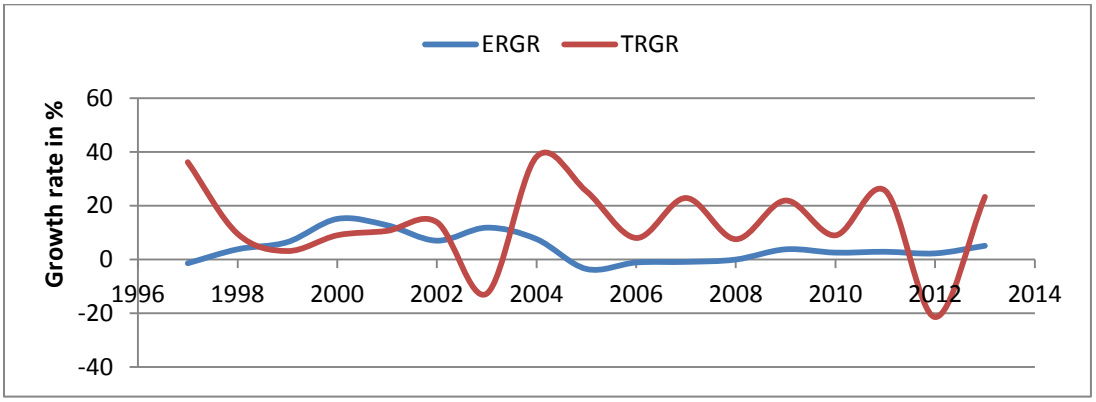
of these regulations included full liberalization of current and capital account operations, market determination of the exchange rate, the introduction of foreign exchange bureaus, authorization of foreign direct investment (FDI) in Rwanda and the transfer abroad of the return on this investment. Foreign currency sales are used as a tool to regulate liquidity in the banking system. Other instruments such as overnight operations, Repos[13] operations and the Key repo rate are also used (BNR, 2013).

Exchange rates have been influenced by both internal and external shocks. It is worth noting that the stability of the local currency [the (Frw)] is supported by a relative large quantity of foreign currency inflows from donors to the Republic of Rwanda (RoR), private transfers and export receipts (Kanimba, 2008). In comparison with previous years, in 2007, due to increased demand for domestic imports, a significant increase in foreign currency demand was observed on the domestic exchange market.

Due to aid cuts (1.2% of GDP), in addition to high demand for imports by the RoR, the Frw depreciated by 4.5 percent against the USD at the end of 2012. By the end of September 2013, the Frw had depreciated by 3.9 percent and by December 2013, by 5.7 percent against the USD due to increased demand for foreign currency to finance industry, construction and consumer goods imports (BNR, 2013). Figure 2.2 shows the growth of the nominal exchange rate and total reserves.

[13]Repo rate is the discount rate at which a central bank repurchases government securities from the commercial banks, depending on the level of money supply it decides to maintain in the country'smonetary system. To temporarily expand the money supply, the central bank decreases repo rates (so that banks can swap their holdings of government securities for cash). To contract the money supply it increases the repo rates. Alternatively, the central bank decides on a desired level of money supply and lets the market determine the appropriate repo rate. Retrieved from http://www.businessd ictionary.com/definition/repo-rate.html.

Figure 2.2 Growth in nominal exchange rate (ERGR) and total reserves (TRGR) in Rwanda[14], 1997 to 2013



Source: BNR, Annual Reports, 2003-2015

World development indicators, World Bank (2014).

It indicates that while the growth in the nominal exchange rate trended down slightly during the period 1997-2013, the growth in total reserves was relatively constant at around 10 percent but exhibited large fluctuations especially during 2003 and 2012.

[14] Total reserves (includes gold, current USD)

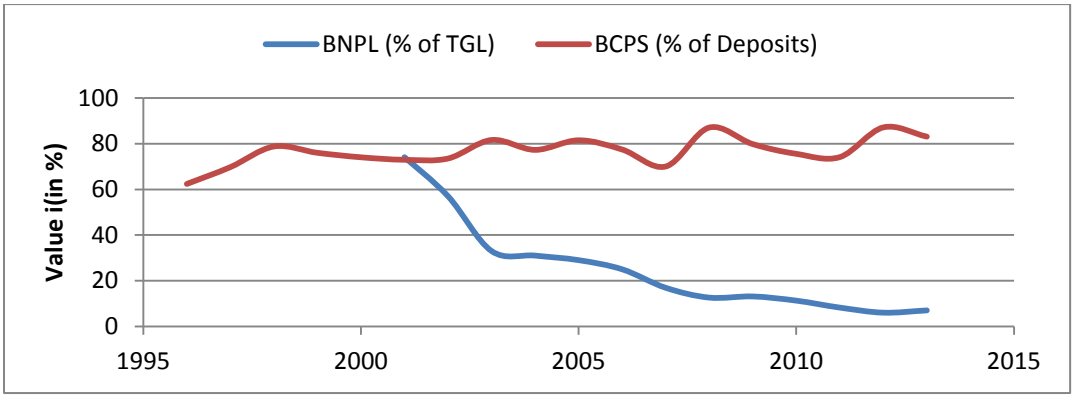
Credit policy, asset price, and financial depth

Rwanda's financial system has improved considerably over the past decade. In 2014, it comprised 16 banks (ten commercial banks, four microfinance banks, one development bank and one co-operative bank), 491 microfinance institutions including 478 savings and credit co-operatives (SACCOs), and 49 non-bank financial institutions (AfDB, 2014). This has led to a relative increase in competition among banking institutions as well as the entry of new foreign banks, prompting banks to embrace new market developments such as agent banking, mobile banking and branch network expansion.

The key indicators show that financial sector depth has improved over time. Gross loans to the private sector remained stable at 17.1 percent of GDP at the end of 2012 and at the end of 2013 after doubling to Frw 1.1 billion (USD 1.8 million) between 2006 and 2011. The annual credit growth of the private sector, of 35.0 percent at the end of 2012, was higher than the 28.0 percent in 2011 and 11.1 percent in 2010 but dropped to 10.8 percent at the end of 2013, implying the lagged effects of aid postponement in 2012/13. The capital adequacy ratio (CAR) increased from 13 percent in 2006 to 23.1 percent in December 2013, exceeding the regulatory minimum capital of 15.0 percent set by the BNR and the Basel Committee benchmark of 10.0 percent. Non-performing loans (NPLs) decreased from 25.5 percent of gross loans in 2006 to 7 percent in December 2013, corresponding to the minimum regulatory requirement of 7.0 percent (AfDB, 2012; and 2014). The capital market is still embryonic and has not yet reached the stage of providing satisfactory long-term financing for the private sector. Rwanda aims to increase the share of the population with access to financial services from 72.0 percent in 2014 to over 80.0

percent in 2017. Figure 2.3 depicts the development of bank's non-performing loans and bank credit to private sector ratios.

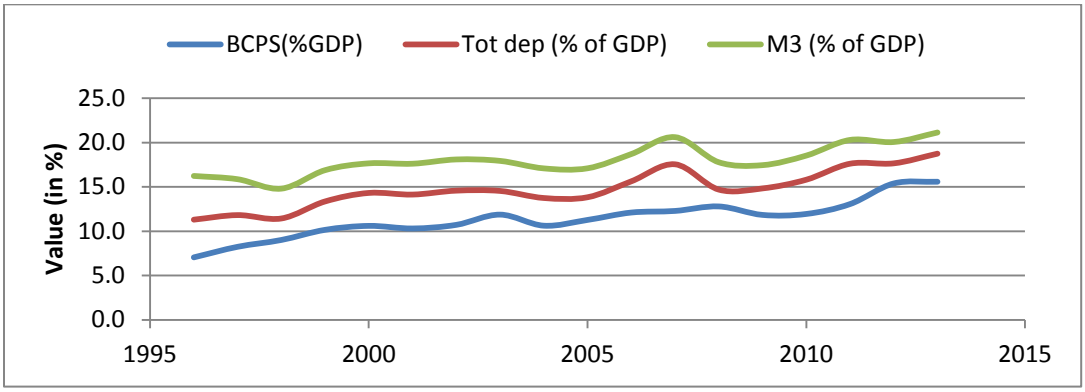
Figure 2.3 Financial depth indicators, 1996 to 2013



Source: World development indicators, World Bank, (2014); BNR Annual Reports, 2003-2014.

Figure 2.3 indicates that the ratio of banks' non-performing loans (BNPL) to total gross loans (TGL) has decreased over time while banks' credit to the private sector to total deposits increased steadily during the same period, implying improved management of credit over time. Other financial indicators, including bank credit to the private sector as well as money supply increased significantly over time as their ratio to GDP increased during the period under study, implying improvement in the financial sector. A positive link between these financial indicators is observed in Figure 2.4.

Figure 2.4 Other financial depth indicators, 1996 to 2013



Source: BNR Annual Reports 2003; 2010; 2014.

The ratios to GDP of bank credit to private sector, total deposit, and money stock have exhibited an increasing trend, and positive relationship among them from 1996 to 2013, indicating improvement in financial sector and possible relationship between the three mentioned variables.

2.3 Literature review

Introduction

This section presents a review of the theoretical and empirical literature on the channels of monetary policy transmission.

2.3.1 Theoretical literature

The MPTM expresses how policy-induced changes in the nominal money stock or the short-term nominal interest rate (exchange rates, bank lending, firm balance sheets, equity and real estate prices) impact real variables such as aggregate output and employment. One of the most detailed discussions on MPTMs was provided by Friedman (1968) who also discussed the relative

importance of monetary and fiscal policies (within the context of the USA and Latin America economies).

Generally, monetary policy transmission is categorized into two basic types: neoclassical channels in which financial markets are perfect and non-neoclassical channels that involve financial market imperfections, which are usually referred to as the credit channel (Mishkin, 2012).

Traditional monetary policy transmission channels are constructed on the fundamental models of investment, consumption, and international trade behaviour mainly developed by neoclassical scholars during the mid-20th century. These include Tobin's (1969) model of investment, Ando and Modigliani (1963), and Friedman's (1957) lifecycle permanent income models of consumption, and Mundell's (1963) international IS/LM-type model. This section distinguishes between the channels of monetary transmission that directly affect investment (the direct interest rate channel operating through the user cost of capital and the closely related Tobin's q channel), consumption (where the channels operate through wealth effects), and international trade (through the exchange rate). Non-neoclassical channels (the credit view) arise because of market imperfections (other than those associated with nominal wage and price rigidities), for instance, due to government interference in markets, asymmetric information or market segmentation that hampers the efficient functioning of financial markets. In this section, the credit view is discussed in terms of bank lending and balance-sheet channels.

Money Channel

This channel assumes that via the money multiplier, changes in reserve money induce proportional changes in broad money; and that banks are also creators. It is also assumed that individuals hold different components of broad money, currency in circulation, and different forms of deposits. The money view of monetary policy assumes that the money balances available for financing transactions affect the composition of nominal GDP between real GDP and the price level. This relation is captured in the quantity theory: $M_3V = PY$ whereby a change in broad money M_3, which is induced by an initial corresponding change in reserve money(RM) given that $RM = \frac{1}{mm}M_3 \; or \; M_3 = mm.RM$(whereby mm is money multiplier) - assuming a constant income velocity of circulation of money V – must manifest in a corresponding change in either P or Y or both. This channel is considered to be effective when a change in RM delivers a significant effect on either P or Y or both P and Y [See the discussion in (Friedman 1968)

Interest rate channel

The interest rate channel can be viewed in the standard Keynesian IS-LM framework, whereby a fall in the real interest rate (or decrease in the cost of capital) as a result of an expansionary monetary policy leads to an increase in aggregate demand through stimulated investment. The interest rate channel is usually initiated by a change in a policy interest, which is generally a short term one, and affects the longer term rate of the money market and yields on financial assets through expectations. The slow adjustment of the price level is a crucial factor that links the real interest rate with the monetary base as well as the real market interest rate with the nominal policy rate. This generally explains why monetary policy has a transitory effect on output, which is a real variable, and a permanent effect on the consumer price index, which is a

nominal variable; the price adjusts progressively in the long run, accommodating the policy change, while real output returns to the initial level (Mishkin, 2012).

Exchange Rate Channel

With economic globalization and the introduction of flexible exchange rates, more attention has been paid to how monetary policy affects net exports and aggregate output through exchange rates. The extent to which movements in the exchange rate are affected by monetary policy is largely influenced by international interest rate arbitrage whereby the interest rate on domestic bonds (i_t) is equalized with the interest rate on foreign bonds of the same risk and maturity (i_t^*) corrected for the expected foreign exchange rate depreciation $\Delta S_{t+1}^e = (\frac{S_{t+1} - S_t}{S_t})$. However, according to the Keynesian national income determination equilibrium condition, $Y_t = C_t + I_t + G_t + (X_t - M_t)$ whereby $(X_t - M_t) = f(\Delta S_{t+1}^e)$. Thus, a change in the policy rate or monetary base (ΔRM) which induces a corresponding change in money supply (ΔM_3) and the interest rate on domestic bonds, leads to a change in the domestic real interest rate differentials, which then impacts real output through the real exchange rate. (Mishkin, 2012).

Credit Channel: Bank Lending and Balance Sheet Channels

An information problem in credit markets induces two types of monetary transmission channels: those related to bank lending and those related to firms and households' balance sheets. Expansionary monetary policy increases the quantity of available bank loans through an increase in bank reserves and bank deposits. Given many firms' dependence on bank loans, an increase in the quantity of bank loans will cause investment (and consumer) expenditure and aggregate demand to rise (Mishkin, 2012). If the increase in firm output matches the increase in aggregate

demand, real output would increase without a monetary effect on prices and by extension inflation. If however, aggregate demand which is supported by increased bank lending surpasses the increase in firm output, it could be possible to have a situation whereby real output and prices increase as a consequence of the initial increase in bank lending.

When monetary policy changes, this eventually affects borrowers' balance sheets and therefore their credit worthiness. Generally, monetary easing which reduces interest rates, including lending rates, will ease borrowers' existing debt service obligations so that their respective balance sheets improve. With improved balance sheets, borrowers opt to borrow more, and expand their consumption (of households) and investment (of firms), thereby causing an increase in output and prices depending on relative access to bank loans on account of consumers and firms' improved balance sheets. Monetary tightening generally results in the opposite effect (Mishkin, 2012).

Asset Price Channel: Tobin's q and Wealth Effects

An increase in the discount rate of financial assets (which implies a monetary contraction) may result in a fall in asset prices, which will negatively affect the real economy because firms find it difficult to raise equity funding of their investments. The implication of the Tobin's q theory is that when the price of equities is low relative to the replacement cost of capital, a decline in investment and output will occur due to the fact that firms do not want to issue new equities to purchase investment goods (Mishkin, 2012).

Under the permanent income hypothesis, equity prices could also have considerable wealth effects on consumption. An increase in stock (housing and land are also considered as equities) prices raises the financial wealth value, thereby inducing an increase in the lifetime resources of households, and thus current demand for consumption and output (Mishkin, 2012).

Expectations Channel

Because of the link between interest rates, expectations of changes in the policy rate can immediately affect medium and long-term interest rates. Economic agents' expectations of future inflation which in turn has an influence on price developments can be guided by monetary policy. Expectations of future inflation matter in two essential areas. First, by influencing the real level, they establish the impact of any particular nominal interest rate. Second, inflation expectations can influence price and money wage-setting behaviour and feed through into actual inflation in following periods. Likewise, changes in the monetary policy stance can affect inflationary expectations and the ex-ante real interest rate and hence determine the future path of economic activities (Mishkin, 2012).

Once the monetary authority has established a track record in inflation control, economic agents will anticipate appropriate actions by this authority. Accordingly, the agents act as if the authority has indeed taken the appropriate action. Consequently, the desirable outcome of, say, reduced inflation pressure is achieved even before (and at best, even without) policy action being taken. For example, if agents expect higher future inflation, they also expect monetary tightening, say in terms of an increase in the policy rate. They will also expect an increase in the domestic interest differentials and accompanying depreciation of the domestic exchange

rate($\uparrow \Delta S_{t+1}^{e}$) = ($i_t \uparrow$ - i_t^*), assuming that foreign interest rates i_t^* are exogenous: fixed. With the expected depreciation, importers may opt to order imported goods before they become more expensive as a result of the expected monetary tightening and subsequent exchange rate depreciation. On the other hand, exporters may postpone export deals, inducing the trade current account to deteriorate ($\downarrow X_t - M_t \uparrow$) so that, other factors remaining constant, real output falls $\downarrow Y_t$= $\bar{C}_t$ + $\bar{I}_t$ +$\bar{G}_t + (\downarrow X_t - M_t \uparrow) \downarrow$ to suit real money supply and for given money supply and closely inflation P; MV = PY (Mishkin, 2012).

2.3.2 Empirical literature

The literature on monetary policy transmission channels tends to either emphasize neoclassical or non-neoclassical channels. For instance, Taylor (1995) emphasized neoclassical channels; while Bernanke and Gertler (1995) emphasized non-neoclassical channels. Chirinko's (1993) study in the US found that in relation to quantity variables, the elasticity of investment to price variables tends to be small and less important. Fagan, Henry, and Mestre (2005) found elasticity after one year of less than 0.1 percent for the Euro area. Estimates for consumer durables are insignificant, but also seem to be small in the short-run. On the other hand, although research has raised doubts with regard to the bank lending channel (Romer and Romer, 1989, and Ramey, 1993), a number of empirical studies support this channel (for instance, Gertler and Gilchrist, 1993, 1994, and Kashyap and Stein, 1995).

Monetary policy makers need to identify the mechanism through which monetary policy affects the economy in order to decide what policy to adopt to affect output and inflation in the future (Mishkin, 2012). To this end, many studies have been carried out, mainly on the USA and

European economies using dynamic stochastic general equilibrium (DSGE) as well as identified vector autoregression models. For instance, Christiano, Eichenbaum and Evans (2005) carried out such a study in the USA, Smets and Wouters (2002) in the European Union, and Cushman and Zha (1997) in Canada.

The seminal paper by Sims (1980) establishes the dynamic effects of monetary policy on real GNP, unemployment, wages, price level, and import prices for the USA and German economies. Using the recursive VAR approach with quarterly data from 1949 to 1975 for the USA and 1958 to 1976 for Germany, it was concluded that in the US, over long horizons, money innovations were the main source of changes in wages, prices, and import prices, while in Germany, money innovations do not persist sufficiently to induce a smooth, neutral response in wages, prices, and import prices.

Christiano, Eichenbaum and Evans (2005) used the structural vector autoregressive model to characterize the dynamic responses of output and prices to an exogenous monetary policy shock. In both cases, the responses are hump-shaped, where the effect on prices tends to be permanent, whilst the effect on output is transitory. Policy transmission lags, measured in terms of when the policy impacts on prices and output are at their maximum levels, tend to be relatively longer for prices than for output.

Past studies have also found that poor identification of monetary policy shocks can lead to paradoxical results such as the exchange rate puzzle dealt with in Cushman and Zha's (1997) study where monetary tightening was found to result in depreciation instead of appreciation.

Using a non-recursive contemporaneous restriction structural VAR, Kim and Roubini (2000) found that in the non-US G-7, monetary shocks have transitory real effects on the exchange rate consistent with the theoretical models. On the other hand, in a bid to identify the sources of business cycle fluctuations in the Euro area, Smets and Wouters (2002) estimate a stochastic dynamic general equilibrium (DGE) model using Bayesian VAR estimation techniques including a number of frictions such as capital utilization, adjustment costs in capital accumulation and habit formation in consumption, and a sticky, but forward-looking nominal wage. A set of structural shocks such as supply shocks, demand shocks, mark-up shocks, and monetary policy shocks is also included. The study results show that the major source of variation in output, inflation and interest rates are monetary policy, preference shocks, and labor supply shocks. On the other hand, productivity shocks adversely affect employment in both the sticky and the flexible price and wage economy. Furthermore, based on the results, they emphasize that the SDGE model with sticky prices and wages is suited for monetary policy analysis.

Neoclassical channels of monetary policy have dominated research of effectiveness of monetary policy. Peersman and Smets (2001) used the VAR model to show that monetary tightening induced real appreciation in the exchange rate in the Euro area and that the effect on the exchange rate was minor but tended to persist longer than in the US economy. Other studies on the MPTM used VAR to identify the effectiveness of channels of monetary policy transmission. Kim and Roubini (2000) used a structural VAR approach with non-recursive restrictions to model the reaction function of the monetary authorities and the structure of the economy to identify monetary policy shocks. Their results indicate that the effects of monetary policy contractions in non-US G-7 induces appreciation of the exchange rate that, however, depreciates

with time after a few months, which is in line with the uncovered interest parity condition. In Asian economies, Hung and Pfau (2009) documented a strong exchange rate channel in Vietnam, while Abdul (2009) was not able to find evidence on the relevance of the exchange rate in India. Disyatat and Vongsinsirikul (2003) assessed the monetary policy channels and the pass-through from the repurchase to retail interest rates Thailand's economy. Similarly, Agha et al. (2005) found a weak exchange rate channel in Pakistan.

Tsangarides (2010) distinguished between core inflation and headline inflation to evaluate the channels of monetary policy transmission in Mauritius. Employing a VAR framework on annual data from 1999 to 2009, the study found that in the benchmark model of headline inflation, an increase in the nominal effective exchange rate negatively affects inflation (puzzle), while other channels including the repo rate, and money supply were ineffective. In the core inflation model, while the interest rate is weak in explaining changes in output and inflation, an increase in the exchange rate induces a decrease in core inflation (puzzle), and an unexpected increase in money supply induces an increase in both output and core inflation. In both cases, monetary policy transmission channels are weak.

The effectiveness of non-neoclassical channels has been the subject of much debate in developed as well as developing countries. Suzuki (2004) used Dungey and Pagan's model to examine the supply-versus-demand puzzle and the conduct of banks that induces the nature of the lending channel in Australia. Using an 11 variable VAR model, and controlling for foreign exogenous shocks by including US output, US interest rates, and US price and commodity prices, the results showed that the lending channel was weak in Australia; monetary contraction induced

contraction of bank loans, but the reduction largely stemmed from a leftwards shift in the bank loans market demand curve. Contradictory results were found in the USA, where Kashyap and Stein (1994) obtained evidence of a strong lending channel. They argued that this difference is due to the different characteristics of financial markets. Australian banks borrow on international markets and use their securities to moderate the impact of the tightening of domestic monetary policy.

Bernanke and Gertler (1995) employed a VAR approach to examine the functioning of the banking lending channel and borrowers' balance sheet to assess the influence of monetary policy on aggregate demand components. They found that unforeseen tight monetary policy has a transitory effect on interest rates but reduces real GDP and price levels, thereby supporting the relevance of the credit channels in the USA. However, earlier work by Romer and Romer (1990) that investigated the money view (banking system liabilities) and the lending view (banking system assets) in the USA, concluded that during periods of monetary policy tightening, the monetary aggregate M1 falls more rapidly than the fall in credit, almost the same time that the fall in output takes place, in their view implying that rather than monetary policy, demand factors drive credit. The authors argued that this observation is consistent with the money view. Conversely, Bernanke and Blinder (1992) maintain that such behaviour reflects the special nature of credit, given that, for fear of driving customers to bankruptcy or of losing them, banks respond slowly to reduce lending and compensate for reduced deposits by selling securities (credit may even rise to finance inventories).

In Pakistan, Agha et al. (2005) employed a recursive VAR approach with monthly data (1996:7-2004:3) to explore the nature of the different channels of monetary policy. Their findings suggested that while the exchange- rate channel was weak, bank lending, interest rate and asset price were channels of monetary policy.

Okoro (2013) examined the impact of monetary policy on Nigerian economic growth using data from 1970-2010 and found that both neo- and non-neoclassical channels had a mixed influence on output. The results show that there is a long-run equilibrium relationship between the instruments of monetary policy and economic growth. The interest rate and inflation rate were found to be negatively correlated with GDP, while money supply, exchange rate, and credit to the economy were positively related to GDP.

A number of studies in the context of East African countries have included exogenous variables to control for external shocks. Generally, these exogenous variables include the global food price index, the global oil price index, US industrial production, and the US federal funds rate. The latter two are proxies for global demand conditions. Country cases results are compared in order to reveal the effectiveness of the MPTM under the same economic structure.

In Kenya, Maturu (2014) examined the effectiveness of channels of monetary policy transmission during 2000Q1-2012Q4 and obtained results that are in contrast with those of Cheng (2006). The former used recursive, short-run and long-run approaches to identify the structural VAR and Bayesian VAR (BVAR) models. The general conclusion was that tightening monetary policy through an increase in the policy rate induces an increase in the Treasury bills

rate and exchange rate appreciation. The effect on inflation is permanent and is indirect through the Treasury bills rate. Other notable results suggest that a monetary shock has a significant short-lived effect on output and a permanent effect on inflation. The major conclusions of Maturu (2014) are in line with Maturu and Ndirangu (2013) who used structural and recursive variants of the BVAR model over the period 2008Q1-2012Q3 to study the effectiveness of channels of monetary policy in Kenya. Their study used seasonally unadjusted data (whose effects were controlled by incorporating seasonal terms in the BVAR model) to avoid discarding useful information in the data. The results indicate that although the magnitude of the direct effects of changes in the monetary policy interest rate are rather small, the effects are fairly fast (within a quarter of a year following a change in policy) and persistent in terms of output and prices. The results also showed that in order of their relative importance, the channels of monetary policy transmission in Kenya were: the interest rate, the exchange rate, and the money and bank credit channels.

Cheng (2006) used the VAR Model to examine the impact of a monetary policy shock on output, prices, and the nominal effective exchange rate in Kenya using data covering the period 1997-2005. The main results suggest that an exogenous increase in the short-term interest rate tends to be followed by a decline in prices and appreciation of the nominal exchange rate, but has insignificant impact on output. Taking into consideration that the monetary stance is perceived to have little impact on agriculture in Kenya, which is often largely driven by exogenous factors beyond the control of the Central Bank of Kenya (CBK), such as weather, agriculture's large share of Kenya's GDP appears to provide the reason for the insignificant relationship between total output and monetary policy. The study therefore isolated agriculture and examined the

monetary impact on non-agricultural output. The findings indicated that, like total GDP, monetary policy had little impact on non-agricultural output.

However, removing agricultural products from total products hides the indirect effect that the weather has on other sectors through agriculture. Changes in agricultural production due to changes in the weather may partly affect other sectors (mostly industry), especially when these sectors are strongly related to agricultural products. Industry in less developed countries is dominated by the agro-sector[15], implying that changes in this sector also stem indirectly from changes in the weather.

In Tanzania, Montiel et al. (2012) used monthly data from January 2002-September 2010 in an identified VAR and were unable to provide strong evidence of effective monetary policy transmission. They found that the point estimates of dynamic monetary policy effects are not consistent with theoretical priors. Although a monetary expansion causes the exchange to depreciate as expected, it results in an increase in the bank lending rate and a reduction in the price level. While the expansion has a cyclical effect on real GDP, the effect proves negative over the first eight months after the expansion. They claim that poor identification is the leading alternative to their conclusion, and argue that "the particular concern is the difficulty, in a low-income country with a large agricultural sector, of distinguishing aggregate demand shocks from shocks to aggregate supply" (Montiel et al. 2012, 28). From their point of view, if real GDP is

[15]Agro-industries occupy a dominant position in manufacturing in LICs and can represent as much as 50% of the manufacturing sector. Their contribution to total manufacturing is 61% in agriculture-based countries, 42% in countries in transformation and 37% in urbanized developing countries (GAIF, 2008). Agro-industry is broadly understood here as the post-harvest activities involved in the transformation, preservation and preparation of agricultural production for intermediary or final consumption. This includes food and beverages, tobacco products, paper and wood products, and textiles, to name but a few.

primarily or substantially driven by temporary supply shocks, innovations in detrended real GDP reflect a combination of supply and demand shocks. If the monetary authority responds asymmetrically to these two types of shocks, the VAR coefficients will be imprecisely estimated and impulse responses will correspondingly be insignificant. To investigate this concern, they claimed to have controlled for rainfall shocks as an exogenous variable in the VARs. The results are qualitatively unchanged. However, Montiel et al.'s (2012) study does not clearly show how rainfall is controlled for. It appears from a table of tests of lag order in the appendix, that the added variables are food and energy as exogenous variables to control for rainfall. However, this would hide the total effect of rainfall on economic activity. Services are also affected by weather shocks. This study proposes the use of rainfall as a variable to understand the total effect of weather on the supply side of GDP.

In Uganda, while Mugume (2011) applied structural VAR models and found the channels of monetary policy transmission (for instance interest rate, bank credit, and exchange rate) as not fully useful, Saxegaard (2006) used threshold VAR techniques and found that contraction in the money supply has a significantly negative impact on CPI inflation, but insignificant effect on output. The effect of monetary policy on inflation in Uganda is supported by the Mikkelsen and Shanaka (2005c), that found that a 1percent increase in broad money (M2) raises core inflation by 0.2 percent. However, the three studies used very short sample time series data from 1999-2009; 1993-2003; and 1993-2004, respectively although the last-mentioned used monthly data.

Two studies on the EAC produced contradictory results. Davoodi et al. (2013) found that reserve money positively influences output but not price in Burundi, Uganda and Rwanda, while a

reduction in the policy rate increases output in Burundi, Kenya, and Rwanda, and prices in Kenya and Uganda. However, these results are based on a short sample time series data from 2000-2010 though the study employed monthly data. Buigut (2009) estimated a three-variable recursive VAR for 1984-2006 for three EAC countries (Kenya, Tanzania, and Uganda) separately, using annual data on real output, price level, and short-term interest rate. The study found that the interest rate transmission mechanism is weak in all three countries. This could be due to the fact the study used a sample that included too few observations for empirical analysis, resulting in limited degrees of freedom. Furthermore, the study includes periods of structural changes that all these economies observed in the late 1980s and early 1990s.

Furthermore, results by Rusuhuzwa et al. (2008) for the case of Rwanda differ from Davoodi et al.'s (2013) in that money stock only affect inflation rate rather output. However, the sample data used covered the period including 1994 and 1995, the years that include outliers for inflation and GDP growth rates. In addition, the sample is relatively short (1994-2006) for empirical analysis.

2.3.3 Overview of the literature review

The literature review in the preceding section reports mixed, contradictory findings and convergence in some studies. Only two studies have explicitly analyzed monetary policy transmission in Rwanda. Davoodi et al. (2013) used SVAR on monthly data and found that an expansionary monetary policy (a positive shock to reserve money) increases output significantly in Rwanda, but has no significant effect on prices. Monetary policy, as measured by shocks to reserve money, has long lags in Rwanda (significant output effects from six to 15 months). Moreover, an expansionary monetary policy (a negative shock to the policy rate) significantly

increases output in Rwanda with short lags ranging from three to five months; thus, it is concluded that the credit channel is the most important. Rusuhuzwa et al. (2008) used a VAR model with quarterly data from 1994 to 2006 to assess the MPTM in Rwanda. They found that a shock to domestic monetary aggregate has a significant effect on price, but no major impact on output.

The two studies obtained divergent results. In the first study, monetary policy affects output but not price, while in the second, monetary policy significantly affects price but not output. Davoodi et al. (2013) used a very short period (2000-2010), further constrained by the fact that the year 2000 is the year the treaty establishing the EAC entered into force. The reason was that the study focused on Rwanda together with other EAC countries. On the other hand, Rusuhuzwa et al. (2008) used a sample period from 1994 to 2006. This includes the period of war from 1990 to mid-1994 that had severe effects on Rwanda's economic activity. From 1994-1995, economic growth and inflation rates in Rwanda reached respectively their lowest (-50 percent in 1994) and highest (51.3 percent in 1995) levels in 50 years. New information is now available beyond the study periods covered by these two studies that can pave the way for improved results.

Moreover, apart from Cheng (2006) and Montiel et al. (2012), all the studies cited did not take into account the effects that the weather has on total output through agricultural production[16]. In contrast to Cheng (2006), and Montiel et al. (2012), the current study maintains agricultural

[16] Several works (Paxson, 1992; Miguel, 2005 and Nastis et al., 2012, to name but a few) have illustrated the weather's contribution in determining output in LICs, where irrigation mechanisms are less developed. Miguel et al.(2004, 726) argue that ''weather shocks are plausible instruments for growth in GDP in economies that largely rely on rain-fed agriculture, that is, neither have extensive irrigation systems, nor are heavily industrialized''.

product in the national product, but includes rainfall as an additional variable that controls for the direct and indirect contribution of weather changes to total agricultural, service and industrial products. The study also considers the economic influence of changes in the aid granted to Rwanda after the war (and genocide)[17]and UN payments to the Rwandan Government. Another domestic exogenous variable taken into consideration in this study is the 1996-2002 war between Rwanda and the DRC. The summary of empirical literature is summarized in Table 2.1.

[17]There has been a longstanding debate on the economic impact of aid on growth. Burnside and Dollar (2000) and Rajan and Subramanian (2008) support the absence of a robust positive relationship between aid and growth. However, studies by Hoeffler (2012); Hoeffler, *et al*. (2011); Collier and Hoeffler, (2004) and Collier and Hoeffler (2002) show that aid has a significant impact on economic growth. To summarize the debate, it is argued that while aid may promote growth in post-war countries, there is no link between particular types of aid and growth to explain why aid is growth enhancing. The proportion of aid provided for particular purposes (for example for economic or social infrastructure, debt relief or humanitarian needs) does not seem to be different across recipients: post-war countries receive a very similar aid package to that of peaceful developing countries.

Table 2.1 Summary of empirical findings

		High, and middle income countries						
Author(s)	**Case**	**Approach**	**Dep var**	**Money**	**Interest rate**	**Bank lending**	**Exchange rate**	**Asset price**
			Neoclassical channels					
Christiano et al. (2005)	US	VAR/ DSGE	Output	Effective	Effective			
			Inflation	Effective	Effective			
Suzuki (2004)	Australia	VAR	Output			Ins		
			Inflation					
Disyatat and Vongsinsirikul (2003)	Thailand	VAR	Output		Effective		Ins	Ins
			Inflation		Effective		Ins	
Smets and Wouters (2002)	EU	SDGE	Output	Effective				
			Inflation	Effective				
Kim and Roubini (2000)	US G-7	VAR	Output	Effective	Effective			
			Inflation	Effective	Effective			
Kashyap (1994)	US	VAR	Output			Ins		
			Inflation					
Sims (1980)	US	VAR	Prices	Effective				
	Germany	VAR	Prices	Ineffective				
		Non-neoclassical channels						
Bernanke and Gertler (1995)	US.	VAR	Output			Effective		
			Inflation			Effective		
		Low income countries						
Author(s)	**Case**	**Approach**	**Dep var**	**Money**	**Interest rate**	**Bank lending**	**Exchange rate**	**Asset price**
			Neoclassical channels					
Maturu (2014)	Kenya	VAR	Output		Ins		Ins	
			Inflation		Effective		Ins	
Maturu and Ndirangu (2013)	Kenya	VAR	Output	Ins	Effective	Ins	Effective	
			Inflation	Ins	Effective	Ins	Ins	
Montiel et al. (2012)	Tanzania	VAR	Output	Ins				
			Inflation	Effective				

Author(s)	Case	Approach	Dep var	Money	Interest rate	Bank lending	Exchange rate	Asset price
Mugume (2011)	Uganda	VAR	Output	INS	Ins		Ins	
			Inflation	INS	Ins		Ins	
Tsangarides (2010)	Mauritius	VAR	Output	Ins	Ins		Ins	
			H.Inflation	Ins	Ins		Puzzle	
			Output	Effective	Ins		Ins	
			C.Inflation	Effective	Ins		Puzzle	
Buigut (2009)	EAC	VAR	Output		Ins			
			Inflation		Ins			
Hung and Pfau (2009)	Vietnam	VAR	Output				Effective	
			Inflation				Effective	
Abdul (2009)	India	VAR	Output				Ins	
			Inflation				Ins	
Rusuhuzwa et al. (2008)	Rwanda	VAR	Output	Ins	Ins	Ins		
			Inflation	Effective	Ins	Ins		
Cheng (2006)		VAR	Output		Ins			
			Inflation		Mixed			
Saxegaard (2006)	Uganda	VAR	Output	Ins				
			Inflation	Effective				
			Inflation				Ins	
Mikkelsen and Shanaka (2005c)	Uganda	VAR	Inflation	Effective	Insignificant		Effective	
			Non-neoclassical channels					
Davoodi et al. (2013)	Rwanda	VAR	Output	Ins		Effective		
			Inflation	Effective		Effective		
			Mixed results					
Okoro (2013	Nigeria	VAR	Output	Effective	Effective	Effective	Effective	
Agha et al. (2005)	Pakistan	VAR	Output		Effective	Effective	Ins	Effective
			Inflation		Effective	Effective	Ins	Effective

H.Inflation and C.Inflation refer to headline and core inflation, respectively; Ins refers to insignificant (ineffective); Dep var stands for dependent variable.

2.4 Methodology

2.4.1 Theoretical framework

As supported by Ireland (2005), building on earlier attempts, a theoretical study of MTM seeks to identify how the traditional Keynesian interest rate channel functions within the context of DSGE models, in order to combine the fundamental assumption of rigidity in nominal price or wage with the hypothesis that all agents have rational expectations in order to overcome the policy ineffectiveness identified by Lucas (1972). This work derives the New Keynesian model's (NKM) behavioural equations from descriptions of the objectives and constraints faced by optimizing households and firms. The basic NKM corresponds to a three equations system that involves three variables: output gap y [obtained by subtracting the actual output from potential output $(Y - \bar{Y})$], inflation (π), and the short-term nominal interest rate (i). The first equation, usually called the expectational IS curve, relates the current output gap to its expected (E_t) future value and to the ex-ante real rate of interest,

$y_t = E_t y_{t+1} - \sigma\ (i_t - E_t \pi_{t+1})$ …….. (2.1)

Whereby the parameter σ in (2.1), as well as β, and γ introduced in equations (2.2) and (2.3) is strictly positive. Equation (2.1) is a log-linearized version of the Euler equation relating the intertemporal marginal rate of substitution to the real interest rate (which is the inflation-adjusted return on bonds) of an optimizing household. The second equation, the New Keynesian Phillips curve, takes the form

$\pi_t = \beta E_t \pi_{t+1} + \gamma y_t$ …….. (2.2)

and is a log-linearized version of the first-order condition presenting the optimal behaviour of monopolistically competitive firms that either face nominal price adjustment explicit costs, as provided by Rotemberg (1987) or set their nominal prices in a randomly staggered way, as

provided by Calvo (1983). The final equation is an interest rate rule for monetary policy suggested by Taylor (1993),

$i_t = \alpha\pi_t + \varphi y_t$ ..... (2.3)

Indicating that the short-term nominal interest rate i_t is systematically adjusted by the Central Bank in reaction to the inflation gap and the output gap. In this benchmark NKM, monetary policy functions through the traditional Keynesian interest rate channel. Following monetary tightening in the form of a shock to the Taylor rule, increasing the short-term nominal interest rate induces an increase in the real interest rate (given the assumption that nominal prices are rigid or move slowly in the short term). This causes households to reduce their consumption spending as recapitulated in the IS curve. Finally, through the Phillips curve, the fall in output induces a decline in inflation, which adjusts only gradually after the shock. However, the IS and Phillips curves, contain expectational terms with the implication that policy actions will differ in their quantitative effects in response to whether or not these actions are anticipated. Hence, this NKM relates to the earlier rational expectation model of Lucas (1972) and that of Sargent and Wallace (1975) by emphasizing the role of expectations in the MTM. An open-economy extension is developed by Obstfeld and Rogoff (1995) in which the interest rate channel of monetary policy transmission operates together with the exchange rate channel. The basic model is extended by Bernanke, Gertler, and Gilchrist (1999), to account for the balance sheet channel of monetary policy transmission.

2.4.2 Model specification

Monetary policy effects have been analyzed within the context of the MPTM. A substantial body of literature has emerged that attempts to measure the empirical effect of monetary policy on aggregate demand. To a large extent, this literature has focused on the experience of the US and other advanced countries, and to a relatively less extent on emerging economies. However, there is now a substantial body of work on LICs. VAR models are the most widely used to analyze the MPTM. The use of VARs for monetary policy analysis began with the seminal work of Sims (1980) and its recursive methodology has been widely used. Christiano, Eichenbaum and Evans (1999) used VAR for the US, while Mishra, Montiel, and Spilimbergo (2010), Mishra and Montiel (2012), and Maturu and Ndirangu (2013) used VAR to analyze monetary policy effects for LICs. In line with the reviewed previous studies, the current study uses VAR methodology to examine the effects of monetary policy on the Rwandan economy.

The literature on the MPTM has generally relied on identified VAR and to some extent on BVAR and DSGE, the latter being mainly applied in developed countries. However, while BVAR requires determining the true priors, that are usually uncertain, the use of DSGE requires a large sample of data, which seems to be a challenge, especially in developing countries. On the other hand, while simple, VAR has been found to have limitations given that it is not a structural model, although attempts are made to use SVAR. The policy impact is not clearly measured. In other words, one might not obtain estimates of the magnitude of change in the variable of interest due to a given percentage change in the policy variable. Apart from the challenge of the size of the sample time series data which is not sufficiently large, the choice of VAR is also motivated by the fact that Davoodi et al. (2013), and Rusuhuzwa et al. (2008), used VAR to analyze the

MPTM in Rwanda, and by using VAR, results can easily be compared. Consistent with previous studies [see for example Cheng (2006), Davoodi et al. (2013), and Maturu and Ndirangu (2013)] this study uses the VAR methodology to examine the effects of monetary policy on the Rwandan economy. The structure of the Rwandan economy is assumed to be presented by the following Structural VAR model.

$AY_t = A_0 + C(L)Y_{t-1} + F(L)X_{t-1} + e_t$ ……. (2.4)

Where Y_t is a k dimensional vector of endogenous variables at time t, Y_{t-1} is a k dimensional vector of lagged endogenous variables, X_{t-1} is the vector of exogenous variables that includes domestic and foreign variables, e_t is a k dimensional vector of structural innovations, where $e_t \sim (0, \Sigma e)$, A_0 is k dimensional vector of constants, A is k x k matrix of structural coefficients and *C(L)* and *F(L)* are the matrix polynomials in the lag operators L of order p that has to be determined empirically. For given data, there is an unlimited set of different values of matrix A and *C(L),* and additional restrictions are necessary in order to obtain the parameters, because different structural forms provide an identical reduced-form VAR model. The structural form VAR model can be presented in reduced form as:

$Y_t = \gamma + D(L)Y_{t-1} + H(L)X_{t-1} + u_t$ ……. (2.5)

$\gamma = A^{-1}A_0$ …..……. (2.6);

$D(L) = A^{-1}C(L)$…….. (2.7);

$H(L) = A^{-1}F(L)$……. (2.7′); and

$u_t = A^{-1}e_t$ ……. (2.8)

Whereby e_t represents the reduced-form innovations without direct economic interpretation in contrast to the structural shocks u_t whereby $u_t \rightarrow (0,\sum u_t)$. The reduced form VAR is estimated by the standard Ordinary Least Squares (OLS) method since the obtained estimator is asymptotically unbiased and efficient (Enders, 2003). Acknowledging that without additional restriction it is impossible to obtain the structural form from the reduced form and hence the impulse response function (IRF) and given that $\sum u_t \neq IK$ (unit matrix of order *k*), implying that u_{kt} are normally correlated in time *t*, makes the interpretation of the reduced form of shocks difficult. It is hence necessary to introduce exogenous (non-sample) constraints in order to obtain the structural form from a reduced form. Given that

$e_t = Au_t$ …….…….…….…. (2.9),

information about the structural innovations can be obtained. It is important to highlight that restrictions on the relationship among the parameters are only applicable for the initial period, while in the subsequent period the effect is transmitted through the VAR according to the specification. It is also possible to orthogonalize the variance and covariance matrix of reduced shocks $\sum u_t$assuming that the u_t is the linear combination

so $u_t = A^{-1}e_t$ and $\Sigma u = A^{-1}\Sigma e A^{-1\prime}$ ……... (2.10).

Given that the structural innovations variance and covariance matrix is a unit matrix, i.e. e_{kt} are uncorrelated in time *t*, it is possible to obtain a matrix *B* for which

$\Sigma u = A^{-1}A^{-1\prime}$ …….…….…….... (2.11).

Equation (2.11) is a system from which A^{-1} can potentially be solved for, as the variance-covariance matrix of regression residuals (Σu) is known. Unfortunately, equation (2.11) represents a system in which the number of independent equations is less than the number of

unknown elements of the A^{-1} matrix given that Σu is symmetric. Thus, one has to fix a sufficient number of elements of A^{-1} s values to the extent that the variant of equation (2.11) constitutes an identified system. The lowest number of identifying restrictions needs to be imposed to equal the number of elements of the variance-covariance matrix of

Σu. i.e. $n^2 - \frac{n^2+n}{2} = \frac{n^2-n}{2}$ (symmetric elements of var-covariance matrix)

for the system to be identified. To do so, the study uses the Cholesky decomposition: recursive (Sims, 1980). Once A^{-1} is obtained, it is used in equation (2.8) i.e. $u_t = A^{-1}e_t$ to recover all the variables.

The endogenous variables include real GDP (RGDP), inflation [(from *CPI*], stock money (*M3*) [Interbank interest rate, a proxy of short-term interest rate (INTBR)], credit to the private sector (BCPS), and the nominal effective exchange rate (*NEER*). That is:

$Y_t' = [\ \mathrm{RGDP_t}\ \mathrm{INF_t}\ \ \mathrm{M3_t}\mathrm{INTBR_t}\ \ \mathrm{BCPS_t}\ \ \mathrm{NEER_t}\ ]$ …….. (2.12)

The exogenous variables include the US Industrial Production Index (USIPI), a proxy for foreign output, the Treasury Bills rate for the USA (USATB), and the world oil price (WOILP). To consider the influence of the weather on Rwanda's total output and inflation through agricultural produce, the study controls the weather effect by introducing the amount of rainfall (RF). Other exogenous variables that were included in this study are foreign aid (AID), a dummy variable (DUN) standing for UN payments, and finally a dummy variable (DWAR) for the 1996-2002 war against the DRC. The effects of the global financial crisis are captured in the international variables that represent the global economic effects. The augmented model is therefore specified as

$X_t' = [USIPI_t \;\; WOILP_t \;\; USATB_t \;\; RF_t AID_t \;\; DUN \;\; DWAR]$ …….. (2.13)

The variables in equation 2.13 were included to control for changes in the overall global economic stance, and fluctuations in energy prices that may affect the Rwandan economy, support from international organizations, and changes in payments that may arise from a new conflict. Variability in the weather that may affect the supply side of the economy is also included. Given that the Rwandan economy is unlikely to influence the global economy, the variables of the weather, international peace keeping missions and international aid are treated as exogenous.

It is worth noting that this study estimated the VAR model using lagged exogenous variables. The rationale for the use of lagged exogenous variables was the fact that both domestic and foreign shocks, are likely to affect the local economy with lags.

2.4.3 Identification procedure

It is common in the literature to use the recursive VAR to determine the channels of transmission of monetary policy. The identification scheme in this study was the standard approach that imposes a recursive structure of the VAR, with the ordering of variables given by equation (2.12). As an extension to Cheng (2006), intuitively, it assumes that prices (*INF*) have no immediate effects on output (*GDP)*, money stock (*M3*) has no instantaneous effect on prices, interest rate (*INTBR*) does not have an immediate effect on the money stock, bank credit to the private sector (BCPS) does not have an immediate effect on the interest rate, and the nominal effective exchange rate (*NEER*) has no instantaneous effect on bank credit to the private sector. Technically, this amounts to estimating the reduced form VAR, then computing the Cholesky

factorization of the reduced form VAR covariance matrix. In other words, the relation between the reduced-form errors and the structural disturbance is given by:

$$\begin{bmatrix} e_t^{RGDP} \\ e_t^{INF} \\ e_t^{M3} \\ e_t^{INTBR} \\ e_t^{BCPS} \\ e_t^{NEER} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 & 0 & 0 \\ f_{41} & f_{42} & f_{43} & 1 & 0 & 0 \\ f_{51} & f_{52} & f_{53} & f_{54} & 1 & 0 \\ f_{61} & f_{62} & f_{63} & f_{64} & f_{65} & 1 \end{bmatrix} \begin{bmatrix} u_t^{RGDP} \\ u_t^{INF} \\ u_t^{M3} \\ u_t^{INTBR} \\ u_t^{BCPS} \\ u_t^{NEER} \end{bmatrix}$$

2.4.4 Data description and measurement of the variables

The study used quarterly seasonally adjusted data from 1996Q1 to 2014Q4. Quarterly data are capable of producing reasonable sample sizes based on relatively short time spans. They have also become increasingly appealing for the purposes of multivariate inference and testing of hypotheses. Data for all endogenous variables [Inflation (CPI), money stock (M3), Interest rate (interbank rate), bank credit to the private sector, and the nominal effective exchange rate] were obtained from the BNR, and from the Ministry of finance and economic planning (Minecofin) for RGDP. The interbank interest rate is used in this study as a proxy for the bank rate[18]. Inflation is represented by the consumer price index [CPI (base: 2011; reference: February 2014=100)].

[18] Immediately after the war that ended in July 1994, there was little money in circulation. The central bank of Rwanda's focus during that period was to inject liquidity in the economic system (using the injection rate). This exercise took several years until early 2001 where the BNR started applying its mop-up rate to absorb money from the system when necessary. In the middle of 2008, the BNR adopted the repo rate which is in use to date. In addition, data for the injection rate is only available from 1999. Given this constraint, this study uses the interbank rate as a proxy for the policy rate.

In terms of data for the domestic and foreign exogenous variables, following Kharas (2008) who argued that Official Development Assistance (ODA) is a comprehensive and hence good measure of support to a country; this study used net official development aid (NODA) as a proxy for aid flow in Rwanda. Annual Data for Net Official Development Assistance from 1996-2013 were obtained from World Bank Meta data while data for the year 2014 was obtained from Minecofin and were all in current USD.

Monthly data for rainfall[19]were obtained from the Rwanda Meteorology Agency and were transformed into quarterly data by calculating monthly averages. The dummy variables representing war (DWAR) and UN payments (DUN) included 0 and 1values. DWAR=1 for the period between 1996:Q3-2002:Q3, and DWAR=0 otherwise. DUN=1 for the period between 2008:Q1-2014:Q4, and DUN=0 otherwise. Although the peace keeping missions started in 2005, a significant number of troops were part of missions from 2008; The study assumes that costs and payments received for anything below 500 troops would not affect Rwandan Government expenditure. Most previous studies of MPTM have included exogenous variables in order to control for the external effects due to world economic developments (such as the global financial and economic crises of 2007/2008), and the incidence of price and exchange rate puzzles. For the purpose of this study, world exogenous variables include the US industrial production index (USIPI)[20]; the USA 90-Day Treasury Bills interest rate (USATB)[21]; and the world oil price (WOILP)[22].

[19]The rainfall data used in this study is the average of five meteorology stations (Cyangugu, Gikongoro, Kigali, Byumba, and Kibungo)in the country.

[20]Board of Governors of the Federal Reserve System (US), in Industrial production index available at https://research.stlouisfed.org/ fred2/series/INDPRO/. *The data is seasonally adjusted from the source; the* Index 2007=100.

Real GDP is the Gross Domestic Product by Expenditure Approach (constant prices, 2011=100) and is generally computed by the National Institute of Statistics of Rwanda (NISR); CPI stands for inflation; and money supply, M3, is computed by the BNR and is currency in circulation outside the banks plus demand, time deposits and foreign currency deposits at commercial banks (deposits include both Rwandan franc and foreign-currency). The nominal effective exchange rate (NEER) is the weighted average value of Rwandan franc currency relative to all major currencies being traded. A positive increase in NEER implies depreciation of the Rwandan currency.

Real GDP [(RGDP) data (constant 2011 prices)] was available at annual frequency[23] and was interpolated using the quadratic match sum (QMS) approach. The choice of the QSM approach was dictated by the fact that the resulting interpolated RGDP data graph fits the quarterly RGDP data for the period 2006-2014 as shown in Figure 1.9 in Appendix 1. Real GDP is interpolated for the period 1996: Q1-2005: Q4 as depicted in Figure 1.10 in Appendix 1, while the period 2006: Q1 to 2014: Q4 uses data from Minecofin and was collected on a quarterly basis by the NISR. The data for NODA were initially in current USD and were adjusted to the nominal exchange rate (USD-Frw) to obtain official development assistance in current Frw. They were then deflated to obtain their constant values in Frw. The series is then interpolated following the

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[21]Board of Governors of the Federal Reserve System (US), in 3-Month Treasury Bill: Secondary Market Rate available at https://research.stlouisfed.org /fred2/series/TB3MS/downloaddata. The data is not seasonally adjusted from the source.

[22] U.S. Energy Information Administration in *Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma*. Available at https://research.stlouisfed.org/fred2/series/DCOILWTICO/downloaddata. The series is not seasonally adjusted from the source, and the price is in dollars per barrel.

[23] In Rwanda, quarterly data for GDP is only available from 2006.

same approach as GDP interpolation. The rainfall data used in this study is the average of five meteorology stations (Cyangugu, Gikongoro, Kigali, Byumba, and Kibungo) in the country. The interbank interest rate (INTBR) as well as the US Treasury bills rate (TBUSA) were converted into log [whereby lintbr = log(1 + intbr), and ltbusa = log(1 + TBUSA)] to allow for interpretation of the impulse responses to shocks to INTBR (the proxy for the policy rate) as short run elasticities instead of semi-interest rate elasticities. Apart from RGDP, and NODA, data for other variables in the study were monthly and were made quarterly by calculating monthly averages.

The data[24] were further expressed in natural logarithms (including interest rates) and are seasonally adjusted[25]. The seasonal factors are assumed to be constant for the moving average method[26]. This study uses the Census X12 method to seasonally adjust the series that exhibit seasonal movements. Regarding the choice of a multiplicative or additive approach, the graphical presentation of the size of the peaks and troughs was used. The literature on the multiplicative model notes that the seasonality of the series is affected by the level of the series. Alternatively, if the size of the seasonal peaks and troughs is independent of the level of the trend, an additive decomposition model is more appropriate[27]. To seasonally adjust data that contain zero values

[24]Apart from RGDP, and NODA, data for the other variables in the study were monthly and were made quarterly by calculating monthly averages.

[25]Eviews 7.0 provides different seasonal adjustment methods which include the Census X12, X11 (Historical), Tramo/Seats or Moving Average Methods. The main difference between X11 and the moving average method is that the seasonal factors may change from year to year in X11.

[26] See Eviews 7 Users Guide I.pdf-Adobe Reader

[27]Office for National Statistics, Methodology and Statistical Development, Guide to Seasonal Adjustment with X-12-RIMA, DRAFT, National Statistics, TSAB, March 2007, available at http://www.ons.gov.uk/ons/guide-method/method-quality/general-methodology/time-series-analys

(such as rainfall), the study used the pseudo-additive decomposition model. This model is only used for time series where there are non-negative values with regular zeros. Regarding the way data enter the model, two approaches are available. The first suggested by Blanchard and Quah (1989) indicates that only stationary data at level and/or differenced enter the model, and the second approach allows data to enter the model in its level form.

2.5 Empirical results and discussion

This section presents the preliminary results, followed by regression results for the benchmark model, and comparison of results with specification one and specification two. The test of stability of the money multiplier closes this section.

Before presenting the substantive results of the analysis, the study provides preliminary results (stationarity, cointegration, lag-order selection criteria, stability, serial autocorrelation, and normality tests).

The data stationarity properties are essential in establishing the relationships between prices, output and policy-related variables, as is making the correct assumption about the true data generating process (DGP). The unit root tests were then conducted on the equations describing the DGP of the series. In this exercise, each stationarity test was preceded by a corresponding graph. Using the Augmented Dickey-Fuller (ADF) test, and the Philips-Perron (PP), and Kwiatkowski-Philips-Schmidt-Shin (KPSS) tests, the results as presented in Table 1.1 in Appendix 1 revealed that the endogenous variables of the model [log of real GDP (LRGDP), log of CPI (LCPI), log of money stock (LM3) , log of interbank rate (LINTBR), log of bank credit to

private sector (LBCPS), and log of nominal effective exchange rate (LNEER)] as well as exogenous variables [log of net Official Development Assistance (LNODA), log of rain fall (LRF), log of US industrial product index (LUSIPI), log of US Treasury bills (LTBUSA), and log of World oil price (LWOILP)] were all integrated of order one [that is I-(1)].

The cointegration test is based on Johansen cointegration test. After all the series were found to be I (1), the cointegration test was run to ensure a long-run relationship among non-stationary variables. The results in Table 2.5 in Appendix 2 show that the series were cointegrated at the 5 percent level.

In the comparative analysis, the selection of the lag is made following the model that minimizes the functions of the sequential modified LR test statistic, Akaike Information (AIC), Schwarz Bayesian (SC), Hannan-Quin (HQ), and Final Prediction Error (FPE) Information criteria. The results in Table 3.2 show that the VAR models with 1lag (by SC:-26.27 and HQ: -27.90), 2 lags (by LR: 57.45, and FPE: $1.03e^{-20}$), and 6lags (by AIC: -30.10) were the best since they presented the lowest computed values. This situation required making a choice between 1, 2, or 6 lags to determine the appropriate lag order for the model to be estimated. The choice in this study was mainly based on the tests of autocorrelation and normality to identify the lag order that allows autocorrelation in the residuals to be removed. However, it also takes into consideration the sample size used in this study that, while not small, is not large, implying that a parsimonious equation would be privileged[28]. The test of stability and normality led to the rejection of 1lag VAR, given that it was not normally distributed. Models with 2 lags and 6 lags were found to be

[28]Bogoev et al.(2013) used the same methodology.

stable, not serially correlated, and normally distributed. However, given the sample size of 76 observations against 13 lagged variables, the VAR with 2lags was selected over the 6lags VAR for parsimonious reasons.

Table 2.2 Selection of VAR lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
1	1098.116	501.797	1.09e-20	-28.975	-26.277*	-27.903*
2	1138.333	57.453*	1.03e-20*	-29.095	-25.241	-27.564
6	1317.493	42.007	1.28e-20	-30.100*	-21.620	-26.731
* indicates lag order selected by the criterion						

The stability test presents the characteristic AR polynomial inverse roots. If the modulus for all roots is less than one and lies inside the unit circle, the estimated VAR is stable.

Figure 2.5 VAR Stability test

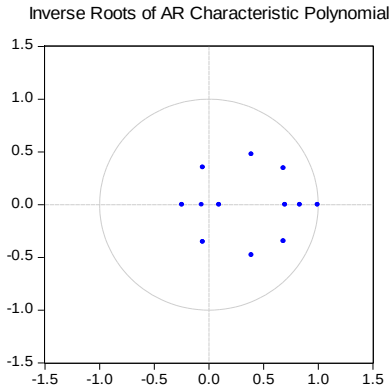


Figure 2.5 indicates that the modulus for all roots is less than one and lies inside the circle. Hence the 2 lags VAR is stable.

The autocorrelation test was done using the multivariate LM test statistics for residual serial correlation up to 12 lags. To compute the test statistic for lag order ‘h’, an auxiliary regression of

the residuals$u_t$was run on the lagged residual u_{t-h} and the original right-hand regressors, where the missing first 'h' values of the residuals were filled with zeros. Under the null assumption of no serial correlation of order 'h ', the LM statistic follows an asymptotic distribution χ^2 with k^2 degrees of freedom, where$k$ is the number of endogenous variables. The LM test results are depicted in Table 2.3.

Table 2.3 VAR Residual Serial Correlation LM tests

Null Hypothesis: no serial correlation at lag order h		
Sample: 1 76		
Included observations: 74		
Lags	LM-Stat	Prob
1	68.79	0.00
2	18.43	0.99
3	38.40	0.36
4	60.86	0.01
5	35.46	0.49
6	30.05	0.75
7	35.90	0.47
8	70.92	0.01
9	38.56	0.35
10	26.26	0.88
11	36.08	0.46
12	56.34	0.02
Probs from chi-square with 36 df.		

The results show that there is absence of autocorrelation for the model with 2 lags.

The normality test presents the multivariate extensions of the Jarque-Bera residual normality test, which compares the third and fourth moments of the residuals to those from the normal distribution. Following the skewness test, the results indicated that the 2 lags VAR model in this

study is normally distributed. The probability values for joint tests for skewness (0.4019 is larger than 0.05, imply the non-rejection of the null hypothesis of normality of residuals at 5 percent significance level.

2.5.1 Regression results for benchmark model

This section presents the empirical findings on the effect of the variables of interest on other variables of interest through impulse response functions and variance decomposition for the benchmark model.

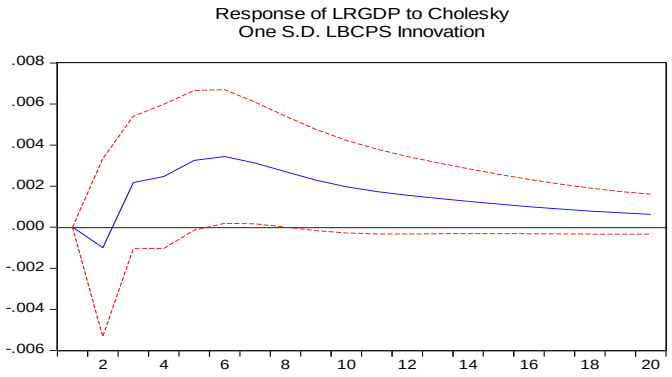
In order to examine the monetary policy transmission mechanism, the study used the impulse response function approach. Gottschalk (2001) indicates that impulse response functions are a useful tool for the analysis of the monetary transmission mechanism. They sketch the reaction of each of the variables' current and future values to a one standard deviation (defined as an unexpected, temporary rise) in the current value of one of the VAR errors, with the assumption that this error returns to zero in the following periods and that all other errors are held equal to zero. Holding the errors equal to zero makes most sense when they are uncorrelated across equations; thus, impulse responses are typically computed for recursive and structural VARs. In this study, the impulse responses for the recursive VAR, ordered log of real GDP, log of CPI, log of money stock, log of interbank rate, log of bank credit to private sector, log of nominal effective exchange rate were computed, and the results are interpreted as the effect of an unexpected 1percentage point increase in one variable of interest on other variable(s) of interest.

Lagged exogenous variables were also allowed to have an influence on the endogenous variables. This is due to the fact that shocks may not be felt immediately but take time to induce effects on policy and non-policy variables. The 2 lag order is considered by observing that variables like rainfall, and the world oil price, are likely to affect output after few months through agricultural output whose harvest is estimated between three and six months. Prices for raw materials and transportation may also increase following a rise in the world oil price. 2 lag order is fixed for all exogenous variables (except war and UNP which are dummies) and then interpret the derived impulse responses. While figures for impulse responses for the effect of monetary policy on output and inflation are reported in this section, the magnitudes of the effects are reported in Table 5.1 in Appendix 5.

Bank credit to private sector channel

Bank credit is usually considered as one of the useful channels of monetary policy transmission in developing countries. The results of this study did not contradict this argument.

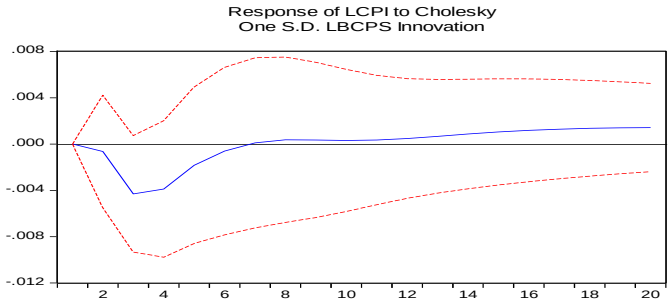
Figure 2.6 Impulse responses of real GDP to shock in bank credit to private sector



As depicted in Figure 2.6, real GDP positively responds to an unexpected rise in bank credit to the private sector. The effect is felt in four quarters after the shock occurs and remains significant up to the 8th quarter, and positive in the subsequent period, though not significant. The

implication of these findings is that bank credit to private sector is a useful channel of monetary policy to output, given that the magnitude of the effect from bank credit to private sector to real GDP is relatively considerable. The results are in line with Bernanke and Gertler (1995) who also found that bank credit has a positive effect on output. However, Figure 2.7 shows that a shock in bank credit to the private sector has a negative effect on inflation though not significant.

Figure 2.7 Impulse responses of CPI to shock in bank credit to private sector

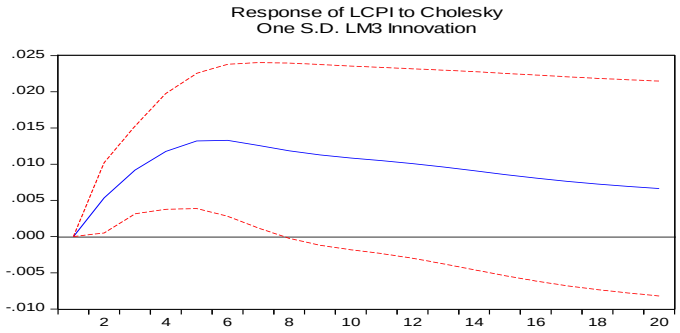


On impact, inflation responds immediately and negatively to a shock in bank credit to private sector although the effect is not significant. One would deduce that careful attention should be paid to inflation management as bank credit to private sector has the potential to cause inflation. The implication of this relationship is that bank credit to the private sector is mainly used to produce goods and services rather than financing the purchase of household consumption goods and services, so that the supply of goods and service increases relative to aggregate effective demand, hence bringing the price level down.

Money stock channel

Money stock is revealed to be the best channel of monetary policy transmission in influencing price.

Figure 2.8 Impulse responses of prices to shock in money stock



As shown in Figure 2.8, after a positive shock in money stock, inflation responds positively after one-and-a-half quarters, and the effects cease to be significant after the 7thquarter, although they remain positive in the subsequent period. This implies that expansionary monetary policy through money supply would raise inflation for a relatively longer period. It is also shown that money stock affects inflation with lag estimated at 6 months, implying probably stickiness of prices in the short term. Consistent with theoretical expectations, a money supply shock is inflationary. The effect of money stock on output is depicted in Figure 2.9.

Figure 2.9 Impulse responses of real GDP to shock in money stock

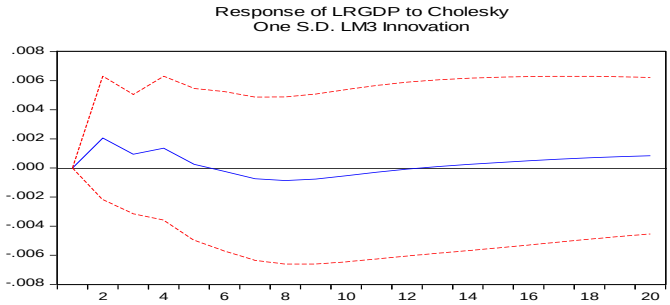
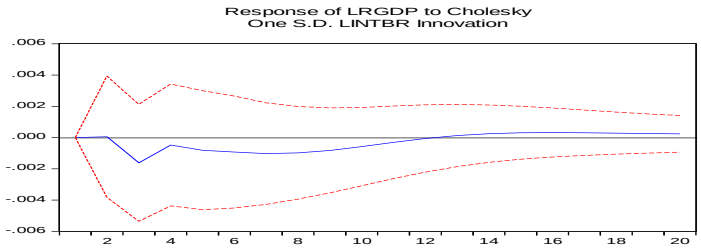


Figure 2.9 shows that expansionary monetary policy through money supply has no significant effect on real output. The insignificant effect on domestic real output is also theoretically expected under the neutrality assumption of money. The study's findings concur with some previous studies, for instance, Rusuhuzwa et al. (2008), and Saxegaard (2006), but differ with Davoodi et al. (2013), who found a weak reserve money effect on price, but a stronger one on output in Rwanda. .

Interest rate channel

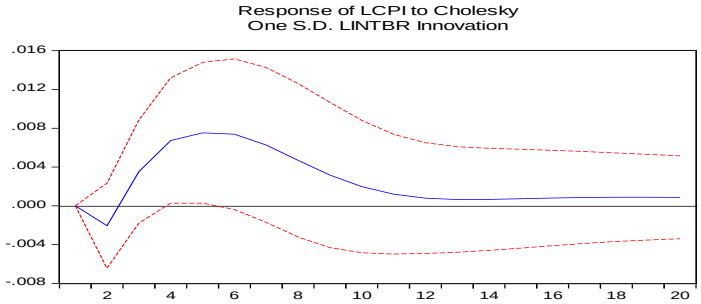
The results on the effect of interest rate on RGDP are displayed in Figure 2.10.

Figure 2.10 Impulse responses of RGDP to shock in interest rate



On impact, output responds negatively and longer to a shock in the interest rate. Although the response is in the expected direction, the effect is not significant. The results are also puzzling as depicted in Figure 2.11.

Figure 2.11 Impulse responses of prices to shock in interest rate



Inflation responds positively to an unexpected shock in the interest rate.

Findings on the effect of interest rate on exchange rate are illustrated in Figure 2.12.

Figure 2.12 Impulse responses of exchange rate to shock in interest rate

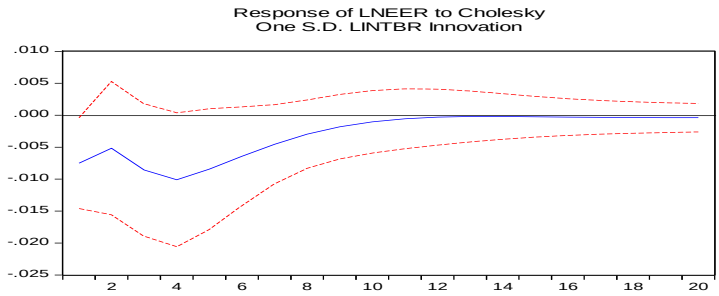
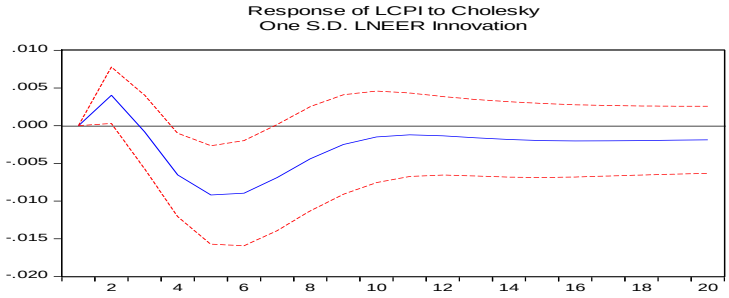


Figure 2.12 shows that the interest rate is relatively weak in explaining changes in exchange rate. Although the effect is negative as expected and last longer, it is insignificant. The main implication of these results is that the interest rate as a channel of monetary policy transmission is ineffective. Some of the possible reasons could be the level of the lending interest rate that is kept almost constant and at a higher level by commercial banks. Figure 2.1 in Chapter Two showed that the lending rate remained in the range of 16 percent to 19 percent from 1996 to 2014, even though banking and non-banking institutions expanded significantly during this period. The assumption made is that the higher cost of capital would discourage business activities, and consequently output, and inflation, in line with the theory of cost-push inflation. Costs related to new information technology, the size of non-performing loans, and the lack of a developed financial capital market as an alternative to obtaining loans could explain the rigidity in the lending interest rate in Rwanda.

Exchange rate channel

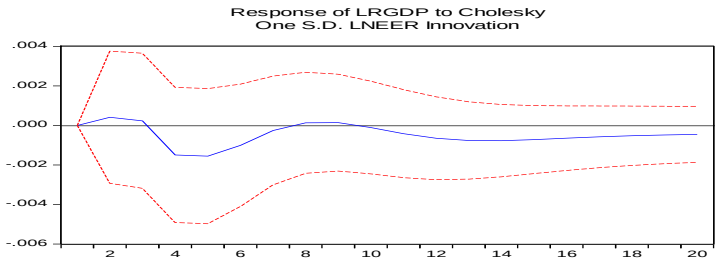
Another channel of monetary policy transmission that was revealed to be significant is the exchange rate. The results in Figure 2.13 reveal a puzzling effect of the exchange rate on prices.

Figure 2.13 Impulse responses of prices to shock in exchange rate



They show that an exogenous unexpected depreciation is followed by a reduction in inflation after 3 quarters and the effect is significant up to 6 quarters. The effect remains unchanged during the subsequent period though not significant. These results match with Tsangarindes's (2010) research, where a puzzle relationship was obtained for the effect of the exchange rate on prices. These puzzles for the case of Rwanda may result from the lower level of development of the financial capital market (for the interest rate), and the BNR's intervention in the foreign exchange market (for the exchange rate). Furthermore, the findings indicate that innovations in exchange rate are not able to explain changes in real GDP.

Figure 2.14 Impulse responses of real GDP to shock in exchange rate

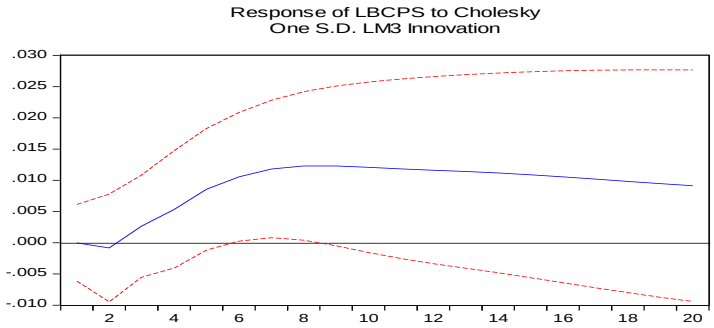


As depicted in Figure 2.14, the exchange rate channel is not operational with respect to real output since the effect is insignificant. The results reveal that exchange rate is not a channel of monetary policy in Rwanda. There is a lack of exchange rate management with a view to enhancing the competitiveness of Rwandan goods and services in international markets. This

could partly be attributable to the fact that the BNR's intervention in the foreign exchange market may weaken the exchange rate channel.

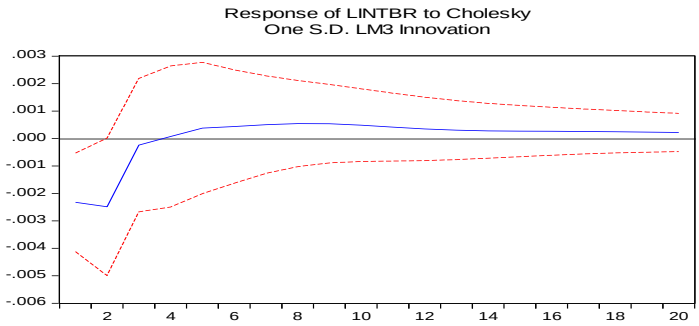
Other relevant results include the response of bank credit to private sector and interest rate to shock in money stock. The effect of money stock on bank credit to private sector is illustrated in Figure 2.15.

Figure 2.15 Impulse responses of bank credit to private sector to shock in money stock



Results indicate that bank credit to the private sector positively responds after 5 quarters to a sudden increase in money stock and the effect remains significant up to the 8th quarter. The implication of these findings is the existence of a clear link between money supply and bank credit to the private sector. This relationship should be seen as useful given that it could imply an indirect effect of money stock on real output in the short-run through bank credit to the private sector.

Figure 2.16 Impulse responses of interest rate to shock in money stock



In addition, the findings in as depicted in Figure 2.16 reveal a negative response of interbank rate to a shock in money stock. An unexpected rise in money stock induces a reduction in the interbank rate that remains significant for almost 2 quarters, implying immediate reaction by the short term rate to change in money stock. Consistent with theoretical expectations, money stock shock has a liquidity effect in Rwanda.

Variance decomposition

The forecast error decomposition is the proportion of the variance of the error made in forecasting a variable (for instance, output) due to a particular shock (for instance, the error term in the policy rate equation) at a given horizon (such as three years). This study is mainly interested in determining the importance of policy variables in explaining changes in economic variables for a period of 20 quarters. Variance decomposition results are helpful in validating the results from the impulse response function. The results presented in Table 2.4 in parts I, II, III, and IV show the proportion of variance error forecasting in real GDP, consumer price index, interbank rate, and bank credit to private sector, respectively due to shocks in other endogenous variables. The value corresponding to when the contributing variable overtakes the own contribution of the explained variable is highlighted while the highest contribution of the same contributing variable is presented in italics and highlighted.

Table 2.4 Variance Decomposition: Effect of monetary variables on real GDP, inflation, and other policy variables (Recursive VAR)

I. Variance Decomposition of LRGDP:							
Period	S.E.	LRGDP	LCPI	LM3	LINTBR	LBCPS	LNEER
1	0.01	100.00	0.00	0.00	0.00	0.00	0.00
10	0.02	84.36	1.39	1.59	1.26	10.37	1.03
20	0.02	81.54	2.35	1.86	1.25	**11.49**	1.52
II. Variance Decomposition of LCPI:							
Period	S.E.	LRGDP	LCPI	LM3	LINTBR	LBCPS	LNEER
1	0.02	0.03	99.97	0.00	0.00	0.00	0.00
7	0.04	0.17	**33.78**	**39.19**	10.93	1.94	13.98
10	0.05	0.70	27.28	47.67	10.32	1.58	12.44
20	0.06	4.60	20.09	***56.21***	7.66	1.49	9.94
III. Variance Decomposition of LINTBR:							
Period	S.E.	LRGDP	LCPI	LM3	LINTBR	LBCPS	LNEER
1	0.01	4.09	0.29	8.30	87.32	0.00	0.00
10	0.01	8.42	7.65	11.14	64.18	4.28	4.33
20	0.01	8.36	7.58	***11.73***	63.62	4.24	4.47
IV. Variance Decomposition of LBCPS:							
Period	S.E.	LRGDP	LCPI	LM3	LINTBR	LBCPS	LNEER
1	0.03	0.12	1.09	3.71E-05	0.41	98.38	0.00
10	0.06	12.36	12.86	26.27	3.15	37.74	7.62
13	0.06	13.21	11.09	**32.86**	3.33	**31.96**	7.54
20	0.07	15.28	9.18	***40.44***	2.84	25.34	6.94
Cholesky Ordering: LRGDP LCPI LM3 LINTBR LBCPS LNEER							

Bank credit to private sector plays a significant role in determining variation in real GDP. For instance, apart from its own shocks which largely account for its variance decomposition, the other main source of change in the variance decomposition of the error of real output is bank credit to private sector. During the period after the shock, the magnitude of the response in real GDP due to bank credit to private sector increases with time and reaches 11.49 percent during the 20th quarter. However, bank credit to private sector does not explain variation in the variance error of CPI inflation, supporting previous results obtained with impulse responses. Regarding

the contribution of money stock to the forecast error variance of real GDP, CPI inflation, bank credit to private sector, and interest rate, results from Table 2.4 indicate that money stock is weak in explaining fluctuations in RGDP. However, the proportion of variance error forecasting in inflation due to money stock increases over time and reaches 56.21 percent during the 20th quarter, supporting the results obtained with impulse responses. These findings imply that variations in inflation in the medium and long term are mainly explained by changes in money stock. This is supported by the fact that the contribution of money stock to variance error of inflation overtakes the own contribution of inflation during the 7th quarter with 39.19 percent for money stock against 33.78 percent for inflation.

In terms of contribution of money stock to bank credit to the private sector, the variance decomposition results support previous findings obtained with impulse response functions. Money stock is revealed as the main variable that explains changes in the variance error of bank credit to the private sector. The peak of the contribution is felt during the 20th quarter and is 40.44 percent, and the effect of money stock exceeds that of bank credit to private sector during the 13th quarter at 32.86 percent against 31.96 percent, respectively, implying a relative connection between money stock and BCPS.

Equally important is the contribution of money stock to changes in the interest rate. Though highly explained by its own shocks, fluctuations in the interest rate are also explained by changes in money stock, in line with liquidity effect theory.

Another interesting contribution is that of exchange rate to the forecast error variance of output and inflation. With the exception of money stock, another variable that explains fluctuations in inflation is the exchange rate. Its contribution to fluctuations in inflation peaks during the 7th quarter reaching 13.98 percent, implying the effect of the exchange rate on inflation in the short term. The results also show that the exchange rate is weak in explaining fluctuations in output. With regard to these results, one would deduce that money stock and bank credit to the private sector play a key role in the transmission mechanism of monetary policy in Rwanda.

2.5.2 Comparison of benchmark model results and other specifications

In order to verify the relevance of controlling for domestic variables in VAR specification of the MPTM, two other specifications were made and the results were compared. The first specification differs from the benchmark model in that it includes only foreign shock variables (it ignores domestic shocks), while the second does not include domestic or foreign shocks.

The impulse responses results for specification one and two are presented in Appendix 2, Figure 2.17 and Figure 2.18 respectively. The findings indicate that there is no significant difference in the results for the benchmark and model one, while in model two bank credit to the private sector does not have significant effect on output as is the case for the benchmark model and specification one. These results provide no evidence that including both domestic and foreign exogenous variables would improve the quality of the results over the model controlling for only foreign shocks. However, failure to control for any of the shocks would affect the results.

2.5.3 Money multiplier predictability analysis

The effectiveness of monetary policy analyzed in previous sections assumed that the money multiplier was stable or at least predictable for the period under study. The effectiveness of monetary policy would depend on how effective it is in controlling the money aggregate growth. To achieve this, the monetary authority should be able to predict movement in the money multiplier with some degree of accuracy. This would enable it to achieve the desired growth in money stock, and hence the effectiveness of monetary policy. In this section, the predictability of the money multiplier is analyzed by testing the cointegration test between the money multiplier and the interbank rate in the benchmark model due to the underlying rationale that the money multiplier increases with the opportunity cost of the monetary base. For robustness, another cointegration test is applied between the money multiplier and the reserve requirement ratio, as a determinant of the money multiplier that is an instrument of monetary policy. The results in Table 2.6 in Appendix 2 show a long-run relationship between the money multiplier and the interbank rate at 10 percent significance level. The probability value of 0.0509 is slightly greater than 5 percent. The long-run relationship is supported in the cointegration test between the money multiplier and reserve requirement ratio at 5 percent significance level in Table 2.7 Appendix 2. Hence, the money multiplier could be predictable during the period under study. These results imply the possibility of effective monetary policy management in Rwanda because the determination of the optimal path of monetary aggregates becomes less complicated.

Overall, monetary policy transmission through money stock and bank lending channels is effective in macroeconomic stabilization in Rwanda. An aspect that should be borne in mind is the point estimate of impulse responses considering the wide confidence interval. The study

considers this to be due to the relatively insufficient data sample size, given that VAR is asymptotically efficient.

2.6 Conclusions and policy implications

This chapter sought to explain the effectiveness of monetary policy in Rwanda by determining the channels that are relevant for the transmission of monetary policy vis-à-vis output and inflation. The study used a sample of quarterly data for the period 1996-2014. Applying a recursive VAR, it used 13 variables, including seven exogenous variables to capture the true contribution of monetary policy to variations in output and inflation in Rwanda. Results are that: firstly, money stock is significant in explaining variations in inflation in Rwanda. It is important to note that the money stock effect on inflation is felt after a short time and lasts for a long period with a relatively large magnitude and strongly significance. Secondly, it was established that due to its indirect effect on output through bank credit to the private sector, money stock can be used as a tool to influence real output if inflation is maintained at low levels. However, balancing these two competing goals would not be easy. Thirdly, puzzle relations were identified. The interest rate as well as the exchange rate seems to influence inflation in an unexpected direction. While an increase in the interest rate increases price levels, depreciation of the exchange rate induces reduced inflation in a very short period, possibly due to lower levels of development of the financial capital market, and Central Bank interventions in the foreign exchange market.

In line with the results, the objective of this essay of determining the important channels of monetary policy was achieved. Money stock and bank credit to private sector are the important channels of monetary policy transmission in Rwanda. The main implication of the results is that

money stock should be regarded as the best channel of monetary policy transmission in Rwanda and should be the first to be considered, especially when the Central Bank of Rwanda finds that there is a need to reduce inflation. Moreover, it could be used to influence the level of output, given its indirect effect through bank credit to the private sector. Equally important is the usefulness of bank credit to the private sector as a transmission channel of monetary policy. Any policy that aims at influencing real output would achieve this objective by employing the bank credit to private sector channel.

This study is the first attempt to consider and control for relevant domestic shocks in the literature on the MPTM. The results obtained did not contradict the relevance of their presence in the model. This allows suggesting the consideration of all relevant domestic shocks in the specification of the monetary policy transmission mechanism, especially in LICs where rainfall and aid play a key role in explaining movements in output. Further research could examine the channels of monetary policy by including all relevant domestic as well as foreign shocks, employing Bayesian VAR to mitigate the challenge of the short data sample found in most developing countries. Other research could attempt the study of monetary policy transmission mechanism by considering all relevant domestic and foreign shocks in a panel framework in order to respond to the issue of the data sample size.

CHAPTER THREE
FISCAL POLICY TRANSMISSION MECHANISM

3.1 Introduction

During the past two decades, the RoR has set the duo objective of financing capacity building and infrastructure development to enhance economic growth, while maintaining a prudent fiscal policy (BNR, 2011). However, since 1995, there has been limited progress in the mobilization of domestic revenue which perhaps explains the persistent fiscal deficit in Rwanda.

The government's overall macroeconomic strategy focused on reinforcing economic growth by stimulating domestic sources of growth, promoting higher productivity and stabilizing the economy. However, the consequences of the war and genocide created exceptional expenses that increased significantly from 1998. These were linked to the government programme which had to deal with urgent but temporary social expenditure needs due to war and genocide. They included the government's contribution to the Genocide Survivors Assistance Fund (FARG), the Gacaca programme (local jurisdictions regarding suspected perpetrators of genocide), the demobilization of soldiers and their reintegration in civilian life, purchasing food for prisoners (mainly suspected perpetrators of genocide), and assistance to orphans and other vulnerable groups (victims of war and genocide). Furthermore, higher government borrowing led to the crowding out of the private sector (RoR 2011).

This study therefore seeks to address the following research questions:

Which transmission channel of fiscal policy is likely to be most effective on output and prices in Rwanda?

The objective of this chapter is therefore to identify the important channel of transmission of fiscal policy in Rwanda, based on timing and magnitude of the effects of policy changes on output and prices. Taking into account the structure of Rwandan economy (where agriculture makes a significant contribution to total output), and given that a number of exogenous variables may affect output and prices in Rwanda, the study explores how best to capture the evidence relating to the effectiveness of fiscal policy innovations including the identification of shocks and exploring the transmission channels. The contribution of this study is the introduction of domestic exogenous variables (rain fall, foreign aid, war, and UN payment) in VAR specification of fiscal policy transmission to control for domestic shocks, especially in developing countries.

3.2 Fiscal policy development

3.2.1 Introduction

The GoR's fiscal policy has been aiming to achieve fiscal consolidation (FC) while supporting the growth of economic activity. The FC policy is based on the principle of achieving improved efficiency in tax administration and Public Financial Management (PFM) systems, and reducing and prioritizing public spending, while reducing domestic financing (AfDB, 2012).

3.2.2 Tax policy

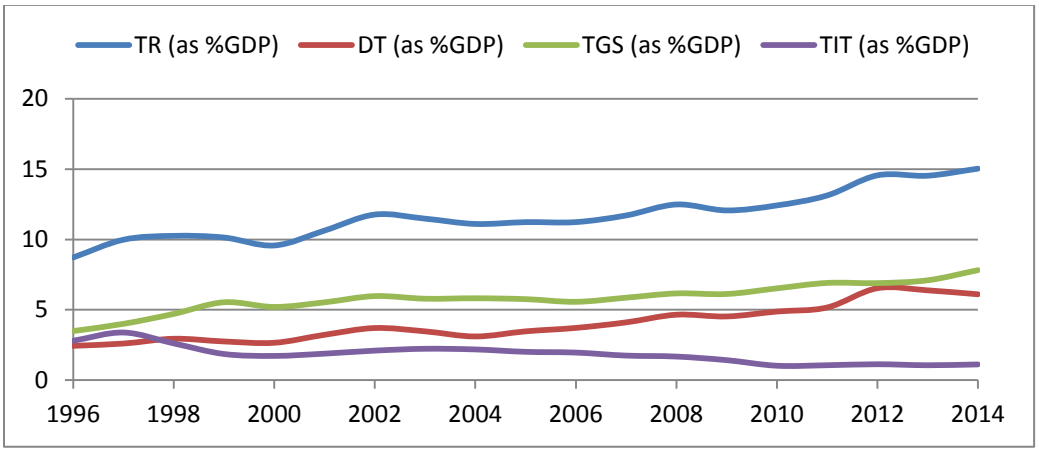
In seeking to improve its tax policy, the RoR established an independent institution, the Rwanda Revenue Authority (RRA) that was recognized by Law No. 15/97 of 8 November 1997. In 2005, parliament adopted several laws to improve fiscal procedures, personal tax, and value added tax (VAT). The Law on direct taxes on income replaced the Law of 1997 on the code of direct taxes on different profits and professional income, and a Law of 1998 established the Rwanda Investment Promotion Agency (RIPA). A law was passed to establish customs in 2006. The 2004 Act of the EAC that provided for the management and administration of customs related matters was adopted in 2009.

The tax structure comprises taxes on goods and services which accounted for 52 percent of total tax revenue during the periods 2009/10 and 2010/11, while VAT made up 58 percent of all taxes on goods and services. While individual and corporate income tax revenue, and property taxes declined, they are still significant, contributing up to 39.5 percent of total tax revenue in 2009/10 and 39.1percent in 2010/11. Taxes on international trade were relatively insignificant and contributed up to 8.4 percent in 2010/11, mainly due to Rwanda's embracing of the Common External Tariff. During the period 2011-2012, the RoR reduced the fuel price by up to 10 percent to ease the economic effects of growing food and fuel prices.

New measures aimed at reducing tax avoidance whereby a single corporate tax rate of 30 percent is applied, as well as the introduction of electronic tax filing and payment in 2010/11 and the merging of social security and income tax files led to improvement in the tax-to-GDP ratio from 12.2 percent in 2009/10 to 12.6 percent in 2010/11. The RoR managed to increase the tax

revenue-to-GDP ratio from 12.6 percent in the period 2006 to 2011 to 14.2 percent in the fiscal year 2012-13, but the level is still below the regional average of around 16.2 percent (Rwanda excluded) during 2006 to 2011(EAC, 2012). Figure 3.1 shows the development of total tax revenue (TTR), direct taxes (DT), taxes on goods and services (TGS), and taxes on international trade (TIT) for the period 1996 to 2013.

Figure 3.1 Development of tax revenue components (as percentage of GDP) from 1996 to 2014



Source: Minecofin, Annual report, 2015

Figure 3.1 shows that taxes on goods and services as well as direct taxes have increased over time, while taxes on international trade have trended down for the period under review. Total tax revenue ratio to GDP has trended up from 1996 to 2014, implying effort made in tax revenue management.

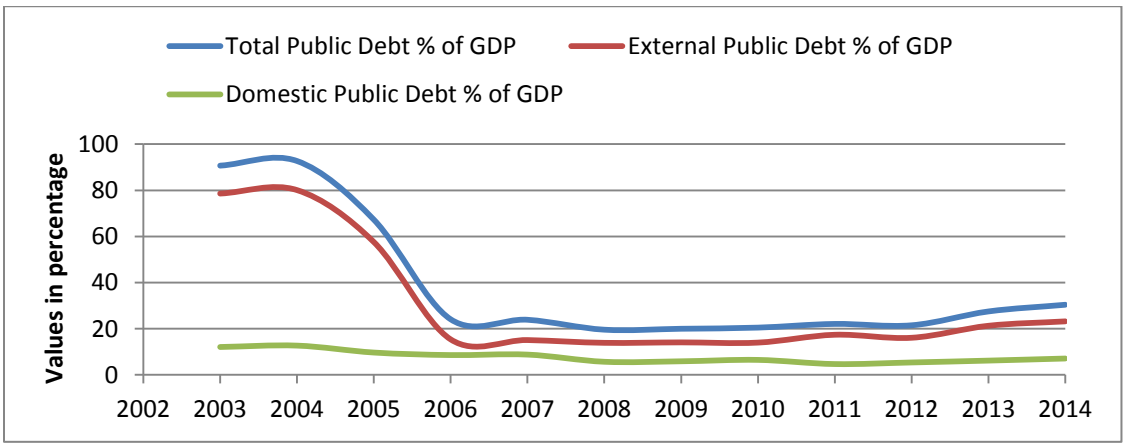
3.2.3 Debt policy

The government's debt policy is tied to the principle that financing and repayments are implemented at least cost and low risk considerations, while ensuring debt sustainability. A Debt

Management Facility (DMF) strategy has been put in place to ensure that loans and guarantees are consistent with the provisions in the Organic Budget Law. In line with IMF/World Bank guidelines, the GoR carried out its first Debt Sustainability Analysis (DSA) in April 2013. In order to conform to international best practice for public investment, the government implements a public investment policy that takes into account fiscal risk exposure and debt sustainability.

Due to prudent macroeconomic policies, in addition to substantial debt relief (about USD 1.5 billion in 2005) and a facility for concessional borrowing, an improvement in Rwanda's risk of debt distress from moderate to low risk was observed as indicated by both the government's and the 2013 IMF/World Bank DSAs (AfDB,2014; and 2012). The total debt (including domestic and external) was USD 1.28 billion at end-2010, equivalent to 23.4 percent of GDP, up from USD 1.1 billion at end-2009, representing 22.1 percent of GDP. This was explained by an increase in domestic financing to cover the deficit in aid disbursements. Figure 3.2 shows the behaviour of debt as ratio of GDP to well capture its development in regards to economic activity.

Figure 3.2 Domestic and foreign debt in Rwanda, 2003 to 2014



Source: BNR, annual reports (2003-2014)

Figure 3.2 shows that foreign debt as a percentage of GDP decreased sharply from 2004 and became stable from 2006 to 2014, while domestic debt appears to exhibit a slight downward trend for the period 2003-2014, implying that debt has increased quite proportionally with economic activity.

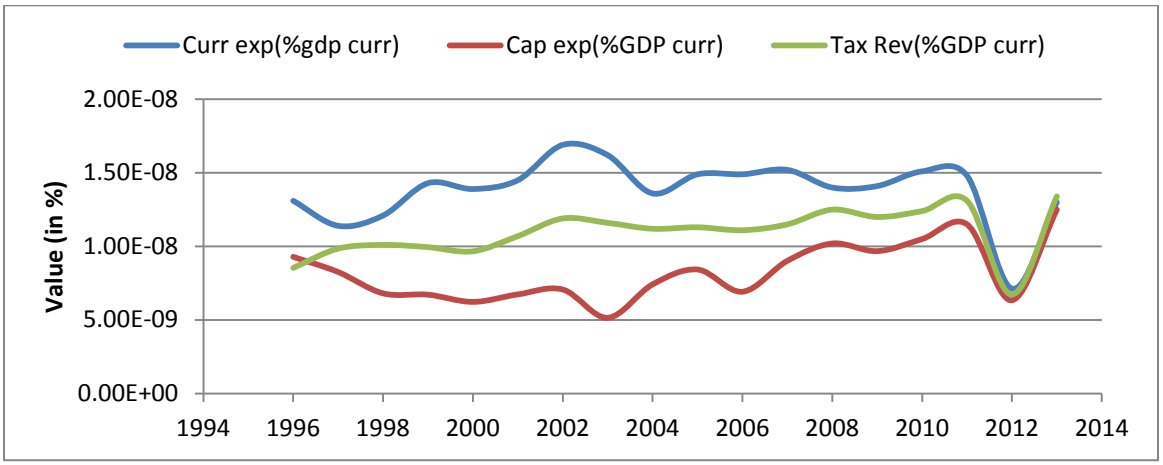
3.2.4 Government spending policy

Over the years, total public expenditure has increased significantly, mainly due to the purchase of goods and services in addition to the repayment of public debt. The budget deficit remains at a relatively high level, with current expenditure accounting for a big share. Expenditure on the acquisition of goods and services on the one hand and wages and salaries on the other made up a significant proportion of total current expenditure, aside from exceptional expenses which expanded from the year 2000, and subsidies and transfers that also account for an important share of public expenditure. These consist of expenses incurred by the state in running some public institutions, financing the community development programmes, assisting districts, towns and some nonprofit making associations and organizations, issuing scholarships and making contributions to international organizations (RoR, 2011).

In fulfilling its objective of boosting economic activity, capital expenditure as a share of GDP increased from 11.0 percent in 2009/10 to 11.5 percent in 2010/11, while recurrent expenditure increased from 14.2 percent to 15.3 percent. During the period 2010-2011, the increase in government revenue and grants was not enough to compensate for the increase in total expenditure and net lending, inducing a drop in the overall balance. The second Economic Development and Poverty Reduction Strategy-2 (EDPRS-2) set clear priorities for public

spending including economic infrastructure, productive capacity and human development; the budget share for these items increased on an average by 68 percent between 2009/10 and 2013/2014 (RoR, 2013). Figure 3.3 depicts the development of current and capital expenditures as ratios to GDP (both in current values) from 1996 to 2013.

Figure 3.3 Government expenditure as percent of GDP, 1996 to 2013



Source: BNR Annual Reports 2003-2014

Figure 3.3 shows that apart from the year 2012, government expenditures as ratio to GDP have fluctuated around their mean values implying that government expenditures have grown proportionally with economic activity. However, the decline in 2012 reflects the possibility of Rwandan public expenditure's vulnerability to fluctuations in aid. The decrease in tax revenue (Tax Rev) as a percentage of GDP suggests that the immediate effect of aid cuts on the private sector was probably due to expectations that affected demand.

3.3 Literature review

Fiscal policy can play a significant role in short as well as medium- and long-term economic growth especially in developing economies where the private sector is relatively weak. Public spending on physical infrastructure and education promotes human capital and affects the productivity of firms and industries, and the entire economy that leads to long-term growth. Taxes can discourage economic activity and hence reduce economic growth because they alter economic incentives and behaviour (Arnelyn et al., 2014).

3.3.1 Theoretical literature

In this section, focus is made on the presentation of the theoretical background on fiscal policy effectiveness as postulated by classical and Keynesian views.

Classical versus Keynesian Framework

According to the classical literature, fiscal policy has no effect on aggregate demand (AD) since wages and prices are fully flexible and the aggregate supply (AS) curve is vertical. On the other hand, the Keynesian framework represented by the traditional IS-LM and the extended Mundell-Fleming (also known as IS-LM-BoP) models, advocates that wages and prices are rigid and that private consumption depends only on the current level of income. In terms of this framework, a fiscal shock will always increase aggregate income for a closed economy, while the effects for an open economy are subject to the prevailing foreign exchange regime and to the degree of openness of the economy measured in terms of the volume of international trade (Mishkin, 2012).

For a closed economy, assuming the money supply is fixed, an expansionary expenditure shock increases aggregate output and the interest rate, which in turn crowds out private investment, given the elasticity of private investment to the interest rate. The final effect of an expansionary expenditure shock is a rise in output, investment and consumption. Fiscal shock by means of cuts in taxation increase disposable income, leading to an increase in consumption and aggregate output. Similar to the expenditure shock, private investment is also crowded out by a rise in the interest rate. It is recognized that the tax multiplier is normally less than the expenditure multiplier given that a portion of the increased disposable income resulting from tax cuts will not be spent, but saved (Mishkin, 2012).

The effects of a fiscal shock for an open economy are dependent on the type of exchange rate regime. Under a floating exchange rate regime, an expansionary fiscal shock increases output, which also increases demand for money and, ultimately, the interest rate. Assuming that there are no restrictions on capital mobility and a fixed foreign interest rate, the high domestic interest rate will attract foreign capital flows into the economy leading to appreciation of the local exchange rate. Considering that prices are sticky, appreciation of the domestic currency discourages exports and incentivizes imports, leading to deterioration in the balance of trade and offsetting fiscal expansion. Hence, the fiscal stimulus in an open economy with a flexible exchange rate regime is ineffective, since the fiscal multiplier is zero. Nevertheless, in a fixed exchange rate regime, an expansionary fiscal shock leads the monetary authorities to increase the money supply in order to maintain the fixed exchange rate parity, magnifying the effects of fiscal shocks to a level greater than what it would have been for a closed economy (Suranovic, 2010).

Keynesian versus new Keynesian and classical fiscal policy approaches

The effectiveness of macroeconomic fiscal policy depends on the impact of policy on AD and the impact of AD on output (Palley, 2012).Different views on the effectiveness of fiscal policy using six approaches to macroeconomics are summarized in this section. The monetarist, post-Keynesian, and neo-Keynesian approaches can all be regarded as Keynesian in spirit, since they share the common approach that AD determines output; that there is no natural level of unemployment and outcome to which the economy gravitates; and that employment outcomes are not related to the labor supply schedule. In the neo-Keynesian and post-Keynesian models, both money and bond financed fiscal policy have a permanent effect on output and employment. However, in the monetarist model, bond financed fiscal policy has no effect because of the monetarist view that money is all that matters.

On the other hand, the new Keynesian, classical, and new classical models can all be regarded as classical in spirit, since they share a classical approach to output determination and the existence of a natural level of unemployment and output to which the economy gravitates. In the Keynesian and classical models workers are on the labor supply schedule at all times, while in the new classical model, due to price expectation errors they can be off it. In the classical as well as the new classical model output and employment are not affected by discretionary fiscal policy, while in the new Keynesian model, owing to price rigidities, fiscal policy can have temporary effects. Palley (2012) argues that although the new Keynesian models imitate the effects of fiscal policy in Keynesian models, there are significant differences. For the Keynesian models, fiscal policy is persistently effective since the economy is likely to be persistently below full employment, while in the new Keynesian model, as prices can reset, the economy is likely to

return to full employment so that fiscal policy is only momentarily effective and only if it is conditioned on unexpected demand shocks.

The crowding out effect

The crowding out effect refers to the view that expansionary fiscal actions dislocate a near-equal amount of private expenditure, hence limiting the net effect of fiscal expansion on national output, if any. One type of crowding out takes the form of the Ricardian equivalence theorem (RET) whereby, for instance, under the permanent income hypothesis of real consumption, fiscal expansion which improves households' incomes today entails an offsetting effect in the future when the government must raise taxes in order to repay the debt that financed fiscal expansion. In other words, households' permanent income remains unchanged and as such fiscal expansion has a limited effect on output.

Crowding out is also thought to occur in the IS-LM model perspective when bonds are sold to finance a deficit. The idea behind the RET is that, for a specific path of overall government expenditure, future taxation due to a bond-financed budget deficit decreases current consumer expenditure. Consequently, any fiscal expansion is crowded out by a dropin private consumption. This is explained by the fact that rational forward-looking agents in an infinite horizon believe that a deficit finance cut in current lump-sum taxes, translates into higher taxes with the same current value as the initial cut (Barro, 1989).

However, the RET involves some assumptions that may not be satisfied in developing countries. Firstly, the Ricardian equivalence proposition is inappropriate in the context of economies that

have unused resources as the theorem was derived in the context of full employment. Secondly, predominantly in the difficult conditions confronting developing countries, the fundamental infinite horizon assumption that permeates the Ricardian equivalence world may be invalid given that the time horizon over which people take decisions maybe relatively short. Furthermore, capital markets in developing countries are far from perfect (Giorgioni and Holden, 2003). If financial markets are not perfect, households can use a discount rate that is higher than the interest the government has to pay on bonds when discounting future tax payments (Jansen, 2002). Finally, some cross-country studies have found that a rise in the total amount of savings in developing countries may be promoted by increased public savings (in contrast to a negative relationship between public and private savings), strengthening the notion that the determinants of household saving behaviour in developed economies may not apply in developing countries and vice versa (Muradoglu and Taskin, 1996).

The other form of crowding out appears in the IS-LM framework model when the sale of bonds is used to finance the deficit. The bonds' price is driven down in the course of fiscal expansion(due to excess supply),and this corresponds to an increase in interest rates[29]. However, experience in Latin American countries (LACs)suggests the need to rethink causality between the interest rate and the fiscal deficit. A reversal in the terms of trade or a sudden halt to capital inflows (that can be considered as a negative external shock) can induce monetary policy reactions. In order to avoid capital flight and devaluation, the Central Bank may want to maintain high interest rates. Because a fraction of the public debt is indexed to the short-term rate of

[29] In examining the crowding out phenomenon along with its related effects of fiscal actions in five South Asian economies (Bangladesh, India, Nepal, Pakistan and Sri Lanka) using a VAR model, Chowdhury (2004) found no significant effect of the budgetary action on the domestic interest rate of the sampled countries.

interest, monetary policy focuses on increased debt service and increased budget deficits (Camara and Vernengo, 2004). The authors add that if an independent Central Bank reacts to fiscal expansion by increasing the interest rate, some form of crowding out could take place.

The fiscal theory of the price level

The New Keynesian (NK) approach is one of the most commonly employed approaches in monetary economics because it offers a suitable framework to examine theoretical and empirical concerns relating to monetary policy and inflation and output determination as well as being based on rational expectations. This approach advocates for a link between money growth, inflation and the budget deficit through the system of AD and AS, and is based on a closed economy model. It is attained through a dynamic stochastic general equilibrium (DSGE) framework based on maximization of the agent's behaviour, taking into account imperfect competition. In the NK approach, the output gap and real interest rate expectations affect the demand equation. The supply equation matches with NK version of the Phillips curve based on maximization of the firm's profits, which adjust its prices temporarily, in a staggered way. According to the NK Phillips curve, increased inflation can reduce unemployment temporarily, rather than permanently (Blanchard and Galí, 2007; and Clarida et al., 1999).

Furthermore, in the NK model the quantity of money is an irrelevant variable for policy purposes given that in this framework, the quantity of money is considered endogenous to the nominal interest rate (or inflation). Woodford (2007) argued that the money-demand function is not essential to solve the model for inflation given that the system is self-contained. Determination of the impact of fiscal policy on the real economy is due to expectations of the current and future

level of government expenditure. Given an output gap and inflation expectations for t+1, if people expect government expenditure to increase in t+1, from the current level, it is logical to expect that private consumption will be reduced by t+1. Because households have to save today to be able to finance added public spending in t+1, consumption expenditure in t will decrease (Barro, 1979). Through a Keynesian multiplier, the decrease in the current consumption level causes a contemporary decline in output, the output gap and inflation. For this reason, individual expectations of the current and future fiscal stance directly affect inflation and through a higher price level, induce money expansion (Galí, 2007; Rotemberg and Woodford, 1997; Clarida et al., 1999; Mankiw, 1985).

3.3.2 Empirical literature

Despite the extensive literature on the economic activity effect of monetary policy, less attention has been paid to fiscal policy and its relevance for economic stabilization (Afonso and Sousa, 2009; Fatás and Mihov, 2001). Moreover, the existing literature provides mixed findings on the effects of fiscal policy on economic activity. For instance, while Perotti (2005, 2007), Blanchard and Perotti (2002) and Fatas and Mihov (2001) report that a positive government spending shock persistently and significantly affects private consumption, Ramey (2007) concludes that government spending shocks negatively and persistently affect private consumption. On the other hand, Mountford and Uhlig (2005) and Edelberg et al. (1999) showed that the response of private consumption is nearly zero and not significant over the whole impulse response horizon. Regarding tax effects on output, Blanchard and Perotti (2002) used a SVAR methodology to show that unanticipated tax increases have strongly negative output effects in the US, while Perotti (2005) used SVAR and found that output does not respond to tax shocks in the US.

Unal (2011) used a structural VAR approach to show the dynamic effects of fiscal variables (government spending and net tax) shocks on GDP and its private components, prices, and interest rate in four OECD countries (Canada, France, the UK, and USA), by splitting total net taxes into four components consisting of personal income taxes, corporate income taxes, indirect taxes and social insurance taxes. The findings indicated that, consistent with the neo-classical model, private investment is crowded out by both government spending and taxation in the USA and the UK. On the other hand, the results for France and partially for Canada showed that increases in government spending and taxes have opposite effects on private investment; this corresponds with Keynesian theory. Moreover, apart from France, private consumption is crowded out by taxation in all other countries, and crowded in by government spending in the other countries except the UK.

Afonso and Soussa (2009) found that government spending as well as government revenue shocks does not have a significant effect on price levels. Government spending shocks tend to have a small effect on GDP, and induce depreciation of the real effective exchange rate. In contrast, government revenue shocks have large positive effects on GDP and induce appreciation of the real effective exchange rate. De Castro and Hernández (2006) found that expansionary government spending shocks have a positive effect on output in the short-term in Spain, while they induce higher inflation and lower output in the medium- and long-term.

Blanchard and Perotti (2002) used a four variables SVAR model on US quarterly data on government spending, taxes, output and its components and found that an increase in government spending shocks has positive effects on output. The effects are negative after a

government revenue shock, as output and public spending decrease. A structural decomposition is implemented in order to identify unanticipated shocks. The method of identification used relies on theory and institutional information. The authors postulate that government spending responds with at least a one-quarter lag to structural innovations other than innovations in government spending itself. Perotti (2002) reported that in West Germany, the UK, and Australia, the effect of net taxes on output was positive and significant in all samples: i.e. the pre- and post-1980 period. Regarding the output effect of government expenditure, he found that in the post-1980 sample, the response of GDP to government expenditure in the USA, UK, and Canada is either insignificant or negatively significant. It is only positive during the first quarter in West Germany and it becomes negatively significant within the first three years. Fatás and Mihov (2001) used a Cholesky ordering in order to identify fiscal shocks and found that an increase in government expenditure is expansionary, and induces a rise in private investment that compensates for the drop in private consumption.

In terms of the positive output effect of taxes, Estevao and Samake (2013) showed that the short-run output effect of a tax increase is positive in heavily indebted poor countries (HIPCs). They argue that this could due to the fact that these countries are usually characterized by a lower tax collection effort and a higher level of debt, implying that supplementary revenue collection could enhance growth even in the short-run. The cumulative effect of tax revenue increases on output is negative for advanced and emerging economies, and oil producers, but positive for Central American countries (CAC), HIPCs, LICs and sub-Saharan Africa (SSA). Closed results obtained by Deak and Lenarcic (2011) in the context of a regime switching model show that during bad times, i.e. in the presence of a debt-to-GDP ratio above 42.63 percent (which is the threshold

value separating two regimes), a positive tax revenue shock would raise output, while a government spending shock negatively affects output over time in the US. The opposite occurs during good times, when the debt-to-GDP ratio is below 42.63 percent.

Moreover, Alesina et al. (1999) and Hagen et al. (2001) provided theoretical arguments and empirical evidence on the positive effects of a tax increase on output, private consumption and investment. They stated that under certain circumstances such as high or rapidly increasing ratios of debt to-GDP, the fiscal consolidation effect may be expansionary even in the short term due to expected lower deficits. Therefore, higher taxes would induce agents to expect lower interest rates resulting from the consolidation process.

In European transition economies, Muir and Weber (2013) found that fiscal multipliers were modest in Bulgaria from 2003-2012. The economic activity fiscal policy impact is larger in downturns than during expansions and direct taxes and capital spending have the largest effect on output, while indirect taxes and non-targeted government transfers are associated with a smaller impact. The results suggest that increased capital spending financed by higher indirect tax revenue collection through base expansion has large growth effects over the medium and long-term. Jemec et al. (2013) examined the effects of fiscal shocks in Slovenia using the structural VAR approach with quarterly data from 1995-2010 and found that while positive government spending shocks have an immediate positive effect on output, private consumption and investment, the effect are short-lived. In contrast, positive tax shocks are negatively associated with GDP, private consumption and investment during the period of the shock and are likewise short-lived.

Mirdala (2009) used a VAR model approach to evaluate the effects of discretionary changes in fiscal policy (associated with an increase in government expenditure) as well as the role of automatic stabilizers (associated with an increase in tax revenue) for six European transition economies (Czech Republic, Hungary, Poland, the Slovak Republic, Bulgaria and Romania) in the period 2000-2008. Applying Cholesky followed by the structural VAR approach (the last is based on applying long-run restrictions to the reduced-form VAR); the impulse responses indicate that in Romania, while GDP responds positively to government expenditure with lag (the effects are short-lived); the tax effects on GDP are positive and permanent. In Slovak Republic, both government expenditure and tax shocks positively affect inflation but the effects are shortly lived.

Turning to low-income economies, Arnelyn et al. (2014), and Ormaechea and Yoo (2012) examined the impact of changing the composition of taxation on long-run economic growth for selected Asian economies. The estimation assumes that altering a given tax instrument requires an offsetting change in other taxes, meaning that the change in tax policy occurs in a context of revenue neutrality. Changes in consumption and other taxes offset changes in income taxes, thus keeping overall tax revenue unchanged. The coefficients for income tax are significant and negative for high- and middle-income economies, indicating a negative relationship between changes in income tax share and growth; however, the results are insignificant for low-income economies. Disaggregating by type of income tax, the results for personal income tax are significant for all high and low income groups, that is, negative for high- and middle-income economies and positive for low-income economies. For corporate income tax, the impact is

significant only for middle-income economies. They also found that increasing property taxes and reducing income taxes increased long-term growth.

Applying a similar exercise, Arnelyn et al. (2014) used estimates from Ormaechea and Morozumi (2013) to simulate the effect of increasing the share of education expenditure on growth in income per capita in developing Asian economies. The results show that the composition of government spending has a significant effect on economic growth. More specifically, the analysis indicates that shifting public spending to education will yield a sizable growth dividend.

Koffi (2009) used a VAR model to individually estimate the effect of a selection of fiscal policy variables (government consumption and investment expenditure, deficit and tax receipts) on South African economic growth using quarterly data for the period 1990 to 2004. The results showed that government consumption expenditure positively affects economic growth. On the other hand, gross fixed capital formation from government also positively affects output growth but the magnitude of the impact is smaller than that of consumption expenditure. Furthermore, while tax receipts have a positive output growth effect, the size of the deficit does not have any significant effect on growth.

To examine the effects of government expenditure on growth, Bose et al. (2007) used a panel of 30 developing countries from 1970 to 1990. Their results indicate that while the size of government capital expenditure with respect to GDP was positively and significantly correlated with economic growth, the current expenditure was insignificant. At the disaggregated level,

government investment in education and total expenditure on education are significantly associated with growth while public investment and expenditure in other sectors (transport and communication, defense) initially have significant associations with growth, but do not survive when the government budget constraint (GBC) and other expenditure components are incorporated into the analysis. However, a previous study by Devarajan et al.(1996) involving 43 developing countries from 1970 through 1990 found a negative relationship between the capital component of public expenditure and per-capita growth in developing countries, but that an increase in the share of current expenditure has a positive and significant growth effect. They argued that governments in developing countries misallocate public expenditure in favor of capital expenditure at the expense of current expenditure.

M'Amanja and Morrissey (2005) estimated an autoregressive-distributed lag model on annual data for the period 1964–2002 to investigate the relationship between various measures of fiscal policy and economic growth in Kenya. The results indicated that unproductive expenditure and non-distortionary tax revenue have a neutral effect on growth. However, while productive expenditure had a strong negative effect on growth, there was no evidence that distortionary taxes affected growth. On the other hand, government investment was found to enhance growth in the long run.

3.3.3 Overview of the literature

The review of previous literature on the effects of fiscal policy on output and inflation in the preceding section shows that the findings have not converged due to differences in the methodology and sample period. For instance, with regard to government spending, Perotti

(2005, 2007), Blanchard and Perotti (2002) and Fatas and Mihov (2001) produced different results from those of Ramey (2007); Mountford and Uhlig (2005) and Edelberg et al. (1999). Regarding the effect of tax on output, Blanchard and Perotti (2002) have different results from those of Perotti (2005). The mixed findings imply that there is no conclusive result, calling for further research.

In addition, none of the studies, especially of low income countries(for instance Mozambique, Kenya, and developing Asian, and other developing countries)took into consideration the impact of weather, aid, and war on their economies. Given that rainfall plays a significant role on the supply side of developing countries; this may lead to incorrect specification of the VAR model. Our study includes rainfall, aid, war, and UN payments as domestic exogenous variables to control for relevant domestic shocks, in addition to foreign exogenous variables. This is the first study that attempts to examine the effectiveness of channels of fiscal policy transmission (FPT) in Rwanda. The conclusions derived from the results could be relevant for policy decisions.

Table 3.1: Summary of findings

	High and middle-income countries						
	Case	**Approach**	**Dep var**	**GEXP**	**Taxes**	**Cap exp**	**Current exp**
Jemec et al. (2013)	Slovenia	VAR	output (s.l)	Posit	negat (s.l)		
			priv invest (s.l)	Posit	negat (s.l)		
			Priv cons (s.l)	Posit	negat (s.l)		
Unal (2011)	UK/U.S.	VAR	Priv invest	Negat	Negat		
	Fra/Can	VAR	Priv invest	Posit	Negat		
	U.S.,Fra,Can	VAR	Priv cons	Posit			
	UK, US.,Can		Priv cons		Negat		
Afonso and Soussa (2009)	U.S., UK,Ger,Italy	VAR	Output	Posit	posit		
			Price	Ins	Ins		
			priv inv	Negat	posit		
			priv cons	Ins			
Mirdala (2009)	Romania	VAR	Output	posit (s.l)	posit (perm)		
	Slovak Rep	VAR	Inflation	posit (s.l)	posit (s.l)		
De Castro and Hernández (2006)	Spain	VAR	output	posit (s.t)	Negat		
			output	neg (m&l.t)			
			Price	posit (m&l.t)			
Blanchard and Perotti (2002)	US	VAR	Output	Posit	negat		
Perotti (2002)	W.Ger,UK,Aust	VAR	Output		posit		
	USA,UK,Can		Output	Ins			
Fatásand Mihov (2001)	US	VAR	Output	Posit			
			priv inv	Posit	negat		
			priv cons	Posit			
Deak and Lenarcic (2011)	US(Hd/GDP)	VAR	Output		posit		
	US(Ld/GDP)	VAR	Output		negat		

Low income countries

	Case	Approach	Dep var	GEXP	Taxes	Cap exp	Current exp
Arnelyn et al. (2014)	Devel Asia	Pannel	output	Posit			
Estevao and Samake (2013)	HIPCs	VAR	output		posit (s.t)		
	Adv&emerging	VAR	output		negat		
Koffi (2009)	South Africa	VAR	output	Posit	posit		
			output	Mixte			
Bose et al. (2007)	30 devel count	pannel	output			posit	Ins
Devarajan et al.(1996)	43 devel count	pannel	per-cap growth			negat	Posit

Dep. Var=Dependent variable; W.Ger=West Germany; Ger=Germany; Can=Canada; Fra=France; Devel=Developing; Count=Country; Adv=Advanced; Hd/GDP=High debt/GDP ratio; Ld/GDP=Low debt/GDP ratio; Aust=Australia; priv inv=private investment; priv cons=private consumption; s.l=short-lived, s.t=short-term; m.t=medium-term; l.t=long-term; Ins=insignificant; posit=positive; negat=negative; cap exp=capital expenditure; exp=expenditure, per-cap=per-capita.

3.4 Methodology

This sub-section develops the theoretical and empirical frameworks. While the theoretical framework discusses the microeconomic and macroeconomic channels of fiscal policy, the empirical framework is concerned with the specification of the VAR models.

3.4.1 Theoretical framework

Microeconomic and macroeconomic channels of fiscal policy

While the analysis of fiscal policy is typically recognized in macroeconomics, fiscal policy microeconomic channels are also affected by individual agents' reactions to policy. These channels provide supplementary possibilities for fiscal policy to have both AD and AS effects,

even though these effects are second-order and differ from first-order macroeconomic effects (Palley, 2012). Micro channels have gained increasing attention following the emphasis on "micro founded" macro models during the past three decades. There are two principal government spending microeconomic channels. The first consists of the effect of government spending on public capital that occurs through the production function. By entering public capital in the aggregate production function, the increments to public capital (i.e. public investment expenditure) may affect investment expenditure and private sector employment, whereby the sign of the cross-partial derivatives of the production function determines the direction of the effect. Let the aggregate production function be given by

$Y = f(L, KP, KG)$ …… 3.1

where$Y$ = output, KP = private capital stock, L =employment, KG = public capital stock. The production function first partial derivatives are positive, while the second partial derivatives are negative. If public capital is found to have a positive effect on private capital and labor (positive cross-partial derivative), it is then a complement to private capital that will lead firms to raise employment, private capital, and private investment spending. However, the effect will work in the opposite direction if public capital is found to be a substitute for private capital (negative cross-partial derivatives).

The second channel is through household consumption choices and it functions through the utility function. If government spending increases private consumption spending, it complements household consumption, and will decrease private consumption spending if it is its substitute. Consider the following utility function of consumers

$V = U(C, G)$ …… 3.2

Whereby G = consumption of government provided public goods, and C = consumption of private goods, and V = utility. Government spending on public goods therefore yields private utility. The first partial derivatives of the utility function (U) with respect to $C$and G are positive, and the second partial derivatives are negative. Consumption and public goods complement one another if the cross-partial derivative is positive, and hence an increase in the provision of public goods will induce increased demand for private goods, that translates into an extra level of demand stimulus to current government spending. If the cross-partial is negative then private consumption and public goods are substitutes and an increase in public goods provision will decrease demand for private goods that reduces the demand stimulus from current government expenditure. If government purchases affect the marginal utility of consumption they may also affect the supply of labor and thereby have a second-order impact on AS. According to neo-classical theory, if the marginal utility of consumption increases, households will want to increase labor supply to earn more income to purchase additional consumption goods (Palley, 2012). The reverse holds if government purchases lower the marginal utility of consumption.

To isolate these microeconomic effects and identify the pure macroeconomic effects, it is assumed that government expenditure does not enter household utility functions and public capital has no impact on private sector productivity (Palley, 2012).

Taxes also have important microeconomic impacts via their impact on relative prices and incomes, and it also matters whether tax changes are temporary or permanent. These microeconomic tax incentive effects impact both businesses and households. With regard to households, the tax effects depend on whether tax changes are targeted at liquidity constrained,

rich, or poor households, because marginal propensities to consume vary by household type. To isolate and identify the purely macroeconomic effects of taxes it is assumed that all taxes are lump-sum so that they have no allocation or incentive effects and are a "pure" tax that only affects income (Palley, 2012).

3.4.2 Model specification

The empirical literature on the fiscal policy transmission mechanism has relied on VAR and DSGE specifications. However, Sims (2006, 6) argued that DSGEs are affected by lack of confidence in "statistical models" at low frequencies, as well as in high frequency behaviour of DSGEs. He adds that one of the crucial objections to DSGEs is that they have to be equipped with many sources of inertia and friction to fit well, which appear arbitrary (that is to say, more uncertain a priori than is acknowledged by the model). Mountford and Uhlig (2005) argue that VAR analysis is suitable for fiscal policy analysis for three main reasons. Firstly, VAR analysis accounts for the effects of announcements; secondly, one can distinguish the changes in fiscal variables due to fiscal policy shocks and those induced by other shocks (for instance monetary policy and business cycle); and thirdly, as opposed to LDCs, DSGE models with monetary policy transmission mechanism have been extensively used in developed economies. Given that the aim of this chapter is to include domestic exogenous variables, a VAR specification is used in order to compare the results with other developing countries.

To identify a structural VAR for analyzing the fiscal policy effects on economic variables, the empirical literature distinguishes four approaches. The first involves the recursive approach introduced by Sims (1980) and applied by Fatas and Mihov (2001) to study the effects of fiscal

shocks. The second is the structural VAR approach introduced by Blanchard and Perotti (2002) and extended in Perotti (2005) and Perotti (2007). The third approach is the sign-restrictions approach that was developed by Uhlig (2005) and applied by Mountford and Uhlig (2005) to fiscal policy analysis, and the fourth is the event-study approach initiated by Ramey and Shapiro (1998) to study the effects of large unanticipated increases in government defense spending in the US, also applied by Ramey (2007), and Perotti (2007). In this chapter, the specification of the VAR model is done through two approaches for the sake of robustness. The study first uses the SVAR specification using Blanchard-Perotti's (2002) identification methodology, and then the recursive specification method of VAR using Cholesky factorization to obtain structural innovations from reduced innovations. A recursive VAR builds the error terms in each regression equation so that they are uncorrelated with the error in the previous equations[30]. In order to do so, some contemporaneous values are judiciously included as regressors. The order of the variables may influence the results; modifying the order also modifies the VAR equations, residuals, and coefficients, and there are $n!$ recursive VARs possible orderings. In order to identify the contemporaneous links among the variables, structural VAR uses economic theory (Bernanke, 1986; Sims, 1986; Stock and Watson 2001). Structural VARs entail identifying assumptions that permit correlations to be interpreted causally. These identifying assumptions may involve the whole VAR in order to spell out all of the causal links in the model, or a single equation to identify a specific causal link. This generates instrumental variables that allow the contemporaneous links to be estimated by means of instrumental variables regression. The

[30] In the jargon of VARs, this algorithm for estimating the recursive VAR coefficients is equivalent to estimating the reduced form, then computing the Cholesky factorization of the reduced form VAR covariance matrix; see Lu¨tkepohl (1993, chapter 2).

number of structural VARs is limited only by the innovativeness of the researcher (Stock and Watson, 2001).

According to Blanchard and Perotti (2002), the SVAR approach seems to be more suitable for fiscal policy analysis. To the extent that there are exogenous fiscal shocks (not due to output stabilization) and decision and implementation lags in fiscal policy; this would imply that there is little discretionary response (within a quarter) to unexpected movements in activity.

This paper used the Blanchard and Perotti identification of the VAR model as presented in Blanchard and Perotti (2002). The identification proceeds by developing reduced form residuals (of different VARs) as a linear combination of the underlying structural innovation. By relying on institutional information and on other studies, it proceeds to the estimation of the impact of unexpected movements of GDP on taxes and government spending by constructing the elasticities to output of public spending and government revenue. The estimated coefficients allow constructing the cyclically adjusted reduced form of taxes and spending, which are not correlated to the structural shocks, and are then used as instruments to estimate the impact of unexpected movement of taxes and spending on output. The other hurdle is the estimation of the impact of unexpected changes in the fiscal variable on this variable. To solve this problem, the approach does not consider the two decisions simultaneously[31]. The decision of increasing expenditure is first considered and then is estimated the impact of unexpected change on spending on taxes. The VAR model is represented as:

$AY_t = B(L)LY_t + CX_t + e_t$ ..... (3.3)

[31]The authors believe that the ordering does not make for a big difference in the results as there is little correlation between the cyclically adjusted reduced form of taxes and spending.

Where Y_t= $(GEXP_t, RGDP_t, CPI_t, TREV_t,$ and $INTBR_t)$ is the vector of endogenous variables, and

Y_t=$Nx1$, A is a NxN matrix of coefficients capturing the contemporaneous relationship between the endogenous variables, $L$is the lag operator (with $LY_t = Y_{t-1}$),

$B(L)$= $\mathrm{B}_0 + \mathrm{B}_1\mathrm{L} + \mathrm{B}_2\mathrm{L}_2^2 +$ ...is a matrix polynomial in the lag operator, holding the lagged effects of the endogenous variables,

C is a NxK matrix holding the effects of the exogenous variables X, where X = [aid, rainfall, war against the DRC, UN payments to Rwanda, US industrial product index, US Treasury bills rate, and the world oil price],

e = is a $Nx1$ vector of structural innovations. The reduced form of the structural VAR model is given by:

Y_t= $A^{-1}B(L)LY_t + A^{-1}CX_t + u_t$ ……...……. (3.4)

With u_t= $A^{-1}e_t$ is the vector of reduced-form residuals, and $E(u_t u_t')$ = Ω =$A^{-1}\Sigma\, A^{-1\prime}$, which is normally not diagonal.

The link between the reduced form disturbances u_t and structural disturbances e_t can be presented as:

$u_t^{TREV} = \alpha_{RGDP}^{TREV} u_t^{RGDP} + \alpha_{CPI}^{TREV} u_t^{CPI} + \alpha_{INTBR}^{TREV} u_t^{INTBR} + \beta_{GEXP}^{TREV} e_t^{GEXP} + e_t^{TREV}$ …….…. (3.5)

$u_t^{GEXP} = \alpha_{RGDP}^{GEXP} u_t^{RGDP} + \alpha_{CPI}^{GEXP} u_t^{CPI} + \alpha_{INTBR}^{GEXP} u_t^{INTBR} + \beta_{TREV}^{GEXP} e_t^{TREV} + e_t^{GEXP}$ …… (3.6)

$u_t^{RGDP} = \alpha_{GEXP}^{RGDP} u_t^{GEXP} + \alpha_{TREV}^{RGDP} u_t^{TREV} + e_t^{RGDP}$ ……. (3.7)

$u_t^{CPI} = \alpha_{GEXP}^{CPI} u_t^{GEXP} + \alpha_{TREV}^{CPI} u_t^{TREV} + \alpha_{RGDP}^{CPI} u_t^{RGDP} + e_t^{CPI}$ …… (3.8)

$u_t^{INTBR} = \alpha_{GEXP}^{INTBR} u_t^{GEXP} + \alpha_{TREV}^{INTBR} u_t^{TREV} + \alpha_{RGDP}^{INTBR} u_t^{RGDP} + \alpha_{CPI}^{INTBR} u_t^{CPI} + e_t^{INTBR}$ …… (3.9)

The parameters α_j^i quantify both the automatic reaction of the fiscal variable i to the economic variable j and the systematic discretionary response of the fiscal variable i to the economic variable j. On the other hand, the coefficients β_j^i capture the random discretionary fiscal policy shocks to fiscal policy variables (i.e. the structural fiscal shocks). Evidence on the practice of fiscal policy advocates the existence of decision lags, implying that it is almost impossible to learn about a GDP shock, make a decision about what fiscal measures to take in response, forward these measures through the legislature and put them into action within three months (Blanchard and Perotti, 2002). Therefore, the discretionary change in variable i in response to a change in variable j is zero. Consequently, using quarterly data, the systematic discretionary component of u_t^T and u_t^g will be zero.The parameters α_j^i's will only reproduce the automatic response to economic movement.

For the system to be identified, $\frac{3K^2-K}{2}$ i.e. 35 constraints (where k the number of endogenous variables) should be imposed in total in both matrices A and B. Matrix B provides 19 coefficients that are equal to zero, and five other restrictions are provided by the main diagonal of matrix A. In addition, it is assumed that interbank rate-reduced innovation does not influence real output, price, and tax revenue, thus providing three more restrictions. The assumption that the reduced form innovation of output is not affected during the same period by the reduced form of inflation generates one more assumption making 28 restrictions so far. Seven more restrictions are obtained as follows. Following leading studies (including Blanchard and Perotti, 2002) in the literature, the study assumes that in quarterly data, the contemporaneous elasticity of government purchases with respect to output is zero, as expenditure is planned on an annual basis within the

budgetary process and is therefore rather inflexible in the short-run. Blanchard and Perotti (2002) also stated that they were not able to identify any automatic feedback from economic activity to government purchases of goods and services[32]. Moreover, given that transfers and interest payments on government debt are excluded from the definition of government net taxes and spending, the semi-elasticities of these two variables with respect to interest rate, α_r^g and α_r^T innovations are set to zero[33]. Regarding the construction of the price elasticity of government spending, Perotti (2005) adopted an eclectic approach where it is set at -0.5. According to Perotti (2002), this value must be set between -1 and 0. The author's justification is that one part of government expenditure made up of the non-wage component is inelastic to prices, and the elasticity of the other part of wages in the public sector is equal to -1. However, Perotti (2004) argued that when this value is set at 0 rather than -0.5, the results are not significantly affected. In this study, the price elasticity of government spending is set at 0, following the assumption that both parts of government spending are inelastic to a change in price in Rwanda at least in the quarter when the change occurs. Moreover, setting change in government spending due to change in tax (a_{TREV}^{GEXP}) = 0 implies government decisions on spending are taken prior to decisions on revenue. However, for robustness reasons, the study sets change in tax with respect to change in government spending (a_{GEXP}^{TREV}) = 0 and the results are compared. Finally, this study uses external information to build GDP[34] and price elasticities of tax. The matrix form of the relation

[32] This is standard in most of the literature i.e. Blanchard and Perotti (2002), Perotti (2004) and De Castro and De Cos (2008).

[33] This is also a standard assumption in the literature. See Blanchard and Perotti (2002), Perotti (2004), Castro and De Cos (2008).

[34] Several studies(including Blanchard and Perotti (2002), and Perotti (2005)) estimated output elasticity of tax by computing the sum of component weighted elasticities whereby the component elasticity is obtained by calculating the elasticity of the tax component with respect to its base, multiplied by the elasticity of the base component with respect to GDP. Because of the lack of data on tax base components, the study runs a proxy of elasticity of tax with

between the reduced form and structural disturbances after imposing restrictions on parameter values is: $\Gamma U_t = BV_t$ where V is the vector containing the orthogonal structural shocks.

$$\Gamma U_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -\alpha_{GEXP}^{RGDP} & 1 & 0 & -\alpha_{TREV}^{RGDP} & 0 \\ -\alpha_{GEXP}^{CPI} & -\alpha_{RGDP}^{CPI} & 1 & -\alpha_{TREV}^{CPI} & 0 \\ 0 & -0.87 & -0.38 & 1 & 0 \\ -\alpha_{GEXP}^{INTBR} & -\alpha_{RGDP}^{INTBR} & -\alpha_{CPI}^{INTBR} & -\alpha_{TREV}^{INTBR} & 1 \end{bmatrix} \begin{bmatrix} u_t^{GEXP} \\ u_t^{RGDP} \\ u_t^{CPI} \\ u_t^{TREV} \\ u_t^{INTBR} \end{bmatrix} = \beta V_t \begin{bmatrix} \beta_{GEXP}^{GEXP} & 0 & 0 & 0 & 0 \\ 0 & \beta_{RGDP}^{RGDP} & 0 & 0 & 0 \\ 0 & 0 & \beta_{CPI}^{CPI} & 0 & 0 \\ \beta_{GEXP}^{TREV} & 0 & 0 & \beta_{TREV}^{TREV} & 0 \\ 0 & 0 & 0 & 0 & \beta_{INTBR}^{INTBR} \end{bmatrix} \begin{bmatrix} e_t^{GEXP} \\ e_t^{RGDP} \\ e_t^{CPI} \\ e_t^{TREV} \\ e_t^{INTBR} \end{bmatrix} \quad \ldots. (3.10)$$

Once all the coefficients are estimated, the study then uses the structural moving average representation of the VAR to estimate the impulse responses.

Recursive VAR approach allows orthogonalization of the residuals using the inverse of the Cholesky factor of the residual covariance matrix. This procedure is simple as one does not need to write a matrix and impose restrictions (Younus, 2005). However, the ordering of the variables in the VAR is fundamental as it attributes all of the effects of any common component to the variable that comes first in the VAR system. Once the ordering is changed the results obtained are different. The recursive ordering of the baseline variables is government spending, real GDP, CPI inflation, tax revenue, and then interbank rate, implying the following form.[35]

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respect to GDP by computing a direct elasticity of total tax with respect to GDP that is equal to 0.87. This almost matches the elasticity obtained in the work of Heppke-Falk, Tenhofen and Wolf (2006) which is 0.95 for Germany, while for Spain, the elasticity calculated by de Castro and de Cos (2006) is 0.62, and it is 0.76 for the UK, 0.81 for Australia (Perotti, 2002), and 0.509 for Kenya (Okech and Mburu, 2011). The same methodology was applied to compute the price elasticity of tax.

[35] The ordering in this study was done following Fatás (2001), Caldara and Kamps (2008), and Almeida (2012).

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \alpha_{GEXP}^{RGDP} & 1 & 0 & 0 & 0 \\ \alpha_{GEXP}^{CPI} & \alpha_{RGDP}^{CPI} & 1 & 0 & 0 \\ \alpha_{GEXP}^{TREV} & \alpha_{RGDP}^{TREV} & \alpha_{CPI}^{TREV} & 1 & 0 \\ \alpha_{GEXP}^{INTR} & \alpha_{RGDP}^{INTR} & \alpha_{CPI}^{INTR} & \alpha_{TREV}^{INTR} & 1 \end{bmatrix} \begin{bmatrix} u_t^{GEXP} \\ u_t^{GDP} \\ u_t^{CPI} \\ u_t^{TREV} \\ u_t^{INT} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^{GEXP} \\ e_t^{RGDP} \\ e_t^{CPI} \\ e_t^{TREV} \\ e_t^{INTR} \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

The causal ordering implies that government spending does not respond contemporaneously to disturbances of other variables in the model; real GDP responds contemporaneously to innovations in government spending, but is not affected contemporaneously by CPI, tax revenue, and interbank rate; CPI responds contemporaneously to innovations in government spending and real GDP but is not affected contemporaneously by tax revenue and interest rate; tax revenue responds contemporaneously to innovations in government spending, real GDP, CPI but is not affected contemporaneously by interbank rate; and interbank rate responds contemporaneously to all innovations in the system. It is worth noting that after the first period, variables in the system are allowed to interact freely.

The assumptions on the contemporaneous links between the variables can be explained as follows. Unlike movements in taxes, movements in government spending are largely unrelated to the business cycle. Hence, it is assumed that government spending is not contemporaneously affected by shocks from the private sector. Ordering output and inflation before taxes can be explained by the fact that shocks to these two variables have an immediate impact on the tax base and, hence, a contemporaneous effect on tax receipts. This specific ordering of variables thus captures the effects of automatic stabilizers on government revenue, while ruling out

contemporaneous effects of discretionary tax changes on output and inflation. Ordering the interest rate last can be justified on the basis of a Central Bank reaction function, implying that the interest rate is set as a function of the output gap and inflation, given that spending and revenue as defined in this study (net of interest payments) are not responsive to interest rate movements. It is important to note that in this study after the benchmark model (with government spending, real GDP, inflation, total net taxes, and interest rate) is estimated, another specification is estimated where real GDP is replaced by its private components (consumption and investment). GDP is disaggregated into real private consumption and real private investment for two reasons. Firstly, because real GDP incorporates government expenditure, the study isolates the government spending component, and then considers its effects on private consumption expenditure. Secondly, disaggregating real GDP allows to capture the existence of the crowding out (or crowding in) effects of government spending on private spending in the Rwandan economy. The interest rate controls for the influence of monetary policy.

3.4.3 Data description and measurement of variables

This study uses quarterly data to achieve the objective of identifying the outcomes of fiscal policy shocks. Using annual, rather than quarterly data would cause the loss of some information as there is the risk that shocks that occur in the first months of the year would be smoothed by the end of the year. Furthermore, within a quarter, a change in fiscal variables is only due to fiscal policy shocks and not economic activity. In other words it takes more than one quarter for fiscal variables to react to variations in economic activity (Blanchard and Perotti, 2002).

In this study, quarterly data for real government spending are used, real net tax revenues, real GDP, CPI, and the interbank rate from 1996Q1 to 2014Q4. The CPI (base: 2011; reference: February 2014=100) and interbank rate variables were obtained from the Central Bank, while government spending, tax revenue, real GDP, and Aid (for year 2014) were gathered from the Ministry of Finance and Economic Planning (Minecofin). Data on aid from 1996-2013 was obtained from World Bank World development indicators), and data on real private consumption and gross fixed capital formation for the private sector were also collected from World Bank (World development indicators) in current values. Monthly data on rainfall were obtained from the Rwanda Meteorology Agency and were made quarterly by calculating the three-month averages. Foreign exogenous variables include the US industrial production index; the USA 90-Day Treasury Bills interest rate; and world oil prices[36].

Variables are defined and measured as follows: Real GDP is the GDP by expenditure approach (constant prices, 2011=100) and is generally computed by the NISR; while CPI represents inflation. The fiscal policy variables used in this study are government spending and tax revenue[37]that are defined in line with Blanchard and Perotti (2002). The revenue variable is defined as total revenue (which includes tax and non-tax revenue) less interest payments and transfers (referred to as taxes or net taxes in this essay). The expenditure variable is called government spending (or government expenditure in this thesis) and involves government consumption (mainly compensation of employees and intermediate consumption), and

[36]For more details on foreign as well as domestic exogenous variables see chapter 2.

[37]"Some of the earlier work on fiscal policy has often relied on the cyclically-adjusted primary deficit as a measure of fiscal policy stance. Although the adjusted deficit does deliver information about current policy, it is inappropriate in dynamic macro econometric analysis because none of the competing theories implies that spending increases and tax cuts have the same effect on the economy" (Fátas and Mihov, 2001).

government investment. The primary reason for using this rather than the GDP deflator is that consumption expenditure represents a very large proportion (more than 80% on average) of Rwanda's total expenditure, implying that inflation in the country is largely driven by demand for consumption.

Real values for government spending, tax revenue, net official development assistance, and gross fixed capital formation were obtained by using CPI. It is worth noting that only annual data for real GDP, private consumption, gross fixed capital formation for private sector, and aid as well as fiscal variables were available for the period 1996-2014, and were transformed into quarterly data in this study using the quadratic match sum approach. Real GDP is interpolated for the period 1996: Q1-2005: Q4, while the period 2006: Q1 to 2014: Q4 uses data from Minecofin which was collected on a quarterly basis by the National Institute of Statistics of Rwanda. The data are expressed in natural logarithms (including the interbank rate)[38] and are seasonally adjusted (except the interpolated ones) using the Census X-12 approach. The dummy variable for war between Rwanda and the DRC takes the value of one during the period of wars (1996:Q3 to2002:Q3) and zero otherwise, while the dummy variable for UN payments for UN peace keeping missions by Rwanda takes zero for the period before 2008, and one from 2008: Q1 to 2014: Q4. Moreover, given that domestic and foreign exogenous variables are likely to affect endogenous variables with a lag; exogenous variables enter the VAR model with 2lags[39].

[38] The logarithm of the interbank rate is defined in chapter 2 of this thesis.
[39]For more details on about exogenous variables lagging, see chapter 2.

3.5 Empirical results and discussion

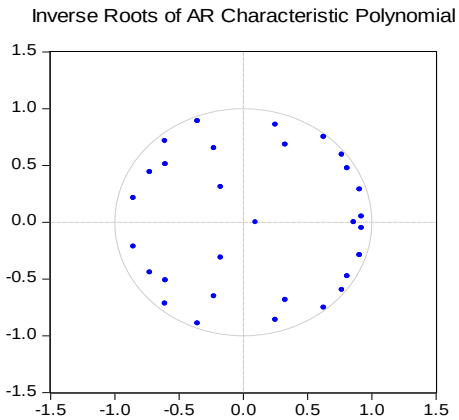
Before the main results of the analysis are discussed, the study presents the preliminary results for stationarity, cointegration, lag order selection, stability, autocorrelation, and normality tests. In the empirical section, the study estimates and interpret the impulse responses and variance decomposition results for the effect of fiscal variables on price and GDP using two distinct approaches to VAR identification, the Blanchard and Perotti (2002), and the recursive approaches, and thereafter, the recursive approach is used to estimate the effect of fiscal variables on price and private components of GDP. Finally, other specifications are estimated and the results are compared to the benchmark model.

To test for stationarity in variables, the unit root tests were conducted on the equations describing the DGP of the series. In this exercise, each stationarity test was preceded by a corresponding graph. Using the Augmented Dickey-Fuller (ADF) test, and Philips-Perron (PP), and Kwiatkowski-Philips-Schmidt-Shin (KPSS) tests, the endogenous variables (log of real government expenditure, log of real GDP, log of CPI, log of real tax revenue, and log of interbank rate) as well as exogenous variables (log of net Official Development Assistance, log of rain fall, log of US industrial product index, log of US Treasury bills, and log of World oil price) are integrated of order one [that is I (1)] and therefore not stationary, as shown in Table 1.1 Appendix 1.

Given that all the series were I (1), the Johansen cointegration test was run to establish if a long-run relationship among non-stationary variables exists. The results in Table 3.2 in Appendix 3 show that the series were cointegrated at the 5 percent level.

The VAR lag order selection criterion in this section was based on the Akaike, Schwarz, sequential modified LR, final prediction error (FPE), and Hannan-Quinn (HQ) information criteria. This is achieved with 2 lags for exogenous variables except War and UN payments that are dummies. The results indicate that all the criteria suggest 6 lags [Akaike (-28.43), Schwarz (-20.72), LR (49.12, FPE ($1.45e^{-18}$), HQ (-25.36)].The stability test of the model was conducted and results for the 6 lag VAR are presented in Figure 3.4.

Figure 3.4 VAR stability test



The results in Figure 3.4 indicate that all the roots are less than 1, and lie inside the unit circle. Hence the 6 lag VAR is stable. Regarding residual serial correlation, the LM tests were used for this purpose.

Table 3.3 VAR Residual serial correlation LM tests

Lags	1	2	3	4	5	6	7	8	9	10	11	12	
LM-Stat	50.69	39.73	29.35	29.72	28.18	32.41	23.29	36.46	27.22	21.19	17.68	39.88	Probs from chi-square with 25df.
Prob	0.002	0.031	0.250	0.235	0.300	0.147	0.561	0.065	0.345	0.682	0.856	0.030	

The results in Table 3.3 reveal the absence of serial correlation in residuals; therefore, the 6lag VAR is suitable for analysis. The normality test was conducted and results are depicted in Table 3.4.

Table 3.4 VAR Residual normality test

Component	Skewness	Chi-sq	Df	Prob.
Joint		4.323	5	0.504
Component	Kurtosis	Chi-sq	Df	Prob.
Joint		0.370	5	0.996
Component	Jarque-Bera	df	Prob.	
Joint		4.693	10	0.911

Table 3.4 shows that there is normality in residuals. The probability values for the three tests(0.5039), (0.9961), and (0.9107) are greater than 5 percent.

3.5.1 Regression results

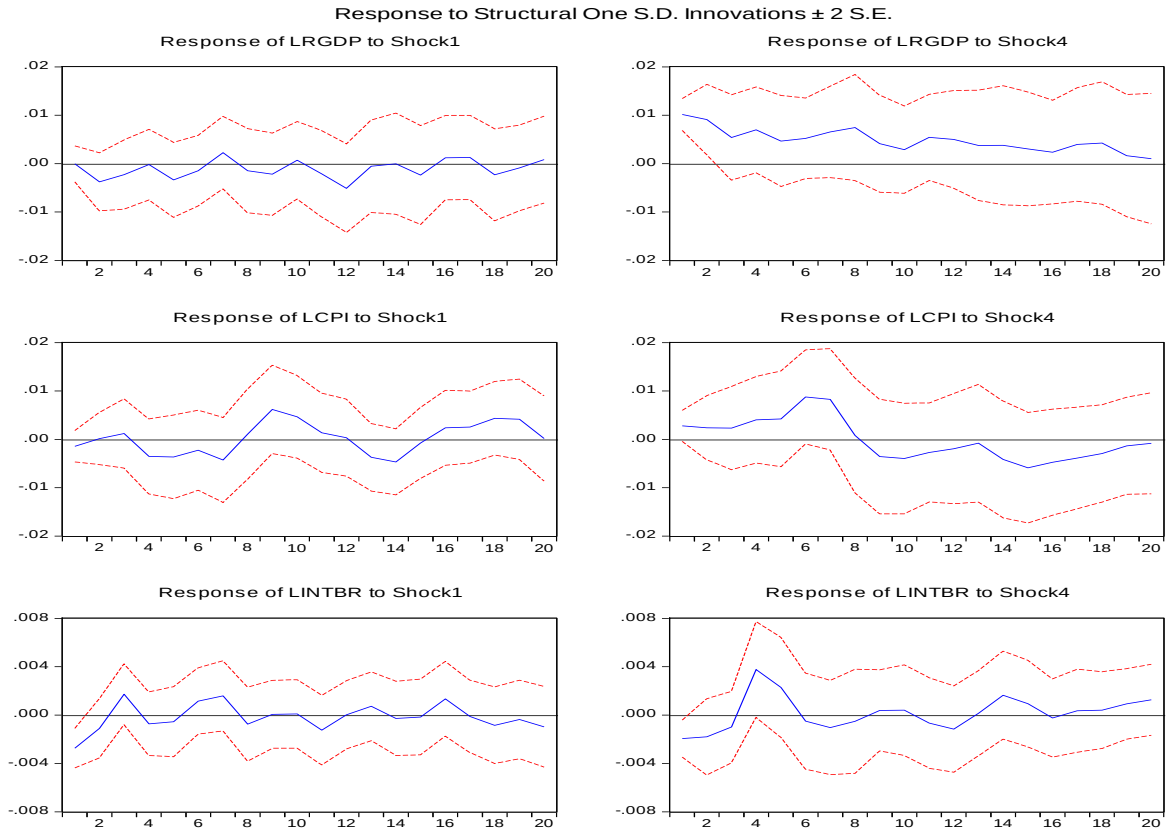
In this section, the first step was estimating the effect of fiscal variables on CPI and GDP, and thereafter, the same estimation is repeated with components of GDP. In this exercise, two approaches (Blanchard and Perotti, 2002; and the recursive) are used for robustness reasons.

Furthermore, the economic variables' response to policy variables was revealed by means of impulse response functions (IRF) and variance decomposition (VD).

A. Fiscal policy effect on real GDP and inflation

Consistent with Blanchard and Perotti (2002), the deduced impulse response functions of real GDP, and inflation, due to innovation in fiscal variables are shown in Figure 3.5.

Figure 3.5 Structural VAR Impulse response functions: Fiscal variables effect on RGDP and CPI inflation



These impulse responses were obtained after having determined the structural VAR estimates. The results indicate that the effect of government spending on output and inflation appears weak.

In particular, GEXP's (shock 1) effect on RGDP is insignificant for the whole period. Similarly, its effect on inflation is insignificantly during the same period.

Regarding the tax revenue (shock 4) effect, an unexpected change in tax revenue positively and significantly affects real GDP during the first quarter and a half before the effect becomes insignificant. Moreover, tax revenue's effect on prices appears to be insignificant for the considered period. These results suggest that the fiscal policy transmission mechanism through government spending is weak in Rwanda. Regarding the tax revenue results, the positive and significant effect on real output supports the results obtained by Estevao and Samake (2013), Deak and Lenarcic (2011), and Perotti (2002), where real GDP positively responds to an unexpected positive change in tax revenue in the short-term. Moreover, Perotti (2002) found that, in the full sample, the effect of tax on prices is zero in the US and West Germany. It is worth noting that when tax revenue is assumed to be determined before government spending, the results do not change significantly, as shown in figure 3.6 Appendix 3.

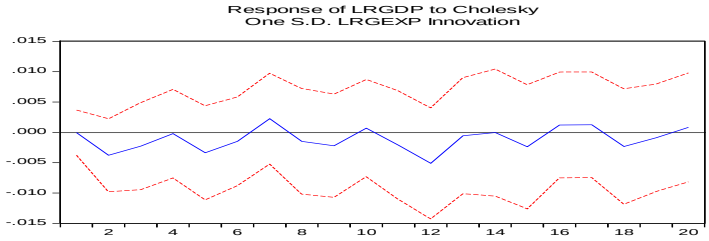
The effect of fiscal policy variables on real GDP and inflation was also revealed through the variance decomposition approach and results are presented in Table 3.5. They indicate that tax revenue (shock 4) contributes to fluctuations in real output in Rwanda's economy, while government spending does not; supporting the results obtained using impulse responses.

Table 3.5 Structural VAR Variance decomposition: Fiscal variables effect on Real GDP and CPI

Variance Decomposition of log of Real GDP:						
Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5
1	0.015545	0.001002	55.96629	1.401295	42.63141	0.000000
9	0.030043	4.997323	42.93146	2.154170	47.37749	2.539564
15	0.034473	6.912005	43.12921	2.333567	44.40445	3.220759
20	0.035997	7.106107	42.82354	2.420357	44.03392	3.616079
Variance Decomposition of log of CPI:						
Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5
1	0.013643	1.118801	3.695229	91.03237	4.153597	0.000000
5	0.028608	3.592582	26.32141	61.02401	6.467082	2.594919
10	0.035998	8.764387	26.65930	44.34536	17.51160	2.719355
15	0.038554	10.21449	26.46534	40.35084	19.55373	3.415604
20	0.040455	12.21947	25.12306	37.95655	20.71402	3.986903
Variance Decomposition of log of INTBR:						
Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5
1	0.007106	14.83937	22.98310	12.31354	7.531124	42.33286
5	0.009672	13.35388	20.85170	12.74831	29.31673	23.72938
10	0.010939	14.13351	24.26530	12.75057	24.51314	24.33749
15	0.011656	14.07032	23.18292	14.24320	25.55523	22.94833

For robustness checks on the effect of fiscal policy variables on real GDP and inflation, impulse responses and variance decomposition functions for recursive VAR specification were estimated and the results are compared with those obtained using Blanchard and Perotti's (2002) approach. The recursive VAR impulse responses results for the effect of fiscal policy variables on output and inflation are shown from Figure 3.7 to Figure 3.10 and results are largely similar to those based on Blanchard and Perotti's identification.

Figure 3.7 Impulse responses of real GDP to shock in government spending



Government spending's effects on real output are insignificant. Regarding the effect of government spending on prices, results are depicted in Figure 3.8

Figure 3.8 Impulse responses of prices to shock in government spending

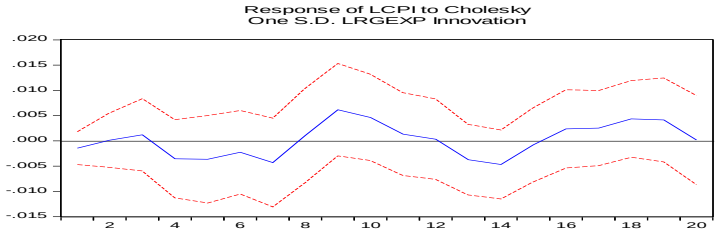
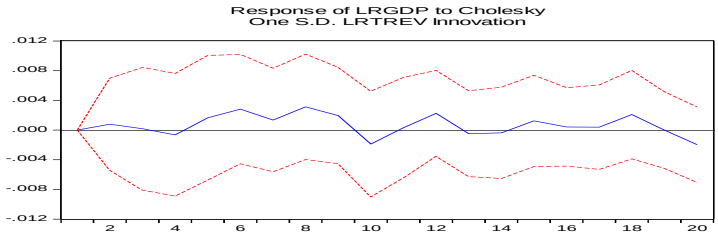


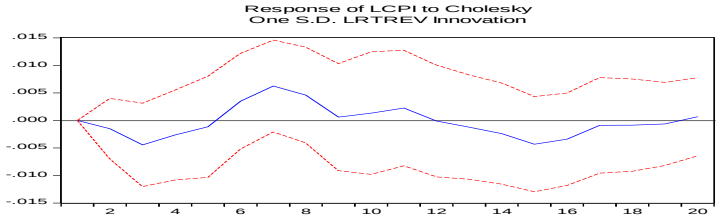
Figure 3.8 indicates that as for real output, prices do not respond to shocks in government spending. Tax revenue's effects on output and inflation are also depicted in Figure 3.9 and Figure 3.10 respectively.

Figure 3.9 Impulse responses of real GDP to shock in tax revenues



The results indicate that the output effects of taxes are insignificant, and hence tax revenue does not have direct influence on real output. Regarding the effect of tax revenue to prices, results are displayed in Figure 3.10.

Figure 3.10 Impulse responses of prices to shock in tax revenues



Results show that as for real GDP, prices do not respond to shock in tax revenue.

Variance decomposition approach was also used determine the effects of fiscal variables to output and prices, and results supports those obtained with impulse response functions. The recursive VAR Variance decomposition results are shown in Table 3.6.

Table 3.6 Recursive VAR Variance decomposition: Fiscal variables effect on Real GDP and CPI

Variance Decomposition of log of Real GDP:						
Period	S.E.	LRGEXP	LRGDP	LCPI	LRTREV	LINTBR
1	0.015546	0.001000	99.99900	0.000000	0.000000	0.000000
5	0.026027	4.546911	90.64182	2.467579	0.558330	1.785358
10	0.030863	4.786094	85.39672	3.851821	3.217768	2.747596
15	0.034473	6.911835	82.08336	4.608791	3.175311	3.220707
20	0.035997	7.105954	80.93373	4.771886	3.572399	3.616028
Variance Decomposition of log of CPI:						
Period	S.E.	LRGEXP	LRGDP	LCPI	LRTREV	LINTBR
1	0.013643	1.118791	2.687401	96.19381	0.000000	0.000000
5	0.028608	3.592614	21.53460	68.58704	3.690898	2.594854
10	0.035998	8.764351	30.86459	49.56654	8.085202	2.719323
15	0.038554	10.21452	32.31842	44.91709	9.134408	3.415555
20	0.040455	12.21948	32.69777	41.94440	9.151514	3.986828

They support the insignificant responses of real output and inflation to the fiscal variables obtained through the impulse responses from Figure 3.7 to Figure 3.10. This is justified by the small contribution of both government spending and tax revenue in explaining fluctuations in real output and inflation as observed in Table 3.6.

A careful scrutiny of the results obtained using the Blanchard-Perotti and recursive approaches reveals a slight difference in the results. While both approaches show that government spending does not affect both real output and price and the weak contribution of tax in explaining changes in price, they differ in the effect of tax revenue on output. While the former reveals a positive effect of tax revenue on output, the latter indicates that output does not respond to unexpected changes in tax revenue. According to Caldara and Kamps (2008), it is expected that the results obtained using the Blanchard-Perotti and recursive approaches will differ given that the latter restricts the short-run output effect of a pure tax shock to zero, while the former approach does not. The authors argue that the results obtained using the Blanchard-Perotti approach are sensitive to the calibrated value of the output elasticity of net taxes, and show that as the calibration increases from 0 to 4, the impact response of output due to taxes decreases from positive values and becomes negative when the output elasticity exceeds 2. In their study, the Blanchard-Perotti and recursive approaches yielded the same results whereby the effect of taxes on output is close to zero. When they run the recursive model, the estimated free parameter (output elasticity of tax) equals 1.93, close to the 1.85 that they had set for the Blanchard-Perotti approach. This could explain the difference in results obtained using both approaches in the current study. In addition, the fact that the elasticity coefficient of taxes with respect to output estimated in this essay is subject to limitations due to the lack of data on tax bases, could create the difference in results.

B. Fiscal Policy's Effect on RGDP Components and Inflation

In this sub-section, focus is made on the use of the recursive VAR approach to detect any crowding out or crowding in effect of government spending on private investment by regressing real GDP private expenditure components to government spending. The stationarity test results for real GDP components in Table 1.1 in Appendix 1 indicated that they are I (1), while the results in Table 3.7 in Appendix 3 panel B indicated that the VAR variables are cointegrated.

The regression analysis (through the recursive impulse responses and variance decomposition) of the fiscal policy variables effect on real GDP components and inflation was preceded by the tests for VAR lag length, stability and error autocorrelation. The lag selection of the VAR model in this section is based on Akaike, Schwarz, sequential modified LR, final prediction error, and Hannan-Quinn.

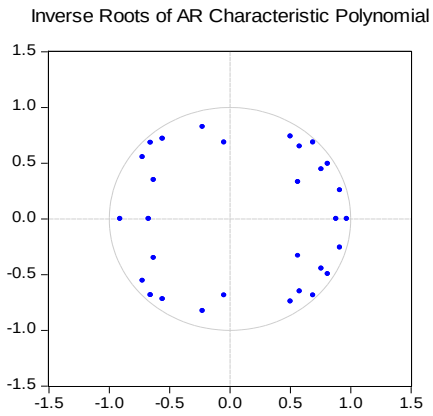
Table 3.8 VAR lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
5	1448.104	88.58295*	1.03e-21	-33.1458	-23.8949	-29.47124
6	1549.795	46.48741	5.13e-22*	-35.02273*	-24.61540*	-30.88881*
* indicates lag order selected by the criterion						

The results in Table 3.8 suggest that 5 and 6 lags are appropriate. However, when the normality test of residuals is employed, the 6-lag VAR residuals are not normally distributed. Only the 5-lag VAR is normally distributed, following a Skewness probability value of 0.0513 which is larger than 5percent of significance level.

The 5lag VAR model was found to be stable as shown in Figure 3.11.

Figure 3.11 VAR Stability test



The results show that all the roots are less than 1, and lie inside the unit circle. Regarding serial error correlation, the results are presented in Table 3.9.

Table 3.9 VAR Serial correlation test

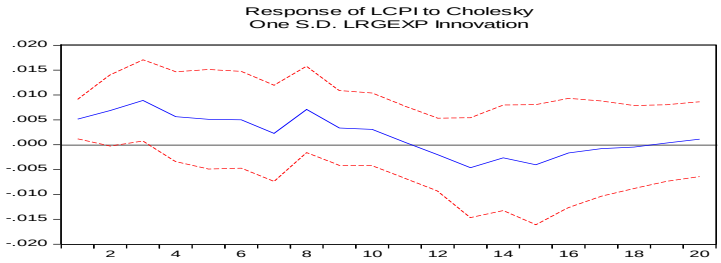
Lags	1	2	3	4	5	6	7	8	9	10	11	12	
LM-Stat	35.8	48.8	54.3	33.4	33.2	21.1	27.3	49.6	39.9	25.4	36.5	43.9	Probs from chi-square with 36 df.
Prob	0.48	0.08	0.03	0.59	0.60	0.98	0.85	0.07	0.30	0.91	0.44	0.17	

They suggest the non-rejection of the hypothesis of absence of residual correlation for the 5-lag VAR. Hence the 5-lag VAR was selected for analysis.

The effect of fiscal policy variables on GDP components and inflation is estimated using the recursive impulse response functions and variance decomposition. In order to understand the crowding out effect of government spending on private investment that is hypothesized in Rwanda's economy, real GDP is broken down into private consumption and private investment. In addition, given that total government expenditure represents a large portion of GDP (more

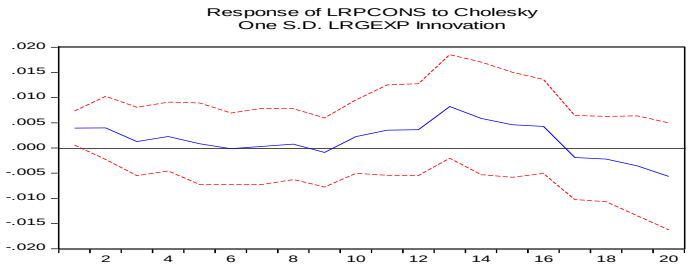
than 20 percent), removing it enables the true contribution of government spending to private consumption, and private investment in Rwanda to be revealed. The response of prices, private consumption, and private investment is captured in Figures 3.12 to 3.17. It is worth noting that results for the magnitude of the effect of fiscal policy variables to real GDP components are reported in Table 5.2 Appendix 5.

Figure 3.12 Impulse responses of prices to shock in government spending



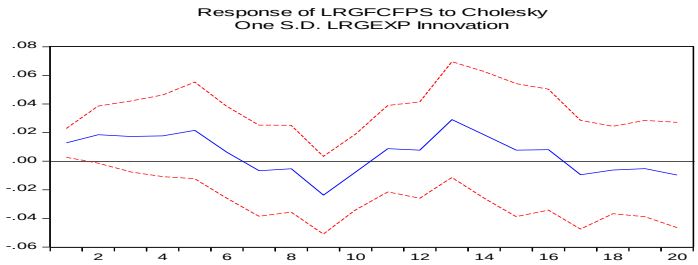
Results from Figure 3.12 suggest that an increase in government spending leads to an increase in inflation in the short term. An unexpected increase in government spending is followed by an increase in inflation up to 2nd quarter after which the effect becomes insignificant. Figure 3.13 shows the response of private consumption to unexpected shock in government spending

Figure 3.13 Impulse responses of real private consumption to shock in government spending



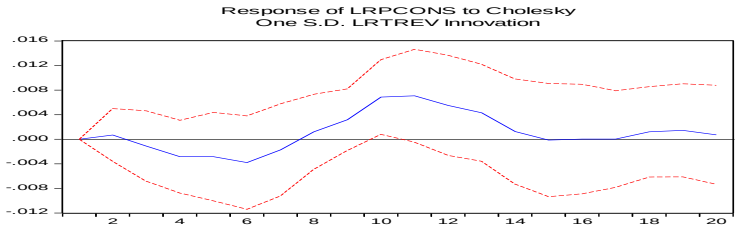
The results in Figure 3.13 reveal that unexpected changes in government spending slightly induce changes in private consumption. Similarly, effects of government spending on private investment are shown in Figure 3.14.

Figure 3.14 Impulse responses of real private investment to shock in government spending



Results indicate that, government spending explains changes in private investment. A positive shock in government spending raises private investment for the first two quarters. These results imply that government expenditure can be useful in influencing movements in private investment. In addition to the influence of government spending on private consumption, the revealed crowding in effect of government spending on private investment implies a direct effect of government spending on real GDP, making government spending a potential tool to influence movements in real output in Rwanda, but at the cost of raising inflation. Regarding the effect of tax revenue on private consumption, the results are depicted in Figure 3.15.

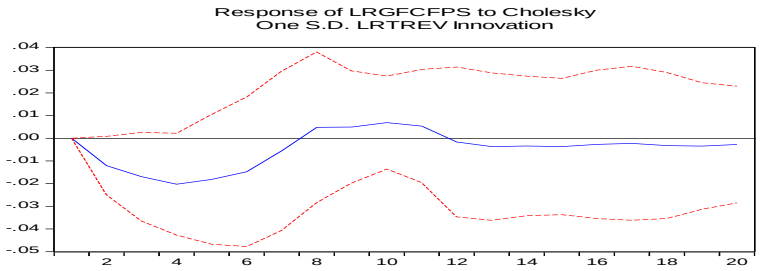
Figure 3.15 Impulse responses of real private consumption to shock in tax revenue



Results from Figure 3.15 show that tax revenue has a positive effect on private consumption. An increase in tax revenue positively affects private consumption during the 9th and 10th quarters. Moreover, it is worth noting that when the recursive VAR order is changed by placing private

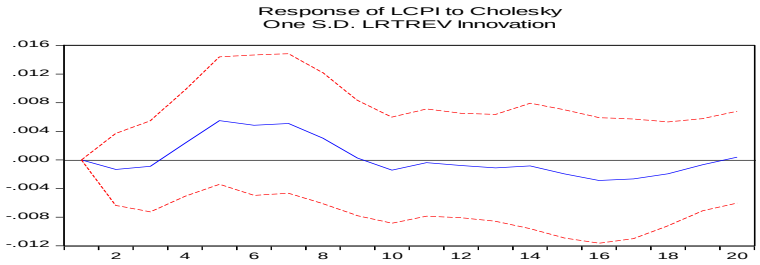
investment before private consumption, the results for the impulse responses do not change significantly. Results for the effects of tax revenue on private investment and prices are depicted in Figure 3.16 and Figure 3.17.

Figure 3.16 Impulse responses of real private investment to shock in tax revenue



The results show that tax revenue does not contribute to changes in private investment. Similarly,

Figure 3.17 Impulse responses of prices to shock in tax revenue



Prices do not respond to shock in tax revenue for the period under consideration.

The effect of government spending on the Variance decomposition of GDP components and CPI is presented in Table 3.10.

Table 3.10 Recursive VAR Variance decomposition: Effect of fiscal policy variables on GDP components and CPI

Variance Decomposition of log of real private investment GFCFPS:							
Period	S.E.	LRGEXP	LRPCONS	LRGFCFPS	LCPI	LRTREV	LINTBR
1	0.014	8.635	8.149	83.215	0.000	0.000	0.000
10	0.031	15.529	14.192	52.791	4.835	10.175	2.477
20	0.043	**18.645**	12.572	50.606	8.023	7.578	2.577
Variance Decomposition of log of CPI:							
Period	S.E.	LRGEXP	LRPCONS	LRGFCFPS	LCPI	LRTREV	LINTBR
1	0.044	9.015	0.0003	35.427	55.557	0.000	0.000
10	0.122	**20.813**	3.522	29.217	38.162	6.602	1.685
20	0.147	18.808	5.376	34.364	33.326	6.432	1.694
Cholesky Ordering: LSIRGEXP LRPCONS LRGFCFPS LCPI LSIRTREV LINTBR							

The results in Table 3.10 indicate that GEXP changes tend to explain fluctuations in GFCFPS with the highest contribution of 18.64 percent during the 20th quarter. Finally, GEXP has a significant effect on inflation, with the highest value of 20.81 percent during the 10th quarter. The overall implication of these results is that GEXP is the best channel of transmission of fiscal policy in explaining changes in prices and private investment.

3.5.2 Comparison of benchmark model with other specifications

In order to verify the relevance of controlling for domestic variables in VAR specification of the fiscal policy transmission mechanism, two other specifications were made and the results were compared. The first specification differs from the benchmark model in that it includes only

foreign shock variables (it ignores domestic shocks), while the second specification does not include domestic and foreign shocks.

The impulse responses results for specifications one and two are presented in Appendix 3, in Figure 3.18 and Figure 3.19 respectively (where total real GDP is considered), and in Appendix 3, in Figure 3.20, and Figure 3.21 respectively (where real GDP components are considered). The findings indicate that there is no significant difference in the results for the benchmark and both models one and two. However, given that the impulse responses for fiscal policy transmission are erratic and mostly not significant, it is difficult to conclude whether or not it is relevant to include domestic exogenous variables in the VAR specification of the fiscal transmission mechanism in addition to foreign exogenous variables.

3.6 Results, interpretation and discussion

The empirical objective set out to be achieved in this essay was to identify the important channel of fiscal policy transmission in Rwanda, through the criteria of the timing and magnitude of the effect of policy change on the macroeconomic variables of interest. Structural and recursive VAR models using quarterly data from 1996:Q1 to 2014: Q4 were estimated for this purpose. In order to correctly specify the estimated VARs models, domestic exogenous variables (rainfall, aid, UN payments and war) in addition to foreign ones were included in the models. The results derived through impulse responses and variance decomposition are in line with the empirical literature on fiscal policy transmission mechanism. Government spending was found to be an important channel of fiscal policy transmission. An increase in government spending has a positive and significant effect on prices, in addition to increasing private investment.

Furthermore, the effect of government spending on prices as well as private investment is quickly felt but lasts for only three quarters for prices and two quarters for private investment. A positive and short-lived effect of government spending on prices was also found by Mirdala (2009) for the Slovakia Republic, while the crowding-in effect of government spending on private investment was found by Jemec et al. (2013) and Fatás and Mihov (2001).

Other results indicate that taxes have a positive significant effect on output. Estevao and Samake (2013) argued that the short-run positive effect on output of tax increases in high indebted poor countries (HIPCs) could be due to the fact that these countries are usually characterized by lower tax collection efforts and high levels of debt, implying that supplementary revenue collection could enhance growth even in the short-run. Similar results were reported by Afonso and Soussa (2009), Koffi (2009), and Perotti (2002). In addition, in the context of a regime switching model, Deak and Lenarcic (2011) show that during the presence of a high debt-to-GDP ratio a positive tax revenue shock would raise output; while a government spending shock would negatively affect output over time.

The finding that the relationship between government spending and output is insignificant is similar to that of Perotti (2002). Furthermore, while not significant, private consumption responds positively to a government spending shock, implying that GEXP could be a potential tool to boost private consumption. Other results indicate that taxes do not affect price levels. Similar results were obtained by Afonso and Soussa (2009).

Another aspect that was examined is the relevance of the domestic exogenous variables in VAR specification of FPTM. Given that the emphasis of the study was to understand the relevance of including domestic exogenous variables, in addition to foreign exogenous variables, and that it would be hard to compare the results with previous studies because they covered different time periods, other specifications were estimated and the results were compared to the benchmark model. Specification1 includes only foreign exogenous variables, and specification2 does not include any exogenous variable. The results do not provide any evidence about the relevance to include domestic exogenous variables given that there is no difference between the benchmark model and both specifications' results.

In light of the study findings, the fiscal policy through government spending is moderately effective as it affects private investment (crowding in) and prices in Rwanda, and is therefore a potential tool to boost demand in the country.

Nevertheless, it is important to note that the impulse responses for all three specifications are insignificant and irregular with a wide confidence interval for both specifications, behaviour that is attributed to the relatively insufficient data sample size.

3.7 Conclusions and policy implications

The objective of this chapter was to identify the channels of transmission of fiscal policy using the criteria of the magnitude and timeliness of the effect. The study used a sample of quarterly data for the period 1996-2014. In the first step of analysis, a structural and a recursive VAR, each containing 12 variables, including five endogenous and seven exogenous variables were

estimated to capture the contribution of government expenditure and that of tax revenue in explaining changes in real output and prices. In the second step of analysis, real output was divided into private consumption and private investment, and a recursive VAR was estimated to capture the crowding out or crowding in effect of the public sector on the private sector.

Interesting results were found, both significant and non-significant. Firstly, government spending (in RGDP specification) was found to be weak in explaining changes in prices, and similarly, does not have an effect on real output. Secondly, while tax revenue does not influence prices, it positively influences real output in Rwanda. Therefore, there was no evidence of fiscal variables' effect on real output and inflation. Thirdly, the effect of government spending on prices (in the real GDP components specification) is positive and significant, implying that government spending exerts a positive effect on prices in the short term. Fourth, there is evidence of the crowding-in effect. Government spending has a significant positive effect on private investment. Hence, the objective of this essay of determining the important channel of fiscal policy was achieved. Government spending is the important channel of fiscal policy transmission, thus the ministry of finance and economic planning should use government spending to influence private investment, and also prices in Rwanda.

The overall implication of the results is that government spending should be regarded as an important channel of the transmission of fiscal policy in influencing movements in prices and boosting private investment. The positive effects of tax on output and private consumption could be explained on the one hand, by the structure of tax revenue that does not account for agricultural production, and the larger informal sector that could increase the magnitude of

untaxed activity. With regard to these results, Estevao and Samake (2013) show that the short-run output effect of tax increases is positive in HIPCs. They argued that this could be due to the fact that these countries are usually characterized by lower tax collection efforts and higher levels of debt, implying that supplementary revenue collection could enhance growth even in the short-run. In addition, in the context of a regime switching model, Deak and Lenarcic (2011) show that during bad times, i.e. in the presence of a debt-to-GDP ratio above 42.63 percent (which is the threshold value separating two regimes), a positive tax revenue shock would raise output in the US. The opposite occurs during good times, i.e. when the debt-to-GDP ratio is below 42.63 percent.

Further research could examine the channels of fiscal policy transmission by including all relevant domestic variables, in addition to foreign shocks, employing Bayesian VAR to mitigate the challenge of the short data sample found in most developing countries. Likewise, the same research could be conducted using a panel framework to respond to this issue. Other suggested future research in this field includes the effect of tax policy on agricultural and non-agricultural output. This would shed light on the true effect of tax policy on agricultural and non-agricultural output, given that a large portion of agricultural output is exempt from tax. This would be useful in investigating if such exemptions have boosted agricultural output, while capturing the effect of tax on taxed output only. Another area of further study would be in relation to Baxter and King's (1993) argument that an increase in government investment has a much stronger impact on the economy than a rise in government purchases of goods and services. Thus, a study that disaggregates government spending into investment, wage, and non-wage spending would show different impacts on macroeconomic variables.

CHAPTER FOUR
RELATIVE EFFECTIVENESS OF MONETARY AND FISCAL POLICIES ON ECONOMIC GROWTH

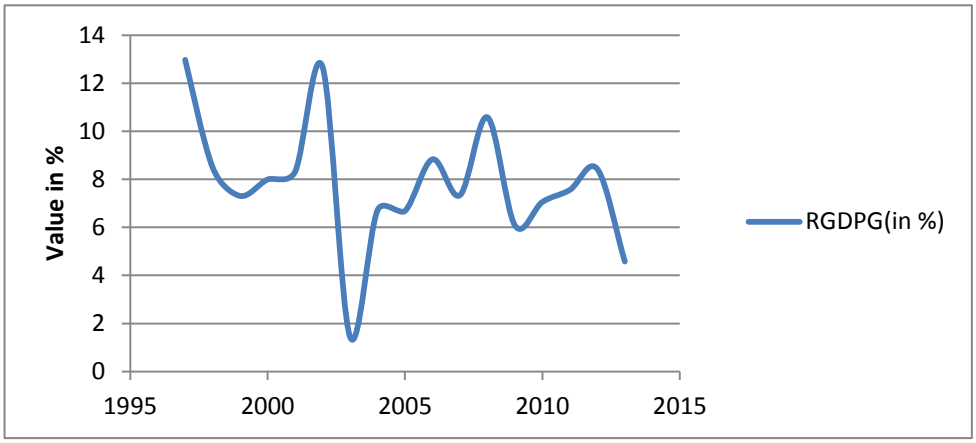
4.1 Introduction

Monetary and fiscal policies are the main tools used by policy makers to influence the level of economic activities. For example, if an economy experiences a recession, two sets of principles are available to policy makers to influence aggregate economic activity: monetary policy to manage interest rates and the money supply, and fiscal policy to manage government expenditure and taxes (Mishkin, 2012). Empirical studies have documented contrasting findings depending on the model employed. For example, monetarists suggest that monetary actions have a greater impact on the economic activities of developed countries, while studies employing structural models advocate that fiscal actions have more impact. This suggests that none of these economic policies should be considered as superior to the others, while their relative effectiveness in a specific economy is dependent on the economic and political conditions prevailing at any point in time (Rakić and Radenović, 2013).

In May 2012, Rwanda adopted the goal of becoming a middle income country by 2020 with a corresponding increase in GDP per capita from $644 in 2012 to $1240, a target that requires sustained average GDP growth of 11.5 percent (Republic of Rwanda, 2013). While the country's economy experienced a high growth rate relative to other African economies after the 1994 tragedy, it has trended down in the past decade, with an average annual growth rate of 9.2

percent between 1996 and 2000; 7.2 percent during the period 2001-2005; 8.2 percent between 2006 and 2009, and 6.9 percent[40] between 2010-2013 as depicted in Figure 4.1.

Figure 4.1 Real GDP growth rate trend in Rwanda from 1996 to 2013



Source: World development indicators, World Bank (2015).

This down trend illustrates the Rwandan economy's vulnerability to structural limitations, including resource scarcity, the size of the country and the fact that it is landlocked. The government's objective thus seems difficult to achieve.

This chapter seeks to answer the following questions:

1. Between monetary and fiscal policy which is relatively more effective than the other in output stabilization in Rwanda?
2. What is the relationship between monetary and fiscal policy in Rwanda?

[40] World development indicators, World Bank (2015).

The chapter investigates on one hand the relative importance of monetary and fiscal policies in altering real output, and on the other hand examines monetary policy's response to fiscal policy shocks and vice versa. A vector autoregressions (VARs) framework, based on the modified St. Louis equation developed by the Federal Reserve Bank of St. Louis, is used to assess this relative contribution. In relation to other studies that sought to assess the relative effectiveness of both policy variables on output in developing countries, a number of exogenous variables that are assumed to have an influence on output in the Rwandan context but that are not controlled for by policy makers (weather variables, aid, UN payments, and expenditure related to the war against the DRC) are included in this framework to capture the true effect of both monetary and fiscal shocks on Rwanda's economic growth. The contribution of this chapter to knowledge is the inclusion of domestic in addition to foreign exogenous variables to control for both domestic and foreign shocks. The empirical literature on the effectiveness of monetary and fiscal policies in terms of output has relied on the use of foreign exogenous variables, thus controlling for foreign shocks while ignoring the effect of domestic shocks such as rainfall's effect on agricultural output, variability in aid, and war, to name but a few.

4.2 Monetary and fiscal policy coordination

The Republic of Rwanda has stressed the need for enhanced coordination of monetary and fiscal policies in order to achieve economic goals. The monetary policy has not only been affected by fiscal policy actions but exogenous factors which hampered the conduct of monetary policy. In 2007, the target for net credit to government was surpassed by 0.2 percent of GDP because of delays in disbursements from a donor [the Fast Track Education Initiative (FTET)] and reimbursements from the African Union (AU) for Rwandan peace keeping in Darfur. These

disbursements were received in the first quarter of 2008, putting net credit to government back on track. Furthermore, the domestic component of expenditure exceeded projections and injected additional liquidity into the economy, making the conduct of monetary policy extremely difficult (IMF, 2008). Another factor that made monetary policy conduct difficult in 2007 was the accumulation of net foreign assets that surpassed the program target. Given the aid-induced fiscal stimulus and the target for domestic debt, the stable exchange rate against the USD could not induce sufficient foreign currency sales to absorb the higher than expected excess liquidity. Consequently, average reserve money and broad money increased beyond program objectives.

In order to facilitate the implementation of the economic and financial program set for each year, a Treasury Management Committee (TMC) has been established in 1998 and involves the Directors of the BNR, the Minecofin, and the RRA. Experts from the same institutions are also involved in the design of the macroeconomic framework. Its meetings take place on a regular basis to assess the level of achievement of the set objectives, both quantitative and structural reforms, and to identify the corrective measure where a possible deviation is identified. This coordination has enabled the achievement of a number of goals. As noted in the monetary policy and financial stability statement "Thanks to effective use of monetary policy and good coordination of monetary and fiscal policies, the economy managed to achieve low and declining inflation rate, stable market interest rates and strong support to economic growth through increased financing to the private sector" (BNR, 2013 b, 25).

In terms of advances by the BNR to the State Treasury, Law No. 55/2007 governing the BNR's relations with the RoR has been adopted to ensure the efficient functioning of the State Treasury

by considering the gap that could occur between public revenue and public expenditure. In terms of this law, when necessary, BNR advances the Treasury an amount not exceeding 11 percent of state revenue collected during the preceding financial year (RoR, 2007). This coordination between monetary and fiscal policies implies possibility of policies complementarities, and that fiscal policy actions would not cause an inflationary monetary policy.

4.3 Literature review

The main objective of this chapter was to examine the relative effectiveness of monetary and fiscal policy. Therefore, both the theoretical and empirical literature on this subject are reviewed

4.3.1 Theoretical literature

Fiscal policy primarily relates to revenue and public expenditure, while monetary policy is concerned with the control of money supply. More specifically, by means of fiscal policy instruments and measures, contemporary governments contribute to social and economic life by stimulating aggregate demand and supply, in an effort to maintain moderate inflation and full employment, stable foreign trade balance, and sustainable economic development. The focus of monetary policy is price stability, economic growth, high employment rates, interest rate stability, in foreign exchange markets, and stable financial markets (Mishkin, 2012).

The debate on the relative effectiveness of monetary and fiscal policy actions as discretionary stabilization tools goes back many decades. During the Great Depression, fiscal policy was regarded as more effective in terms of economic activity. Leeuw et al. (1969), Schmidt and Waud (1973), and Blinder and Solow (1974)present the basic theoretical grounds for active fiscal

policy. However, Gramlich (1971) notes that, the failure of the 1968surtax policy led to monetarists arguing that the effect of fiscal policy on aggregate demand is limited and that monetary policy is more important. It is argued that an increase in government expenditure is fully offset by negative wealth and substitution effects on private investment, resulting in expansionary fiscal policy and eventually reducing income by crowding out private investment. Furthermore, a seminal paper by Friedman and Schwartz (1963 b) on the link between money and output indicates that changes in the money growth rate cause changes in real economic activity.

Tcherneva (2008) discussed the place and role of fiscal policy in the New Neo-classical synthesis, also known as the New Economic Consensus (NEC), and compares it to Post-Keynesian theory. The argument is that the New Economic Consensus sets monetary policy at the control of the steering wheel of the economy. However, fiscal policy has received more attention in the NEC due to concerns relating to the zero-interest rate associated with monetary policy (for example Bernanke et al.2004; Krugman, 2005). Given that the short-term rate, which in the NEC view is exogenous under Central Bank control, is the major policy switch under such control, as it continues to fall, investment is unlikely to increase. On the other hand, when the short-term rate attains a nominal bound of zero, a modern day liquidity trap *a la* Japan occurs, and monetary policy ceases to offer economic incentives. In this context, fiscal policy is called to the rescue.

However, given the central view in the NEC literature of fiscal policy as distortionary and inflationary, it is thought to be helpful mainly during extreme deflationary periods (Krugman,

2005). Bernanke states that, in the short run, the fiscal authorities may have significant motives to deviate from a balanced budget stance, particularly when they have to deal with domestic emergencies or deep recessions. Conversely, in the long run, fiscal discipline is necessary and the national debt must remain at stable and moderate levels to maintain public confidence (Bernanke, 2003a). Thus the Neoclassical Consensus no longer regards fiscal policy as ineffective as was once posited by the New Classical and Real Business Cycle theories. Instead, during difficult times, it can complement stabilization via monetary policy and its distortionary and inflationary effects can be exploited. As noted by Tcherneva (2008), this new role for fiscal policy should be considered in the environment of endogenous money.

Furthermore, the fact that fiscal policy has an effect on output and inflation means that it subsequently affects monetary policy. Likewise, an inflation targeting monetary policy can influence these fiscal effects (Woodford, 1998). For these reasons, monetary and fiscal policies are dependent on each other. It is important to note that some NEC studies have recognized the importance of closely coordinating monetary and fiscal policies (Bernanke, 2002; Woodford, 1998; Wren-Lewis, 2000). Bernanke has suggested the need to use fiscal policy as a stabilization instrument during periods of crisis (Seidman,2006). However, added that for fiscal policy to be effective, it should be strongly coordinated with monetary policy. Bernanke (2003 b) emphasized that the Central Bank's role is different in inflationary and deflationary situations. In a deflationary environment, the Central Bank needs to be more cooperative. Unlike monetarists (who don't believe in fiscal policy domination), Bernanke argued that fiscal policy may need to take control of the reins during severe recessions and monetary policy should help make this possible.

The relative effectiveness of fiscal and monetary policy depends on the shape of the IS and LM curves and the initial position of the economy. If the economy is in the classical range (when the LM curve is perfectly inelastic), monetary rather fiscal policy is effective, while in the Keynesian range (when the LM curve is perfectly elastic), fiscal policy is effective. However, both policies are effective in the intermediate range. In this range, where the IS and LM curves elasticities are neither highly interest elastic nor highly interest inelastic, the effectiveness of both policies is largely determined by the IS curve elasticities. If the IS curve is inelastic, fiscal policy is more effective than monetary policy, otherwise it is less effective than monetary policy. Thus, the best course of action for maximum effectiveness is a monetary-fiscal policy mix (Teigen, 1978).

Monetary and fiscal policies are found to have an indirect effect on each other. Fiscal policy tools can focus on achieving social objectives and efficiency at microeconomic level while monetary strategy aims to smooth unnecessary output oscillations. However, when monetary policy is not devoted to output stabilization, the main goal of the fiscal authorities will be the pursuit of countercyclical stabilization policies. In contrast, more consideration has been given to the potential influence of fiscal policy on monetary policy. If expansionary fiscal policy results in the economy overheating, this would affect price stability, thus requiring a counterbalancing monetary intervention. Furthermore, the level of public debt can influence monetary policy. An increase in government liabilities reduces the level of savings and raises interest rates, which induces reduced potential output, hence requiring a restrictive monetary policy. Furthermore, ineffective tax systems, unproductive public projects, and huge transfer packages may negatively affect the potential output level and therefore require a more restrictive monetary policy (Rakić and Radenović, 2013).

4.3.2 Empirical literature

There are two distinct economic schools of thought regarding the effectiveness of macroeconomic stabilization policy. The first believes that monetary policy is more important than fiscal policy in economic stabilization (Friedman and Meiselman, 1963; Anderson and Jordan, 1968; Carlson, 1978), while the group led by Keynes (1964), followed by the work of Leeuw et al. (1969), Schmidt and Waud (1973), and Blinder and Solow (1974) provided basic theoretical and practical grounds for the effectiveness of fiscal policy.

In past decades, the empirical literature has produced more evidence of the effectiveness of monetary policy. To summarize, a strong long-run relationship has been found between money and prices and studies have concluded that prices are affected by monetary policy with certain lags. In the short run, policy interest rates or monetary aggregates affect output; and in the long run, monetary policy is neutral (see for example, Christiano et al., 1996; Leeper et al., 1996; Bernanke and Mihov, 1998; Dewald, 1998; Gavin and Kydland, 2000; Hoover and Jordá, 2001, and Uhlig, 2005). However, the evidence supporting the traditional Keynesian view finds that fiscal policy shocks have obvious positive effects on consumption, output, and employment. These studies include Fatás and Mihov (2001); Galí et al. (2007); Giordano et al. (2008); and Romer and Romer (2010). Likewise, Ramey (2011b), Mertens and Ravn (2012), and Favero and Giavazzi (2012) supported that unanticipated and anticipated fiscal shocks generate different effects. Finally, Auerbach and Gorodnichenko (2012) provide evidence that the effects of fiscal policy on output are different during expansionary periods and recessions. Furthermore, Ramey (2011b); Afonso and Sousa (2009); Caldara and Camps (2008); Perotti (2004 and 2007); Mountford and Uhlig (2005); Burnside et al. (2004), and Blanchard and Perotti (2002) provide

mixed evidence on Keynesian versus non-Keynesian views on the effects of fiscal policy, showing that expansionary fiscal policy could generate unfavorable effects on some macroeconomic variables as advocated by the theoretical predictions of neo-classicists. This field of research became more attractive during the recent economic crisis when a good number of countries relied significantly on fiscal policy since the use of monetary policy proved limited due to near-zero interest rates (Blanchard et al., 2010).

The empirical literature on the relative effectiveness of monetary and fiscal policies has produced contrasting results, making it impossible to rule in favor of either policy. For instance, while Rakić and Rađenović (2013), Senbet (2011), Ali, Irum and Ali (2008),and Bruce and Tricia (2002) found monetary policy to be more effective than fiscal policy in explaining changes in output, Darrat et al. (2014), Mutuku and Koech (2014), and Dungey and Fry (2008) argued for fiscal policy rather monetary policy. On the other hand, Bogoev et al. (2013) find both policies to have a weak influence on prices.

Likewise, a number of studies have been conducted on the mutual effect of these economic policies and the conclusions contradict one another. While Hinić and Miletić (2013) found that monetary and fiscal policies accommodate each other, Rukelj (2009) found that they negatively affect each other. On the other hand, Franta (2012) and Ravnik and Žilić (2010) observed that fiscal policy had a negative effect on monetary policy, while Baksa et al. (2010) failed to obtain evidence on the effect of monetary policy on fiscal policy.

Darrat et al. (2014) investigated the relative efficiency of monetary and fiscal policies in stabilizing the US economy and Senbet's (2011) contention that monetary policy matters in stabilizing real economic activities while fiscal policy does not. They report that in the context of a properly specified model, the results obtained from cointegration and error-correction tests using data (1959:Q1 - 2010:Q2) and time period similar to Senbet's, consistently suggest that rather than monetary policy as concluded by Senbet (2011), and Bruce and Tricia (2002), only fiscal policy has an effect on real output over the long-run. Furthermore, similar to Senbet (2011), they claim that both monetary and fiscal actions have significant short-run effects on the real side of the economy. The authors maintain that the VAR estimated by Senbet (2011) was not correctly specified. However, Rakić and Rađenović (2013) used a regression analysis on the quarterly data series from 2003 to 2012 in Serbia and found that monetary policy is more important in stimulating economic growth than fiscal policy.

Further, Bogoev et al. (2013) investigated the macroeconomic effects of fiscal and monetary policies in three South Eastern European (SEE) economies: Croatia, Macedonia and Bulgaria. Using VAR methodology based on quarterly data from 1999-2011, they found that domestic economic activity impacts inflation, fiscal policy and, monetary policy behaviour to some extent; fiscal policy has a weak influence on monetary policy and inflation; and monetary policy's effects on inflation are modest. Dungey and Fry (2008) studied the relative effectiveness of monetary and fiscal policy in New Zealand by combining cointegration, identification via sign restrictions, and traditional exclusion restrictions to identify the structural VAR model. The system explicitly models non-stationary and stationary variables and accounts for both temporary

and permanent shocks. The results indicate that for the period 1983-2006, fiscal policy effects on output were larger when compared to monetary policy.

It is worth noting that in order to take into consideration the exogenous shocks of rainfall (which was volatile during the period of the research), the study introduced a climate variable in their VAR model comprising the recorded number of days of deficit of soil moisture in each quarter, that they adjusted by subtracting the long-run average for that particular quarter from each quarterly value [following Buckle et al (2007)][41].Bruce and Tricia (2002) employed an Error-Correction-Vector autoregression to examine the relative effectiveness of monetary and fiscal policies in stabilizing the US economy. Using M2 and the Federal Funds Rate (as measures of monetary policy) and marginal income tax rates and government spending (to measure fiscal policy) to explain movements in consumption, investment, and output, they concluded that monetary policy is relatively more powerful than fiscal policy.

Empirical evidence on the relative effectiveness of monetary and fiscal policies in output in developing countries is also mixed. Mutuku and Koech(2014)used a recursive VAR framework on data for the period 1997-2010 to investigate the relative potency of monetary and fiscal policies in altering real output in Kenya. The results obtained by means of variance decomposition and impulse response functions revealed that while monetary policy shocks are

[41]Buckle et al. (2007) developed a 13 variable structural VAR model capable of demonstrating the relative importance of international and domestic shocks to the business cycle for a small and volatile open economy. Applying block exogeneity procedures, the model included a rich array of international trade and financial variables, and domestic real and financial variables. The results suggest the possibility of incorporating a large number of international and domestic variables in SVAR models of small open economies. The effect of domestic climate on the New Zealand business cycle captured by the soil moisture deficit showed that climate has been an important source of business cycles in New Zealand. Similarly, international price shocks, rather than international or domestic financial shocks have been another important source of business cycles fluctuations. Furthermore, the price and exchange rate puzzles are not encountered by the model.

completely insignificant, fiscal policy has a significant positive impact on real output growth in Kenya. Moreover, fiscal policy exerts influence on monetary policy while fiscal policy does not respond to a monetary policy shock. In contrast, Younus (2013) examined the relative effectiveness of fiscal and monetary policies in output growth in Bangladesh. Using a cointegration and vector error correction approach on annual data from 1980-2011, the study found that monetary policy is more effective in altering real output in Bangladesh while fiscal policy remains relatively less effective. Adeniji and Olaniyi (2013) applied the St. Louis equation with a panel data technique for some SSA countries (South Africa, Nigeria, Niger, Cote d'Ivoire, Malawi, Togo, Tanzania and Madagascar) using data from 1970-2012 and found support for the argument that both the monetary base and government expenditure are viable instruments in stabilizing output. However, monetary policy was found to be more powerful than fiscal policy.

In Pakistan, Jawaid and Naeemullah (2010) examined the effectiveness of both types of policies in economic growth by means of annual time series data from 1981 to 2009. While the cointegration results show that both monetary and fiscal policy have a significant, positive effect on economic growth, due to its larger coefficient, monetary policy appears to have a greater effect on economic growth than fiscal policy. Adefeso and Mobolaji (2010) employed cointegration and the error correction mechanism technique on annual data from1970-2007 to reassess the relative effectiveness of monetary and fiscal policies in economic growth in Nigeria. Their results indicate that monetary policy has a stronger impact on real output when compared to fiscal policy, supporting the results previously obtained by Ajisafe and Folorunso (2002).

Another study by Ali, Irum and Ali (2008) examined the relative effectiveness of monetary and fiscal policies in four South Asian countries, Pakistan, India, Sri Lanka and Bangladesh for the period 1990-2007 using the autoregressive distributed lag approach. Their results show that monetary policy is more powerful than fiscal policy in enhancing economic growth in both the short- and long-run in South Asian economies. Likewise, in Bangladesh, Rahman (2005) used an unrestricted VAR based on the St. Louis equation to show that monetary policy on its own rather than fiscal policy has a significant positive impact on real output growth, supporting the views of advocates of the St. Louis Model.

Jayaraman (2002) investigated the relative effectiveness of monetary and fiscal policy in four South Pacific Island Countries (Fiji, Samoa, Tonga and Vanuatu). The study employed a modified reduced form of the St. Louis equation to reproduce their proneness to periodical cyclones as well as their openness by including export performance for the period from 1980 to 1995. Apart from Samoa, where both monetary and fiscal policies had no effect on growth, in the rest of the region, the results suggest that monetary policy was more effective than fiscal policy in explaining economic growth. Moreover, annual cyclones were found to negatively affect growth in all four island countries. Ajisafe and Folorunso (2002) used a series of annual data from 1970-1998 and found that monetary policy exerts a larger impact on economic activity in Nigeria than fiscal policy.

Jordan et al. (2000) employed a modified St Louis Equation through a cointegrating vector-autoregressive model to test the relative effectiveness of monetary and fiscal policy in economic stabilization in three Caribbean economies, Trinidad and Tobago, Guyana, and Barbados. While

these countries share common characteristics, the findings indicate that they differ in terms of policy effectiveness. In Barbados, fiscal policy rather than monetary policy shocks have an effect on the economy. In Trinidad and Tobago, the results indicate that changes in monetary and fiscal policies affect the economy only in the short run, while in Guyana shocks to both monetary and fiscal policies have significant effects on the economy in the short run but the shock changes over time. Latif and Chowdhury (1998) used a modified version of the St. Louis equation to show that fiscal policy is more effective than monetary policy in Bangladesh. In Nigeria, Olaloye and Ikhide (1995) estimated a slightly modified form of the basic St. Louis equation with monthly data for the period 1986-1991. The results indicate that fiscal policy has more influence on the economy than monetary policy.

With regard to the interaction between fiscal and monetary policies, Hinić and Miletić (2013) found that these policies accommodate each otherin Serbia (they are complementary). Franta (2012) studied the effects of fiscal policy in the Czech Republic and found that government expenditure shocks positively affect output, but the effects are transitory. An expansionary fiscal policy in the Czech Republic induces higher inflation, and the Central Bank reacts by raising short-term interest rates. Ravnik and Žilić (2010) provide evidence that output in Croatia is negatively affected by both government expenditure and tax revenue shocks. In addition, they found that while fiscal shocks have negligible and short-lived effects on inflation, interest rates respond strongly to fiscal shocks.

Baksa et al. (2010) found that fiscal multipliers in Hungary are low and transitory. In terms of the interaction between monetary and fiscal policies, they conclude that fiscal policy effects are

independent of the monetary policy stance. Caraiani (2010) found that an expansionary fiscal policy positively affects both output and inflation in four Central Eastern Europe (CEE) countries, while interest rates act in the opposite way. Rukelj (2009) studied the interaction between monetary and fiscal policy and economic activity in Croatia and found that monetary and fiscal policy shift in opposite directions: fiscal shocks generate strong negative effects on narrow money, while monetary shocks induce negative effects on government expenditure (they are substitutes).

4.3.3 Overview of the literature review

The conclusions reached by studies that examined the relative effectiveness of monetary and fiscal policies were contradictory and therefore inconclusive. No formal study has been conducted on the relative effectiveness of monetary and fiscal policies as stabilization tools in Rwanda. In addition, apart from Buckle et al. (2007), and Dungey and Fry (2008), and Jayaram (2002) for the case of cyclones' effects in Fiji and Tonga, none of the previous cited studies[42] took into consideration the possibility of the exogenous effect of weather variables on growth. The study holds the view that variables such as the weather should be considered in the VAR framework to avoid any specification bias[43]. A major weakness of the St. Louis equation is that it omits relevant variables. This would be the case when one assesses the effect of monetary and

[42]Jayaraman (2002) took into consideration the effects of annual cyclones on growth in four South Pacific island countries. This reflects the need to consider the possibility of exogenous factors (natural) affecting economic activity, especially in LICs that have no means to counteract their effects.

[43]Mutuku and Koech (2014) point out that "*Kenya being an agro-based economy where substantial export volume consists of agricultural products, it is expected that as the economy grows, agricultural export increases, the inflow of foreign currency increases strengthening the shilling against other foreign currencies"*. It is important to note that agricultural output in developing countries is heavily dependent on rainfall, implying that the exogenous variable (rainfall) should be controlled for if one wants to capture the correct contribution of economic policies to GDP.

fiscal policy in a developing country without taking into consideration the influence of domestic shocks. To address this issue, this study included in addition to foreign exogenous variables, a number of domestic exogenous variables such as aid, the weather (rainfall), a dummy variable for the war (1996-2002) between Rwanda and the DRC, and UN payments. In contrast to Buckle et al. (2007), and Dungey and Fry (2008) who used the number of days of soil moisture deficit in each quarter, this study applies a different approach by using rainfall[44] as recorded by the Rwanda Meteorology Agency.

[44]Exenberger and Pandorfer (2011), Nastis et al. (2012), Kumar and Sharma (2013), and Exenberger et al. (2014) used rainfall in their studies as one of the weather variables to estimate the effect of weather variability on agricultural production.

Table 4.1 Summary of findings

	Monetary and fiscal policies effectiveness				
	High and middle income countries				
Author	**Case**	**Approach**	**Dep var**	**Monetary**	**Fiscal**
Darrat et al. (2014)	US	VAR	output	less eff	more eff
Rakić and Rađenović (2013)	Serbia	Mult regression	output	more eff	less eff
Bogoev et al. (2013)	SEE	VAR	inflation	Limited	Limited
Senbet (2011)	US	VAR	output	more eff	less eff
Dungey and Fry (2008)	New Zealand	VAR	output	less eff	more eff
Bruce and Tricia(2002)	US	VAR	output	more eff	less eff
			consumption	more eff	less eff
			investment	more eff	less eff
	Low income countries				
Author	**Case**	**Approach**	**Dep var**	**Monetary**	**Fiscal**
Mutuku and Koech (2014)	Kenya	VAR	output	not eff	Eff
Younus (2013)	Bangladesh	VECM	output	Eff	not eff
Adejini and Olaniyi (2013)	SSA	St Louis(panel)	output	more eff	less eff
Jawaid and Naeemullah (2010)	Pakistan	Mult reg	output	more eff	less eff
Adefeso and Mobolaji (2010)	Nigeria	VEC	output	more eff	less eff
Ali, Irum and Ali (2008)	Pakistan	Autoreg DLM	output	more eff	less eff
	India	Autoreg DLM	output	more eff	less eff
	Sri Lanka	Autoreg DLM	output	more eff	less eff
	Bangladesh	Autoreg DLM	output	more eff	less eff
Rahman (2005)	Bangladesh	VAR	output	Eff	Not eff
Jayaraman (2002)	Fiji	Mod St Louis eq	output	more eff	less eff
	Tonga	Mod St Louis eq	output	more eff	less eff
Ajisafe and Folorunso (2002)	Nigeria	ECM	output	more eff	less eff
Jordan et al. (2000)	Barbados	VECM	output	not eff	Eff
Latif and Chowdhury (1998)	Bangladesh	St Louis eq	output	Eff	not eff
Olaloye and Ikhide (1995)	Nigeria	Mod St Louis eq	output	less eff	more eff
	Interaction of monetary and fiscal policies				

Author	Case	Approach	Dep var	Monetary	Fiscal
Mutuku and Koech (2014)	Kenya	VAR	monetary pol		Posit
			Fiscal pol	Ins	
Author	**Case**	**Approach**	**Dep var**	**Monetary**	**Fiscal**
Hinić and Miletić (2013)	Serbia	VAR	monetary pol		Posit
			fiscal pol	Posit	
Franta (2012)	Czech Republic	VAR	monetary pol		Negat
Ravnik and Žilić (2010)	Croatia	VAR	monetary pol		Negat
Baksa et al. (2010)	Hungary	VAR	fiscal pol	Ins	
Caraiani (2010)	CEE	DSGE	monetary pol		Negat
Rukelj (2009)	Croatia	VECM	monetary pol		Negat
			fiscal pol	Negat	

Mod=model; eq=equation; Autoreg=autoregression; mult reg=multiple regression; DLM=distributed lag model; pol=policy; negat=negative; posit=positive; ins=insignificant; Dep var=dependent variable; eff=effective.

4.4 Methodology

4.4.1 Theoretical framework

The IS-LM model is commonly used to evaluate the effectiveness of monetary and fiscal policy. This model was introduced by Hicks in 1937 and assumes that wages and prices are fixed or predetermined in the short run. The theoretical model for this study is derived from the ISLM model. Aggregate demand can be influenced by either monetary or fiscal policy and it may be possible to achieve the same level of aggregate demand with different combinations of fiscal and monetary policy. However, different combinations may have different effects on other features of the economy's performance. Policy makers make use a variety of instruments to achieve national goals.

Assume an economy described by the following model

$C = C_0 + cY_d \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.1)$;

$Y_d = Y - T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.2)$;

$T = T^* + xY \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.3)$;

$I = I_0 + iY_d - vr$ …… (4.4);

$G = G^*$ …… (4.5);

$Y = C + I + G$ …… (4.6);

$M_d = M_0 + kY - mr$ …… (4.7);

$M_s = M^*$ …… (4.8);

$M_s = M_d$ …… (4.9)

Where the goods market is represented by equations (4.1) to (4.6), and (4.1) is consumption function; (4.2) is disposable income; (4.3) is tax function; (4.4) is investment function; (4.5) is government spending and (4.6) is goods market equilibrium condition. The money market is described by equations (4.7) to (4.9), where (4.7) is money demand function; (4.8) is money supply, and (4.9) is money market equilibrium condition. The uppercase terms in the system are the variables of the model; $G^*, T^*,$ and M^*, are the values of the policy variables that are set exogenously; and C_0, $I_0,$ and M_0 are autonomous components of consumer expenditure, investment spending, and money demand that are also determined exogenously.

C is consumption expenditure by households, Y_d is disposable income, Y is gross national product, T is total tax collections (net of transfer payments), I is investment expenditure, i is the marginal propensity to invest out of disposable income, r is the interest rate, G is government spending, M_d is the quantity of money demanded, and M_s is the money supply. The government is assumed to have three instruments, the values of which it can adjust to regulate the economy: the level of taxes (T*), the level of government expenditure (G*), and the size of the money supply (M*).

Suppose that those responsible for economic policy want to achieve a level of GNP that is consistent with full employment. That is, they have a goal which can, for the purpose of this study be expressed as target values of Y. First, are solved equations (4.1) through (4.9) for Y as a function of the policy instruments G*, T*, and M*. The process begins by substituting (4.2) and (4.3) into (4.1), thereby obtaining

$$C = C_0 - cT^* + c(1-x)Y \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.10)$$

Substituting (4.2) and (4.3) into (4.4) yields

$$I = I_0 - iT^* + i(1-x)Y - vr \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.11)$$

Now substituting (4.5), (4.10), and (4.11) into (4.6), to obtain

$$Y = C_0 + I_o - (c+i)T^* + (c+i)(1-x)Y - vr + G^* \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.12)$$

This equation, which contains only two variables, Y and r, is the IS curve for this economy.

Next is to substitute (4.8) and (4.9) into (4.7) and solve for r, a process which yields the equation

$$r = \frac{1}{m}(M_0 - M^*) + \frac{k}{m}Y \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.13)$$

This is the LM curve of the economy. Substituting (4.13) for r in (4.12) and solving for Y, to obtain[45]

$$Y = \frac{1}{1-(c+i)(1-x)+\frac{vk}{m}}\left[C_0 + I_0 - \frac{v}{m}M_0 - (c+i)T^* + \frac{v}{m}M^* + G^*\right] \ldots\ldots\ldots (4.14)$$

If C_0, I_0, and M_0 are held constant while incremental changes are made in T^*, M^*, and G^*, the change in Y is given by

[45] For equivalent equations to (4.12); (4.13) and (4.14), see Mishkin (2010) in appendix to chapter 21 (Algebra of the ISLM Model) p. 85.

$$\Delta Y = \frac{1}{1-(c+i)(1-x)+\frac{vk}{m}}[-(c+i)\Delta T^* + \frac{v}{m}\Delta M^* + \Delta G^*] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(4.15)$$

This equation shows how changes in the level of taxes(ΔT^*), changes in the stock of money (ΔM^*), and changes in government purchases of goods and services(ΔG^*) will affect income.Equation 4.15 can be written as:

$$\Delta Y = a\Delta T^* + b\Delta M^* + c\Delta G^* \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(4.16)$$

WhereΔY isgovernment target, and $a, b,$ and $c$are the effects produced by instruments $(T^*), (M^*),$ and(G^*), respectively. In order to evaluate the relative effectiveness of both monetary and fiscal policies on the one hand and interaction between these economic policies on the other, this study employs a VAR approach in light of equation 4.16 where the variables of monetary policy, fiscal policy and output are all treated as endogenous.

4.4.2 Model specification

The seminal work on the relative effectiveness of monetary and fiscal policy is by Anderson and Jordan (1968) in the St. Louis equation. While many other studies have used this model to assess the effectiveness of both policies (for instance Carlson, 1978; Darrat, 1984; and Chowdry 1986); some[46] have criticized the validity of using the St. Louis equation approach. Common criticisms of the St. Louis equation include:

(i) The equation is a reduced form. The policy variables (such as money and government expenditure) included in the St. Louis equation are not exogenous;

[46] See Stein (1980), Ahmed et al. (1984), De Leew and Kalchbrenner (1969), and Gramlich (1971).

(ii) By omitting some relevant regressors (for example, interest rate), the St. Louis equation suffers from specification error; and

(iii) The St. Louis equation is based on a constrained Almon lag procedure.

Due to these limitations, results obtained using the St. Louis equation could be biased and inconsistent. In order to address the imperfections of the original St Louis equation, particularly the problem of endogeneity, Bruce and Tricia (2002), Rahman (2005), and Senbet (2011), employed the VAR approach in their studies on the effectiveness of monetary and fiscal policies in economic activity. The VAR model solves the issue of endogeneity and controls for the economy's reaction to the policy variables by treating all the variables in the model as endogenous (Kretzmer, 1992).

Sims (1980) introduced the VARs approach to estimate macroeconomic frameworks. A VAR is an *n*-equation, *n*-variable linear model whereby each variable is explained by its own lagged values, in addition to past and current values of the remaining *n* variables. Stock and Watson (2001) argued that this simple structure offers a systematic way to understand the dynamics in multiple time series, and that VARs models are simple to use and interpret.

The VAR methodology has been employed by most empirical studies on the effects of monetary and fiscal policies. Influential studies that assessed monetary and fiscal policy within the VAR framework include Bernanke and Blinder (1992), Bernanke and Mihov (1998) and Blanchard and Perotti (2002). Caldara and Kamps (2008) identify the VAR framework by employing the available methodology in the literature. They apply the recursive approach introduced by Sims

(1980); the structural VAR approach introduced by Blanchard and Perotti (2002); the sign restrictions approach by Uhlig (2005); and the event-study approach by Ramsey and Shapiro (1998) to assess the effects of fiscal policy in the US.

This essay uses a recursive VAR model approach to address the problem of endogeneity as it considers all the variables in the system to be endogenous. A recursive VAR builds the error terms in each regression equation so that they are uncorrelated with the error in the previous equations. In order to do so, some contemporaneous values are included as regressors. The results are dependent on the order of the variables: altering the order will change the VAR equations, residuals, and coefficients and there are *n*! recursive VARs for all possible orderings.

The ordering of the variables in this chapter is consistent with previous empirical studies (Caldara and Kamps, 2008; and Mutuku and Koech, 2014). The estimated model is the reduced form of a structural VAR model relating the log of government spending (LGEXP), the log of nominal GDP (LNGDP), the log of tax revenue (LTREV), the log of broad money (LM3) and the log of the interbank rate (LINTBR). The structural model is expressed as follows:

$AY_t = B(L)LY_t + CX_t + e_t$ ……. (4.17)

where Y_t= ($GEXP_t$, $NGDP_t$, $TREV_t$, M_{3t},and $INTBR_t$) is the vector of endogenous variables, A is a 5x5matrix of coefficients capturing the contemporaneous relationship between the endogenous variables, L is the lag operator (with $LY_t = Y_{t-1}$), $B(L)$= $\mathrm{B}_0 + \mathrm{B}_1\mathrm{L} + \mathrm{B}_2\mathrm{L}_2^2 +$ ...is a matrix polynomial in the lag operator, representing the lagged effects of the endogenous variables, C is a 5x7 matrix capturing the effects of the seven exogenous variables [aid, rainfall,

war, UN payments, the US industrial product index, US Treasury Bills rate, and the world oil price], and

e_t= (e_{Gexpt}, e_{NGDPt}, e_{Trevt}, e_{M3t}, and e_{Intbrt})' being the vector of structural innovations, with$E$ ($e_t e_t'$) =Σ, a diagonal matrix, and E ($e_t e_{t-j}'$) = 0.

The estimated reduced-form VAR is given by:

$Y_t = A^{-1}B(L)LY_t + A^{-1}CX_t + u_t$ ……. (4.18)

Where $u_t = A^{-1}e_t$is the vector of reduced-form residuals, where$E(u_t u_t')$ = Ω =$A^{-1}\Sigma\, A^{-1\prime}$, which isnormallynot diagonal. The reduced-form VAR will yield an estimate of $A^{-1}B(L)$, as well as of u_t and Ω. The main concern is the dynamic effects of an exogenous monetary policy and fiscal policy shocks on nominal GDP. It is important to note that if matrix A was a diagonal matrix, then Ω would be as well, although this is generally not the case, even for the case of the VAR. Since the elements of A are known, onecan trace the dynamic effects of an exogenous monetary and/or fiscal policy shock on output (the impulse responses) by shocking the structural innovation of these policies in:

$Y_t = A^{-1}B(L)LY_t + A^{-1}CX_t + A^{-1}e_t$ ……..…. (4.19)

and employ this equation to resolve for current and all future values of Y_t.

Unfortunately, an estimate of A is not obtained by estimating the reduced-form VAR. However, some restrictions on those elements are provided. Ω is an observed 5x5 symmetric matrix. It thus contains fifteen distinct elements. By choice of units, one can set$\Sigma = I$, the identity matrix, and obtain Ω =$A^{-1}A^{-1\prime}$. Because Ω is symmetric, it contains 15 distinct elements, and therefore, on the 25 distinct elements of A, this equation provides 15 independent (nonlinear) restrictions. The remaining elements of A can therefore be identified, by providing10 additional independent

restrictions, and then compute the impulse responses. One of the common ways to do this is to suppose that the contemporaneous interaction between the endogenous variables in the VAR is recursive. In this case, A becomes a lower-triangular matrix, and the 10 additional restrictions would consist of zero restrictions on the above-diagonal elements of A. The recursive ordering[47] $GEXP_t, NGDP_t, TREV_t, M_{3t}$, and $INTBR_t$ allows only government spending to affect GDP, and other variables in the system; and GDP to contemporaneously affect other variables in the system except for government spending; while government spending and GDP but not the broad money or interest rate can contemporaneously affect tax revenue; and M3 is contemporaneously affected by all the other variables in the model except the interest rate which is itself affected by all the variables in the model.

4.4.3 Data description and measurement of variables

The study uses quarterly data for nominal government spending (NGEXP), nominal net tax revenue (NTREV), nominal GDP (NGDP), money stock (M3), and the interbank rate (INTBR) from 1996Q1 to 2014Q4. Data for M3 and INTBR were obtained from the BNR, while NGEXP, NTREV, NGDP, and Aid [NODA (for 2014)] were obtained from the Ministry of Finance and Economic Planning (Minecofin). Aid data from 1996-2013 were sourced from World Bank 2015 (World development indicators). Data on rainfall were obtained from the Rwanda Meteorology Agency on a monthly basis, and were made quarterly by calculating the monthly averages. Foreign exogenous variables include the US industrial production index (USIPI); the USA 90-Day Treasury Bills interest rate (USATB); and the world oil price (WOILP)[48].

[47]The recursive ordering is based on Caldara and Camp, 2008, Mirdala, 2009, and Ravnicand Žilić, 2010.
[48] For more detail on foreign as well as domestic exogenous variables see chapter 2.

With regards to definition and measurement of variables, nominal GDP is the GDP by Expenditure Approach and is generally computed by the NISR; money supply (M3) is computed by the BNR and is currency in circulation outside the banks plus demand, time deposits and foreign currency deposits at commercial banks (deposits include both Rwandan franc and foreign currency). The fiscal policy variables used in this study are government spending and tax revenue, and are defined in line with Blanchard and Perotti (2002). The revenue variable is defined as total revenue (which includes tax and non-tax revenue) less interest payments and transfers (referred to as taxes or net taxes in this thesis). The expenditure variable which is referred to as government spending (or government expenditure in this thesis) involves government consumption (mainly compensation of employees and intermediate consumption), and government investment. Regarding the measurement of the variables, reference should be made to chapter three as the data set used in this chapter remained same as in chapter 3.

4.5 Empirical results and discussion

Before the main results are discussed, preliminary tests are conducted to ensure the reliability of the model.

Data pre-testing and appropriate handling of trends and stationarity are highly stressed by the literature in order to arrive at more reliable estimation techniques, including correct estimation equations. The unit root tests ADF, PP and KPSS[49]are then conducted on the equations describing the data generating process (DGP) of the series. Results show that all the endogenous variables of the model (log of government spending, log of nominal GDP, log of tax revenue, log

[49]The latter is used to take into consideration the shift in GDP data in 2006 where quarterly data started being collected. Recall that up until 2006, the GDP data used in this study was interpolated by the author.

of M3, and the log of interest rate), as well as exogenous variables (log of net Official Development Assistance, log of rain fall, log of US industrial product index, log of US Treasury bills, and log of world oil price) are non-stationary at level. They indicate that the series are all integrated of order one [that is I-(1)] as depicted in Table 1.1 in Appendix 1.

Given that all the variables were found to be non-stationary at level, the cointegration test was run to establish if a long-run relationship exists among the non-stationary variables. The Trace as well as the Max-eigenvalue test indicates that variables are cointegrated at the 5 percent level, as shown in Table 4.2 in Appendix 4.

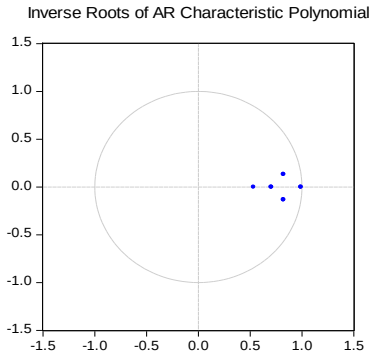
Other preliminary tests include those of lag order selection, stability, autocorrelation, and normality. The lag order choice was made following the model that minimizes the functions of the sequential modified LR test statistic, Akaike Information (AIC), Schwarz Bayesian (SC), Hannan-Quin (HQ), and Final Prediction Error (FPE) Information criteria. They are selected after 2 lags for exogenous variables are fixed.

Table 4.3 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
1	873.9480	474.4591	6.45e-17	-23.1128	-21.02491*	-22.28346*
5	1005.742	67.53475*	3.81e-17*	-24.0212	-18.72117	-21.91596
6	1037.779	29.29114	4.00e-17	-24.22226*	-18.1192	-21.79805
* indicates lag order selected by the criterion						

The results in Table 4.3 show that the VAR models with 1lag (by SC:-21.02, and HQ: -22.28), 5 lags (by LR: 67.53, and FPE: $3.81e^{-17}$), and 6lags (by AIC: -24.22) are the best since they present the lowest computed values. Given this situation, one needs to choose among 1, 5, or 6 lags to determine the appropriate lag order for the model to be estimated. The choice of the lag order was mainly based on the tests of stability of VAR, autocorrelation, and normality, but also on the fact that the sample size used in this study, though not small, is not large so that the lag order that assures a parsimonious model is chosen. As the model with 6 lags was found to be unstable, the next step was to choose between the 5 lag and 1lag models. Taking into account that the sample is only 76 observations, and given 12 lagged endogenous and exogenous variables, the model with 1lag was chosen over the 5 lag model in order to save on the degree of freedom.

Figure 4.2 VAR Stability test



The stability test results presented in Figure 4.2 indicate that the VAR model with 1lag is stable and can thus be used for regression analysis. The modulus for all roots is less than1 and lies inside the unit circle.

The autocorrelation test was done using the multivariate LM test statistics for residual serial correlation up to 12 lags.

Table 4.4 VAR Serial Correlation LM tests

Null Hypothesis: no serial correlation at lag order h	Included observations: 75	Lags	1	2	3	4	5	6	7	8	9	10	11	12	Probs from chi-square with 25 df.
		LM-Stat	30.90	22.18	25.60	87.19	24.20	23.14	25.20	51.17	24.72	28.83	20.41	49.09	
		Prob	0.19	0.63	0.43	0.00	0.51	0.57	0.45	0.001	0.48	0.27	0.73	0.001	

The LM test results depicted in Table 4.4 point to the absence of autocorrelation for the model with 1lag.

The test for normality of residuals was one of the criteria for choosing the1lag VAR model for analysis. The results show that following the Skewness criterion, the residuals of the VAR model in this study are normally distributed. The probability value for joint test for Skewness (0.29) is

larger than 0.05 (the significance level), implying the non-rejection of the null hypothesis of normality of residuals at 5 percent significance level.

4.5.1 Regression results

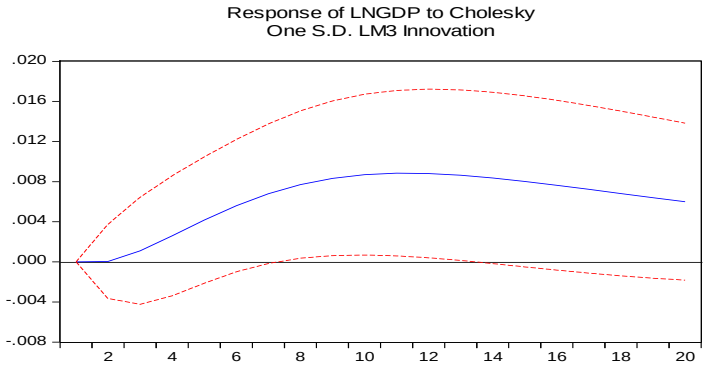
This sub-section provides and discusses the recursive impulse responses and variance decomposition results in order to demonstrate the effect of monetary and fiscal policy on nominal output, and possible interaction between the two policy variables, by employing 2-lag exogenous variables. The use of lagged exogenous variables is explained by the fact that domestic and foreign shocks can influence both monetary and fiscal policy as well as output after a period of time.

In order to trace the effect of a one-time shock to one of the innovations on the current and future values of the endogenous variables, impulse response functions for the recursive VAR, ordered $\mathrm{LGEXP_t}$, $LN\mathrm{GDP_t}$, $LTREV_\mathrm{t}$, $\mathrm{LM3_t}$, $LINTBR_\mathrm{t}$ are computed and plotted in different figures. Figures capture the effect of an unexpected 1 percent increase in a variable of interest on another variable of interest.

The effects of monetary policy variables on output and fiscal policy variables are first presented, while the effects of fiscal policy variables on output and monetary policy variables are presented in second position. Furthermore, results for the magnitudes of the effects of monetary and fiscal variables on nominal GDP and their interaction are reported in Appendix 5 in Table 5.3 and Table 5.4 respectively.

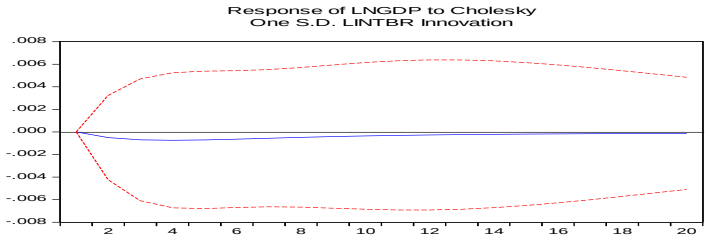
The results showing the response of output to a shock in money stock are presented in Figure 4.3.

Figure 4.3 Impulse responses of nominal GDP to shock in money stock



Results indicate that through money stock, monetary policy exerts a significant positive effect on output. The effect of money stock on nominal output is felt after the 7th quarter and peaks during the 9th quarter. The effect remains relatively high and significant up to 13th quarter, after which it becomes insignificant but remains positive. These results suggest that expansionary monetary policy through money stock can be used to influence output in Rwanda, at least in the short and medium term. The response of output to unexpected change in interest rate is presented in Figure 4.4.

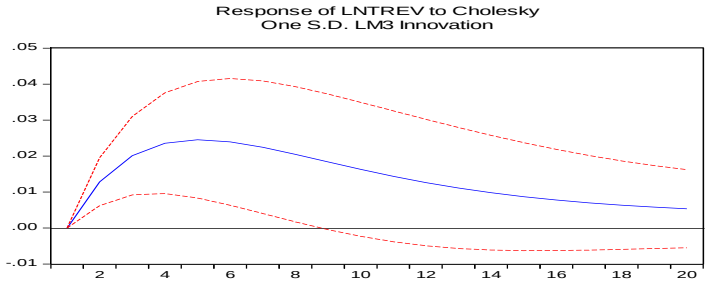
Figure 4.4 Impulse responses of nominal GDP to shock in interbank rate



As depicted in Figure 4.4, the interbank rate (proxy for the policy rate) does not seem to exert any influence on nominal output.

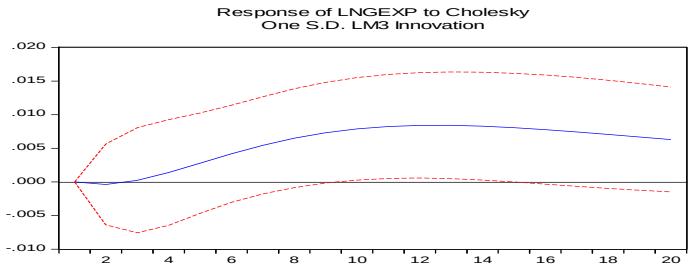
Regarding the effect of monetary policy on fiscal policy variables, results obtained in Figure 4.5 indicate that fiscal policy variables respond to unexpected change in money stock.

Figure 4.5 Impulse responses of tax revenue to shock in money stock



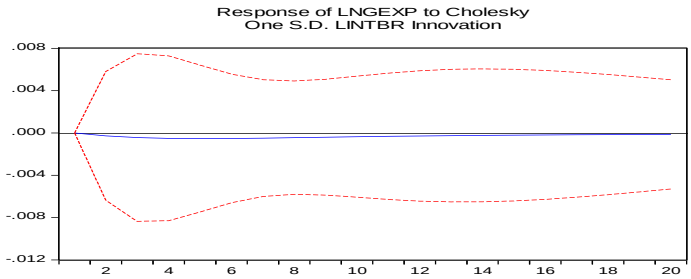
An unexpected positive shock in money stock is immediately followed by a positive significant increase in tax revenue up to the 9th quarter. The implication of these results is that an increase in money stock in the economy would increase consumer confidence and hence consumption that would raise consumption tax revenue. Other important results on the effect of money stock are presented in Figure 4.6.

Figure 4.6 Impulse responses of government spending to shock in money stock



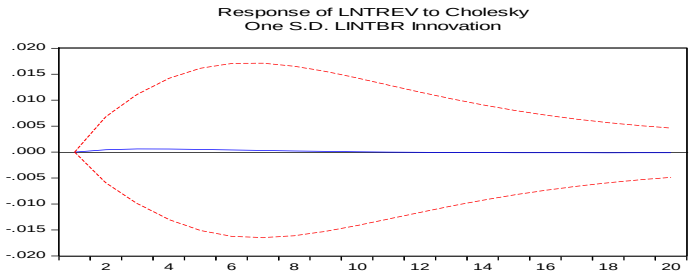
Money stock significantly impacts government spending from the 9th to the 14th quarters, implying that government expenditure is financed by money stock. Results indicating the response of government spending to shock in interest rate are presented in Figure 4.7.

Figure 4.7 Impulse responses of government spending to shock in interbank rate



In contrast to money stock, interbank rate shock does not influence changes in government spending in Rwanda. Similar results were found for the response of tax revenue to shock in interest rate as depicted in Figure 4.8.

Figure 4.8 Impulse responses of tax revenue to shock in interbank rate



Results in Figure 4.8 reveal that tax revenue does not respond to shock in interest rate.

The effect of fiscal policy variables on nominal GDP and monetary policy variables is presented in Figures 4.9 to 4.14.

Figure 4.9 Impulse responses of nominal GDP to shock in tax revenue

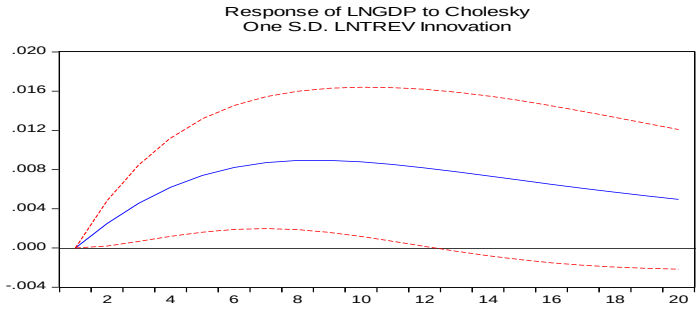
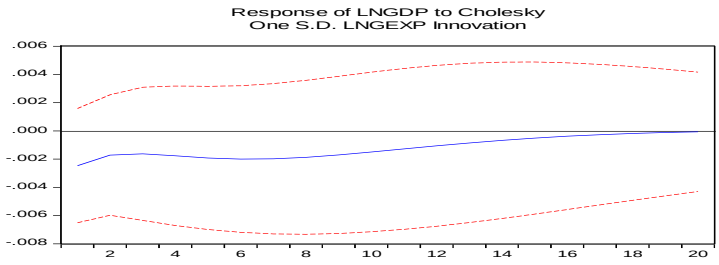


Figure 4.9 shows that tax revenue positively affects nominal output between the 2nd and 12th quarters before the effect becomes insignificant, although it remains positive in the subsequent period. The obtained unexpected sign is an indication that the positive output effect of tax could be explained by a large portion of agricultural products that is exempt from tax, implying that actual tax data does not reflect tax for all economic activity. On the other hand, the informal sector in Rwanda is relatively large, increasing the untaxed portion of the economy. The positive

effect of taxes on output was also found in other studies including Estevao and Samake (2013), and Deak and Lenarcic (2011).

Figure 4.10 Impulse responses of nominal GDP to shock in government spending



The results depict the non response on output to shock in government spending.

Figure 4.11 and Figure 4.12, show the response of money stock to shocks in government spending and tax revenue respectively.

Figure 4.11 Impulse responses of money stock to shock in government spending

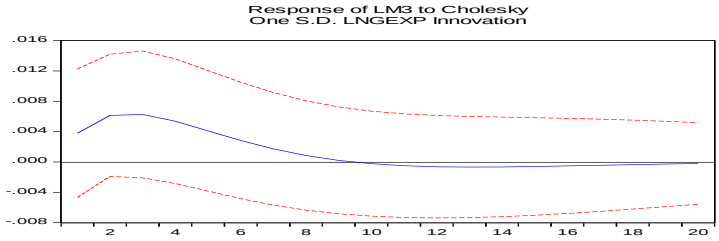
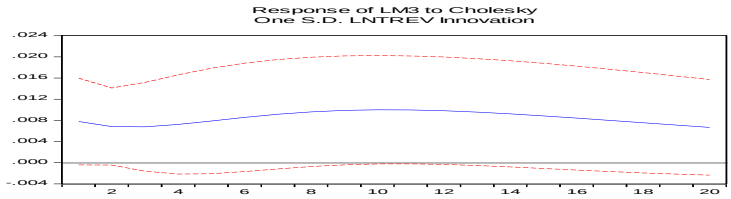


Figure 11 shows that money stock does not respond to shocks in government spending. The effect of tax revenue to money stock is depicted in Figure 4.12

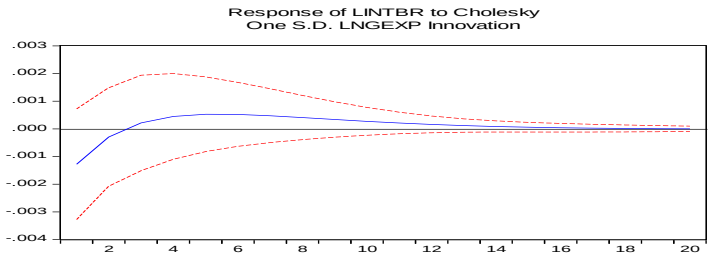
Figure 4.12 Impulse responses of money stock to shock in tax revenue



While it is clear that money stock does not respond to changes in government spending, tax revenue tends to positively explain changes in money stock in the short and medium term, hence

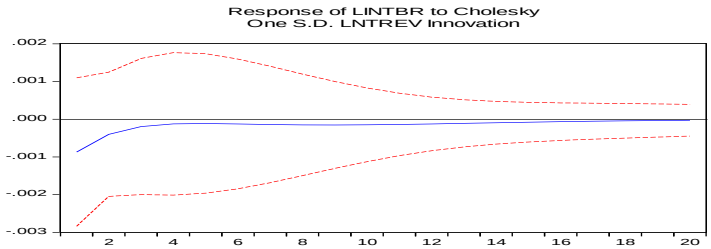
appearing as a potential fiscal variable to influence money stock. Regarding the response of interest rate to fiscal policy variables, the findings are depicted in Figures 4.13 and 4.14.

Figure 4.13 Impulse responses of interbank rate to shock in government spending



Findings revealed that interest rate does not respond to unexpected movements in government spending.

Figure 4.14 Impulse responses of interbank rate to shock in tax revenue



Similar to government spending, an expected change in tax revenue does not have an influence on interest rate.

The overall implication of these results is that monetary policy through money supply is more effective in explaining changes in output in Rwanda. These results are in line with those of previous studies such as Younus (2013), Rahman (2005), and Latif and Chowdhury (1998) who found monetary policy to be powerful in explaining changes in output while fiscal policy was not. Furthermore, monetary and fiscal policies are complementary. This interaction implies an indirect effect of fiscal policy on output through money stock. These results are in line with those of Hinić and Miletić (2013) for the case of Serbia.

This study employs the error variance decomposition in order to investigate the relative magnitude of each random shock in affecting the variables in the VAR model. Results on these relationships are depicted in Table 4.5

Table 4.5 Variance decomposition: Mutual interaction between monetary and fiscal variables and their individual effect on nominal GDP

Variance Decomposition of LNGEXP:						
Period	S.E.	LNGEXP	LNGDP	LNTREV	LM3	LINTBR
1	0.028	100.0000	0.000	0.000	0.000	0.000
10	0.048	64.887	7.845	17.676	9.511	0.081
20	0.058	43.723	5.643	26.503	**24.060**	0.069
Variance Decomposition of LNGDP:						
Period	S.E.	LNGEXP	LNGDP	LNTREV	LM3	LINTBR
1	0.018	1.980	98.020	0.000	0.000	0.000
10	0.042	2.009	51.460	28.713	17.644	0.173
20	0.053096	1.398823	32.05629	34.26785	**32.15504**	0.121992
Variance Decomposition of LNTREV:						
Period	S.E.	LNGEXP	LNGDP	LNTREV	LM3	LINTBR
1	0.030	0.147	3.496	96.357	0.000	0.000
10	0.094	1.235	3.045	52.798	42.905	0.017
20	0.101	1.116	2.742	50.322	**45.804**	0.016
Variance Decomposition of LM3:						
Period	S.E.	LNGEXP	LNGDP	LNTREV	LM3	LINTBR
1	0.037	1.082	3.684	4.532	90.702	0.000
10	0.063	3.740	10.525	17.967	67.605	0.163
20	0.075	2.693	7.965	**25.839**	63.369	0.134
Variance Decomposition of LINTBR:						
Period	S.E.	LNGEXP	LNGDP	LNTREV	LM3	LINTBR
1	0.009	2.184	1.430	1.014	1.243	94.129
10	0.011	2.470	4.374	0.869	1.258	91.029
20	0.011	2.543	4.370	0.926	1.321	90.840
Cholesky Ordering: LNGEXP LNGDP LNTREV LM3 LINTBR						

Table 4.5 shows that money stock is significant in explaining changes in nominal GDP, with a higher contribution of 32 percent during the 20th quarter. However, interest rate does not seem to influence fluctuations in nominal output.

Regarding fiscal policy variables' effect on nominal GDP, the results reveal that government spending does not contribute to fluctuations in nominal GDP. However, tax revenue tends to explain fluctuations over time and the effect is higher during the 20th quarter.

Other results support the presence of interaction between monetary and fiscal policies. It is shown that money stock is quite significant in explaining fluctuations in tax revenue and government spending. On the other hand, although taxes do not have any effect in explaining movements in interest rate, they contribute to the variance decomposition of money stock with the highest value of 26 percent during the 20th quarter. However, government spending does not play an important role in the variance decomposition of monetary variables.

4.5.2 Comparison of the benchmark model with other specifications

In order to verify the relevance of controlling for domestic variables in the VAR specification of monetary and fiscal policy effects on output, two other specifications (specification one and specification two) were made and the results were compared to the benchmark model. This is justified by the fact that it would be difficult to compare the results for the current benchmark model (that includes domestic and foreign exogenous variables) with previous studies (With models including only foreign exogenous variables) because they covered different time

samples, in addition to different economic structures. Specification one included only foreign exogenous variables, while specification two did not include any exogenous variables.

The impulse responses results for specifications one and two are presented in Appendix 4, in Figure 4.15, and Figure 4.16 respectively. The findings indicate that there is a significant difference in the results for the benchmark and both models one and two. The benchmark results differ significantly from both specification one (where only foreign shocks are controlled for) and specification two (where both domestic and foreign shocks are not controlled for) in that money stock in these specifications does not affect output, but does so in the benchmark model (where domestic and foreign shocks are controlled for). In light of these results, it is clear that the introduction of domestic exogenous variables improves rather than harms the quality of results. It can thus be concluded that including both domestic and foreign shocks in the VAR specification of monetary and fiscal policy's effect on output may be relevant.

One of the aspects to bear in mind is that the point estimates of the impulse responses are associated with a wide confidence interval. The study considers this to be attributable to the relatively insufficient sample size, given that VAR is asymptotically efficient.

4.6 Conclusions and policy implications

The objectives of this essay were achieved. Firstly, monetary policy is more effective than fiscal policy in explaining changes in output. Secondly, there is positive interaction between monetary and fiscal policies, as money stock raises tax revenue, and government spending on one hand and tax revenue induces an increase in money stock on the other. Hence monetary policy and fiscal

policies are complementary. Thirdly, the quality of results improved when the VAR model contains domestic variables than when they are not included.

These results suggest that in order to achieve higher growth, the Government of Rwanda should rely more on monetary policy than fiscal policy. Government should also favor the coordination of these policies as fiscal policy has an indirect effect on output through monetary policy.

Further research could focus on the effectiveness of monetary and fiscal policy in explaining changes in output by including domestic exogenous variables and using Bayesian VAR in order to circumvent the issue of sample size. Another study could examine the same issue in a panel framework for sub-Saharan African countries as they are affected by weather and aid variability, and war.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1Summary

This chapter concludes the thesis by summarizing the main findings while setting out the policy implications and areas for further research. At the onset, this study set out four core objectives that were met. These were:

To establish the channels of monetary policy transmission in Rwanda;

To determine the channels of fiscal policy transmission in Rwanda;

To determine the effectiveness of monetary and fiscal policies on output; and

To determine the type of relationship that exists between monetary policy and fiscal policy in Rwanda.

In order to capture the contribution of each policy, the study introduced four domestic exogenous variables in order to control for the exogenous shocks that are common in LICs (the weather effect and aid), and post-conflict economies (war and aid), and current shocks to Rwanda's economy (UN payments for Rwanda's contribution to UN peace keeping missions), as well as three foreign exogenous variables found in the empirical literature (the US industrial product index, US Treasury Bills, and the world oil price index). The period from 1996 Q1 to 2014 Q4 was used, and government spending and tax revenue represented fiscal policy variables while money stock (M3), the interbank rate, exchange rate, and bank credit to the private sector were the monetary policy variables. Finally, real GDP, nominal GDP, private consumption, private investment and CPI inflation were used to measure economic activity. To take the lagged effect of the exogenous variables into account, two lags were fixed following judgment on the average

time rainfall would take to affect crops, and the world oil price would take to affect local prices, given the time it takes for imported goods to reach the country and the port clearing process required before they are sold.

Chapter one also presented the Rwanda's economic environment. It noted that Rwanda has received more aid per capita than other countries in the region. The amount of aid increased over the years except during 2012. Moreover, government spending exhibited a strong growth trend from 1996, implying a possible link between aid and government spending in Rwanda. Furthermore, agricultural output was found to move together with total output, revealing a positive link between the two aggregates. However, a drop in GDP growth was recorded during 2013, implying a possible aid lagged effect due to the cut in aid to Rwanda in 2012, and reduced rainfall during the same period.

Chapter two examined the channels of transmission of monetary policy, based on whether the monetary policy variable has an impact on real output and/or CPI inflation, how fast the impact is felt and the magnitude of the impact. A recursive VAR approach was used and six endogenous variables were estimated as well as seven exogenous variables to control for domestic and foreign exogenous shocks. Preliminary tests were run to ensure the lag order to be selected, stability of the model, non-autocorrelation and normality of residuals, and thereafter, impulse response functions and variance decompositions were used to identify the best channel of monetary policy.

In light of the results, two variables (money stock and bank credit to the private sector) were identified as the best channels of monetary transmission in Rwanda. Money stock's effect on inflation is felt after a short time and lasts for long period (from the 1st to the 7th quarter) with a relatively large magnitude, implying that money stock should be regarded as the best channel of monetary policy transmission in Rwanda, and should be considered as the first option, especially when there is a need to reduce inflation. Moreover, it could also be a potential tool to influence the level of output, given its indirect effect through bank credit to the private sector. Equally important is the usefulness of bank credit to the private sector as a transmission channel of monetary policy. Its effect on output is relatively faster (from the 4th to the 8th quarter) and significant, implying that policy that aims to influence real output in Rwanda would achieve this objective by employing bank credit to the private sector.

Chapter three examined the effectiveness of fiscal transmission channels in impacting real output and inflation. The two most common approaches used in the literature, the Blanchard and Perotti, and recursive VAR were employed, where government spending and tax revenue are fiscal policy variables, and real output and CPI inflation represent economic activity in the first step, and RGDP components (private consumption and private investment) replace RGDP in the second step of analysis. After ensuring that the model was stable and free from serial error autocorrelation, impulse responses and variance decomposition were derived; these indicated that government spending rather than tax revenue is a better channel of transmission of fiscal policy in influencing movements in prices and private investment (the crowding-in effect) in Rwanda's economy.

Chapter four investigated the relative effectiveness of monetary and fiscal policy in explaining fluctuations in nominal output, and the possible coordination of these economic policies. The stable and non-correlated model provided results through impulse responses and variance decomposition that indicated that monetary, rather than fiscal policy is effective in explaining changes in nominal output. In addition, the findings showed that there has been interaction between monetary and fiscal policies, as money stock raises tax revenue and government spending, and on the other hand, tax revenue induces an increase in money stock.

5.2 Conclusion

Based on the findings, the thesis concluded that money stock and bank credit to the private sector are the best channels of monetary policy transmission. Equally, government spending rather than tax revenue is a better channel of transmission of fiscal policy. It was also concluded that monetary policy is more effective than fiscal policy in explaining changes in output in Rwanda. However, monetary and fiscal policies are complementary. The complementarities found between these policies imply that coordination between monetary and fiscal policy is necessary as government spending can increase private investment, but in the cost of inflation. The study has therefore achieved the three objectives already indicated earlier, and made a contribution to literature and policy.

5.3 Recommendations

The investigation of the monetary policy transmission mechanism indicated that money stock and bank credit to the private sector were important channels of monetary policy transmission in Rwanda. This implies that the Central Bank needs to focus more on money stock to manage

inflation. During times of inflation (deflation), the Central Bank should think in first place about changing the quantity of money before rather other alternatives (including interest rate). Likewise, bank portfolios should attract more attention, given the role played by bank credit in changes in output. In times of recession, the Central Bank should think about change in bank credit to private sector before other alternatives. The price puzzle and the non-significance of the interest rate in affecting output could be due to the oligopolistic behaviour of the banking system; hence, enhanced competition in this sector and an improved financial and capital market would enhance monetary policy's ability to promote economic activity. The Central Bank should also ensure that its interventions on the foreign exchange market do not harm the behaviour of the market.

In terms of fiscal policy, government spending was found to be more effective, suggesting that government should keep spending on those sectors that enhance the private sector, but also pay more attention to its inflationary aspect.

The findings on the effectiveness of monetary and fiscal policy in explaining output suggest that monetary policy plays a significant role in explaining changes in output and reveal that these economic policies complement each other. Given the Rwandan authorities' objective of achieving an average growth rate of 11.5 percent up to 2020, it is suggested that more emphasis be placed on monetary policy than fiscal policy. However, given that government spending helps to explain private investment in the cost of rising inflation, careful coordination is required between monetary and fiscal policy in order to boost growth and control inflation. This would also help to avoid the joint inflationary effect of monetary and fiscal policies.

5.4 Contribution to knowledge

The current study contributed to existing knowledge in different ways. In addition to exogenous variables (including World output, oil price, world interest rate) that are found in the literature of monetary and fiscal transmission mechanisms, this study has introduced other exogenous shocks such as war (that most African countries have experienced in past decades), rain fall, foreign aid, and UN payment to Rwanda. These domestic exogenous variables are considered relevant by this study in examining the effectiveness of monetary and fiscal policy transmission mechanisms according to their contribution on the economy in developing countries. This is because ignoring these domestic shocks, as it has been the case in previous studies for developing countries would overestimate or underestimate the contribution of monetary and fiscal policies to macroeconomic stabilization in Rwanda.

The results of the study were found to be better when domestic exogenous variables (rain fall, foreign aid, war, and UN payment) were introduced in the VAR models than when they are left out. The implication of these results is that it is relevant to introduce domestic exogenous variables, in addition to exogenous variables in the studies on the impact of monetary policy, and fiscal policy on macroeconomic variables. This is justified by the fact that same as foreign exogenous variables, domestic exogenous variables also affect macroeconomic variables (even highly, for the case of rain fall).

5.5 Limitations of the study

This study has some limitations and the empirical findings should be viewed in light of these. It considered the period 1996-2014, the period after the 1994 genocide, in order to avoid outliers

that were observed during that period. During the period 1994-1995, output and inflation reached their lowest and highest growth levels, respectively in the past 50 years. In addition, the year 1995 marks the period when liberalization was fully adopted; hence the quarterly data sample used makes only 76 observations. Although this sample cannot be regarded as small, it is not sufficiently large as the study uses 12 to 13 lagged variables. Temperature, which is a weather variable and the global food price index were dropped from the model in order to reduce the number of model variables that could affect the degrees of freedom. The data used could also be of poor quality due to interpolation of GDP, net official development assistance (NODA), tax revenue (TREV), government expenditure (GEXP), private consumption (PCONS), and gross fixed capital formation for Private Sector (GFCFPS). Another challenge arises from the use of the interbank interest rate as a proxy for the policy rate, due to the absence of a policy rate that covers the whole period of study. Finally, it was not possible to obtain data on tax bases for all categories of taxes (for instance, separate bases for personal and firm revenue); hence the output, as well as price elasticities of taxes was directly computed rather through the bases.

Further research could examine the channels of monetary policy by including all relevant domestic and foreign shocks, employing Bayesian VAR/panel framework to mitigate the challenge of the short data sample found in most developing countries. Another suggestion for future research is the interest rate pass-through in Rwanda.

Other research could examine the channels of fiscal policy transmission by including all relevant domestic and foreign shocks, employing Bayesian VAR/panel framework to circumvent the challenge of a short data sample.

Further recommendations for research in this field include the effect of tax policy on agricultural and non-agricultural output. This would assist in understanding the true effect of tax policy on agricultural and non-agricultural output, given that a large portion of agricultural output is exempt from tax. It would determine if, on the one hand, exempting agricultural output from tax has helped it to grow faster, and, on the other hand, capture the effect of tax on taxed output only. Another study could be conducted in relation to Baxter and King's (1993) argument that an increase in government spending on investment has a much stronger impact on the economy than a rise in government purchases of goods and services. Thus, a study disaggregating government spending into investment, wage, and non-wage spending would show the different impacts on macroeconomic variables.

Finally, further research could focus on the effectiveness of monetary and fiscal policy in explaining changes in output by including domestic exogenous variables in a panel framework for sub-Saharan African countries.

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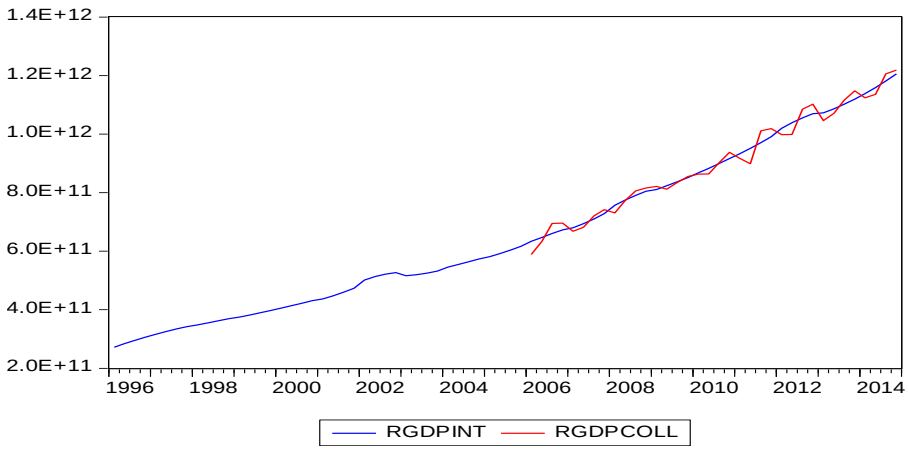
APPENDICES

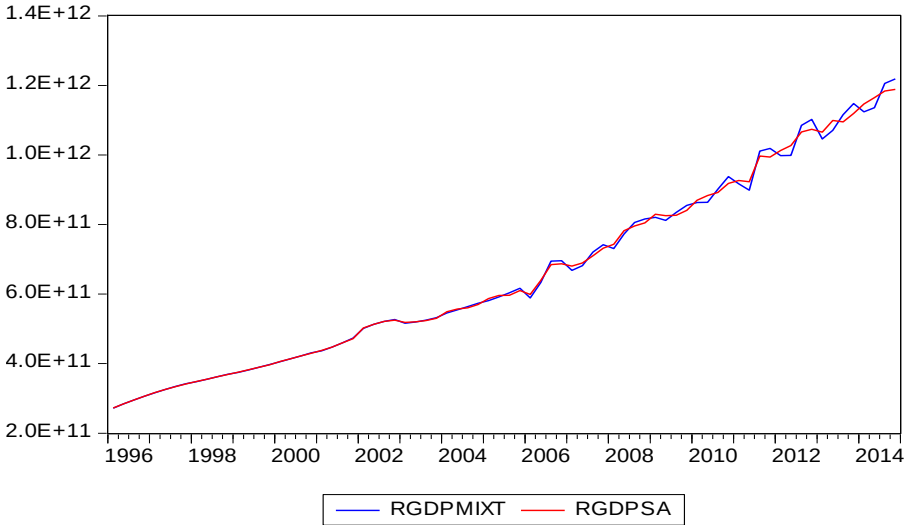
Appendix 1

Figure 1.9 Interpolated Real GDP (RGDPINT) from 1996 to 2014, and quarterly Real GDP (RGDPCOLL) from 2006 to 2014



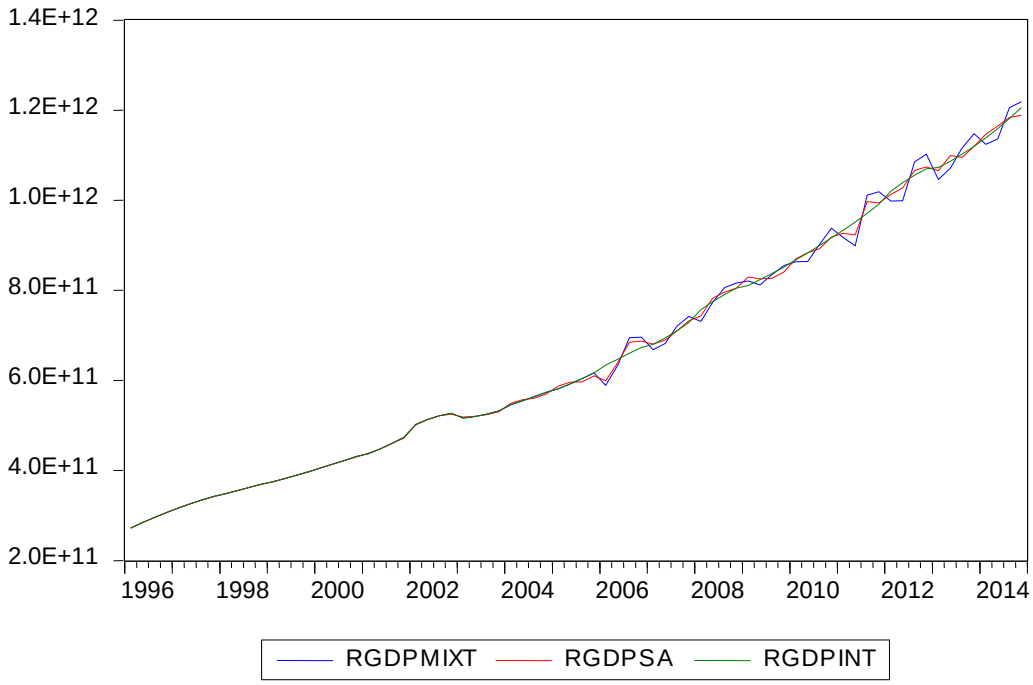
RGDPINT is quarterly RGDP interpolated from annual RGDP from 1996-2014 using quadratic-match sum approach. RGDPCOLL is quarterly RGDP that is collected by the Government of Rwanda. It is available from 2006.

Figure 1.10 Quarterly RGDPMIXT seasonally adjusted (RGDPSA)



RGDPMIXT is made of RGDPINT for the period from 1996-2005 and RGDPCOLL from 2006-2014. RGDPSA is RGDPMIXT that was seasonally adjusted using X-12 census approach available in eviews 7.0.

Figure 1.11 GDPMIXT, RGDPSA, and RGDPINT from 1996-2014



Figures 1.9, 1.10, and 1.11 show that RGDPINT almost behaves like a seasonally adjusted RGDP for the period 1996-2014. This is supported by the fact that for the period from 2006 to 2014, the RGDPINT approximates the RGDPSA from 1996-2014.

Table 1.1 Stationarity tests results

Variable(specification)/ Test	ADF	PP	KPSS	Conclusion
LNGDP (Trend&Int)	-1.733 -5.525***	-1.896 -5.435***	0.153 0.100***	LNGDP is I (1)
LRGDP (Trend&Int)	-1.785 -8.361***	-1.913 -8.384***	1.193 0.255***	LRGDP is I (1)
LCPI (Int)	-0.488 -5.178***	-0.369 -5.211***	0.186* 0.090***	LCPI is I (1)
LM3 (Trend & Int)	-1.718 -10.547***	-1.598 -10.613***	0.278 0.071***	LM3 is I (1)
LINTBR (No Trend, no Int)	-1.391 -8.567***	-1.396 -8.567***		LINTBR is I (1)
LBCPS (Trend & Int)	-2.420 -6.998***	-2.326 -7.086***	0.218 0.052***	LBCPS is I (1)
LNEER (Trend & Int)/ **Int**	-2.382/**-1.964** -6.801***/-**6.777*****	-1.793/ **-1.924** -6.343***/ -**6.216*****	0.177 0.051***	LNEER is I (1)
LNGEXP (Trend & Int)	-1.841 -2.169	-1.855 -5.601***	0.241 0.045***	LNGEXP is I (1)
LRGEXP	-1.685 -2.549***	-2.578 -5.079***	0.133** 0.032***	LRGEXP is I (1)
LNTREV (Trend & Int)	-2.849 -4.951***	-3.150 -5.014***	0.158* 0.071***	LNTREV is I (1)
LRTREV	-2.024 -3.724**	-2.659 -4.703***	0.125* 0.098***	LRTREV is I (1)
LRPCONSPS (Trend and Int)	-2.465 -3.688**	-2.650 -5.151***	0.136* 0.049***	LRPCONSPS is I (1)
LRGFCFPS (Trend and Int)	-2.122 -2.630**	-2.108 -4.829***	0.199* 0.047***	LRGFCFPS is I (1)

Int=intercept; ADF=Augmented Dickey-Fuller; PP=Phillips-Perron; KPSS= Kwiatkowski-Phillips-Schmidt-Shin; (*), (**), and (***) =the series is stationary at 10%, 5%, and 1% respectively for ADF and PP, while stationary at 1%, 5%, and 10% for KPSS. I (1)= the series is integrated of order 1.

Appendix 2

Table 2.5 Cointegration test for MPTM model variables

Sample (adjusted): 4 76				
Included observations: 73 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LRGDP LCPI LM3 LINTBR LBCPS LNEER				
Exogenous series: LNODA(0TO-2) LRF(0TO-2) WAR UNP LUSIPI(0TO-2) LTBUSA(0TO-2) LWOILP(0TO-2)				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.635908	191.4333	95.75366	0.0000
At most 1 *	0.489848	117.6778	69.81889	0.0000
At most 2 *	0.363735	68.54543	47.85613	0.0002
At most 3 *	0.226414	35.53925	29.79707	0.0098
At most 4 *	0.200489	16.79882	15.49471	0.0317
At most 5	0.006346	0.464740	3.841466	0.4954
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.635908	73.75547	40.07757	0.0000
At most 1 *	0.489848	49.13242	33.87687	0.0004
At most 2 *	0.363735	33.00618	27.58434	0.0091
At most 3	0.226414	18.74043	21.13162	0.1046
At most 4 *	0.200489	16.33408	14.26460	0.0232
At most 5	0.006346	0.464740	3.841466	0.4954
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Figure 2.17 Recursive impulse responses of real output and CPI inflation to shock in monetary policy variables (model one)

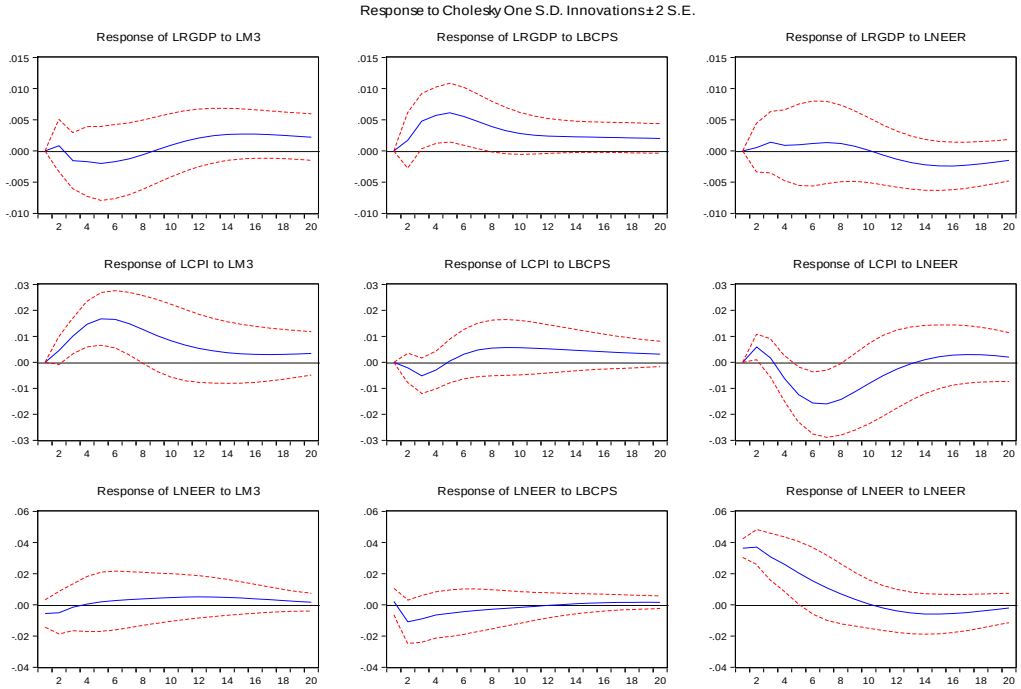


Figure 2.18 Recursive impulse responses of real output and CPI inflation to shock in monetary policy variables (model two)

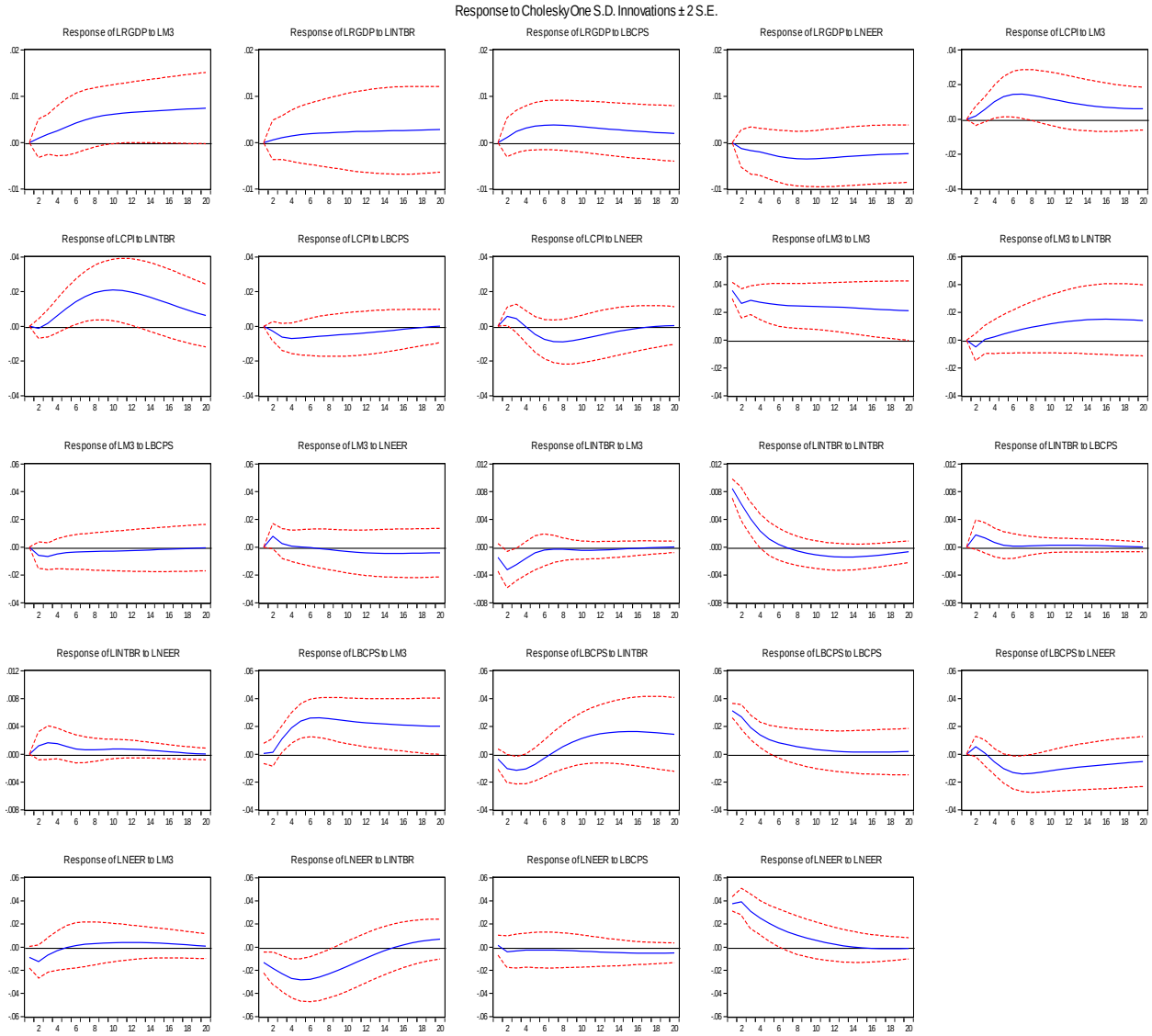


Table 2.6 Engel and Granger cointegration test for money multiplier and interbank rate

Null Hypothesis: EINTBR has a unit root				
Exogenous: None				
Lag Length: 0 (Automatic - based on SIC, maxlag=11)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.937195	0.0509
Test critical values:	1% level		-2.596160	
	5% level		-1.945199	
	10% level		-1.613948	

*MacKinnon (1996) one-sided p-values.

Table 2.7 Engel and Granger cointegration test for money multiplier and reserve requirement ratio

Null Hypothesis: ERR has a unit root				
Exogenous: None				
Lag Length: 0 (Automatic - based on SIC, maxlag=11)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.006625	0.0436
Test critical values:	1% level		-2.596160	
	5% level		-1.945199	
	10% level		-1.613948	

*MacKinnon (1996) one-sided p-values.

Appendix 3

Table 3.2 Cointegration test for FPTM model variables (Real GDP used)

Sample (adjusted): 8 76				
Included observations: 69 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LRGEXP LRGDP LCPI LRTREV LINTBR				
Exogenous series: LRNODA(0TO-2) LRF(0TO-2) WAR UNP LUSIPI(0TO-2) LTBUSA(0TO-2) LWOILP(0TO-2)				
Lags interval (in first differences): 1 to 6				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.796375	254.3957	69.81889	0.0000
At most 1 *	0.740044	144.5841	47.85613	0.0000
At most 2 *	0.458456	51.62426	29.79707	0.0000
At most 3	0.124727	9.304485	15.49471	0.3380
At most 4	0.001627	0.112322	3.841466	0.7375
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.796375	109.8116	33.87687	0.0000
At most 1 *	0.740044	92.95984	27.58434	0.0000
At most 2 *	0.458456	42.31978	21.13162	0.0000
At most 3	0.124727	9.192163	14.26460	0.2705
At most 4	0.001627	0.112322	3.841466	0.7375
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 3.7 Cointegration test for FPTM model variables (Real GDP components used)

Sample (adjusted): 7 76				
Included observations: 70 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LRGEXP LRPCONS LRGFCFPS LCPI LRTREV LINTBR				
Exogenous series: LRNODA(0TO-2) LRF(0TO-2) WAR UNP LUSIPI(0TO-2) LTBUSA(0TO-2) LWOILP(0TO-2)				
Lags interval (in first differences): 1 to 5				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.899082	343.7629	95.75366	0.0000
At most 1 *	0.703930	183.2219	69.81889	0.0000
At most 2 *	0.547104	98.02075	47.85613	0.0000
At most 3 *	0.342690	42.57419	29.79707	0.0010
At most 4	0.158314	13.20223	15.49471	0.1076
At most 5	0.016124	1.137875	3.841466	0.2861
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.899082	160.5410	40.07757	0.0001
At most 1 *	0.703930	85.20120	33.87687	0.0000
At most 2 *	0.547104	55.44656	27.58434	0.0000
At most 3 *	0.342690	29.37196	21.13162	0.0028
At most 4	0.158314	12.06436	14.26460	0.1083
At most 5	0.016124	1.137875	3.841466	0.2861
Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Figure 3.6 Structural VAR Impulse response of Real GDP and CPI to shock in fiscal policy variables (when tax revenue is ordered before government spending)

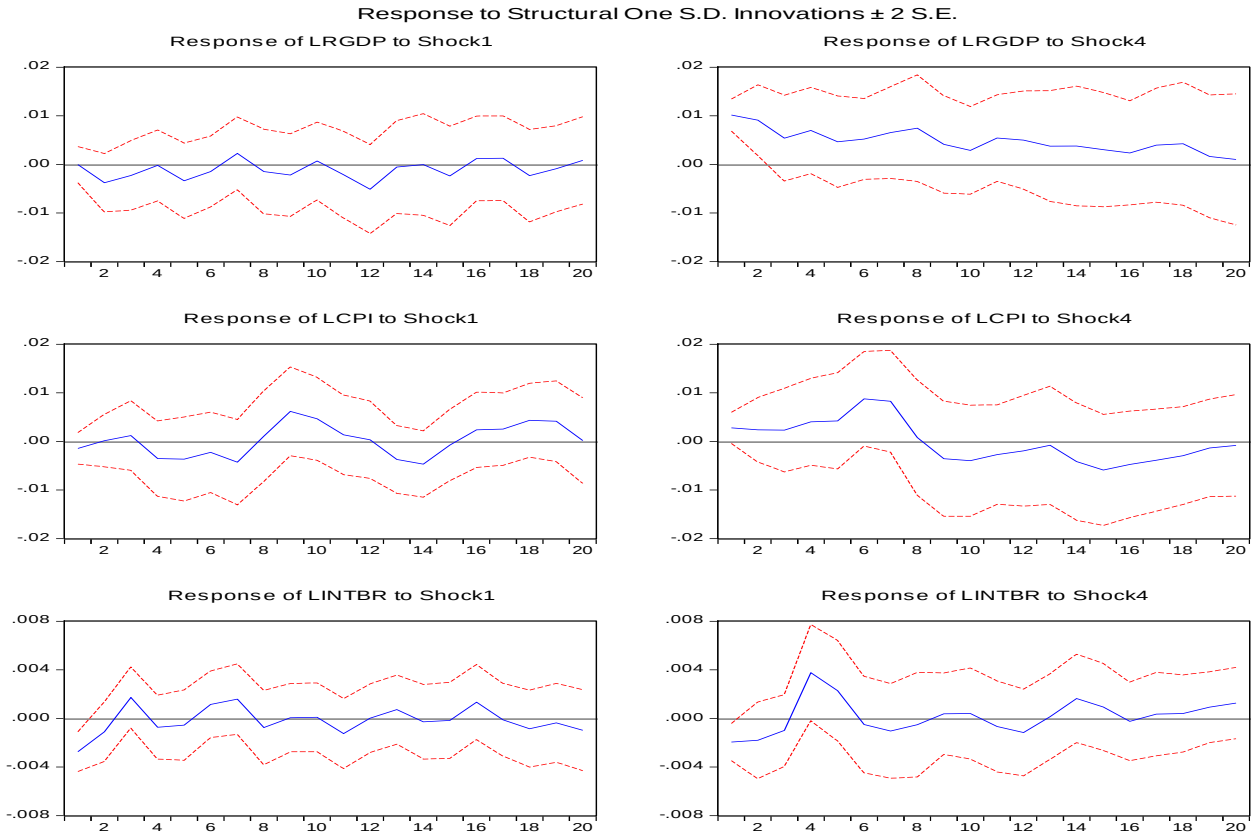


Figure 3.18 Recursive impulse responses of real GDP and CPI to a shock in fiscal policy variables (model one)

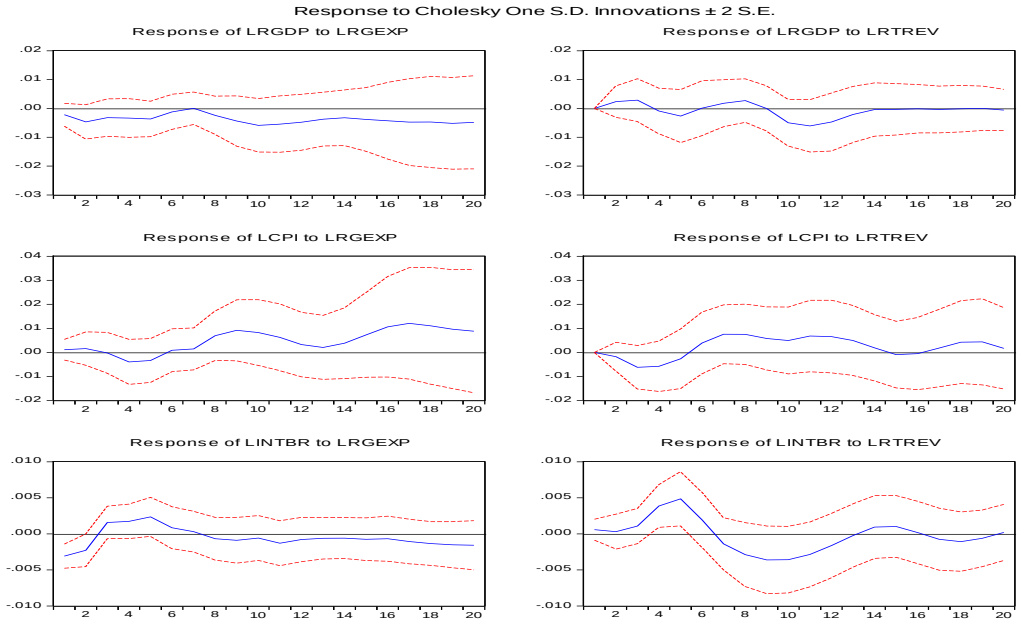


Figure 3.19 Recursive impulse responses of real GDP and CPI to a shock in fiscal policy variables (model two)

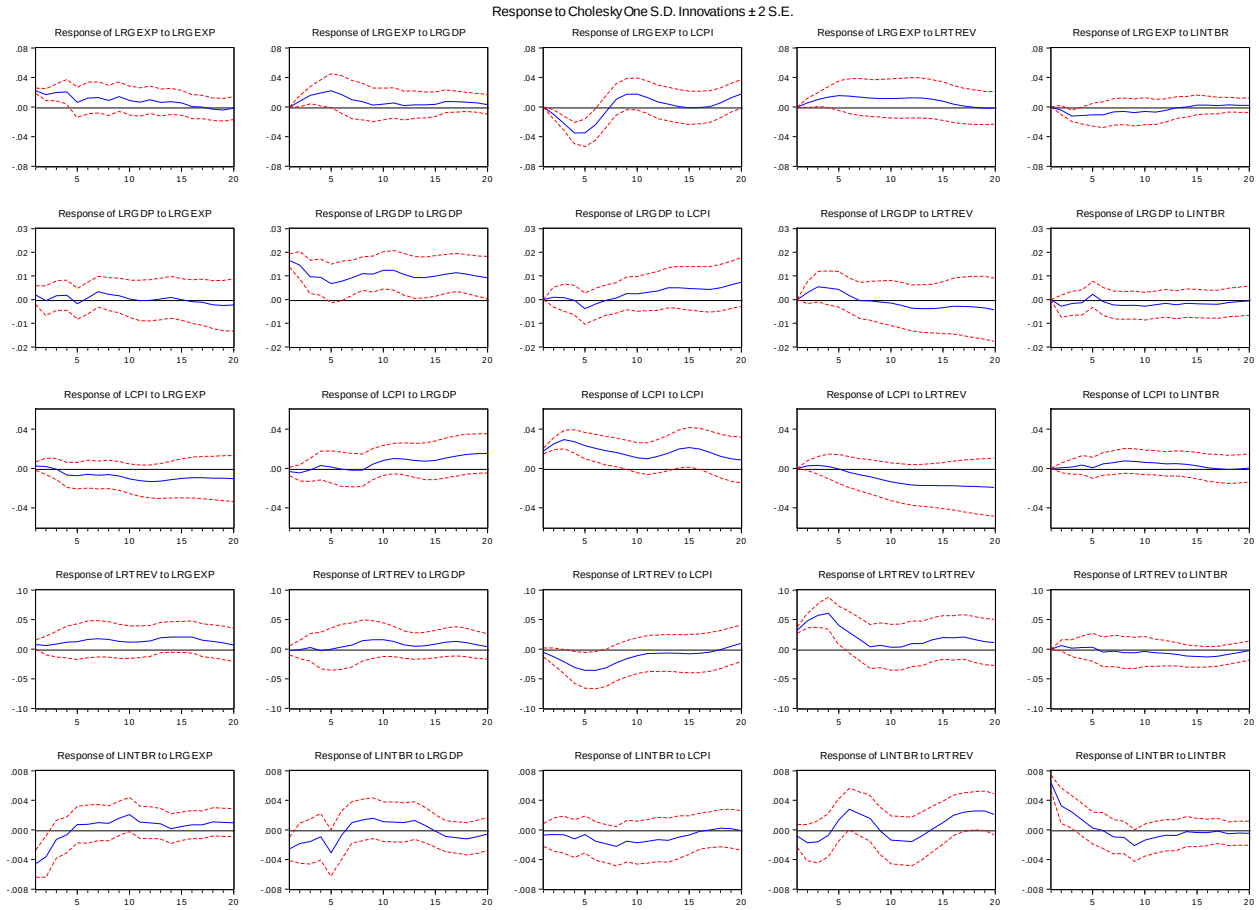


Figure 3.20 Recursive impulse responses of real GDP components and CPI to a shock in fiscal policy variables (model one)

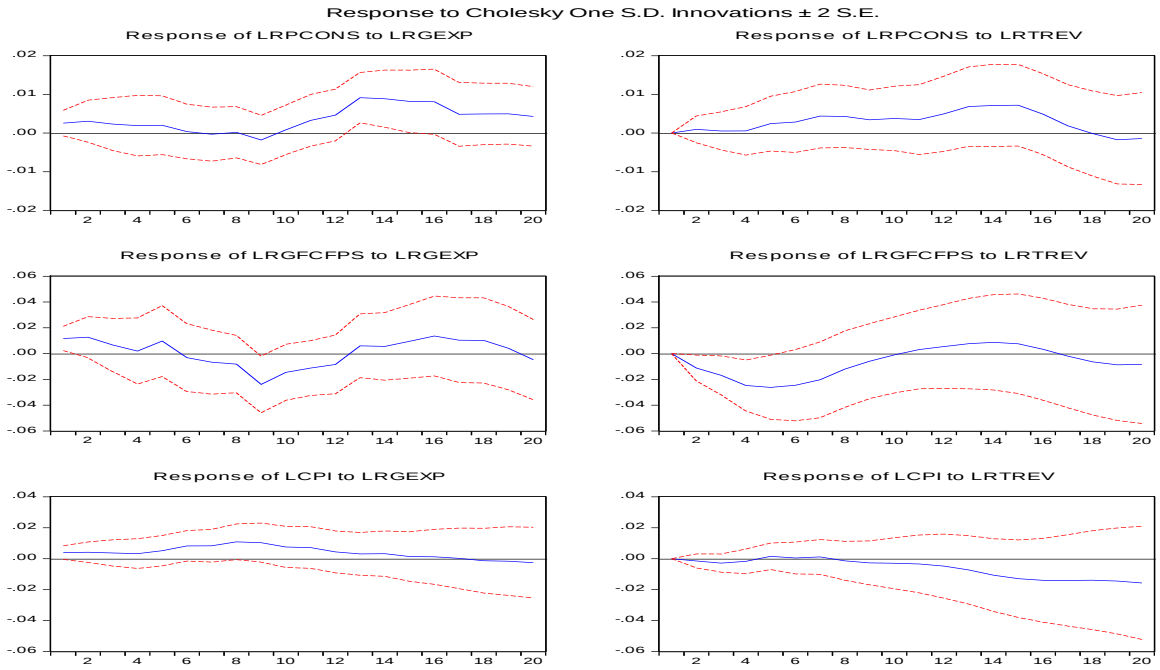
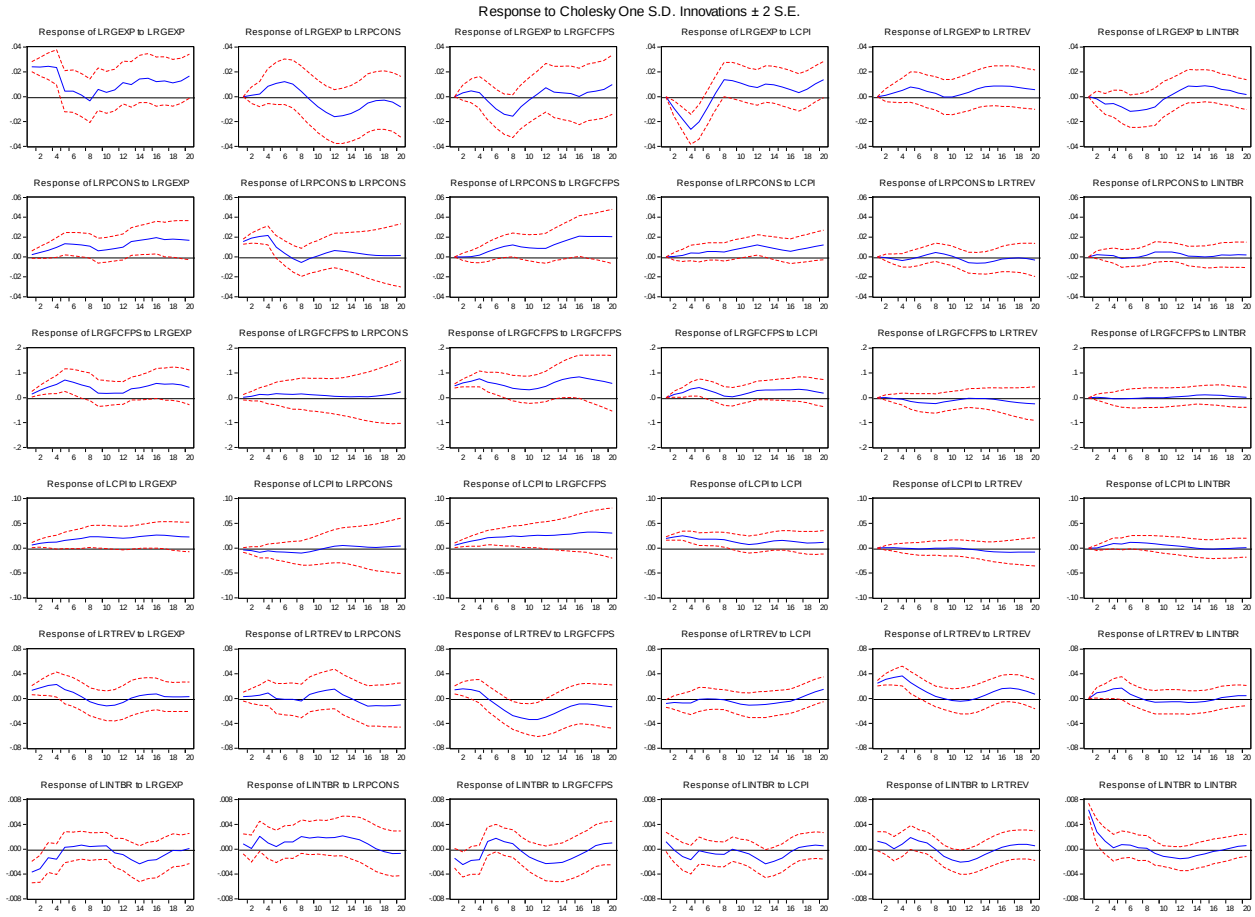


Figure 3.21 Recursive impulse responses of real GDP components and CPI to a shock in fiscal policy variables (model two)



Appendix 4

Table 4.2 Cointegration test for monetary and fiscal policies effects on NGDP

Sample (adjusted): 3 76				
Included observations: 74 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LNGEXP LNGDP LNTREV LM3 LINTBR				
Exogenous series: LNODA(0TO-2) LRF(0TO-2) WAR UNP LUSIPI(0TO-2) LTBUSA(0TO-2) LWOILP(0TO-2)				
Warning: Critical values assume no exogenous series				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.415804	103.3624	69.81889	0.0000
At most 1 *	0.337198	63.58591	47.85613	0.0009
At most 2 *	0.226698	33.15131	29.79707	0.0198
At most 3	0.129197	14.12694	15.49471	0.0795
At most 4 *	0.051208	3.889851	3.841466	0.0486
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.415804	39.77645	33.87687	0.0088
At most 1 *	0.337198	30.43459	27.58434	0.0209
At most 2	0.226698	19.02437	21.13162	0.0961
At most 3	0.129197	10.23709	14.26460	0.1968
At most 4 *	0.051208	3.889851	3.841466	0.0486
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Figure 4.15 Recursive impulse responses of nominal GDP and fiscal variables to a shock in monetary policy variables (model one)

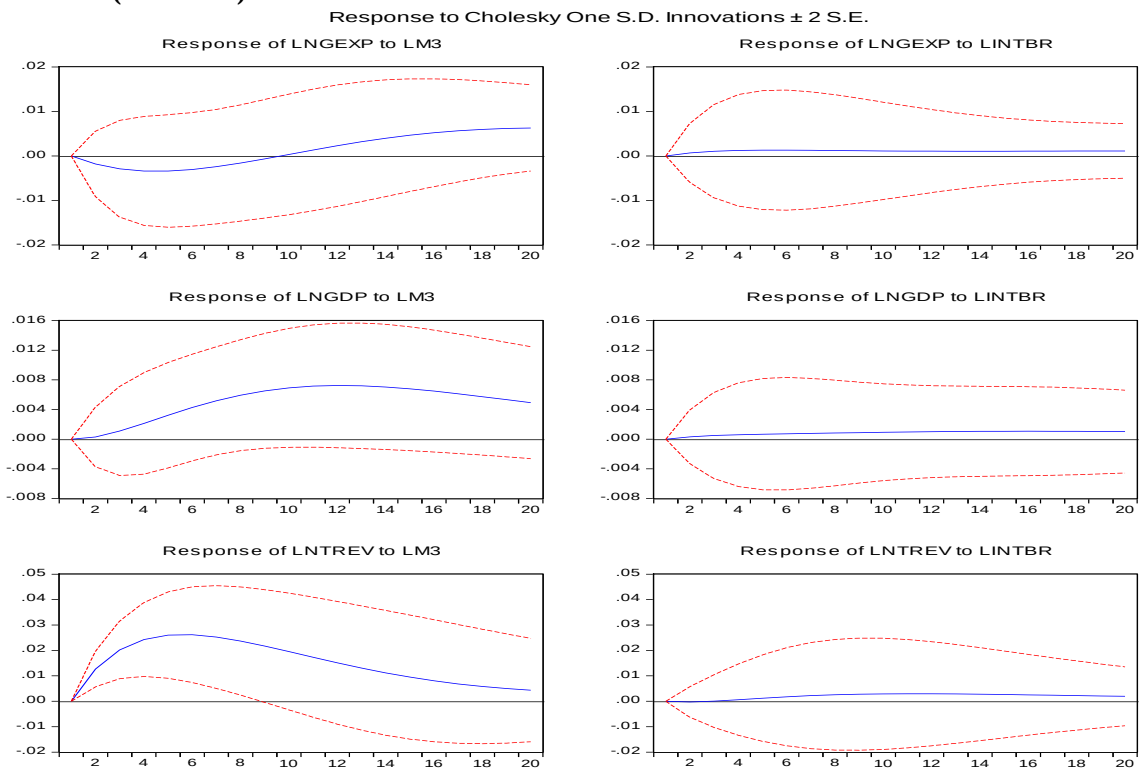


Figure 4.16 Recursive impulse responses of nominal GDP and monetary policy variables to a shock in fiscal policy variables (model one)

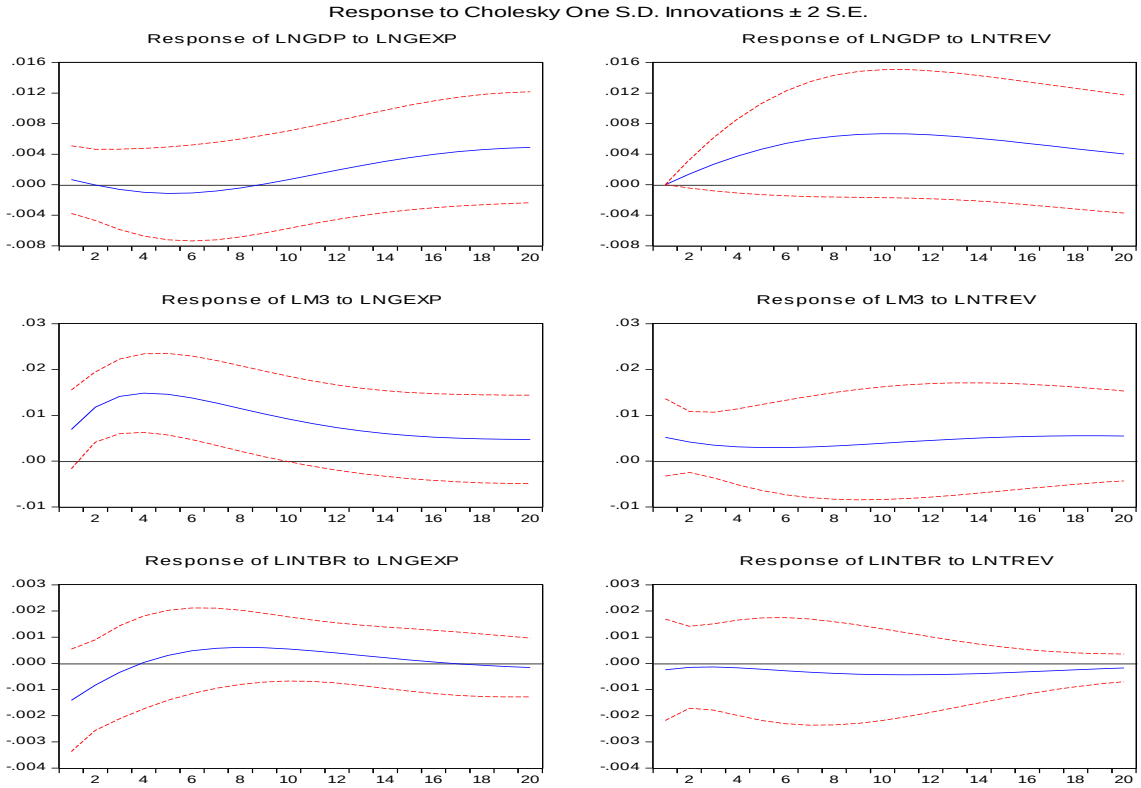
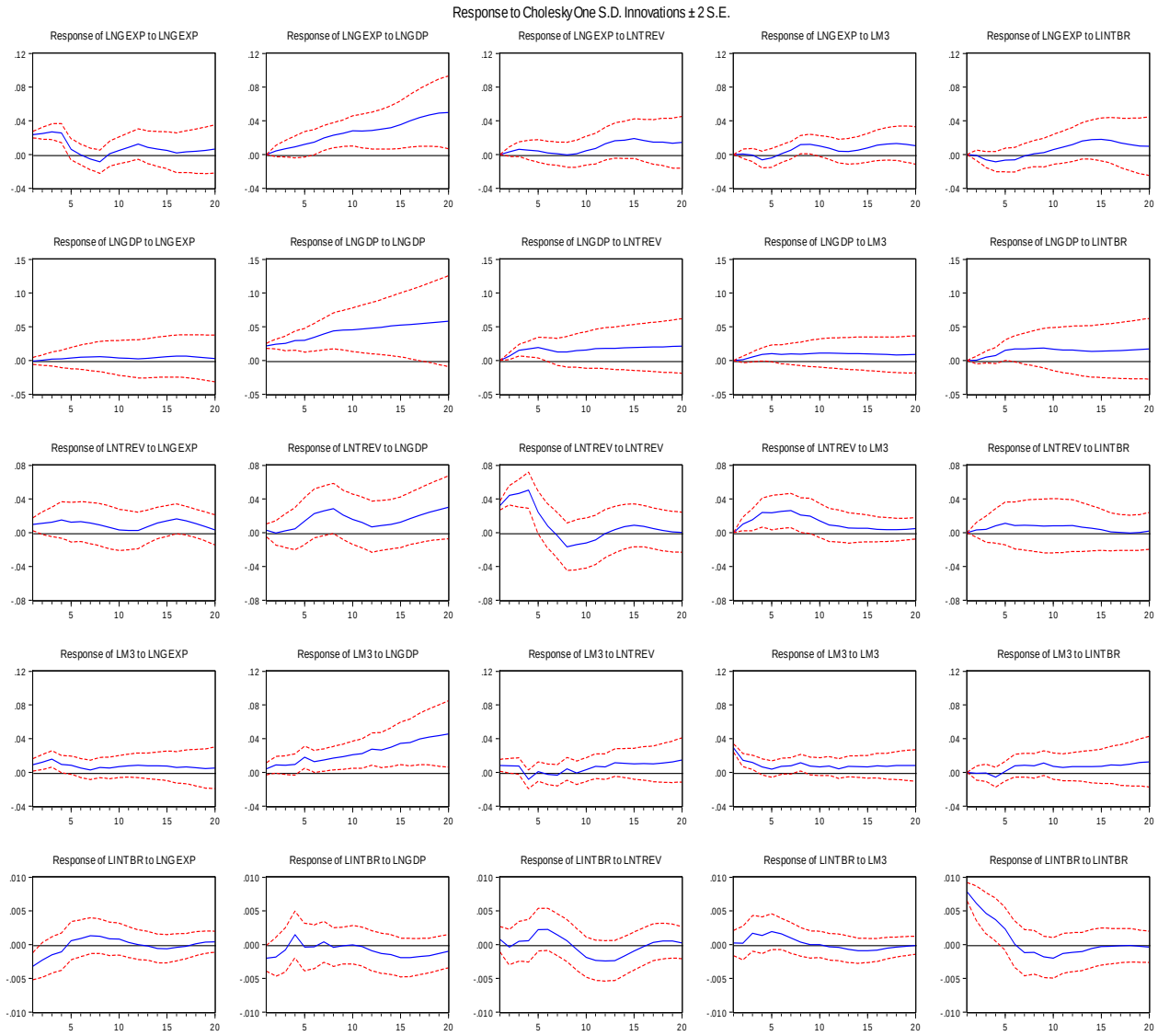


Figure 4.17 Recursive impulse responses: Interaction of monetary and fiscal policy variables and their relative effect on nominal output (model two)



Appendix 5

Table 5.1 Response (in magnitude) of real GDP and LCPI to MPT channel variables shocks

	Response of LRGDP				Response of LCPI			
Period	**LM3**	**LINTBR**	**LBCPS**	**LNEER**	**LM3**	**LINTBR**	**LBCPS**	**LNEER**
1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.002062	5.50E-05	-0.000996	0.000413	0.005348	-0.002046	-0.000647	0.004042
	(0.00212)	(0.00194)	(0.00217)	(0.00167)	(0.00243)	(0.00219)	(0.00243)	(0.00187)
3	0.000947	-0.001614	0.002176	0.000231	0.009192	0.003533	-0.004306	-0.000814
	(0.00205)	(0.00187)	(0.00161)	(0.00171)	(0.00302)	(0.00265)	(0.00252)	(0.00244)
4	0.001358	-0.000476	0.002476	-0.001496	0.011768	0.006739	-0.003883	-0.006533
	(0.00247)	(0.00195)	(0.00176)	(0.00171)	(0.00400)	(0.00323)	(0.00295)	(0.00276)
5	0.000250	-0.000812	0.003258	-0.001557	0.013207	**0.007530**	-0.001833	**-0.009194**
	(0.00261)	(0.00190)	(0.00170)	(0.00171)	(0.00467)	**(0.00363)**	(0.00338)	**(0.00326)**
6	-0.000236	-0.000926	**0.003443**	-0.001009	**0.013300**	0.007380	-0.000607	-0.008955
	(0.00274)	(0.00179)	**(0.00163)**	(0.00155)	**(0.00525)**	(0.00388)	(0.00362)	(0.00349)
7	-0.000742	-0.001028	0.003125	-0.000258	0.012596	0.006260	0.000100	-0.006879
	(0.00281)	(0.00162)	(0.00148)	(0.00138)	(0.00571)	(0.00399)	(0.00368)	(0.00352)
				……..				
20	0.000838	0.000234	0.000630	-0.000455	0.006638	0.000876	0.001425	-0.001876
	(0.00269)	(0.00059)	(0.00049)	(0.00071)	(0.00742)	(0.00214)	(0.00191)	(0.00223)

Table 5.2 Response (in magnitude) of real GDP components and inflation to fiscal policy variables shocks

	Response of LRGFCFPS		Response of LCPI	
Period	**LRGEXP**	**LRTREV**	**LRGEXP**	**LRTREV**
1	0.012791	0.000000	0.005141	0.000000
	(0.00505)	(0.00000)	(0.00199)	(0.00000)
2	**0.018549**	-0.012054	0.006889	-0.001325
	(0.00999)	(0.00644)	(0.00358)	(0.00252)
3	0.017302	-0.016959	**0.008907**	-0.000886
	(0.01239)	(0.00978)	**(0.00408)**	(0.00319)
4	0.017690	-0.020270	0.005635	0.002332
	(0.01427)	(0.01122)	(0.00452)	(0.00371)
		……		
20	-0.009681	-0.002763	0.001112	0.000385
	(0.01841)	(0.01286)	(0.00376)	(0.00321)

Table 5.3 Response (in magnitude) of nominal GDP to fiscal and monetary variables shocks

	Response of LNGDP			
Period	**LNGEXP**	**LNTREV**	**LM3**	**LINTBR**
1	-0.002463	0.000000	0.000000	0.000000
	(0.00202)	(0.00000)	(0.00000)	(0.00000)
		……		
8	-0.001872	0.008926	0.007704	-0.000480
	(0.00273)	(0.00353)	(0.00367)	(0.00309)
9	-0.001703	**0.008936**	0.008329	-0.000413
	(0.00278)	**(0.00367)**	(0.00386)	(0.00317)
10	-0.001498	0.008785	0.008696	-0.000355
	(0.00283)	(0.00381)	(0.00401)	(0.00325)
11	-0.001277	0.008517	**0.008843**	-0.000307
	(0.00285)	(0.00392)	**(0.00412)**	(0.00331)
		……		
20	-6.56E-05	0.004957	0.005999	-0.000131
	(0.00211)	(0.00356)	(0.00392)	(0.00249)

Table 5.4 Response (in magnitude) of fiscal policy to monetary policy variables shocks and vice-versa

	Fiscal policy variables response				Monetary policy variables response			
	Response of LNGEXP		Response of LNTREV		Response of LM3		Response of LINTBR	
Period	**LM3**	**LINTBR**	**LM3**	**LINTBR**	**LNGEXP**	**LNTREV**	**LNGEXP**	**LNTREV**
1	0.000000	0.000000	0.000000	0.000000	0.003802	0.007781	-0.001278	-0.000871
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00424)	(0.00410)	(0.00100)	(0.00098)
				……				
5	0.002792	-0.000536	**0.024538**	0.000519	0.004098	0.007884	0.000528	-0.000114
	(0.00373)	(0.00347)	**(0.00810)**	(0.00781)	(0.00397)	(0.00499)	(0.00067)	(0.00092)
6	0.004183	-0.000523	0.023940	0.000416	0.002828	0.008562	0.000522	-0.000126
	(0.00361)	(0.00304)	(0.00881)	(0.00832)	(0.00383)	(0.00513)	(0.00058)	(0.00086)
				……				
13	**0.008415**	-0.000258	0.011119	-7.46E-05	-0.000674	0.009561	0.000119	-0.000110
	(0.00397)	(0.00313)	(0.00841)	(0.00517)	(0.00333)	(0.00505)	(0.00012)	(0.00031)
				……				
20	0.006303	-0.000141	0.005343	-0.000124	-0.000206	0.006676	2.05E-06	-2.79E-05
	(0.00390)	(0.00258)	(0.00542)	(0.00237)	(0.00269)	(0.00451)	(4.8E-05)	(0.00021)