THE TRANSMISSION OF ECONOMIC SHOCKS: EVIDENCE FROM GHANA

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I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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3rd November, 2020

DATE

DEDICATION

I dedicate this thesis to my mom (Madame Sotorvamade Agbozoh) for winning the argument with my dad (who insisted on keeping me in his blacksmith workshop) to send me to school, to my dearest wife (Rita) for bearing the brunt of my constant absence from home over the last three years, and to my three beautiful children (Jason, Jaslyn and Janisa) for future inspiration and encouragement.

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ABSTRACT

This study investigates possible time variation in the transmission of key macroeconomic shocks to Ghana's economy, namely monetary policy, fiscal policy, and external shocks. In terms of external shocks, the study focuses on foreign monetary policy shocks proxied by the US federal funds rate, foreign demand shocks using real GDP growth rate of the OECD countries as a proxy, and crude oil price shocks. Data analysis is undertaken utilising the TVP-VAR-SV model, and using quarterly data for the period 1984q1-2018q4. In the case of monetary policy shocks, the study finds evidence of time variation with decreasing tendencies in the latter years, implying steady improvement in macroeconomic stability. The transmission mechanism is initially counterintuitive, but becomes more intuitive and in line with traditional theoretical predictions as macroeconomic reforms take hold. In the case of fiscal policy shocks, the empirical evidence points to more gradual shocks with the transmission mechanism exhibiting similar patterns as the monetary transmission mechanism – it is initially counterintuitive but increasingly conforms to traditional expectations over time. Fiscal expansion via government spending exerts a progressively positive impact on private consumption, implying that government expenditure shocks are decidedly Keynesian. This evidence points to the rising number of rule-of-thumb consumers in the Ghanaian population. In the face of positive tax shocks, the study discovers a switch from Ricardian behaviour to displaying characteristics of Keynesian agents. The three key external shocks exhibited time-varying tendencies with the volatilities decreasing and more stable in recent times. The reaction of domestic variables to the various time-varying shocks varied with the transmission mechanism and improved over time as macro stability increased on the back of profound reforms. In particular, an increase in the US federal funds rate was broadly damaging to Ghana's economy whereas a positive foreign demand shock proved generally favourable. Over the last decade, the growth implications of a positive crude oil price shock have been positive, but coupled with inflation, depreciation and tight monetary policy. Broadly, macroeconomic policy and forecasting models will benefit from incorporating features of time variation, which will help minimise costly policy errors. Gradual stabilisation of inflationary shocks, accompanied by an enhanced communication strategy to help minimise supply side effects, and the reinvigoration of the manufacturing sector through the ISI strategy to provide sustainable jobs are also recommended.

KEY TERMS

External shocks; Fiscal policy; Ghana; Impulse response; Monetary policy; Stochastic volatility; Time-varying parameter; Transmission mechanism; Vector autoregressions

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ACRONYMS

AFCON	African Cup of Nations
BCBS	Basel Committee on Banking Supervision
BOG	Bank of Ghana
BRICS	Brazil, Russia, India, China, South Africa
CD	convergence diagnostics
CNB	Czech National Bank
CPI	consumer price index
DSGE	dynamic stochastic general equilibrium
EAC	East African Community
ECB	European Central Bank
ECF	extended credit facility
ECOWAS	Economic Community of West African States
EME	emerging market economy
ERP	economic recovery programme
FAVAR	factor augmented vector autoregressions
FDI	foreign direct investment
FINSAP	financial sector adjustment programme
FINSSP	financial sector strategic plan
FOMC	Federal Open Market Committee
GDP	gross domestic product
GFC	global financial crisis
GMM	generalised method of moments
GRA	Ghana Revenue Authority

GSE	Ghana Stock Exchange
HIPC	highly indebted poor country
IMF	International Monetary Fund
IRFs	impulse response functions
ISI	import substitution industrialisation
IT	inflation targeting
MCMC	Markov Chain Monte Carlo
ML	maximum likelihood
MPC	Monetary Policy Committee
MPR	monetary policy rate
MPTM	monetary policy transmission mechanism
NAFTA	North Atlantic Free Trade Agreement
NEER	nominal effective exchange rate
NK	New Keynesian
NPLs	non-performing loans
NPV	net present value
OECD	Organisation for Economic Cooperation and Development
OLS	ordinary least squares
OMOs	open market operations
PRGF	poverty reduction and growth facility
PRIBOR	Prague interbank offered rate
QE	quantitative easing
RBC	real business cycle
REER	real effective exchange rate
SAP	structural adjustment programme

SOE	state owned enterprise
SSA	Sub-Saharan Africa
SSSS	single spine salary structure
SVAR	structural vector autoregressions
SVECM	structural vector error correction model
TOT	terms of trade
TVP-VAR-SV	time-varying parameter vector autoregression with stochastic volatility
UNDP	United Nations Development Program
VAT	value added tax
VECM	vector error correction model
WACB	West African Currency Board
WDI	world development indicators
WTO	World Trade Organisation

Chapter 1: Introduction

Economic instability has been man's lot through the ages … But relative to the standards of each age and place, some years are prosperous, others dull, still others depressed.

(Burns, 1969)

1.1 Context and Background

If the world were devoid of shocks, life in general and economic life in particular would be bliss (but perhaps also a bit boring). The economy would expand uninterruptedly along its long-term path characterised by steady and rapid per capita income growth, low unemployment (i.e., only voluntary unemployment), low and stable inflation, and a bullish stock market. In such an environment, an increasing number of people would come to believe that as the normal state of affairs new opportunities will keep on opening up at extraordinarily low costs and risks. This utopian vision of ever-increasing real income, employment and wealth will be seductively intoxicating to most people irrespective of profession and geographical location. At times, the vision may even appear reachable and realistic, given the rapid and extended economic expansion in the industrial world during the Classical Gold Standard period preceding World War I, and in the 1990s and 2000s during the Great Moderation prior to the Global Financial Crisis (GFC) of 2007-09 (Zarnowitz, 1999).[1] It was perhaps this vision that influenced the thinking of early economists like Adam Smith who regarded the economy as a structure overseen by equilibrating forces that ensured optimal employment of available resources. With the 'invisible hand' at work, one would anticipate a smooth functioning of the economy at all times.

[1] Bernanke coined the phrase on 20 February 2004 during the meeting of the Eastern Economics Association to describe the reduced volatility of macro data in G7 countries.

However, economic shocks are real and have occurred regularly throughout the course of human history with different consequences, as captured vividly in the quotation above by Arthur Burns. Even the classical economists, including Smith, were well aware of these shocks, but felt they were the exception rather than the rule, and that the system had an inherent capacity to cushion their impact and spontaneously and quickly return itself to equilibrium without leaving any serious, lasting effects on the macroeconomy. During the era of the classical economists, the macroeconomy was hit by shocks such as the South Sea Bubble, Tulip Mania, Mississippi Bubble, Melancholy Decay of Credit, and Manchester Panic, which they viewed as external to the system. They therefore regarded the system itself as inherently self-stabilising. Hence, they were not interested in investigating the vulnerability of the economic system to such external shocks or the mechanisms through which these shocks triggered volatile swings in output and income (Schumpeter, 1939; Kindlebeger, 2000; Reijnders, 2007).

However, the beginning of the 20th century saw increased interest in the significance of impulses and transmission mechanisms aimed at explaining the causes of business cycle fluctuations. Slutzky (1927), for example, proved that random variables were capable of producing time series whose movements were analogous to economic time series. Six years after Slutzky, Frisch (1933) observed that economic fluctuations appear to emanate from trigger shocks that hit the economic system and set in motion output shocks. Insights from these early works have sparked research into the fundamental nature of these trigger shocks and their propagation (Ramey, 2016).

The quest for a better understanding of business cycle fluctuations and their primary causes became even more urgent following the catastrophic Great Depression in 1929 and the inability of the

prevailing mainstream theories to proffer any compelling policy prescription to enable the affected economies to recover from the depression. However, Keynes (1936) offered revolutionary perspectives regarding the fundamental origins of the Great Depression.[2] He also prescribed novel solutions to deal with it, which occasionally, undoubtedly for effect, bordered on the absurd: 'The government should pay people to dig holes in the ground and then fill them up' (Keynes, 1936). In this regard, Keynes favoured active policy intervention (fiscal and monetary) to help smooth out business cycle fluctuations and shocks that may hit an economy – an iconoclastic view at the time but one that has become a standard textbook prescription of the modern age.

Economists have since presented several trigger shocks as being responsible for output shocks, including wars, technological progress, crop failures due to bad weather, natural disasters, commodity price slumps, wayward animal spirits, speculative excesses, and disruptive government actions. These economic shocks may originate from domestic or external sources.[3] Economic shocks, internal or external, may be temporary, which permits monetary and fiscal measures to steer the economy back towards a degree of stability. The techniques for studying the transmission mechanism of these shocks to the domestic economy have evolved from the use of constant parameter vector autoregressions (VAR) to the use of the time-varying parameter VAR with stochastic volatility (TVP-VAR-SV) model. However, to address the inherent vulnerability of the system to shocks, a set of structural reforms may be required (Gafar, 1996). The GFC, which occurred between mid-2007 to early 2009, for example, could be seen as a domestic shock to the

[2] Namely, that the economic system was inherently prone to cyclical instability.

[3] Domestic shocks include aggregate demand shocks, changes in technology, changes in labour supply, bad weather, natural disasters, new discoveries such as oil (e.g. in Ghana in 2007), and domestic policies – fiscal, monetary and structural. External shocks, on the other hand, may manifest in movements in an economy's terms of trade, exchange rate volatility, capital flows volatility, variations in the world interest rate, shifts in foreign demand and changes in commodity prices (Shapiro & Watson, 1988).

US economy, which subsequently acted as an external shock to other economies, including the Sub-Saharan Africa (SSA) region.

The spill-over effects that the crisis had on the SSA region found expression in a significant deterioration in terms of trade, external demand and commodity prices, as well as in tightened financing conditions. Channels of transmission included severe contractions in foreign direct investment (FDI), export growth, remittance inflows and development assistance (Drummond & Ramirez, 2009). The pace of growth in the SSA region slowed to 5.4% and 2.9% in 2008 and 2009, respectively, from 7.2% in 2007 and 7.1% in 2006, but recovered somewhat to reach 5.4% in 2010. The quicker recovery contrasts sharply with the disappointing economic performance of the 1970s and the greater part of the 1980s following the commodity price slumps and the droughts of the 1980s, which indicates that the region as a whole may have become more resilient to unfavourable external developments. The shocks that hit the region at the turn of the 1970s resulted in an economic decline of 0.12% in 1981, a negligible 0.23% growth in 1982, and a further contraction of 1.43% in 1983 (IMF, 2012).

This apparently different way in which macroeconomic performance reacted to external shocks may be due to differences in the state of the macroeconomy and the policy environment that prevailed prior to a shock. Countries that pursue sound macroeconomic and structural policies prior to the onset of a shock are generally more resilient to the adverse impact of the unfavourable event (Collier & Goderis, 2009; Fisher, 2011). More broadly, enhanced institutional frameworks established in normal times are an essential tool in attenuating the procyclicality of domestic macroeconomic policies, and pave the way for the pursuit of more countercyclical policies in times

of crisis (Capistran et al., 2011). For example, cross-sectional evidence indicates that regions known for pursuing sound macroeconomic and structural policies were minimally impacted by the GFC. While the pace of economic growth in Developing Asia (famous for its sound macroeconomic and structural policies) slowed down to 7.1% in 2009 from 7.8% in 2008 and 11.4% in 2007, economic activity in Latin America declined by 1.6% in 2009 from a growth of 4.2% in 2008 and 5.8% in 2007. In the case of the SSA region, growth decreased from 7.1% in 2007 to 5.6% in 2008 and 2.8% in 2009 (IMF, 2012).

At the beginning of the 1980s, the search for a more robust and resilient domestic economy propelled policy-makers in several SSA countries to embark on comprehensive economic reforms. In the case of Ghana, the prior decade was characterised by significant macroeconomic decay as reflected in declining real Gross Domestic Product (GDP) and per capita income growth, rising unemployment, a high and volatile inflation rate, an overvalued exchange rate, and large current account and fiscal deficits.[4] These resulted principally from the repressive financial sector policies, oversized public sector, fixed exchange rates, falling domestic revenue collection, expenditure slippages – mostly on recurrent spending that resulted mainly from the bloated public sector wage bill, and an accommodative monetary policy. Domestic policy missteps were worsened by terms of trade shocks and oil price shocks. These conditions produced severe macroeconomic instability and balance of payments problems and possibly contributed to increased military interventions in government, not only in Ghana but across the continent in much of the period spanning independence to the 1990s (Dornunoo, 2000; Wetzel, 2000; Bawumia, 2010).

[4] For the 1970s decade, average real GDP growth was 1.4%; real GDP per capita declined on average by 0.8%; average fiscal deficit was 6.5%; and average inflation was 38.8%. see chapter two for a comprehensive discussion on Ghana's macroeconomic developments in the 1970s.

The main objective of Ghana's macroeconomic reforms therefore was to dismantle the direct control regime, establish a free market economy, and develop a financial system that would support sound economic policies to deliver the macroeconomic and price stability seen as preconditions for sustainable economic progress and employment. As contended by McKinnon (1973) and Shaw (1973), financial sector reforms would prop up savings mobilisation and so increase investment and growth through the credit channel. Reforms focused on the elimination of price controls, liberalisation of the foreign exchange (forex) market, liberalisation of the financial sector, liberalisation of capital and current accounts, privatisation of state-owned enterprises, and fiscal and monetary policy reforms (Gyimah-Boadi, 1991; Terkper, 1995; Wetzel, 2000; Gyimah-Boadi & Jeffries, 2000; Addison, 2001; Osei & Quartey, 2005; Bawumia, 2010).

On the back of these reforms, the economy, which had shrunk on average by 5% between 1981 and 1983, resumed growth averaging 5% over the period 1984-1999. The macroeconomic environment improved with inflation falling from 142% at the end of 1983 (average inflation was 121%) to 14% at the end of 1999 (average inflation was 12.5%). Government finances also improved considerably with the budget registering surpluses between 1986 and 1991.[5] Some of these gains were reversed however as the country's preparation and subsequent transition to democratic constitutional rule in 1993 coincided with a deterioration in the fiscal position emanating from lax mobilisation of tax revenue and significant expenditure slippages accommodated mostly by monetary policy. As a result of these lingering challenges, a new wave of macroeconomic reforms was initiated, which culminated in the adoption of inflation targeting

[5] It was 0.1% of GDP in 1986; 0.5% in 1987; 0.4% in 1988; 0.7% in 1989; 0.2% in 1990, and 1.6% in 1991.

(IT) as the monetary policy framework. The result was a general decline in the volatility of key macroeconomic variables (Bawumia, 2010; Aryeetey & Fenny, 2017).

Most of the existing literature investigating the possibility of time variation have however concentrated on advanced economies (see Primiceri, 2005; Nakajima, 2011). The application of time-varying techniques in the analysis of transmission mechanisms remains limited in the SSA region. Indeed, as late as 2012, Mishra and Montiel surveyed the literature in search of evidence pertaining to the effectiveness of the monetary transmission mechanism in developing countries. They found that not even a single study they reviewed, reflected in its model the possibility that the monetary transmission mechanism could have altered over time. Since then however Mwabutwa et al. (2016) gave consideration to possible time varying impacts of financial sector reforms on the monetary transmission mechanism in Malawi.

There have been major developments in Ghana's monetary and financial landscape, including financial sector reforms and the attendant financial innovations, deregulation of credit and interest rates, current and capital accounts liberalisation, forex market reforms, the creation of rural and community banks, the emergence of microfinance institutions and, perhaps more importantly, the adoption of an IT framework to replace the monetary aggregate targeting framework. These developments coincided with the less volatile macroeconomic environment alluded to previously and could have impacted the monetary transmission mechanism. Being one of the three countries to adopt IT as a monetary policy framework in the entire SSA region, it is rather startling, in view of the foregoing, that no evidence exists concerning changes in the monetary transmission

mechanism in Ghana.[6] This thesis therefore proposes to investigate possible time variation in the monetary transmission mechanism, particularly during the IT period using the approach of Primiceri (2005) and Nakajima (2011).

The effectiveness of fiscal policy in impacting the macroeconomy has attracted attention following the implementation of significant stimulus packages, mostly in advanced economies, to stem the impact of the GFC and, more recently, the COVID-19 pandemic. This intense interest is deeply rooted in the diametrically opposed conclusions and prescriptions proffered by the Keynesian and neoclassical paradigms. On the one hand, Keynes and his followers believe that active government demand management will stabilise the economy through its impact on employment, consumption, and output. Neoclassical economists, on the other hand, argue that real variables are in the medium to longer term unresponsive to systematic activist policies. The neoclassicals even predict a possible short-term reduction in private consumption in response to expansionary fiscal policy as economic agents attempt to hedge against the expected future tax burden of present fiscal policy actions (Smets & Wouters, 2003; Pereira & Lopes, 2010). Given that Ghana has pursued demand management policies since independence, it will be interesting to investigate which of the theories better fits the Ghanaian data.

Profound external reforms have steered a surge in international investor confidence leading to increased portfolio and foreign direct investment and greater integration into the global trading and financial systems. For example, portfolio and net FDI flows increased steadily from about 1% of GDP in 2002 to peak at 9.5% of GDP in 2008 (at the height of the GFC) before retreating to an

[6] The other countries are South Africa and Uganda.

average of 6.5% of GDP between 2010 and 2018. In addition, the country has been issuing Eurobonds since its debut in 2007 while international companies such as Tullow Oil have listed on the Ghana Stock Exchange (GSE). While increased integration into the global economy may enable quicker growth in Ghana, it is likely that the economy has become more vulnerable to external shocks, suggesting that external spill-overs will assume a more prominent role in explaining domestic macroeconomic developments. As observed by Raddatz (2008), African countries have experienced significant changes that could have influenced the significance of external shocks for output fluctuations on the continent.[7] Yet, studies that incorporate time variation in assessing the effect of external shocks and spill-overs to the domestic economy are generally limited to oil supply and price shocks, and concentrated on advanced economies (see Baumeister & Peersman, 2013).

1.2 Problem statement

A critical analysis of Ghana's macroeconomic data clearly indicates that the post-2000 period has witnessed improved macroeconomic environment when compared with the preceding periods. Despite occasional shocks, the macroeconomic scene has remained relatively stable with inflation and inflation volatility reducing considerably while growth has been more robust. On average, inflation declined from 44.8% during the period of direct controls (1970-1991) to 27.9% during the monetary targeting regime (1992-2001) and further to 14% during the IT period (2002-2018). Growth also picked up steadily from an average growth of less than 2% over 1970-1991 period to

[7] Changes are both domestic and external. Domestic factors include democratic accountability, better economic management, and more effective control of corruption. External developments include unusual increases in commodity prices since the 1990s, and the decline in international volatility of business cycles prior to the 2007/09 GFC.

about 4% during the 1992-2002 period, recording more than 6% over the 2002-2018 period. Indeed, other macroeconomic variables, including exchange rate movements and interest rates, have generally been trending more favourably (Bawumia et al., 2008; Akosah, 2015; Aryeetey & Fenny, 2017).

In a sense, Ghana has achieved its own version of the Great Moderation – a period of reduced volatility in most economic variables. The literature attributes the Great Moderation to less volatile trigger shocks and changes in the transmission mechanism of economic shocks identified to be instigated by shifts in the structure of economy. Structural changes usually originate from switching to a market-based economy, trade liberalisation with greater integration into the world economy, and the adoption of an IT framework (Franta et al., 2012). Models that fail to recognise these time-varying behaviour of the economy are bound to suffer from misspecification and identification problems leading to inconsistent estimates. Conclusions based on such inconsistent estimates are likely to produce wrong policies and wrong macroeconomic outcomes.

Ghana's monetary and financial landscape have witnessed significant reforms including financial sector reforms, deregulation of credit and interest rates, current and capital accounts liberalisation, forex market reforms, the creation of rural and community banks, the emergence of microfinance institutions and the adoption of the IT framework. These reforms could have affected the structure of the economy and hence the monetary policy transmission mechanism. Yet, macroeconomic models, both forecasting and policy, at the central bank fail to incorporate possible time variation. These models are likely to produce spurious outcomes, leading to misleading policy conclusions.

Policy errors resulting from the wrong macro model are costly, implying a more flexible model with time-varying capability is urgently needed.

In tandem with monetary policy, fiscal policy has also undergone reforms, including the introduction of Value Added Tax (VAT), public wage reforms, accession to Highly Indebted Poor Country (HIPC) relief, and the earmarking of expenditure. Other reforms include capping the central bank's financing at 5% of the previous year's revenue and the more recent implementation in 2018 of fiscal rules. These fiscal policy changes are capable of impacting the transmission of fiscal policy shocks. Yet, models for forecasting key fiscal and other macro variables do not account for possible time variation. It is not surprising that fiscal and growth outcomes frequently miss their targets which the country can ill afford given its market access status. Persistently missing fiscal targets, for example, affects the country's sovereign bond spreads and tighten financing conditions.

Ghana's reliance on foreign trade has increased dramatically in recent decades. The increase is underpinned by trade reforms and the broad opening of the economy, which turns it into a textbook small open economy. As a result, the economy has become more exposed to external shocks and spill-overs, although improved domestic policies have enhanced the resilience of the economy to withstand the impact of these shocks. These reforms could have impacted the transmission mechanism of external shocks to Ghana's domestic economy, justifying the suspicion of time variation in the transmission channels of external shocks. Without due consideration to time variation, models attempting to analyse these external spillovers are prone to reaching suboptimal conclusions with potential for policy errors. This has grave consequences for external sector

stability in particular and overall macroeconomic stability in general. In the case of the SSA region including Ghana, no evidence relating to consideration of time variation exists even though there are empirical works that investigate the impact of external shocks on the continent (see Kpogli, 2014; Addison & Ghoshray, 2013; Oyelami & Olomola, 2016).

This thesis, in the study of monetary, fiscal and external shocks as they relate to Ghana's economy, therefore attempts to use a TVP-VAR-SV model, which combines the possibility that both the shocks and transmission mechanisms could vary over time. The conclusions reached should also be applicable to developing countries with similar characteristics.

1.3 Research questions

In response to a changing macroeconomic environment and in reaction to evolving external developments, Ghana has implemented monetary, fiscal and external sector reforms which have resulted in progressively more macroeconomic stability. The following research questions can be asked: Has the monetary transmission mechanism changed over time following successive implementation of monetary reforms? Has the fiscal transmission mechanism altered over time in response to implementation of fiscal reforms? Has the transmission of external shocks to Ghana's domestic economy changed over time?

1.4 Objectives

Appropriate and accurate responses to the research questions above demand systematic empirical investigation. The broad objective of the study, therefore, is to assess the transmission mechanisms of economic shocks in Ghana with a view to determining possible time variation in the

transmission process of these shocks. This is grounded in the belief that macroeconomic, financial and structural reforms that result in financial innovation and greater stability in general usually affect the transmission mechanism of economic shocks. The thesis will however focus on the following specific objectives:

i. Investigate the possible time variation in monetary transmission mechanism;
ii. Assess the extent to which the fiscal transmission mechanism has evolved over time; and
iii. Determine possible time variation in the transmission of external shocks.

1.5 Expected outcomes and significance

The thesis is expected to contribute to the existing knowledge by providing a comprehensive examination of the economic impact of domestic policy changes and external shocks in the context of a developing SSA country. In specific terms, the thesis will broaden appreciation for the evolution of monetary, fiscal and external shocks, and their changing impact on real macroeconomic activity in Ghana in particular, and similar developing countries in general. The issue of evolution in monetary policy is particularly relevant given that Ghana is one of three countries in Sub-Saharan Africa to have adopted IT as a framework for monetary policy having previously adopted direct control and monetary targeting regimes. The thesis will therefore augment the extant literature by analysing the effect on the macroeconomy of transitioning from monetary aggregate targeting to IT. It will also add to the existing literature by exploring the possibility that the way in which monetary, fiscal and external shocks have impacted Ghana's macroeconomy has evolved over time.

Moreover, the thesis intends to point to the possibility of time variation in the Ghanaian time series data, which suggests scope for incorporating time variation into the Bank of Ghana (BOG)'s current forecasting framework or any other macroeconomic model of the Ghanaian economy, for purposes of policy analysis or forecasting. The thesis will also deliver a more reliable methodology for estimating the parameters needed to calibrate the BOG's existing forecasting framework and all future calibrated models, including the Dynamic Stochastic General Equilibrium (DSGE) models of Ghana and other developing countries. The use of TVP-VAR-SV model also tackles the problems of endogeneity, misspecification, identification and inconsistent estimates associated with earlier empirical works on monetary, fiscal and external shocks.

The outcome of the thesis will help policymakers, government and other stakeholders appreciate the importance of reforms in improving macroeconomic outcomes. The result should also serve as a guide for the country's policymakers and its development partners, the International Monetary Fund (IMF) and the World Bank, in designing macroeconomic policies and programmes intended to improve the monetary, fiscal and external sectors of the economy that are accommodative of price stability and growth.

1.6 Scope and delimitation

As indicated in the objectives, the thesis addresses three key questions with the common theme of identifying the effects of economic shocks emanating from external and domestic policy sources. The external shocks of interest are shocks in the oil price, foreign demand, and the foreign interest rate. In the case of domestic shocks, the thesis focuses on fiscal and monetary policy shocks. The thesis is quantitative in nature and investigates the possibility that fiscal, monetary and external

shocks and their transmission mechanisms have changed over time due to years of macroeconomic, financial, institutional, and structural reforms, as contended by Franta et al. (2012). The study therefore does not cover other shocks such as natural disasters (e.g. droughts, bushfires, earthquakes, and floods).

Its quantitative analysis is confined to the period spanning 1984q1 to 2018q4. The starting period was selected based on the desire to cover the three distinct policy frameworks implemented in Ghana since independence, namely direct credit control, monetary aggregate targeting, and IT. Due to the paucity of credible and reliable macro data on Ghana, the study concentrates on the TVP-VAR-SV, because it accommodates the use of fewer variables than factor augmented vector autoregressions (FAVAR).

1.7 Chapters overview

Chapter 2, titled *Historical overview of Ghana's macroeconomic policy and performance*, provides an understanding of the evolution of Ghana's macroeconomic policy and economic performance. The focus is on monetary and fiscal policy strategies and external sector developments over the study period. Particular attention is devoted to the three distinct monetary policy regimes of direct controls of the earlier years, monetary aggregate targeting of the 1990s and early 2000s, and the IT regime of recent years. The main objective is to offer comprehensive background information to aid the resultant econometric analyses in chapters 5, 6 and 7.

Chapter 3, titled *Theoretical and empirical literature*, surveys the relevant theoretical and empirical literature as a basis for the empirical methodology presented in chapter 4 and subsequent

analyses in chapters 5, 6 and 7. Three strands of literature are presented in this chapter. The first strand relates broadly to the monetary policy transmission mechanism with specific attention to channels of transmission and monetary policy rules. The relevant empirical literature focuses on the evolution of the transmission mechanism of monetary policy using the TVP-VAR-SV framework. The second strand presents literature on the transmission of fiscal policy shocks, with the theoretical literature focusing on the controversy between the two main schools of thought concerning the effects of fiscal policy: Keynesian and neoclassical. The empirical literature focuses on time variation in the transmission of fiscal policy shocks. The third strand of literature – still in its embryonic stage – pertains to the transmission channels of external shocks with empirical literature on possible time variations in the transmission mechanism.

Chapter 4, under the heading *Research methodology*, presents the general empirical methodology as a precursor to the empirical analyses presented in chapters 5, 6 and 7. It outlines the econometric methodology pertaining to the TVP-VAR-SV model for investigating possible time variation in the transmission of monetary, fiscal and external shocks. Consistent with Bayesian econometric analysis, priors are specified. The estimation techniques and the identification strategy are then discussed. The chapter ends with issues pertaining to data requirements and sources.

Chapter 5, titled *Empirical evidence on the time-varying transmission of monetary policy actions,* presents the empirical estimates of the monetary policy transmission mechanism based on the TVP-VAR-SV methodology outlined in chapter 4. It traces the evolution of the monetary policy response to macroeconomic shocks. The chapter also provides time-varying evidence of the reaction of key macro variables (output, inflation, exchange rate, and private sector credit) in the

model to monetary policy shocks. As a by-product of the analysis, the chapter discusses the response to exchange rate, private sector credit and money supply shocks. In addition, it presents estimates of the time-varying volatilities to help trace specific events that have influenced the course of macroeconomic policy and developments over the study period. The main findings are that reactions to monetary policy shocks vary over time with the transmission mechanism trending towards the predictions of traditional theory post 2001. This implies that macro financial and institutional reforms that affect the structure of the economy are likely to improve the transmission mechanism of monetary policy.

Chapter 6, under the heading *Empirical evidence on the time-varying transmission of fiscal policy shocks*, examines the time-varying fiscal transmission mechanism based on the methodology presented in chapter 4. The chapter evaluates the effectiveness and time-varying behaviour of two basic tools of fiscal policy. Firstly, it presents time-varying reactions of output and private consumption to shocks in government spending. Secondly, it provides time-varying responses of output and private consumption to government tax shocks. The empirical results point to time variation in responses to fiscal policy shocks. At the start of the 1990s, the transmission mechanism became more broadly in line with Keynesian predictions. This means that the pursuit of policies that change the structure of the economy and elicit more macro stability is critical to the effectiveness of fiscal policy.

Chapter 7, titled *Empirical evidence on the time-varying transmission of external shocks,* assesses the time-varying response of the domestic economy to external shocks. Three external shocks are of interest in this chapter: estimates of output and inflation response to foreign monetary policy

shocks proxied by the US federal funds rate; foreign demand shocks proxied by the Organisation for Economic Cooperation and Development (OECD) output (GDP); and crude oil price shocks. The key results indicate that responses to the three foreign shocks by key domestic macro variables are time varying. In terms of effect, the evidence suggests that spill-overs of shocks in the US federal funds rate are generally highly detrimental to Ghana's macroeconomic health, whereas positive foreign demand shocks are broadly beneficial to Ghana's economy with policy setting being crucial to the realisation of potential benefits. More recently, crude oil price shocks have become generally beneficial to Ghana's economy on the back of a significant shift in policy and the start of commercial oil production. Generally, transmission mechanisms have tended to improve over time, implying that macroeconomic conditions in Ghana are important determinants of the outcome of external shocks.

Chapter 8 contains the thesis' concluding remarks.

Chapter 2: Historical overview of Ghana's macroeconomic policy and performance

[T]here are intimate connections between processes of structural change and long-term economic growth. *(Tony Killick, 2000)*

2.1 Introduction

Ghana's economy at independence in 1957 was essentially agrarian, lacking the basic economic infrastructure necessary to underpin any meaningful development agenda. Macroeconomic policies over the years have therefore sought to affect the structure of the economy and improve the macroeconomic environment with a view to achieving long-term sustainable growth in line with Killick's thinking. This would serve as a catalyst for advancing the economic wellbeing of the people. Today, Ghana's economy is dominated by the services sector in terms of contribution to GDP and employment, which is a dramatic transformation from the 1980s and even the 1990s when the economy was still dominated by the agricultural sector. This chapter traces the evolution of key macroeconomic policies and outcomes. Section 2.2 covers the evolution of macroeconomic policies and outcomes from independence to 1983 with particular emphasis on monetary, fiscal and external policies. Section 2.3 focuses on the stylised facts of macroeconomic policy developments in Ghana between 1984 and 2000, followed by macroeconomic policies and outcomes between 2002 and 2018 (Section 2.4). Section 2.5 recaps the chapter's main findings.

2.2 Macroeconomic policies and performance (1957-1983)

2.2.1 Introduction

The period between 1957 and 1983 can be roughly divided into two – a period of economic hope (1957 to 1970) and a period of economic despair (1970 to 1983). In the first period, Ghana gained political independence with its characteristic, visionary and eloquent leader, Dr. Kwame Nkrumah. With a sizeable reserves, the country embarked upon an ambitious industrialisation programme which saw several industries established across the country in key sectors of the economy. Cracks began to develop in the development plan as resources to support the continued pursuit of such a grand agenda were exhausted. The country then began a journey into the unknown with the first of several military coup d'états in 1966 when the first president was overthrown. What followed particularly from the early 1970s to early 1980s could best be described as economic despair – it was a decade of macroeconomic mismanagement and despondency. By 1983, the economy was on the precipice of complete collapse. This section traces key macroeconomic policies and outcomes with deliberate focus on the second period. Section 2.2.2 discusses monetary policy and macroeconomic outcomes, followed by fiscal policy and outcomes in section 2.2.3. Section 2.2.4 outlines key external policies and outcomes.

2.2.2 Monetary policy and performance

Prior to independence in 1957, Ghana was part of the West African Currency Board (WACB) and could therefore not operate its own monetary policy. Membership of the WACB restricted the country to a fixed exchange rate mechanism with monetary policy designed to maintain the peg to the British pound which was seen as a precondition for price stability. Upon independence in 1957, Ghana created its own central bank, the BOG, charged with the responsibility to conduct monetary

policy by way of regulating the growth of money supply so as to contain inflation and stabilise the monetary system. Regulating the growth of the money supply during this period was effected by way of direct controls on bank credit extension (direct control regime).

The system of direct controls was predicated on the conviction that, in the absence of government intervention, the lopsided colonial financial architecture and market imperfections were incapable of supporting needed investment. Consequently, several state-owned banks were set up to help meet the desired needs of specific sectors of the economy.[8] Under this system, the BOG directed commercial banks to advance their loanable funds to certain priority sectors identified by government, particularly the manufacturing and agricultural sectors, at specified interest rates. In order to ensure the availability of cheap credit, interest rates were also controlled by imposing ceilings and floors on lending and deposit rates, respectively. On the other hand, high reserve requirements were imposed on commercial banks to sterilise excess reserves in the banking system that resulted mainly from the BOG's accommodation of large fiscal deficits. Sowa (1991) observed that the high reserve requirements were not effective restrictions to commercial banks' lending activities as banks' actual reserves constantly exceeded the required ratios to the extent that the cedi was demonetised in March 1978.

The mechanism of direct controls entails that the BOG determined the growth in money supply by setting targets for both inflation and growth. Next, after the credit growth necessary for attaining

[8] These banks were the National Investment Bank (NIB) established in 1963 to assist the industrial sector; the Agriculture Development Bank (ADB) established in 1965 to support the agricultural sector; the Merchant Bank of Ghana (MBG) established in 1972 to underpin export trade; the now defunct Bank for Housing and Construction (BHC) established in 1974 to assist industrial construction, housing and companies producing building materials; and the is National Savings and Credit Bank (NSCB) set up in 1975 and now also defunct, to make credit available to consumers, small industries and cooperatives (Brownbridge & Gockel, 1996; Loloh & Amoah, 2014).

the derived money supply growth had been determined, the available credit was distributed among commercial banks operating in the country. Rigorous monitoring was undertaken to ensure compliance, with hefty penalties imposed on non-compliant banks. While the direct control regime was easy to implement and communicate, over time it began to impose significant costs on the financial system such as huge non-performing loans (NPLs) and high operational costs. The credit control regime also proved unsuccessful as government itself breached the regulations by putting pressure on state-owned banks to extend credit to loss-making state-owned enterprises. In addition, incoherent fiscal policy resulted in large fiscal deficits usually accommodated by monetary policy, i.e., by central bank credit (Antwi-Asare & Addison, 2000).[9]

The period between mid-1970s and early 1980s was characterised by rapid money supply growth as the government relied largely on domestic credit, particularly from the BOG to finance its fiscal deficits following the country's loss of creditworthiness.[10] During the period, government's share of domestic credit rose to 90.6% in 1983 from 64% in 1973. The result was an increase in money supply growth, which invariably translated into high domestic inflation rates. Over time, however, the high money supply growth rates, operating through high inflation, prompted balance of payments problems as the fixed exchange rate regime resulted in the overvaluation of the currency and loss of export competitiveness. The high inflation also eroded real wages resulting in widespread emigration of skilled labour in search of pastures new (Aryeetey & Harrigan, 2000).

[9] The average fiscal deficit between 1970 and 1983 was 5.7% of GDP with the mid-1970s in particular recording double digit figures (11.8% in 1975, 12.1% in 1976 and 10.2% in 1977).

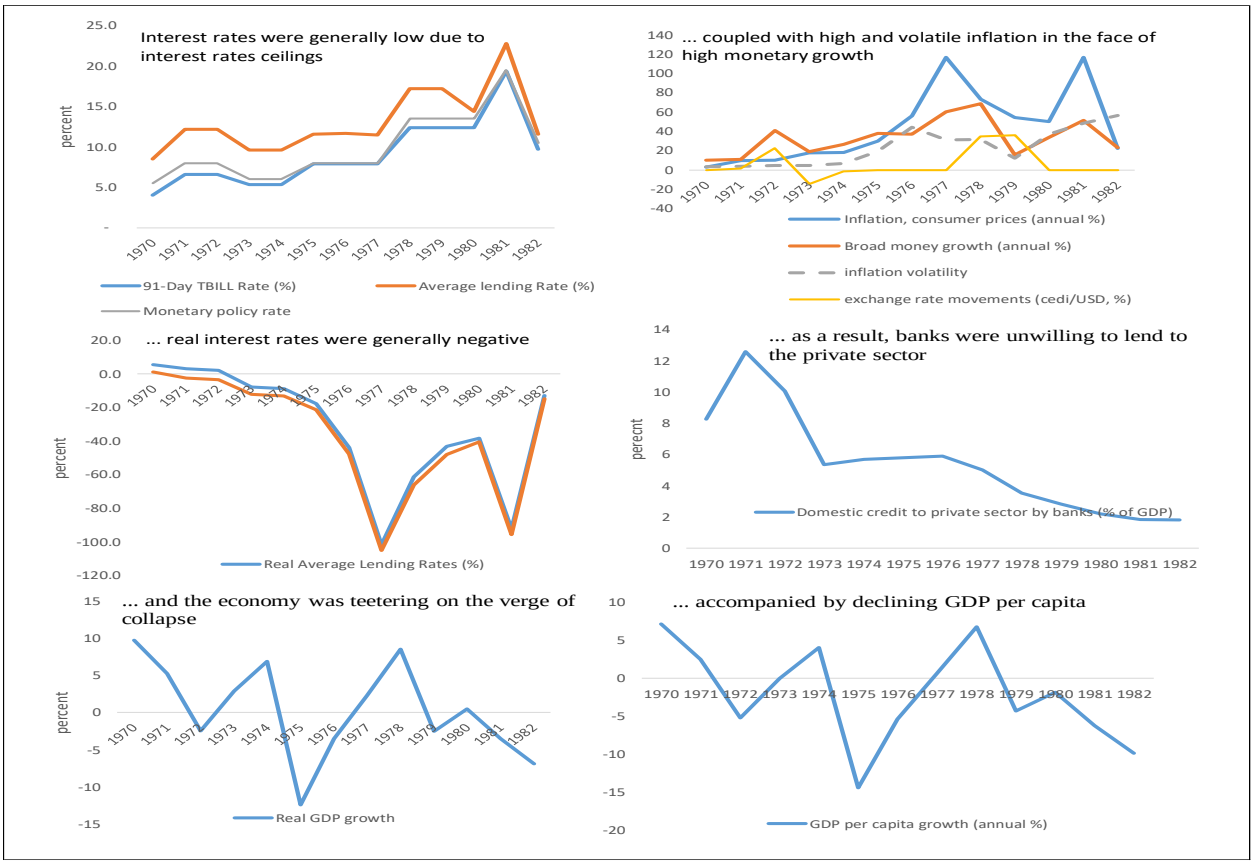
[10] Upon takeover of the realms of government in 1972, the then military leader, Col. Acheampong, unilaterally repudiated some of Ghana's foreign debt and rescheduled some others to be paid over fifty 50 years.

Keeping the nominal interest rates fixed in the presence of inflationary pressures emanating from the high money supply growth rates also created large negative real interest rates which inhibited domestic savings and investment with gross fixed capital formation declining to 3.5% of GDP in 1982 from 12% of GDP in 1970. The authorities' desperate attempt to check the spiralling inflation by instituting a large number of price controls resulted in driving the affected goods into the black market, contributing instead to corruption and rent-seeking behaviour. These price controls also worked as a further impediment to private sector investment (Aryeetey & Harrigan, 2000).

Domestic policy missteps were compounded by unfavourable external developments such as oil price shocks and slumps in commodity prices in the 1972/1973 period. With the exchange rate fixed and pegged to the USD, the economy lacked shock absorbers to prevent or at least minimise the impact of these external shocks on the domestic economy. These developments weighed down on the economy, which declined in 1972 but returned to the path of growth in 1973 and 1974. Inflation was relatively low but rising given the fixed exchange rate regime and the relatively low money supply growth rates. Seen as external shocks coupled with the relatively low inflation, monetary policy reaction (in terms of changes in the short-term nominal interest rate) to these shocks was essentially muted.

In the second half of the 1970s, economic activity came under further stress as money supply growth increased significantly in response to rising fiscal deficits dragging inflation with it except that inflation increased faster than the money supply growth. This was because the bulk of the commercial banks' credit was going to the government to meet its bulging public sector wage bill, which subsequently fuelled consumption in an essentially rent-seeking economy (Aryeetey &

Harrigan, 2000). By the early 1980s the economy had descended into recession, declining by more than 5% annually in real terms and characterised by negative real interest rates, declining credit to the private sector, high and volatile inflation underpinned by high monetary growth, overvalued exchange rate, and precipitous decline in real GDP per capita (see figure 2.1).



Source: Author's own construct based on World Development Indicators (WDI).

Figure 2. 1: Monetary macroeconomic performance (1970-1983)

2.2.3 Fiscal policy and performance

Fiscal policy management in Ghana prior to independence was strictly restrained with government expenditure serving as the fiscal anchor and capped at 10% of GDP, resulting in massive fiscal

surpluses reaching over 14% in 1954. Fiscal outcomes (budget surpluses or deficits) were therefore fundamentally driven by revenue performance as expenditure stayed below the 10% cap until 1958 when it reached 13.5% of GDP. Robust revenue performance was instigated by rising world cocoa prices stimulated by the Korean War. Despite the accumulation of large fiscal surpluses, the economy generally lacked basic social and economic infrastructure and was hugely import-dependent (Osei & Telli, 2017). This situation would influence the defining of fiscal policy in independent Ghana.

With political independence achieved in 1957 and Keynesianism thinking dominating at the time, state intervention appeared a logical choice to facilitate the provision of economic infrastructure to underpin the industrialisation agenda that would characterise the immediate post-independent Ghana. As a result, government spending rose dramatically reaching over 25% of GDP in 1965 as several state-owned enterprises (SOEs) were established in pursuit of import substitution in addition to ambitious programmes aimed at raising the country's human capital base. With the commodity boom over, the pace of revenue mobilisation began to lag behind expenditure growth as the budget balance turned rapidly south, registering its maiden deficit of 1.7% of GDP in 1961. The rising deficit was financed from both domestic and foreign sources with domestic financing coming largely from the banking system. As resources – including external reserves – for financing the budget deficit were running out rapidly, the authorities began issuing treasury bills in 1960 to plug the fiscal hole. The fiscal performance would remain decidedly expansionary with the deficit reaching over 5% in 1966 as Ghana experienced its first of several military coup d'états brought on inter alia by the macroeconomic instability. The large fiscal imbalances inherited by the new military administration prompted the country's first attempt at stabilisation in 1967 under an IMF-

supported standby arrangement to help deflate the economy and restore macroeconomic stability. As a result, the fiscal situation improved to 2.2% of GDP in 1970 (Hutchful, 2002; Leith & Soderling, 2003).[11]

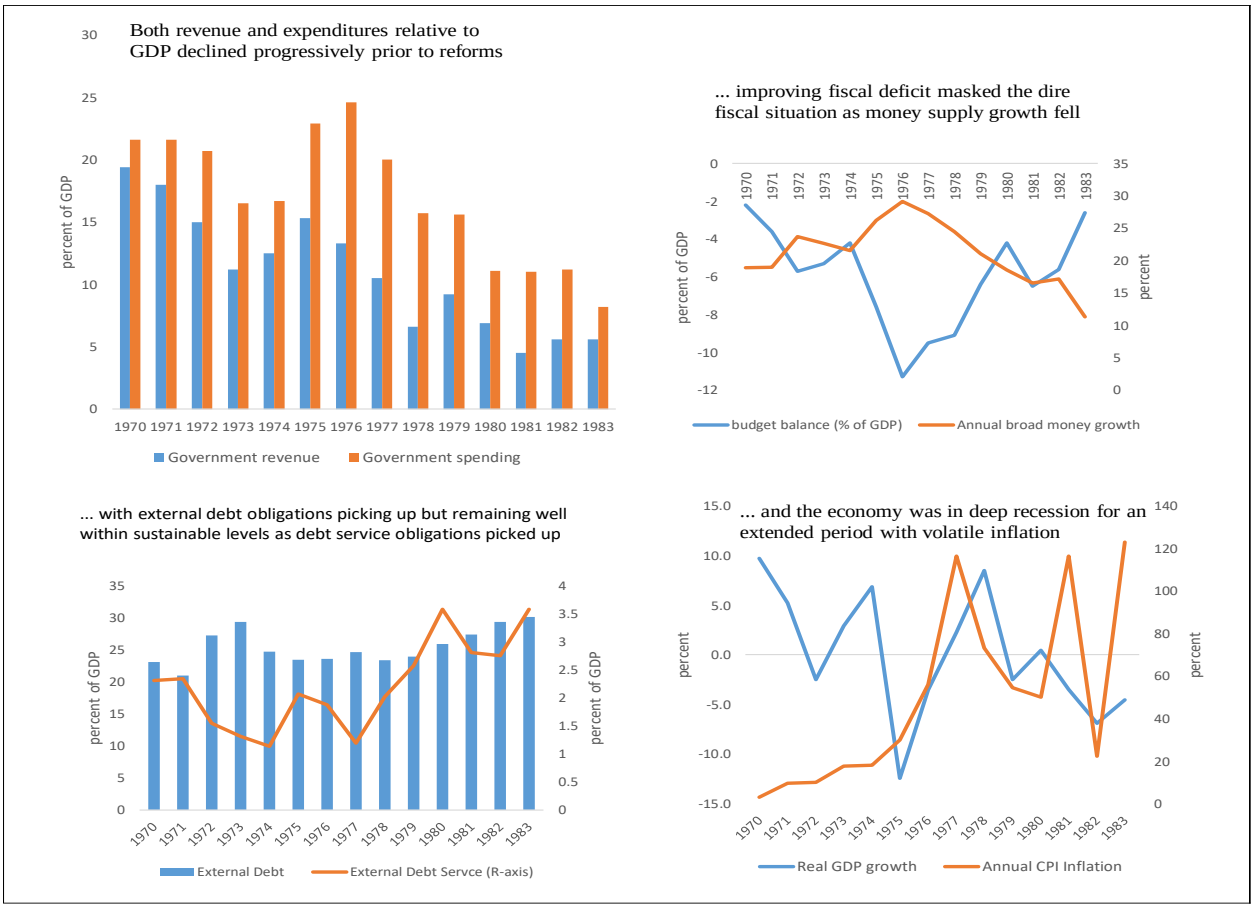
However, the economy witnessed terms of trade (TOT) shock in 1971 resulting mainly from the plummeting of the country's main export commodity, cocoa. The authorities therefore implemented comprehensive fiscal measures to help deal with the situation. These measures included 10-20% taxes on some forex transactions (an implicit devaluation measure) and surcharges on imports; scrapping housing and transport allowances of public sector employees; replacing free university education with a student loan system; a 7% development levy on salaries; a 44% devaluation of the local currency; and a cut in the military budget. As could have been expected, these measures triggered another military intervention in 1972, which reversed most of them. The reversal of these measures further affected government tax revenue and worsened the fiscal situation with fiscal deficit reaching over 11% in 1976, mostly financed by borrowing from the central bank as evidenced by the significant money supply growth. Indeed, much of the second half of the 1970s was characterised by high monetary growth and inflation rates (see figure 2.2). For example, government borrowing from the domestic economy, mostly from the central bank, rose from 0.9% of GDP in 1970 to over 9% of GDP in 1983 (Aryeetey & Harrigan, 2002; Wetzel, 2000; Leith & Soderling, 2003; Nketiah-Amponsah, 2009).

A short-lived military intervention in 1979 and subsequent return to civilian rule later that year did little to reverse the fiscal situation facing the economy. By the early 1980s, the fiscal situation had

[11] By the time Ghana inaugurated its fourth republic in 1993, the military had spent some 21 years in power whereas civilian administrations had only been in power for 14 years in total.

become grave, but this was masked by an apparent improvement in the budget deficit as a percentage of GDP given that government revenue fell from some 13% of GDP in 1976 to just over 5% in 1983 as the tax base eroded resulting from declining domestic production. Public expenditure fell even stronger from 27% of GDP to about 8% of GDP in the same period, resulting in an artificial fiscal deficit of less than 3% in 1983 from the over 11% of GDP recorded in 1976. As shown in figure 2.2, the lower fiscal deficit coincided with lower money supply growth rates, suggesting that the higher and volatile inflation experienced during this period was mostly due to supply constraints and rent-seeking behaviour.

Meanwhile, the country's external debt obligations were edging up with the external debt to GDP ratio rising from 23% in 1970 to 30% in 1983 while the external debt service rose from 1.8% of GDP to 3.5% of GDP over the same period (see figure 2.2). With such significant accumulated shortfalls in revenue and a significant proportion going to service external debt the government was unable to undertake the critical expenditure necessary to pull the economy out of the raging recession. By 1983, the fiscal situation, in tandem with the general macroeconomic instability as discussed in section 2.2.2 above (and later in section 2.2.4), had reached crisis point and required immediate reforms to prevent the economy from collapsing completely. This was clear to the military government that had been in power since 31st December 1981 (Kusi, 1998; Dordunoo, 2000; Wetzel, 2000; Amoah & Loloh, 2008).



Source: Own construct based on data from BOG.

Figure 2. 2: Fiscal performance (1970-1983)

2.2.4 External sector policies and performance

Ghana's immediate post-independence trade policy was largely influenced by dissatisfaction with the colonial era trade arrangement that was perceived to be exploitative and too dependent on imports. Thus, the country embarked upon the import substitution industrialisation (ISI) with the establishment of several SOEs in key sectors of economy. However, such a strategy needed protection, at least in the short term, to achieve its policy objectives. As a result, trade policy was mostly characterised by quantitative restrictions and high tariff regimes. Most industries depended on imported inputs for their operations. Consequently, the nominal exchange rate needed to be kept overvalued to ensure that imported inputs remained cheap, making exchange rate controls an

additional layer of restrictions embedded in trade policy. The crucial factor in the success of the ISI strategy was the availability of forex. Originally this was not an issue following the huge foreign reserves resulting from the commodity boom due to the Korean War. However, following slumps in commodity prices, particularly cocoa, in the 1960s and the depletion of Ghana's foreign reserves, the ISI strategy began to falter as did the general economy. The first military coup d'état that ended the administration of the first president finally put paid to the ISI strategy as most industries were left to collapse (Laryea & Akuoni, 2012).

Ghana's trade policy strategy of import substitution underpinned by protectionist policies and the fixed exchange rate regime continued into the 1970s. These restrictive policies produced artificial favourable trade and current account balances masked by massive reduction in both exports and imports to GDP ratios (see figure 2.3). The shrinking export sector had an adverse impact on the balance of payments, which necessitated even stricter control. The poor performance of the external sector in the 1970s together with other bad domestic policy choices discussed in sections 2.2.2 and 2.2.3 contributed to the disappointing growth outcomes and high and volatile inflation. The unsatisfactory performance of the external sector was also influenced, to a large extent, by terms of trade (TOT) shocks, notably the oil price shocks of 1973/1974 and 1979 and the resulting economic recession suffered by most advanced economies (Harrigan & Oduro, 2000; Oduro, 2000; Laryea & Senadza, 2017).

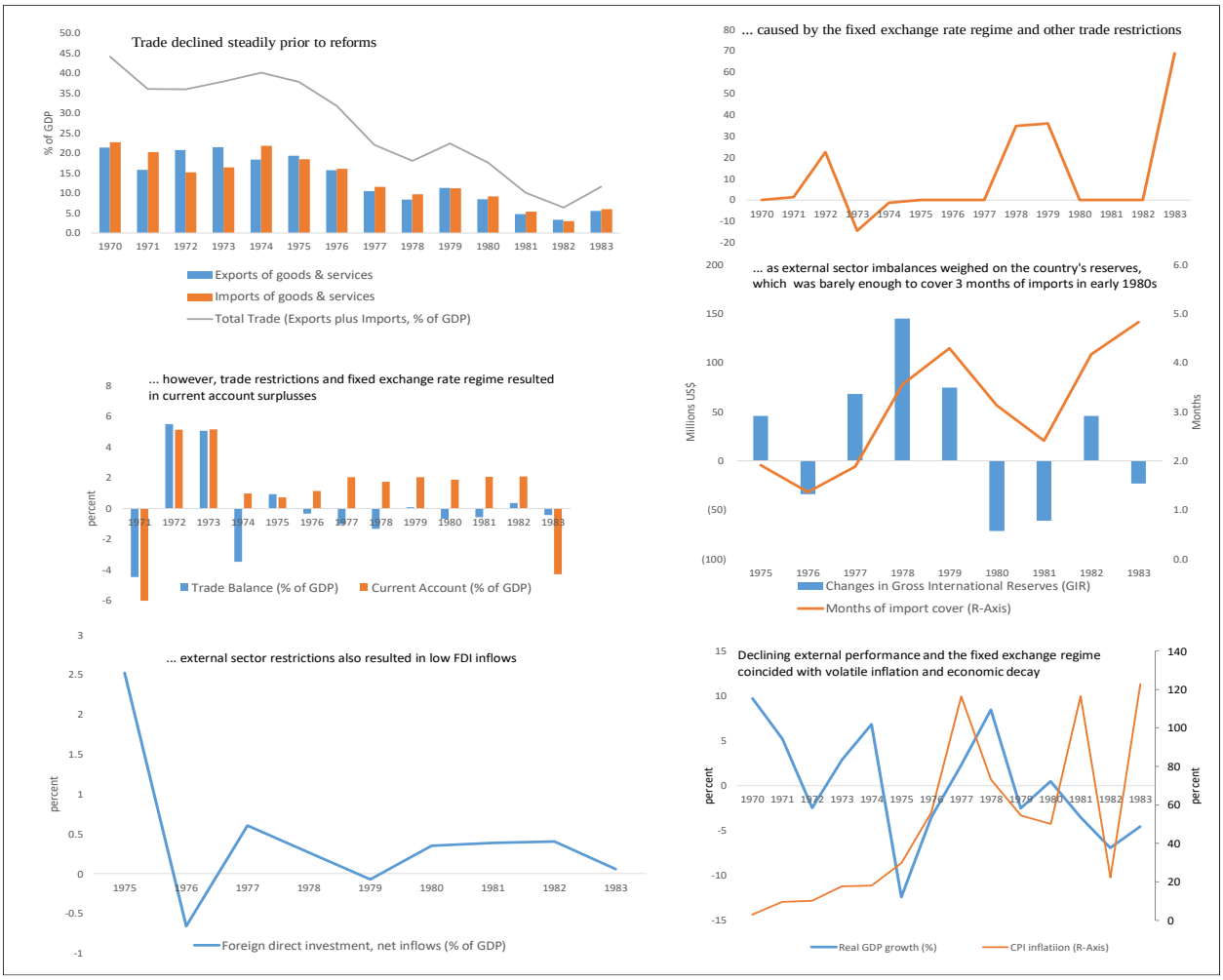
Years of keeping the exchange rate fixed led to a significant overvaluation of the local currency, the cedi, eroded export sector competitiveness and had dire consequences for the country's balance of payments and economic growth. The overvalued exchange rate resulted mostly from the high

inflation rates, which averaged almost 40% in the 1970s. As noted in section 2.2.3, the high rates of inflation emanated from high rate of monetary growth to mostly finance the growing fiscal deficit. With the disappointing performance of the external sector beginning to have an even stronger cascading impact on the growth performance domestic economy, the highly overvalued local currency was devalued by a massive 139%, moving from GH¢1.15 to GH¢2.75 to the US dollar in 1978, aimed at supporting the export sector (see figure 2.3).[12,13] With the parallel market rates significantly higher than GH¢2.75, the devaluation exercise did not result in higher inflation. Instead, inflation slowed from 116.5% in 1977 to 73% in 1978 (see figure 2.3).

The country's economic ills were worsened following the second oil price shock of 1979 to the extent that by the early 1980s the economy was on the verge of collapse characterised by high inflation resulting from high money supply growth rates and widespread rent-seeking behaviour, declining per capita income, dire fiscal situation, desperately poor economic and social infrastructure, overvalued exchange rate, and falling external trade. Trade, measured as the sum of exports and imports relative to GDP, fell steadily from 44% in 1970 to about 6% in 1982 and 11.5% in 1983; annual inflation was 122% in 1983; real GDP growth rates was negative for the three consecutive years of 1981, 1982 and 1983 (see figure 2.3).

[12] With the redenomination exercise that removed four zeros from the currency in 2007, GH¢1.15 and GH¢2.75 would be GH¢0.000115 and ¢0.000275 respectively.

[13] As Leechor (1994) notes, the devaluation came late in the day and was substantially insufficient as the exchange rate in the parallel (black) market approached GH¢60 to the USD.



Source: Own construct based on data from BOG and WDI.

Figure 2. 3: External sector performance prior to economic reforms (1970-1983)

Attempts to mobilise domestic resources included the rehabilitation of the cocoa subsector utilising students and other patriotic citizens to improve the economy, but these attempts were in vain. In 1983, the economy was hit by further shocks, including drought and subsequent bushfires, famine, and the deportation of about one million Ghanaians from Nigeria.[14] Apart from these proximate factors, the poor economic performance during the period under review could be attributed to adverse external shocks such as falling prices of the country's primary export commodities (cocoa

[14] With the 1984 population census reporting Ghana's population as 12.4 million, one million returnees would add around 10% to the country's population.

and gold) and rising oil prices, political instability, and incoherent macroeconomic policy particularly the trade and exchange rate policy. It became increasingly clear that the country needed external assistance to help resuscitate the economy which by now was on the cusp of complete collapse (Hutchful, 2002).

2.3 Macroeconomic policies and performance (1984-2000)

2.3.1 Introduction

This period began in 1984 with the launch of the Economic Recovery Programme (ERP) and the Structural Adjustment Programme (SAP) aimed at liberalising the economy that had been decimated from years of state control and domination. Monetary and fiscal discipline were introduced underpinned by sound external sector policies. Monetary policy reforms involved a switch to indirect instruments in the form of repurchase agreements, open market operations (OMOs), rediscount facilities and reserve requirements so as to control money supply, which was seen at the time as the ultimate source of inflation. Fiscal policy also underwent profound reforms designed to correct fiscal imbalances through restructuring the tax administration system, switching government expenditure from recurrent spending to development (capital) spending, rationalising (downsizing) the overinflated public sector, privatising inefficient SOEs, and rehabilitating the country's critical infrastructure. The external sector also witnessed significant reforms including trade and current account liberalisation, and exchange rate reforms. The period ended with significant macroeconomic instability as the country was hit by commodity price shocks and fiscal slippages associated with the 2000 general elections. This section outlines the evolution of key macroeconomic policies and outcomes during the period under review. Section

2.3.2 discusses monetary policy and macroeconomic outcomes, followed by fiscal policy and outcomes in section 2.3.3. Section 2.2.4 outlines key external policies and outcomes.

2.3.2 Monetary policy and performance

On the global stage, policy-makers had lost faith in direct controls as a monetary policy framework. Consistent with the predictions of McKinnon (1973) and Shaw (1973), financial repression constrained the mobilisation of savings while raising the demand for credit as interest rate ceilings, credit controls and other non-market-based policies took their toll on the economies. It was contended that financial liberalisation would encourage efficient resource allocation. By introducing competition into the financial sector, financial liberalisation should encourage product innovation and enhance financial intermediation. Consequently, the beginning of the 1980s saw the widespread implementation of market reforms with a view to removing restrictions in credit and other financial markets. Monetary policy also underwent profound reforms with indirect instruments such as reserve requirements, central bank lending facilities and OMOs progressively replacing direct quantitative control measures to help peg the monetary base at its target level. The move to adopt indirect instruments was envisioned to enhance the role of price signals and improve market efficiency (Bawumia, 2010).

After decades of macroeconomic and financial instability, Ghana followed suit, launching the IMF/World Bank-supported economic recovery and structural adjustment programmes in 1984. These programmes were aimed at stabilising and liberalising the broader macroeconomy. An important element of the programme was Financial Sector Adjustment Programme (FINSAP) launched in 1988. Its focus was on restructuring distressed banks and dealing with their large

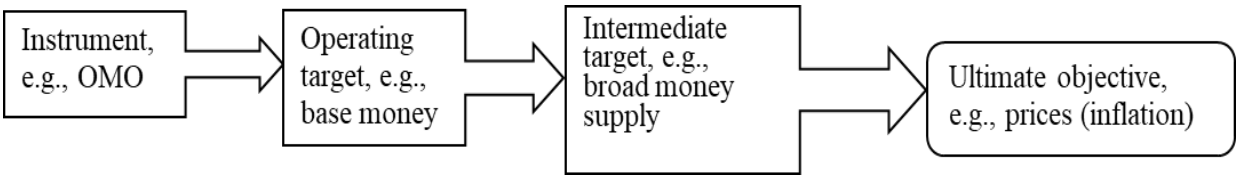
legacy of NPLs with a view to restoring the banks to viability and profitability. The prime objective of FINSAP was to shift the financial sector away from financial repression and into the domain of financial liberalisation. The programme involved the restructuring of financially distressed banks; the privatisation of SOEs (including banks); the strengthening of the supervisory and regulatory framework of the central bank; and the recovery of non-performing assets (Brownbridge & Gockel, 1996).

After almost a decade of reforms, the BOG adopted monetary aggregate targeting as a framework for monetary policy in 1992. It must be noted that the BOG decided to target the broad money supply (M2) which was redefined as M2+ in 1997 to include foreign currency deposits, which had become an important component of money supply after forex market reforms.[15] Prior to the adoption of IT as monetary policy framework, the BOG relied on a plethora of indirect instruments, including OMOs, reserve requirements, rediscount facilities, and repurchase agreements. These instruments enabled the BOG to affect the monetary base (seen as the operational target), which then affected the broad money supply, which is treated as the intermediate target and, ultimately, the final target, namely prices (see figure 2.4).

Ghana's use of the monetary base as the operational target instrument (OTI) seems at variance with conventional practice. Under conventional policy conditions, most central banks undoubtedly tend to use interest rate as their sole OTI. Under unconventional policy conditions (e.g. Quantitative Easing, QE), they use cash quantity (quantity of 'base money' or 'monetary base') provided to the banks as the OTI. Ghana's case could be justified by the high currency ratio at the

[15] A side effect of forex market reforms has been the partial dollarisation of the economy where prices of certain goods and services are quoted and accepted in foreign currency, usually USD.

time, which enabled commercial banks to effectively finance their lending with cash. The BOG probably thought it might exercise more effective control over the money stock by way of the quantity of cash it supplied to the banking system.



Source: Adapted from Bawumia (2010).

Figure 2. 4: Ghana's monetary targeting framework

The period between 1983 and 2000 can be divided into two broad phases – a period of economic and financial reforms characterised by the progressive removal of the direct control mechanism and the implementation of indirect instruments (1983-1991), and the adoption of monetary targeting as a framework for monetary policy (1992-2000). The first phase is usually characterised as part of the direct control regime in the context of monetary policy frameworks.

The removal of the interest rate ceiling led to the realignment of interest rate, resulting in positive real interest rate. In terms of performance, figure 2.5 indicates that the positive real interest rates triggered an increase in banks' willingness to extend credit to the private sector. This resulted in a pick-up in domestic credit given by banks to meet pent-up demand for credit by the private sector, possibly raising investment thereby removing the supply constraints that had been fuelling inflation in the economy through rent-seeking behaviour. Rising private sector demand for credit also exerted upward pressure on the real interest rates.

As discussed next in section 2.3.3, the reforms also resulted in improved government fiscal position, lowering the need for deficit financing and hence lower monetary growth. As a result of these developments, inflation and inflation volatility declined dramatically and forex markets began to witness relative stability. Annual inflation, which was around 123% in 1983, reduced sharply to 20.6% in 1985, reaching a low of about 11% in 1992. However, inflation rose to 43% in 1995 on the back of the ill-fated introduction of the VAT. Yet, the inflation volatility of 13.5% recorded during this period was better than the 33% volatility registered in the 1970-1983 period. Conversely, the local currency's rate of depreciation dropped from about 75.5% in 1984 to 11.4% in 1998 and 13.3% in 1999.[16] The economy also emerged from three years of recession to register an impressive 8.6% growth in 1984. Thereafter, growth averaged about 5% over the next decade, implying low volatility. This reflected favourably on the country's per capita income. In a sense, relative macro stability was restored without sacrificing economic growth.

Macroeconomic instability returned in 2000 because of both external and domestic developments. Externally, the country experienced TOT shocks resulting from the 1999/2000 price collapse of its two major exports commodities, gold and cocoa, and a significant surge in crude oil prices which was a key import product. Meanwhile, the country's external debt position has become unsustainable with significant debt service burden (see section 2.3.2). Domestically, fiscal slippages associated with the 2000 election cycle, accommodated by monetary policy, resulted in

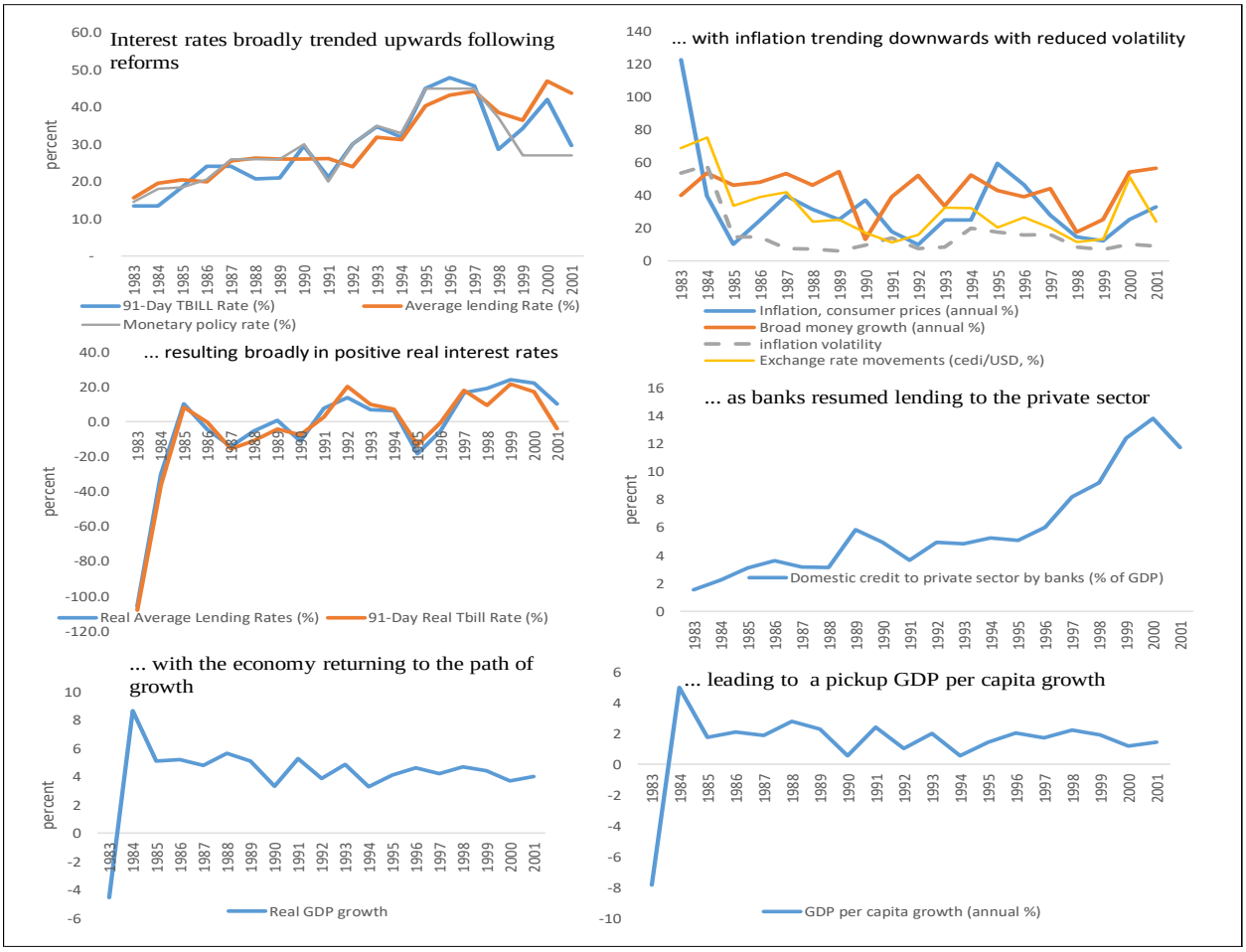
[16] Despite the general decline in inflation over the period, there were notable spikes along the way. For example, significant upward adjustment in ex-pump fuel prices pushed inflation upward from 10% in 1992 to almost 25% in 1993. Further fuel price increases in the next two years were exacerbated by the ill-fated introduction in 1995 of VAT at a rate higher than the sales tax it was supposed to replace. With little education on the application of VAT, prices of goods and services escalated. Despite its withdrawal after just three months of implementation after general public anger and protests, prices never returned to their pre-VAT levels, which is consistent with the idea that prices are sticky downwards. As a result, inflation picked up dramatically to 59.5% and 46.6% in 1995 and 1996% respectively, before decelerating steadily to 12.4% in 1999.

significant money supply growth of over 54% from about 25% in 1999 and 17% in 1998 (see Figure 2.5).

These developments spilled over into the forex market where the local currency began a precipitous fall against its main trading currency, the USD, losing some 51% of its value at the end of 2000. In response, inflation surged to 40.5% at the end of 2000 (but the annual average inflation shown in figure 2.5 was 25.2%) from 13.8% a year earlier. This was a classic case of the vicious cycle whereby depreciation and inflation fed off each other, which left inflation expectations unanchored and created a fertile ground for the realisation of the self-fulfilling prophecy in price formation. Despite these developments, the short-term nominal interest rate was kept constant at 27% between 1999 and 2000 and had shown a downward trend prior to this period. This, perhaps, reflected the fact the short-term nominal interest rate was not the main OTI during this period. On the other hand, both the benchmark 91-Day Treasury bill rate and the average lending rate witnessed sharp spikes during the period. However, unlike the situation described in section 2.2.2, the inflation rate was mostly below the money supply growth, perhaps an indication that the information content of money supply growth for inflation was beginning to wane. The pace of economic growth slowed down further to just 3.7% in 2000 from 4.4% in 1999 resulting in the slowdown in real GDP per capita growth (see figure 2.5).

The latest economic setback prompted questions about the reliability of the monetary targeting framework to deliver the BOG's core policy objective of price stability. By 2001, a search for a new monetary policy framework with the capacity to engineer a sustainable disinflation process

and enhance the credibility of the central bank, thereby anchoring inflation expectations, was well underway in Ghana.



Source: Own construct based on online WDI data.

Figure 2. 5: Monetary and macroeconomic performance (1984-2000)

2.3.3 Fiscal policy during economic reforms

As of 1984 Ghana initiated a series of fiscal and financial reforms aimed at resuscitating the decaying economy and setting it on the path of growth and development. Key components of the fiscal reforms were tax system reforms and rationalisation of expenditure with the objective of eliminating persistent budget deficits. Tax system reforms focused on eliminating prevalent

distortions and reinforcing economic incentives to save and invest. The reforms were anchored in the principles of efficiency and equity. The objective was to restore the tax base through:

i. Correcting the nominal exchange rate to reduce its persistent overvaluation;

ii. Deregulating the prices of goods and services to reflect their true economic cost and scarcity; and

iii. Widening the economy's export base.

One would expect these policy changes to influence the consumption behaviour of households as they internalise the reality of higher prices of goods and services, and particularly of imports.

Regarding expenditure, the focus was on switching expenditure from recurrent to capital spending with a view to rehabilitating the country's dilapidated infrastructure and channel additional resources to operations and maintenance. The approach entailed the elimination of expenditure wastage through:

i. Introducing stringent monitoring and control of government expenses to minimise the ubiquitous financial ill-discipline in the system;

ii. Privatising inefficient SOEs running at a loss; and

iii. Downsising the public sector by removing the deemed surplus of labour.

These strategies were augmented by financial support in the form of grants and concessional loans from the IMF and the World Bank.

The fiscal discipline induced by these measures under the ERP and SAP began to yield positive results almost immediately as revenue mobilisation increased steadily from 5.6% of GDP in 1983 to 14.4% of GDP in 1986. Government expenditure also picked up as revenue improved and the

economy emerged from over 3 years of recession, reaching 14.3% of GDP in 1986 from about 8% in 1983. By 1986 this culminated in total revenue and grants outweighing total expenditure as Ghana recorded its first budget surplus since 1967. Underpinned by robust domestic revenue mobilisation, expenditure rationalisation and significant budgetary support from the IMF and the World Bank under the ERP/SAP programme, the budget would remain in surplus for several years, reaching a high of 1.5% of GDP at the end of 1991. The improvement in the fiscal position lowered the need for deficit financing thereby stabilising money supply growth at an average of about 14% between 1984 and 1990. This reflected favourably on inflation which climbed down from an average of 78% between 1980 and 1983 to an average of 30% between 1984 and 1990 while economic growth averaged 5.4% between 1984 and 1990 compared with an average decline of 3.6% over 1980-1983 period (see figures 2.2 & 2.6).

However, a combination of expenditure expansion (an increase from about 14% of GDP in 1991 to about 17% of GDP in 1992) and a slack in revenue mobilisation (a decrease from about 15% of GDP in 1991 to 12% of GDP in 1992) caused budget deficits to re-emerge. These were recorded as 4.8% of GDP in 1992 as the country was organising its first general elections under the 1992 constitution, which ushered in the fourth and current republic. Buoyed by rising privatisation receipts, the fiscal position improved swiftly and recorded surpluses in 1994 and 1995. Four years went by quickly and the next general elections, in 1996, resulted in yet another episode of fiscal slippages, leading to the suspension of support by the IMF and World Bank. Indeed, the seeds of political business cycles have been sown in every general election year except 2004, which resulted in large fiscal slippages usually reflected in huge expenditure overruns consistent with the fiscal illusion hypothesis of Alesina and Perotti (1997).

The 1990s also witnessed important fiscal reforms. Regarding revenue, Ghanaian tax authorities had grown increasingly frustrated with the existing sales tax system due to its inherently high level of inefficiency. As a result, the Value Added Tax Act 486 of 1994 was passed but its implementation was deferred to 1995 to allow for sufficient preparation and education. Thus, the sales tax of 15% was replaced by valued added tax at 17.5% in 1995. However, nationwide protests triggered its withdrawal within 6 months of implementation and sales tax was reinstated. Despite the quick policy reversal, general prices did not retreat to their pre-implementation levels. This was exacerbated by the fiscal slippages associated with the 1996 general elections, leading to a significant spike in inflation in the 1995/1996 period with economic growth averaging about 4% (see figure 2.6).[17] Following broad consultations and sustained education, VAT was reintroduced in 1998 at 10%, significantly lower than the exiting sales tax. VAT was expected to help broaden the tax base since, unlike sales tax, it would also apply to the distribution and services sectors of the economy and improve revenue stability due to reduced dependency on commodity-based revenue sources, particularly petroleum and cocoa taxes. On the expenditure side, the District Assemblies Common Fund (DACF), presumably aimed at financing rural development, was created in 1993 with a 5% allocation of total revenue. The earmarking of resources, however, has had the unintended consequence of introducing a high level of rigidity into the budget, which undermines the flexibility needed to respond to fiscal shocks.

[17] Fiscal slippages associated with Ghana's general elections are usually a combination of expenditure overruns and lax revenue mobilisation efforts as compliance measures are subtly halted. Revenue mobilisation would usually increase from the second quarter after the election.

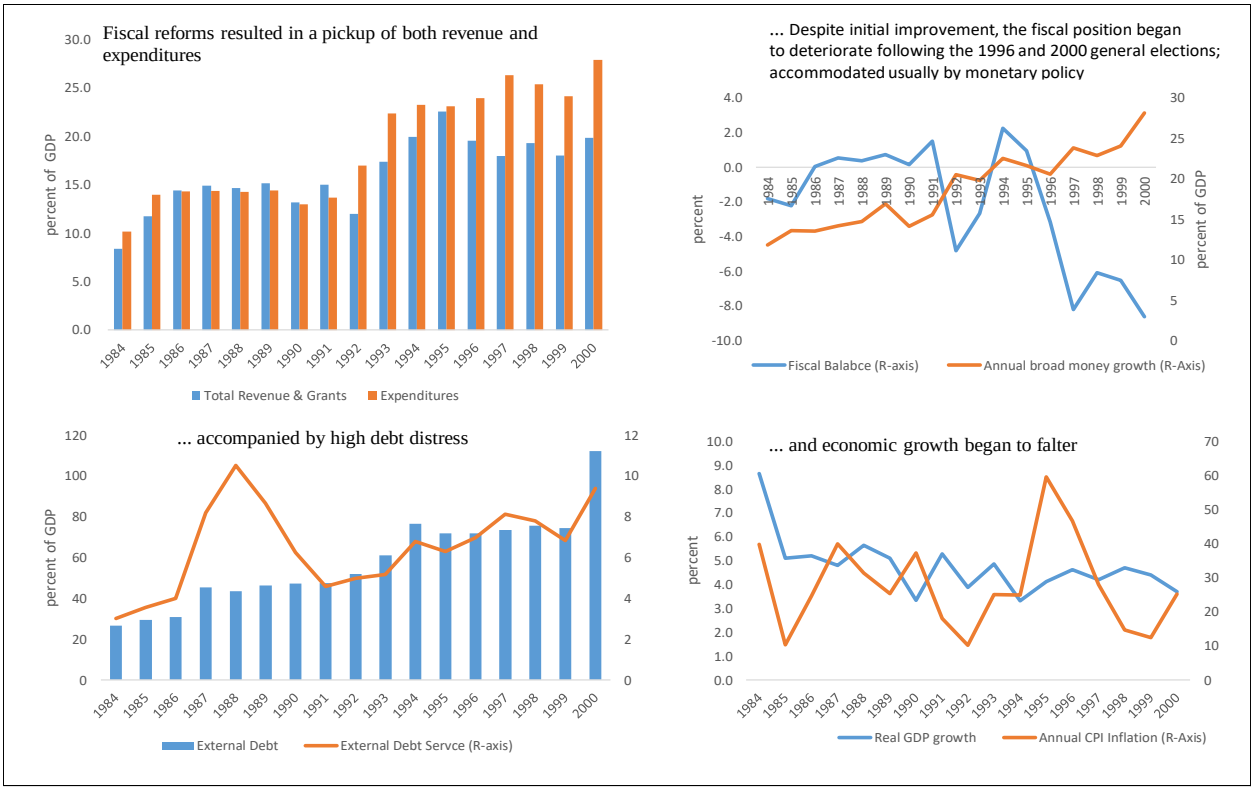
In 2000 the political business cycle retuned with large fiscal imbalances, as the country held its third general elections since the launch of the fourth republic under the 1992 constitution. As the fiscal problems became manifest, the authorities responded by increasing VAT to 12.5% with the additional 2.5% earmarked to support the educational sector under the Ghana Education Trust Fund (GETFund). Despite the additional revenue obtained from VAT, significant expenditure overruns resulted in a budget deficit of almost 9% of GDP at the end of the year, the highest since 1977. The fiscal imbalances were amplified by deteriorating TOT after the collapse of prices of the country's main export commodities, namely cocoa and gold, coupled with escalating crude oil prices on the international market. The price of cocoa, for example, fell from 1676 USD per metric ton in 1998 to about 900 USD per metric ton in 2000. On the other hand, average crude oil prices rose steadily from about 13 USD per barrel in 1998 to over 28 USD per barrel in 2000 – the highest price since 1984 – with dire fiscal consequences for oil importing countries, including Ghana.

Again, years of borrowing, particularly during the SAP period, had resulted in a dramatic increase in the country's public external debt. Public external debt relative to GDP had climbed steadily from about 30% in 1983 to about 112% in 2000, putting strain on the country's ability to service its external debt. Service on external debt accounted for some 9% of GDP in 2000 compared to about 4% of GDP in 1983 (see figure 2.6). Based on the country's debt sustainability analysis at the end of 2000, it was clear that Ghana's external debt had surpassed sustainability thresholds established under the enhanced Highly Indebted Poor Country (HIPC) initiative.[18] At the end of 2000, the net present value (NPV) of Ghana's debt-to-revenue ratio stood at 558% while the NPV of debt-to-export ratio was 152% with both ratios exceeding the enhanced HIPC initiative

[18] The HIPC initiative offered poor developing countries substantial debt relief provided they met set criteria.

thresholds of 250% and 150% respectively, suggesting the country could access debt relief under the initiative (IMF & IDA, 2001; Bawumia, 2010).

The result was an economy characterised by large fiscal imbalances with the fiscal balance reversing from a surplus of about 1% of GDP in 1995 to a deficit of almost 9% of GDP and an unsustainable external debt position that was exerting extra stress on the fiscal position and slower growth. As discussed in section 2.3.2 and emphasised by figure 2.6, the large fiscal deficit in 2000 resulted in high money supply growth, high depreciation of the local currency, spiralling inflation and a slower pace of economic growth. This was the context in which the newly elected government took office in January 2001.



Source: Own construct based on data from BOG & WDI.

Figure 2. 6: Fiscal and macroeconomic performance during reforms (1984-2000)

2.3.4 External sector policies and outcomes

In late 1983, Ghana acceded to undertake economic reforms under the auspices of the IMF and the World Bank with the objective of restoring the economy to internal and external balance.[19] An important component of the reforms was external sector reforms centred on trade and exchange rate liberalisation. The objective was to restore incentives for export-oriented production and to improve the availability of forex allocated through an efficient market mechanism where prices reflected cost and scarcity. The non-traditional export subsector was to receive significant attention to help boost production for export thereby increasing the forex supply in the economy. Ultimately, the reforms aimed at removing quantitative control instruments and instead introduce price instruments in a liberalised trade system.

Trade liberalisation in this period can be divided into three phases. The first phase, between 1983 and 1986, constituted the preparatory stage towards import liberalisation. During this period, the exchange rate was gradually and indirectly adjusted through a scheme of bonuses and surcharges and not through the direct devaluation of the past which had led to the overthrowing of many governments in the 1970s. Later, several direct devaluations were undertaken in order to engineer a depreciation of the real exchange rate, as well as to bring the nominal exchange rate in line with parallel market rates. The nominal devaluations also allowed the government to increase the producer price of cocoa to serve as an incentive to farmers to rehabilitate their cocoa farms after the droughts and the subsequent bushfires that had devastated a significant number of cocoa farms in the early 1980s. The high import tariffs, including import duties on consumer goods and sales tax on luxury imports, witnessed downward revisions (Oduro, 2000).

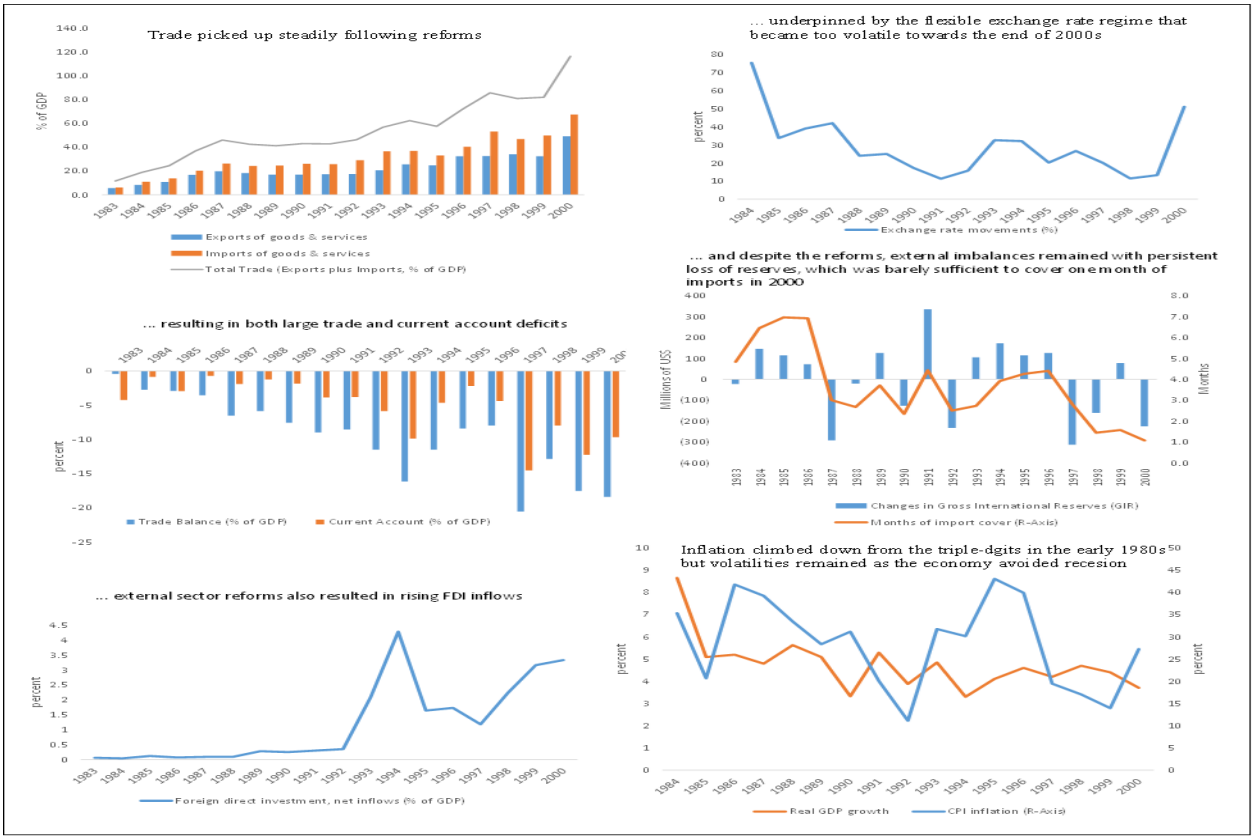
[19] Though the reform programme was agreed in 1983, its implementation began with the 1984 budget and financial statement of the government

The second phase, the import liberalisation period, lasted from 1986 to1989 and involved the official introduction of a dual exchange rate scheme. In the first window, the official exchange rate usually set at the beginning of the year governed all official transactions, cocoa earnings and the purchase of essential raw materials. In the second window, the exchange rate was determined via weekly foreign-exchange auctions organised by the BOG and was used for all transactions other than the categories mentioned previously. In 1987, the first window was closed with all transactions undertaken subject to the auction-determined rate. Then, in 1988, forex bureaux were established, which enabled individuals to undertake forex transactions freely at the existing spot rates and allowed the import licence regime to be reorganised and simplified. Restrictions on forex retention by exporters were also reduced.

The process of trade and exchange rate liberalisation was completed in the third and final phase, from 1989 to 2000. In 1990, the retail forex rate auction system was replaced by a wholesale auction system, which gave way to the interbank market system in 1992. By now, the official exchange rate and the parallel market rates had virtually merged, leading to the virtual disappearance of parallel markets. Earlier in 1989, the import licensing scheme was eliminated since it had become redundant due to the changes in the forex market. The sales tax on imports was replaced with VAT in 1998 after its initial introduction failed in 1995.[20] The tariff system was also streamlined to harmonise it with those of the World Trade Organisation (WTO) and Economic Community of West African States (ECOWAS).

[20] The introduction of VAT meant that Ghana complied with the ECOWAS protocol that mandated members to implement VAT by the end of 1999.

With liberalisation and exchange rate liberalisation largely completed, trade picked up from about 19% of GDP in 1984 (the year economic reforms were launched) to almost 60% a decade later in 1993 and would reach 116% by 2000. The external sector reforms also resulted in an uptick in FDI, reaching 3.3% of GDP in 2000. The economy rebounded strongly growing at an annual average of about 5% in real terms between 1984 and 2000 compared to an annual decline of about 1% in the preceding decade (i.e., 1973 to 1983). Inflation climbed down from the triple-digits in early 1980s to annual average of about 28% with reduced volatility (see figure 2.7). Despite these benefits derived from trade and exchange rate liberalisation, one problem remained. While the current account had been liberalised through trade liberalisation, Ghana's capital account remained controlled, which could be constraining the economy from reaching its full potential output level.



Source: Own construct based on data from BOG and WDI.

Figure 2. 7: External sector performance during economic reforms (1984-2000)

2.4 Macroeconomic policies and performance (2001-2018)

2.4.1 Introduction

As discussed earlier in section 2.3, Ghana's economy was hit by further shocks compounded by election-related fiscal slippages in 2000. As a result, a second wave of macroeconomic reforms were launched in 2001 as the country agreed to access debt relief under the enhanced HIPC initiative. This section traces key shocks, macroeconomic policy response and outcomes during the period under review. Section 2.4.2 discusses monetary policy and macroeconomic outcomes, followed by fiscal policy and outcomes in section 2.4.3. Section 2.4.4 outlines key external policies and outcomes.

2.4.2 Monetary policy and performance

Ghana's economy experienced severe macroeconomic instability in 2000. This prompted a comprehensive assessment of the economy to determine the underlying causes of the crisis. One of the key conclusions was that the monetary targeting adopted a decade earlier was unable to deliver the expected inflation outcomes due to sustained monetary accommodation of large fiscal deficits. Recognising price stability as a key nominal anchor for achieving macroeconomic stability, the authorities passed ground-breaking legislation, the Bank of Ghana Act 612 of 2002, which established an operationally independent central bank and created the Monetary Policy Committee (MPC) charged with the obligation to formulate and implement appropriate monetary policy for the country.[21] In an attempt to minimise the age-old problem of fiscal dominance, the

[21] The MPC consists of seven members – five internal members and two external members originally appointed by the BOG's supervising minister, the Minister of Finance. However, in order to enhance the independence of the BOG, the two non-BOG members are to be appointed by the BOG's governing board (see Bank of Ghana Act 918 of 2016, as amended).

Act also limited net domestic financing, i.e., how much of government spending can be financed by borrowing from the domestic economy, to 10% of the projected domestic revenue for the current fiscal year without a limit on how much of this 10% can be borrowed from the central bank.[22]

The MPC undertook a broad review of the existing monetary targeting regime to determine its future appropriateness for the country. A key focus area was the stability of the money demand function. This is because the effectiveness of the monetary targeting regime is anchored in the existence of a stable money demand function, which ensures predictable effects of money supply changes on key macroeconomic variables, including aggregate spending and, ultimately, inflation. In other words, the effectiveness of the monetary policy transmission mechanism under the monetary targeting regime is crucially dependent on a stable money demand function. As outlined previously in this chapter, Ghana's economy has undergone steady economic and financial sector reforms with a particular emphasis on structural reforms and liberalisation of the financial sector. It was not surprising that an assessment of Ghana's money demand function revealed that substantial parametric shifts emerged in the latter parts of the 1990s (see Bawumia et al. 2008).[23] The implication of this finding was obvious – movements in monetary aggregates no longer contained substantially useful information for future price developments.[24] Based on this finding,

[22] As a result, this provision has been amended to limit the BOG's financing of government to 5% of the previous year's domestic revenue (see Bank of Ghana Act 918 of 2016, as amended). This is an attempt to satisfy one of the basic perquisites for successful IT.

[23] This paper was originally written for the MPC in 2002.

[24] Admittedly, instability in the money demand function may also be due to instability in the transactions demand for money emanating from instability of the volume of trade in items not captured by GDP figures: intermediary goods (components and non-finished goods), original factors (labour and raw material), secondary financial assets (stocks and bonds), and second-hand goods (second-hand cars, but especially existing real estate). The latter two categories are especially large, which is why, as Ghanaian financial markets developed and deepened, it came as no surprise that the size and variability in trade volumes increased in these markets, which is one of the factors that causes the money demand function to become unstable.

the MPC abandoned the monetary targeting regime and instead, in 2002, adopted IT as a framework of monetary policy. The formal announcement of this decision was made in 2007.[25,26] In a sense, '[t]he MPC did not abandon the monetary aggregates, they abandoned the MPC.'[27]

Several important decisions were made to ensure that the IT process induce the transparency and credibility necessary to anchor inflation expectations. Key among these decisions was the targeted price level. The MPC chose to focus on headline inflation based on the Consumer Price Index (CPI). The MPC also decided to derive and track core inflation, which excludes energy and utility prices, to help gauge underlying inflation in order to deliver a useful guide for monetary policy. Having decided on the targeted price level, the MPC settled on a medium-term inflation target of 8% with a tolerable 2% band (i.e., 8±2) to be achieved over a four-quarter horizon given the lags in transmission of monetary policy.

Another important decision related to the choice of a monetary policy instrument to signal the stance of monetary policy. In consonance with other IT regimes and in pursuit of its price stability objective, the MPC decided to use a short-term nominal interest rate, the Monetary Policy Rate (MPR) (previously known as the prime rate, PR).[28] As the main policy tool, its positioning prompts economic agents about the monetary authority's view on the pace of economic activity and its likely effects on inflation within the forecast horizon, as well as the future direction of the bank's lending rate.

[25] Some authors refer to 2007 as the starting date of the adoption of IT in Ghana (see Kwakye, 2012).
[26] South Africa adopted IT as a framework of monetary policy in 2000, becoming the first country in the SSA to do so. Uganda adopted IT in 2011.
[27] This is in reference to the famous saying of the former governor of the Bank of Canada, Gerald Bouey: 'We didn't abandon the monetary aggregates, they abandoned us.'
[28] Prior to IT, the prime rate was the rate at which the Bank of Ghana met the credit demands of commercial banks.

The BOG undertook deliberate actions to strengthen the monetary policy transmission mechanism, thereby increasing the probability that the ultimate goal of price stability will be achieved by the central bank. The actions undertaken included the abolition of secondary reserve requirements on deposits to improve financial intermediation, and reforms of the monetary policy's operational framework envisioned to influence liquidity in the interbank market and to improve the propagation of monetary policy actions via the financial markets to the broader macroeconomy.[29,30]

The MPC furthermore abandoned the financial programming framework used during the monetary targeting regime and adopted the NK gap model to forecast inflation, which is considered a central component of the IT framework. The model encapsulates macroeconomic linkages among output, domestic prices, interest rates and the exchange rate through equations such as the aggregate demand (or IS curve), aggregate supply (or Philips curve), uncovered interest rate parity (UIP) and monetary policy reaction function (or policy rule) equations. The output from the model provides

[29] Prior to 2006, commercial banks were required to hold 9% of their eligible deposits as primary reserves at the BOG and an additional 15% (35% until 2005) as secondary reserves in treasury bills and medium-term government securities. This was part of the efforts aimed at dealing with the banks' excess reserves emanating from accommodation of large fiscal deficits. Over time, however, the policy was constraining banks' ability to perform their basic function of credit intermediation. As a result, the secondary reserve requirement was abolished in July 2006. The cash reserve requirements for all commercial banks was 10% having been increased in 2014 as part of the measures to deal with significant volatilities in the forex market. As part of measures to support the intermediation efforts of commercial banks following the COVID-19 pandemic, the cash requirement was reduced to 8% in March 2020.

[30] The objective of the new policy framework was to deliberately steer the overnight (short-term) interest rate within a corridor (band). The lower band was defined by the reverse repo rate (i.e., the policy rate minus 200 basis points while the upper band was defined as the policy rate minus 100 basis points. This widened the interest rate corridor to 300 basis points from the existing 100 basis points to encourage banks to trade among themselves. The corridor has since been recalibrated to a symmetric 200 basis points. For a more comprehensive exposé, see Bawumia (2010).

guidance on the interest rate path over the forecast horizon and helps to position the MPR appropriately.

The adoption of the IT framework coincided with significantly improved macroeconomic stability and a dramatic slowdown in inflation and inflation volatility. This is consistent with Mishkin's (2000) observation that levels and volatilities of macroeconomic variables in general tend to decline following the adoption of an IT framework. As indicated in figure 2.8, inflation, which averaged 44% (average volatility was 22.7) over the period 1971-1991 (direct control regime) and 27.9% with a volatility of 12.5 between 1992 and 2001 (monetary targeting period), declined further to about 14% with a volatility of 4.4 over the period 2002-2018 (IT period). Economic growth also picked up, averaging 5.7% between 2002 and 2009 despite the effect of the GFC. With commercial oil production starting in late 2010, growth climbed further, peaking at 14% in 2011 with an average growth of 9.6% between 2010 and 2013. Growth witnessed increased volatilities in the latter parts of the sample as energy supply shortages and oil price shocks took their toll on the economy.

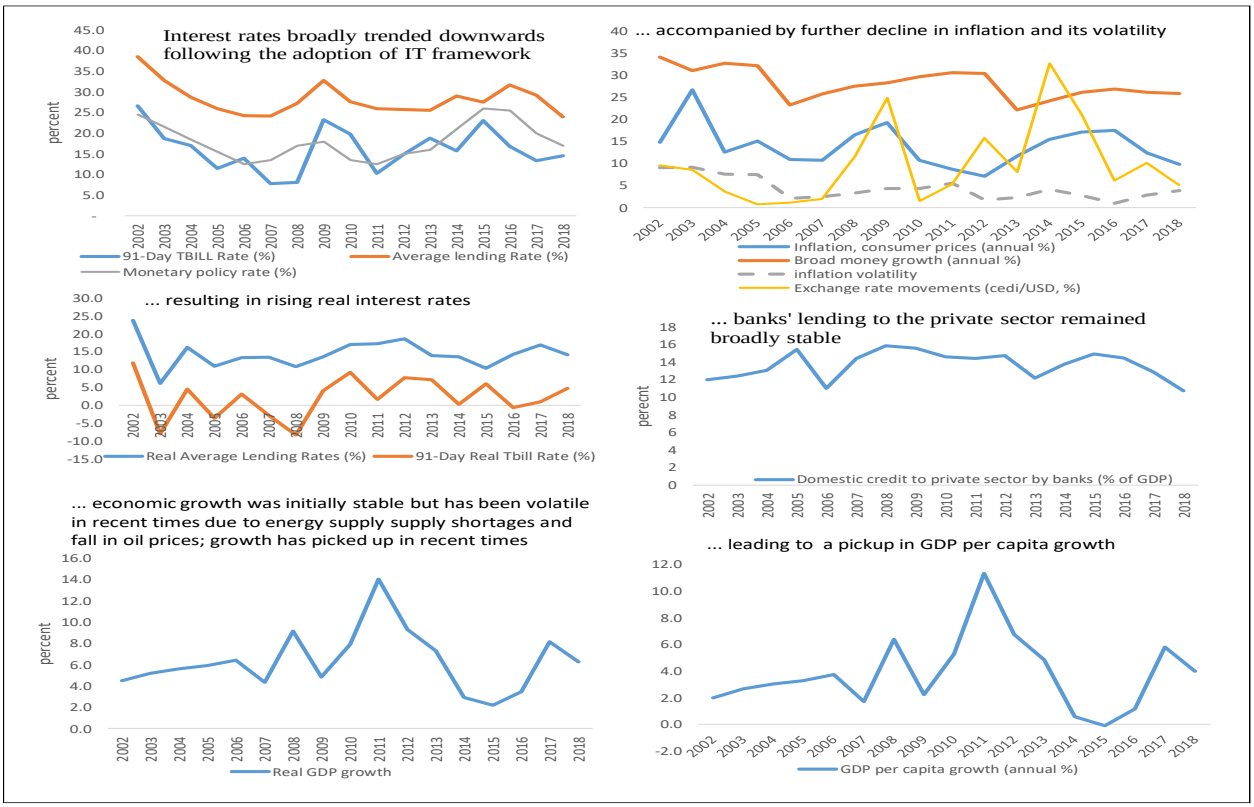
As figure 2.8 illustrates, Ghana's economy was markedly impacted by the GFC with the full effect experienced in 2009. For example, the bilateral cedi/USD exchange rate depreciated by 11.5% in 2008 from 2% depreciation in 2007. The currency would go on to depreciate a whopping 24.9% in 2009 as the full impact of the crisis was felt throughout the developing world including Ghana. As a result, inflation rose steadily from 10.7% in 2007 to 16.5% in 2008, peaking at 19.2% in 2009. Growth also decelerated to 4.8% in 2009 from 9.1% in 2008. It would appear that the robust growth recorded in 2008 coupled with the incipient inflationary pressures and the significant loss

in reserves which was enough to support only two months' imports prompted steep monetary policy tightening to help deal with the oncoming shock. As a result, the monetary policy rate was increased from 13.5% at end-2007 to 17% at end-2008, peaking at 18% at end-2009. Other interest rates including the benchmark 91-day Treasury bill rate and the average lending trended upwards in consonance with the monetary policy rate.

Conversely, the protracted energy supply shortages and oil price shocks of 2014/2015 dramatically increased the country's forex demand to import fuel to power its thermal plants. Consequently, the local currency depreciated against the dollar (its main trading currency) by a significant 32.6% in 2014 and a further 20.9% in 2015. Money supply growth rose by more than 26% at end-2015 from about 22% at end-2013, resulting mainly from an accommodative monetary policy in response to the dire fiscal situation. As a result, inflation rose steadily from about 11.7% at end-2013 to 15.5% at end-2014, 17.1% at end-2015 and 17.4% at end-2016. Real economic activity took a significant hit with growth slowing to below 3% in both 2014 and 2015, the lowest growth rates since 1983. In response to these developments, monetary policy was tightened sharply with the monetary policy rate reaching 26% at end-2015 from 16% at end-2013, a whopping 10 percentage points increase in two years. In response to the higher interest rates as well as rising financial stability concerns resulting from the energy sector crisis, banks tightened credit conditions resulting in a decline in bank credit to the private sector as a percent of GDP (see figure 2.8).

Given this context, the country turned to the IMF at the beginning of 2015 for balance of payments support under the Extended Credit Facility (ECF) program. The implementation of the ECF suffered a setback following the fiscal imbalances that characterised the 2016 general elections.

The new administration that came into office in 2017 renegotiated the ECF with the programme ending in 2019 instead of 2018 as originally envisaged. With the energy crisis virtually resolved by end-2016, relative macroeconomic stability returned with economic growth rising to over 8% at end-2017 and 6% at end-2018 from 3.4% at end-2016. Inflation and exchange rate also trended favourably allowing gradual easing of monetary policy with other interest rates trending downwards. For example, the monetary policy rate declined from 24.5% in 2002 to 17% in 2018. As a result, the average lending rate declined from 38.5% in 2002 to 24% in 2018. The benchmark 91-Day Treasury bill rate also declined from 26.6% in 2002 to 14.5% over the same period. During this period, money supply growth unambiguously outweighed inflation rates, affirming the believe that money supply growth no longer holds sufficient information for price development in Ghana (see figure 2.8).



Source: Own construct based on online WDI data.

Figure 2. 8: Macroeconomic performance during the IT period (2002-2018)

2.4.3 Fiscal policy and performance

Early in 2001, the new government undertook several important measures aimed at achieving fiscal consolidation as a foundation for restoring macroeconomic stability. Huge subsidies in the utilities sector and on petroleum prices had resulted in large losses, which put additional stress on the budget. Tackling the issue of subsidies was therefore seen as an essential element of achieving fiscal sustainability. As a result, ex-pump fuel (petroleum) prices were doubled while electricity and water tariffs saw significant upward adjustments. Government's 2001 budget and financial statement introduced new fiscal measures, including downward revision of the VAT threshold; an increase in airport tax; 5% tax on hitherto zero-rated goods under the VAT system; the imposition of VAT on imported pharmaceutical products; as well as a plethora of measures to curtail government expenditure, including putting a halt to contract appointments. With the benefit of hindsight, the most significant measure in the 2001 budget statement was the decision to submit to and access debt relief under the enhanced HIPC initiative (Loloh, 2011).

With Ghana agreeing to access debt relief under the enhanced HIPC initiative, it was expected that the country's public external debt would reduce significantly if it met all the HIPC criteria. These criteria included a proven record of at least 3 years of good macroeconomic policies and sustained poverty reduction through expenditure switching toward more pro-poor spending. Thus, fiscal policy was set in a medium-term framework aimed at achieving macroeconomic stability and poverty reduction. Prior to 2001, the overall budget (fiscal) deficit served as the anchor for fiscal policy, but the evidence pointed to its ineffectiveness as large fiscal deficits were virtually automatically accommodated by monetary policy, i.e., by the BOG buying up government debt paper. Given that the public external debt was set to decline under the HIPC initiative, the

authorities decided to anchor fiscal policy instead on domestic debt reduction.[31] In a sense, fiscal policy was setting the groundwork for its new role under the IT framework launched by the central bank in 2002.

As indicated by figure 2.9, by the end of 2001, clear signs of fiscal consolidation had emerged with the fiscal deficit shrinking to about 4% of GDP from about 9% at the end of 2000 as a result of improved revenue mobilisation and expenditure containment. Government revenue mobilisation improved to over 22% of GDP from about 20% of GDP at the end of 2000 while expenditure decreased to about 26% of GDP from about 28% of GDP at the end of 2000. The improvement in revenue performance coupled with HIPC benefits reduced the need for central bank financing of the deficit, resulting in lower money supply growth rates during this period. The benefits of the enhanced HIPC initiative were beginning to manifest with the external debt service that had breached 9% of GDP at the end of 2000 being reduced to about 6% at the end of 2001 and about 3% in 2004, which created the needed fiscal space to underpin the fiscal consolidation process and undertake the needed infrastructure projects. The reduced external debt and the general improvement in the country's fiscal position presumably also lessened the pressure on the exchange rate, with favourable effects on the local inflation rate.

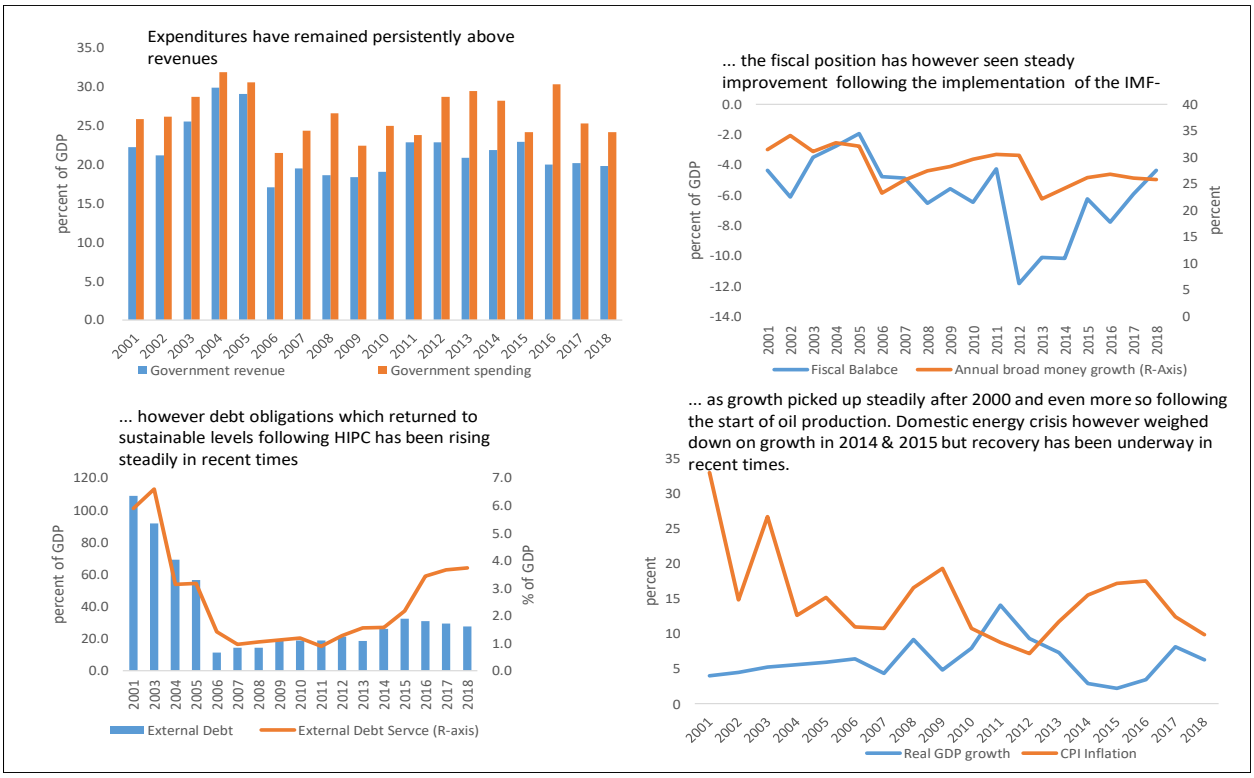
An additional 90% adjustment in ex-pump petroleum prices in 2003 effectively removed the subsidy element and brought the price to cost recovery levels (IMF, 2003). Revenue collection

[31] Perhaps this was also in preparation to meeting the legal restrictions imposed on government's ability to borrow by the Bank of Ghana Act 612 of 2002, which limits the NDF in any fiscal year to within 10% of the projected revenue for the year. This was redefined in 2016 to limit the central bank's financing of the budget to 5% of the previous year's revenue.

picked up further reaching almost 26% of GDP in 2003, which allowed expenditure to increase to about 29% of GDP from 26% of GDP in 2001. Consequently, the fiscal deficit improved further to 3.5% of GDP at the end of 2003. The country's public debt also began to show signs of improvement on the back of the ensuing fiscal consolidation and benefits accruing from the HIPC initiative. The improvement was reflected in both domestic and external debt. Domestic debt improved to about 21% of GDP at the end of 2003 from 29% of GDP at the end of 2000 while external debt edged down to 92% of GDP at the end of 2003 from 112% at the end of 2000, bringing the total public debt to 112% of GDP at the end of 2003 from over 140% of GDP at the end of 2000.[32] The 2004 election cycle passed without the usual fiscal imbalances on the back of robust revenue performance, which increased to about 30% of GDP. Thus, despite expenditure picking up to about 32% of GDP, the fiscal deficit improved to below 3% of GDP with domestic debt remaining steady in 2004.[33] Further improvements were recorded in 2005 (see figure 2.9).

[32] Total public debt declined steadily to some 36% of GDP in 2006 following the cancellation of a significant proportion of the country's external debt after having reached the HIPC completion point a year earlier. In fact, external debt at the end of 2006 was some 11% of GDP.

[33] HIPC benefits were tied to social intervention projects such as the provision of toilet facilities (KVIPs), safe drinking water (boreholes) and rural and community health facilities. This might have lessened the demand for 'our share of the national cake or we won't vote' mantra that characterised the 2004 general elections thereby preventing the usual significant expenditure slippages associated with Ghana's elections.



Source: Own construct based on data from BOG and WDI.

Figure 2. 9: Fiscal and macroeconomic performance (2001-2018)

However, in 2006, in response to domestic energy supply shortages, government expenditure went up markedly, resulting in an elevated fiscal deficit. The fiscal situation weakened further in 2007 as the energy crisis persisted and the country celebrated its Golden Jubilee of nationhood while preparing to host the 2008 African Cup of Nations (AFCON) tournament, which entailed the construction of two new stadia and the renovation of two existing ones. The year 2007 furthermore witnessed two important events in the country's history with the discovery of offshore oil estimated to be commercially viable and the introduction of a maiden eurobond issue of 750 million USD. The authorities increased the VAT rate from 12.5% to 15% with the additional 2.5% earmarked to finance the country's national health insurance scheme. The fiscal position deteriorated as the country went through the 2008 general elections with the deficit reaching almost

7% of GDP financed partly from the eurobond proceeds issued in late 2007 and divestiture receipts from the sale of Ghana Telecom (a public telecommunications company) to Vodafone.[34,35] The economy was destabilised as a result of the highly expansionary fiscal policy stance amid the GFC in 2008 that was characterised by large currency depreciation and high inflation as discussed earlier in section 2.4.2.

The newly elected government that took office in January 2009 sought a three-year IMF-sponsored Poverty Reduction and Growth Facility (PRGF) aimed at macroeconomic stability anchored in fiscal consolidation. The credibility of the policies implemented under the PRGF programme would underpin a disinflation process; inflation declined from 18% at the end of 2008 to 8.6% at the end of 2010 despite the budget deficit remaining stubbornly above 6% of GDP over the same period. Fiscal performance was undermined largely by the implementation in 2010 of the Single Spine Salary Structure (SSSS), a new wage policy that sought to remove the existing wide disparities in the government's wage structure by ensuring equal pay for equal work. This led to a significant jump in the fiscal wage bill, absorbing about 50% of tax revenue over the next several years. The year 2010 was also a watershed moment for revenue administration in Ghana in that the separate revenue agencies were consolidated into a single revenue authority, the Ghana Revenue Authority (GRA), with separate divisions overseeing domestic revenue and customs. Another important development with implications for fiscal policy was the rebasing of the national accounts in 2010, which resulted in per capita income exceeding USD1 000 thereby moving the country into the lower middle-income bracket. As a result, the country no longer qualified for the

[34] This figure was much higher at 11.5% (see Loloh, 2011). The lower figure reflects the rebasing of national accounts in 2010 with 2006 as the base year.
[35] The divestiture proceeds were some USD800 million (GH¢998 million).

development assistance usually reserved for low-income countries. In 2011, Ghana embarked on commercial oil production with the expectation that it would provide additional resources to support government's development agenda despite oil revenues having, over time, largely replaced the withdrawn development assistance. As a result, there was little net improvement in overall government finances.[36]

In patterns mirroring previous election cycles, fiscal policy became excessively expansionary in the run-up to the 2012 general elections with the budget recording a deficit of over 12% of GDP. The resultant fiscal stress was amplified by a protracted energy crisis, which complicated the usual post-election fiscal adjustments despite a further 2.5% increase in VAT to 17.5% in 2013. The fiscal balance would remain in double-digit deficit in 2013 and 2014 as the pace of economic activity swiftly began to slow down. The local currency came under severe pressure depreciating over 32% in 2014, which weighed heavily on the country's external debt and pushed up inflation significantly above its medium-term target so that it reached 17% at the end of 2014 from below 9% at the end of 2012. With the economy teetering on the edge of a full-blown crisis, the authorities hesitantly agreed to adopt a three-year IMF-supported ECF programme in 2015 to lend credibility to its own home-grown policies. The ECF programme would largely help restore fiscal stability in 2015 with the budget deficit improving to about 6% of GDP by end-2015 from over 10% of GDP in 2014. The second year of the ECF programme coincided with the 2016 election cycle and the fiscal imbalances recurred (see figure 2.9), forcing the IMF and the newly elected government to renegotiate the programme. This was concluded successfully at the end of 2018 placing both the

[36] It is not surprising that the country recently launched the Ghana Beyond Aid agenda and also issued several eurobonds to help support its development agenda.

fiscal position and the macroeconomy on a firmer footing as economic growth and inflation began to trend favourably.

2.4.4 External sector reforms and performance

Despite profound external sector reforms over the previous two decades, as discussed in the preceding section, Ghana entered the 21st century without liberalising its capital account. This inhibited cross-border financial transactions and limited the ability of the financial sector to fully support the economy. As part of a second wave of financial sector reforms under the Financial Sector Strategic Plan (FINSSP), launched in 2003, the Foreign Exchange Act 723 was passed in 2006. The Act repealed and replaced the Exchange Control Act 71 of 1961, which had been the legal foundation for capital controls in Ghana. With the capital account now liberalised, Ghana had effectively positioned itself to compete with its regional counterparts for capital inflows to support the critical investment needed to achieve accelerated economic growth. The phenomenon of capital flows came to the fore in the mid-2000s as lower interest rates in advanced economies triggered capital outflows in search of yield in emerging markets and developing countries, including Ghana.

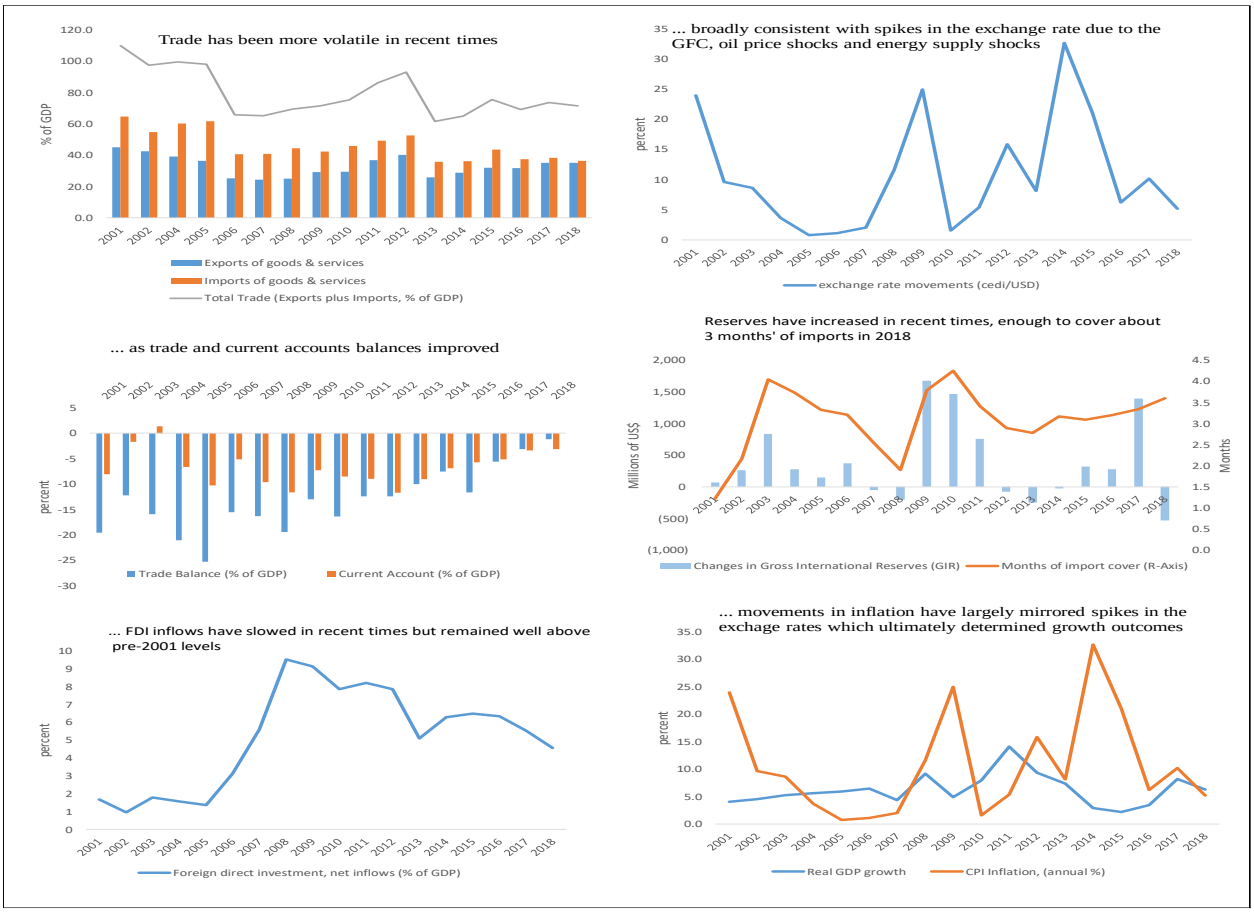
In the case of capital account transactions, restrictions on external loans between residents and non-residents, as well as restrictions on the issuance and transfer of securities, were removed. Other restrictions were initially maintained. For example, non-residents were only permitted to invest in money market instruments with tenors of at least three years with the added constraint that such investments had to be held for a minimum of two years. In 2015, the first-mentioned restriction was relaxed to two years while the latter was completely removed as it was seen as a

form of capital control. Though Ghana had launched its capital market in 1990 by establishing the GSE, capital restrictions limited its growth as foreign investors could not participate in the market by way of buying equities. Foreign participation in the capital market also became possible with the lifting of capital controls in 2006, making the GSE deeper and more liquid.

The capital account liberalisation led to a surge in FDI inflows into Ghana. In 2005, a year before the promulgation of the Foreign Exchange Act 723 of 2006, net FDI inflows into Ghana were 1.4% of GDP. These more than doubled by 2006, the year the Act was passed. At the peak of the GFC in 2008 and 2009, net FDI flows into Ghana averaged more than 9% of GDP as capital flows into emerging markets and developing countries increased dramatically in search of higher yields amid plummeting interest rates in advanced economies.[37,38] Despite slowing down somewhat in recent years due to the start of interest rate normalisation in the US in particular, net FDI inflows into Ghana now constitute more than 5% of GDP on average. Non-resident participation in the domestic money markets has also picked up, averaging more than 30% of the total outstanding stock of domestic debt in 2018. Despite the apparent benefits from the capital account liberalisation, an important drawback has been the sensitivity of the exchange rate to these flows and other external developments. As discussed in section 2.4.2, the exchange rate depreciated sharply in the aftermath of the GFC and during the oil price shocks and energy supply shortages of 2014/15, adversely impacting both inflation and real growth (see figure 2.10).

[37] It is entirely conceivable that a large proportion of these inflows were portfolio flows into the financial markets, which are highly movable – 'easy in, easy out' – rather than genuine investment in productive capacity, which is more permanent.

[38] See section 2.4.2 for a comprehension discussion on the deleterious impact of the GFC on Ghana's economy.



Source: Author's own construct based on data from BOG and WDI.

Figure 2. 10: External sector performance (2001-2018)

As noted in section 2.4.2, Ghana made a successful historic entry into the international capital market by issuing its maiden sovereign bond (eurobond) of USD750 million in 2007, just a year after completing the HIPC process successfully. Ghana had thus transformed itself from an aid dependent HIPC economy in the previous decades to a vibrant economy with access to the international capital market in the second half of 2000s. Several successful sovereign bond issues have since been conducted on the back of dwindling official foreign assistance and robust economic performance. These bonds are traded on the GSE and reputable international trading platforms such as Bloomberg and Reuters, enabling buy-sell spreads to be computed in order to

facilitate international comparison. Trade on these platforms also makes those bonds more liquid and therefore more appealing to international investors. No doubt these developments have allowed the country to raise the needed resources from abroad to support critical investment locally. However, the country has been exposed to the vagaries of the international financial markets, which increased the risk of severe exchange rate shocks as foreign investors are quick to prematurely redeem and repatriate their investments.

Box 1: Selection of external sector variables

US Federal Funds Rate

The US Federal Funds rate is selected as a proxy for foreign monetary policy shocks. This choice is influenced by the fact that Ghana's economy is more integrated to the US economy than to any other economy. Until its floatation in 1992, the Ghana cedi was pegged to the USD. In addition, the USD has been Ghana's main trading currency with other currencies such as the British pound sterling operating as cross rate currencies to the USD. This suggests that changes in the federal funds rate is likely to exert greater impact on Ghana's economy than either changes in Bank of England (BOE) or European Central Bank (ECB) policy rate. For example, when the US Federal Reserve announced in 2014 that it was embarking on policy normalisation,[39] there was a significant capital outflow from developing countries including Ghana as foreign investors rebalanced their portfolios in favour of US bonds. The policy normalisation also led to tight financing conditions for emerging markets and developing countries including Ghana. This, no doubt, contributed to the sharp depreciation of the cedi witnessed in 2014 and 2015 as discussed in section 2.4.2.

In addition, Ghana's economy has been historically highly dollarised with major goods and services quoted in the USD. For example, most major hotels and auto dealerships in Ghana either quote their rates in the USD or link rates quoted in the local currency to the USD. With the capital liberalisation in 2006 and Ghana's subsequent access to the capital market, changes in the federal funds rate has had more visible impact on the movements in the cedi/USD exchange rate as foreign investors are quick to rebalance their portfolios. In addition, commercial banks in Ghana grant foreign currency loans, usually in USD, to their customers. On average, these foreign currency loans constitute about 30% of net advances, meaning that movements in the cedi/USD exchange rate raise the debt of the borrowers. The foregoing justifies the choice of the US federal funds rate as a proxy for foreign monetary policy variable.

OECD GDP growth rates

The choice of OECD GDP growth rates as a proxy for foreign demand is borne out of the study's attempt to capture foreign demand conditions across a large spectrum of the global economy that encapsulates the major destinations for Ghana's primary commodities. The OECD countries are

[39] The policy normalisation was an attempt by the US Federal Reserves to raise the federal funds rate from its zero-lower bound to a more normal level and reduce the asset purchase programme under its quantity easing (QE) programme.

fairly distributed across the key economic regions of the world – North and Latin America, Europe, Middle East, Asia and Oceania.[40] The OECD economic block also includes the world's most industrialised countries whose demand conditions have usually been responsible for the boom-bust behaviour of key commodity prices of developing countries including Ghana. Ghana's main export commodities are cocoa, gold and more recently crude oil. On the eve of the start of commercial oil production in 2010, the exports of cocoa and gold amounted to USD 1,854.2 million (17.5.% of GDP) and accounted for over 75% of merchandise exports. On average, cocoa and gold account for about 70% of merchandise exports from Ghana. With oil coming on stream in the second half of 2010, the share of the three commodities in merchandise exports has shot up to an average of 80% between 2011 and 2018. On average, the three primary commodities constituted about 20% of GDP between 2011 and 2018 (Bank of Ghana var).

In the past, slumps in the prices of cocoa and gold, Ghana's key primary commodities, particularly in 1982/83, 2000 and 2008/09 have coincided with aggregate demand shocks in the industrialised world. This is because the OECD countries account for substantial exports from Ghana. Ghana's exports to OECD countries accounted for about 41% of the country's total exports in 2016, down from about 51% in 2005 due to the emergence of China and India as key export destinations (Bank of Ghana var). Abradu-Otoo and Walley (2019) contended that Ghana's main trading partners are US, UK and the Euro area (key OECD economies) with exports to the three economic blocks accounting for over 34% of GDP in 2014. Despite the drop in importance in recent times, on aggregate, the OECD group remain the main destination for Ghana's exports. By using OECD growth rates as a proxy for foreign demand, the study is able to capture a significant source of foreign demand for Ghana's primary exports commodities.

Crude oil prices

Ghana discovered oil in 2007 and began commercial production in 2010. Yet, oil imports remain a significant proportion of the country's total imports. For example, crude oil imports bill at the peak of the prolonged electricity supply shortages in 2014 shot up to USD 3,694 million (25.3% of total imports) from USD 2,236 million (20.5% of imports) in 2010 (Bank of Ghana var). As explained in section 2.4.2, this exerted significant pressure on the country's forex reserves, leading to substantial depreciation of the local currency along with other macroeconomic malaise. The high oil bill in recent times is partly due to the country's inability to refine the domestically produced crude oil for domestic consumption. As a result of refinery challenges, the crude oil produced in Ghana is sold on the international market while the country relies on imported refined fuel for domestic consumption. In addition, the country's energy mix has changed in recent times in favour of thermal power due to challenges with hydro power and the expansion in the economy. Conversely, as a commercial oil producer, variations in crude oil prices have had cash flow implications whereby the country's fiscal position turns to improve during periods of higher oil prices and worsen in times of price falls (Dogah, 2015). This makes crude oil price an important external sector variable and a candidate for the investigation of the effects of external shocks on Ghana's economy.

[40] North America (US & Canada), Latin America (Chile & Mexico); Europe (Austria, Belgium, Czech Republic, Demark, Estonia, Germany, Greece, Iceland, Ireland, Luxemburg, Netherlands, Norway, Poland, Slovenia, Spain & UK); Israel Middle East (Israel), Asia (Japan & South Korea); and Oceania (Australia & New Zealand).

2.5 Summary

This chapter traced the evolution of macroeconomic policy and outcomes in Ghana with particular emphasis on monetary, fiscal and external sector policies. In broad terms, macroeconomic policy in Ghana can be delineated into three phases – the period between 1957 and 1983 when interventionist policies prevailed; the period of economic reforms (between 1984 and 2000) when market reforms were undertaken (and monetary aggregate targeting was introduced) and trade restrictions lifted; and the period after 2000, which coincided with capital account liberalisation and the introduction of IT as monetary policy framework.

At independence, hopes were high for Ghana's economic future as solid foundations were laid including the establishment of key institutions such as the Bank of Ghana to be responsible for monetary policy. Hope would soon give way to despair following the overthrow of the first president. The subsequent political instability that ensued during the 1970s prevented the pursuit of coherent monetary, fiscal and external sector policies. Fiscal policy was distinctly expansionary during this period and was usually accommodated by monetary policy. Monetary policy was conducted under a regime of direct credit controls where the central bank regulated the overall amount of credit advanced by commercial banks and determined the sectors that received credit with ceilings on the credit interest rates. External sector policies were essentially inward looking characterised by trade restriction policies, an import substitution strategy and exchange rate controls. As a result of these domestic policy missteps, the economy was susceptible to exogenous shocks such as the two oil price shocks of 1973 and 1974, slumps in commodity prices in the late 1970s, the repatriation of over one million Ghanaians from Nigeria and the 1982 droughts and its associated bushfires that ravaged the country's farms and forests. By early 1980s, the economy

was on the verge of collapse characterised by declining output, high and volatile inflation, severely overvalued exchange rate, diminishing trade and shortage of basic goods emanating from import controls and rent-seeking behaviour.

The economic decay that resulted from these financially repressive policies motivated the adoption of comprehensive economic reforms that would involve the liberalisation of the exchange rate regime, external trade and financial sector as well as the introduction of indirect (market-based) instruments of monetary policy. After a decade of reforms Ghana adopted monetary targeting as an anchor for monetary policy based on the conviction that a stable relationship existed between money supply and inflation. The recurring fiscal imbalances also witnessed a measure of containment as economic reforms gathered pace and revenue collection improved. There were also significant external inflows to support the reforms program which would raise the country's external indebtedness. As a result of these reforms, trade improved dramatically reflected positively on the domestic economy. Growth rebounded strongly averaging almost 5% between 1984 and 2000. Inflation and inflation volatilities declined considerably. However, both external and domestic shocks occurred in 2000, leaving the economy badly battered and in need of urgent reforms.

With new government in power in early 2001, a comprehensive analysis was undertaken to determine the fundamental causes of the macroeconomic imbalances that occurred in 2000. The obvious culprit was the existing macroeconomic management framework that allowed large fiscal imbalances to be almost automatically accommodated by monetary policy. In the case of monetary policy, an identified breakdown in the relationship between money and inflation motivated the

adoption of IT as the anchor for monetary policy. The legal framework that allowed for the adoption of the IT framework also resolved the issue of fiscal dominance by limiting central government borrowing from the central bank, hence the rest of the domestic economy in a given fiscal year. On the fiscal front, the country agreed to access debt relief under the enhanced HIPC initiative in order to reduce its external debt burden. This was expected to resolve the issue of persistent fiscal imbalances. In the case of external sector, capital account restrictions were lifted during this period to enable the country take advantage of cheap foreign capital flows in search of higher yields. These reforms coincided with more macroeconomic stability, a dramatic slowdown in inflation, and a reduction in inflation volatility. The drop in the levels and volatilities of Ghana's macro variables during the IT period is consistent with Mishkin's (2000) observation that levels and volatilities of macroeconomic variables in general tend to decline following the adoption of an IT framework. However, the GFC, start of commercial oil production, oil price shocks, and energy supply shortages were some key events that shaped macroeconomic outcomes during the 2002-2018 period.

The question is: Do these reforms impact the transmission of monetary, fiscal and external shocks?

Chapter 3: Theoretical and empirical literature

[G]iven that the structure of an econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure of econometric models. *(Robert Lucas, 1976)*

3.1 Introduction

This chapter surveys both theoretical and empirical literature on the transmission of both domestic and external shocks. Domestic shocks include aggregate demand shocks, changes in technology, changes in labour supply, bad weather, natural disasters, new discoveries such as oil (e.g. in Ghana in 2007), and domestic policies – fiscal, monetary and structural. External shocks, on the other hand, may manifest in movements in an economy's terms of trade, exchange rate volatility, capital flows volatility, variations in the world interest rate, shifts in foreign demand and changes in commodity prices. After this introductory remark, section 3.2 surveys the theoretical literature with the empirical literature contained in section 3.3. The summary and synthesis of the literature review is taken up in section 3.4.

3.2 Survey of the theoretical literature

This section surveys the theoretical literature on the transmission channels through which monetary, fiscal and external shocks impact the real economy. The successive reviews cover the theoretical literature on the monetary transmission mechanism, the fiscal transmission mechanism and the transmission of external shocks. It ends with a discussion of potential causes of changing transmission mechanisms.

3.2.1 Monetary policy regimes, tools and transmission mechanisms

This section commences with a comprehensive discussion of the evolution of monetary policy regimes with focus on the main surviving frameworks of monetary targeting regime and its acclaimed natural successor, inflation targeting framework. Monetary policy tools also find space in the theoretical survey. Given that changes in the policy framework can alter the transmission mechanism, the theoretical survey also discusses the monetary policy transmission mechanism(s) (MPTMs), focusing on the main transmission channels of monetary policy, namely the traditional interest channel, the exchange rate channel, the asset price channel, and the credit view channel. The section concludes with a summary.

3.2.1.1 Monetary policy regimes

One of the few consensus among economists in recent times has been the belief that price stability should be the overriding objective of monetary policy over the long term. Yet, fierce disagreements remain over how monetary policy should be conducted in the pursuit of the price stability objective. This section discusses the source of such disagreements and how it gives rise to the different monetary policy regimes. The review will then focus attention on the different regimes, detailing their respective key characteristics as well their strengths and weakness.

3.2.1.1.1 The use of a nominal anchor

A nominal anchor may be thought of as a nominal variable that is used by central bankers to secure the price level such as the exchange rate, the money supply or the inflation rate. According to Mishkin (2006), a nominal anchor is an essential component for successful operation of a monetary

policy regime as it serves a constraint on the value of money in the domestic economy. This is because a nominal anchor allows the price level to be uniquely established, a prerequisite for price stability, and plays a crucial role in promoting price stability through its ability to help tie down economic agents' expectations of inflation. For example, Levin (2014) contended that an important practical test for central bankers is their ability to accurately assess economic agents' perception about the transparency and credibility of the nominal anchor. More broadly, a nominal anchor can help reduce the time-inconsistency problem of Kydland and Prescott (1977) and Barro and Gordon (1983) by constraining discretionary monetary policy actions.

Moreover, a monetary policy regime or framework is described by the nominal variable that is used as its nominal anchor. In practice, the exchange rate, money supply and inflation rate are the three key variables that have been used as nominal anchors. As a result, there are three main monetary policy regimes – exchange rate targeting regime (with exchange rate as the nominal anchor), monetary targeting regime (with money supply as the nominal anchor), and inflation targeting regime (with the inflation forecast as the nominal anchor).

3.2.1.1.2 Exchange rate targeting regime

Exchange rate targeting is probably the earliest form of monetary policy regime. It usually involves fixing the value of a local currency to a commodity, say, gold as was the case during the gold standard. In recent times, exchange rate targeting regimes have entailed setting the value of the local currency to the currency of a more mature, large, low inflation economy. The objective is to nudge the inflation of the adopting country to ultimately drift toward the inflation of the anchor economy. In other instances, countries adopt a peg or crawling target whereby the domestic

currency is permitted to weaken at a constant rate in order that their domestic inflation rate remain above the inflation rate of the anchor economy. The higher domestic inflation relative to the inflation of the anchor country may lead to real exchange rate appreciation, making domestic goods more expensive. This may prompt a fall in demand for domestic goods, dampening aggregate demand pressures and lifting pressure off domestic prices (Mishkin, 2006, Agenor & Montiel, 2015).

One obvious advantage of the exchange rate targeting regime is that the domestic country is, in a sense, "borrowing" the credibility of the monetary policy process of the anchor country. If the anticipated credibility is indeed bestowed by domestic economic agents via anchored inflation expectations, then inflation is likely to be brought under control. Second, a regime of exchange rate targeting delivers an automatic monetary policy rule that circumvents the problem of time-inconsistency. That is, under exchange rate targeting regime, central banks do not have a lot of leeward to pursue loose monetary policy for the purposes of achieving short-term employment gains, a recipe for time-inconsistency. Third, the exchange rate targeting regime can be easily understood by the public due to its simplicity and clarity. Unsurprisingly, some industrialised countries such as France and UK have successfully used the fixed exchange rate regime to bring inflation under control by fixing the value of their respective currencies to the German mark. Some emerging economies such as Argentina have used the exchange rate targeting regime to quickly contain their spiralling inflation rates.

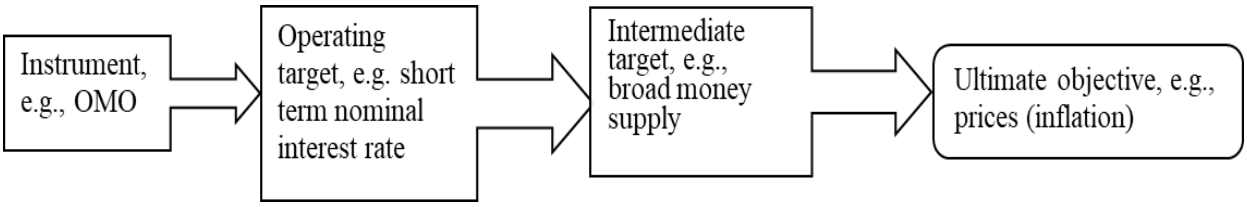
However, the exchange rate targeting regime is bedevilled with serious problems. First, countries that adopt the exchange rate targeting regime are no longer in a position to pursue independent

monetary policy – they surrender their independence to the ancho country. The domestic economy is unable to use its own monetary policy firepower to react to shocks hitting the domestic economy independent of the shocks affecting the anchor country. Similarly, shocks that hit the anchor country are directly transmitted to the domestic economy of the targeting country as variations in interest rates in the anchor economy trigger an equivalent interest rate variation in the targeting economy. Mishkin (2006) cited the case of the German reunification and the increase in long term interest rates on German bonds due to the need to rebuild East Germany. The higher interest rates in Germany was directly transmitted to France and UK who were members of the then Exchange Rate Mechanism (ERM), implying that their monetary policy stance was tighter than it would have been without their membership of the ERM. The outcome was a slowdown in the pace of growth and a pickup in unemployment in the targeting countries, especially France.

Obstfeld and Rogoff (1995) contended that exchange rate targeting makes countries vulnerable to speculative attack on their currencies. Argentina's currency crises in the 1990s as a result of its currency board arrangements have often being cited as a classic case of speculative currency attack. In the case of emerging markets and developing countries, the exchange rate targeting regime is much riskier due to its financial stability concerns. Finally, if not conducted properly, the exchange rate targeting regime may lead to severe overvaluation of the domestic economy, affecting the country's export competitiveness with dire consequences for the domestic economy. This was the situation within the SSA region including Ghana in the 1970s and much of the 1980s.

3.2.1.1.3 Monetary targeting regime

Monetary targeting is premised on the monetarist proposition that links inflation to monetary growth as captured vividly in Friedman's famous dictum that 'inflation is always and everywhere a monetary phenomenon'. This implies that a central bank's ability to control inflation ultimately depends on its ability to constrain the growth in money supply to levels necessary to keep the macroeconomy in both internal and external balance. However, central banks are typically unable to control the money supply directly and so they rely on a plethora of indirect instruments, including OMOs, reserve requirements, rediscount facilities, and repurchase agreements (repos). These instruments enable central banks to affect the monetary base (seen as the operational target), which then affects the broad money supply, which is treated as the intermediate target and, ultimately, the final target, namely prices (see figure 3.1).



Source: Adapted from Horska (2004).

Figure 3. 1: Monetary targeting framework

According to Mishkin and Savastano (2002), a monetary targeting regime aimed at price stability consists of three key features: (i) dependence on evidence derived from monetary aggregate(s) as basis for the conduct of monetary policy, suggesting a stable relationship between money supply growth and inflation as predicted by the quantity theory of money, (ii) announcement of target(s) for monetary aggregate(s) as a guide to economic agents' formation of inflation expectations, and (iii) presence of some form of accountability procedure that ensures the monetary targets are not

systematically missed. A feature, which is relevant to other regimes, is that monetary policy is not subservient to fiscal policy – absence of fiscal dominance precludes disorderly money supply growth rates – and the presence of a flexible exchange rate system to ensure that the country does not suffer the loss of independent monetary policy.

In the presence of the above mentioned features, monetary policy can aim to achieve a predetermined money supply growth rate (the intermediate objective) consistent with its medium term inflation objective. One advantage of the monetary targeting regime is that monetary aggregates data are readily available within few weeks and can help transmit instant signals to markets and other economic agents regarding the monetary policy stance. Therefore, it can be easily verified if the central bank is committed to meeting its inflation objectives, a key ingredient for anchoring inflation expectations. An embedded advantage is the promotion of practically instantaneous accountability for monetary policy with a view to keeping inflation low and stable.

Despite these potential advantages, the monetary targeting framework demands sufficient knowledge of the parameters describing the money demand function. However, for an economy experiencing rapid financial liberalisation, these parameters (particularly, the interest elasticity of demand for money) are likely to be extremely unstable. In that case, the relationship between money supply (the intermediate target) and inflation (the final objective) is unstable, suggesting that dynamics in money supply no longer contain sufficient information to predict future inflation. Conversely, during the period of disinflation, money demand may undergo large and erratic swings and, as a result, undermine the information content of monetary aggregates for future price developments. The foregoing discussion implies that relying on money supply to glean information

to predict future inflation is potentially dangerous. (Agenor & Montiel, 2015). This was why several advance economies and some emerging markets and developing countries abandoned the monetary targeting regimes starting in early 1990s in favour of the inflation targeting regime.

3.2.1.1.4 Inflation targeting regime

The IT framework traces its roots to 1989 when New Zealand became the first country to adopt it. By then, evidence of a breakdown in the relationship between inflation and the growth of money supply had emerged in advanced countries, prompting a number of them to shift from monetary aggregate targeting to IT as a monetary policy framework. Canada was second to implement the framework in 1991, followed by the UK in 1992, Finland and Sweden in 1993, Spain and Australia in 1994, Israel in 1997 and South Africa in 2000 (Hammond 2012). The GFC, which triggered the implementation of unconventional monetary policies in most advanced countries and some emerging market economies, might have slowed down the adoption of the IT framework post-2008.

According to Mishkin (2001), IT comprises five key ingredients:

i. A public announcement of medium-term numerical targets for inflation;
ii. An institutional commitment to the primacy of price stability as the long-term objective of monetary policy to which all other objectives are subordinated;
iii. An information inclusive tactic in which several variables (with monetary aggregates playing a diminished role) are relied upon in positioning the instrument of monetary policy (conventionally the bank rate or discount rate);

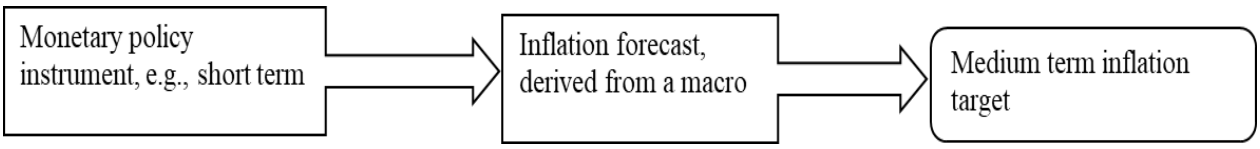
iv. Improved transparency in the conduct of monetary policy by communicating to the markets and the public the considerations (indicator-variables, objectives, strategies) that led the central bank to take a particular policy (bank rate) decision; and

v. Increased accountability of the monetary authority in achieving its inflation objectives.

Mishkin's view of the IT framework suggests that some preconditions must be met for successful implementation of the framework. These preconditions can be divided into two broad categories on the basis of their level of importance – basic requirements and additional or other requirements. The basic requirements are the conditions needed for implementing an IT framework effectively, including sufficient central bank independence, the absence of fiscal dominance and an explicit commitment to achieving price stability in addition to a non-commitment to extra nominal objectives. The additional prerequisites are those factors that are not absolutely necessary for launching IT, but they significantly improve the likelihood of its successful implementation. These include well-developed financial and money markets, public support for price stability, reasonably low inflation to start with, and the ability of the monetary authority to model and predict inflation and other key macroeconomic variables (Horska, 2004; Bawumia et al., 2008).

In IT, the policy instrument – usually a short-term interest rate – is altered to retain the predicted inflation for the given time horizon at the desired medium-term target.[41] The extent of the alteration in the policy instrument is influenced by the estimated gap between forecasted inflation and the desired target inflation, and knowledge of the workings of the monetary policy transmission mechanism. This makes IT a forward-looking framework of monetary policy (see figure 2.4).

[41] In the case of Ghana, the adoption of the IT monetary policy meant that interest rate replaced the monetary base as the OTI.



Source: Horska (2004).

Figure 3. 2: The inflation targeting framework

IT is founded on the assumption that the central bank has adequate knowledge of the MPTMs. In other words, the central bank must be able to reasonably and accurately determine how inflation (final goal) reacts to changes in the interest rate (monetary policy instrument), and also be well informed about the various channels through which policy decisions are propagated. Based on Mishkin's advice (see item iii in Mishkin's definition of IT above), the inflation forecast is usually based on several macroeconomic variables which, in the central bank's view, contain information relevant for future price developments.

In the spirit of Horska (2004), an IT framework can be specified as:

$$i_t = \beta_o(E[\pi_{t+n}/\Omega_t] - \pi^*_{t+n}) + \beta_1(E[x_t/\Omega_t] - x^*_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3.1)^{42}$$

where i_t is the short-term nominal interest rate (i.e., the monetary policy instrument), $E[\pi_{t+n}/\Omega_t] - \pi^*_{t+n}$ denotes the deviation of the forecasted inflation, π_{t+n}, from the desired inflation target, π^*_{t+n}, with the inflation forecast grounded on an all-inclusive information set, Ω_t, available to the monetary authority at time *t*. By incorporating all the available information, the forecasting framework can be appropriately categorised as a 'rational expectations' model. The term $t + n$ indicates the forecast horizon and typically ranges between 18-24 months (i.e., 6-8 quarters). The parameter β_o captures interest rate elasticity of inflation deviation or it indicates to

[42] Admittedly, equation (3.1) is a fairly conventional Taylor rule equation.

the central bank the magnitude of the change in interest rate necessary to engineer one percentage point change in the inflation gap. The term $E[x_t/\Omega_t] - x^*{}_t$ denotes forecasted gaps (i.e., forecast value, $E[x_t/\Omega_t]$, minus equilibrium value, $x^*{}_t$) of other relevant macroeconomic variables such as the output gap, while β_1 indicates the importance that the central bank places on other gaps in the model. It is noteworthy to indicate that the parameter β_1 is an important component in the IT literature in that its assigned value indicates the type of IT framework pursued by the central bank. For example, if β_1 assumes the value of zero, the framework is termed 'strict IT', in which case the central bank focuses solely on eliminating the inflation gap and does not consider other macroeconomic gaps such as the output gap. However, if β_1 is greater than zero but less than one (i.e., $0 < \beta_1 < 1$), the framework is characterised as 'flexible IT' in that due consideration is given to both the inflation gap and other important gaps such as the output gap.

The framework outlined in equation (2.4) has been criticised by, for example Clarida et al. (2000), who contend that it is too restrictive in its description of the variations in the actual monetary policy rate. By assuming that monetary policy-makers are only forward looking in their disposition, the specification overlooks the inclination of central banks to smoothen variations in the interest rate. Woodford (1999) encourages central banks to concentrate on limiting the volatility of the monetary policy instrument (i.e., the interest rate) while Orphanides (1998) favours a gradual response by central banks to shocks due to difficulties in understanding the nature of the shock hitting the economy – pure economic shock, or measurement error, or a combination of

both.[43] Central banks' preference for smoothing changes in interest rates emanates from uncertainty about the impacts of abrupt changes in interest rates (Sack, 1998) and fears of disorder in financial markets (Goodfriend, 1991).

Consequently, equation (2.4) can be seamlessly modified to incorporate interest rate smoothing, as follows:

$$i_t = \beta_o(E[\pi_{t+n}/\Omega_t] - \pi^*_{t+n}) + \beta_1(E[x_t/\Omega_t] - x^*_t) + \beta_2 i_{t-n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

where all variables are as previously defined except for the inclusion of i_{t-n} which represents the level of short-term interest rate in the previous period and the parameter β_2 which captures the degree of interest rate smoothing (or policy inertia or backward-looking expectations) and is typically less than unity (i.e., $\beta_2 < 1$).[44] If the economy is populated mostly by forward-looking economic agents, β_2 will be fairly small (if it is less than 0.5 the central bank is highly credible), implying that a small response to expected inflation should be sufficient to steer inflation back to the central bank's desired target. Conversely, if expectations are typically backward-looking, β_2 is relatively large (i.e., closer to one and the central bank is less credible) and a more aggressive posture may be warranted in the short run to steer inflation back to the desired medium-term path. A typical value for β_2 in the empirical literature ranges between 0.7 for advanced economies and 0.9 in emerging market economies (EMEs), pointing to slow adjustment of policy rates to their target level (see Hofmann & Bogdanova, 2012).

[43] It would appear sloppy if central banks were to continually adjust their policy stance (the level of their policy rate) in the light of continually changing expectations as shaped by continual change in the current inflation gap and other gaps. The central bank obviously changes its policy interest rate intermittently, if only to see whether gap changes are persistent. As a result, central banks strive to determine the length of time it takes for policy decisions to have their full impact on the economy (i.e. the transmission lags).

[44] $\boldsymbol{\beta_2}$ also captures the credibility of the central bank in that when economic agents perceive the central bank to be credible, they tend to be more forward looking in forming expectations.

The adoption of IT has been observed to coincide with the decline in both levels and volatilities of inflation, improvement in output volatility, decline in the pass-through of exchange rate. In addition, inflation expectations appear to be better anchored with lower inflation persistence in IT countries than in non-IT countries. IT also appears to have ameliorated the impact of inflation shocks. That is, with a better anchored inflation expectations, the IT framework seems to be able to greatly minimise the second round effects of shocks. Despite these observed outcomes of the IT framework, critics mainly within academia (see Friedman & Kuttner, 1996; Friedman, 2004) and in non-IT central banks such as the Federal Reserves (see Kohn, 2003; Meyer, 2004) contended that a firmer devotion to a rigid policy rule would elicit greater output volatility (Mishkin, 2006; Kuttner & Posen, 2012; Agenor, 2019). This criticism is misplaced because the IT framework does not impose any (rigid) rule on the central bank; it merely requires the central bank to employ all information available to it to ascertain the appropriate policy choices to achieve the desired medium-term target for inflation. Unlike other monetary policy regimes, inflation targeting does not restrict the central bank to ignore other potential useful information and rely on just one of them – it uses all available information! In practice, IT involves considerable degree of policy discretion and the exercise of judgement that leaves substantial scope to achieve price stability without igniting output volatility.

3.2.1.1.5 Monetary policy regime without an explicit nominal anchor

A monetary policy regime can exist without an explicit nominal anchor such as inflation, monetary aggregate or exchange rate as was the case in the USA prior to 2012. Such a regime is usually predicated on an implicit nominal anchor such as an overriding worry to control inflation over the

long term underpinned by a coherent policy strategy. The framework also entails a forward-looking behaviour characterised by painstaking monitoring for traces of any future inflation combined with occasional preemptive policy actions against any risk of inflation. While the framework permits the pursuit of multiple objectives, the absence of an explicit nominal anchor may undermine efforts aimed at anchoring inflation expectations.

3.2.1.2 Monetary policy tools

3.2.1.2.1 Introduction

Central banks may implement monetary policy by either acting directly through their regulatory powers or indirectly through their influence on the conditions in the money market. Monetary policy tools can therefore be divided into broad categories – direct instruments (non-market tools) and indirect instruments (market tools). This section focuses on the use of these policy instruments to steer the short term nominal interest rate toward its desired target. The direct instruments of monetary policy is discussed in section 3.1.1.2.2 while section 3.1.1.2.3 focuses on the use of indirect instrument.

3.2.1.2.2 Direct tools of monetary policy

Direct instruments are non-market instruments used by the central bank to limit or set either the quantities (amounts of outstanding credit) or prices (interest rates) through its regulatory powers. This is usually aimed at achieving compatibility between the instrument (e.g., interest rate ceiling) and the policy objective (e.g., amount of outstanding credit) in the economy. The main direct

instruments are credit ceilings, interest rate ceilings (controls), and directed lending which is usually not for commercial motives but rather at the behest of the central bank.

A number of reasons have been adduced to underpin the use of direct instruments. First, at least in the short term, direct instruments are seen to be reliable in limiting aggregate credit levels, both in terms of cost and distribution of credit. Second, direct instruments are perceived to be fairly uncomplicated to execute and elucidate with relatively low direct fiscal costs. Third, direct instruments tend to appeal to governments desirous to route credit to satisfy specific policy objectives. Finally, for economies with undeveloped and uncompetitive financial markets, the use of direct instruments remains the sole possibility as an interim arrangement until institutional reforms permit the adoption of indirect instruments.

Despite the perceived advantages, the use of direct instruments imposes costs in terms of inefficient resource allocation. There is also the problem of ineffectiveness emanating from possible evasion and unfairness in its application. For example, if institutional credit ceilings are imposed, they tend to paralyse credit distribution and constrain competitive behaviour as well as impede the entry of new banks. In addition, the use of direct instruments has the tendency to breed more controls as the authorities strive to prevent efforts by affected banks/institutions to outwit the original controls. This may result in a convoluted, multi-tiered construct of credit controls and interest rates. To the extent it is effective, the use of direct control measures can trigger liquidity overhang, financial repression and its attendant disintermediation. Disintermediation has the tendency to shrink financial assets under the control of the authorities as funds move into informal

financial or unregulated markets. Finally, direct instruments ultimately lose their effectiveness as economic agents discover ways to sidestep them (Alexander et al., 1996; Cottarelli et al., 1986).

3.2.1.2.3 Indirect tools of monetary policy

3.2.1.2.3.1 Introduction

A central bank can act indirectly by exploiting its control on conditions in the money market as the issuer of reserve money. Indirect instruments, unlike their direct counterparts, act via the market by affecting the supply of and demand for bank reserves. Countries move to adopt indirect instruments as parts of measures aimed at liberalising the financial sector from the clutches of financial repression. There are three main types of indirect instruments – OMOs, reserve requirements, and lending facilities. The discussion in this section is based on useful synopses provided by (Van Eeghen, s.d.; Binseil, 2004b; Cecchetti & Disyatat, 2009; Gray, 2011).

3.2.1.2.3.2 Open market operations (OMOs)

Broadly, OMOs are the buying and selling operations conducted by the central bank with banks and/or nonbank public at the behest of the central bank. That is, the central bank purchases financial instruments when it desires to enlarge the cash reserves of banks and sells financial instruments when it desires to shrink the reserves. To the extent that interbank settlements are invariably conducted in cash, a central bank's open market sale instigates loss of cash (i.e., reduction in the banks' deposits at the central) by banks, while its open market buy prompts cash gain (i.e., increase in the banks' deposits at the central bank) by the banks. To the extent that the settlements are effected via bank deposit transfers, the outcome of OMOs is irrespective of whether

it is conducted with the nonbank public or with the banks. There is a subtle difference though in that OMOs conducted through banks alters only the cash reserves of banks with the stock of money unaffected while OMOs with the nonbank public alters both the cash reserves of banks and the stock of money.

Currently, central banks perform the portion of their OMOs via repurchase agreements (repos) whereby they sell (purchase) securities to (from) the banks with the pledge to reverse the sell (purchase) at a prescheduled future price (repo rate), varying between one day and a couple of weeks. Thus, repos may be thought of as loans collaterised by securities. Most modern central banks including the BOG perform repo transactions on a weekly basis. By its short-term nature, banks cannot rely on repo transactions to meet their more long-term cash requirements.

3.2.1.2.3.3 Standing facilities

The second tool central banks used to influence banks' cash reserves is the standing facilities. Unlike OMOs, the standing facilities are usually at the behest of the banks and not the central bank. Standing facilities may come in three types. The oldest of the three being the discount facility which allowed banks to acquire the greater part of their cash reserves from the central bank between the 1800s and World War I (early days of central banking). The discount facility permits banks to obtain cash through the sale of their bills to the central bank at a discount with the rate appropriately termed the discount rate. With repo transactions more fashionable among central banks nowadays, the discount rate has collapsed into a repo rate. Consistent with the previous discussion, a repo discount transaction is normally conducted through a weekly auction. Unlike repo transactions, the repo discount transaction can be used by banks for more long-term cash

requirements and so the central bank would typically buy government bonds outright from the banks instead of using repo transactions.

The advance or Lombard facility is the second type of the standing facility through which banks access a facility from the central bank to satisfy their unusual cash requirements as they come under a certain form of distress.[45] This is where central banks derive the lender of last resort (LOLR) function by supporting distressed banks. In normal times, the Lombard facility deals with cash requirements of given banks needing special additional support. The Lombard facility may be deployed to extend cash to all banks during the periods of systemic banking crisis. Under the Lombard facility, the central bank can provide loans outright or purchase assets from the appropriate banks with the interest rate on such loans normally set at a premium over the discount rate.

The third type of the discount facility is the deposit facility which is aimed at absorbing excess cash reserves with the banks through a deposit account at the central bank. This may happen when banks receive large unexpected deposits (late in the day) without any immediate need for its deployment or through quantitative easing (QE) measures. These deposit balances at the central bank are traditionally unrequited. However, they may become requited when the central bank attempts to maintain the interest rate within a specified bounds (i.e., the corridor system) or when the central bank conducts QE.

[45] Lombard facility is named after Water Bagehot's prescription about the conduct of LOLR operations by central banks.

3.2.1.2.3.4 Reserve requirements (RR)

Central banks can impose cash RR on banks and adjust the required reserves. In most countries, the RR is a statutory requirements whereby banks are legally obligated to keep a specific minimum amount of cash reserves. Previously, the minimum cash reserve was to be maintained always. There were two problems associated with it. First, the banks could not use these cash reserves for their daily operations. Second, these reserves are usually unrequited and lay idle in central bank vaults. This imposed significant costs on the banks and could show up in interest rates (low deposits and high lending rates). In response to these challenges, most central banks use a reserve averaging system whereby banks are required to maintain an average minimum cash reserves over a maintenance period, typically a duration of one month as in South Africa.[46] This means that the cash reserves can fluctuate around the required minimum so long as, on average, the minimum can be preserved over the stipulated period.

The required minimum cash reserves to be maintained by a bank over the maintenance period is usually calculated as a proportion of the average outstanding deposits of the relevant bank over the period proximately preceding the maintenance period. The system is not uniform across countries with some countries such as the US having different percentage for monetary demand and non-monetary term deposits. A distinction can be made between the required reserves and the excess reserves (reserves held by banks above what they legally obliged to maintain). Unlike the required reserves, the excess reserves are freely available and can be used by the banks to meet their daily cash needs.

[46] However, the maintenance period in the case of Ghana is one week.

3.2.1.3 Theory of the MPTMs

The MPTMs defines the various conduits through which monetary policy activities influence macroeconomic phenomena, including inflation and output. The theoretical literature on the MPTMs distinguishes four broad categories of conduit through which monetary policy is transmitted to the macroeconomy. These are (1) the interest rate channel, (2) the exchange rate channel, (3) the asset price channel comprising wealth and Tobin's q channels and (4) the credit channel, which can be further broken down into (4a) the bank balance sheet channel (or bank lending channel) and (4b) the borrower balance sheet channel.

However, Kuttner and Mosser (2002) assert that mutual exclusivity may be difficult to establish among the main monetary transmission channels, insisting that an economy's overall reaction to monetary policy actions will generally involve simultaneous interaction among multiple channels.[47] They however concede that any meaningful assessment of possible variations in the monetary transmission mechanism must involve a thorough, separate examination of each channel. The subsections below discuss the various channels under each broad category based on useful summaries provided by Mishkin (1996), the Bank of England (1999), Dovciak (1999), Loayza and Schmidt-Hebbel (2002), Ireland (2005), Boivin et al., (2010), ECB (2010), BCBS (2012), and Brinkmeyer (2014).

[47] For example, the exchange rate channel and most versions of the wealth channel are elaborations of the interest rate channel, and add a few logical steps to the causal sequence of the interest rate channel. The credit channel, however, specifies a different logical sequence, which is nonetheless compatible with the interest rate channel.

3.2.1.3.1 Traditional interest rate channel

In practice, at least among central banks, conventional monetary policy actions are usually effected by modifying the nominal interest rate (usually a short-term rate) by the monetary authority's policy committee to guide its daily operations.[48] In other words, the interest rate that the central bank charges banks for providing them with cash, is the operational target instrument (OTI). That rate can be set in the interbank market to be targeted by way of OMOs. The policy rate is then an interbank market rate. The Fed, for example, sets and announces its policy rate after Federal Open Market Committee (FOMC) meetings, whereby its policy rate – the fed funds rate – takes the shape of an interbank market rate. The European Central Bank's Governing Council and the Bank of England's MPC also set their policy rates as interbank rates, which guide their conduct of open market operations, reflecting their respective commitments to attain desirable short-term market rates (Bindseil, 2004a, 2004b). However, some central banks, like the South African Reserve Bank (SARB), set their policy rate at the discount window, using OMOs not to influence market rates but to create a cash shortage for banks, forcing them to the discount window to have their remaining marginal cash needs met there. The policy rate is then a discount window rate rather than an interbank market rate. However, through the guarantee of an open discount window, the interbank market rate is pushed down towards the discount rate as a floor under the market rate.

As witnessed during the GFC, central banks may also conduct unconventional monetary policy operations by directly altering the quantity of cash supplied to the commercial banking (financial)

[48] This is at variance with the fallacious reserve position doctrine (RPD), mostly among some academics, which attempts to define the operational target as a quantity variable, say reserve money. The original argument was put forward by Meigs (1962) and popularised by Poole (1968, 1970).

system in what has become known as QE.[49] These actions are intended to indirectly affect intermediate target variables, including the money growth rate and inflation expectations with the ultimate aim of influencing inflation and output (Van Eeghen, s.d.; Borio, 1997; Borio & Disyatat, 2009; Bindseil, 2004a, 2014). When the central bank practises QE, the policy rate is set by way of the rate that the central bank pays banks on their excess cash held on deposit with the central bank. Market rates are then pushed down towards that floor rate by the superabundance of banks' cash holdings (Goodfriend, 2002).

The traditional interest rate channel posits that a monetary contraction brought about by a rise in the short-term nominal interest rate (i.e., the policy rate as operational target) causes the long-term nominal interest rate to rise, as investors move to rebalance their portfolios of various maturities. With nominal rigidities inhibiting prices to adjust quickly one-on-one, variations in the nominal interest rate trigger variations in real interest rate. Businesses are likely to decrease their investment spending when they realise the increasing real cost of borrowing over all horizons. Faced with the reality of a higher borrowing cost in real terms, households will also reduce investment in residential housing and other durables such as automobiles. These reactions by economic agents combine to reduce aggregate spending and demand, hence output and inflation. The opposite holds in the case of monetary policy expansion (see figure 3.3). This conduit remains the workhorse of the traditional Keynesian IS-LM analysis found in most macroeconomic textbooks.[50]

[49] The distinction between the use of price of cash (interest rate) during normal non-crisis periods (conventional monetary policy) and that of quantity of cash (i.e., reserve money) during crisis episodes as operational targets is consistent with emerging consensus regarding operational target instruments (OTIs). Disagreements over the use of OTI stemmed from Meigs (1962) and was popularised by Poole (1968, 1970). Bindseil (2004a, 2004b) provides an excellent summary of the disagreements.

[50] The IS-LM analysis was originally formulated by Hicks (1937) as his fundamental interpretation of Keynes' (1936) general theory.

Here, the long-term real interest rate, which serves as the main source of guidance for business and consumer choices, is crucial in the interest rate transmission mechanism of monetary policy. This is because expectations about the future direction of the short-term interest rate affect the long-term rate. Given that these are long-lived assets, households and businesses take a longer view in acquiring such assets. Key among the factors considered are the expected real appreciation in the value of the asset and the long-term real interest rate. As demonstrated by the market expectations hypothesis of the term structure of interest rates, movements in the short-term interest rate could influence consumers' and firms' expectations of the future long-term real interest rate, hence the user cost of capital. For example, decisions made by monetary authorities to increase the target interest rate will raise the long-term real interest rate and the user cost of capital. This will depress the demand for capital assets, leading to lower investment spending and aggregate demand. As a result, output will fall and exerts downward pressure on inflation (see figure 3.3).

The traditional interest rate channel has also been incorporated into the DSGE models founded on wage or price rigidity and rational expectations so as to reverse the policy ineffectiveness outcome proposition of McCallum (1979). The DSGE models usually involve the derivation of behavioural equations from given objective functions and constraints that optimising firms and households face within the context of the New Keynesian (NK) models. The NK models usually comprise three equations comprising output, inflation and the short-term nominal interest rates. The first equation is the IS curve that connects current output (y_t) to future output ($E_t y_{t+1}$) and the ex-ante real interest rate (($i_t - E_t \pi_{t+1}$):

$$y_t = E_t y_{t+1} - \delta(i_t - E_t \pi_{t+1}); \quad \delta > 0$$

The second equation is the NK Phillips curve that links the current inflation rate (π_t) to inflation expectations ($E_t\pi_{t+1}$) and the output gap (y_t) intended to capture the optimal behaviour of firms operating under monopolistically competitive conditions that set their prices in a staggered manner or face explicit costs resulting from nominal price changes:

$$\pi_t = \varphi E_t\pi_{t+1} + \beta y_t; \quad \varphi, \beta>0$$

The final equation is the typical Taylor rule or interest rate rule that guides the central bank to systematically tweak the short-term nominal interest rate (i_t) in reaction to variations in output (y_t) and inflation (π_t):

$$i_t = \alpha\pi_t + \phi y_t; \quad \alpha, \phi>0$$

The foregoing discussion confirm the earlier remark that most central banks tend to conduct their monetary policy via the use of a target short-term nominal interest rate and not through any monetary aggregates.

The framework presented above confirms the traditional interest rate channel of monetary policy. For example, a tight monetary policy action – an increase in i_t (or a shock to the Taylor rule) – will raise the real interest rate resulting from sluggish movements in nominal prices due to the assumption of staggered price setting. Given the higher real interest real interest rate, investment and consumption fall as firms and households reduce their spending through the IS curve. As a result, output will decline through the Phillips curve, exerting a downward pressure on inflation to fall gradually as inflation expectations improved.

However, changes in the target interest rate can have the opposite effect, particularly on inflation, and reinforce output via the supply side by raising businesses' interest costs, which affects their

working capital. Higher interest expenses imply a higher marginal cost of production. Consequently, output prices may rise (and not fall) in response to monetary policy actions, at least in the short run. Hicks (1979) for example contends that the short-term nominal interest rate must be seen as the price of 'waiting time', an implicit factor of production separate from capital and labour. Barth and Ramey (2001) even propose a cost channel, i.e. a separate channel of monetary policy transmission that works mostly in the short run by affecting the economy's productive capacity as both supply and demand functions are shifted in the same direction. In their view, the demand side effects tend to dominate over the longer term. Despite empirical support for this postulation, the broader literature tends to view it as an anomaly and therefore labels it as a puzzle, hence the price puzzle (Sims, 1992; Christiano & Eichenbaum, 1992).

3.2.1.3.2 Exchange rate channel

The exchange rate channel works through the exchange rate's impact on net exports and aggregate demand. This channel has attracted growing interest over the last three decades following the increased internationalisation of several hitherto closed economies, and an increasing evolution toward more flexible exchange rate regimes throughout the world. The exchange rate channel assumes that the exchange rate and the short-term interest rate (i.e., the policy rate) are mutually related in the sense that variations in the monetary policy stance emanating from changes in the policy rate will affect returns on domestic assets relative to foreign assets with investors likely to readjust their portfolios in order to arbitrage any incipient differential in expected returns.

For example, all things being equal, a contractionary monetary policy triggered by a hike in the short-term interest rate raises the returns on domestic assets relative to their foreign counterparts,

which stimulates foreign capital inflows and causes the domestic currency to appreciate. However, the stronger domestic currency renders foreign goods less expensive compared to domestic goods. This leads to a higher demand for foreign goods at the expense of domestic goods both at home and abroad. As a result, net exports fall, depressing aggregate demand, output and inflation in the process (see figure 3.3). The contrary is true for monetary expansion emanating from a cut in interest rate. Developments in the forex rate market have a direct impact on domestic prices where imports are meant for direct consumption. This assigns an important role to the exchange rate channel in the propagation of monetary impulses to the wider macroeconomy.

The same developments will have an indirect impact (via a pass-through rate) on local prices when domestic goods are produced with foreign inputs. For example, a stronger local currency resulting from a tight monetary policy (an increase in the short-term nominal interest rate) will lead to lower prices for imported inputs, resulting in a lower per unit cost of production. Other things being equal, this should cause a fall in the prices of the final goods produced with the imported inputs, exerting a downward pressure on domestic prices (inflation). Should intermediate inputs constitute a larger share of imports, domestic production should rise over time (see figure 3.3).

The usefulness of this channel hinges on two factors: First, the exchange rate elasticity of the interest rate. That is, for the exchange rate channel to be important, foreign investors must respond quickly and meaningfully to the changing interest rate differential by demanding the country's bonds in order to cause the exchange rate to appreciate. This will indicate a large channel. On the other hand, if foreign investors do not respond significantly to the interest rate differential, the currency may not react adequately to the changes in the short-term nominal interest rates,

indicating a small conduit. In general, smaller, more open economies are more likely to experience larger impact via the exchange rate channel. Second, the extent of the pass-through of exchange rate movements to domestic prices affects the importance of this channel. If the currency appreciation after the monetary policy action is not reflected in domestic prices of goods and services, then this channel may be less important. The reverse is true. In general, countries with stronger domestic macroeconomic policy tend to experience less exchange rate pass-through.

3.2.1.3.3 Asset price channel

The asset price channel consists of **Tobin's q theory** (Tobin, 1969) and **wealth channels**, both of which work through equity prices. Tobin's q theory describes the processes by which monetary policy actions influence the macroeconomy through its effect on how equities are assessed. Tobin's q channel is grounded on the assumption that monetary policy impact market valuation of a firm's stocks. For example, an expansionary monetary policy occasioned by a cut in the short-term nominal interest rate increases money supply in general including the amount of money that flow into the stock markets in search of stocks. As a result, demand for stocks rises, leading to a rise in stock prices. This raises the market value of firms, suggesting that interest rates and stock prices (and market value of firms) are inversely related.

The firm's market value is linked to the concept of Tobin's q ratio, which is expressed as the market value of a firm relative to how much it would take to replace the firm's capital (replacement cost of capital). Defined this way, a high value for q suggests that the market valuation of the firm in question will be greater than the replacement cost of its capital, thus becoming appealing to issue new equity (stocks) to fund new investments. A rise in investments raises aggregate spending

and output, exerting upward pressure on prices (see figure 3.3). As Mishkin (1996) pointed out, Tobin's q theory adequately explains the exceptionally low investment expenditure during the Great Depression as stock prices plummeted; in 1933 they were worth only one-tenth of their value in 1929 with q falling dramatically to record low levels. Hayashi (1982) links Tobin's q theory to the user cost of capital, thereby fusing Tobin's q theory with the Keynesian view of monetary policy propagation. In this formulation, an increase in interest rates through a contractionary monetary policy is likely to engender a reduction in the demand for stocks, triggering a drop in stock prices thereby leading to decreased investment spending and aggregate demand, output and inflation (see figure 3.3).

The **wealth effect** of monetary policy actions works through equity prices. It is based on the 'life cycle hypothesis' of consumption, which postulates that consumption spending is a function of the consumer's lifetime (permanent) income comprising real and human capital, as well as financial wealth such as stocks (see Ando & Modigliani, 1963). The hypothesis predicts that the value of financial wealth moves with stock prices, suggesting a rise in stock prices will bring about an increase in the consumer's lifetime resources (income), a potential fillip for increased consumption.[51] The wealth channel of the monetary transmission mechanism can be outlined as follows: An increase in the target interest rate will decrease money supply and dampen the demand for financial assets, including stocks. Given the inverse relationship between interest rates and asset prices, the higher interest rate will cause asset prices to decline and ultimately hurt consumer

[51] This prediction may be more relevant in a micro context because price movements (including asset price changes) merely alter the distribution of income among economic agents without affecting the aggregate income of all economic agents.

wealth with a possible knock-on effect on consumption, output and inflation (see figure 3.3). The reverse is true for monetary expansion initiated through a cut in the short-term interest rate.

Another asset price channel that is pivotal in DSGE modelling is the intertemporal substitution effect. According to Boivin et al. (2010), this channel emanates from the use of the Euler equation connecting marginal rate of substitution in consumption (i.e., between current and future consumption) with the real rate of interest. Here, variations in the short-term nominal interest rates changes the slope of the consumption curve. For example, an increase in the short-term nominal interest rate raises the opportunity cost of consumption today relative to consumption tomorrow. As a result, the increase in the interest rates discourages holding money balances, leading to investment in financial assets (stocks) thereby lowering current consumption, output and inflation. This conclusion is fundamentally inconsistent with the conclusions based on the traditional Keynesian wealth effect as outlined above.

3.2.1.3.4 Credit view channel

The credit view was put forward by Bernanke and Gertler (1995) in response to the difficulties associated with adequately explaining the economy's reaction to monetary policy impulses that emanate exclusively from the traditional interest rate effects. Financial frictions in the shape of costly enforcement of contracts or asymmetric information impede the smooth operation of financial markets and drive a wedge between the cost of raising funds externally and the opportunity cost of relying on internally generated funds. Known as the external finance premium, the wedge reveals the magnitude of the deadweight costs related to the principal-agent problem between lenders and borrowers commonly found in financial markets. The external finance

premium captures (1) the lender's expected costs of evaluating and monitoring the borrower, as well as debt collection; (2) the 'lemons' premium resulting from the borrower possessing better information on his/her ability to honour the contract; and (3) the costs of misrepresentations associated with borrower behaviour, which stem from a moral hazard or restrictions provided in the contract aimed at containing the moral hazard, for example collateral requirements. The external finance premium is predicted to be broadly positive and inversely associated with the strength of the borrower's financial position, which is a function of his/her liquidity position, current and expected cash flows, and net worth. A financially strong borrower is seen as having more 'skin in the game' and therefore has greater inducements to make better investment decisions (backed by well-informed actions) that will guarantee good results. Such firms generally face a lower external finance premium. The credit view contends that monetary policy actions impact general interest rates, as well as the magnitude of the external finance premium with the complementarity offering a better explanation of monetary policy effects than the traditional interest rate channel (Bernanke & Gertler, 1989, 1995; Bernanke, 2007; Brinkmeyer, 2014). The literature recognises two distinct channels of the credit view, namely the balance sheet channel and the bank lending channel.

3.2.1.3.4.1 Balance sheet channel (BSC)

The BSC is predicated on the expectation that the external finance premium faced by a borrower hinges on his/her net worth, which is defined as the sum of marketable collateral (solvency) and liquid assets (liquidity). Net worth is predicted to be inversely related to the external finance premium, which implies that greater net worth attracts a lower external finance premium. This is why a healthy net worth (sturdier financial position) allows a borrower to lessen his/her potential

risk factors in the financial market, either by posting more collateral to guarantee issued liabilities or by self-financing a larger proportion of the project. With the borrower's financial health linked to the external finance premium and hence the overall credit terms he/she faces, variations in the quality of the borrower's balance sheet should impact his/her spending and investment decisions. Bernanke and Gertler (1995) and Bernanke (2007) contend that endogenous procyclical oscillations in the borrower's balance sheet can potentially amplify and propagate business cycles, a process known as the financial accelerator.

The BSC of monetary policy results from changes in monetary policy that impact both the solvency and the liquidity of a borrower, directly and indirectly. Directly, an increase in the monetary policy rate (tight monetary policy) triggers a deterioration in the balance sheet of a borrower in two possible ways: Firstly, given that a borrower has an outstanding floating rate or short-term debt, an increase in the interest rate directly raises his/her interest expenses, depressing net cash flow and weakening his/her financial position (i.e., his/her liquidity). The direct effect may be important given that firms typically depend on short-term debt to meet their short-term obligations such as financing of inventories. Secondly, interest rates and asset prices are inversely related in that rising interest rates are known to be accompanied by falling asset prices, with potential shrinkage in the borrower's collateral value (i.e., his/her solvency). Indirectly, an increase in the policy interest rate can lower the net cash flow and collateral value of borrowers through its negative effects on the balance sheet of the borrower's downstream customers. Bernanke and Gertler (1995) contend that the indirect effect may persist well beyond the initial period of the monetary policy action. Consequently, the borrower's ability to access bank credit for investment and/or consumption purposes is undermined, leading to lower aggregate demand, output and inflation (see figure 3.3).

3.2.1.3.4.2 Bank lending channel (BLC)

Bernanke and Gertler (1995) contend that the BSC may have become important to commercial banks too, since rising interest rates reduce the value of securities, which then impairs the banks' capital. Banks' impaired capital constrains their ability to attract funding and hence their capacity to advance credit may also be impaired. The BLC refers to the general idea that monetary policy actions can affect the supply of intermediated credit by impacting the external finance premium of commercial banks and hence loanable funds of banks.

The channel traces the role of commercial banks in the transmission of monetary impulses to the real economy by leveraging on the impacts of monetary policy decisions on bank lending behaviour. Kashyap and Stein (1995) cite Roosa's (1951) availability doctrine as the source of early theorising about the BLC. (Roosa's availability doctrine contends that a central bank's success in monetary operations hinges crucially on its influence on the decisions and positions of lenders.) According to the bank lending view, banks perform a unique function in the financial context due to their distinct capacity to circumvent the information asymmetry problems in credit markets, which makes them the main source of intermediated loans in most economies despite non-bank financial intermediaries' having increased in importance in recent decades. Bernanke (2007) makes a connection, on the one hand, between the financial positions of commercial banks and their funding costs and, on the other hand, between the spread commercial banks charge and their financial strength. He hypothesises that monetary policy affects the spread. Bernanke and Blinder (1988) however predicate the potency of this channel on the assumption that commercial banks are incapable of swiftly replacing their lost reserves following the central bank's open

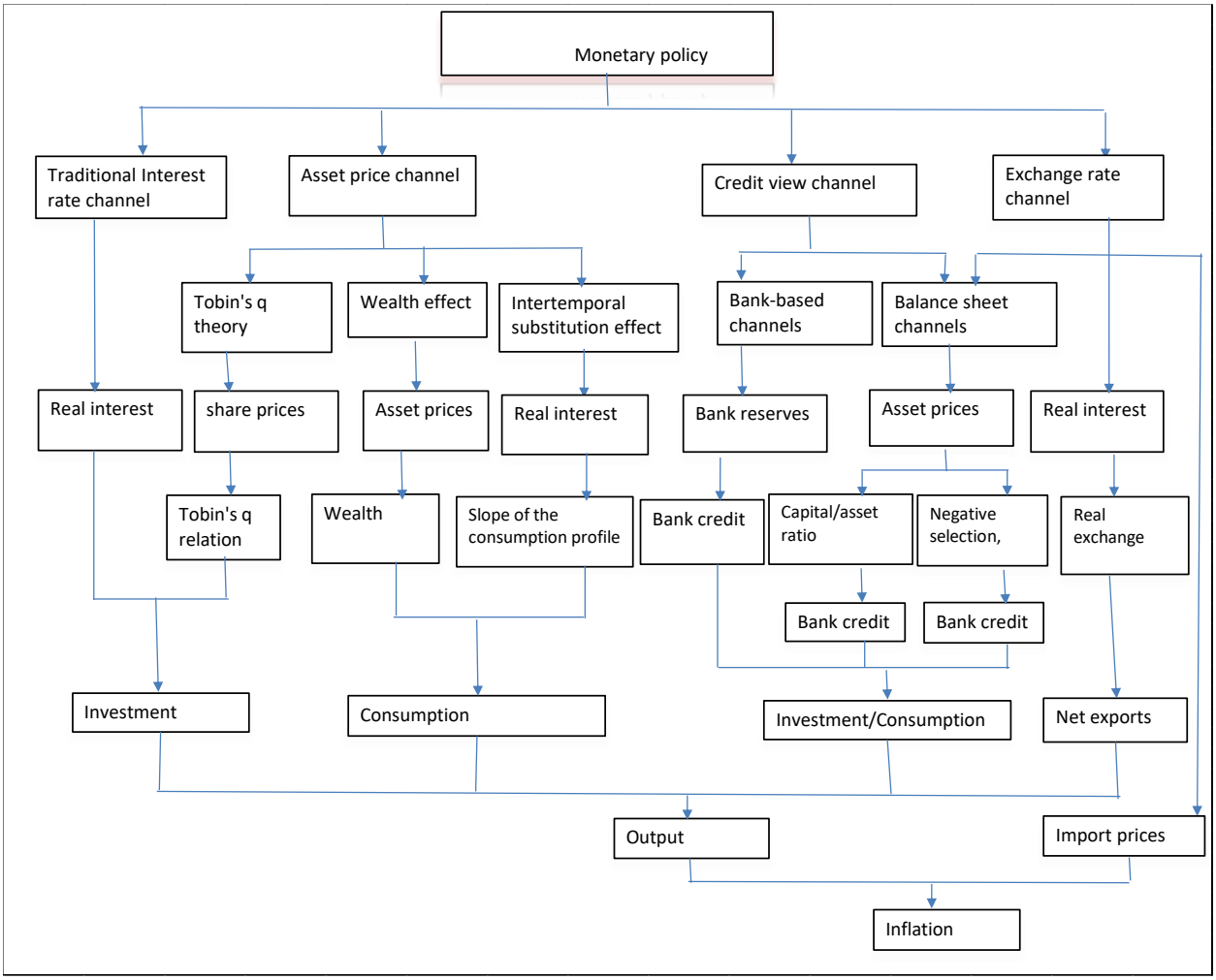
market operations. Thus, the bank's inability to quickly replace lost reserves weakens its ability to extend credit to its customers (both firms and households) for investment and/or consumption purposes, leading to lower aggregate demand, output and inflation (see figure 3.3).

3.2.1.3.5 Summary of the monetary policy transmission mechanism

Loayza and Schmidt-Hebbel (2002) contend that reactions to changes in monetary policy actions differ from one economy to another, and that responses to monetary policy actions hinge on the specific characteristics of the economy under consideration. In their view, the principal monetary transmission conduits in a given economy depend on the limits imposed on international capital flow, the structure of the financial system, including legal and institutional settings, and the exchange rate regime. In that regard, Mishra and Montiel (2012) assert that a country's idiosyncratic characteristics are important determinants of the monetary policy transmission mechanism.

A natural implication of the foregoing is that the four main channels of monetary transmission outlined above are better established in more mature economies than in emerging markets and developing countries. Knowledge of the transmission mechanism is undermined by an absence of reliable data, recurring oscillations in the economy's structure, challenges in untying cause from effect inherent in the data, and the long lags associated with monetary policy actions (Mahadeva & Sinclair, 2001). These difficulties are much more pronounced in developing countries, including those in the SSA, which are less integrated in the global financial markets and more predisposed to forex market intervention – a potential impediment to the effectiveness of the exchange rate channel. Underdeveloped domestic bonds and capital markets also tend to weaken the traditional

interest rates channel and the asset price channel, respectively. In developing countries, the strength and reliability of the credit (lending) channel tends to be weakened by the existence of large informal sectors, the uncompetitive nature of the banking systems, and adverse institutional environments. Sacerdoti (2005), for example, suggests that the importance of the bank lending channel is inhibited by the large imperfections associated with financial sectors in several SSA economies.



Source: Author's construct based on Mishkin (1996), Bank of England (1999), Dovciak (1999), Loayza and Schmidt-Hebbel (2002), Ireland (2005) and Boivin et al. (2010), Brinkmeyer (2014).

Figure 3. 3: Diagrammatic illustration of the monetary transmission mechanism

3.2.2 Fiscal policy transmission mechanism (FPTM)

This section describes the theoretical aspects of the conduits via which fiscal policy actions are passed on to the real economy. The detailed discussion of the main theoretical positions outlined in the following subsections, draw on valuable accounts by Hemming, Kell and Mafouz (2002), Capet (2004), Briotti (2005), Beetsma (2008), Fontana (2009), Hebous (2011), Beetsma and Giuliodori (2011), Arestis (2011), Fragetta and Melina (2011), Almeida (2012), Palley (2013), and Yang (2013). The section starts with a review of the theoretical literature on FPTM, concentrating mainly on the controversy between Keynesians and neoclassicals with regard to the impacts of government actions on the broader economy.

3.2.2.1 Theory of the FPTM

The FPTM defines the different conduits via which fiscal policy activities are passed on to the broader macroeconomy, particularly consumption and output. Unlike monetary policy, which has limited tools, fiscal policy actions can utilise several processes, including modifications to government taxes and spending, whereby taxes can be levied in different ways and spending can be differently allocated, each of which has a potentially different effect on the macroeconomy. Beyond the issue of fiscal policy tools, a number of different issues complicate the potential macroeconomic outcome of fiscal policy, including: (1) the degree of persistence of the policy shift; (2) the different ways in which budget deficits are financed;[52] (3) whether the policy change is anticipated; (4) the reaction of monetary policy to the fiscal policy change; (5) the way in which policy impacts affects different economic agents in the economy; (6) the stage of the economy in

[52] Such as (a) bond issues sold to the banking system, (b) bond issues sold to the private non-banking sector, or (c) the central bank buying back bonds previously issued to the private sector

the business cycle at the time of the policy change; (7) the time horizon considered, i.e., whether short-term, or long-term, or both effects are considered; (8) other characteristics of the economy, including the level of development, the openness of the economy, and the exchange rate regime; and – more importantly, (9) the different types of theoretical model used to analyse the effect of fiscal policy, since each type of model is capable of employing various ad hoc assumptions, all of which may yield a multitude of different, often contradictory, predictions (Ramey, 2019; Cavallo et al., 2018).[53]

This study is mainly interested in the short- and medium-term impacts of fiscal policy on key macro variables, particularly output and consumption. It therefore focuses primarily on the theoretical contestations about the outcome of fiscal policy on these macro variables. A natural starting point is item (9), namely the different theoretical frameworks adopted in the study of fiscal policy. However, in order to ensure a deeper appreciation of the FPTM and not to completely detract from the remaining issues, a discussion of other important considerations is provided in subsection 3.1.2.1.4.

3.2.2.1.1 The demand channel through the traditional Keynesian framework

Classical economists assume full flexibility of prices and wages under perfect competitive conditions in all markets. In such a setup, assuming sufficiently strong price elasticity, the economy equilibrates itself, which implies that there is no role for fiscal activism. Keynesians disagree with the self-regulating properties of the economy and assume the opposite view. The traditional Keynesian model assumes price rigidity, households and businesses with constrained excess capacity and liquidity where the current level of consumption depends solely on current

[53] Issues (1) to (8) are discussed in section 3.1.2.1.5

income and no weight is given to expected future income. In the short run, fiscal expansion can exert both direct and indirect impact on the economy. Government spending is a component of aggregate demand, implying that an increase in government spending (an expansion fiscal policy) directly increases aggregate demand, hence output and inflation. Indirectly, government spending raises businesses' revenue (profit) and incomes of households with potential multiple stimulating effects on private consumption, hence aggregate demand, output and inflation. This is the demand channel of the transmission mechanism and hinges on a plethora of critical factors that may induce crowding out effects. These factors include the level of excess capacity in the economy; the degree of price stickiness; the reaction of interest rates; the composition of government expenditure (quality of expenditure); the extent of economic openness; and the adopted exchange rate regime.[54]

For example, monetary policy may react to the potential inflationary pressures by raising the short-term nominal interest rate that may stifle consumption and investment thereby dampen aggregate demand and reduce the effectiveness of the fiscal expansion. In addition, if the economy is close to full employment without excess capacity, then the fiscal expansion can exert disproportionate inflationary pressures on the economy with potential reaction by monetary policy. The extent of economic openness is key in that in an open economy context, part of the fiscal expansion may leak through imports and reduce domestic aggregate demand. The fiscal expansion may mostly involve government consumption on its rising public sector wage bill and not increased investment (capital expenditure). With government consumption rising faster than its investment, the increase in aggregate demand will be mostly felt on inflation instead of output, dampening the multiplier effect.

[54] See table 3.1 for the predicted outcome of fiscal policy in the traditional Keynesian framework.

Under a fixed exchange rate regime, fiscal expansion triggers incipient exchange rate appreciation. In this case, monetary policy intervention by way of increased money supply becomes necessary so as to buy the excess foreign exchange in the domestic economy and maintain the fixed exchange rate regime, magnifying the original effects of the fiscal expansion. However, under a flexible exchange rate regime, the exchange rate appreciation will cause net exports (a component of aggregate demand) to decline by raising imports and reducing exports. This may moderate or even outweigh the original increase in aggregate demand. As mentioned above, price stickiness and excess capacity in the economy are the bedrocks of the Keynesian framework, implying that in their absence the entire Keynesian framework crumbles and we are back to the realm of classical economics.

3.2.2.1.2 The supply channel and the neoclassical framework

Fiscal policy through the supply channel, as proposed by the neoclassicals, works through the wealth effects. The transmission mechanism may be stated as follows. If parts of the financing required to meet the increased government spending is sourced from foreign investors who participate in the bonds issued, domestic private wealth is assumed to have fallen. Given that leisure and goods are assumed to be normal goods, consumers will substitute work for leisure in order to compensate themselves for the loss in wealth. The increased labour supply will reduce real wages and raise the marginal product of capital, given a standard (e.g., Cobb-Douglas) production function. According to Baxter and King (1993), in the short-term the increased marginal product of capital will lead to increase in investment in a process underpinned by the accelerator effect, which is akin to the multiplier effect within the Keynesian framework. The

higher marginal product of capital produces an indirect effect too. That is, the increased marginal product of capital will bring about an increase in the short-term nominal interest rate, resulting, in the long-term, in increased labour and capital inputs without changes in capital/labour ratio. In the long run, this will cause investment and output to rise and a fall in consumption (Baxter & King, 1993)

The supply channel is often referred to as the labour-market channel given the critical role of the labour market within the neoclassical framework outlined above. The question is whether people actually perceive a rise in the fiscal deficit partially financed from abroad as constituting a loss in their wealth. However, Alesina and Perotti (1996) and Bola et al. (2015) showed that fiscal alterations within OECD countries have had significant effects on the labour market dynamics, particularly on unit labour costs.

3.2.2.1.3 Micro-founded forward-looking frameworks of fiscal policy transmission

The channels outlined above are however not anchored in micro foundations and ignores the optimising behaviour of economic agents. Macroeconomic theory has progressively been built on DSGE frameworks so as to obtain micro founded aggregate interactions that describe the factors underlying economic fluctuations. DSGE models typically embrace rational expectations and forward-looking economic agents. In a DSGE model, all economic behaviour tracks an optimal strategy in terms of which (1) households maximise expected lifetime utility subject to their lifetime budget constraint; (2) firms maximise their profits given rental rates of capital services and real wages, subject to the existing technology; and (3) government actions are subject to the government's budget constraints. Solving the model usually requires the linearisation of

optimising, as well as clearing conditions, which results in a set of linear equations. The economy as captured by the derived system is subject to stochastic disturbances (shocks). For example, a fiscal shock will result from a disturbance to a fiscal variable, government taxes, or spending. Investigation of the dynamic behaviour of the model's variables after a shock involves calibration and/or estimation of the model's parameters.

There are two classes of DSGE model, each of which is based on two key assumptions: The Real Business Cycle (RBC) models assume flexible prices and competitive conditions in all markets whereas the NK models take the opposite view and assumes sticky prices and the existence of imperfect competition in all markets.[55] The next two subsections review the macroeconomic outcomes following fiscal shocks in the two types of the DSGE model.

3.1.2.1.1.1 Fiscal policy and the RBC models (the neoclassical framework)

The primary focus of the RBC models is the role of real disturbances (shocks) in the form of preferences, as well as technological shocks, in elucidating fluctuations in economic activity. The neoclassical framework is rooted in the classical model and assumes that prices and wages are flexible under conditions of perfect competitive markets.

Baxter and King (1993) were the first authors to employ the RBC model to analyse the macroeconomic effects of fiscal policy. The prototypical fiscal policy RBC model assumes that an

[55] See McCandless (2008) and Gali (2008) for a comprehensive description of the DSGE models.

increase in government spending now would be paid for by high taxes later.[56] This increases economic agents' future tax liabilities and reduces their wealth (negative wealth effect), causing savings to rise while private consumption declines. As a result, labour supply increases (increased hours of work and less leisure) depressing real wages while raising investment and output. In their seminal contribution, Baxter and King (1993) assert that the output effects are stronger for a permanent fiscal expansion financed by lump-sum taxes due to the longer-term impact of higher employment on the capital stock. This is because the increase in employment elevates the marginal productivity of capital, inducing further private investment.

The most distinctive characteristic of the basic neoclassical framework is that it tends to predict an increase in output, but a fall in private consumption and real wages, after fiscal expansion. The negative prediction about real wages and private consumption emanates from two key characteristics of the basic neoclassical framework, namely the separable utility function (in consumption and leisure) and Ricardian behaviour, which describes the negative wealth influence instigated by the rise in the time value of future tax obligations because of government's intertemporal budget constraint.

In an attempt to engineer a positive private consumption response to fiscal shocks, Linnemann (2006) enriches the standard neoclassical framework with the assumption of non-separable utility

[56] Future tax liabilities need not rise following fiscal expansion if rational households accurately determine that: I) even though the public debt may increase in nominal terms to finance the fiscal expansion, it still remains sustainable in terms of the debt-to-GDP ratio (it is only when this ratio becomes unsustainable with the real threat of default and/or bailout by multilateral institutions that tax liabilities may go up); and II) the banking sector may purchase a large proportion of the issued debt, which may leave little or nothing for non-banking firms and households and leaves their tax-to-income ratio unchanged. However, increased interest payments on debt may raise government's financing needs resulting in higher taxes.

functions in consumption and leisure. This modification indicates that leisure and consumption are now substitutes, implying that in response to the negative wealth effect following fiscal expansion, households increase the number of hours worked, which reduces leisure. This raises the marginal utility of consumption, inducing households to work more and raise their level of consumption, which counteracts the negative wealth effect. Bilbiie (2009) however contends that the assumption of non-separability holds only in the case of inferior goods.

Another approach to generate a positive impact on consumption after fiscal expansion is the assumption of habit persistence (i.e., deep habits) at the level of individual goods in a monopolistic goods market, as suggested by Ravn et al. (2006). The model therefore deviates from the basic RBC framework. It does not however assume nominal rigidities, which would have brought it closer to the NK model. The framework suggests that demand for a particular commodity consists of an inelastic price component that does not respond to price movements, and an elastic price element that is consistent with the behaviour of standard monopolistic competition frameworks. For example, the weight of the elastic part is predicted to increase in response to a rise in aggregate demand, which induces monopolistic producers to reduce the prices of the goods in question, stimulating additional demand by the non-government sector. The increased demand for goods by the private sector encourages firms to increase demand for labour in order to produce the goods demanded (i.e., the labour demand schedule shifts to the right). The rise in labour demand increases real wages, which may offset the downward pressure from the higher supply of labour that results from the negative wealth effect following fiscal expansion.

In a closely related work, Bouakez and Rebei (2007) permit preferences of households in a standard RBC framework to display persistence in consumption, as well as dependence on fiscal policy (government purchases). As a result, the marginal utility of consumption rises after fiscal expansion since public and private spending are treated as complements.

3.1.2.1.1.2 Fiscal policy and NK models

Like the RBC models, the NK models follow the DSGE modelling strategy but differ fundamentally in terms of the underlying assumptions. NK models are predicated on nominal rigidities in the presence of monopolistic competition, which is at variance with the price flexibility and perfect competition assumed under the RBC models. However, fiscal policy analysis based on the standard NK DSGE framework produces predictions consistent with those from the standard RBC framework – a rise in output and a fall in consumption. This derives from the negative wealth impact of an expansionary fiscal policy subsequent to the fundamental assumption of forward-looking rational behaviour in both frameworks.

The point of departure is the dynamics in the labour market. Contrary to the predictions of the standard RBC DSGE model, the basic NK DSGE model predicts an increase in the real wages following fiscal expansion. This is because in terms of the NK model, the increase in output resulting from fiscal expansion increases labour demand, which may outweigh the rise in labour supply because of the negative wealth effect (Pappa, 2009).

Just as their RBC counterparts, the NK DSGE models have made ad hoc assumptions, ascribing a number of characteristics to the representative consumer in order to achieve positive consumption

effects after fiscal expansion. Gali et al. (2007) for example assume the existence of 'rule-of-thumb' consumers who do not save and therefore spend their entire disposable income. Rule-of-thumb consumers may be seen as households that are facing binding borrowing constraints. In this setup, the rise in real wages emanating from the fiscal expansion induces these consumers to boost their consumption. In this sense, the economy is populated by two groups of consumer – Ricardian households that are forward looking and will therefore anticipate high taxes tomorrow emanating from today's fiscal policy actions; and non-Ricardian (rule-of-thumb) households described above. To the extent that the proportion of rule-of-thumb consumers in total households is significant, their consumption behaviour can overturn the predicted negative consumption. Forni et al. (2009) estimate that between 30% and 40% of eurozone households are rule-of-thumb consumers. Earlier, Coenen and Straub (2005) estimated this ratio to be less than 25% of eurozone consumers, suggesting perhaps that the GFC pushed a significant number of eurozone households to the point where they began to exhibit 'tomorrow-will-take-care-of-itself' behaviour.

Another adjustment to the NK model relates to the incorporation of a group of 'buffer stock' consumers (Callegari, 2007). These consumers reserve a buffer of assets to prevent their consumption from falling to zero due to binding constraints on borrowing today against their expected future income. This behaviour implies a positive relationship between asset holdings (cash-on-hand) and private consumption in that when asset holdings fall below a certain psychological target level, these consumers tend to build up 'buffer stock' at the expense of current consumption, and vice versa. As described previously, fiscal expansion produces a negative wealth impact with the features of the NK model ensuring increases in labour demand and real wages. The increase in real wages raises buffer stock (cash-on-hand), inducing buffer stock consumers to

raise their consumption. The buffer stock effect may offset the negative wealth impact depending on the proportion of buffer stock consumers in the total number of households.

Corsetti et al. (2012) criticise the standard assumption of assigning to taxes the burden of debt stabilisation without a role for government spending, which is usually treated as an exogenous quantity. They argue that when public debt becomes unsustainable, government response to rein in debt involves adjustment in both taxes and spending. Intuitively, permitting endogenous government spending is not only consistent with the political reality of constraints on government's ability to increase taxes, but also reflects empirical evidence of a strong stabilising reaction of government spending to the debt-to-output ratio in the US, whether or not state legislation explicitly mandate fiscal control (see Pappa, 2005). Corsetti et al. (2012) therefore assume that current fiscal expansion may not only trigger future tax increases, but may also lead to future cuts in government spending, a phenomenon known as spending reversal. In their framework, spending reversal is permitted to occur in reaction to dynamics in the debt stock. The model also allows for the existence of a group of rule-of-thumb consumers. In this framework, fiscal expansion leads to increased output and consumption.

3.2.2.1.4 Critique of fiscal policy micro-founded models

As noted earlier, micro-founded DSGE models (both RBC and NK models) are typically anchored in rational expectations and forward-looking economic agents. Rational expectations assume that economic agents have access to the correct model of the economy and incorporate all the available information into the model in order to arrive at averagely (stochastically) correct expectations as a basis for their current economic decisions. With rational economic agents, the longer-run

influences of fiscal policy actions are important, even in the shorter term and, more crucially, the distinction between transitory (unanticipated) and permanent changes in fiscal policy will have an impact.

It is however doubtful that private economic agents understand the complexity of the modern economy to the extent required to accurately predict future outcomes of current fiscal policy actions. Unreasonably excessive resources may be required to enhance the representative consumer's capacity to reach meaningful conclusions about the future direction of the economy. In a sense, too much is expected of the representative forward-looking agent. Even central banks with huge resources and equipped with state-of-the-art models grapple with the workings of the economy – the black box is real.

Forward-looking consumers may become Ricardian. It is the Ricardian behaviour inherent in standard DSGE models that produces the empirically inconsistent negative wealth effect after fiscal expansion. In a desperate attempt to reverse negative wealth effects, various ad hoc features are ascribed to the representative consumer. Admittedly, some consumers may possess such characteristics, but there is hardly any evidence to indicate that such individuals constitute the dominant share of the population. As empirical evidence shows, at the height of the GFC, rule-of-thumb consumers in the eurozone rose to between 30 and 40% (Forni et al., 2009) from about 25% before the crisis (Coenen & Straub, 2005). Despite the rising trend, rule-of-thumb consumers do not constitute the majority of the eurozone population. It is entirely possible that the increase in the share of rule-of-thumb consumers was due specifically to the GFC that produced a significant number of liquidity constrained consumers who then became hand-to-mouth consumers during the

crisis. This suggests that consumer behaviour may be more time dependent and so models that clothe consumers, a priori, with definite characteristics over their entire life may be problematic.

3.2.2.1.5 Potential determinants of macroeconomic outcomes of fiscal policy shocks

As noted in the introductory section (i.e., section 3.1.2.1), the macroeconomic effects of fiscal policy may be influenced by a number of factors. The degree or perception of persistence of fiscal changes may affect fiscal outcomes as economic agents, particularly labour, internalise the policy changes in their labour market decisions. For example, if economic agents anticipate fiscal policy shocks to be temporary, the wealth effect will be smaller as economic agents make minimal or temporary adjustment to their leisure/work preferences. In this case, the effect of the fiscal shock will be weaker as consumption, investment and output react mildly to the shock. Conversely, if economic agents envisage changes in fiscal policy to be more permanent, they make more permanent adjustments to their leisure/work choices, resulting in stronger and more permanent effect (Ramey & Shapiro, 1998).

Fiscal policy outcomes are also determined by the different ways in which the fiscal deficits are financed. As noted previously, the budget deficits can be financed through (a) bond issues sold to the banking system, (b) bond issues sold to the private non-banking sector, or (c) the central bank buying back bonds previously issued to the private sector. For example, if the higher deficit is financed by the commercial banking system, it will create credit squeeze and raise the real interest rates unless interest rate ceilings and credit control measures are in place. As explained in chapter two, however, these control measures are known to result in financial repression and misallocation of credit. Higher real interest rates may constrain private consumption and investment, hence

output. Reliance on the central bank credit to finance the deficit may lead to inflationary pressures, undermining the effectiveness of fiscal policy. Financing from the private non-bank sector may have more benign effects on interest rates but may exert stronger negative impact on the availability of long term financing for the private sector. If non-residents participate in the bonds issued to the private non-banking sector, it may lead to the appreciation of the exchange rate with deleterious impact on the country's net exports. Finally, if the central bank buys back bonds previously issued to the private sector, it may resolve the issue of credit squeeze for the private sector but may ignite inflationary pressures (Easterly & Schmidt-Hebbel, 1993; Gaber, 2010).

Conversely, Corsetti and Muller (2008) observe that the impact of fiscal expansion on the economy hinges on the source of financing. In their view, the effect of fiscal expansion is greater if it is underpinned by a credible strategy to reduce future expenditure instead of raising taxes. In such a scenario, fiscal expansion tends to prop up current consumption and investment when long-term interest rates fall. In similar vein, Fatas and Mihov (2001) observe that if additional government purchases are financed via distortionary taxes rather than a lump sum, both labour supply and output respond much more tepidly and may even fall. However, Eichenbaum and Fisher (2005) demonstrate that the impact of distortionary taxes is fundamentally akin to the impact of lump sum taxes apart from differences in timing of the peak reaction.

Fiscal policy may also be affected by whether the policy is anticipated. If the policy is anticipated, economic agents are able to internalise and take steps to avert the potential adverse effects of the policy prior to its implementation. This is likely to undercut the effectiveness of fiscal policy (Mountford & Uhlig, 2009). The time dimension of fiscal policy must be taken into consideration.

Fiscal multipliers are likely larger over the shorter horizon and decay with time (De Castro & Cos, 2008). In the long run however, the effects of rising debt to finance the fiscal stimulus may dampen any short-run benefits of fiscal expansion (Kitao, 2010).

Fiscal policy outcomes are also influenced by the way in which the policy affects different economic agents in the economy. Fiscal expansion may involve government's purchases from heterogenous firms and industries producing different capital equipment, intermediate goods and consumable goods within the economy. For example, fiscal expansion may comprise purchases of capital equipment and intermediate products and if these enter the economy's production function, then private sector investment and employment will be positively impacted over a reasonable period of time. However, if the purchases are mostly consumable goods, the effects on employment and investment may be minimal and transitory. Government purchases can serve as a substitute or a complement to private consumption. For example, private consumption expenditure will fall if it is a substitute to government purchases. Conversely, private consumption expenditure will increase if it is a complement to government purchases. The effects of tax policy on households is contingent upon whether the incidence of the tax changes falls on poor, liquidity constrained or rich households as marginal propensity to consume differ for different households (Palley, 2012).

The state of the economy, the exchange rate regime and the extent of public debt also affect the effectiveness of fiscal policy. Fiscal expansions are known to be more effective in recessions than during economic expansion (Auerbach & Gorodnichenko, 2012; Mahedy & Wilson, 2018). Corsetti and Muller (2015) note that: (1) fiscal multipliers appear to be higher under a fixed exchange rate regime than under a flexible regime; (2) fiscal multipliers tend to be lower in the

presence of a high stock of public debt and large fiscal deficits (see also Ilzetzki et al. 2013; Auerbach & Gorodnichenko, 2013), (3) the largest fiscal multipliers occur during economic and financial crises. Corsetti and Muller (2008) assert that fiscal policy is more potent if it is accommodated by monetary policy. If central banks are single minded in their focus on their primary objective of price stability (particularly IT central banks) and fear that fiscal expansion pose a threat to price stability, they may respond by raising the policy rate, which may counteract and even render fiscal policy ineffective. However, with improved coordination between fiscal and monetary policy, monetary policy tends to be more supportive of fiscal policy, particularly during periods of macroeconomic and financial stress as witnessed during the GFC and the COVID-19 pandemic.

Interest rate risk premiums are an important conduit through which the accumulation of debt may influence the fiscal multiplier. For example, fiscal expansion financed by issuing bonds leads to a rising accumulation of debt and increasing risk premiums, which reflect the rising risk of default and strengthen the effects of crowding-out via interest rates. In such a context, and given that fiscal policy-makers are credible, a transitory expansionary fiscal policy has a greater chance of succeeding than does a permanent one, because the implications of its debt sustainability are more benign. On the contrary, if firms and households do not anticipate that a temporary fiscal measure (tax cut or increase in spending) will be overturned in future due to government's credibility gap in fiscal prudence, interest rates are bound to reflect risk premiums since the temporary fiscal action is interpreted as a permanent one. Significant risk premiums may explain negative fiscal

multipliers where fiscal contractions cause an expansion of spending and output, as observed in Denmark and Ireland by Giavazzi and Pagano (1990).[57]

Fiscal policy actions that induce an increased risk of fiscal disarray may trigger precautionary behaviour by households and firms, reducing the fiscal multipliers and possibly even turning them negative.[58] For example, firms may postpone planned irremediable investments, households may attempt to accrue precautionary savings, and capital flows may be affected as foreign investors reassess their investment position in the country (Caballero & Pyndick, 1996). This suggests that consumption and/or investment may be contingent upon firms' and households' sentiments towards the general macroeconomy and their confidence may be influenced by government policies.[59]

The impact of fiscal policy on the macroeconomy is a function of institutional settings. Critical institutional factors include the state of economic and financial advancement, political economic considerations, and inside and outside lags. Long lags may occur between the time of identification and acknowledgement of a problem and the execution of policy measures aimed at rectifying the problem (inside lags), which may reduce the size of fiscal multipliers. Inside lags reflect the time it takes for the political decision-making procedure to run its course. For example, the government

[57] They contend that fiscal contractions have two effects: (1) a Keynesian effect, which is contractionary, and (2) an expectations effect, which may be expansionary when the public expects fiscal consolidation to improve government finances to such an extent that it increases confidence in the future and so stimulates current spending. They showed that in the case of Denmark and Ireland, effect (1) was overshadowed by effect (2), so that their economies expanded as a result of contractionary fiscal policies. For these countries, the perceived reduction in risk premiums is caused an increase in private sector spending.

[58] This implies that a reduced risk of fiscal disarray may also produce expansionary fiscal contractions or contractionary fiscal expansions (Giavazzi & Pagano, 1990).

[59] For example, expected future fiscal slippages may have an adverse impact on households' and firms' confidence and trigger a response that may run counter to the intended effect of the policy.

may have to prepare an involved spending bill that will go through several stages before submission to parliament, which may pass, modify or even reject the bill. If passed, it may take time to implement the measure and even longer for it to impact the economy (outside lags). Consequently, an intended ex-ante-countercyclical fiscal policy action could metamorphose into an ex-post-procyclical measure, undermining the achievement of the original objective.

3.2.2.1.6 Summary of theoretical predictions

The theoretical survey undertaken in this section can be roughly depicted as in table 3.1.

Table 3.1: Fiscal shocks and predicted outcomes

	Y	C	L^d	L^s	Real wage	Interest rate	Private investment	Trade balance	Real exchange rate
Keynesian: closed economy	+	+	+	-	-	+	-		
Keynesian: flexible exchange rate	=	+	=	=	=	=	=	-	+
Keynesian: fixed exchange rate	+	+	+	+	-	=	=	=	=
Real business cycle	+	-	=	+	-	+	+	-	+
NK	+	-	+	+	+	+	-	-	+
Separable utility	+	+	=	+	-	+	-	-	-
Deep habits	+	+	+	+	+	=	-	-	
Spending reversals	+	+	+	+	+	+		-	-
Rule of thumb	+	+	+	+	+	+	-		-

Note: Y is output; C is consumption; L^d is labour demand and L^s is labour supply. The + sign denotes a positive impact (appreciation in relation to exchange rate); whereas - signifies a negative impact (and a depreciation in relation to exchange rate); and = denotes no impact.

Source: Adapted from Hebous (2011) and Almeida (2012).

Apart from the Keynesian prediction in the case of open economy with a flexible exchange rate system, there seems to be consensus in the literature that fiscal expansion has an unambiguous positive effect on output. The reaction of other macro variables such as consumption, demand for and supply of labour, real wages, interest rate, and the real exchange rate are endogenously determined (responses are model specific). Authors are in strong disagreement about the way that these variables respond to fiscal stimulus. While traditional Keynesian models predict a positive response of consumption to fiscal expansion, the standard DSGE models (both NK and RBC

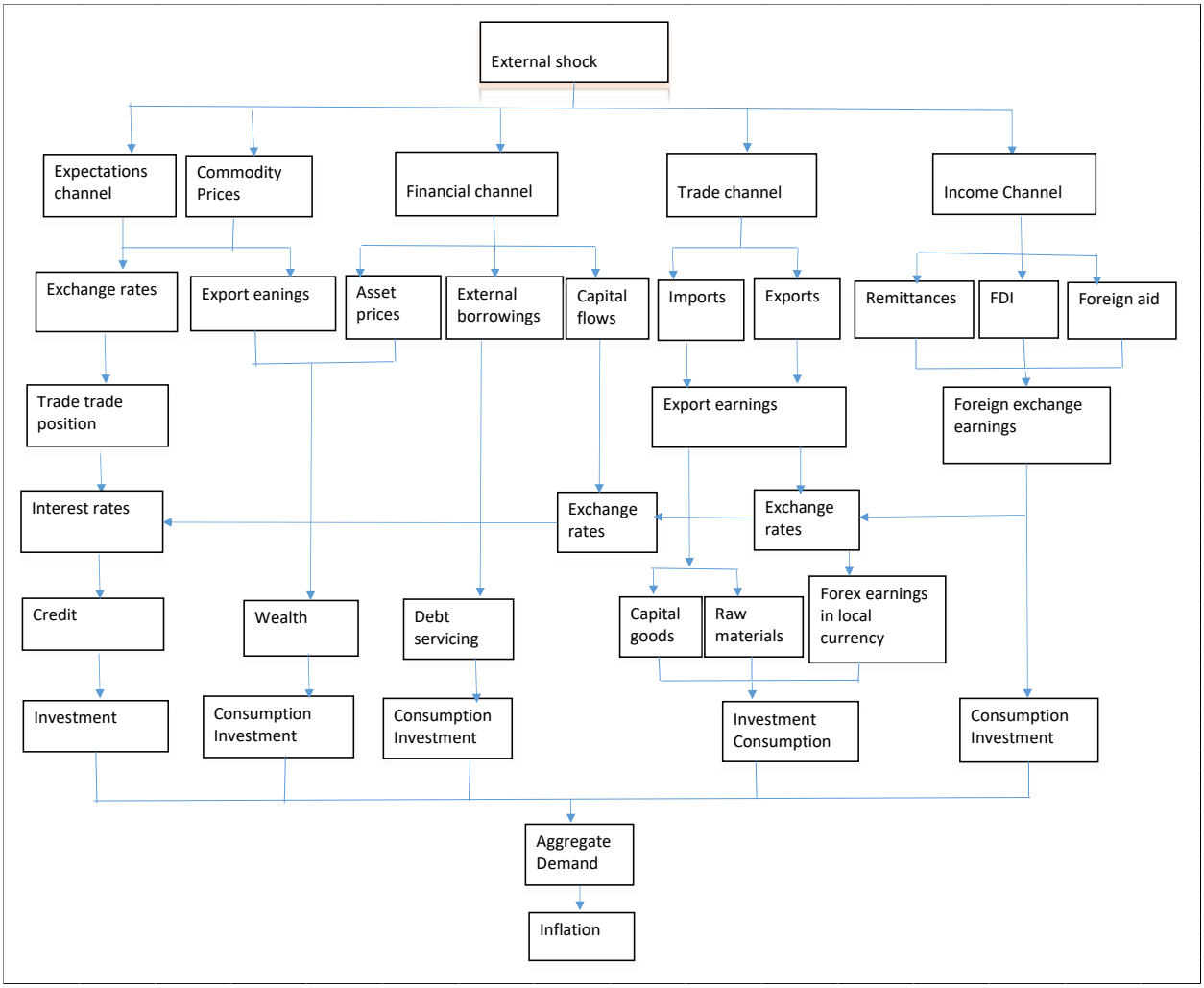
models) take the opposite view. The key point of departure in DSGE models relates to the response of real wages; it increases in NK models due to the predicted increase in labour demand, and it falls in RBC models because of the expected increase in labour supply. In a typical DSGE setup, the real exchange rate appreciates while the trade balance weakens after fiscal expansion. Some attempts have been made to modify the DSGE models to achieve a positive response from consumption and cause the real exchange rate to depreciate after an expansionary fiscal policy.[60] These entail modification of preferences, adoption of deep habits or non-separable utility or rule of thumb consumers or spending reversals as a mechanism to lower the public debt stock. It is evident from the discussion above that the literature remains miles apart in its quest to achieve a measure of consensus on the effect of fiscal policy (unlike monetary policy) on the economy.

3.2.3 Transmission channels of external shocks

External shocks are uncontrollable events that occur beyond the borders of a given economy but exert a substantial impact on its macroeconomic variables, such as output and prices. External shocks affect export earnings, import prices, the cost of foreign borrowing, the availability of foreign borrowing, the level of foreign assistance, remittances, foreign direct investment, the exchange rate and capital flows (see Tanzi, 1986). The literature distinguishes five main conduits via which external developments could be transmitted to the domestic economy. These are: the (1) trade channel, (2) financial channel, (3) expectations channel, (4) incomes channel, and (5) commodity price channel. The complex interactions among the various channels can be roughly

[60] Most DSGE models tend to cause the real exchange rate to appreciate after fiscal expansion (Hebous, 2011). Based on a model of deep habits, Ravn et al. (2006) however observe that the impact of fiscal expansion on the real exchange rate depends on whether the fiscal action is anticipated. While an anticipated fiscal expansion, on impact, causes consumption to decline and trigger the appreciation of the real exchange rate, an unanticipated fiscal expansion induces more consumption and the depreciation of the real exchange rate. Corsetti et al. (2012) observe the depreciation of the real exchange rate after fiscal expansion in their model of spending reversal.

illustrated as in figure 3.4, which clearly shows the importance of the exchange rate to all the channels.



Source: Author's construct based on Melo and Rincon (2012).

Figure 3. 4: Summary of a theoretical survey of the transmission channels of external shocks

Factors such as the strength of domestic policy prior to the shock and the level of integration into the global economy determine the relevance of transmission channels. The subsection below describes the conduits via which external shocks are propagated to the developing world, including the SSA.

3.2.3.1 Trade channel

The link between foreign trade and domestic macroeconomic prosperity has been the focus of most international trade theories. Basically, the trade channel is envisaged as operating through imports and exports of merchandise and other tradable services. For example, exports are envisioned to support domestic economic growth through a number of factors, including improved demand; access to more advanced technology; enhanced productivity (especially when exports are locally produced by foreign companies); economies of scale; research and development; and the optimal allocation of resources. The transmission of external shocks via the trade channel may emerge through the income effect and the competitiveness effect; either one of the two impacts is likely to be dominant. This means that a currency depreciation (devaluation) in a given country may not automatically produce a loss of welfare in other countries. For example, an exchange rate depreciation (or devaluation) in one country may improve that country's export competitiveness, shifting demand away from countries that produce comparable goods. However, these cheaper exports may enhance terms of trade in other countries, permitting them to finance a larger amount of consumption (the cheap import effect) at a given nominal income level (Corsetti et al., 2000; Forbes, 2002).

Usually, an external shock may well have an adverse effect on a country's output, inflation and employment as a result of its impact on the country's net exports (exports minus imports), inhibiting its ability to import critical raw materials and capital goods and also constraining employment and output in export dependent sectors. However, the impact of external shocks on developing countries via the trade conduit is influenced by the composition of trade or the extent of export diversification. The sharp decline of mineral and oil prices during the Great Recession

severely impacted the national budget of countries exporting oil and minerals. The transmission channel as illustrated in figure 3.4 may be stated as follows: A fall in aggregated demand abroad will lead to a fall in demand for developing countries' exports, particularly key primary commodities. This will shrink net exports and lower exchange rate earnings from exports, leading to the depreciation of the domestic currency in a flexible exchange rate regime. The lower forex earnings will affect investment and consumption while the depreciated currency will have pass-through effect on inflation. In addition, lower foreign earnings will also affect the country's ability to import critical capital equipment and raw materials to prop up domestic investment, hence output. However, the currency depreciation may be beneficial to the non-traditional export sector whose demand may remain stable during economic downturn in advanced economies.

The empirical literature seems tilted toward support for the power and relevance of the trade channel. Audiguier (2012), for example, contends that after the Great Recession there was a strong correlation between the growth losses of developing countries and the decline in demand for their exports. Berkmen et al. (2009) find that the trade channel is important in growth revisions, and that countries exporting manufactured goods are impacted more than countries exporting food. Similarly, Comert and Ugurlu (2015) find the trade channel to be the main propagation mechanism of the GFC – from advanced economies to the 15 worst affected developing countries.[61]

3.2.3.2 Financial channel

The effects of external shocks could be propagated via the financial channel to third world economies, including the SSA. These shocks are recorded in the capital (financial) account of the

[61] Botswana was the only country from the SSA among the 15 worst affected developing countries.

balance of payment and can refer to movements in external borrowings, flows in and out of (local and international) capital markets, asset prices, and the exchange rate. Rising interest rates in international capital markets emanating from tighter financing conditions in advanced economies may have important adverse repercussions for developing countries. As illustrated in figure 3.4, higher interest rates impact the costs of new loans and the ability to service the stock of existing foreign debt. Due to higher debt service obligations, government investment spending (including the importation of critical capital equipment) could be undermined with seriously negative consequences for the local aggregate demand and output. Higher debt obligations and even debt sustainability may result from a depreciation in the exchange rate. A weakening exchange rate in developing countries are known to increase foreign debt in the local currency, imposing an additional burden of debt service. For example, when Ghana's currency depreciated by some 32% in 2014, it added more than ten percentage points to the total public debt stock because foreign debt accounts for the greater part of the country's national debt.

The second leg of the financial channel through which external shocks can impact development in developing countries – and hence the SSA – is capital flow. Increased global financial integration has brought in its wake co-movements in financial cycles between developing and more advanced countries. Prior to the GFC, increased global financial integration encouraged investors from mostly the more mature markets to diversify their investment portfolios by taking positions in other markets, including in the SSA.[62] As noted by Prasad et al. (2003), financial integration is greatly beneficial to developing countries because of its potential to help them cope better with consumption and output volatility. This is because financial integration offers benefits such as

[62] The process of investment portfolio diversification can also influence the flow of FDI.

international risk-sharing to underpin consumption smoothing; improved macroeconomic discipline; increased domestic investment; and improved efficiency and stability of the domestic financial system (Agenor, 2003). However, financial globalisation also has potential costs as was amply demonstrated during the GFC when abrupt portfolio reversal and capital outflows from emerging markets and developing countries caused severe macroeconomic disruption, including a decline in domestic capital formation in these countries.

The transmission mechanism can be summarised as follows: aggregate demand shock in advanced economies creates financial stress, resulting in capital flow reversals from developing countries. As a result, the domestic currency comes under pressure to depreciate with the central bank likely to react by raising the short-term nominal interest rate to avert the disorderly capital outflow and stop the volatility in the forex market. The higher short-term nominal interest rate may lead to higher lending rate thereby discouraging credit demand with adverse consequences for investment and aggregate demand. The effect on price depends on the net effect of the negative aggregate demand and the positive supply side effects (see figure 3.4).

Depending on the degree of stock market integration between advanced economies and their counterparts in emerging markets and developing countries, a stock market collapse in advanced countries is easily transmitted to the developing world, where it affects stock returns and wealth, and hence consumption and aggregate demand (Lehkonen, 2014). The transmission mechanism can be traced as follows (see figure 3.4): the financial stress in advanced economies leads to collapse in the stock market in advanced economies that is transmitted to the stock markets in emerging markets and developing countries. As a result, asset prices in emerging markets and

developing countries collapse, creating negative wealth effect with undesirable implications for consumption and aggregate demand, hence output. This may however have a dampening effect on domestic prices (inflation).

3.2.3.3 Commodity channel

Developing countries, including most of the SSA, depend greatly on the export of a limited number of commodities such as cocoa, oil and a few minerals for their forex earnings. However, shocks could stem from unanticipated price variations of these few commodities emanating from changes in demand or supply conditions. For example, a ceiling on oil supply imposed by OPEC countries that constrains oil output may raise oil prices, which will hurt oil importing economies, but benefit oil exporting economies. An obvious example was the sharp oil price increases in the 1970s that reduced real incomes severely and devastated the economies of several oil-importing countries, but improved the real incomes of oil exporting countries. Oil price volatility has been known to amplify the difficulty of economic conditions in many developing countries. Broadly speaking, unfavourable terms of trade resulting from falling prices of export goods relative to import goods, may create resource-movement and spending effects. The transmission mechanism may be stated as follows: Lower export prices originating from falling international prices of export commodities lead to lower export earnings and hence lower wealth in the export dependent sectors of the economy; aggregate demand is subsequently impacted with implications for output, employment and inflation (see figure 3.4).[63] However, if the exchange rate depreciates as a result of low export earnings, exporters may be partially compensated as the depreciated currency increases export

[63] The extent of the impact of lower export prices on inflation may depend on whether such developments trigger currency depreciation and the extent of pass-through of the depreciation to domestic prices.

earnings in the local currency. The reverse transmission mechanism is true for a higher export price. In general however exchange rate volatility may introduce uncertainties and complicate trade outcomes (see Tanzi, 1986; Cordon, 1984; Funke et al., 2008). Hedging against exchange rate risk is possible but expensive.

3.2.3.4 Expectation channel

This channel operates through economic growth expectations. For example, if the growth expectations of investors in advanced economies weaken in times of crisis, capital outflows from emerging markets and developing countries back to the advanced economies may occur instantaneously in order to increase local liquidity in anticipation of the crisis. This will probably compel domestic currencies in developing economies to depreciate, amplifying the initial capital outflows with a further feedback loop to the exchange rate. An inelastic supply of and an elastic demand for exports, coupled with an inelastic demand for imports, will likely deteriorate trade positions prompting monetary policy in particular to respond endogenously by raising the short-term interest rate. As a result, long-term rates may increase, constraining credit, investment and hence aggregate demand and output. The impact on inflation depends on the net effects of the negative aggregate demand and the positive supply side effects (see figure 3.4). In normal times however uncertainty about future growth prospects in advanced economies will trigger capital outflows to developing economies, which will have opposite outcomes (Melo & Rincon, 2012).

3.2.3.5 Income channel

The income channel works via the effects of external shocks on remittances, foreign assistance in terms of grants, and foreign direct investment.[64] Migrant remittances remain a key avenue of forex inflow for several developing economies, and far exceed inflow in the form of official foreign aid (Kpodar & Le Goff, 2011). Remittances are tightly linked to the earnings of migrant workers, particularly those in advanced economies, which implies that a slowdown and consequent job losses in these economies are likely to reduce worker remittances. Primarily, remittances are sent either to complement the consumption of family and friends, or to repay debts, or to invest in residential housing. Remittances could also have the secondary effect of increasing the supply of forex in the recipient country, which could facilitate an increase in the importation of investment goods thereby boosting the local economy. A severe economic downturn in advanced economies, such as witnessed during the GFC and the COVID-19 pandemic, would reduce remittance inflows to developing countries, decrease consumption and investment, and hence aggregate demand, output and employment. The forex rate may also depreciate subsequent to reduced remittances, foreign aid and FDI flows, and potentially lead to the central bank's stamping out volatility in the emerging forex rate market. The resulting higher policy rate may trigger tighter credit conditions and dampen the demand for credit by both firms and households (see figure 3.4). Foreign aid and FDI to developing economies are to a great extent connected to the level of economic activity in advanced countries with implications for private investment and government budgetary spending, respectively (UNDP, 2011; Ricketts, 2011).

[64] Foreign direct investment can also be treated as going through the financial channel.

3.2.4 Changing transmission mechanisms and volatility of shocks

This subsection discusses possible reasons why the transmission mechanisms and volatility of monetary, fiscal and external shocks could have varied over time. Changes in the institutional arrangements of credit markets have the ability to affect the transmission mechanism of monetary policy by influencing, in particular, the imperfections in the market that underpin non-neoclassical conduits. Credit markets around the world underwent profound changes in the 1980s with the removal of direct control measures that had repressed the financial and credit markets throughout the 1970s and early 1980s. Market-based policies were introduced instead. The resulting financial liberalisation might have impacted the monetary transmission mechanism in respect of the credit market. Advancements in financial technology enhanced credit market efficiency with the emergence and growth of the shadow banking system, which permitted lending through the securities market, where otherwise illiquid assets are converted into marketable securities (securitisation). The shadow banking system allowed borrowers to sidestep traditional banks in search of credit. This may have diminished the importance of traditional banks in the credit market pointing to a weakening of the bank lending conduit. However, the shadow banking system, at least until the eruption of the GFC, eased access to credit, suggesting a greater role for the balance sheet channel, at least for households.[65] Important adjustments were made to the monetary policy strategy with fundamental shifts to the frameworks and instruments, and a more deliberate attempt to utilise expectations management as a crucial tool of monetary policy. Changes in the behaviour of monetary policy-makers may have a fundamental influence on the transmission mechanism (see Boivin et al., 2010).

[65] The shadow banking system and the process of securitisation associated with it was partly blamed for the GFC, because shadow banks invested heavily in highly risky subprime securities, were highly leveraged, and financed their investments with short-term repossession debt, which was prone to reversals leading to both illiquidity and insolvency.

Explanatory factors have been identified as potential sources of variation in the fiscal transmission mechanism. The first factor relates to modifications to the monetary policy strategy, which might have impacted the transmission of macroeconomic shocks more broadly, including fiscal transmission. The second factor buttresses the possible effects emanating from increased participation in the asset market after the removal in early 1980s of restrictions on the retail credit market, which may have changed the behaviour of private consumers. The restricted financial markets could have inhibited a huge proportion of households from exhibiting desired consumption smoothing behaviour, leaving them with suboptimal choices. In this regard, the observed change in the fiscal transmission mechanism around the early 1980s could be explained by the financial liberalisation policies introduced around the same time. It is entirely possible that over time, fiscal policy itself has undergone changes, perhaps in reaction to occurring alterations in monetary policy strategy (Bilbiie & Straub, 2004; Perotti, 2005; Bibiie et al., 2008).

Throughout the 1970s and early 1980s, most of the developing world had autarkic financial markets and, as a result, the transmission of external shocks occurred mainly via the trade channel in addition to adjustment in real exchange rates. However, the past four decades have seen an extraordinary surge in the process of capital account liberalisation in developing countries, which resulted in a considerable evolution in financial interdependency on advanced economies and among developing economies. These profound changes increased the integration of developing countries into the global economy and could also have changed the key transmission channels of external shocks to developing countries (Canova, 2005; Allegret et al., 2012). With specific reference to crude oil shocks, Baumeister and Peersman (2013) note that the economic impact of

oil price shocks on the US economy dropped to a sizeable extent. They attribute this to changes relating to the oil intensity of macroeconomic activity. This was a consequence of the reaction to the oil price shocks of the 1970s as industries in the US and other advanced economies slowly substituted oil for other sources of energy, improved conservation, and developed more energy-efficient technologies. The process was reinforced by the US's transitioning from an industry-based to a service-based economy and the increased outsourcing of industrial production to emerging countries, particularly in East Asia.

Dating back to the early 1980s, declining volatility in macroeconomic activity have been observed in many advanced economies. These volatility drops were apparent in macro variables such as output and employment, but also across most expenditure categories and industrial sectors. In addition, inflation and inflation volatility declined dramatically during the episode appropriately described as the Great Moderation (Primiceri, 2005; Davis & Kahn, 2008). Several candidates have been identified to account for the decreasing volatility of macroeconomic variables during the Great Moderation, including improved monetary policy practice, diminished exogenous shocks, increased integration of global financial markets, financial innovation and improved inventory management procedures (Stock & Watson, 2003; Kahn et al., 2002; Dynan et al., 2008).[66] Obviously the Great Moderation came to an abrupt halt with the advent of the 2007-2008 GFC, when volatility increased once again. However, more recently, Charleroy (2013) documents volatility reductions in macro data in BRICS countries. He attributes it to a shift to IT as a framework of monetary policy, complemented by the flexible exchange rate regime in most BRICS countries.

[66] However, as the GFC illustrates, financial innovation can also represent a source of instability in financial markets.

3.3 Review of empirical literature

Empirical research in the decades preceding the 1980s concentrated on policy shocks. These were usually identified from single equation analysis or large-scale econometric models. However, the advent of two significant novelties in the 1980s profoundly altered the course of research in the context of shocks. First, in an attempt to reconcile macroeconomics with reality in response to the Lucas critique captured in the quote at the beginning of this chapter, Sims (1980) introduced vector autoregressions (VARs), which transformed the analysis of structures set in motion via random shocks by establishing a link between macroeconomic shocks and innovations by way of a linear system. The discovery of VARs facilitated discussions on identification assumptions, impulse response functions, and innovation accounting by means of variance decomposition of forecast errors. Kydland's and Prescott's (1982) seminal article, 'Time to build and aggregate fluctuations', published in *Econometrica*, extended the study of macroeconomic shocks to non-policy shocks such as technological shocks. These innovations triggered a wave of empirical research into shocks and their transmission mechanisms. Cochrane (1994), for example, comprehensively reviewed the fundamental drivers of economic fluctuations by using VARs in the spirit of Sims.[67]

The next three subsections discuss relevant empirical works related to the propagation of monetary, fiscal and external shocks.

[67] Shocks Cochrane considered included oil price shocks, technological shocks, monetary policy shocks, credit shocks, and consumption or news shocks. However, the conclusion was drawn that none of the shocks considered could explain the greater proportion of economic fluctuations.

3.3.1 Monetary policy shocks

Using post-war US quarterly data, Primiceri (2005) assesses the possible origins of the less-than-desirable macroeconomic outcomes in the US prior to the mid-1980s, as well as monetary policy's role in the ensuing episodes of stagflation.[68] Primiceri contends that such an investigation requires an econometric model that has two distinct characteristics: (1) time-varying parameters to capture changes in monetary policy and inferred variations in the behaviour of the private sector, and (2) a multivariate system to help appreciate the reaction of the macroeconomy to variations in monetary policy.

Primiceri's multivariate time series TVP-VAR-SV model therefore incorporates time-varying coefficients to capture possible time variation or non-linearities in the VAR's lag structure and time variation in the variance-covariance matrix to gauge the possibility of heteroskedastic shocks and non-linear simultaneous interactions among the model's variables. These assumptions free up the data to evaluate potential time-dependent behaviour in the linear system that could originate from variations in the magnitude of the shocks or variations in the transmission mechanism. Here, the parameters are treated as unobserved variables that display a random walk without drift.[69] The study assumes that the initial states of the four key parameters in the model – coefficients, covariances, log volatilities and hyperparameters – are not dependent on each other. Priors distributed as independent inverse-Wishart are assumed for the hyperparameters. However, for the

[68] Data on the US inflation rate, unemployment rate, and a short-term interest rate run from 1953q1 to 2001q3.

[69] Other types of the TVP-VAR frameworks include the following: (1) parameters are allowed to switch between regimes propelled by an unobserved variable whose behavior mimics a Markov switching process (Sims & Zha, 2006); (2) multivariate extension of the STAR framework where parameters transition smoothly and permanently from one regime to another (He, Teräsvirta & González, 2005); (3) mixture innovation models that permit to evaluate whether, where, when and how parameters have evolved (Koop et al., 2009).

initial states of the time-varying log standard errors, simultaneous relations and coefficients, the priors are specified as normal distributions. Taken together, these assumptions produce normal priors for the coefficients, covariances and log volatilities conditional on the hyperparameters.

Bayesian techniques with the help of the Markov Chain Monte Carlo (MCMC) are used to estimate the unobservable states' posterior distributions and the hyperparameters of the variance-covariance matrix of the three-variable TVP-VAR-SV model. Primiceri (2005) concluded that monetary policy has exhibited time-varying behaviour over time so that systematic reactions by the short-term interest rate to unemployment and inflation show a tendency towards a more activist conduct, in spite of significant fluctuations. However, the effect on the US macroeconomy of the observed variation in monetary policy has been minimal, which gives a more prominent role to other exogenous shocks (i.e., non-policy shocks) in accounting for past periods of stagflation in the economic history of the US.

Following Primiceri's 2005 seminal work on the TVP-VAR-SV model, a flurry of studies examined the possibility of time variation in the monetary transmission mechanism. Benati (2008) utilised quarterly data on the growth rate of broad money (M4); GDP deflator inflation; a three-month nominal interest rate; and real GDP growth from 1959q1 to 2006q4; and a Bayesian TVP-VAR-SV to evaluate the underlying sources of the Great Moderation that started in the 1990s in the UK. Benati set the lag order to $p = 2$ and impose a stability condition on the VAR to help reject unstable draws. Whereas Primiceri (2005) identified only a monetary policy shock through Cholesky decomposition, Benati identified four structural shocks, namely non-policy demand shocks, supply shocks, money demand shocks and monetary policy shocks via the imposition of

appropriate sign restrictions on the impulse response functions (IRFs). Benati estimated the system using Bayesian methods with the help of the MCMC, which facilitates the simulation of the posterior distribution of the hyperparameters. Results reveal a fairly meagre long run reaction to inflation pre-1970/80, a clear rise during the Thatcher years, and an additional upswing under the IT regime. Overall evidence suggests that good luck played a central role in stabilising the macroeconomy in the latter part of the sample.[70] Evidence from two counterfactual simulations reveal that: (1) imposing the Monetary Policy Committee in the earlier periods would have had an insignificant influence on the higher inflation episodes of the 1970s but at a steadily higher sacrifice ratio, and 2) large (non-policy) demand shocks caused the higher inflation episodes. Benati (2008) also found evidence of the diminished significance of monetary aggregates during the IT era. Benati and Surico (2008) replicated the Benati (2008) approach using US macroeconomic data (short-term interest rate, inflation, output growth and money growth) spanning 1983q1 to 2005q4. They uncovered evidence of an evolution of the coefficients in the structural monetary policy rule.

In the case of Japan, Nakajima (2011) provides a broad synopsis of the estimation procedure for the TVP-VAR with stochasticity volatility, which facilitates the capturing of possible variations in the economy's basic structure in a way that is more robust and flexible. In Nakajima's view, incorporating stochastic volatility into the TVP-VAR framework markedly increases estimation performance. Nakajima cautions that the assumption of stochastic volatility renders the likelihood function intractable and advocates the use of MCMC techniques based on Bayesian inference to estimate the TVP-VAR-SV model. Nakajima subsequently provided empirical illustrations with

[70] This meant that the UK economy experienced relatively larger exogenous shocks in the 1970s with subsequent shocks becoming increasingly smaller.

the help of Japanese macroeconomic data spanning 1977q1 to 2007q4. Results of the three-variable model indicate significant differences in macroeconomic performance over the study period, suggesting potential structural variations in the Japanese economy over time.[71] Evidence from the time-varying IRFs points to substantial variations in the interactions among the macro variables.

Using quarterly data from 1996q1 to 2010q4, Franta et al. (2012) used the Bayesian TVP-VAR-SV to assess the transmission mechanism of monetary policy in the Czech Republic. In the benchmark model, they use seasonally adjusted GDP data to capture the level of economic activity; the three-month PRIBOR to proxy for the short-term interest rates and hence monetary policy; the nominal effective exchange rate to capture economy's connection to the rest of the world; and the CPI to indicate price levels.[72] They combined sign and zero restrictions as an identification strategy so as to discriminate between exchange rate and monetary policy shocks, given that the Czech Republic is an open economy.[73] Results from the time-varying IRFs indicate that output and prices are progressively more sensitive to monetary policy actions, which the authors attribute to the process of disinflation in the latter part of the sample; the deepening of the financial sector; and more persistent monetary policy shocks. However, the pass-through of the exchange rate gradually weakened, which reflects, according to the authors, that the credibility dividend from the IT framework implemented by the Czech National Bank (CNB) has helped anchor inflation expectations. Next, the benchmark model was augmented with the lending rate and credit to the

[71] Nakajima examined two sets of variables: inflation, output, and medium-term interest rates; and inflation, output, and short-term interest rates.

[72] PRIBOR refers to the Prague Interbank Offered Rate – the average interest rate that signals banks' preparedness to trade among themselves.

[73] As noted by Christiano et al. (1999), in a closed economy it is possible to set the recursive identification strategy in order to identify the impact of monetary policy shocks.

private sector to capture credit market developments. The results showed prices and output to have become more sensitive to credit shocks during the time of bank reform, as characterised by a more constrained access to credit. They conclude that the aggregate economy may have become less responsive to financial shocks in the context of a stable financial system.

With regard to Poland, Arratibel and Michaelis (2014) also followed the Bayesian TVP-VAR-SV model to investigate the time variation in the response of inflation and output to the exchange rate and monetary policy shocks that took place between 1996 and 2012. The variables included in the TVP-VAR model were consumer prices; the short-term interest rate; consumer prices; real GDP; and the exchange rate. The analysis was done on a quarterly basis. They allowed the dynamics of the time-varying coefficients and the variances to follow a driftless random walk with the co-variances following a geometric driftless random walk. For the priors, they use a training sample derived from the entire sample (i.e., 1996q1to 2012q3).[74] Sign and zero restrictions were used so as to differentiate between exchange rate and monetary policy impulses in view of Poland's open economy. Empirical results based on the IRFs indicate that the effects of monetary policy shocks vary over time. The impact on GDP was stronger initially but, as of the beginning of 2000, it weakened progressively despite a number of reversals at the onset of the GFC. Price responses also showed time variation – being stronger initially and then becoming weaker (e.g., the largest cumulative impact was estimated to be 1.4% in 1996q4 while the lowest cumulative effect of 0.3% was recorded in the first quarter of 2012 after four quarters.

[74] To ensure robustness, the priors were estimated on a subset of the sample.

Phan (2016) investigated possible time variation in monetary policy and its attendant transmission in four mature economies: Australia, Canada, the UK and the US using the TVP-VAR-SV framework. The basic framework incorporates the policy interest rate, the rate of unemployment, and the inflation rate, but augmented with the exchange rate in the case of Australia on the basis of it being a small open economy. Following Primiceri (2005) and Nakajima (2011), the study employed a recursive identification strategy with the variables ordered as follows: inflation, unemployment, and interest rate, which implies that a shock in monetary policy (interest rate) affects the non-policy variables with a lag.[75] Phan's 2016 paper used quarterly data spanning 1971q2 to 2011q4, and consciously avoided the potential biases associated with interest rates' reaching the zero-lower bound accompanied by extended unconventional monetary policy in those countries. In line with general empirical practice, a two-lag structure is employed to estimate the TVP-VAR-SV model, using Bayesian techniques with simulations based on 20 000 iterations of the Gibbs sampler. The paper differs from that of Primiceri (2005) by assuming the variations in inflation and unemployment are temporary and not permanent, which implies short run monetary policy reactions derived from the TVP-VAR-SV model and not the long run parameters implied by the Taylor rule. The results are summarised by the posterior means and indicate a more aggressive monetary policy reaction to unemployment in the latter part of the sample across the four countries. The paper also found that the impact of monetary policy shocks on inflation and unemployment has become weaker in recent times.

The studies discussed above all used TVP-VAR-SV techniques and relate mostly to advanced and emerging market economies. In a broad review of empirical works using VARs to assess the

[75] The exchange rate is placed last (i.e., after the interest rate in the case of Australia).

efficacy of monetary transmission in developing economies, including those in the SSA, Mishra and Montiel (2012) failed to find any concrete evidence that support the response of aggregate demand to monetary policy impulses consistent with the identified effects in the case of advanced economies. They therefore expressed their reservations about the potency of monetary policy in developing economies. They attributed this lack of potency of monetary policy to methodological shortcomings. These include the choice of a proxy for monetary policy, the absence of open-economy considerations in the estimated VARs, arbitrary identification assumptions and, more importantly, ignoring in-sample variations that can impact the functioning of the transmission mechanism. Confirming the methodological challenges in previous studies, Davoodi et al. (2013), in their study of the monetary transmission mechanism in the East African Community (EAC), discovered that standard statistical inferences (such as traditional VARs) reveal a weak response to policy shocks, and that non-standard inference techniques such as BVAR and FAVAR show a much stronger reaction.[76]

Thlaku (2011) considered the possibility of time variation in his evaluation of the South African monetary transmission mechanisms by estimating two reduced-form VARs, one for the monetary targeting regime spanning 1986q1 to 1999q4, and the other for the IT regime, spanning 2000q1 to 2010q4. Results from the data splitting VAR analysis show that the transmission mechanisms became stronger after the implementation of the IT framework.

This early attempt at investigating possible time variation in the transmission of monetary impulses in an African context may have led Mwabutwa et al. (2016) to use the TVP-VAR-SV model of

[76] Countries in the EAC block are Burundi, Kenya, Rwanda, Tanzania and Uganda.

Primiceri (2005) to examine the possibility that the financial liberalisation policy adopted in Malawi had a time-varying effect on the transmission mechanism of its monetary policy.[77] Four variables (consumer prices, exchange rate, bank rate, and GDP) are included in the baseline model. Private sector credit was subsequently added as a variable. Like Primiceri (2005), Benati (2008) and Nakajima (2011), Mwabutwa et al. (2016) estimated the system with a lag order of 1 (i.e., $p = 1$) using Bayesian methods and MCMC techniques. Furthermore, they used similar priors as Nakajima (2011). Empirical results based on the IRFs point to a clearer transmission mechanism after the launch of the financial liberalisation policy, which indicates an improvement in the macroeconomic environment. The price puzzle usually observed in the standard VAR model was not evident, which reinforced the methodological issues raised by Mishra and Montiel (2012).

Abdullahi (2016) used the TVP-VAR-SV framework to investigate possible time variation in the monetary policy transmission mechanism in Nigeria for 1970q1 to 2014q2. In the paper's view, the Nigerian economy underwent structural shifts and other changes in its monetary policy regimes, rendering inadequate the use of the standard VAR framework in assessing the importance of monetary policy in the dynamics of forex reserves, inflation, and output (real GDP). The TVP-VAR-SV model consists of four variables: forex reserves, short-term interest rate, real GDP and CPI inflation. Consistent with the general norm, the TVP-VAR-SV model was estimated using two lags with simulations based on 10 000 iterations of the Gibbs sampler, having discarded the initial 2 000 iterations. Normal distribution priors were set with the mean and variance selected from an Ordinary Least Squares (OLS) estimate of a traditional fixed parameter VAR framework based on a training sample of the initial 40 observations (quarters). The system's parameters were

[77] This paper is based on chapter 3 of Chance Ngamanya Mwabutwa's 2014 PhD thesis titled *Essays on financial reforms and monetary policy in Malawi*.

estimated using MCMC procedures with time-varying IRFs as the main tool of analysis. The results point to evident time variation in the monetary policy transmission mechanism, and in the variance of exogenous shocks. The paper also found monetary policy to play a substantial role in accounting for inflation dynamics in Nigeria.

In the case of Ghana, Abradu-Otoo et al. (2003) used quarterly data from 1969q4 to 2002q4 to examine the monetary transmission mechanism in a 7-variable structural vector error correction model (SVECM) with zero restrictions.[78] Due to conflicting results from the various lag order selection criteria, they chose an initial lag length of 4 to ensure the absence of serial correlation and to achieve parsimony. The two identified co-integrating vectors were normalised to form price and money demand equations. Based on the generalised IRFs, they discovered that the effect of monetary contraction is felt after the second quarter when inflation starts to fall, which pointed to the existence of a price puzzle. Once underway, the disinflation process takes up to eight quarters to return to its baseline. The results also revealed an exchange rate puzzle: After an interest rate hike, the bilateral cedi/USD exchange rate depreciated instead of appreciating. The contractionary monetary policy caused output growth to fall by 0.1%, returning to the pre-shock level 14 quarters later. In terms of the strength of the various channels, the study identified the exchange rate as the main channel through which monetary actions were propagated to the broader economy.

Kovanen (2011b) investigated the effectiveness of the interest rate channel of the MPTMs for Ghana using a two-stage approach. In the first stage, the paper looked at the impact of the short-

[78] The variables are real GDP, consumer price inflation, nominal exchange rate (i.e., bilateral cedi/USD rate), private sector credit as a percentage of GDP, 91-day treasury bill rate, and the world price of crude oil converted to local currency.

term policy rate on the wholesale interest rates (interbank rate and 91-day Treasury bill rate) with the help of constant parameter VAR and monthly data spanning December 2004 to April 2010. The paper ran a three-variable VAR consisting of the short-term policy rate, the interbank rate and the 91-day Treasury bill rate with two lags. The paper found that movements in the short-term policy rate influenced both the interbank rate and the 91-day Treasury bill rate despite the pass-through being faster for the interbank rate (46% and 44% pass-through achieved with a month's lag for the interbank rate and the 91-day Treasury bill rate, respectively). In the second stage, the paper simulated the impact of monetary policy actions on retail interest rates (deposits and lending rates) and found that retail interest rates reacted to monetary policy actions with a considerable lag of between five to six quarters. In the paper's view, such a sluggish response by retail rates is worrisome given the rapid reaction by wholesale rates. Kovanen (2011a) also examined the relevance of money for inflation dynamics and hence monetary policy in Ghana using a single equation inflation gap model for the period 1990q1 to 2009q4. The paper found that while money provides only limited information content in respect of Ghana's inflation dynamics, demand pressures (measured by the output gap) and currency depreciation hold useful information for future inflation in Ghana.

Other studies investigating the transmission of monetary policy in Ghana focused largely on estimating the demand for money function (Bawumia et al., 2008); a single inflation equation with money supply among the regressors (Ahiabor, 2010); using VAR estimation techniques (Nyumuah, 2018); and employing vector error correction model (VECM) estimation methods (Akosah, 2015). Results from these studies are plagued by issues relating to parametric shifts and the inherent price puzzles identified in the IRFs.

While these works are relevant to the current study, they are underpinned by strong assumptions of time-invariant coefficients and constant volatility of exogenous monetary shocks. This study relaxes both assumptions by using the TVP-VAR-SV framework to accommodate possible time variations in both the monetary policy propagation mechanism and the variances associated with the monetary policy shocks.

Table 3.2: Summary of empirical works on monetary transmission mechanism

Author and date	Country or region	Sample period and data frequency	Variables	Methodology and identification strategy	Main findings
Abradu-Otoo et al. (2003)	Ghana	1969q1 to 2002q4	Real GDP, CPI inflation, nominal exchange rate (bilateral cedi/USD), private sector credit to GDP ratio, 91-day Treasury bill rate, world crude oil price in local currency	SVECM, zero restrictions	The exchange rate channel is the main conduit via which monetary policy impulses are propagated to the economy.
Davoodi et al. (2013)	EAC block	January 2000 to December 2010	Real GDP, CPI, reserve money, short-term interest rate, private sector credit, nominal effective exchange rate (NEER), US federal funds rate, US industrial production, global food price index, global oil price index	Traditional constant parameter VAR, BVAR, FAVAR	The monetary transmission mechanism tends to be broadly feeble when applying standard statistical inferences (such as traditional VARs), but appears to be strong when employing non-standard inference techniques such as BVAR and FAVAR.
Thlaku (2011)	South Africa	1986q1 to 2010q2	Real GDP, repo rate, CPI, real effective exchange rate (REER), credit to the private sector, all share index, money supply	Split sample (two-period) traditional constant parameter VAR	The monetary transmission mechanisms became stronger after the implementation of the IT framework.
Kovanen (2011a)	Ghana	1990q1 to 2009q4	Inflation, output, money supply, NEER	Generalised Method of Moments (GMM)	Money has limited information content for future inflation dynamics while currency depreciation and demand pressure are key indicators of future inflation.
Kovanen (2011b)	Ghana	December 2004 to April 2010	Short-term policy interest rate, interbank rate, 91-day Treasury bill rate	Constant parameter VAR	Variations in the short-term policy interest rate have a significant effect on both interbank and 91-day Treasury bill rates.

Primiceri (2005)	USA	1953q1 to 2001q3	Federal funds rate, real GDP, unemployment	TVP-VAR-SV, recursive identification	Monetary policy has varied over time. Systematic reactions of the short-term interest rate to unemployment and inflation show tend toward a more aggressive behaviour despite significant fluctuations.
Benati (2008)	UK	1959q1 to 2006q4	Real GDP growth, 3-month nominal interest rate, GDP deflator inflation, broad money growth	TVP-VAR-SV, sign restrictions	The structural monetary policy rule reveals a fairly meagre long-run reaction to inflation before 1970/80, an evident rise during the Thatcher years, and an additional upswing under the IT regime. Good fortune played a central role in anchoring a better macroeconomic context in the latter part of the sample.
Nakajima (2011)	Japan	1977q1 to 2007q4	Inflation, output, medium-term interest rate, short-term interest rate	TVP-VAR-SV, recursive identification	There were significant differences in macro performance over the study period, which suggests potential structural variations in the Japanese economy over time. Evidence from IRFs points to significant changes in the interactions among the macro variables.
Franta et al. (2012)	Czech Republic	1996q1 to 2010q4	Consumer price index, GDP, NEER, 3-month, PRIBOR[79] augmented with lending rate and credit	TVP-VAR-SV, sign and zero restrictions	Output and prices have become more sensitive to monetary policy actions due to disinflation in the latter part of the sample, financial sector deepening, and a more persistent monetary policy shock.
Arratibel & Michaelis (2014)	Poland	1996q1 to 2012q3	Short-term interest rate, consumer prices, real GDP, exchange rate	TVP-VAR-SV, sign and zero restrictions	The response of macro variables exhibits time variation over time.

[79] PRIBOR refers to the Prague Interbank Offered Rate, which is the average interest rate at which banks are prepared to trade among themselves

3.2.1 Fiscal policy shocks

Empirical regularity regarding the impact of monetary impulses on inflation, output and other macroeconomic variables has been well established, while no such consensus exists, even qualitatively, in the empirical literature on fiscal shocks (Perotti, 2007). This is a direct consequence of the conflicting theoretical underpinnings of the basic Keynesian model and the neoclassical model. The basic Keynesian model predicts increases in GDP and private consumption after an unexpected expansionary fiscal policy, whereas the neoclassical model holds the opposite view.[80] In a sense, the mantle has fallen on empirical research to resolve key issues left unresolved by economic theory, particularly the magnitudes of the impacts on output (i.e., the multipliers), and the qualitative reaction of other important variables, including interest rates and private consumption.

As in the case of monetary policy, VAR frameworks have assumed prominence in the evaluation of the dynamic reaction of economic variables to fiscal policy shocks. First generation fiscal VAR models typically employ a three-dimensional vector[81] (see Perotti, 2007), with later works have extended the model to account for other important macroeconomic variables, including inflation, interest rates and private consumption. While disparities exist in the way that various reduced-form VAR models are specified with regard to for example the set of endogenous variables, sample period, lag length and deterministic terms, the main distinguishing feature of empirical studies on fiscal shocks relates to the approach adopted to identify these shocks (see Caldara and Kamps, 2008). There are four key ways of identifying shocks emanating from fiscal policy, namely the recursive identification technique originally suggested by Sims (1980) and later used by Fatas and

[80] See table 3.2 detailing the theoretical expectations regarding the qualitative reactions of major fiscal variables.
[81] For example, *K* = [spending output taxes], where *K* is a vector.

Mihov (2001), as well as Corsetti and Muller (2007); the structural identification approach popularised by Blanchard and Perotti (2002) and extended by Perotti (2007); the sign restriction approach suggested by Mountford (2005) and applied by Mountford and Uhlig (2009); and the narrative or dummy or event-study approach. The latter attempts to separate the classic aberration from the usual route of the endogenous variables brought about by a number of unusual post-war fiscal events – mainly military build-ups driven by US foreign policy such as the Korean and Vietnamese wars, and the Carter-Reagan and Bush build-ups (Perotti, 2007).

Irrespective of the identification approach adopted, many VAR analyses of fiscal shocks document a hump-shaped increase in output following on positive government spending shocks despite differences in the magnitude of the effect and the peak response. Even in the same empirical literature, the magnitude of the multiplier is a function of the sample period and/or the model specification. Perotti (2005), for example, documented a negative multiplier for certain sub-samples for Canada, the UK and Australia. The paper noted a gradual diminishing influence of fiscal policy shocks on the components of the US GDP. Bilbiie et al. (2008) attributed this to a more active monetary policy and the role of increased asset market participation. In the case of a tax shock, Blanchard and Perotti (2002) discovered that in the US, the impact multiplier emanating from a tax increase is about -0.7, a finding confirmed by Romer and Romer (2010). Consistent with spending shocks, Perotti (2005) observed that the direction of the multiplier is sensitive to the study period in certain OECD countries. Hebous (2011) concluded that evidence does not undoubtedly underpin the Keynesian prediction that the multiplier of a tax reduction is smaller than that emanating from a positive spending shock.

Evidence on the consumption response to fiscal shocks is dependent on the identification approach adopted and therefore not unambiguous. For example, results from studies based on the Blanchard-Perotti or the recursive identification schemes generally document that consumption responds positively from a positive spending shock (see Blanchard & Perotti, 2002), while evidence from studies using sign restrictions is mixed with Pappa (2009) reporting a positive response of consumption but Mountford and Uhlig (2009) finding evidence for a zero and insignificant response of consumption in the case of the US. Ramey (2011)'s narrative approach reveals a negative impact on consumption for the US. For both tax and spending shocks, evidence from VAR estimates do not definitively support any particular theoretical prediction.

Burnside et al. (2004) found that employment increases due to positive spending shocks, which is consistent with the positive response of output. Blanchard and Perotti (2002) documented a positive but weak impact on real wages after a positive spending shock. Caldara and Kamps (2008) found a muted interest rate reaction to fiscal shocks.

The empirical literature discussed so far appears to depend strongly on methodology. In addition to the identification challenges, the VAR models that were used, overlooked the possibility of time variation in the fiscal data. Ramey (2011) recognised this possibility by employing a sub-sample strategy in the study of spending shocks in the US and presented evidence of instability showing different effects of fiscal policy depending on whether or not the sample included World War II. Using rolling window analysis, Rebei (2017) scrutinised US fiscal data for a possible crowding-in effect on private consumption after a government spending shock. The paper concluded that the crowding-in effect observed in the earlier part of the sample reverted later on. Pereira & Lopes

(2010) contended that the problem of time heterogeneity must be carefully addressed to ensure that the effects of fiscal shocks after profound structural variations are accurately determined. In the view of Pereira & Lopes (2010), fiscal policy itself might have lost its effectiveness in stimulating consumption and output in the advanced economies since the 1980s. The TVP-VAR-SV model became the standard approach to analysing shocks since the seminal work of Primiceri (2005). Initially, the model was applied mostly to monetary impulses and their macroeconomic responses in advanced countries.

Kirchner et al. (2010) were the first to employ the TVP-VAR-SV model to analyse fiscal shocks, attributing its superiority over the constant parameter VARs and sub-sample estimation methods to: (1) the inability of the standard VAR to easily and precisely identify structural changes a priori; (2) the fact that fiscal multipliers may not change in a monotonic manner as implicitly assumed in the standard VAR; and (3) possible arbitrariness in the dating of a perceived structural break under the standard VAR. Using a four-variable VAR consisting of the interest rate, private consumption, GDP, and government spending (all, except the interest rate, in real per capita terms) with quarterly data spanning 1980q1 to 2008q4, they investigate eurozone government spending shocks. They evaluate their TVP-VAR model with a Bayesian inference approach and MCMC techniques, which permits them to simulate the posterior distribution of the hyperparameters. They also follow a recursive identification scheme by ordering government spending first to shield it from the contemporaneous impact of the other variables ordered after it.[82] They report the time-varying IRFs for three separate quarters available in the sample, namely 1980q1, 1995q4 and 2008q4. The results indicate that the contemporaneous reactions of consumption and output to a spending shock

[82] They use government spending net interest payments.

decreases over time.[83] For example, the impact multipliers based on the point estimates are 0.37 (consumption) and 0.72 (output) in quarter four of 1980 compared to 0.28 (consumption) and 0.42 (output) in quarter four of 2008. The result also shows that the persistence in the responses of output and consumption have evidently reduced over time with the output response to the shock being positive between six and seven quarters in quarter four of 1980, four to five quarters in quarter four of 1995 and three to four quarters in quarter four of 2008. They also observe a sturdier reaction of the short-term nominal interest rates and a weaker reaction of real wages to spending shocks. They conclude that the efficacy of public spending to stabilise private consumption and real GDP has decreased over time with substantial reduction in government spending multipliers.

Using quarterly US fiscal data spanning 1965q2 to 2009q2, Pereira and Lopes (2010) assess possible time variation in the transmission mechanism of US fiscal policy with the help of a TVP-VAR-SV model. The baseline model specification consists of four variables, namely, inflation, GDP, net taxes, and government expenditure, which they subsequently augment with private consumption. Unlike Kirchner et al. (2010), they rely on Blanchard and Perotti (2002)'s (structural) identification scheme with calibrated elasticities of spending to prices and net taxes to output but an estimated price elasticity of taxes. They assume the coefficients and the co-variances to track a driftless random walk process with the volatility states evolving as geometric random walks. Initial states priors are assumed to be Gaussian with point estimation based on a constant parameter VAR spanning 1947q1 to1959q4. They simulate the heteroskedastic TVP-VAR using standard Bayesian methods with the hyperparameters assumed to have conjugated inverse-Wishart

[83] They also report results from a fixed-parameter Bayesian VAR model which generally indicate both output and private consumption respond positively to government spending shock, turning negative after 13 quarters (output) and 15 quarters (private consumption) before gradually returning to their initial levels.

priors. In order to validate the application of the TVP-VAR-SV, they undertake two separate parameter instability tests: Nyblom-Hansen test and the Quandt likelihood-ratio statistic intended to test for parameter constancy vis-à-vis an unknown single breakpoint.

The results broadly support the application of TVP-VAR-SV model instead of sub-sample or rolling-sample fixed coefficient VARs with constant volatility. Results from the TVP-VAR-SV framework point to dwindling impacts of tax shocks over the study period of simulation with the impact multiplier gradually declining to -0.4 by 2009 from about -0.8 in the 1960s. For government spending, the extent of time variation appears limited as the impact multiplier increases from 0.25 in the earlier parts of the sample to stabilise around 0.5 at the latter part of the sample. Further evidence presented indicates a weakening impact of fiscal policy over time, with the effects of taxes more pronounced than spending. For private consumption, they find that a positive shock to net taxes steadily moderates private consumption with the multipliers one year ahead and even for longer horizons remain within the vicinity of -0.5 over the entire period. Positive shocks to government spending are found to produce a slightly negative contemporaneous consumption multiplier but over a longer horizon, a small positive value of not more than 0.3 in the early years, decaying to essentially zero in later years.[84] In their view, this evidence is incongruous with the huge Keynesian effect of spending shocks on consumption. On possible time-varying behaviour of fiscal policy, they discover an increasing countercyclical reaction of taxes to output over time, appearing to peak during the 2008-2009 recession. On the other hand, expenditure tend to respond countercyclically to output over time, exhibiting decreasing tendency over the study period.

[84] The authors compare the results from the TVP-VAR with those derived from a 25-year rolling-sample with the results consistently showing TVP-VAR model to have much less instability.

Boiciuc (2015) also apply the Bayesian TVP-VAR-SV model to ascertain the macroeconomic impacts of fiscal policy in Romania. The study uses quarterly data on government spending, government revenue and GDP spanning 2001q1 to 2013q3. The three-variable system follows a recursive identification strategy whereby spending is ordered first, followed by GDP and government revenue put last. The study employs Bayesian techniques to estimate the model with the hyperparameters assumed to have independent inverse-Wishart priors. The initial values of the model's parameters are derived from OLS estimates based on the initial twenty-seven observations of the data. Results based on the IRFs indicate a positive output reaction to a positive government spending shock but its intensity has reduced over time with the fiscal multipliers consistently less than one spanning the entire study period. Real GDP's response to a tax revenue shock appears to be positive initially but becomes negative beyond one year. Evidence obtained from the TVP-VAR-SV also shows a greater impact of a spending shock on real GDP compared to that obtained from the fixed-parameter VAR model. On the basis of the positive but generally small fiscal multipliers, the study concludes that fiscal policy has lacked potency to be the key catalyst of aggregate economic activity in Romania.

Ferreira (2015) assesses the response of private consumption to government spending shock in Brazil with the help of TVP-VAR-SV model. The specification includes private consumption, the interest rate, real GDP, and government final consumption expenditure. The model is estimated with Bayesian techniques spanning 1996q1 to 2014q2. The results reveal that fiscal policy through government spending has become a more effective tool to stimulate the Brazilian macroeconomy from the beginning of 2007. The estimated time-varying IRFs of GDP also indicate that the

persistence of the shock appears to have increased somewhat at the end of 2002, which he attributes to the election of Lula as president of Brazil. The author discovers that private consumption responds positively to positive government spending shock, confirming a crowding-in effect, with the effect appearing to be unchanging over time.

In the case of Africa, Jooste et al. (2013) investigate possible time variation in the transmission of public spending shocks in South Africa using a TVP-VAR-SV model. The framework's time-varying properties follow the usual random walk processes with the innovations assumed to be normally distributed. They employ quarterly data spanning 1970q1 to 2010q4 on general government expenditure, interest rates, and household consumption. The model is estimated based on Bayesian inference with the first seven years used in calibrating the prior distributions. Time-varying IRFs are generated for 1994, 1999, 2007, 2008 and 2009 with the results showing that South Africa's fiscal policy prior to 2000 was procyclical in nature but became less so thereafter.[85] The computed multipliers are generally less than one during the pre-2000 period and take about five quarters to exert its full effect on the South African macroeconomy. The authors observe that the largest multipliers were recorded during the build-up to the 2007/09 GFC. They conclude that fiscal policy in South Africa is effective in the short-run and that the authorities must avoid running large fiscal deficits for extended periods.

Most of the studies reviewed above apply to advanced and emerging market economies (South Africa included in this group). The only attempt in the case of the entire SSA (excluding South

[85] Du Plessis et al (2007) also find evidence pointing to a procyclical fiscal policy in South Africa since 1994 which seems to have become even more procyclical in the latter part of the sample. In a similar vein, Calitz and Siebrits (2003) contend that South African fiscal authorities have not pursued countercyclical policies since the latter part of the 1970s.

Africa) was made by Akpan and Atan (2015) who use a fixed-parameter structural vector autoregression (SVAR) with recursive identification to assess the fiscal transmission mechanism in Nigeria with the results indicating that output and inflation respond asymmetrically to different components of government spending.

Table 3.3: Summary of empirical works on fiscal transmission mechanism

Author and date	Country or region	Sample period and data frequency	Variables	Methodology and identification strategy	Main findings
Akpan & Atan (2015)	Nigeria	1980 to 2010 Annual	Government consumption, real output, inflation rate, real interest rate, private investment	Fixed parameter structural VAR with recursive identification	Fiscal expansion through capital spending has a positive significant impact on private consumption and output while fiscal expansion via higher business taxes has the opposite effect.
Gemechu (2018)	Ethiopia	2000/01 to 2015/16 Quarterly	Government spending, taxes, real GDP, interest rates, exchange rate	Bayesian VAR	Fiscal expansion via government spending has a small positive impact on output and inflation but the effect on interest is negative.
Alimi et al. (2015)	Nigeria	1970 to 2013 Annual	Government revenue and expenditure, fiscal balance, lending rate, exchange rate, trade/GDP ratio, money supply/GDP ratio, per capita income	Fixed parameter VAR with recursive identification	Fiscal policy shocks have a significant impact on the Nigerian macroeconomy.
Kirchner et al. (2010)	eurozone	1980 to 2008 Quarterly	Government spending, real GDP, real private consumption, short-term interest rate	TVP-VAR-SV with recursive identification	The efficacy of public spending to stabilise private consumption and real GDP decrease over time with a substantial reduction in government spending multipliers.
Pereira & Lopes (2010)	US	1965 to 2009 Quarterly	Government spending, net taxes, GDP, inflation	TVP-VAR-SV with structural (non-recursive Blanchard-Perotti) identification	Results point to dwindling impacts of tax shocks over time while the extent of time variation in spending, appears limited. For private consumption, the evidence is incongruous with the huge Keynesian effect of spending shocks on consumption. Taxes show an increasing countercyclical behaviour.

Boiciuc (2015)	Romania	2001 to 2013 Quarterly	Government expenditure, GDP and government revenues	TVP-VAR-SV with recursive identification	Results indicate a positive output reaction to a government spending shock but its intensity reduces over time. The real GDP response to a tax revenues shock appears to be positive initially but becomes negative beyond one year. The study concludes that fiscal policy has lacked potency to influence economic activity in Romania.
Ferreira (2015)	Brazil	1996 to 2014 Quarterly	Private consumption, government consumption expenditure, real GDP, short-term interest rate	TVP-VAR-SV with recursive identification	As of 2007, fiscal policy via government spending has become a more effective tool to stimulate the Brazilian macroeconomy.
Jooste et al. (2013)	South Africa	1970 to 2010 Quarterly	Government expenditure, interest rates, household consumption	TVP-VAR-SV with recursive identification	South Africa's fiscal policy prior to 2000 was procyclical but became less so after 2000.

3.2.2 Transmission of external shocks

Dornbusch (1985) made an early attempt to assess the effects of dynamics in large markets on world prices and therefore on developing countries' business cycles. Using a simple framework of a semi-open small economy, he explored the channels through which developments in OECD countries impact economic performance in less developed countries (LDCs), particularly those in Latin America and Asia. The paper observes that sustained growth in OECD countries promotes growth in LDCs with trade being the main conduit. In the paper's view, economic growth in OECD countries influences LDCs by improving their external position and creditworthiness, thereby enhancing their access to capital. Additional capital subsequently enables LDCs to pursue growth-enhancing policies. The paper therefore concluded that economic dynamics in advanced economies have significant trade and welfare consequences for LDCs.

Calvo et al. (1993) investigated the notion that external shocks are directly responsible for the dynamics in small open economies in Latin America. Using principal components analysis and vector autoregressions (VARs), they concluded that external shocks remain the core drivers of real exchange rate volatility in most Latin American economies. Using VARs on a bilateral basis, Canova (2005) found evidence suggesting that the largest proportion of the dynamics in Latin American economies can be attributed to Fed monetary policy actions. Rusnak and Horvath (2008) employed a VAR framework with a Blanchard-Quah identification scheme to assess the effects of external shocks on the real economy in several transition economies. They concluded that developments in large economies have a substantial effect on the dynamics in small open transition economies.

Uguyen et al. (2014) ascertained the influence of external shocks on seven East Asian countries using structural VARs.[86] They discovered that US monetary policy and oil price shocks had significant consequences for the volatility of domestic economic variables. Sosa (2008) studied the importance of US factors for business cycle fluctuations in Mexico. Based on a VAR framework with block exogeneity restrictions, the study noted that US economic dynamics accounted for a very large proportion of economic variations in Mexico, particularly during the post North Atlantic Free Trade Agreement (NAFTA) period with the most important driver being the US GDP. Andrle et al. (2013) investigated the link between eurozone economic conditions and macroeconomic trends in Poland using a trend-cycle VAR model and data on output, the policy interest rate, inflation, and the exchange rate. They imposed block exogeneity restrictions which allowed them to identify how external factors impacted the evolution of Poland's business cycles from 1999-2012. They found that developments in the eurozone accounted for some 50% of business cycle variance of output and interest rate and some 25% of inflation variance in Poland.

Other studies used VARs to assess the influence of diverse forms of external shock on the macroeconomic context in Africa. The external shocks they investigated, included foreign demand, terms of trade, and cost of borrowing shocks (Selim, 2008; Amira, 2013; Mangadi & Sheen, 2016); agricultural price shocks (Addison & Ghoshray, 2013); private capital flow shocks (Alley & Poloamina, 2015); commodity price shocks (Haile, 2016); oil price shocks (Oyelami & Olomola, 2016); and financial shocks (Ncube et al., 2012). These studies document a significant impact of external shocks on macroeconomic and financial developments across the African

[86] China, Indonesia, Malaysia, Philippines, Singapore, South Korea, Vietnam.

continent with the financial and trade channels being particularly important in the propagation process.

In the case of Ghana, Nchor et al. (2016) explored the macroeconomic response to oil price shocks using VARs and the VECM for forecasting. Their findings point to an asymmetric response of macroeconomic variables to negative and positive shocks. They concluded that oil price shocks are generally detrimental to Ghana's economy. In similar vein, Kpogli (2014) used VARs to examine the influence of oil price shocks on inflation in Ghana. Her results indicate a positive weight of oil price shock on inflation in both the short and the long run. The study revealed that an increase in the oil price results in higher inflation both directly and indirectly via the exchange rate.

Although the aforementioned literature is relevant to the current study, they rely on the assumption of fixed coefficients without due consideration of the fact that an economy's dependency on other economies may evolve over time. This happens because of stronger domestic policies, increased financial integration, alterations in the composition of trade, and variations in the importance of crude oil to the domestic economy (Mumtaz, 2016; Baumeister & Peersman, 2013), all of which played an important role in Ghana.

Shioji and Uchino (2012) employed a TVP-VAR model with stochastic volatility (with the co-variances assumed to be constant) that allowed them to assess the influence of external shocks on the Japanese business cycle as it related to aggregate industrial production, particularly the automobile industry. This industry was severely affected during the GFC as global export demand

fell dramatically. The variables they considered are oil prices, the exchange rate, US total imports, EU total imports, Japanese automobile exports, automobile production in Japan, and general industrial production in Japan. They estimated the model using a monthly dataset spanning the period July 1980 to December 2010. The IRFs were estimated at five-year intervals between January 1985 and January 2005 (to measure pre-crisis responses) and other IRFs generated for October 2008 (to capture the onset of the crisis); December 2008, and March 2009 (to account for the most severe period of the crisis), and June 2009 (to mark the end of the crisis). Based on their results they concluded that structural variation was not evident in the link between automobile exports and foreign sector variables throughout the period preceding the crisis. This may have been because of Japan's protracted deflationary recession in the 1990s to early 2000s.

Using Bayesian TVP-VAR-SV, Baumeister and Peersman (2013) determined whether oil supply shocks have had a time-varying impact on real economic activity in the US. They used quarterly data spanning 1947q1to 2011q1, with the first 25 years as a training sample to create priors. The maximum lag length for the VAR was set at four (i.e., $p = 4$) to capture lags in the transmission of oil shocks and permit adequate dynamics in the structure. Variables included in the VAR model were US consumer prices, US real GDP, the real cost of US refiners' acquisition of imported crude oil, and global oil production. They assumed the time-varying parameters tracked a driftless random walk route while the vectors of volatility were independent of each other and evolved as geometric random walks. They hypothesised a block-diagonal system in the case of the co-variance matrix due to its appropriate characteristic of abridging inference and raising the efficacy of the estimation procedure. They relied on sign restrictions to identify the structural oil supply shocks based on a basic model of competitive market dealing in crude oil. Based on the IRFs, they

found a significant weakening in the responsiveness of oil prices to oil demand dating back to the 1980s. In their view, this discovery could help clarify why, over time, oil prices tend to respond more strongly with more severe macroeconomic outcomes to the same oil production shortfall, whereas an equivalent increase in the oil price is connected to a smaller impact on output. They observed that the impact exerted by oil supply shocks on real price variability has become smaller in more recent times, whereas oil demand shocks have assumed a more prominent role. In conclusion, they noted that the overall effect of oil supply shocks on the US economic activity has lessened.

Kim et al. (2014) analysed the reaction of monetary policy (interest rate) to oil price shocks in China using variants of VAR models, including the TVP-VAR-SV model with recursive identification.[87,88] They indicated that the TVP-VAR-SV framework is aimed at testing whether the monetary policy response to oil price shocks had evolved over time. The study was based on monthly data of the real price of oil, oil production, China's industrial production, the CPI, the one-year lending rate, and the real exchange rate. They considered data from January 1992 to May 2014. The priors and the initial states are based on Nakajima (2011), and Bayesian techniques (MCMC algorithm) were used to estimate the model based on 10 000 draws and 1 000 burn-ins. Diagnostic tests confirmed convergence and efficiency. The results presented (using IRFs) indicated time variation in monetary policy to oil price shocks in China.

[87] Other VAR types used are structural VAR with short-run identification and a VAR with generalised impulse response.

[88] Recursive identification involves ordering world oil production first, followed by oil price. Domestic variables are subsequently ordered. This is consistent with Kilian (2010).

More recently, He and Zhou (2018) studied the implications of an oil-specific demand shock for investor confidence in China using the TVP-VAR-SV framework of Primiceri (2005). The variables of interest were world crude oil production; investor sentiment index; the real price of crude oil; and global real economic activity, from 1986m1 to 2015m9. The model was estimated by an MCMC algorithm via Bayesian inference. The simulations performed were based on 20 000 iterations. The initial 2 000 were discarded and diagnostic tests performed to achieve convergence and efficiency. The reaction of investor sentiment to an oil-specific demand shock is displayed using time-varying IRFs based on the recursive identification for three selected horizons of four, eight, and twelve periods forward. The authors discovered that an oil-specific demand shock displayed a marked positive effect on investor sentiment over the different time horizons, and also over time, apart from 1990-1992 when the impact turned negative but insignificant. The paper notes that the negative non-significant impact was due to the Gulf War that triggered disruption in the oil supply in Iraq and Iran together with the associated persistent hike in oil prices.

Researching developing countries, Winkelried and Saldarriaga (2012) employed an SVAR approach to investigate trade linkages and growth in Latin America. They used real GDP growth rates spanning 1989q1 to 2011q2 collected from nine Latin American countries,[89] two North American countries,[90] eight European countries,[91] eight Asian countries,[92] and two from Oceania.[93] The bilateral trade weights were allowed to change over time, which permitted them to calculate time-varying IRFs. The computed IRFs indicated that domestic US and German shocks triggered

[89] Venezuela, Uruguay, Peru, Mexico, Ecuador Colombia, Chile, Brazil, Argentina.
[90] Canada and the US.
[91] The UK, Italy, Sweden, Spain, the Netherlands, Germany, France, Switzerland.
[92] India, South Korea, Malaysia, Japan, Thailand, Mainland China, Singapore, Hong Kong.
[93] Australia and New Zealand.

substantial and robust reactions throughout Latin America with the impact remaining fairly stable over the sample period. However, they discovered that around 50% of the robust economic growth witnessed in most of Latin America in the first decade of the 21st century derived from multiplier effects induced by the remarkable performance of the Chinese economy in the same time frame.[94]

[94] Much of the world experienced robust economic performance during this period – part of the period that became known as the Great Moderation.

Table 3.4: Summary of empirical works on the transmission of external shocks

Author	Country or region	Sample period and data frequency	Variables	Methodology and identification strategy	Main findings
Sosa (2008)	Mexico	1980 to 2007 Quarterly	International oil prices, world real interest rate, Mexican exports, real output, real exchange rate	Fixed parameter SVAR with block exogeneity restrictions	US economic dynamics account for a very large proportion of economic variation in Mexico, particularly during the post-NAFTA period with the most important driver being the US GDP.
Ncube et al. (2012)	South Africa	1973 to 2007 Quarterly	Aggregate output, CPI, money supply, real interest rate, nominal exchange rate (R/USD), US bond prices, federal funds rate, US money supply	Fixed parameter VAR with block exogeneity restrictions	Monetary stimulus in the US results in rand appreciation, weak consumer prices, buoyant stock market, lower bond yields and a decline in real interest rates. However, positive bond yield shock from the US triggers rand depreciation with rising bond yields. Unanticipated US monetary policy tightening leads to rising bond yields and currency depreciation.
Amira (2013)	Tunisia	1970 to 2009 Annual	Real GDP, REER, CPI, terms of trade, real GDP of trading partners	Fixed parameter SVAR with recursive identification	The economy is sensitive to external shocks, particularly those relating to terms of trade.

Addison and Ghoshray (2013)	17 SSA countries[95]	1960 to 2010 Annual	Real per capita GDP, real commodity prices	Fixed parameter VAR	Commodity price shocks have had a deleterious impact.
Uguyen et al. (2014)	Seven East Asian countries	2001 to 2012 Monthly	Federal funds rate, international oil prices, domestic real exchange rate, domestic nominal exchange rate, domestic CPI	Fixed parameter structural VAR with recursive identification	US monetary policy and oil price shocks have had significant consequences for the variance of domestic economic variables.
Nchor et al. (2016)	Ghana	1980 to 2014 Quarterly	Real Government expenditure, real imports, REER, inflation, real industry value added, real oil prices	VAR and VECM	An asymmetric response of macroeconomic variables to negative and positive shocks. Oil price shocks are generally detrimental to Ghana's economy.
Winkelried and Saldarriaga (2012)	Latin America	1989 to 2011 Quarterly	Time-varying bilateral trade weights, real GDP growth rates	SVAR	Domestic US and German shocks trigger substantial and robust reactions throughout Latin America with the impact remaining fairly stable over the sample period.

[95] The 17 countries are Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic (CAR), Chad, Democratic Republic of Congo (DRC), Gabon, Ghana, Kenya, Lesotho, Malawi, Rwanda, Togo, and Zambia.

Baumeister and Peersman (2013)	USA	1947 to 2011 Quarterly frequency	TVP-VAR-SV model with sign restrictions	US CPI, US real GDP, real US refiners' acquisition cost of imported crude oil, and global oil production.	They find significant weakening in the responsiveness of oil prices to oil demand dating back to the 1980s.
Kim et al. (2014)	China	1992 to 2014 Monthly frequency	TVP-VAR-SV framework	real price of oil, oil production, industrial production in China, China's CPI, nominal exchange rate	They discover presence of time variation in monetary policy to oil price shocks in China.
He and Zhou (2018)	China	1986 to 2015 Month frequency	TVP-VAR-SV model with recursive identification	world crude oil production; investor sentiment index, real price of crude oil and global real economic activity	Oil specific demand shock displays a marked positive effect on investor sentiment over different time horizons as well as over time except for the 1990-1992 period when the impact turns negative but insignificant.

3.4 Summary and synthesis of the literature review

This study is motivated by a number of issues identified in the reviewed literature. In the case of monetary policy shocks, the theoretical literature confirms that conventional monetary policy is usually conducted by deploying short-term nominal interest rates as their operational target instrument (see section 3.2.1.3.1). This has had a profound influence on empirical work with most studies identifying monetary policy shocks via either a central bank's short-term nominal interest (e.g., the US fed funds rate used by Primiceri, 2005), a three-month inter-bank rate (e.g., PRIBOR in the Czech Republic used by Franta et al., 2012) or a benchmark money market interest rate (e.g., such as the three-month Treasury bill rate used by Abradu-Otoo et al. (2003). In order to avoid running into difficulties as a result of the evolution of monetary policy, the study sample is usually selected to coincide with the start of the current regime (e.g., IT as in the case of Franta et al., 2012). This creates the potential danger of missing any interesting dynamics that may have occurred when switching from one regime to another. Benati (2008) did not follow this technique when he investigated the time-varying monetary transmission in the UK using a data sample that predated the adoption of the IT framework (i.e., 1959-2006). His choice of time period enabled him to include both interest rate and monetary growth in his TVP-VAR-SV model with a view to assessing the evolving stance of monetary policy in the UK.[96] While Benati (2008)'s approach is appealing, most of the recent literature have simply ignored money from the VAR setup perhaps in recognition of the standard Taylor rule. Additionally, the surveyed empirical literature points to the dearth of studies applying the TVP-VAR-SV model to developing country data. Given Ghana's

[96] Though Abradu-Otoo et al. (2003) adopted a comparable method, they employed a constant parameter VAR and used a 91-day Treasury bill rate as a proxy for monetary policy. In addition, their analysis predated the introduction of IT as a framework of monetary policy.

unique identity as a developing SSA country with changing monetary policy regimes, the empirical enquiry in this study relating to the evolution of monetary transmission mechanism should offer valuable contributions to the empirical literature.

The theoretical literature presented in section 3.1.2 clearly demonstrates that, unlike monetary policy shocks, there is a considerable lack of consensus regarding the macroeconomic outcomes of fiscal policy shocks. Although the empirical literature (outlined in section 3.2.2) using data from mostly advanced or emerging market economies, tends to support the Keynesian position with observed decreasing multipliers over time, the evidence remains largely inconclusive. Again, the use of the TVP-VAR-SV framework demonstrates its superiority over the fixed-coefficient VAR or rolling-window analysis as it resolves the difficult challenge of identifying the specific breakpoint or the fixing of the rolling window. In the case of Africa, Jooste et al. (2013) is the author to have used the TVP-VAR-SV model to investigate the effects of spending shocks in South Africa. The dearth of literature is not surprising given that the seminal work on the application of the TVP-VAR-SV model to fiscal shocks is less than a decade old. The empirical focus on Ghana, a typical developing SSA country described as a 'star reformer' in view of the significant strides it made in economic transformation in the 1980s and 1990s, but then, at the turn of the 20th century, had to access debt relief under the enhanced HIPC initiative, will yield useful extensions to the empirical literature.[97]

[97] See Devarajan et al. (2001).

Section 3.1.3 identifies five key channels through which external disturbances are propagated to the domestic economy, namely the trade, financial, expectations, commodity prices and income channels. The empirical literature outlined in section 3.2.3 clearly indicates the dearth of studies, particularly in the developing world, that assess the propagation of external shocks with due consideration to the possible time variation in the transmission mechanism of these shocks. This is surprising given the importance of these shocks and the devastating effects they have had on the developing world to date. Technically speaking, the study by Winkelried and Saldarriaga (2012) does not even qualify as a TVP-VAR-SV model since they only allow trade shares to vary over time a priori. Consequently, the investigation of the time-varying impacts of external shocks on domestic output and inflation based on Ghanaian data will no doubt expand the frontiers of knowledge in the sphere of external shocks analysis.

To the best of our knowledge, there is no study that systematically investigates the propagation of monetary, fiscal and external shocks in Ghana by applying the TVP-VAR-SV model with a view to determining potential time variation in the transmission mechanisms. The present study attempts to fill this critical void in the literature.

Chapter 4: Research methodology

[T]he existence of any type of learning dynamics by private agents or the monetary authorities definitely favours a model with smooth and continuous drifting coefficients …

(Giorgio Primiceri, 2005)

4.1 Introduction

Following Sims's (1980) seminal work in response to the famous Lucas Critque, VAR frameworks have assumed prominence as the basic workhorse for exploring the transmission mechanism of monetary shocks. Much of the early empirical literature applying the traditional VARs with different identification schemes concentrated on monetary policy shocks, using mostly US data (see Christiano et al., 1999).[98,99] However, results from the first generation VAR models were apparently counter-intuitive in that a tight monetary policy could trigger an upward movement in inflation, at least in the short run, the so-called Price puzzle (see Sims 1992; Christiano & Eichenbaum, 1992). Several alternative solutions were proposed to deal with the price puzzle such as adding commodity prices (Sims, 1992), including a measure of potential output (Giordani, 2004), using a richer dataset (Bernanke et al., 2005), employing non-recursive identification schemes (Kim & Roubini, 2000), or using sign restrictions (Canova & De Nicolo, 2002).[100]

One problem with the early application of the VAR model was its strong assumption of time-invariant parameters and constant volatility, given that the structure and workings of the economy are subject to gradual change (Primiceri, 2005; Koop et al., 2009). In recognition of this

[98] Sims (1980) popularised the recursive approach; Ramey and Shapiro proposed the event-study approach (1998); Blanchard and Perotti (2002) introduced the structural VAR model; and Uhlig (2005) proposed the sign restrictions approach.

[99] Ramey (2011) provides an excellent survey of the propagation of macroeconomic shocks.

[100] Canova and De Nicolo used the FAVAR model, which permits the use of several variables approximated by their principal components.

observation, the earlier empirical literature investigating the possible time variation in the transmission mechanism relied on subsample VAR analysis (see Stock & Watson, 1996; Boivin & Giannoni, 2006). An important criticism of this approach is that the specific date on which the data are split may not have been accurately determined given that the changes occurring in the economy can be gradual rather than abrupt (Koop et al., 2009). Advances in econometrics have made it possible to permit the parameters of the VAR model to vary over time by relying on the Kalman filtering procedure for the entire sample instead of time-invariant estimation techniques (Franta et al., 2012). This has helped to fully capture the spirit of the Lucas Critique as reflected in the quotation above from Primiceri.

Another issue with constant parameter VARs relates to the inflexibility of the IRFs in that they do not permit selection of different horizons or periods – everything is boxed in a single IRF. The application of the TVP-VAR-SV model however offers flexibility in terms of how the IRFs are presented. Firstly, the IRFs can be presented as a time series for selected horizons, enabling the comparison of both short- and long-run horizons. This helps to draw a distinction between long-term demand side-effects and short-term supply side-effects as proposed by Barth and Ramey (2001). Secondly, the IRFs can also be drawn for selected periods to determine the effectiveness of monetary policy at specific dates.

The advent of time variation in econometric analysis dates back to Canova (1993), who used a multivariate framework with time-varying considerations to analyse a panel of US, French, Swiss, German, and Japanese exchange rate data. In their contribution to the debate on ‘good policy’ versus ‘bad policy’ initiated by Clarida et al. (2000), Cogley and Sargent (2001) evaluate the time-

varying parameter VAR (TVP-VAR), but assumed time-invariant volatility of shocks, which was a key limitation in their approach due to the possible heteroskedastic shocks, as well as non-linear interactions among the variables being modelled. In response, Cogley and Sargent (2005) introduced time-varying variances while the covariances (simultaneous relationship within the VAR model) are kept constant.

As Primiceri (2005) notes, the assumption of constant covariance condenses the model to a reduced-form framework obstructing any form of structural interpretation. He therefore emphasises the importance of permitting the variance-covariance matrix of VAR innovations to be time varying, giving rise to a full-fledged TVP-VAR structure that consists of time-varying parameters (both coefficients and covariances) and heteroskedastic innovations, which results in a TVP-VAR-SV.

This chapter describes the research procedures used in the present study to investigate the possible time variation in the transmission of monetary, fiscal and external shocks. The TVP-VAR-SV model is specified in section 4.1 with a clear distinction drawn between it and the traditional time-invariant (constant parameter) VAR. The TVP-VAR-SV model belongs to the family of Bayesian VARs that require prior information to underpin its estimation. The priors are specified in section 4.2. The estimation strategy, including the Gibbs sampler in the spirit of Nakajima (2011), is discussed in section 4.3. Section 4.4 deals with the identification of structural shocks, and data related issues are discussed in section 4.5. Section 4.6 contains a summary of the research methodology.

4.2 Econometric methodology

Following Abradu-Otoo et al. (2003), a simple structural VAR model that encapsulates Ghana's macroeconomic structure can be presented as follows:

$$Ay_t = C + \Gamma_1 y_{t-1} + \cdots + \Gamma_s y_{t-s} + \mu_t, \quad t = s+1, \ldots, T \tag{4.1}$$

In equation 4.1, y_t is an m x 1 vector of observed economic variables; A represents an m x m matrix of contemporaneous relationships; C is an m x 1 vector of constants, $\Gamma_1, \ldots, \Gamma_s$ is an m x m matrix of parameters; and $\mu_t \sim N(0, \Sigma)$ represents an m x 1 structural shock vector, where:

$$\Sigma = \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \sigma_2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_m \end{bmatrix} \tag{4.2}$$

and σ_i represents the standard deviations of the (unknown homoscedastic) structural shocks. The simultaneous interaction of the structural shock is specified on the basis of recursive identification so that A takes the form of a lower triangular matrix with unity diagonal elements given as:

$$A = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \alpha_{21} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{m1} & \cdots & \alpha_{m,m-1} & 1 \end{bmatrix} \tag{4.3}$$

However, equation 4.1 cannot be directly estimated as its structure permits Γ and A to exhibit an infinite combination of values even if conditioned on the same probability distribution. Hence, the unique determination of parameter values is problematic since the variables in the model may exert a mutually contemporaneous impact (Bredin & O'Reilly, 2004; Ferreira, 2015; Mwabutwa et al.,

2016). A re-specification of equation 4.1 into a reduced-form VAR model is required to permit the estimation of the parameters such that:

$$y_t = c + \beta_1 y_{t-1} + \cdots + \beta_s y_{t-s} + A^{-1}\Sigma\varepsilon_t, \qquad \varepsilon_t \sim N(0, I_m) \tag{4.4}$$

It is evident from equations 4.1 and 4.4 that $\beta_i = A^{-1}\Gamma_i$, $c = A^{-1}C$ for $i, \dots, s$, and $\mu_t = A^{-1}\Sigma\varepsilon_t$ with Σ introduced to capture the variance of μ_t (see equation 4.2). By further defining β as a stacked row, $\beta_1, \dots, \beta_s$, a reduced form representation can be obtained, given as:

$$y_t = X_t\beta + A^{-1}\Sigma\varepsilon_t \tag{4.5}$$

From equation 4.5, X_t can be defined as: $X_t = I_m \otimes [1, y'_{t-1}, \dots, y'_{t-s}]$, where $\otimes$ symbolises the Kronecker product. However, the parameters in 4.5 (β, A, Σ), are fixed across time.

Following the ground-breaking work of Primiceri (2005), which was reaffirmed by Nakajima (2011), the model's parameters, (β, A, Σ), are now assumed to vary over time with the lower triangular matrix in equation 4.2 and the diagonal matrix in equation 4.3 re-specified respectively as follows:

$$\Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \cdots & 0 \\ 0 & \sigma_{2,t} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_{m,t} \end{bmatrix} \tag{4.6}$$

And

$$A_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \alpha_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{m1,t} & \cdots & \alpha_{m,m-1,t} & 1 \end{bmatrix} \tag{4.7}$$

The time-varying version of equations 4.4 and 4.5 can then be specified respectively as:

$$y_t = \beta_{1t} y_{t-1} + \cdots + \beta_{st} y_{t-s} + \epsilon_t, \tag{4.8}$$

$$y_t = X_t \beta_t + \epsilon_t, \qquad \epsilon_t = A_t^{-1} \Sigma_t \varepsilon_t, \qquad t = s+1, \ldots, T \tag{4.9}$$

Here, y_t and X_t remain as previously defined in equations 4.1 and 4.5, respectively; α_t in equation 4.7 is a time-varying stacked row vector of non-one and non-zero unrestricted elements of the lower triangular matrix A_t. That is, $\alpha_t = \left(\alpha_{21}, \alpha_{31}, \alpha_{32}, \alpha_{41}, \ldots, \alpha_{m,m-1}\right)'$. β_t in equations 4.8 and 4.9 is *m* x *m* time-varying coefficients defined as stacked row vector of $\beta_{1t}, \ldots, \beta_{st}$, and ϵ_t in equations 4.8 and 4.9 are *m* x 1 (unknown heteroscedastic) structural shocks.

As noted by Primiceri (2005), permitting matrix A_t to change over time is important for a TVP-VAR-SV model as it allows a shock to one endogenous variable in the model to exert a time-varying impact on other variables in the model. This offers a more flexible framework for evaluating the transmission mechanism of structural shocks (innovations), which is particularly appropriate for developing countries such as Ghana whose economy has evolved dramatically over the last four decades.

Therefore, the strategy in this study involves modelling the dynamic coefficient processes in equation 4.9, which bears one-to-one mapping with equation 4.8. In order to capture both the gradual and the abrupt evolution of the underlying economic structure, the time-varying parameters (A_t, β_t) are assumed to follow a driftless random walk while the time-varying variance matrix (Σ_t) of the stochastic volatility σ_t^2 are modelled as a geometric random walk process.

Formally, the laws of motion guiding the system's dynamic time-varying parameters are stated as follows:

$$\beta_{t+1} = \beta_t + \upsilon_{\beta t} \tag{4.10}$$

$$\alpha_{t+1} = \alpha_t + \upsilon_{\alpha t} \tag{4.11}$$

$$h_{t+1} = h_t + \upsilon_{ht} \tag{4.12}$$

where $h_t = (h_{1t}, h_{2t}, \dots, h_{mt})'$ such that $h_{jt} = log\sigma_{jt}^2$ (i.e., h_t denotes log volatilities),

for $j = 1,2, \dots, m, t = s+1, \dots, T$, and σ_t is a vector of time-varying standard deviations holding the diagonal elements of matrix Σ_t. Following Primiceri (2005) and Nakajima (2011), all the model's innovations $[\epsilon_t, \upsilon_{\beta t}, \upsilon_{\alpha t}, \upsilon_{ht}]$ are assumed to be jointly normally distributed and the variance-covariance matrix is conditional on the following assumptions:

$$\begin{bmatrix} \epsilon_t \\ \upsilon_{\beta t} \\ \upsilon_{\alpha t} \\ \upsilon_{ht} \end{bmatrix} \sim N(0, V), \text{ and } V = \begin{bmatrix} I_m & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_\alpha & 0 \\ 0 & 0 & 0 & \Sigma_h \end{bmatrix} \tag{4.13}$$

For $t = s+1, \dots, m$ where I_m is an m-dimensional identity matrix, and Σ_β, Σ_α and Σ_h are positive definite matrices of hyperparameters. Consistent with Nakajima (2011), the initial conditions relating to the time-varying parameters are assumed to be $h_{s+1} \backsim N(\upsilon_{h0}, \Sigma_{h0}), \alpha_{s+1} \backsim N(\upsilon_{\alpha 0}, \Sigma_{\alpha 0})$ and $\beta_{s+1} \backsim N(\upsilon_{\beta 0}, \Sigma_{\beta 0})$, with Σ_α assumed to be block diagonal, indicating that the parameters of the contemporaneous interactions among the model's variables evolve independently, which enables the covariance states to be estimated row by row. Similarly, Σ_h is restricted to be a diagonal matrix in order to reduce the dimensionality of the estimation. The TVP-

VAR-SV model as presented satisfies a state space representation with equation 4.9 serving as the measurement equation while equations 4.10, 4.11 and 4.12 are the transition (or state) equations.

Therefore, the TVP-VAR-SV model used to test the three objectives is summarised as follows:

$$y_t = X_t\beta_t + \epsilon_t, \quad \epsilon_t = A_t^{-1}\Sigma_t\varepsilon_t, \qquad t = s+1, \ldots, T \tag{4.9}$$

$$\beta_{t+1} = \beta_t + \upsilon_{\beta t} \tag{4.10}$$

$$\alpha_{t+1} = \alpha_t + \upsilon_{\alpha t} \tag{4.11}$$

$$h_{t+1} = h_t + \upsilon_{ht} \tag{4.12}$$

The prior specification, identification, estimation, and data requirements to test the individual objectives are discussed in subsequent sections.

4.3 Specification of priors

Parsimony is a virtue in empirical work. However, VAR models usually contain many variables and lags are not parsimonious, resulting in the estimation of several parameters.[101] Without restrictions, the estimation of VAR models entails much data, which still does not guarantee precision of the estimates. Prior information, for both hyperparameters and initial states, is required to improve the chances of obtaining accurate estimates. Prior specification to aid the assessment of the posteriors follows Nakajima (2011):

$$(\Sigma_\beta)_i^{-2} \backsim G(20, 10^{-4}),\ (\Sigma_\alpha)_i^{-2} \backsim G(4, 10^{-4}),\ (\Sigma_h)_i^{-2} \backsim G(4, 10^{-4}) \tag{4.14}$$

[101] In a traditional constant parameter VAR with four endogenous variables and two lags, the number of parameters to be estimated is 36, which can rise dramatically to 666 in the case of TVP-VAR models.

where G denotes gamma distributions; and $(\Sigma_h)_i$ and $(\Sigma_\alpha)_i$ indicate the $i\text{-}th$ diagonal elements of the relevant matrices. In case of the initial states of the TVPs, this study relies on flat priors in a manner that $\upsilon_{h0} = \upsilon_{\alpha 0} = \upsilon_{\beta 0} = 0$ and $\Sigma_{h0} = \Sigma_{\alpha 0} = \Sigma_{\beta 0} = 10\ x\ I$.

4.4 Identification strategy

This subsection discusses the identification schemes employed to ensure that the dynamic TVP-VAR-SV models can be interpreted meaningfully. This is achieved by transforming the reduced VAR characterised by correlated innovations into a structural VAR characterised by uncorrelated, economically interpretable shocks. Like Primiceri (2005) and Nakajima (2011), this study follows the recursive identification strategy. Unlike other identification strategies, the recursive identification strategy allows the researcher to remain agnostic and allow the data to 'speak'.

In the case of monetary policy shocks, the underlying assumption is that other macroeconomic variables such as inflation and economic growth respond to monetary policy actions with a lag only. As stressed by Primiceri (2005), this assumption is an identification strategy to isolate monetary policy shocks and not an ordering strategy. This assumption also allows the monetary authorities to have a full view of developments in the economy prior to any policy reaction. In this study, the basic model has five variables, ordered sequentially as output growth, inflation, nominal exchange rate movements, private sector credit growth, and short-term interest rate. These variables minus private sector credit are required to enable an effective reflection of the dynamics associated with small open economies (Franta et al., 2012; Alonso-Carrera & Kam, 2016). Following Benati (2008), a modified version of the TVP-VAR-SV model replaces the credit

variable with money supply growth in order to ascertain the potency of money supply shocks in Ghana.

The controversy over the impact of fiscal policy on the economy, particularly consumption, is well documented in section 3.1.2. The study follows Kirchner et al. (2010) and Ferreira (2015) and adopts a recursive identification strategy. Being agnostic about the impact of fiscal policy shocks reflects an attempt to contribute to the debate regarding whether fiscal policy has Keynesian, Ricardian or even non-Keynesian impacts. As a result, current government spending (i.e., government spending adjusted for interest payments) shock is identified by taking for granted that government spending is pre-set in a framework with GDP (output), net taxes, private consumption and the short-term nominal interest rate. That is, current government spending is ordered first with the innovation in the spending equation viewed as a structural spending shock. In this configuration, other variables in the model are permitted to react contemporaneously to government spending shock while government spending cannot respond within a quarter to innovations in the other variables in the model. The assumption of acyclicality of government spending (i.e., government spending does not respond contemporaneously to changes in the business cycle) can be justified by the fact that government spending is adjusted for subsidies. Other forms of transfers such as unemployment benefits are virtually non-existent in most developing countries including Ghana, removing the influence of automatic stabilisers on government spending. In similar vein, in the presence of inside and outside lags in policy making and implementation (see subsection 3.1.2.1.4), a discretionary fiscal policy action to movements in the business cycle is not likely to occur within a quarter. The two assumptions are inherent in the structural identification scheme proposed by Blanchard and Perotti (2002) and Perotti (2005)

based on institutional information regarding the tax system to identify fiscal structural shocks. Net taxes (i.e., net of transfers) are ordered after GDP given the sensitivity of taxes to the business cycle. Private consumption is ordered next, suggesting that while it can be contemporaneously influenced by government spending, output and taxes, it can only affect the other variables with a lag. The short-term nominal interest rate is included in order to gauge the effects of fiscal shocks on interest rates (i.e., central bank behaviour).

The basic idea behind recursive identification is that the most exogenous variable is ordered first since it cannot be impacted immediately by other less exogenous variables. Therefore, the external variables (oil prices, foreign OECD growth, and federal funds rate) are ordered first followed by domestic variables (exchange rate movements, GDP growth, CPI inflation and short-term interest rate) in the case of external shocks. For example, oil price shocks are allowed to contemporaneously affect domestic variables but contemporaneous feedback from domestic variables to oil prices is not permitted. For domestic variables, GDP growth is first ordered followed by the exchange rate grounded on the implicit assumption that demand shocks tend to trigger exchange rate volatility with a feedback to growth occurring only with a lag. Inflation is then ordered after the exchange rate to ensure that while the exchange rate shock can contemporaneously impact inflation, a feedback from inflation to the exchange rate occurs with some time lag. The final variable to be ordered is the short-term nominal interest rate with a view to allowing the monetary authorities to react to the oncoming macroeconomic situation after careful assessment. An attempt is made to investigate how the individual foreign shocks impact domestic macroeconomic variables and so the three foreign variables will appear in the VAR model alternatively and not jointly.

4.5 Estimation strategy

TVP-VAR-SV models are such that classical maximum likelihood (ML) techniques are incapable of providing reliable parameter estimates. Again, the existence of stochastic volatility in the VAR framework exerts difficulties on the estimation because of the intractability of the likelihood function (Peretti et al., 2012). As observed by Koop and Korobilis (2010), permitting time variation both in the parameters of the VAR and the covariance matrix, creates significant over-parameterisation concerns, which undermine the precise estimation of the parameters and the IRFs. To sidestep these problems, the TVP-VAR-SV model will be estimated with the help of the Bayesian approach via the MCMC techniques, which has become a fairly standard procedure for handling this type of model (Primiceri, 2005; Benati, 2008; Nakajima, 2011; Franta et al., 2012; Arratibel & Michaelis, 2014).

The Bayesian inference methods permit the original estimation problem to be split into many smaller problems, thereby enhancing the efficiency of dealing with the non-linearities and the high dimension associated with the parameter space (Nakajima, 2011). Banerjee and Malik (2012) contend that the use of MCMC algorithm circumvents the dimensionality concern since it fundamentally involves recursively drawing from lower dimensional items and helps to moderate difficulties related to parameter explosion. Given the information in section 4.2, the use of the MCMC algorithm facilitates the assessment of the joint posterior distributions of the relevant parameters. The estimation procedure entails the application of the Gibbs sampler whose comprehensive technical details are given in Primiceri (2005) and Nakajima (2011) with the

simulations based on the MATLAB-based TVPVAR codes developed by Nakajima (2011; 2018).[102]

The model outlined above will be applied to analyse monetary, fiscal and external shocks. The findings from the model will be summarised using the stochastic volatilities and the IRFs. While the stochastic volatilities facilitate accounting for the dynamic shocks hitting the system, the IRFs map out the moving average representation of the VAR structure. The TVP-VAR-SV model is capable of computing state-dependent impulse responses at each point in time, allowing for the assessment of potential variations in macro dynamics over time. To achieve comparable results over time, this study follows Nakajima (2011): It computes the impulse responses by setting a preliminary shock of magnitude equivalent to the time-series mean of the stochastic volatility of the sample combined with the estimated simultaneous interactions at each point in time (i.e., each quarter).

4.6 Model robustness checks

The robustness of the TVP-VAR-SV model is tested to ensure the absence of likely divergence in the results emanating from either the prior specification or the identification strategy. For the prior specification, alternative priors are specified for the TVP-VAR-SV model by raising the mean of the parameters $(\Sigma_\beta)_i^{-2}$, $(\Sigma_\alpha)_i^{-2}$, and $(\Sigma_h)_i^{-2}$ by 20%. Equation (14) is respecified as:

$$(\Sigma_\beta)_i^{-2} \backsim G(24, 10^{-4}),\ (\Sigma_\alpha)_i^{-2} \backsim G(5, 10^{-4}),\ (\Sigma_h)_i^{-2} \backsim G(5, 10^{-4}) \qquad (15)^{103}$$

[102] See Nakajima's Google Scholar site for the codes.

[103] Raising 4 by 20% gives 4.8 with the result rounded up to 5.

The baseline models in chapters 5, 6 and 7 will be re-estimated with the specified priors in equation 15.

In terms of identification, the monetary policy model involves ordering the private sector bank credit variable before the exchange rate variable. Here, the nominal exchange rate is seen as a policy variable that reacts to changes in the macroeconomy. Thus, the variables in the respecified monetary policy model are reordered sequentially as output growth, inflation, private sector credit growth, nominal exchange rate and short-term nominal interest rate. For the fiscal policy model, net taxes is ordered after the expenditure variable to ensure that the two fiscal variables are ordered before the other macroeconomic variables. In the case of the three external sector models, it is assumed that the monetary authorities anticipate the effects of the external shocks and take steps to avert or minimise their impact on the domestic economy. Thus, the short-term nominal interest rate is ordered after the external variable and before the other domestic variables.

4.7 Preliminary assessment of parameter stability

Following Pereira and Lopes (2010), parameter instability tests are performed on the constant parameter VAR models as specified in section 4.2. The outcome of these tests will provide support for the application of the TVP-VAR-SV model. Two of such tests are performed using the EViews 11 software. The first test is the Nyblom-Hansen (NH) test as detailed in Hansen (1992). Here, the null hypothesis is the parameter constancy with the alternative hypothesis being the random-walk TVP framework. The NH test is best suited for detecting system wide instability (Pereira & Lopes, 2010).

The second test is the Quandt likelihood- ratio (QLR) statistic or the Quandt-Andrews test. This is based on the maximum of the Chow statistics computed for a series of dates identified as structural breakpoints over a segment of the data. The null hypothesis is the constancy of the parameter versus a single break of unspecified timing as the alternative hypothesis. However, the Quandt-Andrews test is capable of indicating the potential break date in the data. The sequential dates are defined based on a 15% symmetric trimming with the coefficients in each equation permitted to vary through interacting dummies, which are generated based on the identified breakpoint. The sample runs from 1984q1 to 2018q4, implying that the trimmed sample starts from 1989q4 and ends at 2013q4. The constancy of the variance is also tested based on a procedure adopted by Stock and Watson (2002). The procedure involved running the absolute residuals from the equation used to test the constancy of the parameter in the QLR test on a constant and a dummy for the identified break date and performing White's heteroscedasticity test on the result.

4.8 Data requirements, sources and description

The dataset comprises quarterly observations with the sample spanning 1984q1 to 2018q4. For the study on the transmission of monetary policy shocks, data requirements include gauging economic activity (real GDP); gauging price level (CPI); measuring the short-term interest rate (monetary policy rate); measuring the money supply (M2+); and measuring the bilateral nominal exchange rate defined as Ghana cedi per unit of USD (e). In order to investigate the transmission of fiscal policy shocks, the data used includes the GDP, government spending, interest rates, private consumption, and net taxes. Finally, the data requirements for studying the transmission of external shocks include measuring foreign demand (OECD GDP); measuring the foreign interest rate

(federal funds rate); measuring commodity (oil) prices; as well as the GDP, the domestic CPI, and the exchange rate. The data were obtained from the following sources:

1) Real GDP, money, private consumption, private sector bank credit: World Bank's World Development Indicators online database;
2) Bilateral (cedi/USD) nominal exchange rate, short-term nominal interest rate, government expenditure and revenue: Bank of Ghana;
3) CPI: Ghana Statistical Service (GSS);
4) US Fed funds rate: St Louis Fed online database;
5) Seasonally adjusted real GDP growth of OECD countries: OECD online database; and
6) Crude oil price: World Bank online commodities price database (the Pink Sheet).

While most of the data are available on a quarterly basis, domestic real GDP, private consumption, and money supply are not available in quarterly series for the entire study period.[104] The quarterly series of these variables is therefore interpolated from the annual series using the Denton (1971) approach without an indicator variable as implemented in EViews 11.[105]

4.9 Summary and conclusion

This chapter presented the general research methodology used to investigate the possible time variation in the transmission of monetary, fiscal and external shocks. It derived the TVP-VAR-SV model from the traditional time-invariant VAR by relaxing the assumptions of time-invariant parameters and constant volatilities to fully capture the spirit of the Lucas critique. Following

[104] For example, the compilation of quarterly GDP in Ghana began in 2006.
[105] Mwabutwa et al. (2016) adopted similar approach by using quarterly changes in M1 as an indicator variable to interpolate the annual real GDP into quarterly frequency.

Primiceri (2005) and Nakajima (2011), the simultaneous relations among the variables in the model are also allowed to vary over time, permitting a shock to an endogenous variable to exert a time-varying impact on the other variables in the model. This strategy offers a more flexible framework for evaluating the transmission mechanism of structural shocks. In order to capture both the gradual and the abrupt evolution of the underlying economic structure, the model's time-varying parameters are assumed to follow a random walk process.

Being Bayesian in nature, the TVP-VAR-SV model requires prior information for both the hyperparameters and the initial states to improve the chances of obtaining accurate estimates. The study follows Nakajima (2011) by adopting gamma distributions for the prior information while relying on flat priors in the case of the initial states. Like Primiceri (2005) and Nakajima (2011), the study adopts the recursive identification strategy in order to remain agnostic and allow the data to 'speak'. To circumvent the overparameterisation concerns stemming from the assumption of time variation in both the VAR parameters and the covariance matrix, the TVP-VAR-SV model is estimated with the Bayesian approach via MCMC techniques. The Bayesian inference methods permit the original estimation problem to be split into many smaller ones, thereby enhancing the efficiency of dealing with the non-linearities and the high dimension associated with the parameter space.

The estimation procedure entails the application of the Gibbs sampler. The dataset consists of quarterly observations with the sample spanning 1984q1 to 2018q4. The data is sourced from domestic and international institutions: the BOG, GSS, St Louis Federal online database, OECD

online database, and the World Bank. The quarterly series of variables, available only on an annual basis, is interpolated using the Denton (1971) approach.

Chapter 5: Empirical evidence on the time-varying transmission of monetary policy actions

5.1 Introduction

This chapter contains the empirical results of the evolution of monetary policy actions. The evolution of monetary policy in Ghana, as discussed in chapter 2, identifies the short-term nominal interest rate (mostly used as the OTI of monetary policy since the end of 2002), private sector credit developments and movements in the nominal exchange rate as key variables in monetary policy discourse regarding the future path of output and inflation. As a result, the study analyses the mutual interaction between these variables without contradicting the fact that the short-term nominal interest rate mostly functions as the OTI of monetary. Given that reserve money was once the OTI of monetary policy, an alternative formulation of the model replaces the private sector credit with money supply growth to help ascertain the macroeconomic effects of money supply shock.

The OTIs of monetary policy are the variables over which the central bank has direct control. By virtue of being the monopoly supplier of cash, the central bank has direct control over only two variables: (a) the interest rate at which it supplies cash to the banking system (short-term interest rate) and (b) the quantity of cash it supplies to the banking system. In view of the high inelasticity and high volatility of the banking sector's demand for cash in most developed economies, central banks in developed economies are effectively forced to use the interest rate on cash provision as their OTI of conventional policy. In practice, this means that central banks passively adapt their supply of cash to the banks' demand for cash at the policy rate level. Other macroeconomic

variables can only be influenced indirectly, via the OTIs. For developing countries such as Ghana, large monetisation of debt can enable it exercise some degree of direct control over the money stock. The central bank's inability to have a firm grip on the other macroeconomic variables does not undermine the relevance of the TVP-VAR-SV model that seeks to analyse the mutual interaction between variables that are closely monitored by the central bank. This is why the chapter looks both ways: i) ascertain the causal direction from the short-term nominal interest rate (OTI) to the other variables – effectiveness of monetary policy, and ii) assess the reverse causal direction from the other variables to the short-term nominal interest rate (OTI) – policy reaction.

The empirical results were obtained by means of the central tools of stochastic volatilities and IRFs. After the results of the parameter instability tests in section 5.2, preliminary discussions on data transformation and estimation diagnostics are presented in section 5.3. Estimates of the simultaneous relations among the model's variables are detailed in section 5.4. Section 5.5 contains the results of the stochastic volatilities related to the structural shocks. This is followed in section 5.6 by a discussion of the time-varying reaction of monetary policy (interest rate) to macro shocks. The time-varying reaction to monetary policy shocks is taken up in section 5.7, followed in section 5.8 by the time-varying response to exchange rate shocks. Section 5.9 looks at the empirical results of time-varying responses to credit shocks. The time-varying responses to money supply shocks in a modified version of the TVP-VAR-SV model are presented in section 5.10. Section 5.11 performs model robustness tests while section 5.12 contains a summary of the empirical evidence.

5.2 Results of parameter stability tests

The results of the parameter stability test is presented in Table 5.1 with the p-values revealing extensive parameter instability within the model. At the conventional 5% level of significance, the HN test fails to reject the null hypothesis of parameter constancy for real GDP growth equation (though the null is rejected at 10% level of significance). However, results from the QLR tests partially contradict the NH tests by rejecting the null hypothesis of constancy of coefficients at the 5% level of significance. As contended by Pereira and Lopes (2010), the parameter instability in the real GDP growth equation might reflect a single structural break that is better depicted by the QLR test. The QLR test selected 2010q2 as the potential break date, a date that coincided with the start of commercial crude oil production in Ghana. The result is however reversed in the case of the variances whereby the NH test rejects the null hypothesis of homoscedasticity at the 5% level of significance while the QLR test fails to reject the null. This, perhaps, points to multiple breaks in the variance that is better captured by the NH test as demonstrated by evidence presented later in section 5.5.

In the case of the inflation equation, both the NH and the QLR tests confirm coefficients instability (with a potential breakpoint at 1996q2 – reflecting the significant increase in inflation on the back of the botched implementation of the VAT in 1995) and the presence of heteroscedasticity. Regarding the exchange rate equation, the NH test fails to reject the null of constant parameter at the 5% level of significance (the null is however rejected at the 10% level of significance) while the QLR test rejects the null, indicating parametric shift around 1990q2. The NH test also fails to reject the null of homoscedasticity while the QLR test indicates heteroscedasticity. For the private sector bank credit equation, both the NH and the QLR tests point to nonconstant parameter and

heteroscedasticity with the QLR test selecting 1990q1 as a potential break date. Similar evidence relates to the money supply equation with 2003q4 selected by the QLR test as a potential break date. It is interesting that the same break date 2003q4 is selected by the QLR test for the interest rate equation as the potential break date. This was about a year since the MPC of the Ghana was launched with intensified practical steps toward the implementation of the IT framework. Both tests point to evidence of heteroscedasticity in the interest rate equation. However, unlike the QLR test, the NH test fails to reject the null of constant parameter.

The evidence presented in this section undoubtedly validate the introduction of time variation in the model against the use of a constant parameter model. The presence of heteroscedasticity also supports a model with stochastic volatility. In addition, the QLR test reveals differences in the timing of the potential breakpoints in the different equations, undermining the usefulness of the traditional split or rolling sample approach of the constant parameter framework. The foregoing discussion clearly shows the superiority of the TVP-VAR-SV model and justifies its use for this study.

Table 5. 1:Results of parameter stability tests (p-values and breakdates)

Equation	Nyblom-Hansen (NH)		Quandt-Likelihood Ratio (QLR)		
	lc	Variance	Break date	Cofficients	Variance
Real GDP (y)	0.0897	0.0000	2010q2	0.0000	0.4527
Inflation (p)	0.0253	0.0000	1996q2	0.0000	0.0237
Exchange rate (e)	0.0523	0.1433	1990q2	0.0003	0.0000
private sector credit (psc)	0.0244	0.0000	1990q1	0.0000	0.0000
money supply (m)	0.0309	0.0000	2003q4	0.0000	0.0221
Interest rate (i)	0.1561	0.0000	2003q4	0.0000	0.0487

Note: The p-values are calculated based on Hansen's (1997) method. The first column (lc) denotes p-values for the null hypothesis of parameter constancy under NH test, the second column (variance) represents p-values for the null hypothesis of homoscedasticity, the third column denotes the potential structural break dates under the QLR tests, the four column (coefficients) denotes p-values for the null hypothesis of no breakpoints within 15% of trimmed data, the fifth column (Variance) represents p-values for the null hypothesis of no breakpoint in the variances. The trimmed sample runs from 1989q4 to 2013q4.

5.3 Data transformation and estimation diagnostics

In accordance with Christiano and Eichenbaum (1992), Bernanke and Blinder (1992) and Mwabutwa et al (2016), the five variables that enter the baseline model are ordered sequentially as: real GDP growth rate (y); CPI inflation rate (p); the percentage change in the bilateral (cedi/USD) nominal exchange rate (e); the growth of private sector bank credit (psc); and the short-term nominal interest rate (i). A sixth variable, the money supply growth rate (m), replaces psc in an alternative model to determine the time-varying macroeconomic effects of money supply shocks. The variables are not checked for the presence or absence of unit roots. This approach is consistent with a Bayesian analysis in terms of which non-stationarity is not a consideration since the likelihood function is not affected by the existence of unit roots in the data. This approach helps circumvent the possible occurrence of inconsistencies through the imposition of

cointegration restrictions on the system (Sims et al., 1990; Franta et al., 2012). All the variables except the interest rate are seasonally adjusted using the TRAMO/SEATS method as implemented in EViews 11. The data covers 1984q1 to 2018q4. In accordance with Franta et al. (2012) and Mwabutwa et al. (2016), the model is estimated with lag one in order to save on the degree of freedom.[106]

Table 5.1 indicates the results for the posterior means; standard deviations; 95% credible intervals; CD statistics as in Geweke (1992); and the inefficiency factors as estimated using the MCMC sample.[107] The 95% credible intervals are used to designate the extent of uncertainty around the estimated parameters. Within the estimation, 15 000 iterations are administered with the initial 1 500 draws discarded during the burn-in period. Based on the evidence in table 5.1, the study fails to reject the null hypothesis affirming the convergence to the posterior distribution given the 5% significance level in relation to the CD statistics. It is also evident from table 5.1 that the parameters are estimated efficiently since all the inefficiency factors fall below 100. Further evidence in table 5.1 confirming efficient estimation is that the estimated posterior mean of the selected parameters all fall within the respective 95% credible intervals.

[106] The maximum lag length selection procedure selected two lags. However, this procedure is amenable to the constant parameter VAR due to the small number of parameters that are usually estimated. Given the huge number of parameters estimated in the TVP-VAR-SV model, it is logical to assume that a lower lag length (than the one selected for the constant parameter model) will be required to save on the degree of freedom. Indeed, the use of two lags in the TVP-VAR-SV model produced inefficient estimation results and unstable IRFs, justifying the selection of one lag.

[107] See Nakajima (2011) for the computation of the CD and the inefficiency factors.

Table 5.2: Selected parameters of the estimated monetary policy TVP-VAR-SV model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0030	[0.0018	0.0028]	0.7790	9.79
sb2	0.0023	0.0003	[0.0018	0.0029]	0.2630	8.65
sa1	0.0055	0.0016	[0.0034	0.0095]	0.2520	39.71
sa2	0.0056	0.0016	[0.0034	0.0097]	0.7750	52.43
sh1	0.7463	0.0739	[0.6163	0.9065]	0.2990	70.70
sh2	0.4005	0.1298	[0.1778	0.7160]	0.7560	73.66

Note: Stdev refers to standard deviation.

Figure 5.1 shows the sample autocorrelation (top row), sample paths (middle row), and posterior densities (lower row) for the selected parameters. With the initial 1 500 draws discarded during the burn-in stage, the sample paths look stable with evidence of a steady drop in the sample autocorrelation. Consistent with Nakajima (2011, 2018), this result indicates that the adopted sampling strategy capably yields samples with small autocorrelation.

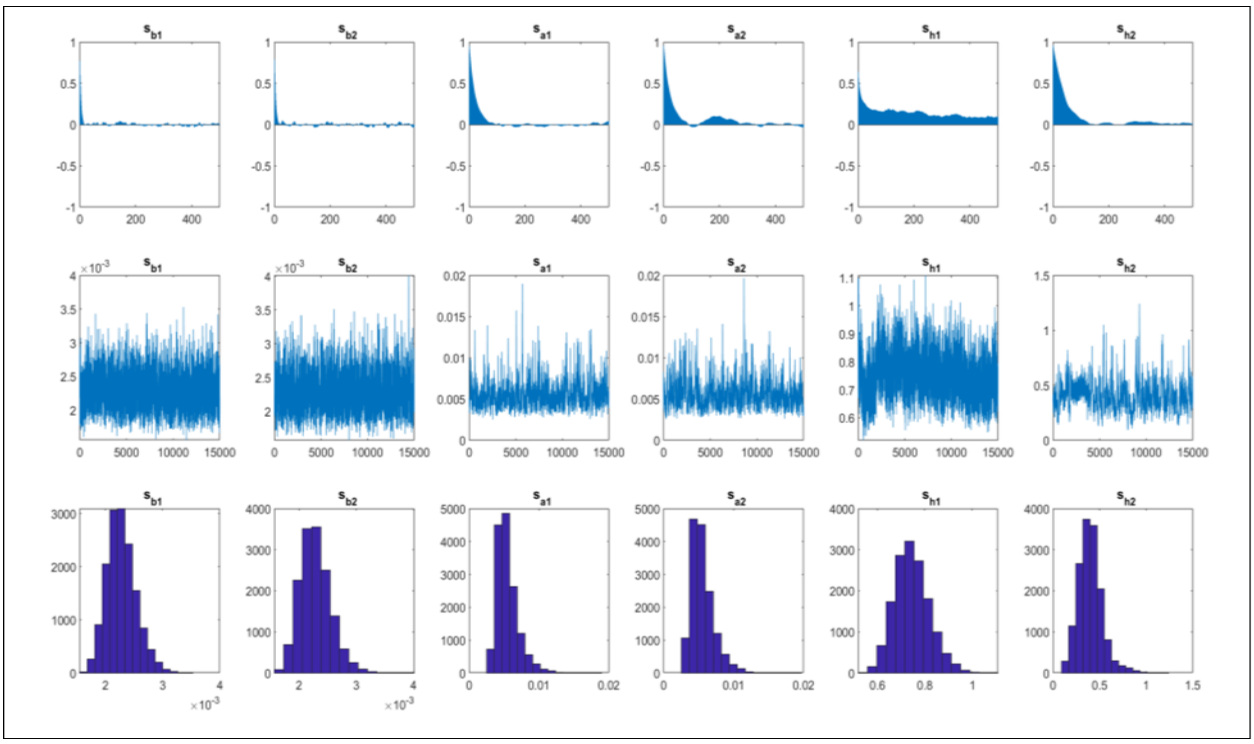


Figure 5.1: Sample autocorrelation, sample paths and posterior densities for selected parameters in the monetary policy model

5.4 Posterior estimates of the simultaneous relations among the variables

Figure 5.2 shows the results of the time-varying simultaneous interactions, which is a key characteristic embedded in the TVP-VAR-SV model. From figure 5.2 one can discern that the simultaneous relation of real GDP to inflation (y → p), exchange rate (y → e), and interest rate shock (y → i) is negative and remains virtually constant throughout the sample period. Conversely, the simultaneous relation of GDP to private sector credit (y → psc) prints positive and also remains largely unchanged over the sample period. The simultaneous relation of inflation to exchange rate (p → e), interest rate (p → i), and private sector credit (p → psc) is positive and appears time invariant throughout the sample period. The simultaneous relation of private sector credit to interest rate shock (psc → i) is positive and remains fairly stable throughout the sample

period. However, the simultaneous relations of exchange rate to interest rate (e → i) and exchange rate to private sector credit (e → psc) vary over time. Further scrutiny of figure 5.2 reveals that apart from the simultaneous relations of output growth to interest rate (y → i), inflation to interest rate (p → i), and inflation to exchange rate (p → e) – all of which display no time variation – the one standard deviation bands of the remaining simultaneous relations contain zero. This evidence suggests absence of time variation in the simultaneous relations among the variables in the TVP-VAR-SV model and is inconsistent with Nakajima (2011) who finds partial time variation in a three-variable TVP-VAR-SV macro model for Japan.

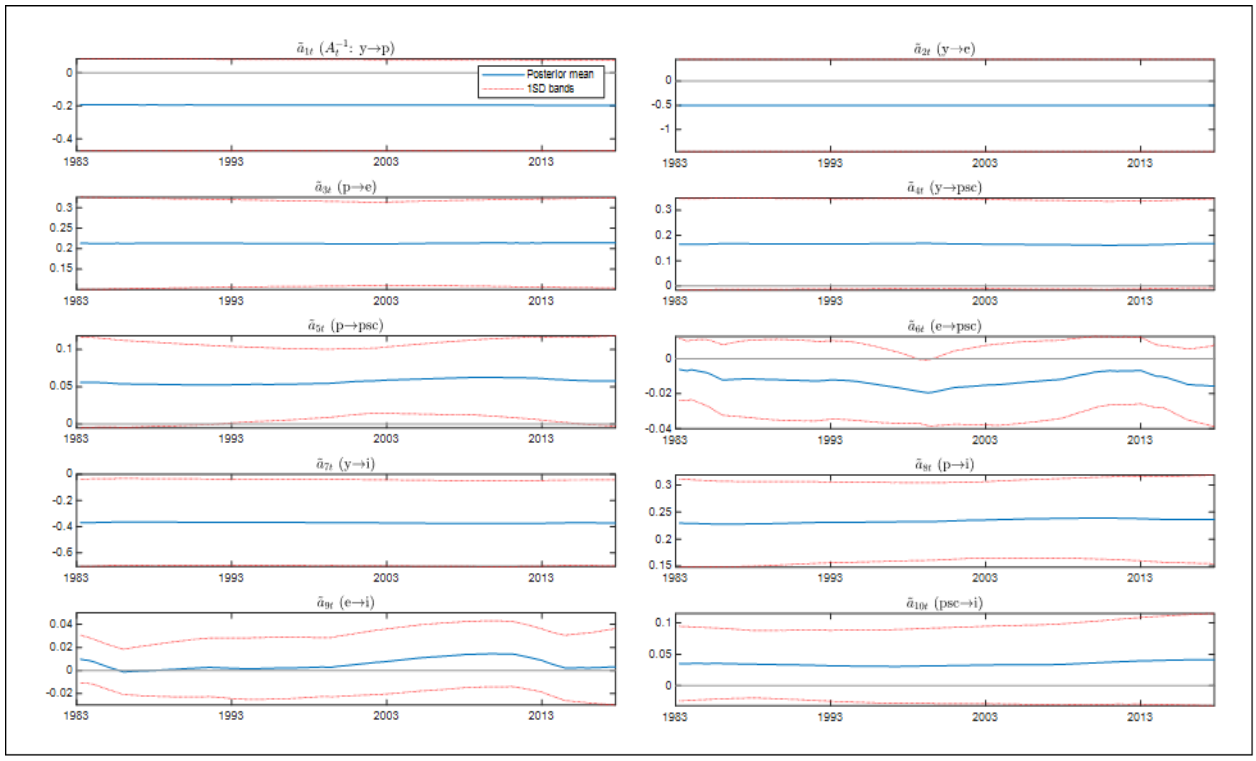


Figure 5.2: Posterior estimates of the simultaneous relations in the monetary policy model

5.5 Posterior estimates for the stochastic volatilities

Figure 5.3 shows the posterior means for the stochastic volatility of GDP growth (y); inflation (p); exchange rate movements (*e*); private sector credit growth (psc); and short-term nominal interest rate (i). There is a clear indication of time variation in the shocks to volatility across the variables in the TVP-VAR-SV model. This is **evidence that shocks to monetary policy have varied over time**. The stochastic volatility of GDP growth exhibits higher volatility in the early parts of the data (mid-1980s). As indicated in chapter 2, Ghana started implementing economic recovery and structural adjustment programmes at the end of 1983 to reverse the economic decline that had characterised the greater part of the previous decade. Economic growth spurted by the end of 1984. The low and stable volatility experienced afterwards reflected a more stable growth path. Significant spikes were again observed from around 2007, reflecting the country's spending to celebrate 50 years of nationhood and to host the African Cup of Nations football tournament in 2008. Perhaps, the most significant shock to output growth volatility was the start of crude oil production in commercial quantities in 2011. A subsequent slowdown in the pace of growth followed as the country battled severe energy shortages due to power generation bottlenecks from 2012.

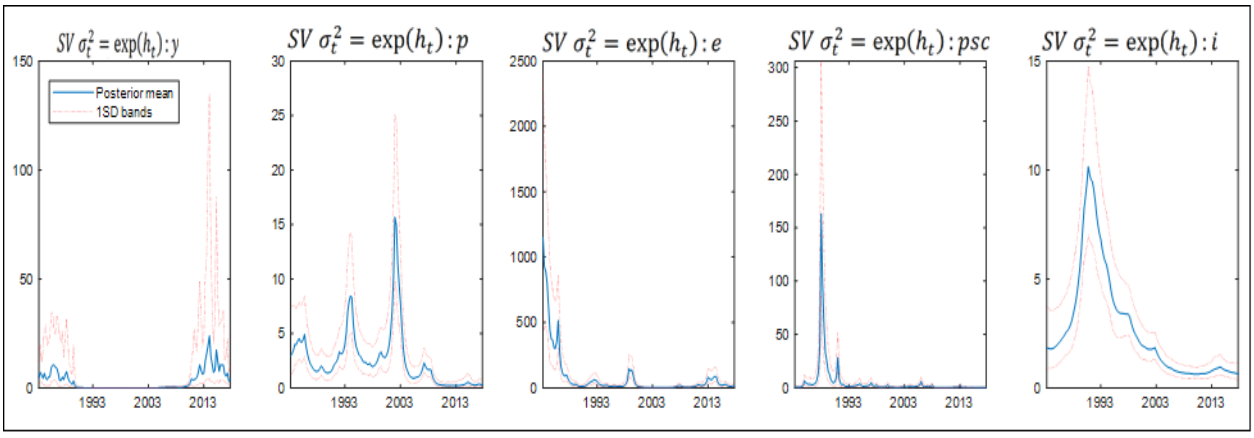


Figure 5.3: Posterior estimates for the stochastic volatilities of the monetary policy model

The initial spike in the stochastic volatility of inflation reflects general price level adjustments during the process of dismantling the price control regime as part of Ghana's economic recovery and structural adjustment programmes. A further spike was observed around 1994 after sustained upward adjustments in ex-pump fuel prices and the initial ill-fated introduction of VAT in 1995 that led to the escalation of domestic prices of goods and services. The most severe shock to inflation volatility occurred around 2003 after an upward adjustment of over 100% in the ex-pump fuel prices as the country attempted to deregulate the energy sector to enable prices to reflect their USD parity value. Inflation volatility subsequently exhibited a broad downward tendency, dropping to a particularly low and stable level after the introduction of IT as a monetary policy framework in the mid-2000s.

Stochastic volatility of the nominal exchange rate was particularly high in the mid-1980s after forex market reforms that resulted in the realignment of the nominal exchange rate to reflect market conditions. It displayed a general downward trend with some spikes in 1999/2000 after deteriorating commodity terms of trade. The same trend occurred in 2014/2015 as the protracted energy shortages degenerated into general macroeconomic instability and severe depreciation of the local currency.[108]

Private sector credit growth during the early stages of ERP/SAP was low and stable. It however displayed a significant spike around the start of FINSAP in 1988. This was the beginning of the

[108] It stands to reason that the extremely high stochastic volatility in the earlier parts of the data would have obscured a number of volatility spikes along the way including the one that occurred in 2008/09.

process of lifting credit restrictions as part of market reforms. It showed a rapid downward trend that became low and stable for the remainder of the sample period.

Stochastic volatility of the short-term nominal interest rate displayed a major spike in 1994/1995 when the BOG tightened monetary policy in response to the inflationary pressures that followed frequent adjustments in ex-pump fuel prices and the ill-fated introduction of VAT in 1995. Thereafter, it followed a clear downward trajectory with some points of inflection as policy temporarily reacted to inflationary pressures emanating from the deregulation of energy prices. Even though stochastic volatility turned low and stable in the latter parts of the data reflecting a general improvement in the macro scene and the implementation of IT as a framework of monetary policy, a spike was observed around 2014/2015, which suggests that monetary policy reacted to the 2014/2015 exchange rate shock. The foregoing discussion confirms stochastic volatility in the Ghanaian macro data, which justifies using the TVP-VAR-SV model for estimating and identifying structural shocks (Nakajima, 2011).[109] Shocks to monetary policy (as reflected in the interest rate), the exchange rate, credit, output, and inflation vary over time. More broadly, stochastic volatility, apart from growth, showed a downward trend and became low and stable from 2000 onwards. This implies a steady improvement in macroeconomic stability after the adoption of IT as a framework of monetary policy.

[109] This outcome also invalidated results from the traditional constant parameter VARs, which is why it was not used in this study.

5.6 Monetary policy (interest rate) reactions to macroeconomic shocks

Figure 5.4 indicates the evolution of monetary policy reactions to a positive one standard deviation shock to growth, exchange rate and private sector credit. Figure 5.4a plots the time series responses for selected horizons of one year (4 quarters), two years (8 quarters), and three years (12 quarters). Figure 5.4b indicates the impulse responses for three carefully selected periods of the post-direct control regime (1991q4), post-monetary targeting regime (2002q3), and a decade since the formal introduction of IT (2017q2).

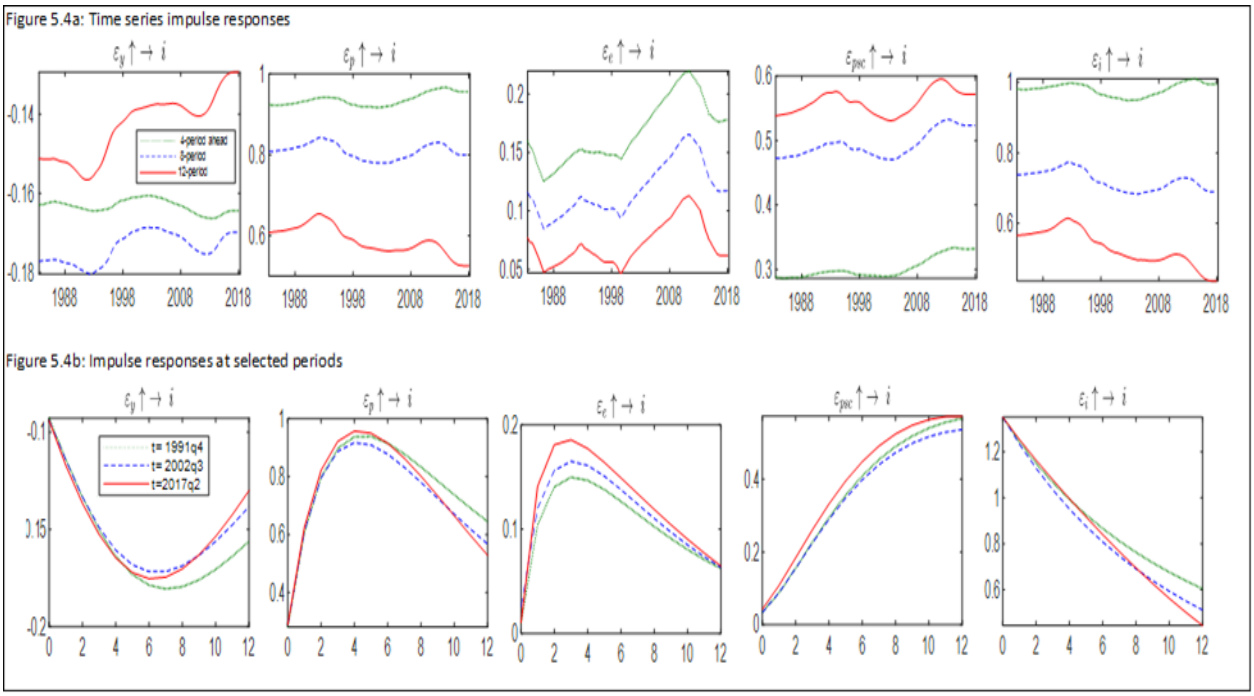


Figure 5.4: Monetary policy response to macro shocks

The time-varying impulse response indicates that the BOG tended to raise the short-term nominal interest rate over time and all horizons in response to inflation shocks ($\varepsilon_p \uparrow \rightarrow i$). Broadly, monetary policy became less aggressive after the formal introduction of the monetary targeting framework

in the early 1990s and remained so until IT was formally introduced in 2007. The pursuit of a more aggressive monetary policy during this period would explain the achievement of low and stable inflation in the later years. More recently, policy tended to be less aggressive as inflation trended broadly downwards towards the BOG's medium-term target. In addition, the BOG relied on transparent communication to help influence market sentiments and anchor expectations. During the IT period, monetary policy appeared more aggressive in the short term (4 quarters) and less so over the medium term (12 quarters). The overall response of monetary policy as reflected in interest rate to inflation shocks does not appear to be regime specific (see figure 5.4b).

In contrast, the monetary authority's time-varying reaction to a (positive) output shock ($\varepsilon_y \uparrow \rightarrow$ i) was negative over the whole study period and over the 12-quarter horizon for the three periods selected, which suggests that the policy reaction was coincidentally pro-cyclical. There two possible explanations for the seemingly counterintuitive result. First, as noted in chapter two (see Box 1), Ghana's exports is dominated by primary commodities and accounted for a significant share of GDP , implying a limited role for domestic monetary policy to influence output conditions. This is because domestic output conditions are more likely to be driven by the prices of these primary commodities in the international commodity markets. Second, the result confirms that the BOG is orientated more towards achieving its price stability mandate than to securing sustained high output growth, at least in the short run. The implicit assumption is that low and stable inflation would stimulate output in the longer term. Moreover, given that output growth averaged over 5% in the presence of lingering inflationary concerns over the greater part of the study period, the BOG was more likely to devote all its fire power to fighting inflation. As Akosah (2015) noted, this was consistent with the primacy of the price stability mandate as enshrined in the Bank of

Ghana Act 612 of 2002. With inflation expected to move towards the lower single-digit territory over the medium to long term in line with the BOG's medium-term target, a more balanced approach to implementing the Taylor Rule is likely to become more evident in the Ghanaian data.

This study also observed a time-varying positive response to exchange rate shocks ($\varepsilon_e \uparrow\rightarrow i$). In other words, the BOG reacted appropriately by raising the short-term nominal interest rate in response to forex market developments that exerted downward pressures on the domestic currency. The positive response to the exchange rate shock underpinned the inflationary concerns of exchange rate movements given that the exchange rate pass-through in Ghana used to be high.[110] However, evidence presented later in section 5.8 (see figure 5.6) points to declining pass-through of the exchange rate consistent with the observation of Jasova et al. (2016) that the pass-through of the exchange rate has been falling in emerging markets and developing economies (EMDEs). The Central Bank became more aggressive in its response to exchange rate movements during the period of flexible exchange rates. As figure 5.4a illustrates, the central bank reacted aggressively to the exchange rate shock that occurred around 2009-2014 period. As explained in chapter two, this period largely captured two significant events – the economy's delayed reaction to the GFC that saw the local currency depreciated by almost 25% in 2009 and the prolonged energy supply shortages and oil price shocks of 2014/2015 that caused the local currency to depreciate by over 32% in 2014. Inflation rose sharply, causing the central bank to react aggressively with the monetary policy rate witnessing a 9% percentage point increase between 2008 and 2015. However, as shown in figure 5.4b, this aggressiveness diminished somewhat during the IT period as a whole

[110] For example, using the traditional constant parameter VAR, Loloh (2014) found that the pass-through of the exchange rate to CPI inflation exceeded 22% in the first year, and more than 30% in the case of non-food inflation over the same period.

compared with the monetary targeting period. This finding derives from the fact that a flexible exchange rate regime is a necessary prerequisite for the successful implementation of an IT regime in that flexible exchange rates serve as shock absorbers, although central banks are still expected to douse excessive exchange rate swings with the aid of their reserves (Mishkin, 2006). The study also revealed a more heavy-handed response to exchange rate depreciation in the short term (4 quarters) and less so over the medium term (8 quarters and 12 quarters).

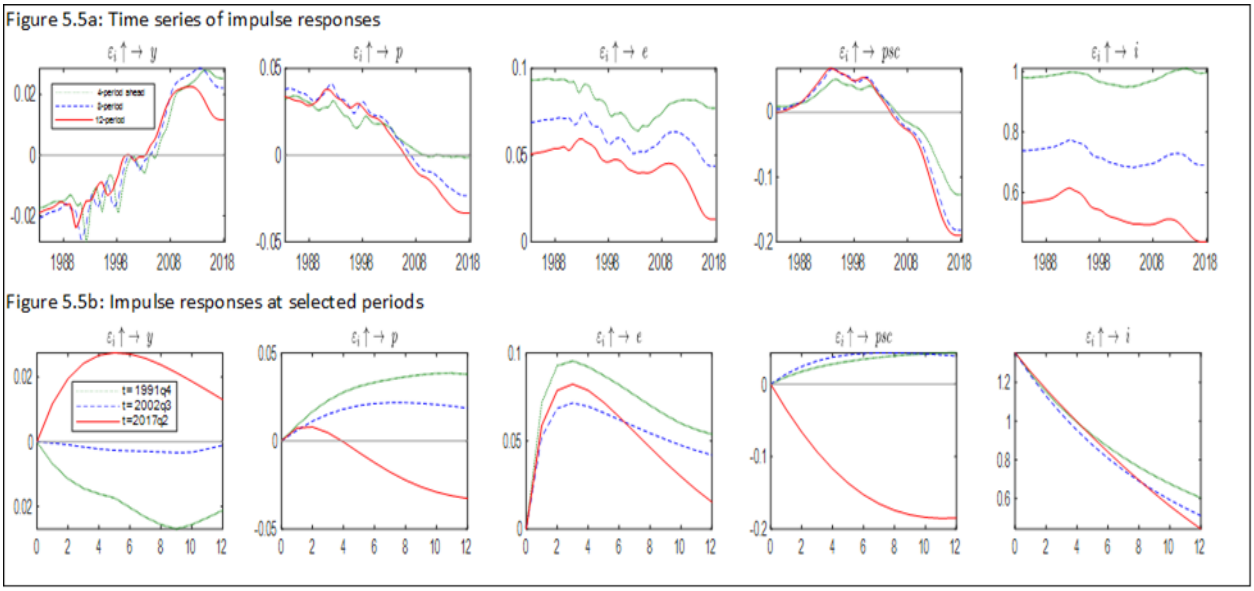
The evidence presented in figure 5.4 also reveals a time-varying positive monetary policy reaction to credit shocks ($\varepsilon_{psc} \uparrow\rightarrow$ i) with the BOG appearing unresponsive to credit developments in the short term (first 4 quarters) until 2008 when financial stability concerns became a priority to central banks around the world after the start of the global financial crisis (GFC). Monetary policy tended to become more responsive over the longer horizon (8 and 12 quarters). Generally, policy has become more aggressive in its reaction to credit developments post-GFC, perhaps in an attempt to prevent the excessive credit growth that is known to precede most episodes of financial instability (Schularick & Taylor, 2012). Therefore, the response of monetary policy to macro shocks varies over time.

5.7 Time-varying reaction to monetary policy (interest rate) shocks

Figure 5.5 plots impulse responses to a one-standard deviation monetary policy (interest rate) shock ($\varepsilon_i \uparrow$) over time and at selected time periods. The figure shows clear evidence of time variation in the response of output growth to the shock ($\varepsilon_i \uparrow\rightarrow$ y). In particular, a one-standard deviation shock to the short-term nominal interest rate (the policy rate) led to a negative response in output growth between 1984 and 2005. This outcome is consistent with the predictions of the

traditional interest channel of the transmission mechanism of monetary policy that posits that a contractionary monetary policy, working through the real interest rate, raises the real cost of borrowing. This, in turn, slows business investment and consumer purchases of durables and residential investment, thereby reducing aggregate demand, hence output (see 3.2.1.3.1). However, the output growth response to the monetary policy shock turned positive after 2005, which, incidentally, came just six quarters before Ghana announced the formal introduction of IT as a framework of monetary policy having operated with the framework since the MPC was inaugurated in September 2002. As noted in chapter 2, the introduction of the IT framework was the culmination of profound institutional and financial sector reforms that began in 2001. These reforms undoubtedly led to increased macro stability. The positive response of output growth to the monetary policy shock during this period could be attributed to the capital account liberalisation, improved productivity, start of commercial crude oil production and macroeconomic stability dividend in that the negative effect of the raised interest rates on output growth was overshadowed by the positive effect of more positive sentiments that arose from greater macro stability. The impulse responses for the selected periods confirmed this outcome with the responses for 1991q4 (representing the post-direct control regime) and 2007q2 (representing the post-monetary targeting regime) being negative, whereas the response for 2017q2 (representing a decade since IT was formally introduced) indicate a positive response to the monetary policy shock. Mwabutwa et al. (2016) also found a positive response to the interest rate shocks in the latter parts of their sample using macro data from Malawi, which they attributed to improved agriculture productivity on the back of economic reforms.[111]

[111] Malawi has not adopted the IT framework but has pursued monetary and financial sector reforms over years.



Source: Author's computation.

Figure 5.5: Responses to monetary policy (interest rate) shocks

Until 2007, the inflationary response to monetary policy shocks ($\varepsilon_i \uparrow\rightarrow p$) was positive at the three selected time horizons. Taken at face value, this outcome was inconsistent with the traditional interest rate channel theory of the monetary transmission mechanism and was considered a puzzle, the so-called price puzzle. However, various explanations can be offered for this phenomenon. Firstly, the response of inflation to a positive interest rate shock might have displayed positive tendencies if the systematic reaction of the BOG to the rising expectation of inflation were insufficient to thwart the oncoming inflation (Sims, 1992; Balke & Emery, 1994; Christiano et al., 1999; Belaygorod & Dueker, 2006). Secondly, as Hicks (1979) and later Barth and Ramey (2001) observed, interest rate shocks can also exhibit supply-side effects in the sense that the cost of capital rises in response to interest rate increases. Thirdly, in addition to these interest cost push and passive monetary policy effects, other effects – both cost push and demand pull – may

dominate the demand-side effects generated by the interest rate, at least in the short term. The rudimentary nature of Ghana's financial markets, the BOG's low credibility and its associated unanchored inflation expectations, and the structural rigidities in the preceding decades could have contributed to supply-side or other demand-side effects, overshadowing the interest-rate induced demand-side effects in the medium term. Even after 2007, the inflationary response to the monetary policy shock in the first year (4 quarters) remained unresponsive for the most part, suggesting the persistence of substantial supply-side effects in the short term as the financial sector remained largely undeveloped. It was only after the first year (4 quarters) that prices began to respond negatively to the positive interest rate shock, as postulated by the traditional interest rate channel theory of the monetary transmission mechanism. This period coincided roughly with the start of the GFC and the period of the protracted energy supply shortages that prompted significant exchange rate volatility, rising inflationary pressures and aggressive response by the central bank. This suggests that, unlike the earlier period, the systematic reaction of the BOG to the inflationary pressure was sufficient to foil the advancing inflation. As Ghana continues to implement policies to deepen its financial markets and minimise the structural rigidities inherent in its economy, it is expected that the traditional predicted relationship between monetary policy shock and inflation will begin to hold, even in the short run. This result is broadly at variance with Franta et al. (2012) who found that prices have become more sensitive to monetary policy shocks in the Czech Republic.

The time-varying exchange rate response to a monetary policy shock ($\varepsilon_i \uparrow\rightarrow e$) remains positive (i.e., depreciates instead of appreciates) over all three selected time horizons and at the selected periods throughout the sample period. At first glance, this may again seem counterintuitive, but

more careful scrutiny will suggest otherwise. As noted in chapter 3 (see subsection 3.2.1.3.2), the effect of a positive monetary policy shock (a raise in the policy rate) on the exchange rate depends on two countervailing factors. Firstly, foreign investors may rebalance their portfolios in favour of domestic currency denominated assets, causing the domestic currency to appreciate initially. Secondly, cheaper foreign goods resulting from the stronger domestic currency may hurt net exports, and prompt the depreciation of the local currency. A third factor relates to the inflationary implications of interest rate changes and how that feeds into expectations formation, since, as discussed in the preceding paragraph, an interest rate shock tends to have a positive effect on inflation. Given the high inflationary environment during the period under review, interest rate shocks were likely to trigger extrapolative expectations of a future increase in inflation. This would feed into the local forex market and cause the local currency to depreciate, setting in motion a vicious cycle of inflation and exchange rate depreciation (see Laidler, 2015). Depending on the various elasticities and the inflation outcomes of interest rate changes, the net effect may then be a currency weakening. A key implication of the foregoing is that the domestic currency is more likely to depreciate over all time horizons in an economy with capital controls and high inflation. As noted in chapter 2, Ghana only removed capital flow restrictions in 2006, which suggests that the possible currency depreciation was in response to monetary policy shocks prior to 2006. This was because the initial depreciation generated by the rising inflation (via the supply-side effects) was amplified by the subsequent impact of the monetary policy shock on net exports. Again, despite the removal of capital flow restrictions, the effect of capital movements on the domestic currency after 2006 in response to changes in the domestic interest rates were outweighed by the effects of inflation and net exports. This result was consistent with the finding of Abradu-Otoo et

al. (2003), namely that the bilateral cedi/USD exchange rate depreciated following a hike in interest rates.

Private sector credit growth reacted positively to a monetary policy shock ($\varepsilon_i \uparrow \rightarrow$ psc) between 1984 and 2005. This seems to be at variance with the credit channel view of the transmission mechanism of monetary policy. As pointed out in chapter 3 (subsection 3.2.1.3.4), a positive monetary policy shock (increase in policy rate) lowers borrowers' net cash flow and collateral value, which inhibits their ability to borrow. This suggests that, in the absence of credit referencing and collateral registry assisting commercial banks to assess the creditworthiness and collateral values of borrowers, credit growth may not respond appropriately to monetary shocks. Moreover, bank lending rates are not the only influencing factor on bank lending (and hence on the money stock). Bank lending is also powerfully impacted by Keynesian 'animal spirits' (the sentiments in the economy). However, the financial sector reforms that were embarked on in 2001 culminated in the establishment of credit delivery institutions such as collateral registry and credit reference bureaux. The passage of the Bank of Ghana Act 612 of 2002 also helped deal with the issue of the BOG's financing of large fiscal deficits. As a result of these reforms, the response of private sector credit growth turned negative after 2005 and became particularly sensitive to monetary policy shocks in recent times. This result is consistent with the finding of Franta et al. (2012) for the Czech Republic that private sector has become more sensitive to monetary policy shocks following financial sector reforms.

5.8 Time-varying responses to exchange rate shocks

The dynamic response of output growth, inflation and credit growth to a one standard deviation shock to the exchange rate is shown in figure 5.6. In terms of its effect on output, a depreciation is expected to improve economic activity by boosting exports and depressing imports. This however depends on export and import demand elasticities. The response of output growth to an exchange rate shock ($\varepsilon_e \uparrow\rightarrow y$) was initially weakly negative appearing to approach zero briefly around 1995 within the first year (4 quarters). This result is not surprising given that this period coincided largely with the direct control and fixed exchange rate regime, which was progressively relaxed until the exchange rate finally started to float freely in 1992 as well as accommodative monetary policy. Imports were largely controlled during this period due to the scarcity of forex. With a weak export base, the floating of the exchange rate and the lifting of import restrictions led to an explosion of imports to meet pent-up demand, leading to significant leakages from the economy. The impact of the exchange rate shock on output growth remains negative but becomes pronounced over all horizons after 1995. The more aggressive monetary policy response to the exchange rate shocks in the latter parts of the data could have resulted in the bigger decline in output growth. Franta et al. (2012) found similar results for the Czech Republic and attributed these to the absence of foreign variables in the TVP-VAR-SV model.

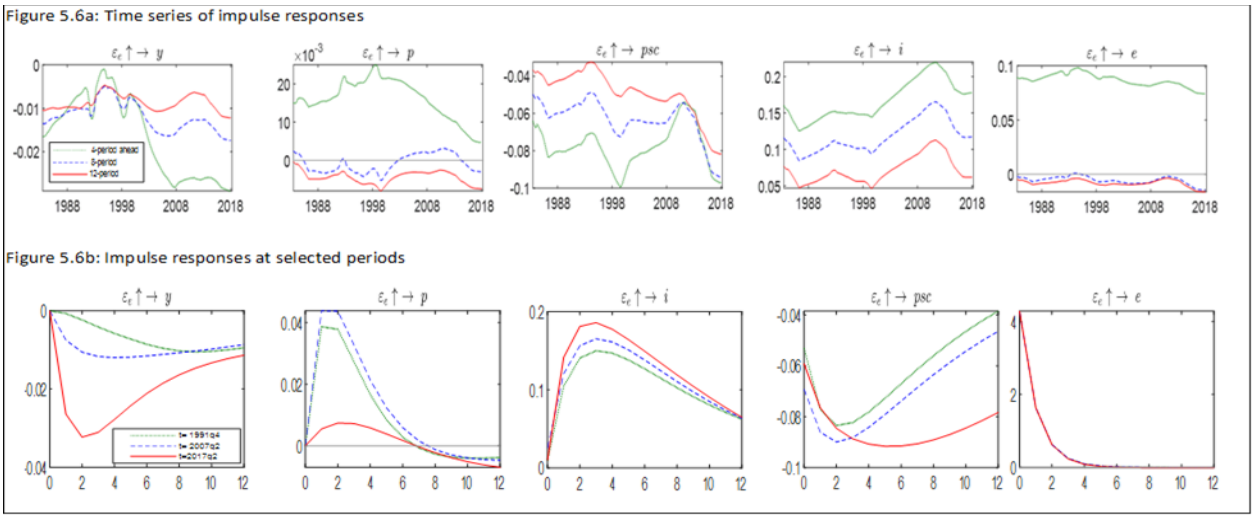


Figure 5.6: Time-varying responses to exchange rate shocks

The time-varying effect of an exchange rate shock on the general price level ($\varepsilon_e \uparrow \rightarrow p$) in the first year (4 quarters) rose steadily, peaking around 1999, suggesting a high pass-through of the exchange rate shock to domestic prices. The impact has since declined steadily, reaching appreciably low levels toward the end of the sample, which points to declining pass-through of the exchange rate in line with Jasova et al. (2016), as noted earlier. As explained above, monetary policy also became more aggressive following the higher exchange rate and inflation volatilities that characterised the economy during the GFC and the period of the protracted energy supply shortages. This helped anchor inflation expectations thereby reducing the pass-through of the exchange rate. The effect of the shock over the medium term (8 and 12 quarters) remained broadly negative (except for the period between 2003 and 2014 when the 8-quarter horizon response was positive) throughout the entire sample, suggesting that following the unexpected exchange rate shock, prices tend to overshoot and over-recover import cost increases.

The dynamic impact of the unexpected one standard deviation movements in the exchange rate on private sector credit growth ($\varepsilon_e \uparrow\rightarrow$ psc) is negative over all the time horizons with the impact becoming weaker towards 1993. The impact however appears to have become stronger after 2008, being highest within the first year (4 quarters) and lowest after three years (12 quarters). The stronger response after 2008 coincided with the period of higher exchange rate and inflation volatilities that followed the GFC and the prolonged energy supply shortages. This prompted aggressive monetary policy response, leading to a general increase in the interest rates including lending rate thereby constraining demand for credit. In Ghana, exchange rate shocks tend to weaken the ability of borrowers to repay loans, particularly foreign currency loans, and as a result demand for and supply of loans tend to slow in the face of unexpected depreciation of the local currency.[112] In the circumstances, the response of monetary policy to the exchange rate shock was dynamically positive.[113] Hence, the transmission of exchange rate shocks is, once again, time varying. Arratibel and Michaelis (2014) found similar results for Poland.

5.9 Time-varying responses to credit shocks

This section is motivated by two mutually reinforcing considerations. Firstly, adverse credit shocks featured highly as one of the core results of the 2008/2009 GFC, because banks suffered large losses and, as a consequence, sought to shore up their solvency by deleveraging and thus reducing their credit extension (and hence the money stock), resulting in the worst economic downturn since

[112] On average, foreign currency loans granted by Deposit Money Banks (DMB) in Ghana constitute about 30% of net advances. Despite mortgage and other consumer loans (for durables, e.g. cars) being classified as local currency denominated loans, they are usually USD-indexed, meaning that movements in the exchange rate raise the debt of the borrowers. Households' share in DMBs credit to the private sector averages 15% (Bank of Ghana, various) while official statistics do not exist on mortgages in Ghana but they could be sizeable.

[113] The interest rate response to the exchange rate shock was discussed earlier in section 5.6

the Great Depression. Secondly, with an increasing focus on macroprudential policies, central banks must have a sense of the macroeconomic impact of possible regulatory measures that may trigger a credit shock (Borio & Disyatat, 2011). Figure 5.7 plots the time-varying effects of a one standard deviation positive private sector credit shock on output growth ($\varepsilon_{psc} \uparrow\rightarrow y$), inflation ($\varepsilon_{psc} \uparrow\rightarrow p$) and the exchange rate ($\varepsilon_{psc} \uparrow\rightarrow e$). The dynamic response of output growth to the private sector credit shock ($\varepsilon_{psc} \uparrow\rightarrow y$) was positive until the mid-1990s over all horizons. Much of this period coincided with the era of economic and financial sector reforms. For example, credit control measures were lifted enabling much needed financial deepening. During the second half of the 1990s however, output became unresponsive to the credit shock, pointing to a period of credit saturation (moving towards the peak of the credit boom) as output growth momentum began to taper off. From 2001, the output growth reaction to the credit shock returned to positive territory and became stronger than the initial phase on the back of the second wave of institutional and financial sector reforms.

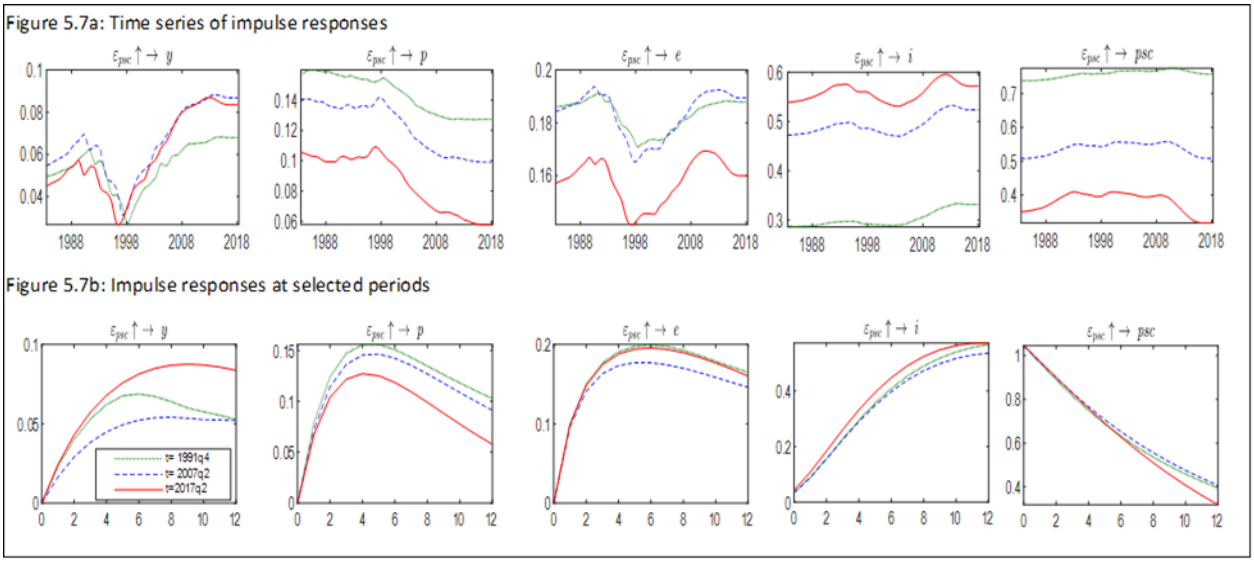


Figure 5.7: Time-varying impulse responses to credit shocks

A generally positive output growth response to private sector credit shocks is fertile ground for inflationary pressures insofar as it causes output to move towards the economy's productive capacity constraints. As a result, the dynamic response of general prices to credit shocks ($\varepsilon_{psc} \uparrow \rightarrow$ p), was positive and peaked around 2000. Thereafter it has followed a downward trend with the impact on prices stronger over the shorter horizons. The inflationary environment ignited by the positive credit shock feeds into the local forex market. As a result, the local currency depreciates with time-varying tendencies in response to a one standard deviation positive credit shock ($\varepsilon_{psc} \uparrow \rightarrow$ e). Given this context, the BOG reacts appropriately by raising the short-term nominal interest rate ($\varepsilon_{psc} \uparrow \rightarrow$ i), a reaction that varies over time as observed in section 5.6. **Hence, the transmission of credit shocks varies over time.**

5.10 Evolution of the money supply shock

This discussion is based on the alternative model in which credit growth variable is replaced by money supply growth (m). It should be noted that private sector credit (psc), insofar as it consists of bank credit, corresponds closely to broad money, with bank credit extended to the government. Cross-border money flows are the main factors that drive a wedge between psc and m. Since the results do not change dramatically from the version of the model with psc, attention is focused mainly on how other variables in the model (i.e., output growth, inflation, exchange rate movements, and interest rate) react to a money supply shock over time. It is however important to mention that the estimation, after 9 000 iterations with 900 discarded during the burn-in period,

satisfies all the conditions of efficient estimation and convergence.[114] When economic reforms were first instituted the stochastic volatility of the money supply growth was relatively high because the fiscal authorities frequently relied on the BOG to finance the fiscal deficit.[115] However, as the reforms gained traction amid massive external support from the Bretton Woods institutions, the stochastic volatility of money supply growth trended downward. It remained low and stable since it was stimulated mainly by way of deposits money banks (DMBs) credit growth until a major spike occurred around 2014. The spike resulted from a brief but significant accommodative monetary policy instituted when the BOG was forced to finance the government deficit as the country grappled with years of energy supply shortages that had crippled economic activity and undermined domestic revenue mobilisation. When home-grown policies failed to resuscitate the ailing economy, the authorities sought financial support from the IMF.

Figure 5.8 plots the impulse responses to a one standard deviation positive money supply shock ($\varepsilon_m \uparrow$) over time (figure 5.8a), and at selected time periods (figure 5.8b). This money supply shock in the Ghanaian economy was tantamount to a large injection of liquidity to accommodate fiscal policy and/or to finance the purchase of cocoa crops (Abradu-Otoo et al., 2003). Figure 5.8 shows clear evidence of time variation in the reaction of output growth to the money supply shock ($\varepsilon_m \uparrow \rightarrow y$). In particular, a one standard deviation shock to the money supply growth elicited a negative response in output growth between 1984 and 2000. This was due to the relatively higher positive links between money supply growth and inflation during this period ($\varepsilon_m \uparrow\rightarrow p$). It is not yet clear why the exchange rate ($\varepsilon_m \uparrow\rightarrow e$) appreciated in the short term (first 4 quarters) after the money

[114] See appendices A.5.1 & A.5.2.
[115] See appendix A.5.3.

supply shock, and then, consistent with conventional wisdom, depreciated over the medium term. The monetary authorities reacted to the inflationary pressures by raising the short-term nominal interest rate ($\varepsilon_m \uparrow \rightarrow i$). Economic activity was further affected since the high interest rate affected the cost of capital on the supply side, depressing business investment and consumer purchases of durables and residential investment.

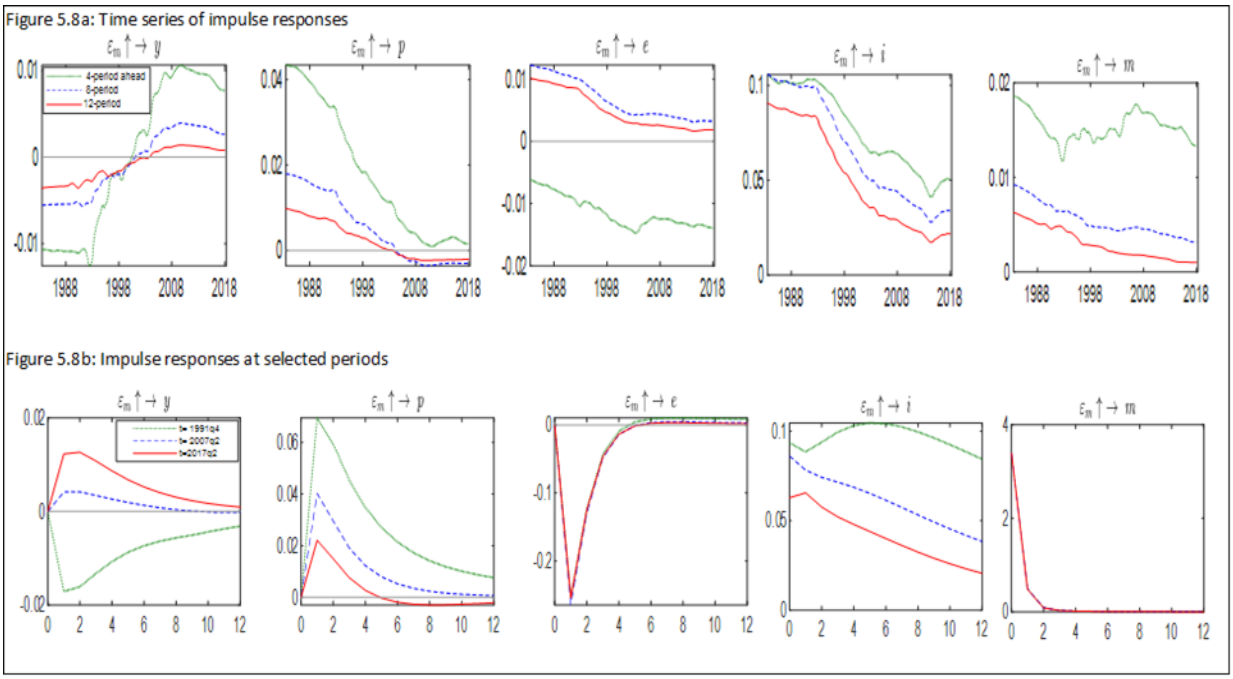


Figure 5.8: Time-varying impulse responses to money supply shocks

The inflationary response to money supply shocks weakened dramatically on the back of emerging evidence of a breakdown in the relationship between money supply growth and inflation as macro stability took hold post-2000. This period coincided with the preparation and formal adoption of IT as a framework for monetary policy. Under IT, money is de-emphasised as the main driver of inflation, although any central bank would be imprudent to disregard it completely. Institutional

reforms at this time meant that monetary policy accommodating fiscal deficits was minimised as the Bank of Ghana Act 612 of 2002 capped the extent to which fiscal authorities could finance the budget deficit domestically through the BOG. Consequently, the reaction of output growth to the money supply shock turned positive and significantly high, particularly in the short term. Reinforcing the growth outcome of the money supply shock was evidence that the inflation response to money supply shocks was near zero in the short term. The inflation response subsequently tended to become negative over the medium term (8 to 12 quarters) as evidence emerged of a breakdown in the relationship between money supply growth and inflation. In this context, the monetary authorities steered interest rates downward as the macro environment improved. In a sense, money supply shocks prior to 2001 were detrimental to Ghana's macroeconomy since they resulted in high inflation, lower growth, and high interest rates even though the impact they had on the nominal exchange rate is unclear. Post 2001, output growth responded positively to the positive money shock with diminished inflationary consequences. Evidence from figure 5.8b indicates that the monetary authorities had become less aggressive (the response to the money supply shock at $t = 2017q4$ was the lowest of the three selected periods) in their response to money supply shocks ($\varepsilon_m \uparrow\rightarrow i$). This is supported by the view that money supply holds only limited information for price formation in Ghana.[116]

[116] Admittedly, the money supply shocks could have been smaller after 2001 given the legal restrictions that the Bank of Ghana Act 612 of 2002 imposed on deficit financing. If these shocks were larger, their impact on inflation could have been more significant. However, Bawumia et al. (2008) observed that inflation remained low despite strong monetary growth post-2001 and questioned the stability of the money demand function. Furthermore, the large shock to the money supply experienced around 2014/15 did not produce the high inflationary pressures of the past.

5.11 Results of the monetary policy model robustness tests

This section presents the results of the robustness checks using the respecified priors and the alternative identification as outlined in Section 4.6. In the case of the respecified priors, the TVP-VAR-SV model is re-estimated by administering 50 000 iterations with the initial 5 000 draws discarded during the burn-in period. For the alternative identification, the TVP-VAR-SV model is re-estimated by administering 38 000 iterations with the initial 3 800 draws discarded during the burn-in period.

Estimation diagnostics reaffirm the efficient estimation of the model's parameters. Appendices A.5.4 and A.5.9 validate the sampling method by affirming the convergence to the posterior distribution given the 5% significance level in relation to the CD statistics. The estimated posterior mean of the selected parameters all fall within the respective 95% credible intervals. It is also clear from the two appendices that the parameters are estimated efficiently since only one inefficiency factor exceeds 100 but remains within tolerable levels (see Appendix A.5.4). Appendices A.5.5 and A.5.10 indicate the sample paths look stable with evidence of a steady drop in the sample autocorrelation and efficient generation of uncorrelated samples by the sampling method. These evidence confirm the robustness of the strategy adopted in the estimation of the baseline model.

The posterior estimates of the simultaneous relations among the variables are consistent with those obtained in the baseline model (see appendices A.5.6 & A.5.11). The time-varying volatilities from the two robustness tests perfectly track trends observed in the baseline model (see appendices A.5.7 & A.5.12). In addition, evidence from the IRFs robustly confirm the conclusion from the baseline model which pointed to the presence of time variation in the transmission of monetary

policy shocks (see appendices A.5.8 & A.5.13). Thus, the robustness checks performed in this section affirm the results of the baseline model.

5.12 Summary of monetary policy shocks

This chapter presented the empirical results of monetary policy shocks using the main TVP-VAR-SV model, which comprises the short-term nominal interest rate (*i*), and the growth rates of four seasonally adjusted variables, namely output growth (y), inflation (p), cedi/USD nominal exchange rate (e), and private sector credit (psc). Estimation diagnostics confirm the efficient estimation of the model's parameters. The results provided evidence of time variation in the simultaneous relations among some of the model's variables, thereby affirming the adoption of the TVP-VAR-SV framework. The variables in the model showed individual stochastic volatility over time, suggesting that the shocks to the system were time varying. Evidence from the IRFs confirmed time variation in the response of monetary policy to macro shocks. The response to inflation and exchange rate shocks tended to be more aggressive in the short term. However, the overall response of monetary policy (as reflected in interest rate) to inflation and exchange rate shocks does not appear to be regime specific. Conversely, the response of monetary policy to credit shock tended to be less aggressive in the short term (within one year) than in the medium term (more than one year). Monetary policy also became more responsive to credit shocks as financial stability concerns took centre stage after the global financial and economic crises.

The study also confirmed time variation in the reaction of macro variables to monetary policy (interest rate) shocks. In particular, output growth responded negatively to a positive, one standard deviation shock to the short-term nominal interest rate between 1984 and 2005, which was

consistent with the predictions of traditional theory in respect of the interest channel of the monetary policy transmission mechanism. However, the output growth response to the monetary policy shock turned positive after 2005, which could be seen as a stability dividend. In broad terms, the dynamic response of inflation to monetary policy shocks supported the supply-side hypothesis of Hicks (1979), and Barth and Ramey (2001) in that inflation reacted positively, over all horizons, to the monetary shocks until 2010. Beyond 2010 the inflation response to monetary policy shocks turned negative over longer horizons in conformance to the postulation of the traditional interest rate channel. The time-varying exchange rate response to monetary shocks remained positive (i.e. depreciated instead of appreciated) over the three selected time horizons and at the selected periods throughout the sample period. This can be attributed to the capital restrictions prior to 2006 and the dominance of net export effects over capital flows effects. The result is consistent with Abradu-Otoo et al. (2003) who found that the bilateral cedi/USD exchange rate depreciated after a hike in the interest rate. Credit growth in the private sector reacted positively to the monetary policy shock between 1984 and 2005, which is incongruous with the credit channel view of the monetary policy transmission mechanism. This can be ascribed to the absence of credit referencing and a collateral registry to assist commercial banks in assessing the credit worthiness and collateral value of borrowers, which inhibited the transmission mechanism. The response of private sector credit growth turned negative after 2005, and has become particularly sensitive to monetary policy shocks in recent times following profound financial sector reforms.

As a by-product of the monetary policy shocks analysis, the study also looked at the time-varying response to exchange rate, credit and money supply shocks. In terms of exchange rate shocks, output growth reacted mostly negatively. It became even more sensitive after trade liberalisation

and floatation of the exchange rate as imports exploded without a corresponding increase in exports. As Franta et al. (2012) observed, this result may have been due to the absence of foreign variables in the TVP-VAR-SV model. The time-varying effect of the exchange rate shock on general prices in the first year (4 quarters) rose steadily and peaked around 1999, which suggests a high pass-through of the exchange rate shock to domestic prices. The impact has since declined steadily and reached low levels at the end of the sample, which is in accordance with international experience. Credit growth responded negatively to exchange rate shocks over all the time horizons with the impact becoming pronounced after 1993. However, the impact appeared to have weakened over time, being highest in the first year (4 quarters) and lowest after three years (12 quarters). In Ghana, exchange rate shocks tended to weaken the ability of borrowers to repay loans – in particular, foreign currency loans – and as a result, the demand for and provision of loans tended to slow down in the face of the unexpected depreciation of the local currency. The dynamic impact of an exchange rate shock on private sector credit growth was negative over all the time horizons, and weakened towards 1993. Thereafter, the impact became stronger, which is consistent with the idea that, in Ghana, an exchange rate shock tends to weaken borrowers' ability to repay loans. Monetary policy is tightened dynamically in response to an exchange rate shock.

The output growth response to a credit shock was generally positive apart from a brief period of unresponsiveness in the mid-1990s due to credit saturation. Output growth responded more strongly to the credit shock that followed the financial and institutional reforms as of 2001.[117] The dynamic response of inflation to the credit shock was positive and peaked around 2000. Thereafter,

[117] In an improved macroeconomic policy setting, the credit shocks are milder – of a standard size – and therefore less inflationary, which tends to have a stronger effect on output.

it followed a downward trend with the impact on prices being stronger over the shorter horizons. The exchange rate also depreciated dynamically in response to the positive credit shock. As a result, the BOG raised the short-term nominal interest rate dynamically. This interest rate was raised even more aggressively post-2008 as financial stability issues came to the fore.

This study revealed that in the case of Ghana, money supply shocks were highly inflationary and affected output growth adversely prior to 2001 with the exchange rate implications being largely counterintuitive. Post-2001, the output growth response to money supply shocks turned positive after macro financial reforms and as the inflationary implications of the shocks diminished. As a result, the monetary policy (interest rate) response to money supply shocks became progressively less aggressive. Over the medium term (12 quarters), the response of output growth to the money supply approached zero, which confirmed the neutrality of money in respect of the Ghanaian data in the medium term instead of the hypothesised long term.

Chapter 6: Empirical evidence of the time-varying transmission of fiscal policy shocks

6.1 Introduction

This chapter contains the empirical results of the evolution of fiscal policy actions. The results were obtained by using the central tools of stochastic volatilities and IRFs. After the preliminary discussion on data transformation and estimation diagnostics in section 6.2, results of parameter stability tests is presented in section 6.3. The results of the estimates of the simultaneous relations among the model's variables are reported in section 6.4 while the results of the stochastic volatilities related to the structural shocks are presented in section 6.5. This is followed in section 6.6 by a discussion of the time-varying reaction to expenditure shocks. The time-varying reaction to tax shocks is taken up in section 6.7. The results of the robustness tests are detailed in section 6.8. The empirical evidence is summarised in section 6.9.

6.2 Results of parameter stability tests

The results of the parameter stability is presented in Table 6.1 with the p-values showing broad parameter instability within the system. At the conventional 5% level of significance, the NH test fails to accept the null hypothesis of parameter constancy for the expenditure equation but the QLR test fails to reject the null. In terms of the variance, the NH test would only accept heteroscedasticity at the 10% level of significance while the QLR rejects the null hypothesis of homoscedasticity in the expenditure equation at the conventional 5% level of significance. For the real GDP growth equation, while the NH test points to parameter constancy and homoscedasticity, the QLR test takes the opposite route. The QLR test also identifies 2007q4 as the potential break

date (different from the 2010q2 selected in growth equation in chapter 5), a period that coincides with the discovery of commercially viable crude oil.

For the net taxes equation, the NH test indicates parameter instability and the presence of heteroscedasticity. Conversely, the QLR test fails to reject the null hypothesis of constant coefficients at the 10% level of significance with the potential break date being 1997q2 while accepting the null of homoscedasticity. In the case of the private consumption equation, the two tests show contradictory results – the NH indicates parameter constancy and heteroscedasticity while the QLR test reveals unstable coefficients and homoscedasticity. The potential break date for the private consumption equation is 2012q3. The two tests confirm the presence of heteroscedasticity in the case of the interest rate equation. However, while the NH test indicates parameter constancy, the QLR test indicates nonconstant coefficients with 2004q1 being the potential break date. Based on the conclusion reached in chapter 5 (see section 5.2), the foregoing discussion justifies the use of the TVP-VAR-SV model instead of the traditional constant parameter VAR.

Table 6. 1: Results of parameter stability tests (*p*-values and breakdates)

Equation	Nyblom-Hansen (NH)		Quandt-Likelihood Ratio (QLR)		
	lc	Variance	Break date	Cofficients	Variance
expenditure (ce)	< 0.0100	0.0845	2002q2	0.2194	0.0402
Real GDP (y)	> 0.2000	> 0.2000	2007q4	0.0000	0.0076
Net taxes (nt)	0.0124	0.0298	1997q2	0.0548	0.6167
Private consumption (pc)	> 0.2000	0.0006	2012qq3	0.0000	0.2966
Interest rate (i)	0.1095	0.007	2004q1	0.0000	0.0009

Note: This table has the same characteristics as table 5.1 in chapter 5 (see Section 5.2).

6.3 Data transformation and estimation diagnostics

The TVP-VAR-SV model consists of five variables: current government expenditure (ce), GDP (y), net taxes (nt), private consumption (pc), and short-term nominal interest rates (i), in that order.[118,119,120] In accordance with Kirchner et al. (2010), Pereira and Lopes (2010), Jooste et al. (2013), and Ferreira (2015), all the variables, except the short-term nominal interest rate, are in real per capita growth terms to enable a comparison of the impulse responses (fiscal multipliers)

[118] Consistent with the general empirical literature, the short-term nominal rate was used to ascertain the Central Bank's direct behaviour in response to fiscal shocks. Replacing the short-term nominal interest rate with the short-term real rate did not alter the conclusions of the study (see appendices A.6.1 to A.6.6). The present study did not use a long-term rate due to paucity of data. However, Kirchner et al. (2010) observed that the use of the longer-term rate did not significantly change the results. This is not surprising given that the long-term rate, in the absence of central bank interference in the bond market, is merely an average of market expectations about future short-term rates, with the addition of expected future inflation plus a risk premium. Given that the short-term rate is the operational instrument of policy, it makes more sense to use that rate to capture the central bank's policy stance.

[119] As noted in chapter 4 (see section 4.4), taxes are net of transfers while government spending is adjusted for both interest payments and transfers.

[120] For scaling purposes, ce, nt and i are divided by 10.

across various countries.[121] The data run from 1984q1 to 2018q4, and the estimation was undertaken with one lag, consistent with Franta et al. (2012). To ensure efficient estimation, 22 000 iterations were administered, and the initial 2 200 draws were discarded during the burn-in period. The output diagnostics presented in table 6.2 and figure 6.1 indicate that the parameters were estimated efficiently.[122,123]

Table 6. 2: Selected parameters of the estimated fiscal policy TVP-VAR-SV model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0029]	0.1920	6.85
sb2	0.0023	0.0003	[0.0018	0.0029]	0.2300	7.60
sa1	0.0048	0.0011	[0.0032	0.0075]	0.2170	20.85
sa2	0.0055	0.0015	[0.0034	0.0095]	0.1200	48.49
sh1	0.0055	0.0016	[0.0034	0.0093]	0.8310	37.12
sh2	0.4877	0.1099	[0.3039	0.7370]	0.9050	48.78

Note: Stdev denotes standard deviation.

[121] The annual population figures were taken from WDI and converted into quarterly series using the cubic last approach as implemented in EViews 11.

[122] See section 5.3 of chapter 5 for a more complete discussion.

[123] Growth of per capita GDP is used most frequently in the empirical literature to assess the effects of fiscal policy on growth, since this controls for differences in the population growth rate in various countries.

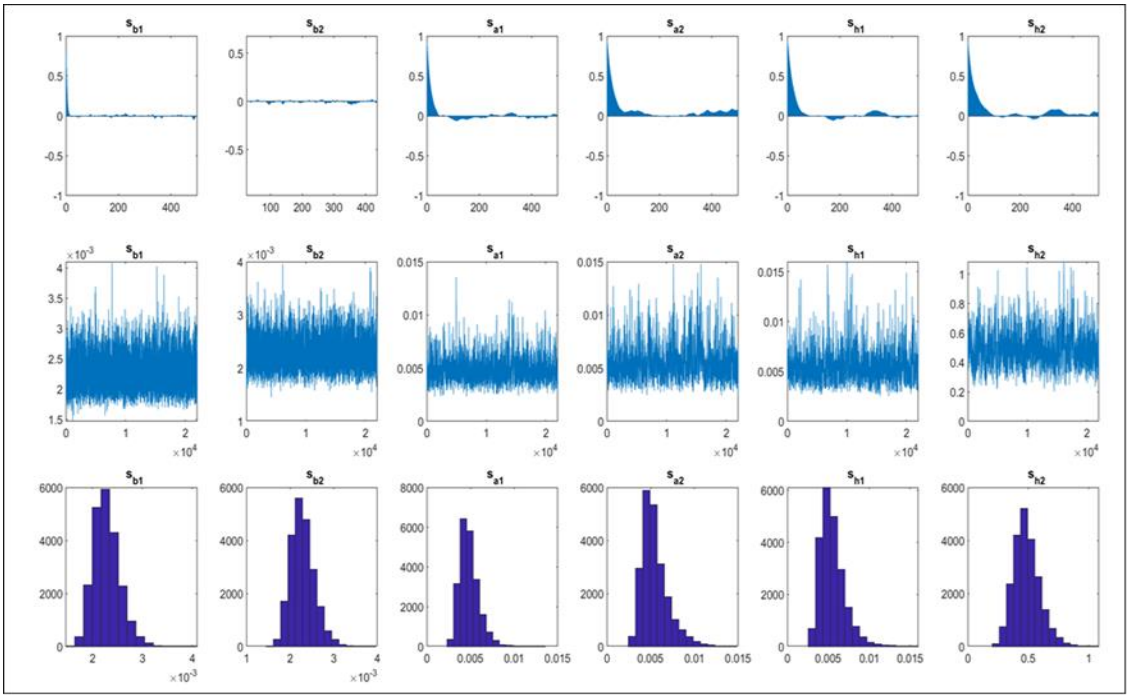


Figure 6.1: Sample autocorrelation, sample paths and posterior densities for selected parameters in the fiscal policy model

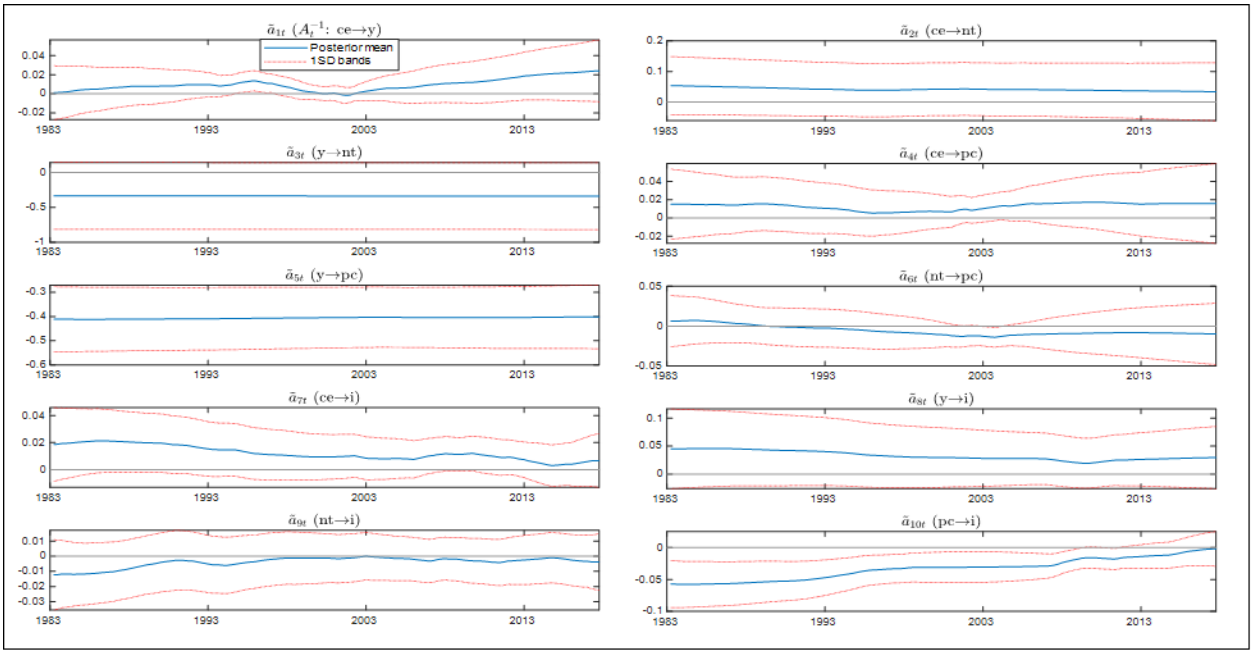
6.4 Posterior estimates of simultaneous relations among the model's variables

Figure 6.2 shows the results of time-varying simultaneous interactions. It is evident from these results that the simultaneous relations of GDP to private consumption (y → pc) and net taxes (y → nt) are negative and time invariant throughout the study period. However, while y → pc is statistically significant, y → nt is statistically insignificant. Conversely, the simultaneous relation of GDP to the short-term nominal interest rate (y → i) is positive and statistically significant throughout the sample.

The simultaneous relations of government spending to private consumption (ce → pc), the short-term nominal interest rate (ce → i), and GDP (ce → y) vary over time but are statistically

insignificant over the sample period. However, the simultaneous relations of government spending to net taxes (ce → nt) are positive and appear time invariant over the sample period.

While the simultaneous relation of net taxes to the short-term nominal interest rate (nt → i) was near zero during the study period, the simultaneous relation of net taxes to private consumption (nt → pc) varied over time and was statistically significant between 2002 and 2005. The simultaneous relations of private consumption to the short-term nominal interest rate (pc → i) varied over time and was statistically significant over most of the study period (except for the brief period between 2012 and 2018). This result confirms the presence of time variation in the simultaneous relations among the model's variables and is consistent with the findings of Ferreira (2015) using Brazilian fiscal data.



Note: 1SD denotes one standard deviation.

Figure 6. 2: Posterior estimates of simultaneous relations in the fiscal model

6.5 Time-varying volatilities

Figure 6.3 shows the posterior means and the one standard deviation bands for the stochastic volatility of government spending (ce), GDP (y), net taxes (nt), short-term nominal interest rate (i), and private consumption expenditure (pc), with all except i in real per capita growth rate. The stochastic volatility of government spending shocks appeared fairly stable throughout the sample period. This observation suggests that shocks to government spending growth are time invariant, which should be generally unexpected given the plethora of expenditure events that have characterised Ghana's fiscal policy as elucidated in chapter 2, including political business cycles and the introduction of the SSSS wage policy. However, the wide one standard deviation bands point to high uncertainty around the seemingly stable spending volatility. The stochastic volatility of net taxes also displays a fairly stable pattern except for a marginal drop around 1992 resulting from laxity in revenue mobilisation in the run-up to the general elections that ushered in the 4th republic in 1993. It is also surprising that policies such as the introduction of VAT did not affect the stochastic volatility of net taxes in Ghana. One possible explanation is that VAT was introduced at a rate (10%) lower than the sales tax (15%) it replaced, as indicated in chapter 2. As in the case of real government spending, the one standard deviation bands are wide, suggesting high uncertainty around tax volatility.

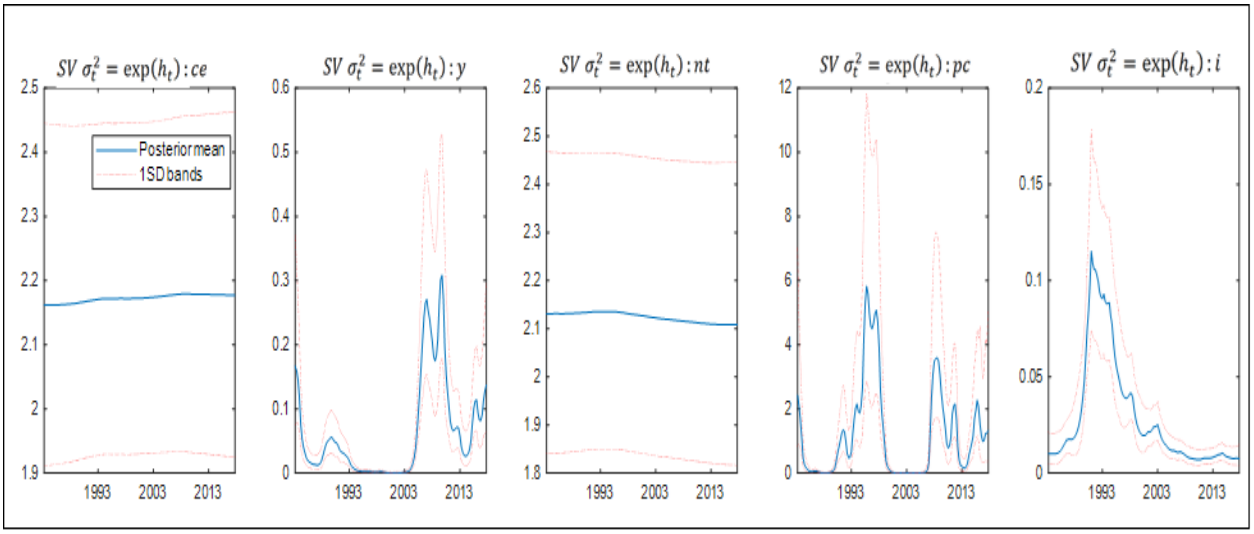


Figure 6. 3: Posterior estimates of the stochastic volatilities of the fiscal policy model

The initial spike in the stochastic volatility of real private consumption growth reflected the knock-on effects on real household income that resulted from the general upward price level adjustments during the dismantling process of the price control regime as Ghana began rolling out its economic recovery and structural adjustment programmes from the mid-1980s. Stochastic volatility became low and even approached zero as the reforms gained traction and real income growth stabilised. As indicated in chapter 2 (see section 2.3.2), FINSAP, which was launched in 1988, targeted the restructuring of distressed banks and resolving their large legacy of NPLs with a view to restoring them to solvency and viability. With that objective achieved, the banks could support consumers to meet pent-up demand and support the smoothing of life-time consumption. The result was a significant spike in stochastic volatility around 1992, which peaked four years later in 1996. The low stochastic volatility that ensued was brief. Another spike was recorded, and peaked around 2009. This could have resulted from positive sentiment after Ghana's 2007 discovery of oil in commercial quantities and the announcement in 2008 of a new wage policy that was expected to dramatically improve the living standards of public sector employees. Recent spikes in stochastic

volatility mainly reflected the decline in real wages resulting from years of energy supply shortages that had a severe impact on the economy and its subsequent recovery after 2016. The time-varying volatility of real GDP per capita growth and the short-term nominal interest rate was explained in chapter 5 (see section 5.5). The foregoing discussion justifies the use of the TVP-VAR-SV model to estimate and identify structural shocks (Nakajima, 2011).

6.6 Time-varying responses to government spending shocks

Figure 6.4 plots the time-varying responses to a positive one standard deviation shock to real government spending growth ($\varepsilon_{ce} \uparrow$). Figure 6.4a traces the time series responses for selected horizons of one year (4 quarters), two years (8 quarters) and three years (12 quarters). Conversely, figure 6.4b indicates impulse responses for three carefully selected periods of the pre-ERP/SAP (1984q2), post-ERP/SAP (2007q1), and a decade since Ghana met the requirements of the HIPC initiative (2016q4).

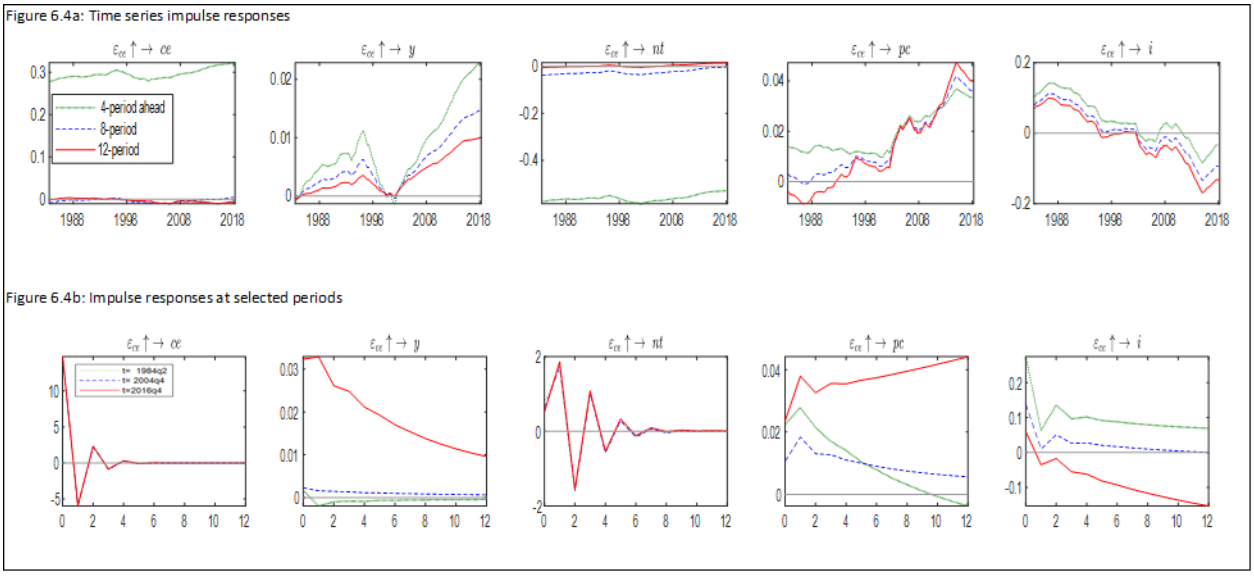


Figure 6.4: Time-varying responses to spending shocks

The figure reveals clear evidence of time variation in the response of output growth to the spending shock ($\varepsilon_{ce} \uparrow\rightarrow y$) . In particular, figure 6.4a indicated that a one standard deviation positive shock to government spending triggered a weak positive response in output (in real per capita growth terms), which gradually increased to reach a peak in 1996. Between 1997 and 2003 it then declined steadily to almost zero. This indicated low or zero Keynesian multipliers and less effective discretionary spending between 1984 and 2003. This is confirmed by figure 6.4b (see second panel) which indicates that the responses at time horizons 1984q2 and 2004q4 were negative and near zero, respectively. As noted in chapter 3, several factors affect the effectiveness of fiscal policy, including the quality of expenditure (composition of government spending), a degree of crowding out of possibly more productive private investment, and the response of monetary policy. (As will be explained in the last paragraph of this section, the initial positive response of the short-term interest rate could have undermined the efficacy of fiscal policy from 1984 to 2003.) There was indeed significant wastage in public expenditure at the time of launching the ERP/SAP in 1984 – loss-making SOEs, a bloated public sector, and financial ill-discipline – that the reforms sought to correct. As indicated in chapter 2, the expenditure reforms initially focused on switching from spending on consumables to capital spending, as well as downsizing the public sector. With the reforms gaining traction, output growth began to respond more positively to the expenditure shock, which is in line with most theoretical predictions. The output response to the expenditure shock became particularly strong in the latter parts of the sample (especially in the short term), suggesting higher spending multipliers and a pick-up of the fiscal policy's effectiveness. This is confirmed by figure 6.4b (see second panel) which indicates that the response at time horizon

2016q4 was positive but weakened over time, suggesting output growth response to government spending shock was regime specific.

The dynamic response of net taxes to a government spending shock (in real capita growth terms) ($\varepsilon_{ce} \uparrow\rightarrow$ nt) was negative over all horizons and throughout the sample, except for the medium term (8 and 12 quarters), which appeared unresponsive towards the end of the sample. Figure 6.4b (panel three) suggests that tax response to government spending is not regime specific. The negative response of taxes to government spending shock is fundamentally unexpected but two factors may help explain it. Firstly, an increase in government expenditure may crowd out the private sector, which depresses its contribution to net taxes. Secondly, government contracts in Ghana are mostly tax exempt, which implies that government expenditure shocks cannot generate enough taxes to compensate for the loss in private sector taxes.

The time-varying response of private consumption to a government spending shock (in real per capita growth terms) ($\varepsilon_{ce} \uparrow\rightarrow$ pc) remained broadly positive over all three time horizons and at the selected periods throughout the sample period. The response was modest at first, being stronger in the short term (4 quarters) than the medium term (8 and 12 quarters). However, the response rose steadily after 2000 with the medium term response stronger than the short term. The stronger reaction of private consumption after 2000 reflected expenditure switching policies, which could have flipped government spending from being a substitute to a complement to private consumption as explained in chapter three (see subsection 3.2.2.1.5). The stronger medium-term response is also consistent with the expenditure switching policy as capital spending implies longer gestation period. This evidence is corroborated by figure 6.4b (see panel 4) which indicates that the response

at 2016q4 was stronger than the responses at both 1984q2 and 2000q4, implying private consumption to government spending shock was regime specific. The positive reaction of private consumption to a government spending shock is consistent with the traditional Keynesian prediction and predictions of RBC micro-founded models predicated on assumptions of the non-separable utility function in consumption and leisure (Linnemann, 2006), and deep habits (Ravn et al., 2006). The progressively stronger response may have reflected the rising number of rule-of-thumb consumers in Ghanaian society as the informal sector continued to expand. Ferreira (2015) found similar results using Brazilian data.

The dynamic response of the short-term nominal interest rate to the positive government spending shock ($\varepsilon_{ce} \uparrow \rightarrow$ i) was positive between 1984 and 1996, broadly zero between 1997 and 2012 and negative between 2013 and 2018. The negative response of the short-term interest rate to the government spending shock in the latter parts of the sample reflected the inverse relationship between falling government spending and rising interest rate during this period. First, the fiscal slippages that characterised the 2012 general election forced the government to pursue fiscal consolidation from 2013 reinforced by the IMF-supported ECF programme in 2015, implying cutback in government spending. On the other hand, the short-term nominal interest rate was increased sharply on the back of the energy supply shortages that resulted in significant exchange rate and inflation volatilities during the same period.

6.7 Time-varying responses to tax shocks

Figure 6.5 traces the time-varying responses to a positive one standard deviation shock to net taxes ($\varepsilon_{nt} \uparrow$). The dynamic response of government spending to the positive net taxes shock (in real per

capita growth terms) ($\varepsilon_{nt} \uparrow\rightarrow ce$) was positive in the short term (4 quarters), peaking around 2001. It remained stable and positive throughout the remainder of the study period. In terms of the medium term (8 to 12 quarters), the response was broadly inconclusive over the entire sample, perhaps suggesting that the Ghanaian fiscal authorities were less reliant on net taxes over the medium term. Figure 6.5b (panel 1) suggests that the response of government spending to the tax shock was not regime specific.

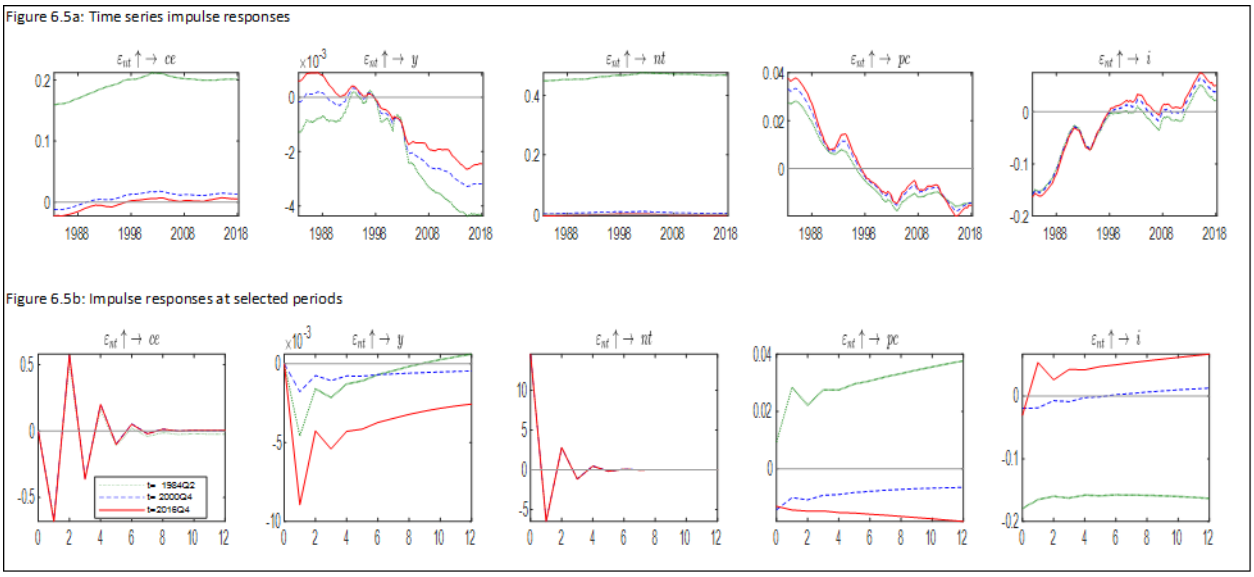


Figure 6.5: Time-varying responses to tax shocks

In line with both Keynesian and neoclassical theories, the initial response of output to a positive real net tax shock (in real per capita growth terms) ($\varepsilon_{nt} \uparrow\rightarrow y$) was negative in the short term, indicating short-term negative tax multipliers. The medium-term response was generally inconclusive over the 8-quarter horizon and positive over the 12-quarter horizon. The response was broadly inconclusive between 1992 and 1998 as dissatisfaction with sales tax grew. The replacement of sales tax with VAT during this period failed initially, and sustained nationwide

protests eventually led to its withdrawal. Thereafter, the response of output per capita growth to the tax shock turned negative over all three horizons, becoming progressively sensitive to the positive tax shock towards the end of the sample, which confirmed negative tax multipliers. While figure 6.5a shows that the responses were broadly stronger in the shorter term, figure 6.5b (panel 2) confirms that the economy has become more sensitive to tax shocks. The reaction of an economy to tax shocks depends on the state of the economy: A positive tax shock exerts a greater (deleterious) impact on the economy when it is operating below its long-term path than when it is operating closer to that path (Whalen & Reichling, 2015). The behaviour of Ghana's output gap (see Atta-Mensah & Nakijoba, 2019) seems to correlate well with the economy's response to the positive tax shock.

The time-varying response of private consumption to a positive tax shock (in real per capita growth terms) ($\varepsilon_{nt} \uparrow\rightarrow pc$) was initially positive over all three time horizons, but weakened steadily to zero around 1997, the last year of the sales tax regime. Perhaps the sales tax system was incapable of exacting a change in tax income at least proportionate to the change in private consumption spending, triggering its replacement in 1998 by VAT. It could also have been a purely anticipation effect, giving credence to Ricardian behaviour as documented by Hebous (2011) and Ramey (2011). As of 1998 (when VAT was introduced), the response of private consumption turned negative, varying over time for the remainder of the period sampled. The VAT system possibly allowed tax authorities to derive a tax income that was more than proportionate to the change in private consumption spending. Perhaps, consumer behaviour became Keynesian, consistent with the earlier finding in section 6.6 with regard to the response of private consumption to a government spending shock. It could also have been a purely anticipation effect, giving credence

to Ricardian behaviour as documented by Hebous (2011) and Ramey (2011). Figure 6.5b (see panel 3) confirms the regime specific behaviour of private consumption to tax shock.

The initial time-varying responses of the short-term nominal interest rate to a positive tax shock in real per capita growth terms ($\varepsilon_{nt} \uparrow\rightarrow$ i) were negative, and became broadly unresponsive between 1998 and 2012 before turning positive towards the end of the sample. The positive reaction of the short-term interest rate to the tax shock in the latter parts of the sample reflected the inverse relationship between rising tax revenue and rising interest rate during this period. As explained in section 6.5, the fiscal slippages that characterised the 2012 general election forced the government to pursue fiscal consolidation from 2013 reinforced by the IMF-supported ECF programme in 2015, implying increase in tax revenue as typical of most IMF-supported programmes. On the other hand, the short-term nominal interest rate was increased sharply on the back of the energy supply shortages that resulted in significant exchange rate and inflation volatilities during the same period. Figure 6.5b (see panel 4) confirms the positive response of the short-term nominal interest in the latter parts of the data.

6.8 Results of the fiscal model the robustness tests

This section reports the results of the two robustness tests described in Section 4.6. For the alternative prior specification test, the TVP-VAR-SV fiscal model is re-estimated by drawing 15 000 samples after the initial 1 500 draws are discarded during the burn-in period. In the case of the alternative identification, the TVP-VAR-SV model is re-estimated by administering 9 000 iterations with the initial 900 draws discarded during the burn-in period. Appendices A.6.7 and A.6.13 validate the sampling method by affirming the convergence to the posterior distribution

given the 5% significance level in relation to the CD statistics. The estimated posterior mean of the selected parameters all fall within the respective 95% credible intervals. It is also clear from the two appendices that the parameters are estimated efficiently since the inefficiency factor are rather low. Appendices A.6.8 and A.6.14 indicate the sample paths look stable with evidence of a steady drop in the sample autocorrelation and efficient generation of uncorrelated samples by the sampling method. These diagnostics robustly validate the estimation procedure used in the baseline model.

The posterior estimates of the simultaneous relations among the variables are consistent with those obtained in the baseline model (see appendices A.6.9 & A.6.15). The time-varying volatilities from the two robustness tests reflect trends observed in the baseline model (see appendices A.6.10 & A.6.16). In addition, the IRFs robustly confirm the obtained evidence from the baseline model of time variation in the transmission of fiscal policy shocks in terms of both government spending (see appendices A.6.11 & A.6.17) and taxes (see appendices A.6.12 & A.6.18). Thus, these evidence reaffirm the robustness of the obtained results from the baseline model.

6.9 Summary of fiscal policy shocks

This chapter discussed the empirical evidence on the transmission of fiscal policy shocks in the context of discretionary spending and tax shocks. The TVP-VAR-SV model consists of five variables, in the following order: current government spending, GDP, net tax income, private consumption, and short-term nominal interest rate. All these variables except the short-term nominal interest rate are expressed in real per capita growth rate terms. In addition, all the variables except the short-term interest rate were seasonally adjusted using the TRAMO/SEATs as

implemented in EViews 11. The model's diagnostics validated the estimation procedure as the parameters had been efficiently estimated.

The posterior estimates of the simultaneous relations among the variables in the model yielded mixed results, and evidence of time variation was discovered. The posterior estimates of the time-varying volatilities indicated a fairly stable fiscal policy path over time, implying more gradual rather than abrupt shocks. This was particularly surprising given the litany of profound fiscal reforms undertaken during the study period (see chapter 2). However, there was clear evidence of time variation in the volatility of the response to shocks in the other variables (GDP, private consumption, and short-term nominal interest rate) in the TVP-VAR-SV model.

The IRFs confirmed time variation in the reaction to fiscal policy shocks. The response of GDP to an unexpected expansion in discretionary government spending (in real per capital growth terms) was weakly positive and/or near zero in the initial stages of the sample (1984 to 2003). This pointed to low positive and/or zero Keynesian expenditure multipliers and less effective fiscal policy as a result of the bloated public sector, loss-making SOEs, and financial ill-discipline. With expenditure switching policies under economic reforms, the response of GDP to a government spending shock (in real per capita growth terms) rose steadily over time, indicating positive Keynesian multipliers and effective fiscal policy. Unexpectedly, the response of net taxes to government spending (in real per capital growth terms) remained negative over time, which could be explained by crowding out and the tax exemptions regime. The initial time-varying response of private consumption was modestly positive, but rose steadily over the study period, suggesting that discretionary fiscal expansion via increased spending is decidedly (traditional) Keynesian. As a result, the time-

varying reaction of the short-term nominal interest rate changed from positive to zero (neutral stance) to negative as deemed appropriate by the central bank.

The time-varying response of GDP to a positive net tax shock (in real per capital growth terms) was broadly negative, consistent with theory. The strength of the response seemed to correlate well with the business cycle, in line with the observation of Whalen and Reichling (2015). The time-varying response of private consumption to the positive tax shock was initially positive but turned negative in later parts of the sample, suggesting that Ghanaian consumers had switched from Ricardian behaviour to showing characteristics of Keynesian agents. The dynamic reaction of the short-term nominal interest rate changed from positive to negative over time.

Chapter 7: Empirical evidence on the time-varying transmission of external shocks

7.1 Introduction

This chapter contains the results of three external shocks: foreign monetary policy, foreign demand, and crude oil price. The results of parameter stability tests are reported in section 7.2. This is followed in section 7.3 with the results of the foreign monetary policy shock. The results of foreign demand shocks are presented in section 7.4, and that of crude oil price shocks in section 7.5. Section 7.6 reports the results of the model robustness tests. The chapter concludes with section 7.7 – a summary of the empirical evidence. In each section, the foreign variable in question (US federal funds rate in section 7.3; seasonally adjusted OECD output growth rate in section 7.4; and changes in crude oil price in section 7.5) enter the TVP-VAR-SV model with four domestic variables: percentage change in the bilateral (cedi/USD) nominal exchange rate (e), domestic real GDP growth rate (yd), CPI inflation rate (p), and the short-term nominal interest rate (i). The transformation of the domestic variables, data span and number of lags remain as discussed in chapter 5, except that for the purposes of scaling, the exchange rate, nominal interest rate (in the case of foreign demand and crude oil price models) and crude oil price are divided by 10. Each of the three main sections comprises two subsections. The first subsection looks at the empirical results related to the simultaneous relations among the model's variables and the stochastic volatilities. The second subsection presents evidence related to the time-varying responses using IRFs as the central tool. These discussions are preceded by brief introductory information on the estimation procedure and output diagnostics.

7.2 Results of parameter stability tests

The results of the parameter stability is presented in Table 7.1 with the p-values showing broad parameter instability within the system. For example, at the conventional 5% level of significance, both tests confirm parameter instability for the federal funds rate equation. For the null hypothesis of homoscedasticity, the NH rejects the null at the conventional 5% level of significance while the QLR rejects it at 10% level of significance. The potential break date associated with the federal funds rate equation is 2001q3, coinciding with the Fed's systematic response to the busting of the dot.com bubble and the 9/11 terrorist attacks on the US. For OECD GDP equation, both tests confirm nonconstant parameters with 2008q1 as a potential break date, marking the start of the significant output loss during the Great Recession. However, while the NH tests indicates heteroscedasticity, the QLR test signals homoscedasticity. In the case of the crude oil price equation, the tests send conflicting signals. While the NH test points to constant parameter, the QLR test reveals nonconstant coefficient, picking 2007q4 as the potential break date which marks the beginning of the oil price shock of the 2007/2008 period. Conversely, while the NH test signals the presence of heteroscedasticity, the QLR takes the opposite path by pointing to homoscedasticity.

For the exchange rate equation, both tests point to parameter instability (the NH test at 10% level of significance) and the presence of heteroscedasticity. As in the previous case in chapter 5, the potential break date is 1990q2. For the real GDP equation, the two tests confirm nonconstant coefficients at the 5% level of significance. However, while the NH test points to the presence of heteroscedasticity, the QLR test signals the acceptance of the null hypothesis of homoscedasticity. Both tests confirm parameter shift and the presence of heteroscedasticity for the inflation equation

with 1996q2 selected as the potential break date. Regarding the domestic interest rate equation, the two tests indicate the presence of heteroscedasticity but send mixed signals about parameter constancy. While the NH test indicates constant parameter, the QLR test signals nonconstant coefficients, selecting 2000q4 as the potential break date. The evidence presented in this section clearly underpins the use of the TVP-VAR-SV model instead of the constant parameter VAR.

Table 7.1: Results of parameter stability tests (*p*-values and breakdates)

Equation	Nyblom-Hansen (NH)		Quandt-Likelihood Ratio (QLR)		
	p-value	p-value	Break date	p-value	p-value
Federal funds rate (ffr)	< 0.0100	0.0000	2001q3	0.0000	0.0565
Exchange rate (e)	< 0.0100	0.0722	1990q2	0.0011	0.0001
Real GDP (y)	0.0426	0.0000	2010q2	0.0000	0.4776
Inflation (p)	0.0191	0.0000	1996q2	0.0000	0.0267
Interest rate (i)	0.1617	0.0000	2000q4	0.0001	0.0202
OECD GDP (yf)	0.0217	0.0000	2008q1	0.0000	0.1882
Crude oil price (cop)	> 0.2000	0.0000	2007q4	0.0000	0.1632

Note: This table has the same characteristics as table 5.1

7.3 Evolution of foreign monetary policy shocks

The estimation involves 15 000 iterations with the first (initial) 1 500 draws discarded during the burn-in period. The diagnostic results are presented in table 7.2 and figure 7.1, and indicate that the parameters were efficiently estimated as discussed in chapter 5, section 5.3.

Table 7.2: Selected parameters of the estimated foreign monetary policy shock model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0029]	0.1950	6.30
sb2	0.0023	0.0003	[0.0019	0.0029]	0.2400	7.66
sa1	0.0056	0.0017	[0.0033	0.0102]	0.2220	42.09
sa2	0.0054	0.0014	[0.0034	0.0087]	0.4430	30.77
sh1	0.5615	0.1232	[0.3535	0.8349]	0.7660	47.08
sh2	0.4533	0.1119	[0.2624	0.7016]	0.1180	44.51

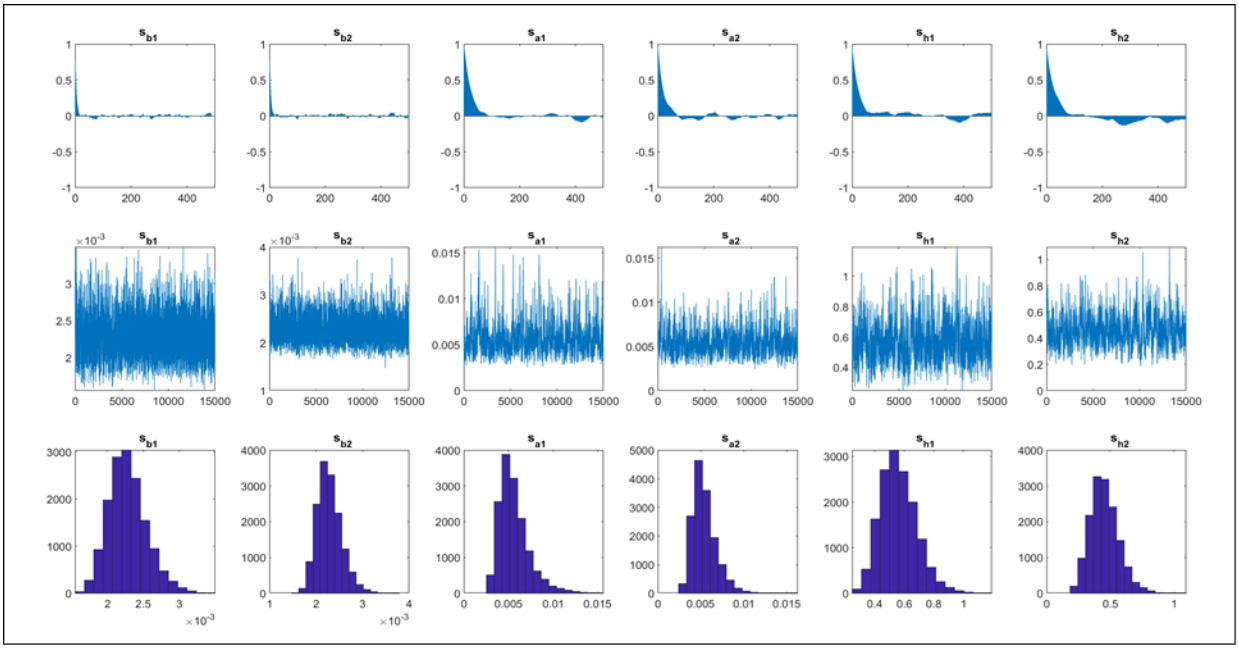


Figure 7. 1: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign monetary policy shock model

7.2.1 Posterior estimates of the simultaneous relations among the model's variables and stochastic volatilities

Figure 7.2 shows the results of the posterior estimates of the simultaneous interactions based on the TVP-VAR-SV model. Evidently, the simultaneous relation of the US federal funds rate to exchange rate movements (ffr → e) and domestic output growth (ffr → y) exhibit time-varying tendencies. The simultaneous relation of federal funds rate to inflation (ffr → p) was positive and remained unchanged throughout the study period, whereas the simultaneous relation of the federal funds rate to the domestic interest rate (ffr → i) was negative and remained constant through time. However, there was no evidence that these simultaneous relations were statistically significant since the one standard deviation bands included zero.

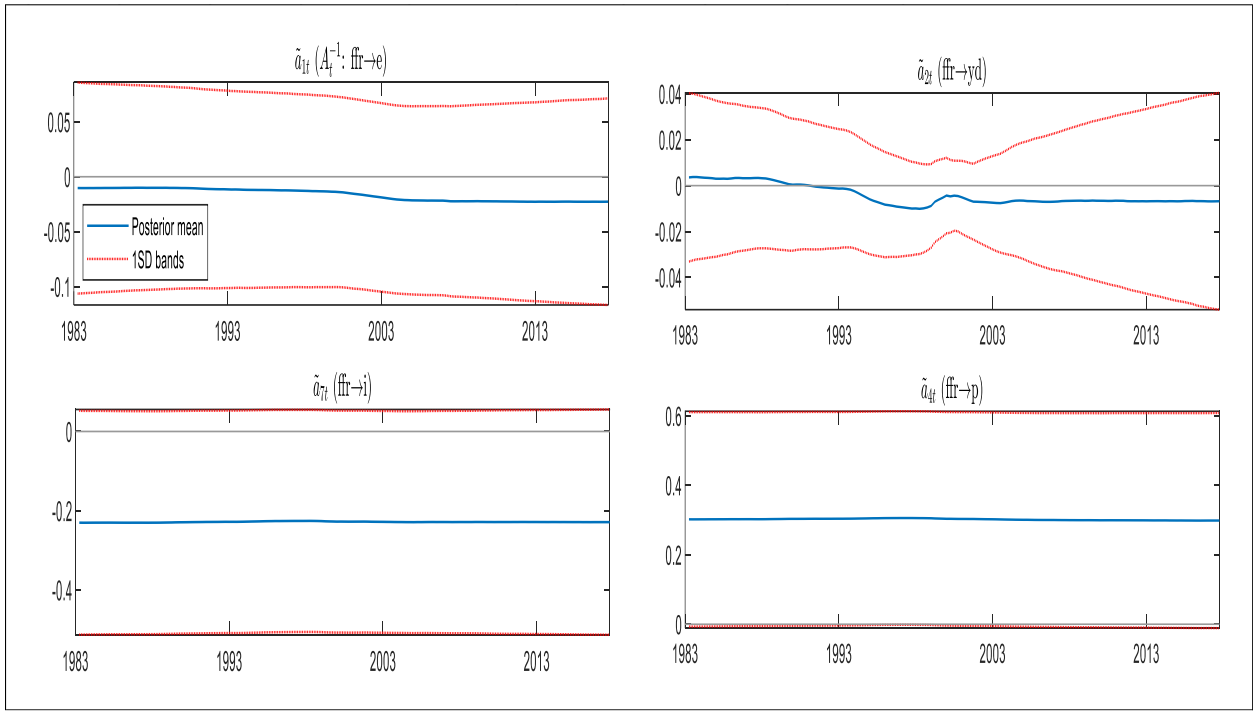


Figure 7. 2: Posterior estimates of the simultaneous relations among the model's selected variables

Figure 7.3 shows the estimates of the posterior means and the one standard deviation bands of the stochastic volatility of the federal funds rate; exchange rate movements; real growth in domestic GDP; domestic inflation; and short-term domestic nominal interest rate. Time variation in the shocks to volatility across the variables in the TVP-VAR-SV model are clearly indicated, i.e. evidence that shocks to foreign monetary policy varied over time. The stochastic volatility of the federal funds rate $(\exp(h_t) : ffr)$ at the start of the sample was high, reflecting in part the disinflation strategy of Chairman Volcker of the US Board of Governors of the Federal Reserve System (Fed). In this regard Primiceri (2005) noted that the monetary targeting strategy of the time was atypical to US monetary policy history. The stochastic volatility subsequently trended downward but remained unstable to the end of Volcker's chairmanship. A spike in stochastic volatility around 1994/95 reflected an attempt by the Fed to deal decisively with the inflation scare as indicated by massive, persistent increases in the longer-term interest rate (Goodfriend, 1993; Hetzel, 2017). A subsequent drop in stochastic volatility was short lived since a significant spike occurred around 2001, which reflected the Fed's response to the economic slowdown resulting from the imploding of the dot.com bubble and the 9/11 terrorist attacks on the US. Low stochastic volatility ensued but was soon overridden by another spike in 2007 as the Fed reacted to the looming global financial and economic crises (USA, 2002; Labonte & Makinen, 2008). The subsequent near zero level of stochastic volatility reflected mainly the policy to keep the federal funds rate at the zero-lower bound as recovery from the GFC remained tepidly anaemic for an extended period. A marginal rise in stochastic volatility towards the end of the sample pointed to an attempt to normalise interest rates. The domestic variables in the TVP-VAR-SV model displayed varying degrees of individual stochastic volatility as detailed in chapter 5, section 5.3.

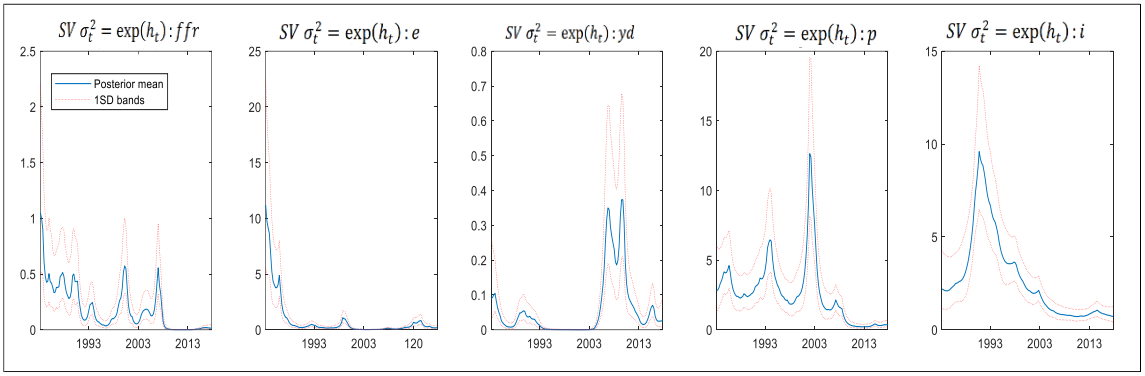


Figure 7. 3: Posterior estimates for the stochastic volatilities of the foreign monetary policy shock model

7.2.2 Time-varying responses to foreign monetary policy shocks

Figure 7.4 plots the posterior estimates of the impulse responses of the domestic variables to a positive one standard deviation federal funds rate shock ($\varepsilon_{ffr} \uparrow$). Figure 7.4a plots the time series responses for selected horizons of one year (4 quarters), two years (8 quarters) and three years (12 quarters). Conversely, figure 7.4b indicates impulse responses for three arbitrary but carefully selected periods of the pre-trade liberalisation (1985), post-trade liberalisation (2005), and a decade after capital account liberalisation (2016). The figure shows clear evidence of time variation in the response of domestic variables to the federal funds rate shock.

The time-varying exchange rate response to a federal funds rate shock ($\varepsilon_{ffr} \uparrow \rightarrow e$) was expectedly positive (i.e., depreciated) over all three time horizons and at the selected periods throughout the sample period. With trade and capital controls in place in the mid-1980s (early part of the sample), prior to the reforms gaining traction, a positive one standard deviation shock to the federal funds rate working through the financial channel (see figure 3.4) triggered a minimal exchange rate

depreciation in that both capital flows and net exports experienced little movement. Following trade and exchange rate reforms, the pace of exchange rate depreciation picked up substantially, peaking around 2003 at the dawn of further external sector reforms that would culminate in capital account liberalisation in 2006. With a more resilient economy following on further forex and capital market reforms and the adoption of IT as a framework of monetary policy, the impact of the federal funds rate shock on the nominal exchange rate has been falling steadily in recent times.

Domestic real GDP growth reacted negatively to the federal funds rate shock ($\varepsilon_{ffr} \uparrow\rightarrow$ yd), as predicted by the financial channel of the transmission mechanism of external shocks elucidated in chapter 3 (section 3.2.3.2). A shock to the federal funds rate raised the interest costs of new foreign borrowings and constrained the capacity to service existing foreign debts as the local currency depreciated, which undermined debt sustainability and critical domestic investment. The response appeared to get stronger as the country went through the painful period of economic recovery and structural adjustment programmes on top of the rapidly rising external debt burden in the late 1990s. With debt relief achieved under the HIPC initiative as pointed out in chapter 2 (section 2.2.3) and anchored in additional financial and institutional reforms, the economy became more resilient to external shocks. The result was a milder negative response of the domestic GDP growth to the federal funds rate, at least in the medium term (the short-term impact remained unchanged) with a measure of over-recovery in the medium term in recent times.

The initial inflation response to federal funds rate shocks ($\varepsilon_{ffr} \uparrow\rightarrow$ p) at the three time horizons was positive but modest given the initial marginal exchange rate depreciation and cooling off of real GDP growth. However, as the pace of exchange rate depreciation picked up after the federal

funds rate shock, inflation responded increasingly strongly peaking around 2008. The response has since trended downwards as the federal funds rate was rapidly cut to the effective lower bound in response to the GFC. For the greater part of the sample, the inflation response to federal funds rate shocks was milder in the short term. The federal funds rate shock leads to rebalancing of portfolios by foreign investors in favour of US stocks. This triggers capital outflow from Ghana, sparking exchange rate and inflation volatilities. To stop or minimise the speculative capital outflow, monetary policy reacted with the short-term nominal interest rate rising ($\varepsilon_{ffr} \uparrow \rightarrow i$) modestly in the short term (4 quarters) and much more strongly over the medium term with little evidence of time variation (8 and 12 quarters). Figure 7.4 suggests that the foreign monetary policy shock is mostly absorbed by the nominal exchange rate and alongside appropriate central bank response tends to insulate growth and inflation from taking a significant hit. This result is consistent with the finding of Crespo-Cuaresma et al. (2018) that US monetary policy changes have had time-varying international spill-over effects.

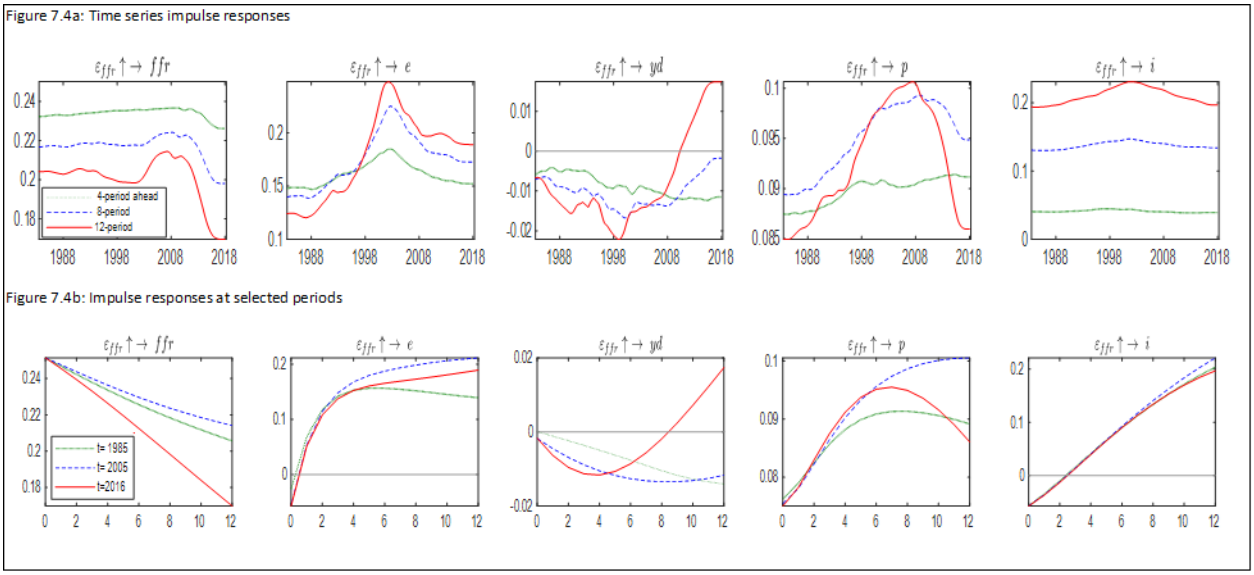


Figure 7. 4: Time-varying responses to foreign monetary policy shocks

7.4 Foreign demand shocks

In the estimation, 12 000 iterations were undertaken with the first 1 200 draws discarded during the burn-in stage. The diagnostic results presented in table 7.3 and figure 7.5 confirm that the model was estimated efficiently (see chapter 5).

Table 7.3: Selected parameters of the estimated foreign demand shock model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.2570	9.31
sb2	0.0023	0.0003	[0.0018	0.0029]	0.1580	11.97
sa1	0.0056	0.0016	[0.0016	0.0096]	0.6540	54.91
sa2	0.0057	0.0017	[0.0017	0.0100]	0.1480	55.35
sh1	0.0056	0.0016	[0.0034	0.0097]	0.2900	52.51
sh2	0.3546	0.0797	[0.2257	0.5399]	0.9370	44.08

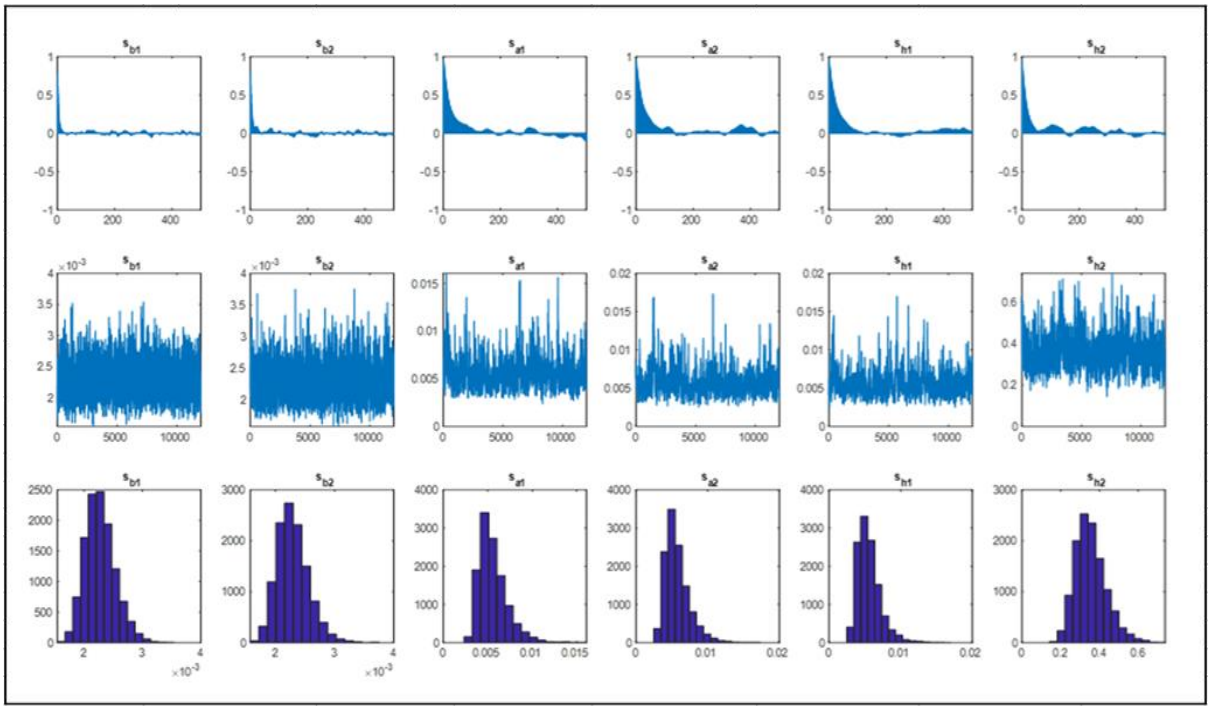


Figure 7. 5: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign demand shock model

7.3.1 Posterior estimates of simultaneous relations and stochastic volatilities

Figure 7.6 shows the results of the posterior estimates of the simultaneous relations among the variables in the TVP-VAR-SV model. The simultaneous relations of foreign output growth to the exchange rate (yf → e) were negative and statistically significant throughout the study period. However, the simultaneous relations of foreign output growth to domestic inflation (yf → p) were positive, statistically insignificant, and did not show any evidence of time variation. The simultaneous relations of foreign output growth to domestic output growth (yf → yd) exhibited time-varying tendencies but were statistically insignificant. Finally, the simultaneous relation of foreign demand to domestic interest rate (yf → i) varied over time, turning statistically significant at the beginning of 2004. This result indicates partial time variation in the simultaneous relations among the variables in the model.

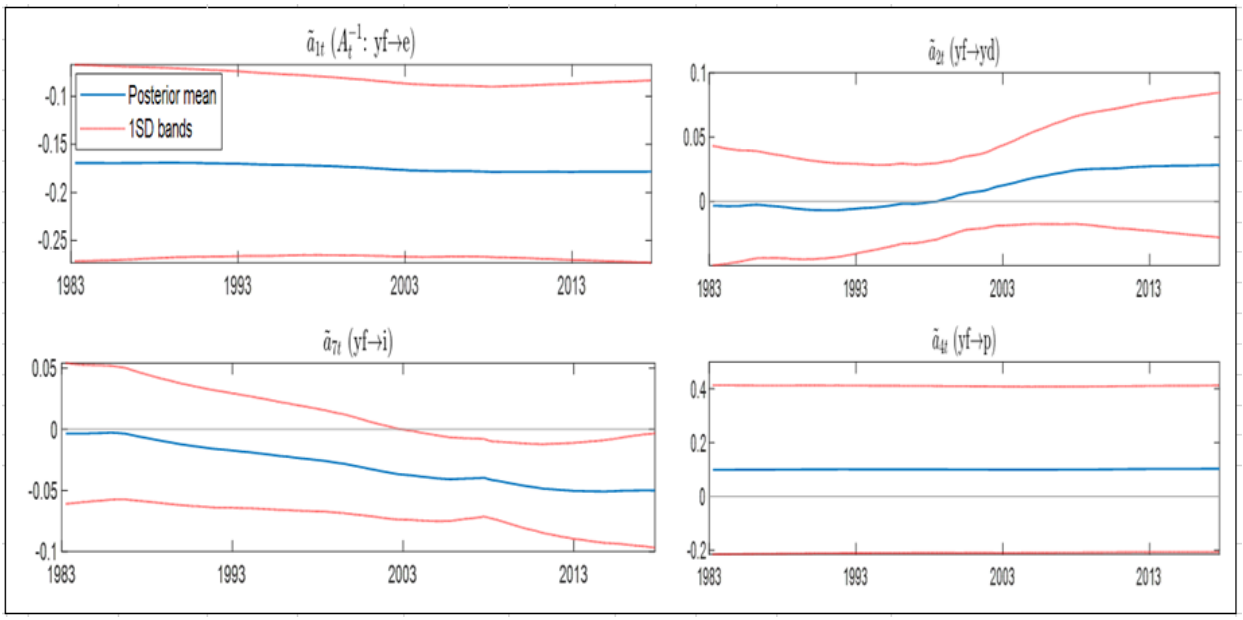


Figure 7. 6: Posterior estimates of simultaneous relations in the foreign demand model

Figure 7.7 shows the posterior means and the one standard deviation bands for the stochastic volatility of foreign demand (yf), exchange rate movements (e), domestic GDP growth (yd), domestic inflation (p), and domestic short-term nominal interest rate (i). The stochastic volatility of the foreign demand shock remained fairly stable until a spike was recorded in 2008, which reflected the deep output losses that resulted from the GFC. It then returned to trend and remained fairly stable for the remainder of the sample. However, the wide one standard deviation bands indicated high uncertainty around the apparent stable output volatility. The domestic variables in the TVP-VAR-SV model displayed varying degrees of individual stochastic volatility as discussed in section 5.5 of chapter 5. This result points to the presence of time variation in foreign demand shocks to Ghana's economy and justifies the use of the TVP-VAR-SV model.

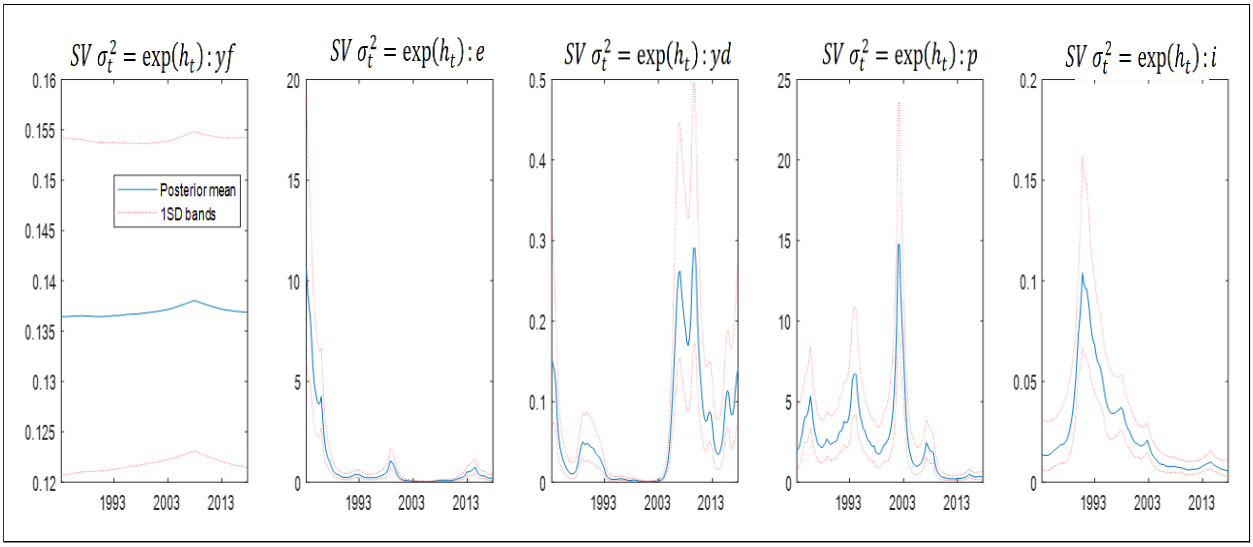


Figure 7. 7: Posterior estimates of stochastic volatilities of the variables in the foreign demand TVP-VAR-SV model

7.3.2 Time-varying responses to foreign demand shocks

Figure 7.8 plots the time-varying impulse responses to a positive one standard deviation shock to the foreign demand shock (ε_{yf} ↑) over time and at the selected time periods. This shock operates through income and trade channels of the external transmission mechanism (see figure 3.4) by affecting worker remittances, FDI flows, foreign aid, and net exports. Higher incomes in advanced economies (OECD) improved Ghana's terms of trade, inward remittances and FDI flows. These developments boosted the country's forex earnings, causing the local currency to appreciate (yf → e).[124] The appreciation of the currency remained fairly stable over time and was stronger in the shorter term. The stable path is confirmed by the responses at the selected periods, which moved closely together over time (see figure 7.8b).

[124] Inward remittances (personal) reached 5.4% of GDP while FDI flows (BOP) were about 4.5% of GDP in 2018 (WDI online database). Note that the FDI from the perspective of BOP does not include portfolio investment.

The dynamic response of domestic output to the foreign demand shock ($yf \rightarrow yd$) was mildly positive at the early stages of the sample, a period that encapsulated financial repression, trade and capital controls, and general macroeconomic instability. As a result, the economy did not benefit fully from the favourable external sector, suggesting an economy's initial condition as a necessary pre-condition for taking full advantage of a favourable external environment. Perhaps the stronger currency (overvalued) brought about by the favourable foreign demand shock could have undercut the full potential benefits for the economy given its initial conditions. However, the domestic output response to the foreign demand shock picked up pace as the domestic policy environment improved and more macro stability was achieved.

The inflation response to the foreign demand shock ($\varepsilon_{yf} \uparrow\rightarrow p$) was strongly positive in the short term (4 quarters), but mildly negative over the medium term (8 and 12 quarters). The short-term positive response became milder while the medium-term negative response became stronger as the economy became more resilient after years of macro financial and external sector reforms. Given the context of a stronger currency, improved economic performance and inflation's expected decline over the medium term, monetary policy ($\varepsilon_{yf} \uparrow\rightarrow i$) was eased, initially modestly but much more aggressively towards the end of the sample consistent with the behaviour of the macro variables. The policy response was also stronger in the short term than in the medium term. This result contradicts the findings of Shioji and Uchino (2012) that foreign demand shock (automobile exports demand) does not elicit any structural variation in Chinese domestic variables.

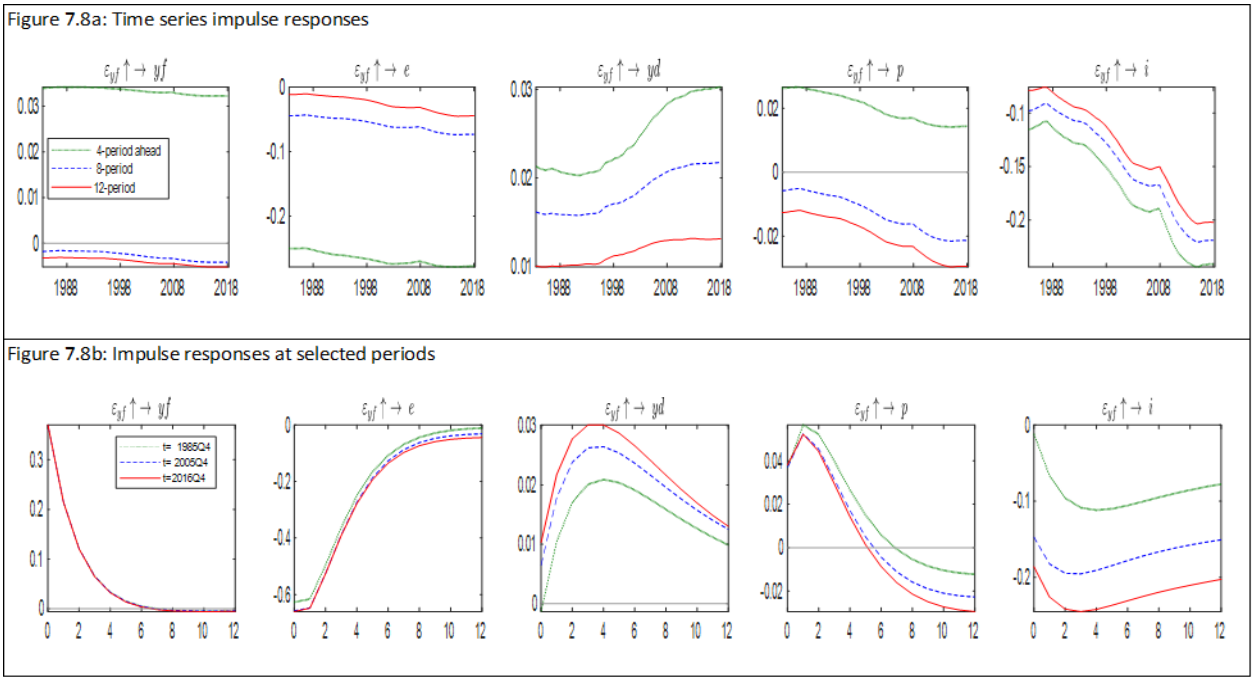


Figure 7. 8: Time-varying responses to foreign demand shocks

7.5 Crude oil price shocks

As in section 7.2, the estimation required 12 000 iterations with the initial 1 200 draws discarded during the burn-in period. The diagnostic results presented in table 7.3 and figure 7.9 manifestly point to efficient estimation (see section 5.3 of chapter 5).

Table 7.4: Selected parameters of the estimated crude oil price using the TVP-VAR-SV model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.8050	7.03
sb2	0.0023	0.0003	[0.0018	0.0028]	0.1670	8.23
sa1	0.0055	0.0015	[0.0034	0.0094]	0.7990	36.38
sa2	0.0049	0.0011	[0.0033	0.0076]	0.4220	29.13
sh1	0.5559	0.1104	[0.3750	0.8069]	0.7130	30.98
sh2	0.6025	0.1462	[0.3464	0.9465]	0.8780	55.42

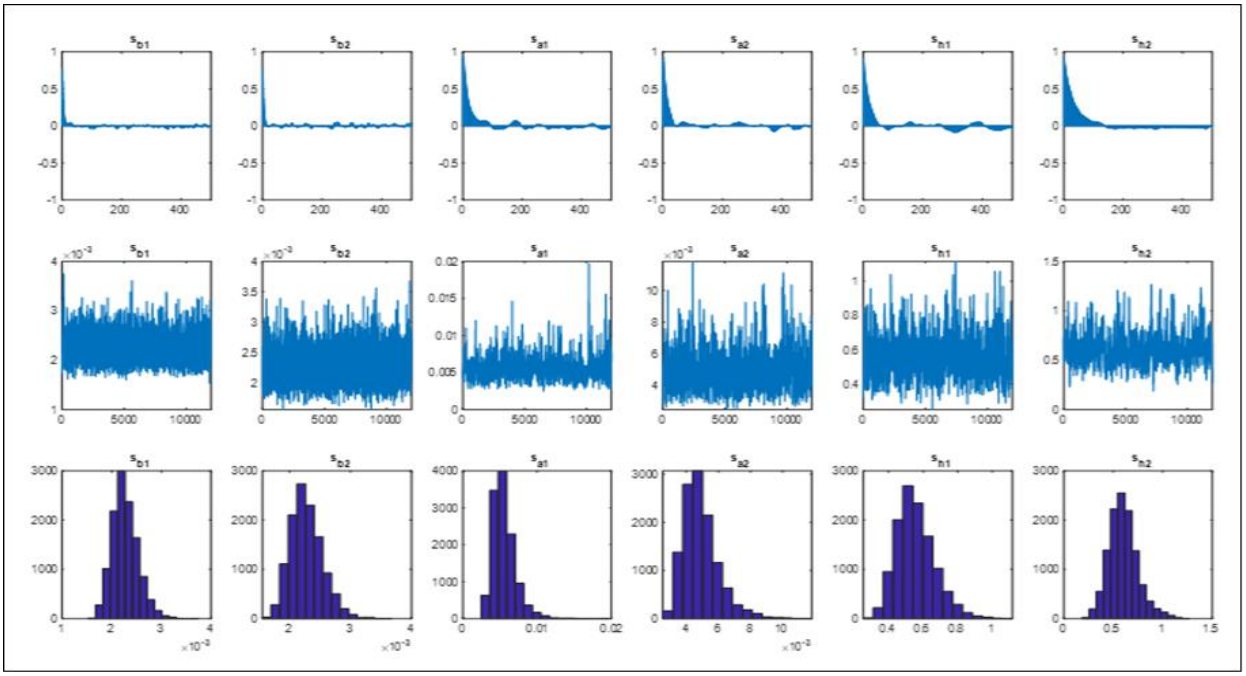


Figure 7. 9: Sample autocorrelation, sample paths and posterior densities for selected parameters in the crude oil price model

7.4.1 Posterior estimates of the simultaneous relations among the crude oil price model's variables and stochastic volatilities

Figure 7.10 indicates the results of the posterior estimates of the simultaneous interactions among the variables in the TVP-VAR-SV model. Clearly, the simultaneous relation of the crude oil price to exchange rate movements (cop → e) was positive and varied over time – a statistically significant behaviour because the one standard deviation bands do not include zero. Even though the simultaneous relations of crude oil price to domestic real GDP growth (cop → yd) and interest rate (cop → i) exhibited time-varying tendencies, these relations are not statistically significant given that the one standard deviation bands included zero. The simultaneous relation of the crude oil price to inflation (cop → p) was positive, appeared fairly stable over time, and was statistically significant. This result indicates partial time variation in the simultaneous relations among the

model's variables, together with time-varying volatilities, justifies the use of TVP-VAR-SV model.

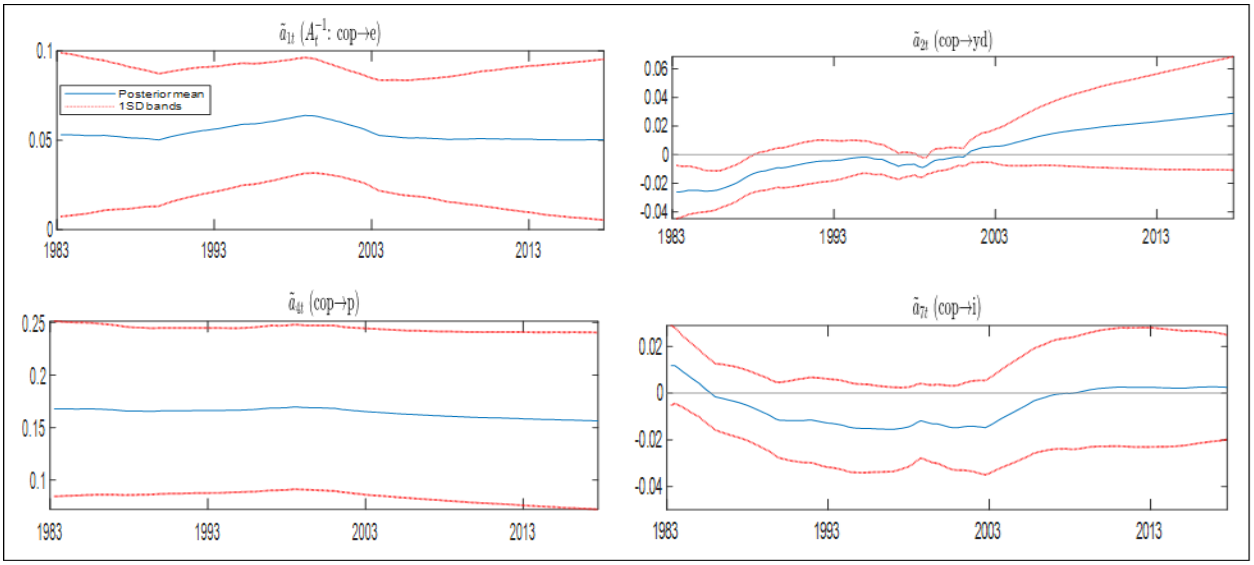


Figure 7. 10: **Posterior estimates of the simultaneous relations among the crude oil price TVP-VAR-SV model's variables**

Figure 7.11 shows the estimates of the posterior means and the one standard deviation bands of the stochastic volatility of the crude oil price; exchange rate movements; domestic real GDP growth; domestic inflation; and domestic short-term nominal interest rate. There is a clear indication of time variation in the shocks to volatility across the variables in the TVP-VAR-SV model. As shown in figure 7.11, the stochastic volatility of the crude oil price ($\exp(h_t) : \text{cop}$) was high and unstable in the beginning of the sample (i.e., mid-1980s) as significant disagreements among OPEC members triggered a crude oil glut, resulting in price collapse. Another spike occurred around 1990 after Iraq's invasion of Kuwait and the subsequent Gulf War, which disrupted oil production and led to the escalation of crude oil prices (Kilian, 2010). Thereafter, stochastic volatility trended downward with some cyclical oscillations that would end with another significant spike in the late 1990s following the Asian financial crisis (Kilian, 2010). Stochastic

volatility then dropped sharply and remained low and stable until a rise around 2007/2008 after the global economic and financial crises. The stochastic volatility remained broadly low and stable in the latter part of the sample. The domestic variables in the TVP-VAR-SV model showed varying degrees of individual stochastic volatilities as detailed in section 5.5 of chapter 5.

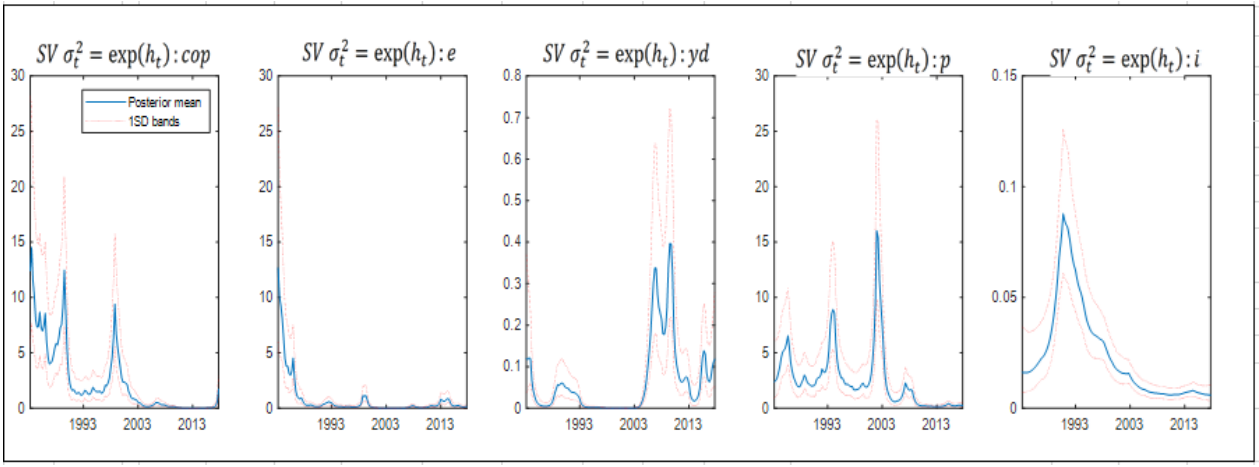


Figure 7. 11: Posterior estimates of the stochastic volatilities of the variables in the crude oil price model

7.4.2 Time-varying responses to crude oil price shocks

Figure 7.12 plots the time-varying impulse responses to a positive one standard deviation shock to the crude oil price ($\varepsilon_{cop}\uparrow$) over time and at the selected time periods. This shock operates through the commodity channel of the external transmission mechanism (see figure 3.2) by affecting forex earnings (reserves). As mentioned in chapter 3 (section 3.2.3.3), the impact of the crude oil price shock depends on whether a country is an oil exporter or importer. This is where it gets interesting and tricky in the case of Ghana, which started commercial oil production in 2011. However, due to refinery difficulties, the crude oil produced domestically is sold on the international market while the country continues to import refined fuel, implying the country's status as a net oil

importer has not changed. Being a refined fuel importer at a price that is substantially higher than that of its crude oil exports, a crude oil price shock leads to a substantial net outflow of forex and hence causes Ghana's exchange rate to depreciate $(\text{cop} \rightarrow \text{e})$ relatively strongly, particularly in the short term (4 quarters), at the early part of the sample. The impact moderated over the medium term (8 to 12 quarters). The drought of the early 1980s had affected the country's hydroelectricity production at Akosombo and consequently increased its demand for crude oil, which impacted the exchange rate. With Akosombo restored, the country's energy mix heavily moved in favour of hydro, lifting substantial pressure from the exchange rate throughout the 1990s and early 2000s. However, as the country's energy demand rose in response to the dramatic expansion of the economy, the energy mix flipped back in favour of thermal power, raising Ghana's demand for crude oil to power its thermal power stations.[125] This had implications for the country's forex reserves, exerting renewed pressure on the exchange rate from 2003 onwards. The protracted electricity supply shortages that started in 2012 also raised the demand for crude oil to power thermal plants and domestic generators, amplifying the sensitivity of the exchange rate to the crude oil price shock. It is expected that the exchange rate's sensitivity to movements in the crude oil price will drop over time as the country ramps up investment in infrastructure to take advantage of the gas produced at its offshore oil fields.

Prior to 2003, fuel prices in Ghana were heavily and indiscriminately subsidised at significant fiscal cost, and at the expense of investment in critical infrastructure to prop up economic activity. As a result, domestic output responded negatively to a positive one standard deviation crude oil

[125] Ghana's electricity demand increases annually by 10-15% (see Eshun & Amoako-Tuffour, 2016).

shock ($\mathrm{cop} \rightarrow \mathrm{yd}$). However, the deregulation of the energy sector and the subsequent removal of the government's unbridled subsidies freed up long-overdue fiscal space to enable the government to make investments that would reverse the economic activity's inverse relationship with crude oil prices. As a result, the domestic output response to crude oil prices turned positive after 2001. The start of commercial oil production in 2011 helped accentuate the positive response of domestic output growth to crude oil price shocks.

The subsidising of fuel prices impeded the full pass-through of crude oil price movements to domestic prices. Even as the energy sector was deregulated and fuel prices were allowed to fully adjust to developments in the international markets, a price stabilisation levy was incorporated into the pricing formula to allow the authorities to smoothen price volatilities. As a result, the inflation response to a crude oil price shock ($\mathrm{cop} \rightarrow \mathrm{p}$) has been positive but fairly stable (apart from a transitory rise in slope around 1999) with the impact felt mostly in the short term (4 quarters). Further scrutiny of figure 7.12 reveals that inflation has become more sensitive to crude oil price shocks in recent times despite the stabilisation levy. In this context, the interest rate reacted positively to the crude oil price shock ($\mathrm{cop} \rightarrow \mathrm{i}$) as authorities presumably sought to lean against the cost-push inflationary effect. The response was more modest in the beginning of the sample, and became stronger after deregulation of the energy sector. Overall, the effect of the crude oil price shock on growth and inflation appears to be small relative to its impact on the nominal exchange rate and the short-term nominal interest rate. Baumeister and Peersman (2013) find similar time-varying impact of oil price shocks on the US economy.

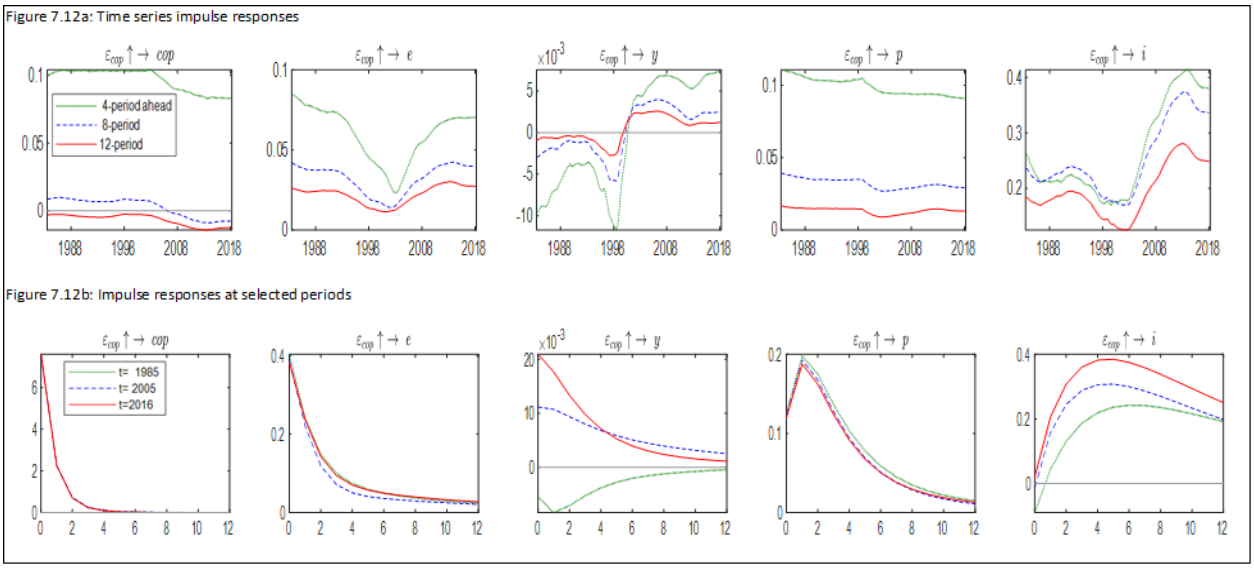


Figure 7. 12: Time-varying responses to crude oil price shocks

7.6 Results of the external shocks model robustness tests

This section reports the results of the two robustness tests. In the case of the foreign monetary policy model, estimation with the alternative prior specification requires drawing 40 000 samples after the initial 4 000 draws are discarded during the burn-in period. Similarly, the estimation with the alternative identification entails administering 6 550 iterations with the initial 655 draws discarded during the burn-in period. Appendices A.7.1 and A.7.6 validate the sampling method by affirming the convergence to the posterior distribution given the 5% significance level in relation to the CD statistics.[126] The estimated posterior mean of the selected parameters all fall within the respective 95% credible intervals. It is also clear from two appendices that the parameters are estimated efficiently since the inefficiency factors are rather low.[127] Appendices A.7.2 and A.7.7

[126] Note that in the case of Appendix A.7.6, the study fails to accept the null hypothesis of convergence to the posterior distribution given a 10% significance level in relation to the CD statistics in the case of one parameter.

[127] Note that one inefficiency factor in the case of Appendix A.7.6 exceeds 100 but remains well within tolerable limits.

indicate the sample paths look stable with evidence of a steady drop in the sample autocorrelation and efficient generation of uncorrelated samples by the sampling method.[128] These diagnostics strongly justify the estimation technique used in the baseline model.

The posterior estimates of the simultaneous relations among the variables are consistent with those obtained in the baseline model (see appendices A.7.3 & A.7.8). The time-varying volatilities from the two tests exhibit trends similar to the observed trends in the baseline model (see appendices A.7.4 & A.7.9). In addition, the IRFs robustly confirm the obtained evidence from the baseline model of time variation in the transmission of foreign monetary policy shocks (see appendices A.7.5 & A.7.10). Thus, these evidence reaffirm the robustness of the obtained results from the baseline model.

For the foreign demand model, the alternative prior specification test is carried out by drawing 25 000 samples after the initial 2500 draws are discarded during the burn-in period. In the case of the alternative identification, the TVP-VAR-SV model is re-estimated by administering 7 750 iterations with the initial 775 draws discarded during the burn-in period. The estimation diagnostics presented in appendices A.7.11, A.7.12, A.7.16, and A.7.17 confirm the estimation procedure used in the baseline model.[129] The observed trends in the posterior estimates of the simultaneous relations among the variables (see appendices A.7.13 & A.7.8); the time-varying volatilities (see appendices A.7.14 & A.7.19); and the IRFs (see appendices A.7.15 & A.7.20) are

[128] The sample path for one of the estimated parameters looks unstable (see Appendix A.7.7).
[129] One parameter does not converge to the posterior distribution at the 5% significance level (see Appendix A.7.16)

consistent with the obtained evidence from the baseline model. Thus, these evidence reaffirm the robustness of the obtained results from the baseline model.

The prior specification test for the crude oil price model is undertaken by drawing 40 000 samples after the initial 4 000 draws are discarded during the burn-in period. In the case of the alternative identification, the TVP-VAR-SV model is re-estimated by administering 20 000 iterations with the initial 2 000 draws discarded during the burn-in period. The model's estimation diagnostics robustly validate the estimation procedure used in the baseline model (see appendices A.7.21, A.7.22, A.7.26, & A.7.27). The posterior estimates of the simultaneous relations among the variables (see appendices A.7.23 & A.7.28); the time-varying volatilities (see appendices A.7.24 & A.7.29); and the IRFs (see appendices A.7.25 & A.7.30) are consistent with the obtained evidence from the baseline model. Hence, these evidence reaffirm the robustness of the obtained results from the baseline model.

7.7 Summary of evolution of external shocks

This chapter presented the empirical results of the evolution of external shocks, focusing on three key shocks: monetary policy (federal funds rate) shocks, demand shocks (OECD output growth), and crude oil price shocks. These variables were used in the TVP-VAR-SV model alternatively along with four domestic variables: real domestic output growth (yd), inflation (p), percentage change in the cedi/USD nominal exchange rate (e), and short-term nominal interest rate (i). Estimation diagnostics confirmed that the models' parameters were estimated efficiently.

The main empirical evidence on foreign monetary policy shocks showed clear evidence of time variation in the shocks to volatility across the variables in the TVP-VAR-SV model. The IRFs confirmed the time variation in the response of domestic variables to the positive one standard deviation shock to the federal funds rate. The time-varying reaction of domestic variables have been influenced by trade and current accounts liberalisation in the first half of the sample and forex, capital market, and institutional reforms in the latter parts of the sample.

The results of the foreign demand shocks point to a fairly stable foreign demand shock, apart from the spike reflecting the GFC, but with wide uncertainties. The IRFs indicate time-varying responses of domestic variables to foreign demand shocks operating through the income and trade channels. These time-varying responses were initially either mild or counterintuitive given the economy's autarky condition characterised by trade and capital controls, and a fixed exchange rate regime. However, as the macro setting improved over time on the back of reforms, the time-varying responses to the foreign demand shock became more consistent with expectation.

The results of the crude oil price shocks showed clear evidence of time variation in the shocks to volatility across the variables in the TVP-VAR-SV model. The IRFs indicated evidence of time variation in the responses of domestic variables to crude oil price shocks. The time-varying response of domestic variables have been shaped by energy sector reforms, changes in the country's electricity production mix, and start of commercial oil production.

Clearly, the evidence in this chapter suggests that the transmission of the three external shocks was broadly counterintuitive initially, given the country's initial conditions of trade and capital

controls, as well as its fixed exchange rate regime. After years of macro financial and external sector reforms, the transmission mechanisms appear to be broadly consistent with predictions regarding the transmission of external shocks of traditional theory.

Chapter 8: Conclusions and policy recommendations

8.1 Introduction

Following these introductory remarks, section 8.2 contains a summary of this study that investigated the transmission mechanism of key macroeconomic shocks that hit Ghana's economy with a view to determining possible time variations in both the shocks and their propagation. Section 8.3 contains the key empirical findings of the study. The main conclusions and policy recommendations are discussed in section 8.4. The inherent limitations of the study are taken up in section 8.5. Opportunities identified for future research are detailed in section 8.6.

8.2 Summary of the study

The lethal combination of policy missteps, political instability, and severe external shocks that characterised much of the 1970s and early 1980s resulted in Ghana's economy's teetering on the verge of collapse. As a result, the authorities launched comprehensive macro financial and structural reforms in the mid-1980s to help resuscitate the battered economy. The economy returned to the path of growth despite the initial induced volatility in macro variables as market reforms took hold. Over time, more macro stability was achieved, resulting in reduced volatility in key macroeconomic variables, particularly inflation, the exchange rate, and economic growth. This emboldened the authorities to implement further institutional reforms such as IT as a framework for monetary policy in order to up-end lingering institutional and structural challenges and bolster the resilience of the economy against external shocks, which occur regularly. Yet, some of these policies (e.g. capital account liberalisation) could have had a negative effect in that they increased the economy's exposure to the vagaries of the international financial markets. Profound

changes in the policy milieu and its concomitant structural changes in the broader economy are known to affect the transmission processes of both policy and non-policy shocks.

The broad objective of the study was therefore to investigate the impact of these reforms on the transmission mechanism of key macroeconomic shocks in the Ghanaian context. The assessment pivoted around three distinct but related tasks. The first task was to investigate whether the MPTMs had changed over time in Ghana. The second task was to ascertain possible time variation in the FPTM. The final task focused on the investigation of time variation in the transmission of three key external shocks insofar as they affected the Ghanaian economy. The focus on the transmission mechanisms was appropriate in the light of the emerging consensus that macroeconomic reforms are capable of altering the channels of transmission over time.

These tasks were accomplished with the help of the of TVP-VAR-SV model à la Primiceri (2005) and Nakajima (2011). The data ran from the first quarter of 1984 to the fourth quarter of 2018 with the models estimated with lag one in order to save on the degree of freedom. Where necessary, the variables were seasonally adjusted and growth rates were computed. Appropriate iterations were done and initial draws discarded during the burn-in period to ensure efficient estimation of the parameters.

In the case of task one, the short-term nominal interest rate was chosen to represent monetary policy since it is the main and usually the only conventional policy tool at the disposal of the monetary authorities. Other key macro variables selected included the real GDP to represent the level of economic activity; CPI inflation to capture the general price levels in the economy; the

nominal exchange rate as a link between the Ghanaian economy and the external sector; and private sector bank credit to investigate the impact of a private sector credit shock on economic activity in Ghana. Broad money supply (M2+) was included in an alternative formulation to assess the effects of money supply shocks on the Ghanaian economy.

The second task was executed using current government spending and net taxes as the key fiscal policy tools. The main macroeconomic response variables were real GDP, private consumption (to contribute to the debate between Keynesians and neoclassicals on the impact of fiscal policy on private consumption), and interest rate to gauge the impact of fiscal policy on the interest rate.

In the case of the third and final task, three external sector variables were selected: the US federal funds rate to represent foreign monetary policy shocks; the real GDP of OECD countries to capture foreign demand shocks; and the crude oil price to represent oil price shocks. These variables entered the TVP-VAR-SV model alternatively with four domestic variables: nominal exchange rate, real GDP, CPI inflation, and short-term nominal interest rate.

8.3 Key empirical findings

In task one, which dealt with monetary policy transmission, the study detected evidence of time variation in the Ghanaian data. In particular, shocks to monetary policy varied over time with the size of those shocks decreasing and becoming more stable over time as macro financial, structural and institutional reforms gained traction. Evidence of time variation was also discovered in the transmission of the shocks. Specifically, the transmission mechanism (which initially yielded broadly counterintuitive results) became more consistent with traditional theoretical predictions as

macro reforms took hold in Ghana. The study also found that monetary policy became more aggressive in its response to macro shocks in Ghana following the implementation of monetary policy through the IT framework and concerns over financial stability.

Task two investigated the transmission of fiscal shocks using evidence from the TVP-VAR-SV framework. It revealed an unexpectedly stable stochastic volatility implying that fiscal policy changes have been much more gradual over time. However, the transmission of those shocks changed over time with possible negative expenditure multipliers in the periods leading up to 1990, and turned positive thereafter, which is more in line with the expectations suggested by most theories. The impact of fiscal expansion (via higher expenditure) on private consumption was unequivocally Keynesian and also in line with RBC micro founded models predicated on rule-of-thumb consumers (Gali et al., 2007), deep habits formation (Ravn et al., 2006), and non-separable utility functions (Linneman, 2006). Positive tax shocks suggest Ghanaian consumers have switched from exhibiting Ricardian behaviour to showing characteristics of Keynesian agents.

For the third task, which concerned external shocks, the empirical results indicated that the volatilities of the three foreign shocks that hit Ghana's economy varied over time. The volatilities became broadly low and stable during the latter part of the period sampled. The response of the domestic variables to the respective shocks varied over time with the transmission mechanisms confirming traditional predictions following increased macro stability as a result of profound macro financial, external and institutional reforms. In particular, a positive shock to the US federal funds rate was broadly detrimental to Ghana's economy in that it brought about a weaker currency, lower economic growth, inflationary pressures across all time horizons, and a higher short-term

nominal interest rate. On the other hand, a positive output shock in OECD countries was generally beneficial to Ghana's economy as it engineered a stronger currency, higher domestic output growth, temporary inflationary pressures (which diminished over the medium term) and lower nominal interest rates. Finally, a positive crude oil price shock was broadly inimical to Ghana's economy, but the output implications have flipped since Ghana itself embarked on commercial oil production.

8.4 Policy recommendations

A number of distinct policy conclusions and recommendations can be gleaned from the empirical findings of the present study. Firstly, the well-documented evidence of time variation in the Ghanaian time series data has significant implications for constant parameter macroeconomic policy and forecasting models. Results from such models are likely to be biased and trigger misleading policy conclusions. It is not surprising that the medium-term inflation target has been persistently missed even though the BOG in its communications keeps assuring the market that the target was within reach. It is reasonable to assume that the BOG's pronouncements about the future trajectory of inflation are usually based on the results from its forecasting model. Given that the present forecasting model does not incorporate time-varying properties, the forecast results are likely to be sub-optimal, implying potential policy errors. To ensure improved outcomes and minimise policy errors, consideration should be given to the incorporation of features of time variation into such models.

Secondly, the study documented evidence that the positive correlation between monetary policy actions and inflation prior to the formal introduction of the IT regime seemed to be receding. As

of 2007, the response of inflation to the positive interest rate shock was essentially zero in the short term from the earlier positive responses whereas the response over the medium term became consistent with traditional theoretical predictions. The policy implication is obvious: Inflationary shocks should be stabilised more gradually and complemented with an enhanced communication strategy, which should ensure, among other things, that policy statements from the BOG are cleared of jargon. Such a strategy must make sure that monetary policy decisions reach and are understood in every nook and cranny of the country. In that regard, the BOG should consider the translation of its MPC press statements into the various local languages as a way of reaching out to the entire country and to get rid of the notion that monetary policy in Ghana is an 'Accra thing'. One other point worth considering is the publication of the minutes of the MPC meetings in line with best practice. Such a strategy will enable participants in financial markets and other economic agents to ascertain the specific concerns of the individual MPC members and how they vote. As forcefully argued by Guthrie and Wright (2000) and Disyatat (2010), an enhanced communication strategy, which they called 'open mouth operations', can have similar effects as open market operations.

Finally, the study discovered a rising response of private consumption to government expenditure shocks, which implies an increasing number of rule-of-thumb consumers in the Ghanaian population. A large number of Ghanaians work in the informal sector, the majority of which earn daily wages that are usually insufficient to encourage savings in support of consumption smoothing. In 2017[130], more than 71% of Ghana's labour force was employed in the informal

[130] See the seventh edition of the *Ghana living standard survey* (GLSS7) published by the Ghana Statistical Service (GSS) in 2019.

sector. This situation has been attributed to a moratorium on employment in the public sector over the last decade and an increase in unemployment (appreciable economic growth without a concomitant growth in job creation) as most formal sector growth is generated in the services sector, which has high scale economies as a result of developments in information technology. The problem may continue to worsen in a world where such technological advancements are labour saving. The 'good old days' for Ghana's labour force were characterised by a growing manufacturing sector that employed a sizeable proportion of the labour force. Thus, it is recommended that the manufacturing sector be reinvigorated through tangible support to the private sector coupled with a carefully considered industrial policy strategy. This may take the form of an ISI strategy to enable the country to produce a number of basic goods domestically, which affords Ghana a comparative advantage. This must be supported by a sustained campaign to shift the unbridled taste for foreign goods toward domestically produced goods (the so-called made-in-Ghana goods). These initiatives will also help save substantial forex earnings to strengthen the country's currency, which has been discovered in this study to be key to economic growth in Ghana.

8.5 Limitations of the study

As in any real-life enterprise, the study encountered some limitations related mainly to data issues. Time series data on GDP, money supply, and private consumption were not available on a quarterly basis (on which the study is founded) for the entire study period. As a result, the quarterly series of these variables was interpolated from their annual series with the help of Denton's (1971) approach. This may introduce dynamics into the resulting quarterly time series, which may be unreflective of the dynamics in the original annual series. In addition, the TVP-VAR-SV model

used in the study is Bayesian in nature and therefore requires priors that are reflective of the Ghanaian economy. In the absence of such country-specific priors, the study relied on priors usually applied in the literature, which may not have been an accurate reflection of the Ghanaian business cycle. Nevertheless, it is believed that these limitations are not sufficiently grave to invalidate the conclusions reached in the study.

8.6 Suggestions for future research

The present study should serve as a springboard for new research opportunities in Ghana, as well as in economies with similar characteristics. It would be interesting to explore joint shocks in the TVP-VAR-SV model. At the time of finalising this study Ghana's economy is grappling with a number of shocks. Firstly, crude oil prices have fallen by almost 50% of their 2019 levels, which has had a significant effect on the expected revenue from oil exports. Given Ghana's large imports of refined fuel, the fall in crude oil prices may have reduced forex outflows and led to a stronger exchange rate. Secondly, the world has been battling the COVID-19 pandemic with most economies virtually shut down for several months. This has had a negative effect on global demand (i.e., negative foreign demand shock), with dire consequences for the Ghanaian economy. Thirdly, like the rest of the world, Ghana has been fighting the COVID-19 pandemic with border closures, lockdown and social distancing protocols that have had an enormously devastating impact on revenue mobilisation and the broader economy, particularly the informal sector. General government spending has also been hugely impacted as it attempted to provide personal protective equipment (PPE) and some relief to frontline health workers and the general population. The 2020 budget statement presented to Ghana's Parliament in November 2019 has been incapacitated with rising financing needs. How does the TVP-VAR-SV framework handle this multiplicity of shocks

to ascertain the net effect on Ghana's economy? Future research should seek the answer to this question. In the case of fiscal policy shocks, output and private consumption are known to react differently to different expenditure items and tax types. It will therefore be interesting to undertake the analysis using disaggregated fiscal data depending, of course, on the availability of such data.

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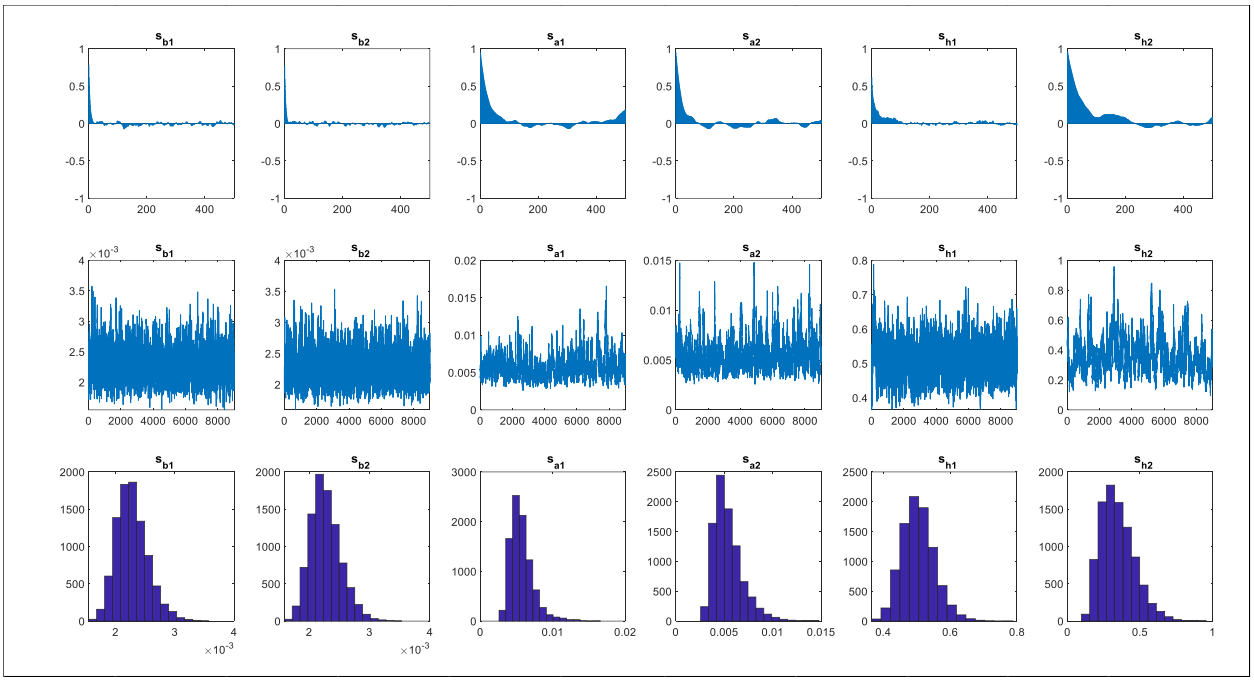
Appendices

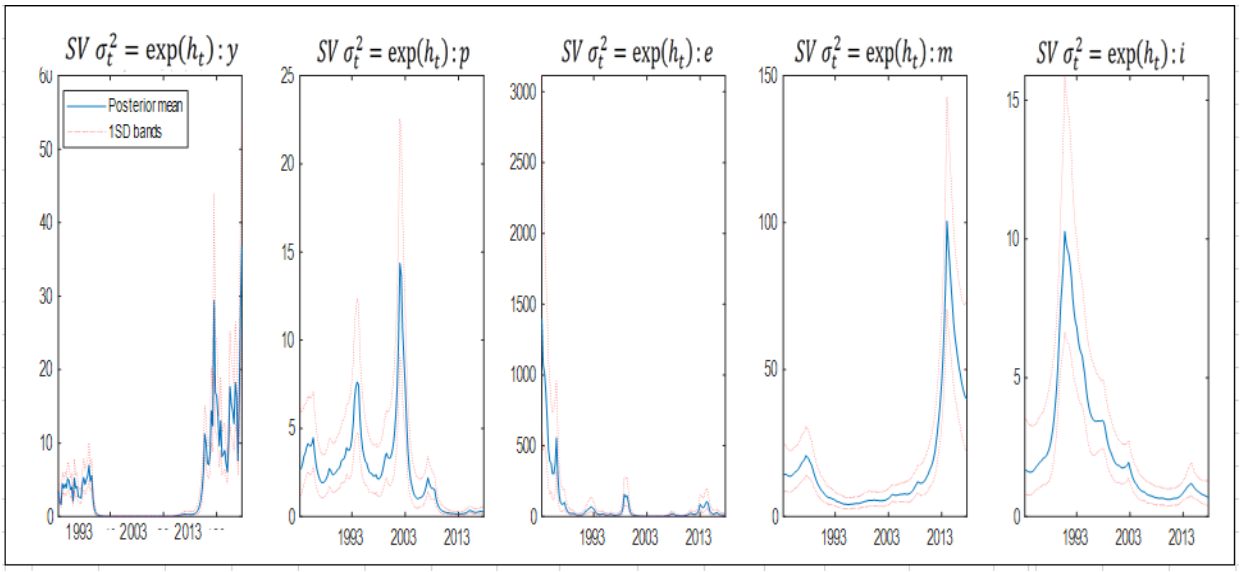
Appendix A.5.1: Selected parameters of the estimated money supply model

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0029]	0.3670	6.04
sb2	0.0023	0.0003	[0.0018	0.0028]	0.7880	8.96
sa1	0.0057	0.0016	[0.0035	0.0099]	0.4430	47.32
sa2	0.0054	0.0015	[0.0034	0.0092]	0.3000	31.48
sh1	0.5045	0.0486	[0.4190	0.6103]	0.2850	22.67
sh2	0.3474	0.1165	[0.1697	0.6141]	0.8280	84.62

Appendix A.5.2: Sample autocorrelation, sample paths and posterior densities for selected parameters in the money supply model



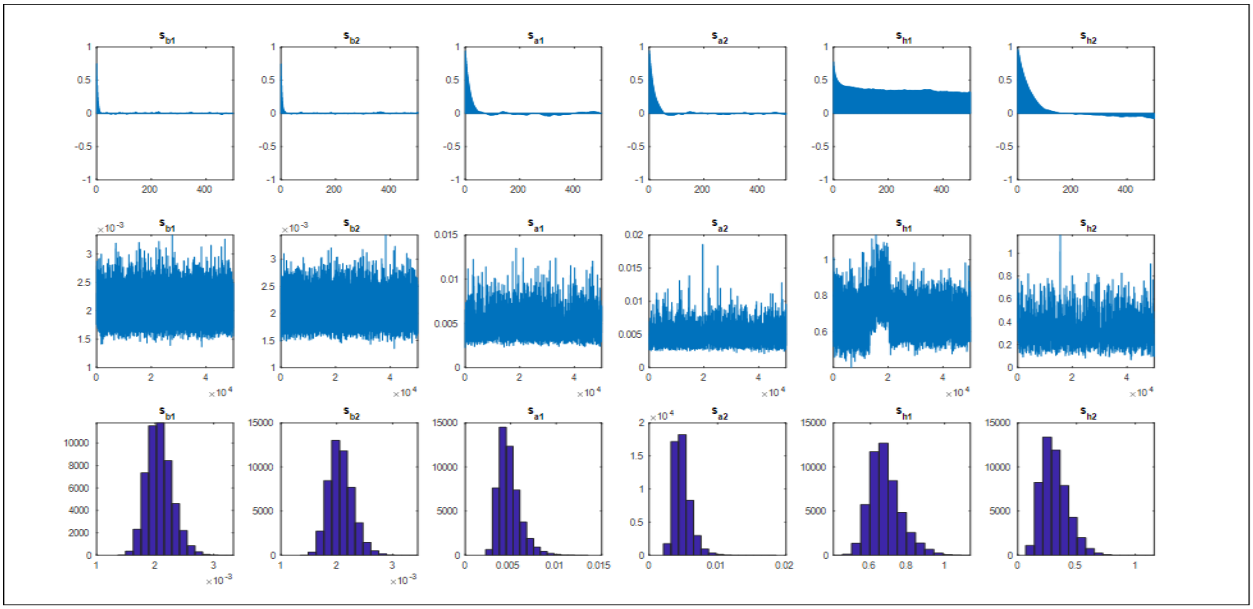
Appendix A.5.3: Posterior estimates for the stochastic volatilities of the money supply model



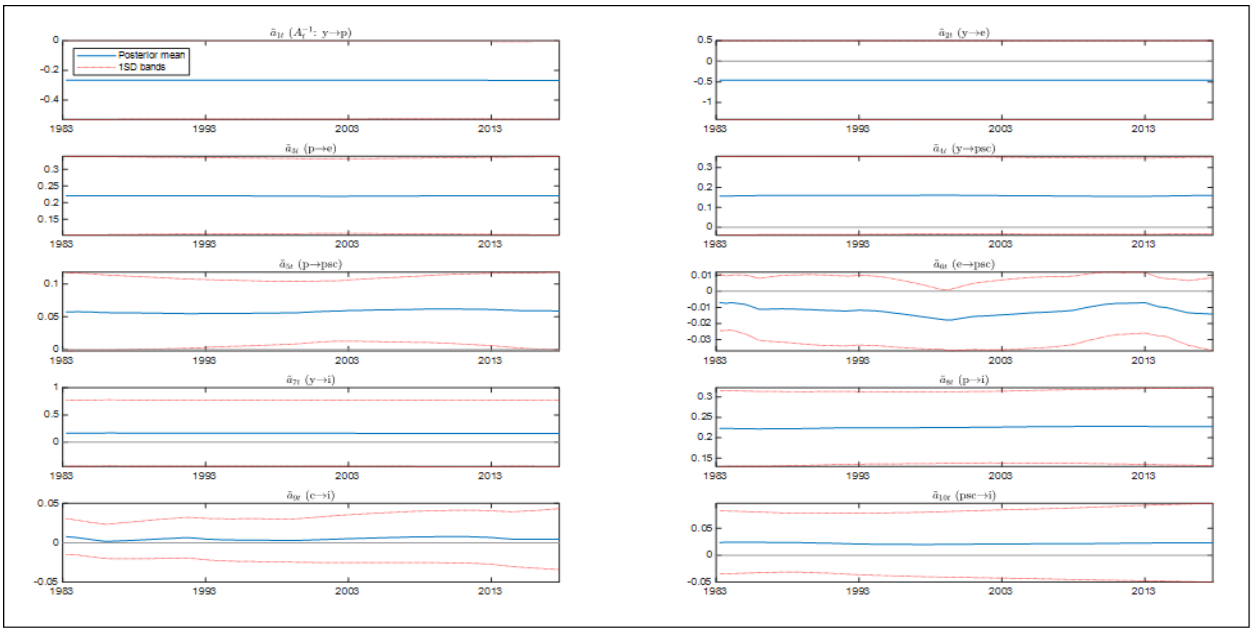
Appendix A.5.4: Selected parameters of the estimated monetary policy model – the alternative prior specification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0021	0.0002	[0.0017	0.0026]	0.4850	8.08
sb2	0.0021	0.0002	[0.0017	0.0025]	0.2270	7.45
sa1	0.0048	0.0012	[0.0031	0.0079]	0.1550	28.76
sa2	0.0048	0.0012	[0.0031	0.0078]	0.3090	30.54
sh1	0.6801	0.0850	[0.5434	0.8830]	0.3470	149.10
sh2	0.3147	0.1124	[0.1436	0.5720]	0.3910	73.13

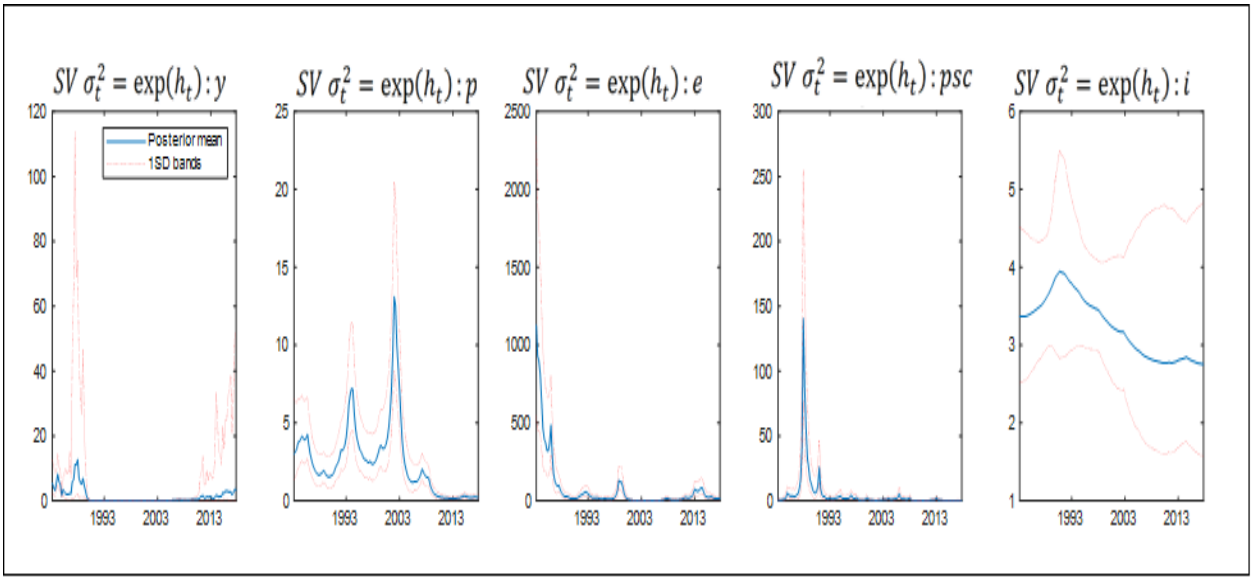
Appendix A.5.5: Sample autocorrelation, sample paths and posterior densities for selected parameters in the monetary policy model – the alternative prior specification test



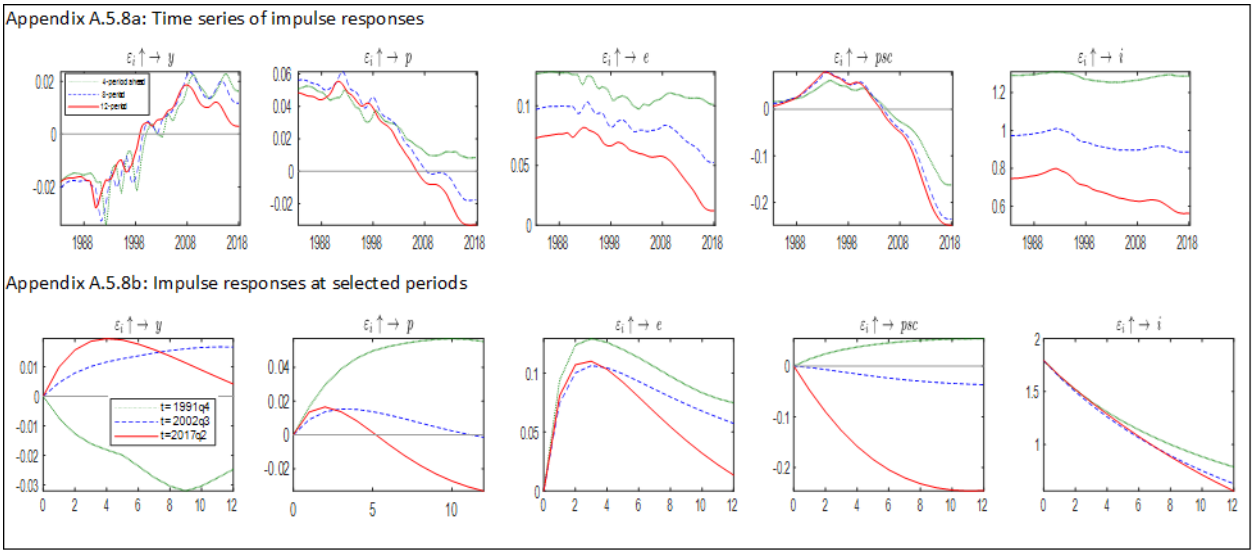
Appendix A.5.6: Posterior estimates of simultaneous relations in the monetary policy model – the alternative prior specification test



Appendix A.5.7: Posterior estimates for the stochastic volatilities of the monetary policy model – the alternative prior specification test



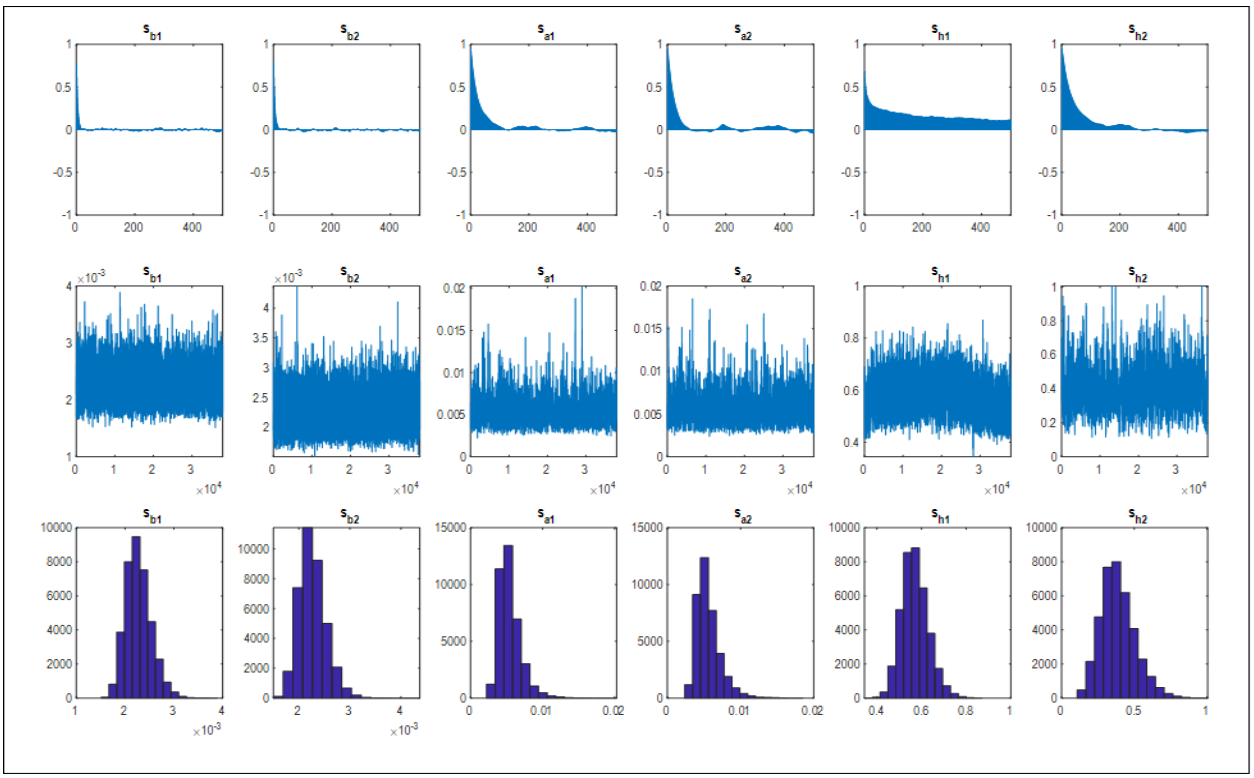
Appendix A.5.8: Time-varying responses to monetary policy shocks – the alternative prior specification test



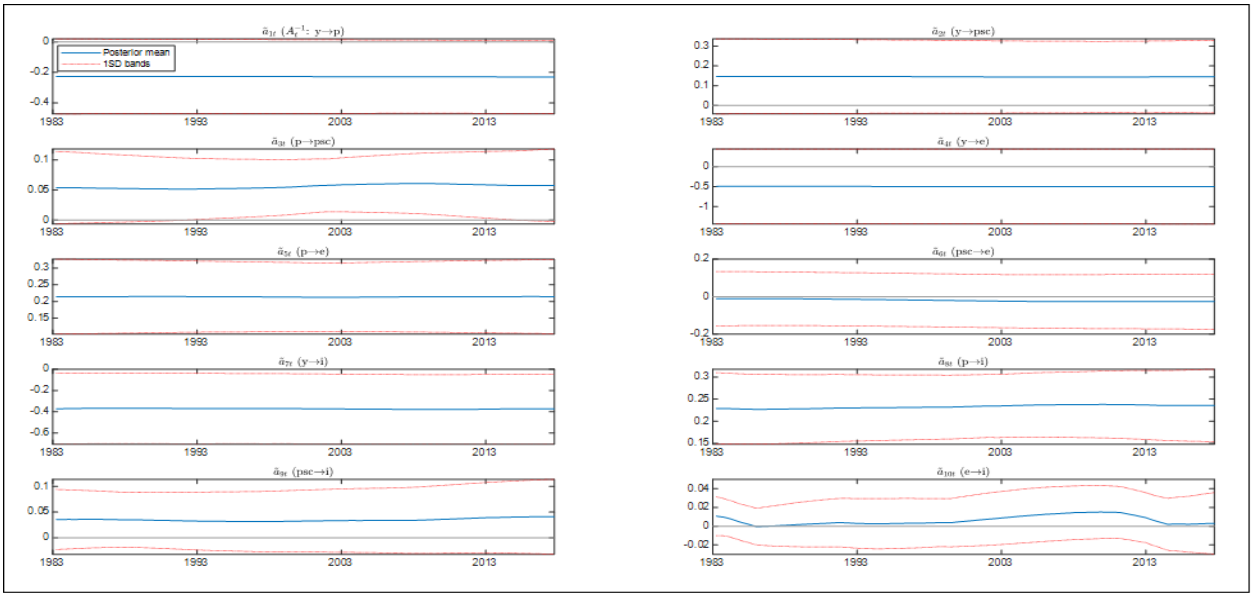
Appendix A.5.9: Selected parameters of the estimated monetary policy model – the alternative identification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.1030	8.62
sb2	0.0023	0.0003	[0.0018	0.0028]	0.1630	7.75
sa1	0.0054	0.0016	[0.0034	0.0093]	0.6880	54.28
sa2	0.0056	0.0017	[0.0034	0.0097]	0.3140	40.82
sh1	0.5700	0.0600	[0.4647	0.7001]	0.7050	83.53
sh2	0.3872	0.1184	[0.1861	0.6545]	0.9980	76.96

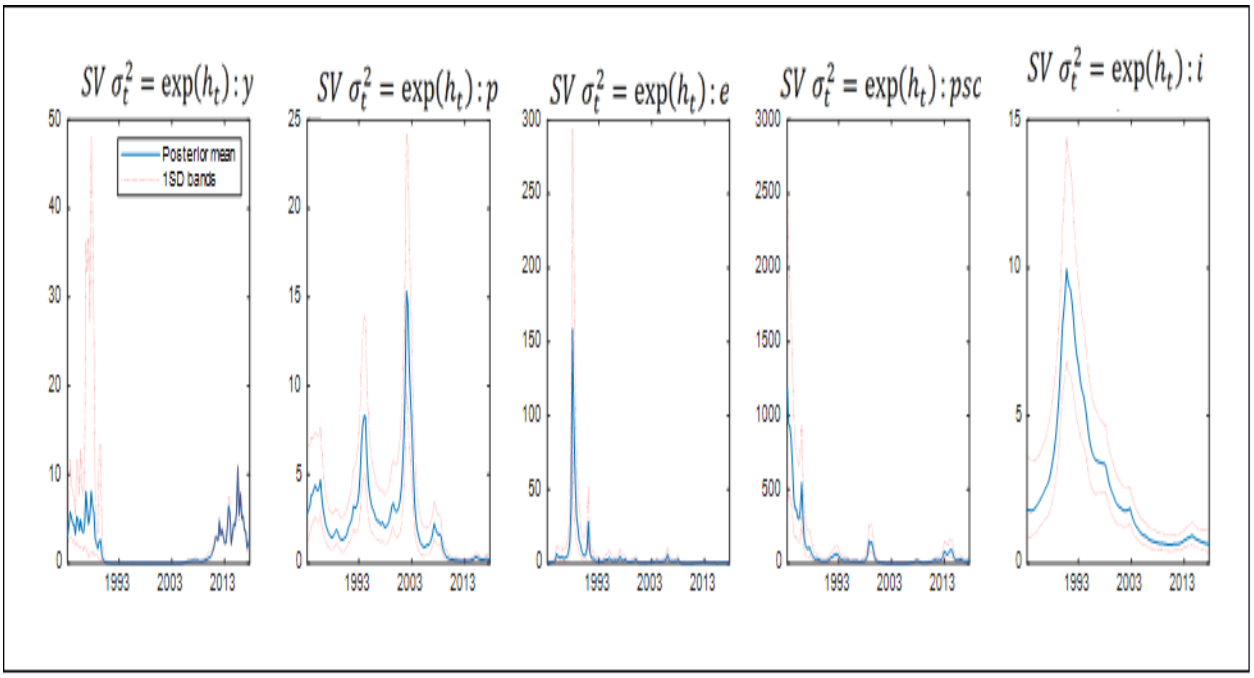
Appendix A.5.10: Sample autocorrelation, sample paths and posterior densities for selected parameters in the monetary policy model – the alternative identification test



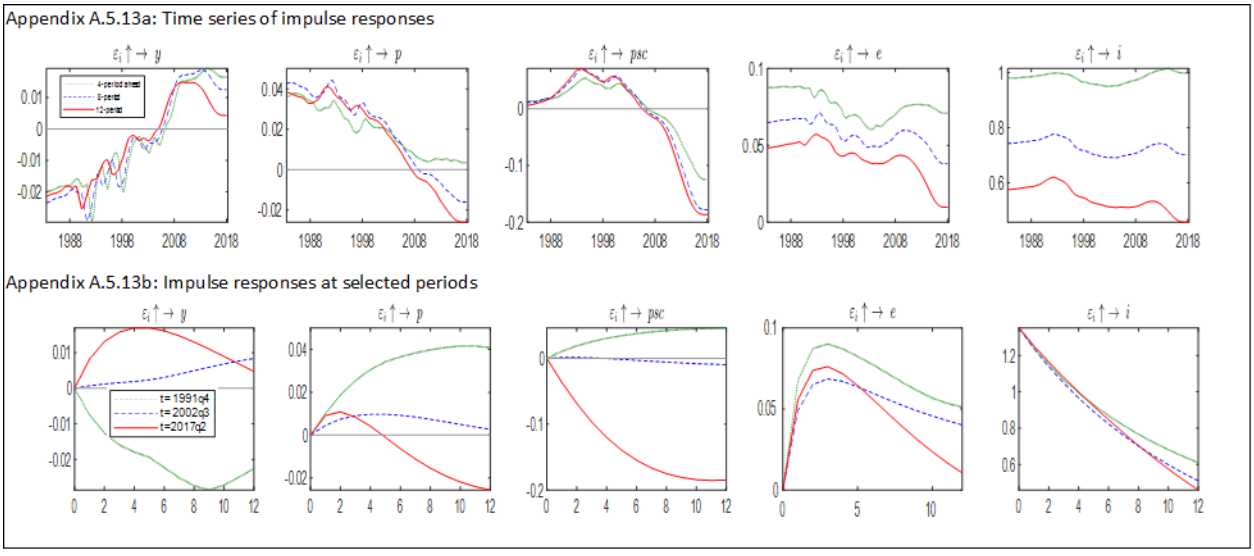
Appendix A.5.11: Posterior estimates of simultaneous relations in the monetary policy model – the alternative identification test



Appendix A.5.12: Posterior estimates for the stochastic volatilities of the monetary policy model – the alternative identification test



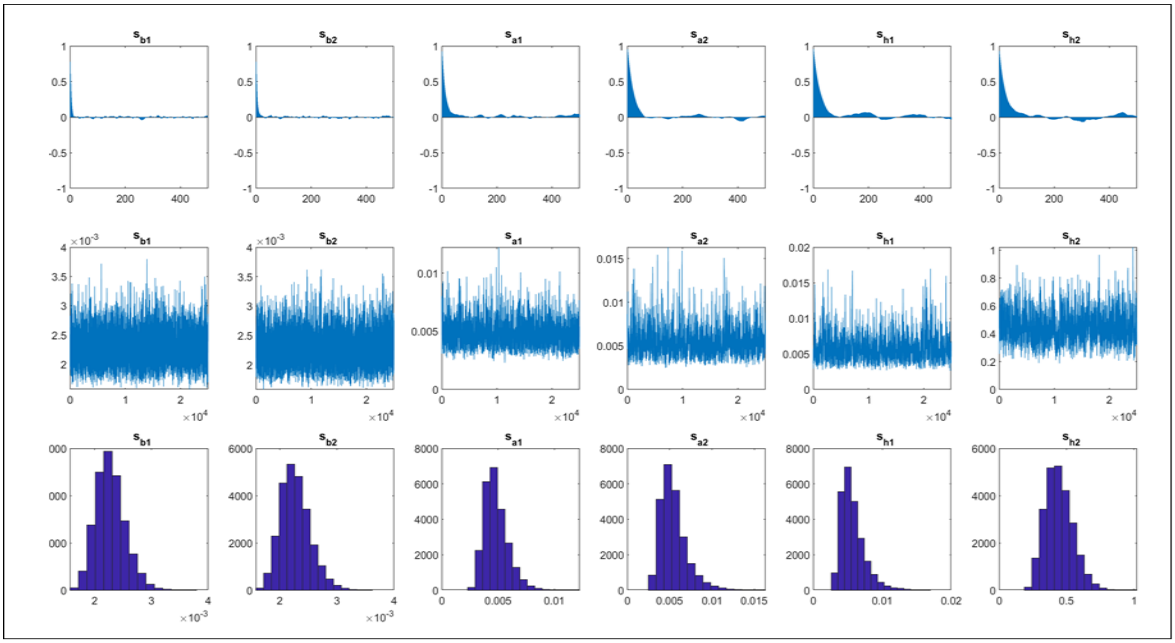
Appendix A.5.13: Time-varying responses to monetary policy shocks – the alternative identification test



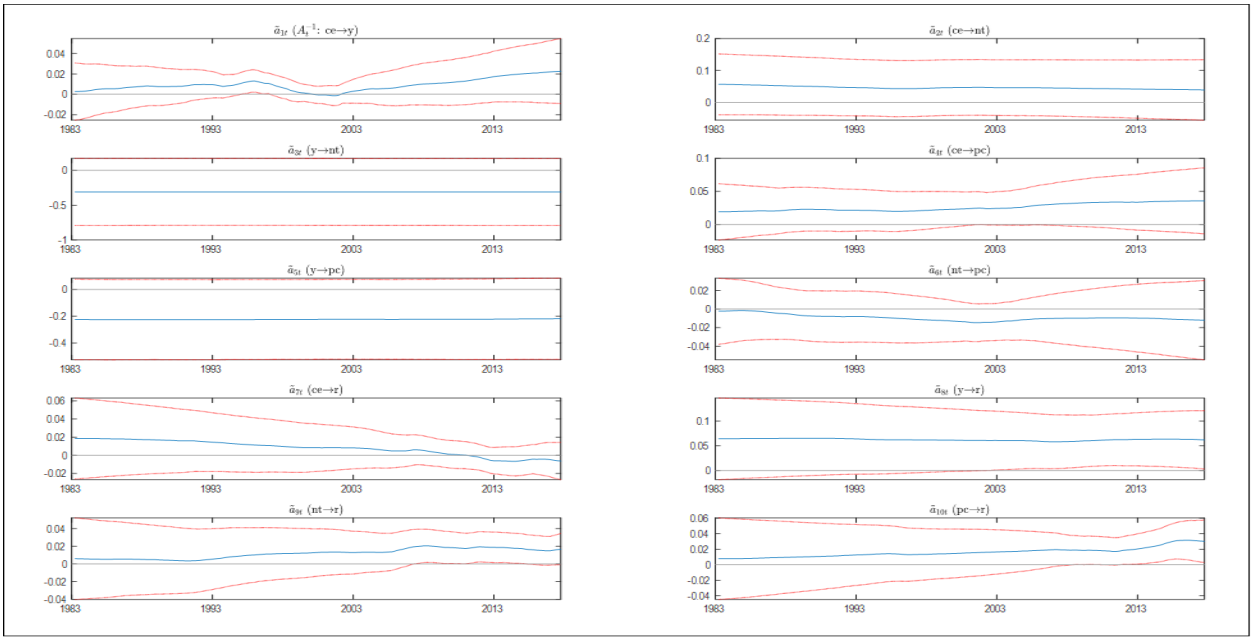
Appendix A.6.1: Selected parameters of the estimated fiscal policy model – the real interest rate version

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.2600	6.51
sb2	0.0023	0.0003	[0.0018	0.0028]	0.8830	8.80
sa1	0.0048	0.0011	[0.0032	0.0073]	0.5450	28.54
sa2	0.0055	0.0016	[0.0033	0.0096]	0.1620	37.81
sh1	0.0057	0.0017	[0.0034	0.0101]	0.4630	50.24
sh2	0.4433	0.1018	[0.2711	0.6625]	0.1980	44.44

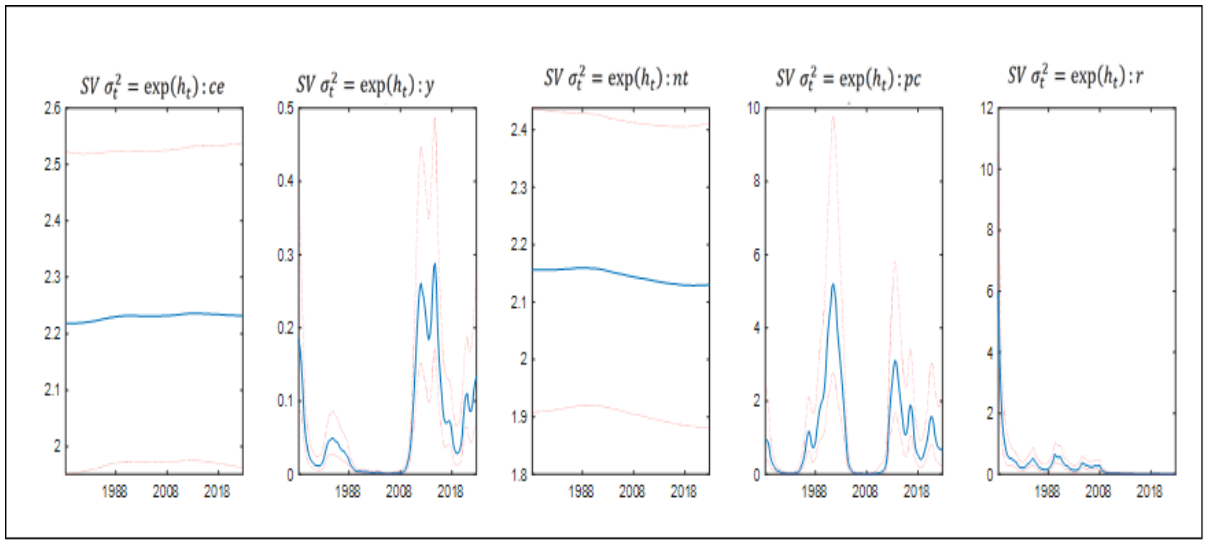
Appendix A.6.2: Sample autocorrelation, sample paths and posterior densities for selected parameters in the fiscal policy model – the real interest rate version



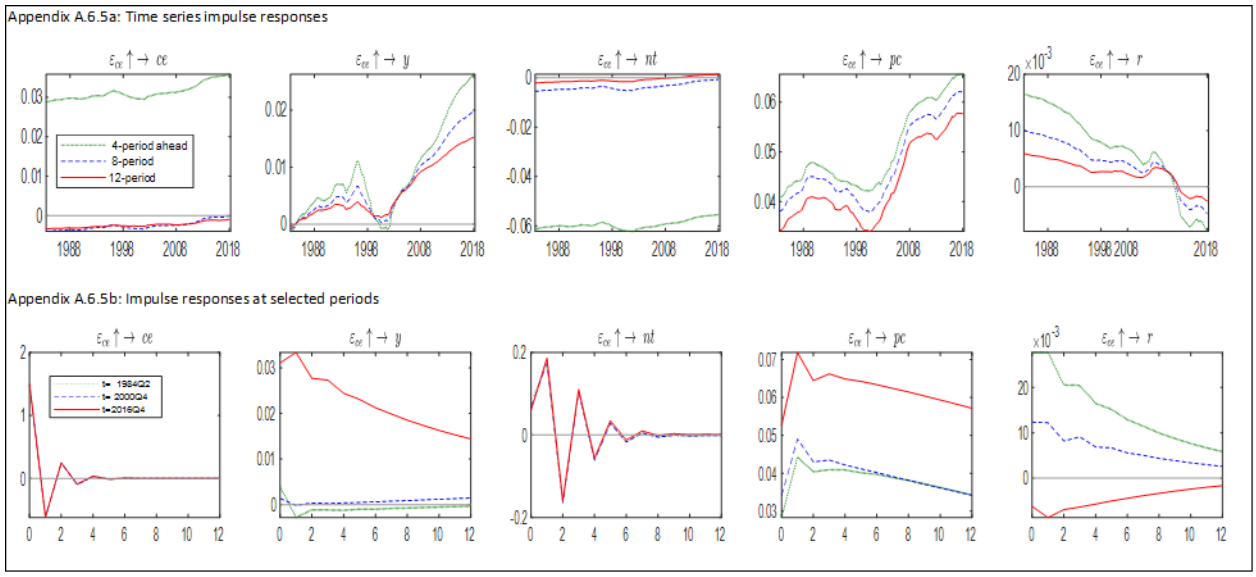
Appendix A.6.3: Posterior estimates of simultaneous relations in the fiscal policy model – the real interest rate version



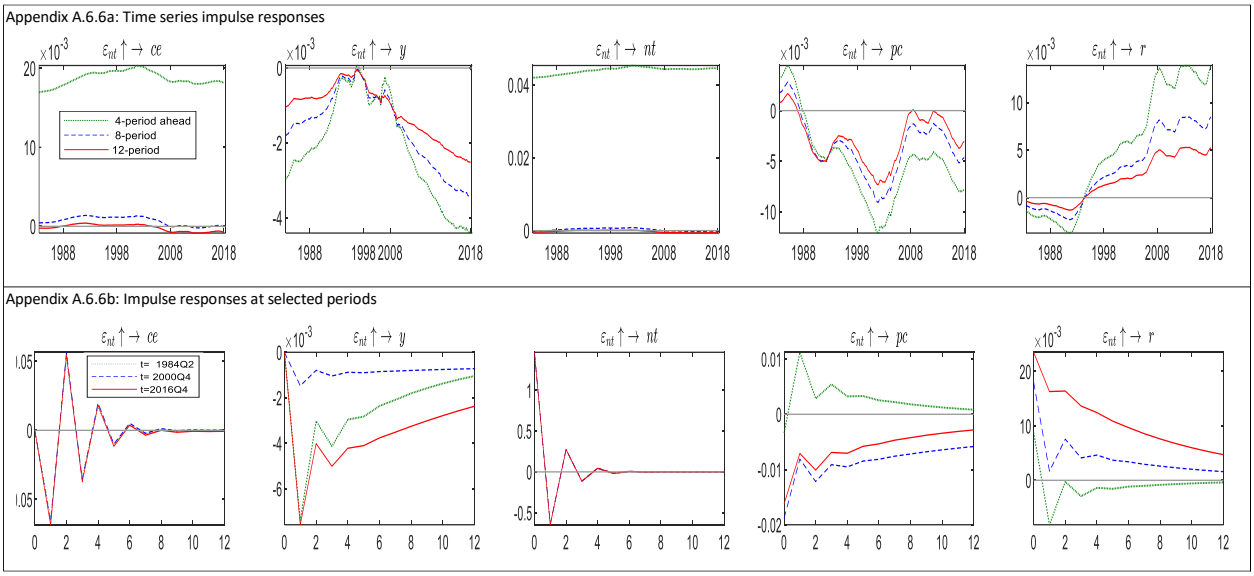
Appendix A.6.4: Posterior estimates for the stochastic volatilities of the fiscal policy model – the real interest rate version



Appendix A.6.5: Time-varying responses to spending shocks – the real interest rate version



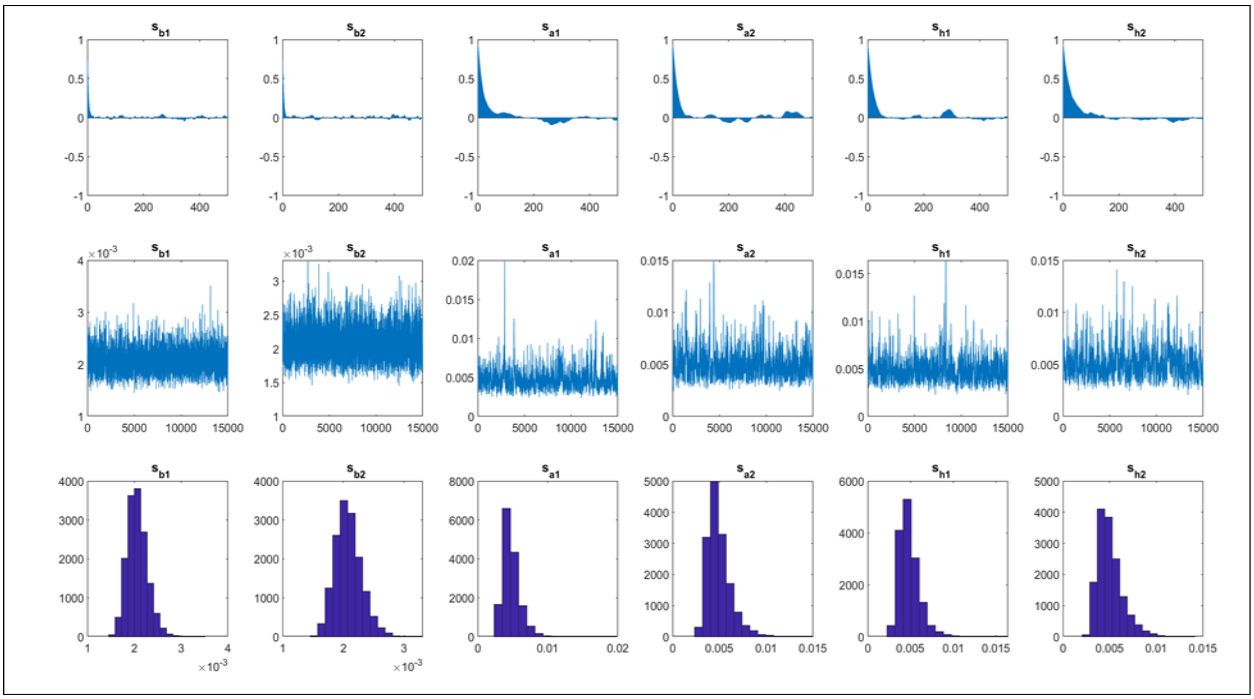
Appendix A.6.6: Time-varying responses to tax shocks – the real interest rate version



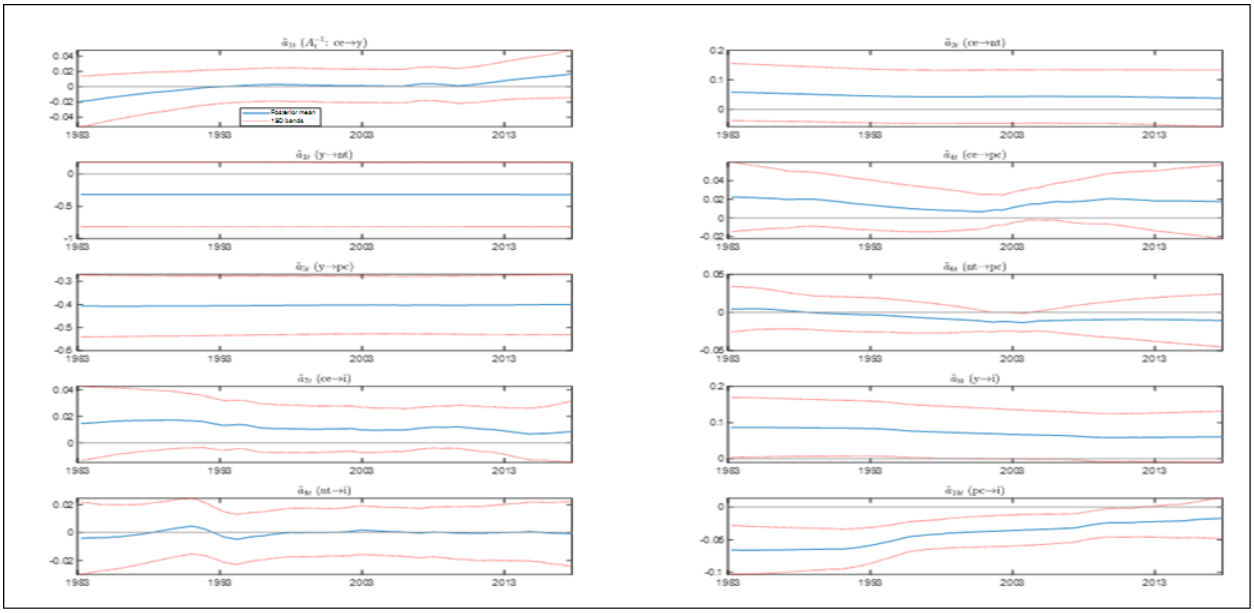
Appendix A.6.7: Selected parameters of the estimated monetary policy model – the alternative prior specification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0021	0.0002	[0.0017	0.0025]	0.8440	8.20
sb2	0.0021	0.0002	[0.0017	0.0026]	0.9240	8.19
sa1	0.0048	0.0013	[0.0031	0.0079]	0.6960	40.12
sa2	0.0050	0.0013	[0.0032	0.0082]	0.2260	30.01
sh1	0.0048	0.0012	[0.0032	0.0079]	0.6960	34.71
sh2	0.0050	0.0014	[0.0032	0.0085]	0.9820	51.06

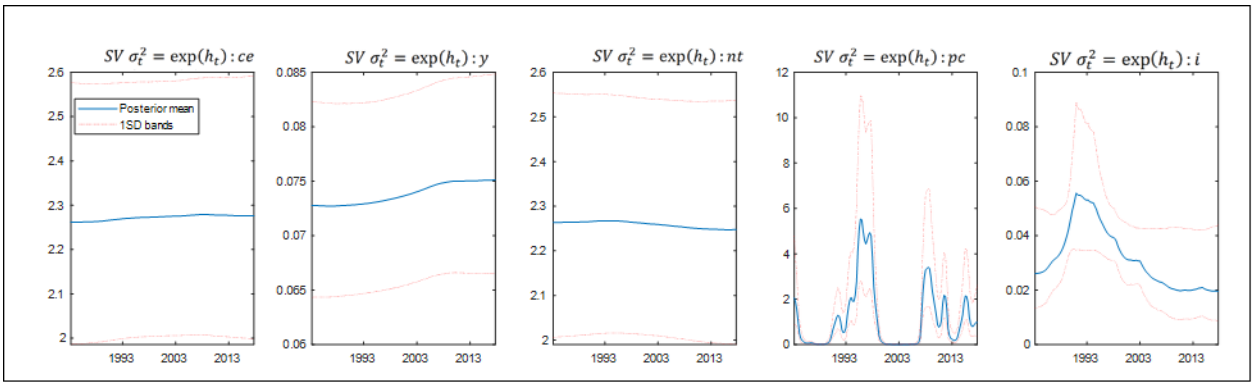
Appendix A.6.8: Sample autocorrelation, sample paths and posterior densities for selected parameters in the fiscal policy model – the alternative prior specification test



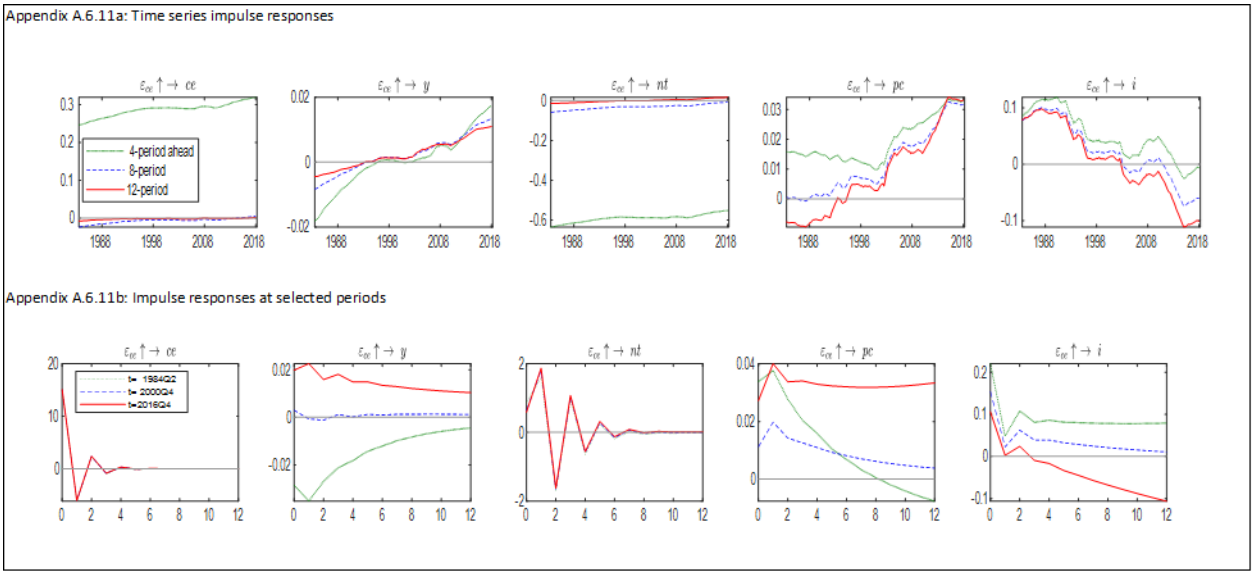
Appendix A.6.9: Posterior estimates of simultaneous relations in the fiscal policy model – the alternative prior specification test



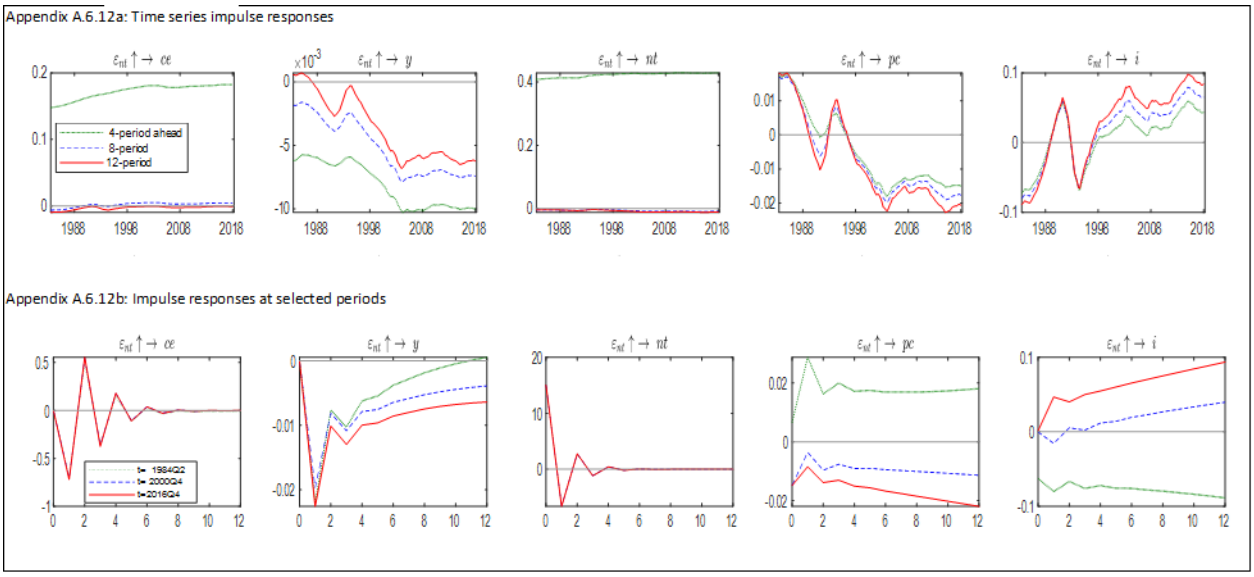
Appendix A.6.10: Posterior estimates for the stochastic volatilities of the fiscal policy model – the alternative prior specification test



Appendix A.6.11: Time-varying responses to spending shocks – the alternative prior specification test



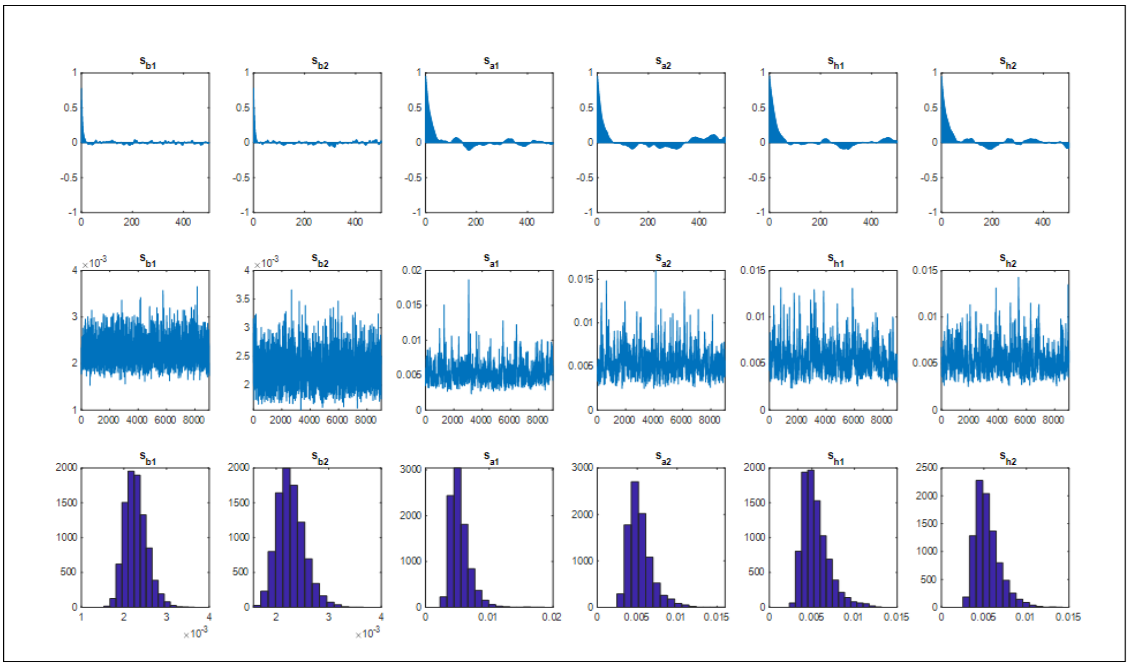
Appendix A.6.12: Time-varying responses to tax shocks – the alternative prior specification test



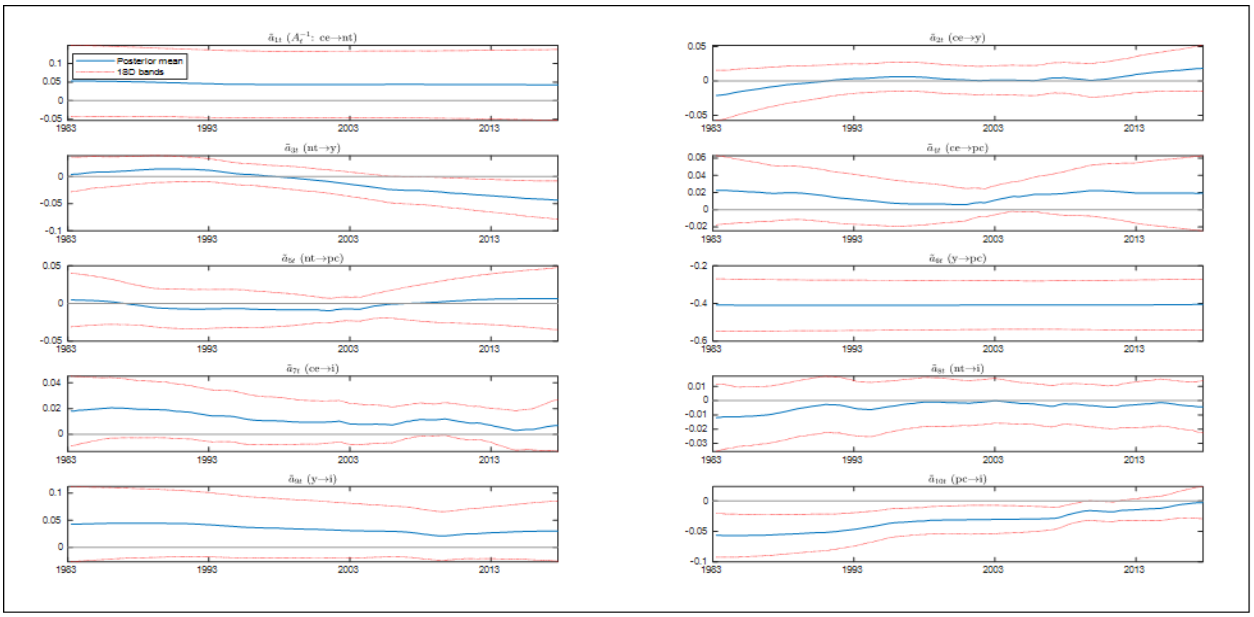
Appendix A.6.13: Selected parameters of the estimated monetary policy model – the alternative identification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0029]	0.1590	8.42
sb2	0.0023	0.0003	[0.0018	0.0029]	0.4980	7.07
sa1	0.0054	0.0015	[0.0034	0.0090]	0.3600	35.69
sa2	0.0054	0.0015	[0.0033	0.0093]	0.2630	26.64
sh1	0.0055	0.0016	[0.0033	0.0095]	0.1930	37.63
sh2	0.0054	0.0015	[0.0034	0.0091]	0.7060	38.47

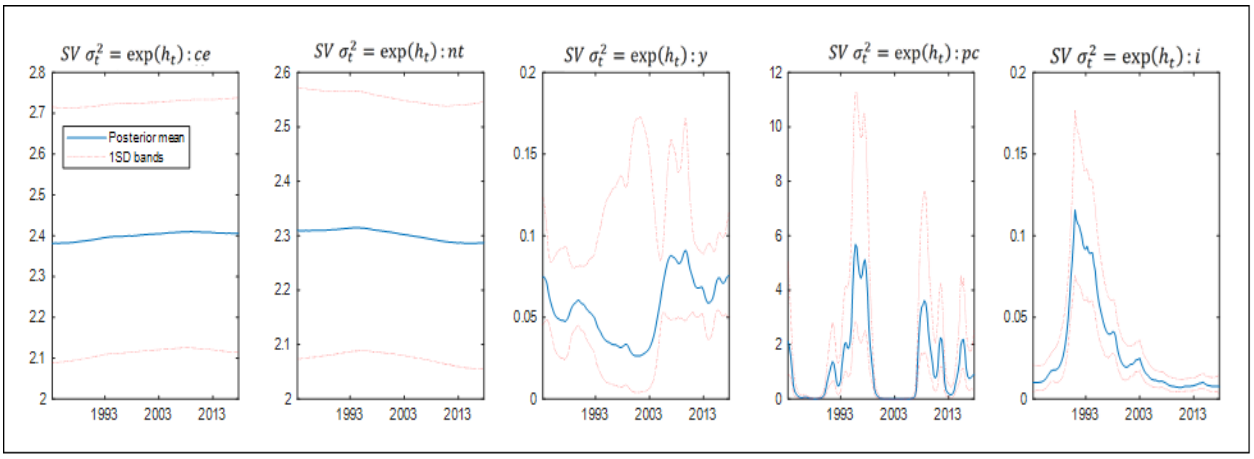
Appendix A.6.14: Sample autocorrelation, sample paths and posterior densities for selected parameters in the fiscal policy model – the alternative identification test



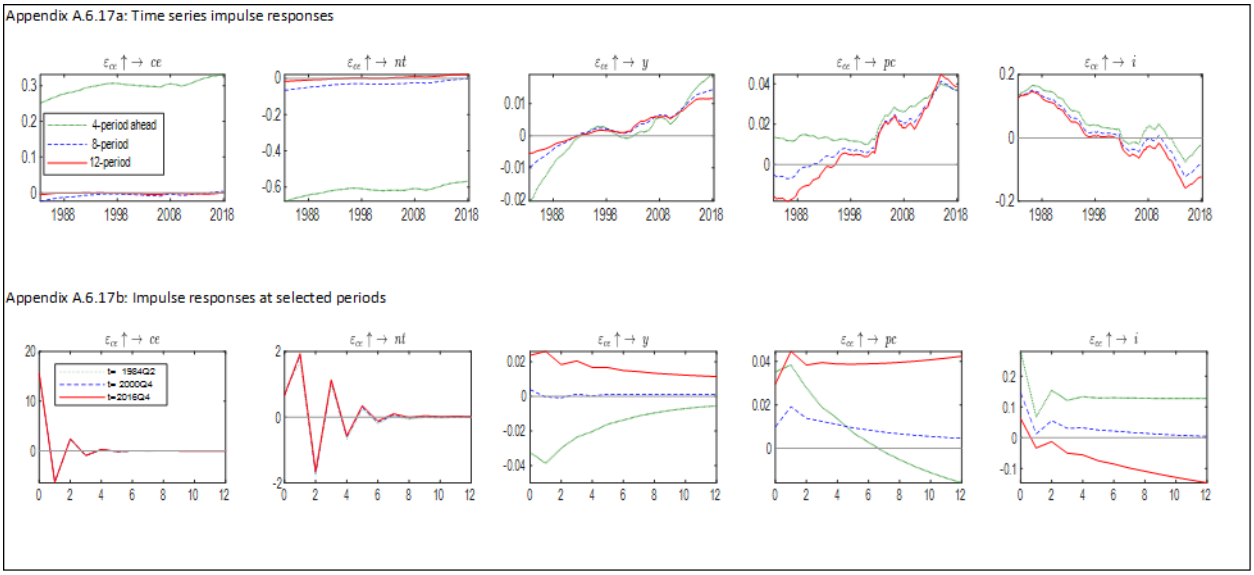
Appendix A.6.15: Posterior estimates of simultaneous relations in the fiscal policy model – the alternative identification test



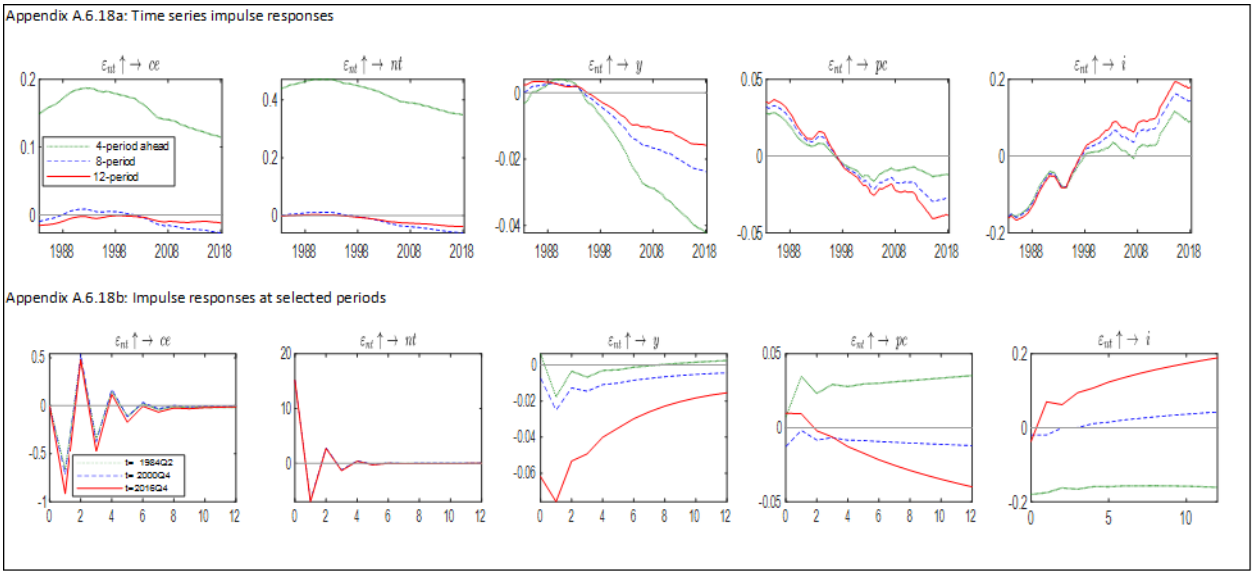
Appendix A.6.16: Posterior estimates for the stochastic volatilities of the fiscal policy model – the alternative identification test



Appendix A.6.17: Time-varying responses to spending shocks – the alternative identification test



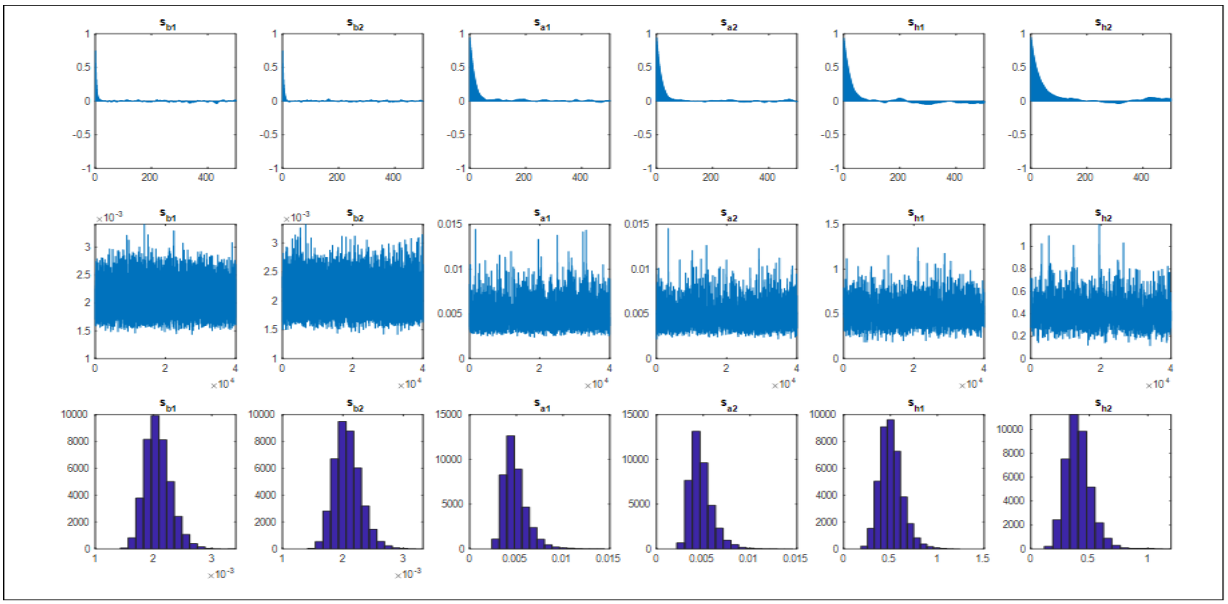
Appendix A.6.18: Time-varying responses to tax shocks – the alternative identification test



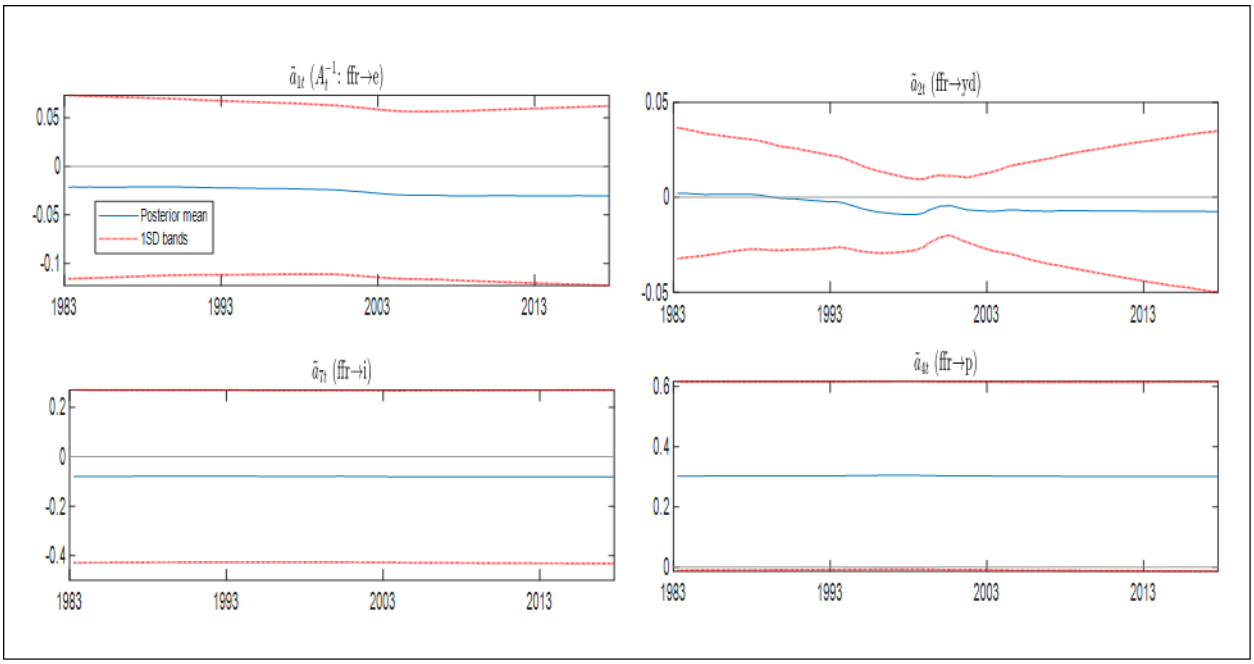
Appendix A.7. 1: Selected parameters of the estimated foreign monetary policy model – the alternative prior specification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0021	0.0002	[0.0017	0.0026]	0.7680	7.70
sb2	0.0021	0.0002	[0.0017	0.0025]	0.9840	7.81
sa1	0.0049	0.0013	[0.0032	0.0080]	0.1550	35.81
sa2	0.0048	0.0012	[0.0031	0.0077]	0.4620	33.24
sh1	0.5072	0.1211	[0.3040	0.7821]	0.7870	47.08
sh2	0.4049	0.1075	[0.2266	0.6460]	0.6260	60.77

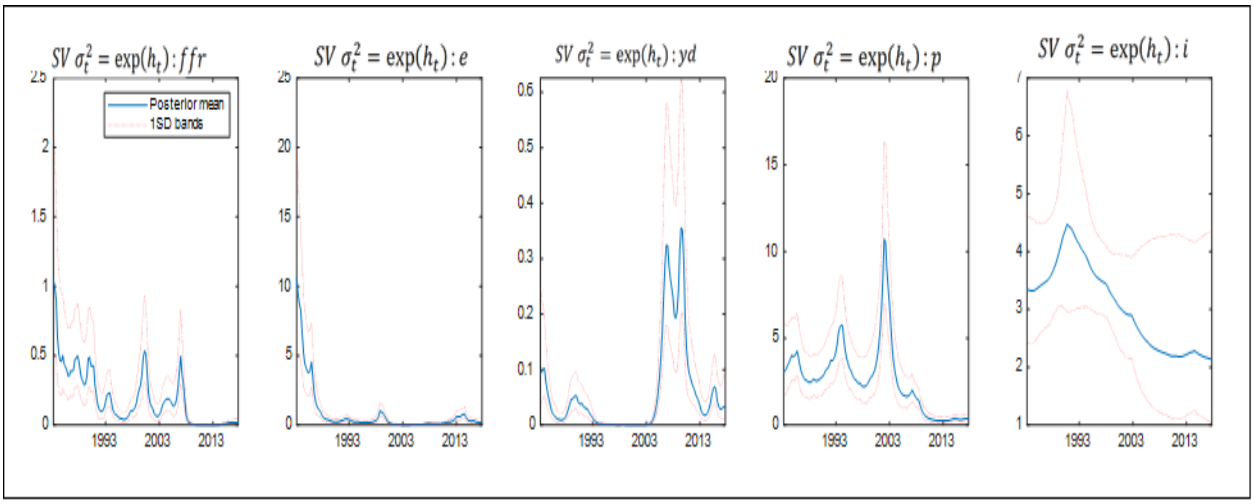
Appendix A.7.2: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign monetary policy model – the alternative prior specification test



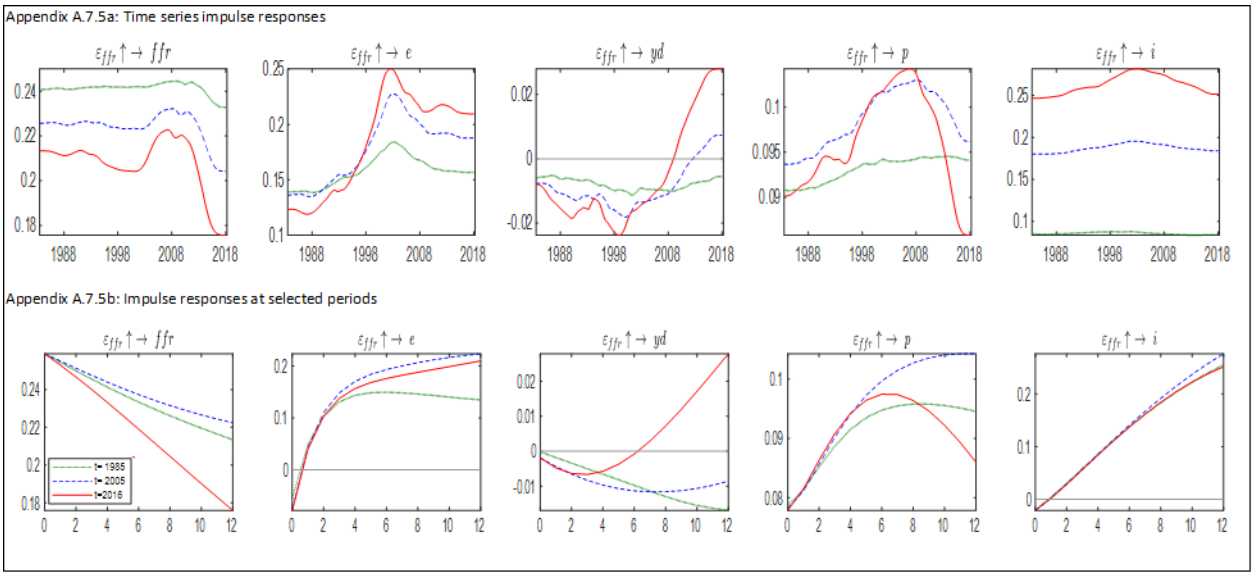
Appendix A.7.3: Posterior estimates of simultaneous relations in the foreign monetary policy model – the alternative prior specification test



Appendix A.7.4: Posterior estimates for the stochastic volatilities of the foreign monetary policy model – the alternative prior specification test



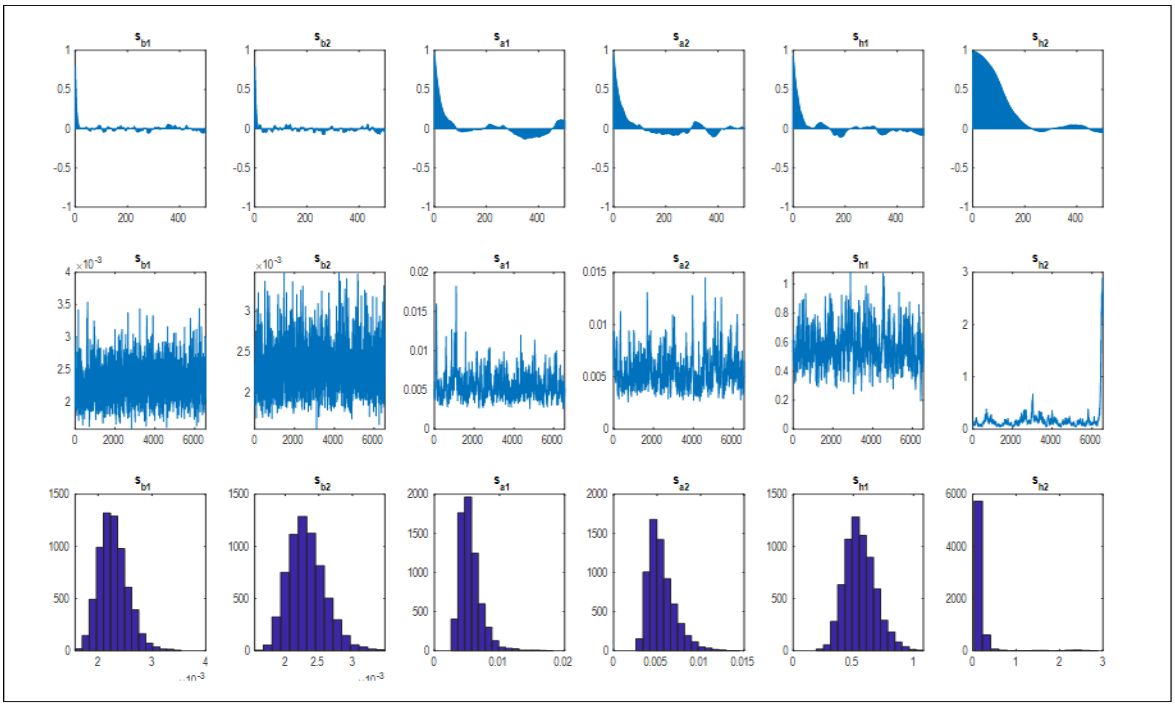
Appendix A.7.5: Time-varying responses to foreign monetary policy shocks – the alternative prior specification test



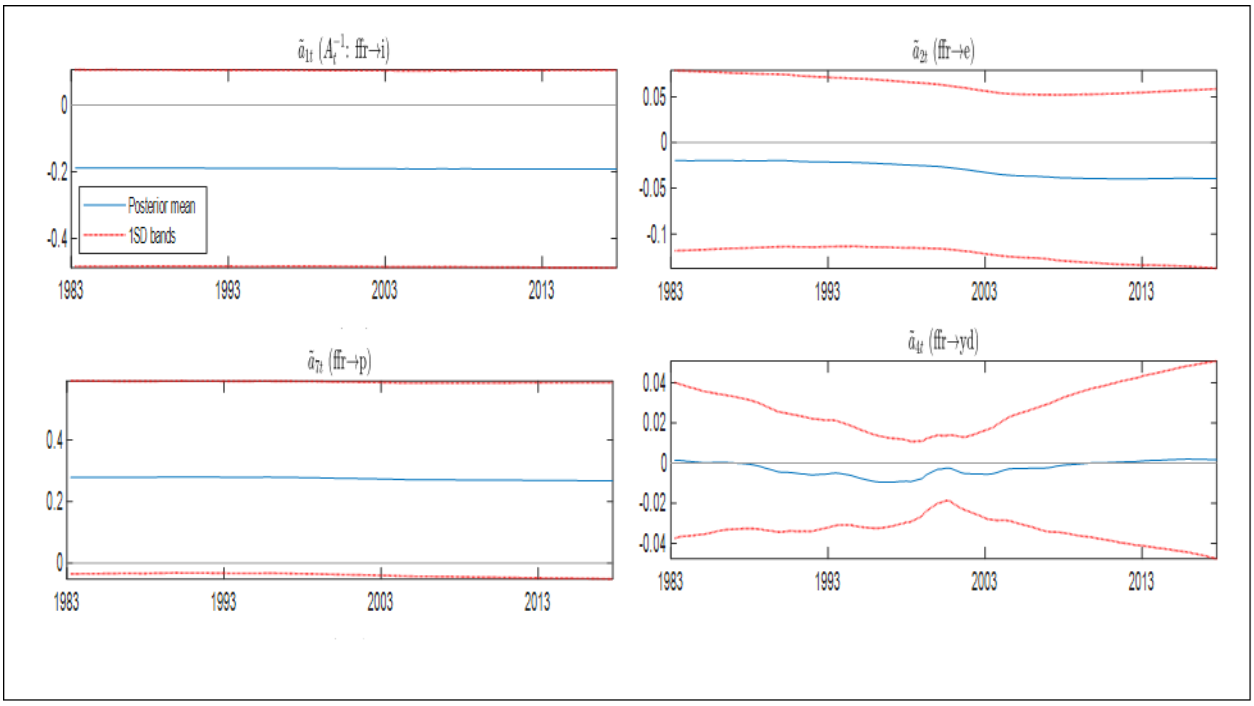
Appendix A.7.6: Selected parameters of the estimated foreign monetary policy model – the alternative identification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0029]	0.0670	8.48
sb2	0.0023	0.0003	[0.0019	0.0029]	0.1160	6.72
sa1	0.0055	0.0017	[0.0033	0.0096]	0.5690	42.12
sa2	0.0055	0.0015	[0.0034	0.0094]	0.9030	40.80
sh1	0.5570	0.1257	[0.3389	0.8358]	0.9930	35.64
sh2	0.1768	0.2805	[0.0503	0.5278]	0.1810	127.42

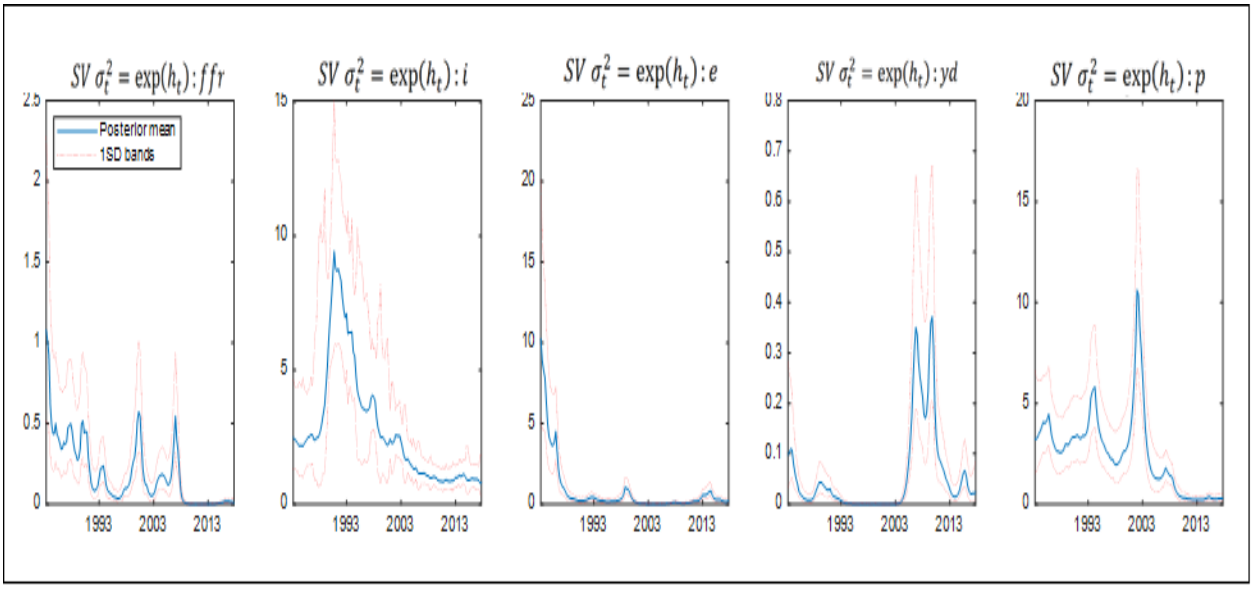
Appendix A.7.7: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign monetary policy model – the alternative identification test



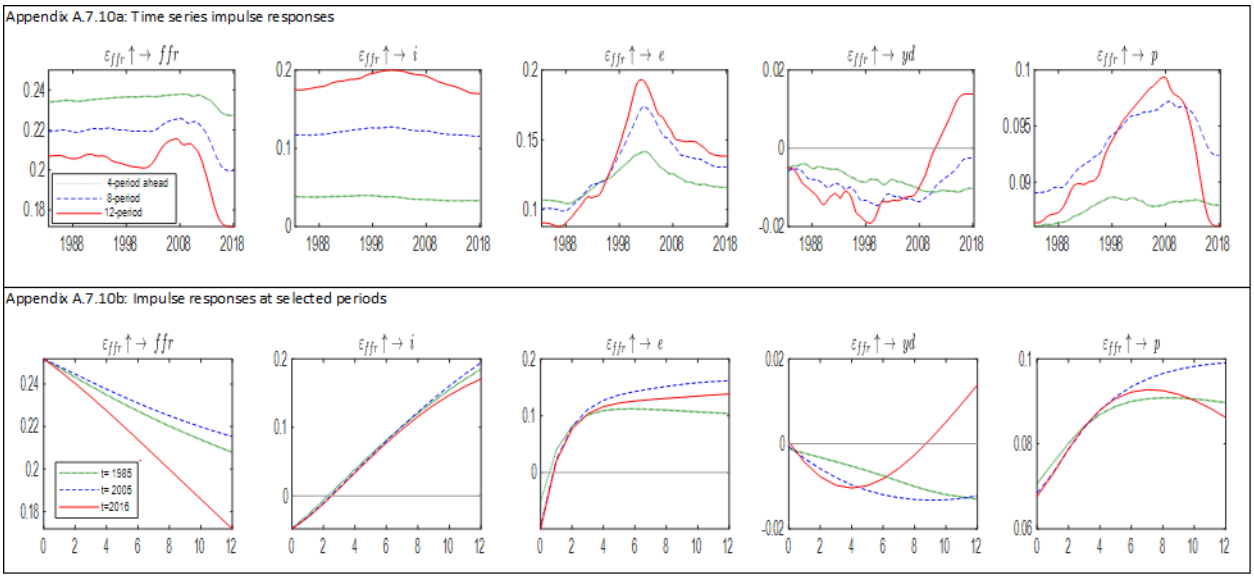
Appendix A.7.8: Posterior estimates of simultaneous relations in the foreign monetary policy model – the alternative identification test



Appendix A.7. 9: Posterior estimates for the stochastic volatilities of the foreign monetary policy model – the alternative identification test



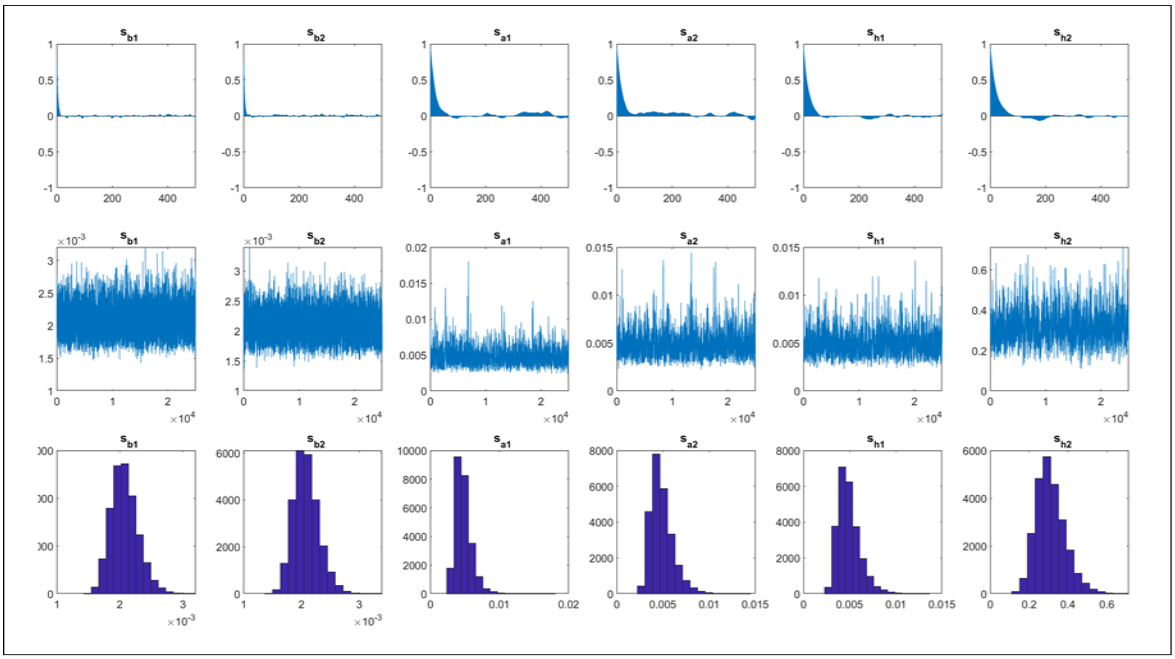
Appendix A.7.10: Time-varying responses to foreign monetary policy shocks – the alternative identification test



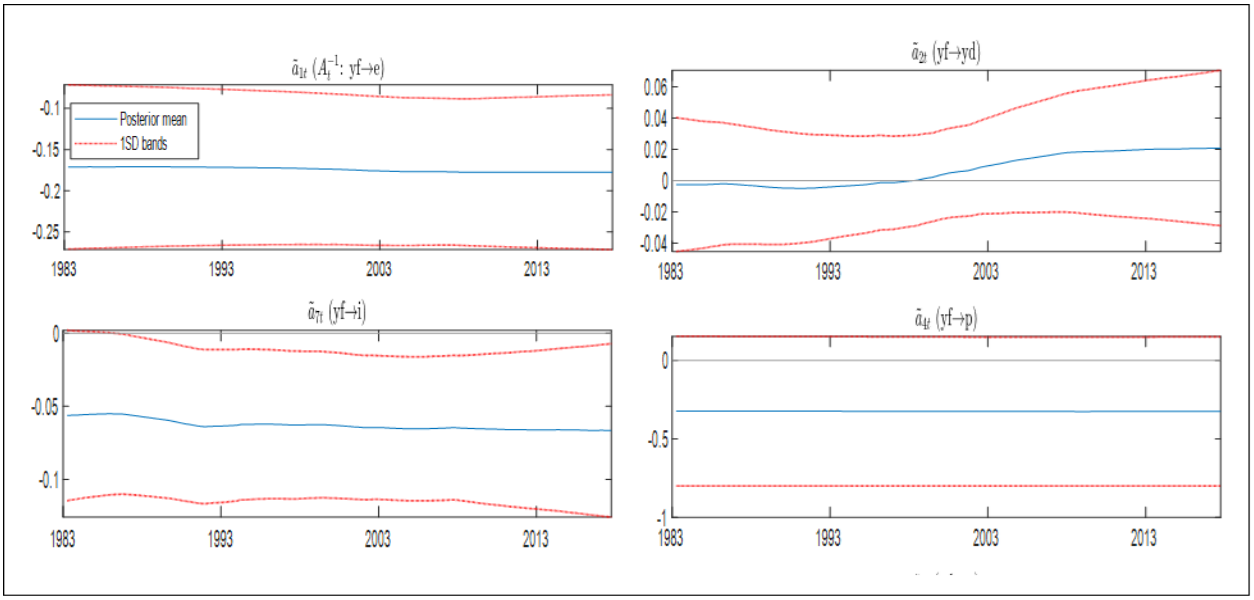
Appendix A.7.11: Selected parameters of the estimated foreign demand model – the alternative prior specification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0021	0.0002	[0.0017	0.0025]	0.7120	5.35
sb2	0.0021	0.0002	[0.0017	0.0026]	0.2210	7.05
sa1	0.0048	0.0012	[0.0031	0.0077]	0.2390	31.26
sa2	0.0049	0.0012	[0.0031	0.0079]	0.2620	42.58
sh1	0.0049	0.0012	[0.0032	0.0079]	0.0300	29.79
sh2	0.3101	0.0747	[0.1864	0.4813]	0.2880	35.61

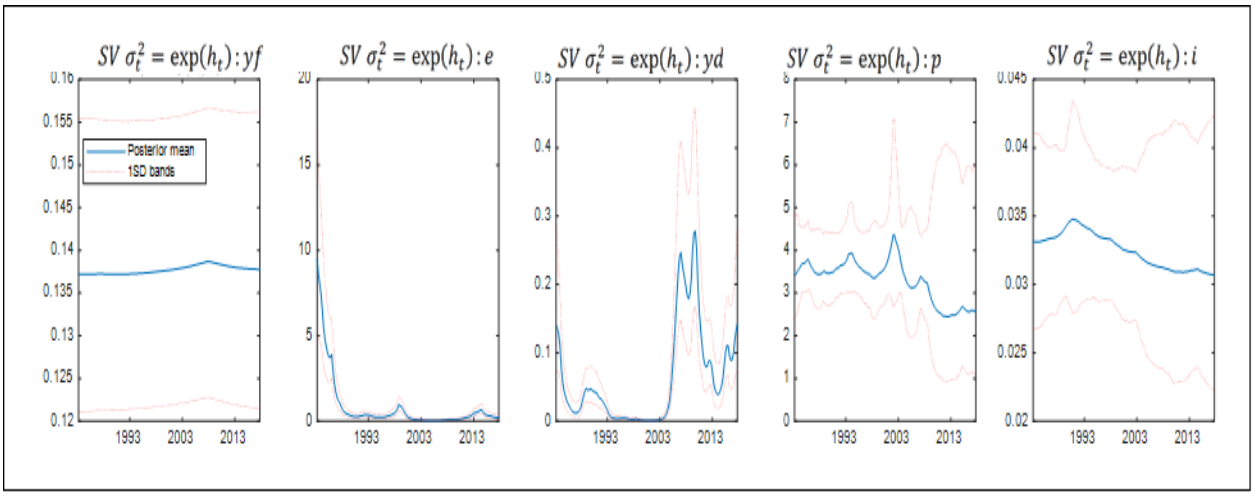
Appendix A.7.12: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign demand model – the alternative prior specification test



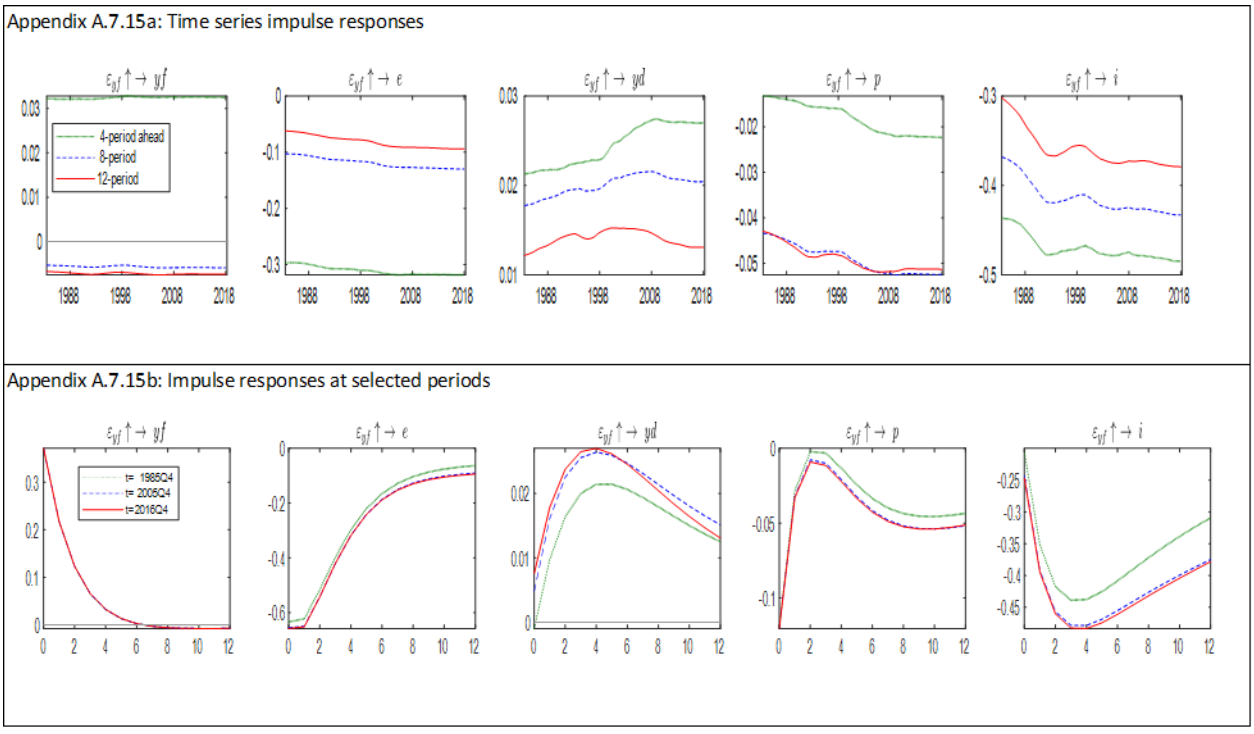
Appendix A.7.13: Posterior estimates of simultaneous relations in the foreign demand model – the alternative prior specification test



Appendix A.7.14: Posterior estimates for the stochastic volatilities of the foreign demand model – the alternative prior specification test



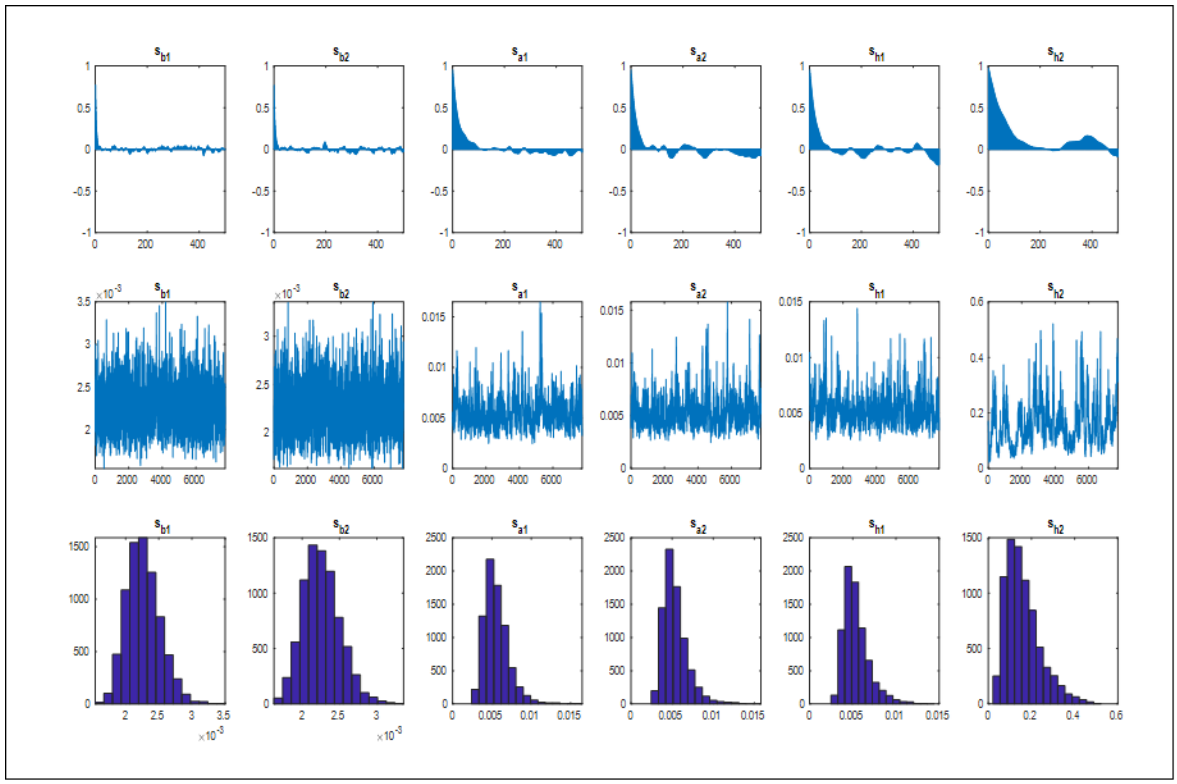
Appendix A.7.15: Time-varying responses to foreign demand shocks – the alternative prior specification test



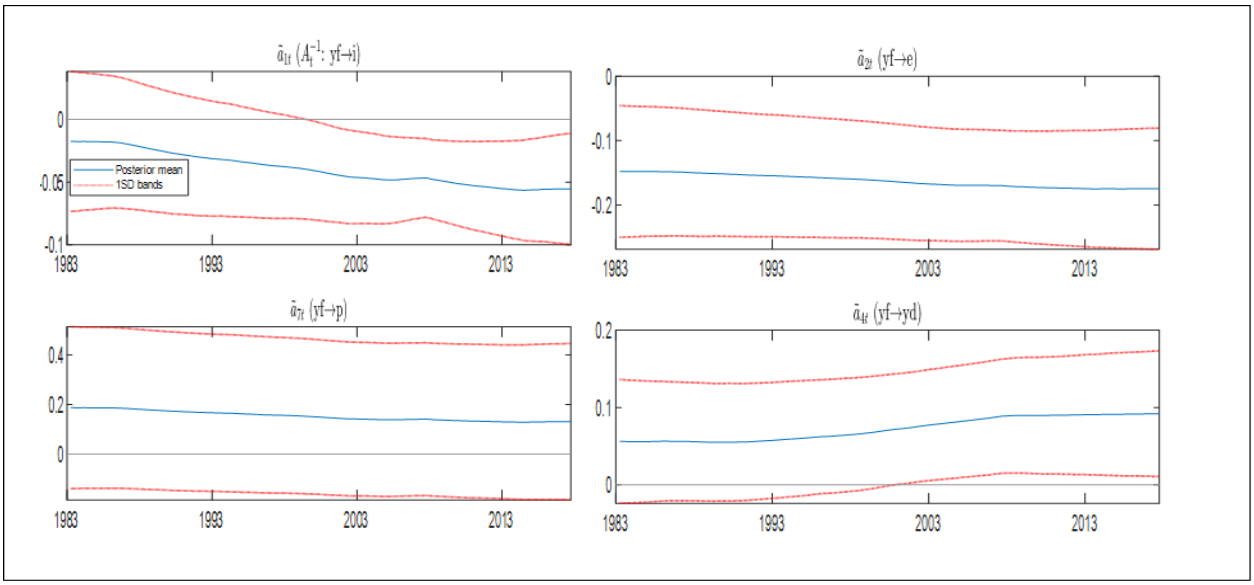
Appendix A.7.16: Selected parameters of the estimated foreign demand model – the alternative identification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.0380	7.88
sb2	0.0023	0.0003	[0.0018	0.0028]	0.9130	9.69
sa1	0.0056	0.0016	[0.0033	0.0094]	0.6750	46.05
sa2	0.0054	0.0015	[0.0033	0.0091]	0.8900	35.21
sh1	0.0054	0.0015	[0.0034	0.0093]	0.3150	35.52
sh2	0.1599	0.0806	[0.0028	0.3608]	0.1370	101.46

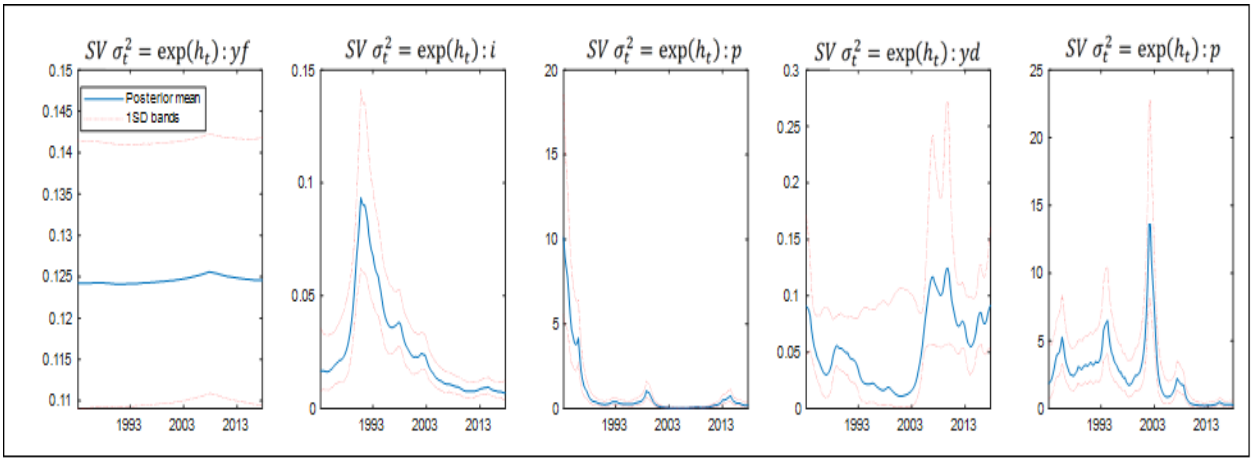
Appendix A.7.17: Sample autocorrelation, sample paths and posterior densities for selected parameters in the foreign demand model – the alternative identification test



Appendix A.7.18: Posterior estimates of simultaneous relations in the foreign demand model – the alternative identification test

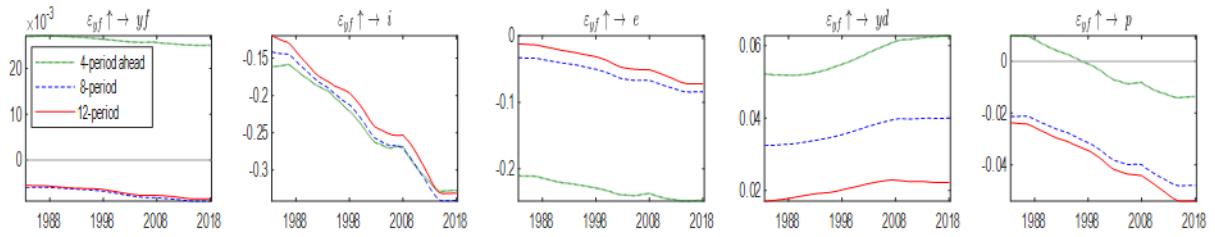


Appendix A.7.19: Posterior estimates for the stochastic volatilities of the foreign demand model – the alternative identification test

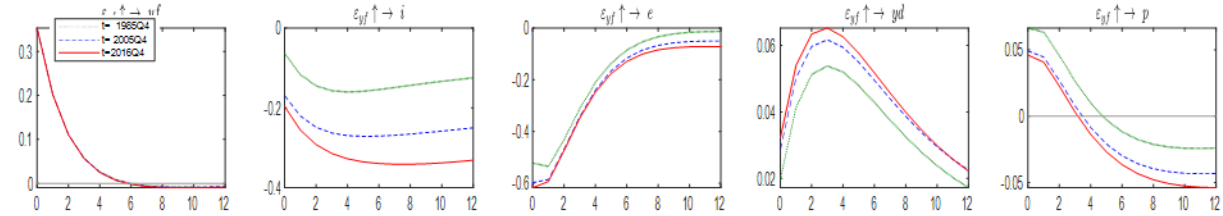


Appendix A.7.20: Time-varying responses to foreign demand shocks – the alternative identification test

Appendix A.7.20a: Time series impulse responses



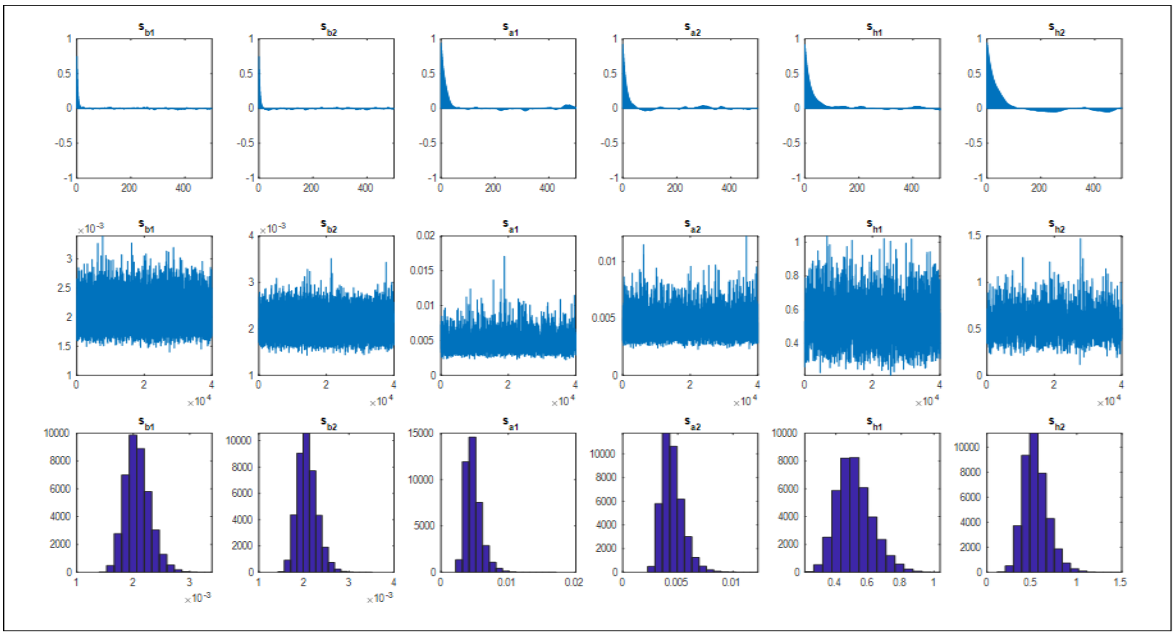
Appendix A.73.20b: Impulse responses at selected periods



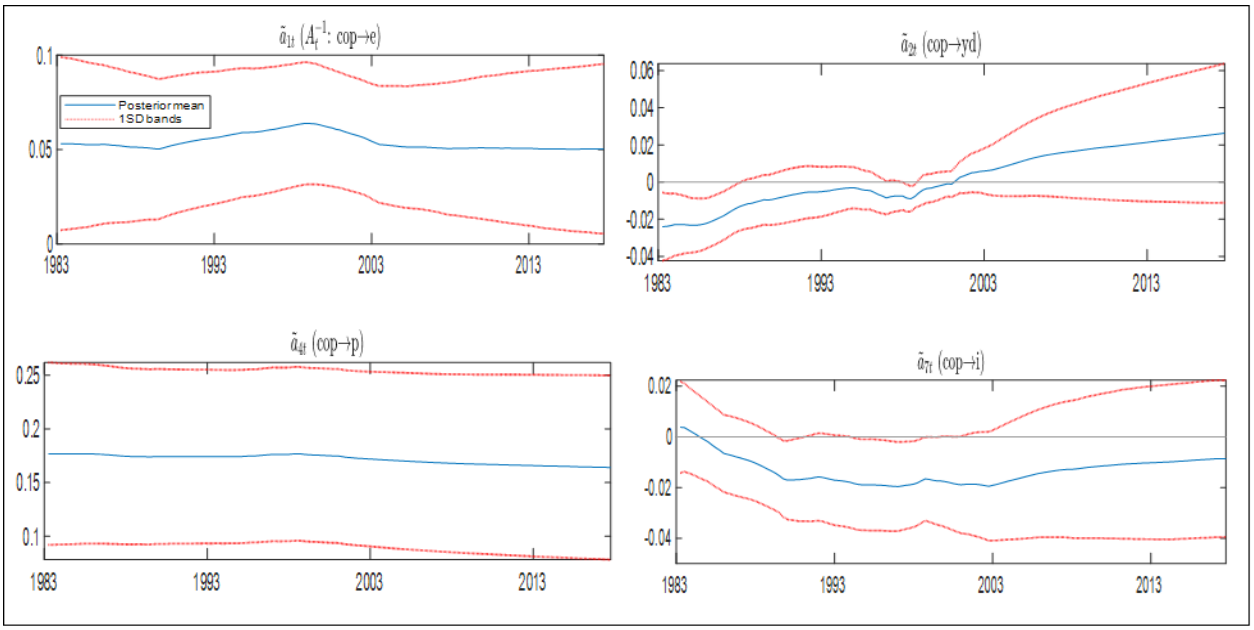
Appendix A.7.21: Selected parameters of the estimated crude oil price model – the alternative prior specification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0021	0.0002	[0.0017	0.0026]	0.7250	8.11
sb2	0.0021	0.0002	[0.0017	0.0026]	0.9680	5.18
sa1	0.0048	0.0012	[0.0031	0.0077]	0.5340	29.70
sa2	0.0045	0.0010	[0.0031	0.0068]	0.5660	23.46
sh1	0.5130	0.1076	[0.3350	0.7566]	0.1620	42.75
sh2	0.5430	0.1371	[0.3172	0.8566]	0.7300	52.50

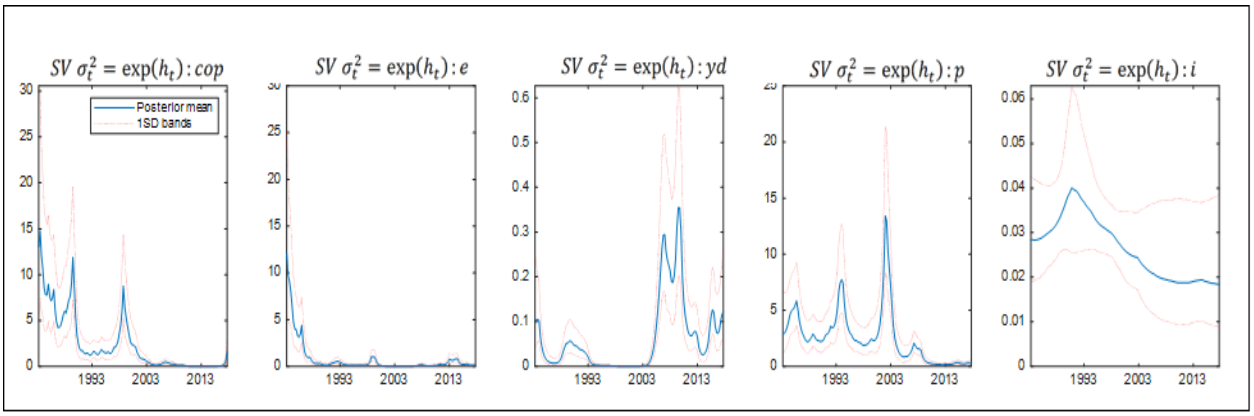
Appendix A.7.22: Sample autocorrelation, sample paths and posterior densities for selected parameters in the crude oil price model – the alternative prior specification test



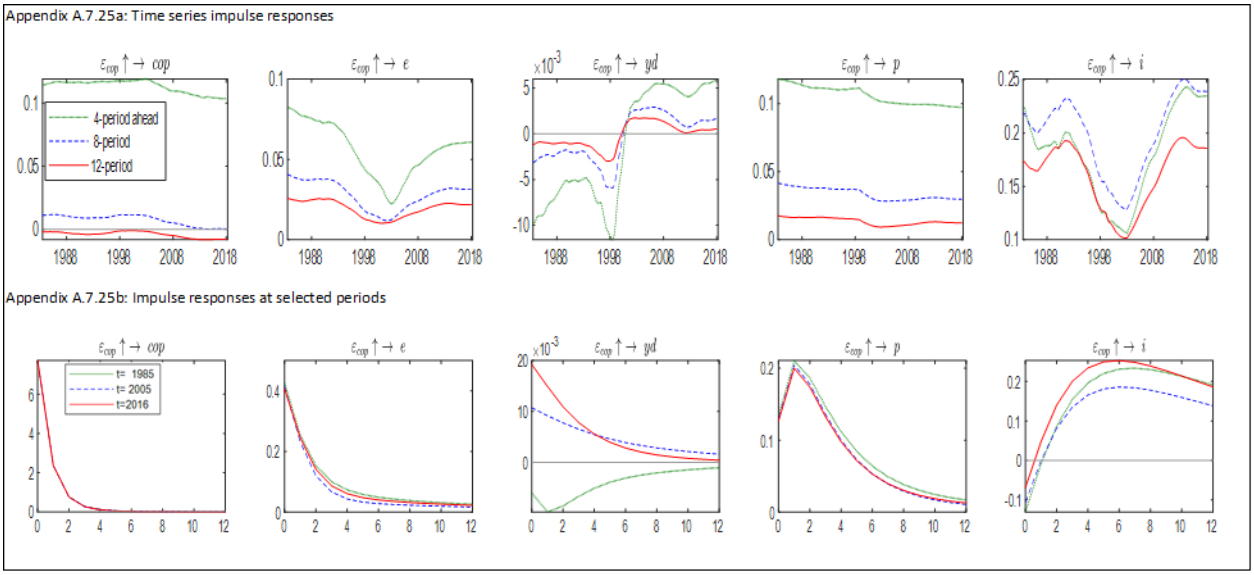
Appendix A.7. 23: Posterior estimates of simultaneous relations in the crude oil price model – the alternative prior specification test



Appendix A.7.24: Posterior estimates for the stochastic volatilities of the crude oil price model – the alternative prior specification test



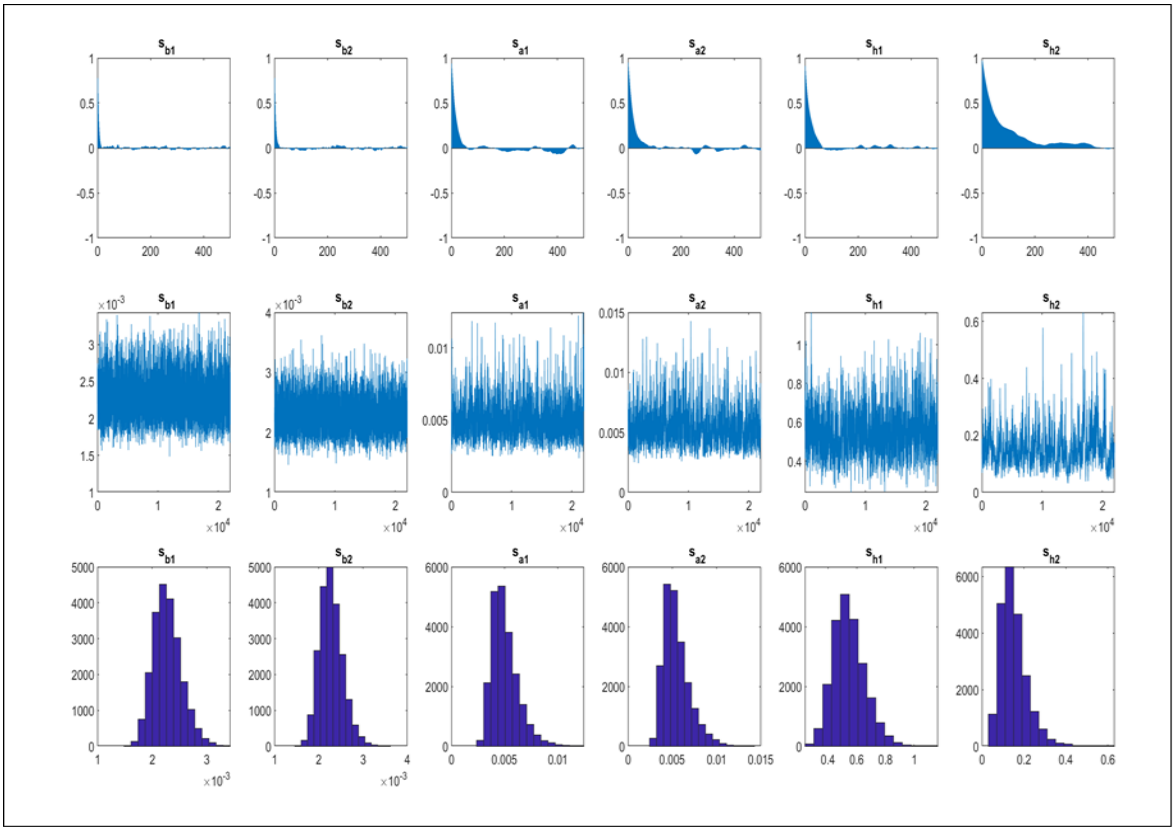
Appendix A.7.25: Time-varying responses to crude oil price shocks – the alternative prior specification test



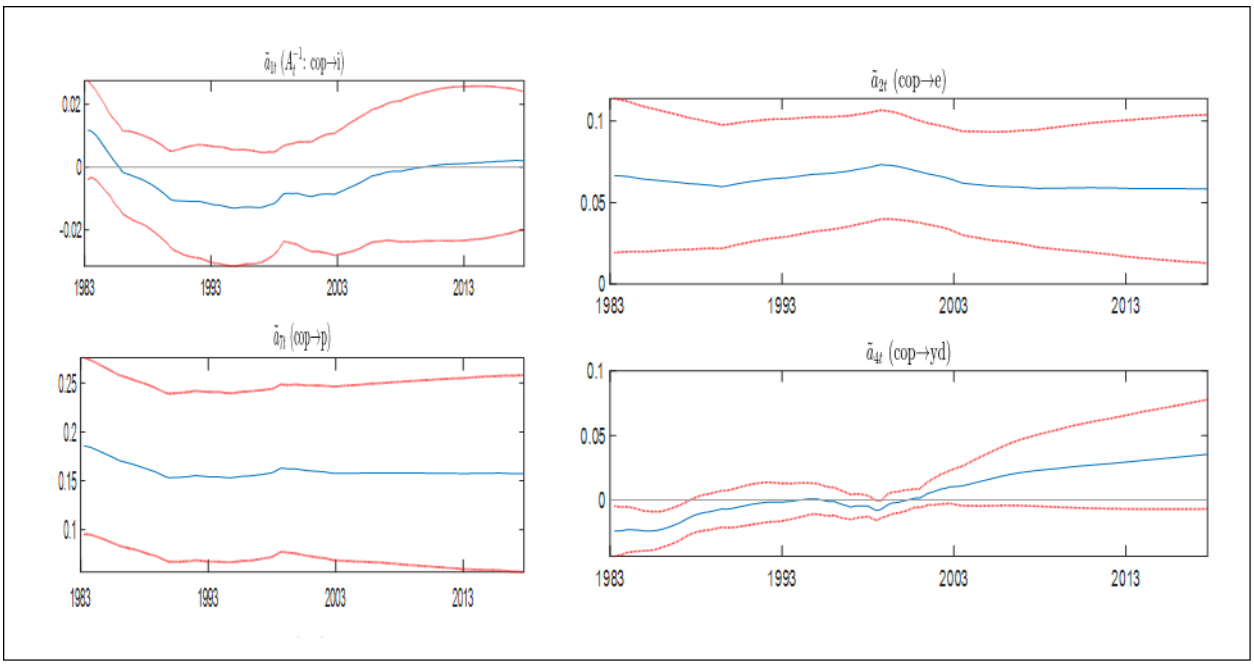
Appendix A.7.26: Selected parameters of the estimated crude oil price model – the alternative identification test

Parameter	Mean	Stdev	95% credible interval		Geweke	Inefficiency
sb1	0.0023	0.0003	[0.0018	0.0028]	0.7450	9.47
sb2	0.0023	0.0003	[0.0018	0.0029]	0.5940	6.35
sa1	0.0050	0.0013	[0.0033	0.0081]	0.2950	27.95
sa2	0.0055	0.0015	[0.0034	0.0092]	0.4840	37.53
sh1	0.5461	0.1115	[0.3552	0.7930]	0.3770	34.60
sh2	0.1518	0.0638	[0.0614	0.3052]	0.3052	103.39

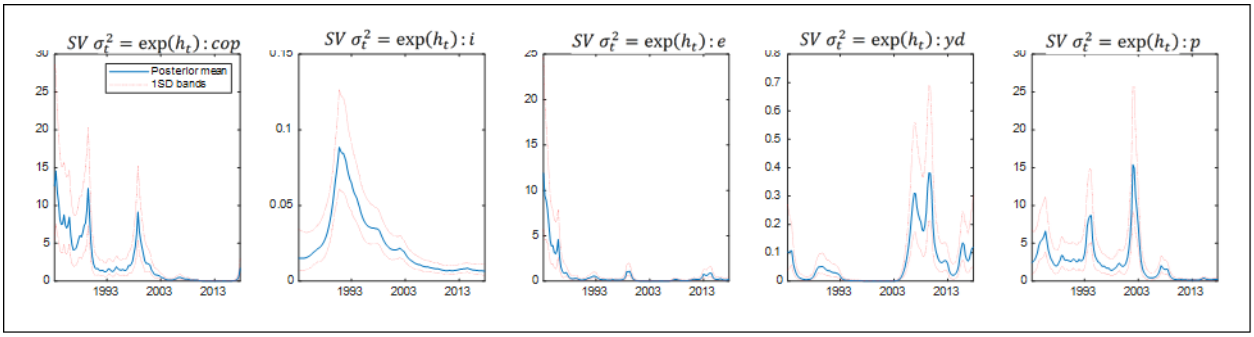
Appendix A.7.27: Sample autocorrelation, sample paths and posterior densities for selected parameters in the crude oil price model – the alternative identification test



Appendix A.7.28: Posterior estimates of simultaneous relations in the crude oil price model – the alternative identification test



Appendix A.7.29: Posterior estimates for the stochastic volatilities of the crude oil price model – the alternative identification test



Appendix A.7.30: Time-varying responses to crude oil price shocks – the alternative identification test