EFFECTS OF MONETARY POLICY, FISCAL POLICY, AND HEALTH SHOCKS ON HOUSEHOLD OUTCOMES: THE ROLE OF FINANCIAL INCLUSION

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Abstract

This dissertation aims at examining the role of financial inclusion as a means by which households in an economy could insulate themselves against the effects of adverse economic shocks. In addition, it evaluates the implications of limited financial market participation for the conduct of monetary and fiscal policies in Sub-Saharan African (SSA) economies and Ghana in particular. Overall, the dissertation covers three empirical chapters (studies).

The first study, designated as chapter 3 of the dissertation, examines the effectiveness of monetary policy and its implications for financially included and excluded households through an estimated New-Keynesian dynamic stochastic general equilibrium (NK-DSGE) model. It exploits time series data spanning 1985Q1-2016Q4 to estimate the model for Ghana, Gabon, Lesotho, and Mauritius through a Bayesian approach. The estimation results show that the share of financially excluded households in those economies is relatively small, usually between 35% and 42%. Additionally, the results show that a contractionary monetary policy tends to have differentiated impacts; it decreases the consumption of financially excluded households more than that of financially included ones. Also, the analysis suggests that a positive monetary policy shock does perform its intended role of significantly reducing inflation and output, despite a sizeable fraction of the population is financially excluded. Generally, although an increase in households who cannot participate in the financial markets reduces the effects of interest rate policies, it finds an opposite result: monetary policy becomes more effective as the fraction of households who participates in the financial markets falls.

Chapter 4 presents the second study where it develops and estimates a standard NK-DSGE model for the Ghanaian economy, for the analysis of the impact of government spending, consumption tax, and labor income tax shocks on household consumption and working hours. It also applies the model to examination of the effects of fiscal policy shocks on key macroeconomic variables in the Ghanaian economy. The model's parameters are estimated through a Bayesian approach using time series data from 1985Q1-2017Q4. Overall, it finds that increased government spending has a positive effect on consumption, output, employment, and inflation but turns to crowd-out consumption when wages are sticky. The results also show that the presence of sticky wage dynamics requires high degree of households who cannot participate in the financial markets in order to generate rather a short-lived positive consumption multiplier of government spending shock. At the disaggregated level, it finds that positive consumption and labor income tax shocks decrease consumption by financially excluded households more than that by financially included ones. The results also show that whereas financially excluded households increase their working hours in order to mitigate the negative effect of those shocks on their consumption, financially included households reduce their working hours to the same effect.

The third study is presented in chapter 5 where it explores the role of financial inclusion in the mitigation of the effects of a health shock at the household level. To that end, it examines empirically the effect of financial inclusion on household working hours and health care utilization, using round six of the Ghana Living Standard Survey data. It finds that a health shock does decrease household working hours and increase the likelihood of health care utilization. However, it finds that, faced with a health shock, households who are

financially excluded see their working hours decrease more than those who enjoy full financial inclusion. Also, financial inclusion increases the likelihood of health care utilization when households experience a health shock. It finds evidence that loan acquisition is one of the main mechanisms by which households can insure themselves against a health shock.

Dedication

I dedicate this work to my dear parents Rev. Emmanuel Abbaw Takyi and Mrs. Jane Takyi, and to my brothers and sisters.

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CHAPTER 1

INTRODUCTION

Monetary and fiscal policies, as macroeconomic policies, are policy tools available to monetary and fiscal authorities to intervene in and influence the level and the direction of real economic activities in an economy. On one hand, monetary policy is an action taken by central banks to influence the cost of borrowing (i.e. the rate of interest and availability of credit and liquidity in an economy) and to affect the overall demand for and supply of money, which have consequences on macroeconomic variables. For example, to stabilize prices, the central bank could adjust the monetary policy rate upwards (contractionary monetary policy) to reduce the amount of money supply in an economy. On the other hand, fiscal policy largely consists of changes in government spending and taxes, which is regarded as a countercyclical demand management policy. That is, during economic downturns (recession), an increase in government spending and/or a tax cut are used to boost aggregate demand and thus induce economic growth, whereas during economic upturns (boom), where the economy overheats, a decrease in government spending and/or a hike in taxes are adhered to in order to stabilize the economy.

Although those macroeconomics policies are of importance to the general health of an economy as whole, the impacts of the alterations in their policy variables (e.g., changes in interest rate and taxes) on household outcomes—consumption, employment (working hours), and welfare in general—could, however, be devastating. For example, an increase in consumption and labor income taxes (a negative fiscal policy shock) by the fiscal authorities

is necessary to generate revenue to finance government debts and government expenditures geared towards developmental projects to boot the economy. However, at the same time, the increased consumption and labor incomes taxes would decrease the (real) disposable income of households, affecting their consumption and welfare negatively. Also, to stabilize inflation, monetary authorities are required to increase nominal interest rate (a positive monetary policy shock), as one of the monetary policy options. However, the transmission mechanism of such a policy may result in less borrowing and investment, which would have a restrictive effect on employment and income, and hence on consumption of households in the economy.

The insights from the above suggest that households are more likely to face many policy shocks and other idiosyncratic economic shocks such as health shocks. Faced with those shocks, households are left with options that could help them insulate themselves against such income shocks. The literature is replete with many options that households could use to insulate themselves. For instance, households could sell off their assets, adjust their human capital investment, tap into their savings or borrow from the financial sector, among others (Mehrotra & Nadhanael (2016); Resenzweig & Woldpin (1993)). With household participation in the financial sector (financial inclusion) receiving significant empirical and policy attention from major international and development organizations, financial inclusion seems to be one of the major means by which households could insulate themselves against economic shocks. That is, mainstream empirical accounts on financial economics suggest that financial inclusion both maximizes societal welfare (by expanding options for safe borrowing and saving practices) and increases credit accessibility and opportunities for investment in the productive sectors of an economy. Those accounts argue that, under

conditions of adequate institutional support and extensive stakeholder consultation, the gains from pursuing financial inclusion strategies could (1) facilitate attainment of macroeconomic goals including output growth, poverty reduction, bridging of income inequality, and price stability; (2) enhance the prospects for sustained economic growth; and (3) serve as a means by which households protect their consumption from volatility of their income (Beck et al. 2007). This suggests that while financial inclusion/exclusion could be beneficial for policy makers to achieve their macroeconomic goals, it could as well be helpful for households in protecting themselves again adverse economic shocks.

In recognition of the above considerations, this dissertation aims at examining financial inclusion as one of the means by which households could insulate themselves against negative effects of income or economic shocks. In addition, it evaluates the implications of limited financial market participation (the presence financially excluded households in an economy) for the conduct of monetary and fiscal policies in the attainment of macroeconomic goals. To that end, it performs the analysis at both microeconomic and macroeconomic levels, leading to three empirical (studies) chapters in this dissertation.

The first study, which is presented as chapter 3, focuses on examining the effectiveness of monetary policy and its implications for financially included and excluded households through an estimated NK-DSGE model. The model is estimated for Ghana and three other Sub-Saharan Africa (SSA) countries: Gabon, Lesotho and Mauritius. Chapter 4 presents the second study where it develops and estimates a standard NK-DSGE model for the Ghanaian economy, for the analysis of the impact of fiscal policy shocks on household consumption and working hours. It also applies the model to examination of the effects of

the fiscal policy shocks on key macroeconomic variables in the Ghanaian economy. The third study, which constitutes chapter 5 of the dissertation, explores the role of financial inclusion in the mitigation of the effects of a health shock at the household level. To that end, it examines empirically the effect of financial inclusion on household working hours and health care utilization using household level data in Ghana.

It is be noted that the models in Chapters 3 and 4 are augmented by structural shocks such as monetary policy shock; government spending shock, consumption and labor income tax shocks, preference shock; labor supply shock; and price mark-up shock. For example, it introduces price mark-up shock into the model because the Ghanaian economy, over the years, has been experiencing electricity power outages. This imposes high production cost to firms as they resort to alternative sources of power supply (such as generator) to keep them in operation. Also, monetary policy shock, which basically involves the use of short term nominal interest rate, is equally relevant for the economies in this dissertation. All those four countries use short-term nominal interest rate as one of their policy instruments. Ghana and Mauritius, for example, operate under inflation targeting monetary policy framework, and resort mainly to the nominal interest rate as one of their main price stabilization tool. Also, Gabon and Lesotho have price stabilization as one of their monetary policy targets which require, in some cases, the use of the nominal interest rate.

Previewing our results from the first study, we find that the estimated share of financially excluded households is relatively small for all the four countries, usually between 35% and 42%. This finding suggests that previous efforts to enhance financial inclusion in those countries have contributed to a general lowering of the cost of financial market

participation. Also, we find that financially included households are able to absorb shocks, and thus can smooth consumption more effectively than financially excluded households. In particular, contractionary monetary policy decreases the consumption of the financially excluded households more than that of the financially included ones. Further, our results show that monetary authorities in Ghana and SSA countries have aggressively targeted lower levels of inflation relative to output growth over our sample period. Additionally, we find that monetary policy is effective in those economies despite a sizeable fraction of the population being excluded from the financial sector. Specifically, contractionary monetary policy brings about a fall in inflation and other real economic variables including output, employment, consumption, and investment. Generally, we find that monetary policy becomes more effective as the fraction of households who participates in the financial markets falls.

Moreover, the results from the second study show that a positive government spending shock has an expansionary effect on consumption, output, employment, and inflation but turns to crowd-out consumption when wages are sticky. We find that sticky wage in the economy dampens the expansionary effect of a positive government spending shock on consumption and output. At the disaggregated level, the results show that an increase in government spending has a negative effect on the consumption of households who enjoy full financial inclusion but has an expansionary effect on that of financially excluded ones. Furthermore, we find that hikes in consumption and labor income taxes discourage working and, thus, lead to a fall in labor supply, output, and consumption. At the disaggregated level, our results signal that lack of access to the financial sector and savings

leave financially excluded households with no alternative to increasing their labor supply in order to mitigate the negative effect of those shocks on their consumption. Nevertheless, households that are financially included use the financial sector as a mechanism for tapping into their savings to insulate themselves from those shocks, and rather reduce their working hours. Sadly, despite those inter-temporal optimal decisions by both households, we find that both shocks decrease the consumption of the former more than that of the latter.

In the third study, the results from our analysis suggest that households in Ghana are not able to fully insure themselves against health shocks, and thus significantly reduce their working hours during health shocks. At the same time, the probability of households visiting a health facility, or consulting a health practitioner or a traditional healer during a health shock, increases. However, with financial inclusion, our empirical findings indicate that financially included households who experience a health shock see their working hours reduce less than financially excluded households. We find that the role of financial inclusion in mitigating the negative effects of health shocks on household working hours is more pronounced when adults in the household experience health shocks than when children experience such shocks. Also, we find that financially included households are more likely to utilize health care than excluded ones when they experience a health shock. Regarding self-insurance mechanism, our results indicate that financially included households are more likely to acquire a loan or borrow for a visit to a health clinic or a consultation with a doctor, which helps to speed healing and return to work.

Generally, the finding in this dissertation support the financial inclusion agenda of policymakers in Ghana and many other countries. Thus, efforts to ensure full financial

inclusion are necessary. Those efforts will increase the probability of households using the financial sector as a means of insulating themselves against negative effects of adverse economic shocks.

The remainder of the dissertation is structured as follows: chapter 2 describes the background of the study area. Chapters 3, 4, and 5 cover the three empirical studies mentioned above and chapter 6 presents conclusions and implications for policy-makers.

CHAPTER 2

BACKGROUND OF THE STUDY AREA

2.1 Introduction

This chapter presents the structure of the economies considered in this dissertation by focusing on overview of the economies of each country with their economic performances, inflation dynamics, and financial development over the years. It also highlights the overview of financial inclusion and financial inclusion commitment in Ghana. Overall, it describes the state of each of the economies and how the financial sector has evolved over the years in Ghana.

2.2 Overview of the Economies of Ghana, Gabon, Lesotho, and Mauritius

The four countries considered in this dissertation are all within the middle-income brackets (according to the World Bank's economic classifications), although some countries are in the upper-middle income category while others are in the lower-middle income group. Ghana is in the lower-middle income group and it is a developing country located on the west coast of Africa with an estimated population of about 29.6 million in 2018. At its birth in 1957, the Ghanaian economy has gone through various economic transformation and has had characteristics that pointed to a promising future. The country is well endowed with natural resources and has moved from agricultural driven economy in the 1960s and 70s to a service driven economy in recent years. The main sectors that are currently driving the economy includes the primary sector (agriculture), secondly sector (manufacturing and industry), and tertiary sector (services sector.) Data from the World Bank indicates that, as at 2017, the

service sector contributed to about 42% of Gross Domestic Product (GDP) while the agricultural sector contributed to approximately 20% of GDP, with the industry and manufacturing sectors contributing to about 31% and 11% of GDP, respectively. In addition, Gold and cocoa production and individual remittances are major sources of foreign exchange in the country. Oil production at Ghana's offshore Jubilee field began in mid-December 2007 and is expected to boost economic growth. Currently (as at 2017), the oil sector contributes to about 3% of the nation's GDP. The country's average real GDP from 1985 to 2018 is about US$23.4 billion with average real GDP per capita standing at US$1,100. As at 2018, Ghana registered annual real GDP value of about US$53.8 billion and per capita GDP value of approximately US$ 1,800 (World Bank, 2019).

Gabon is an upper-middle income country and the fifth largest oil producer in the African continent. The country is located at the central part of Africa with an estimated population of about 2.1 million as at the year 2018. Gabon, like Ghana, is endowed with natural resources with very rich forestry and mineral resources. Discovered in the 1970s, oil used to be the key economic sector, accounting for about half of the country's GDP and a major contributor to the country's revenue. However, the oil production has seen a large decline in the past 10 decades resulting in a shrinkage in the oil sectors' contribution to GDP. As a result, the share of oil sector as a percentage of GDP has declined from 42% in 2000 to about 15% in 2017. Other sectors have, however, taken over as a driven force in the economy's output. As a share of GDP, the industry and the services sectors recorded a value of about 45% and 42% of GDP in 2017, respectively with the manufacturing and the agricultural sectors registering a share of about 18% and 5% of GDP, respectively. The

country's average real GDP, from 1985 to 2018, is about US$13.4 billion with average real GDP per capita standing at US$10,000 within the same period. In 2018 alone, real GDP stood at about US$19.2 billion and GDP per capita at approximately US$9,100 (World Bank, 2019).

Alike Gabon, Mauritius has made tremendous strides since her independence in 1968, and has attained upper-middle economic status. The country is located off the southeast coast of Africa with total population of about 1.3 million as at 2018 and mostly rely on agriculture, tourism, financial services, and exports for her survival. The main engine of growth of the economy is the financial services (service sector) accounting for almost two-third of the county's GDP. In particular, the share of the service sector to GDP, from 1985 to 2018, averaged 57% of GDP. Currently, (in the year 2018), the contribution of the services sector to GDP stands at approximately 68% of GDP with the industry and the manufacturing sectors contributing to about 18% and 11% of GDP, respectively, and agriculture (3% of GDP). The country's average real GDP, from 1985 to 2018, stands at about US$ 7.4 billion with average real GDP per capita standing at US$6,200 within the same period. In 2018 alone, real GDP stood at about US$13.4 billion and GDP per capita at approximately US$10,500 (World Bank, 2019).

Last but not the least, Lesotho is a lower-middle income and a small mountainous, and landlocked country with a total population of approximately 2.1 million. Lesotho is located in the Southern part of Africa and the economy is largely based on manufacturing, agriculture, remittances, and it is endowed with natural resources (mostly diamond). Like Ghana, the economy of Lesotho has moved from agricultural driven economy in the 1960s to a service driven economy in recent times. As at the year 2017, the average share of the

services sector to GDP from 1985 to 2017 is about 54% with that in the year 2017 alone being 52%. Also, the industrial, manufacturing, and agricultural sectors account for almost 32%, 14%, and 6% of GDP, respectively. The country's average real GDP, from 1985 to 2018, is about US$ 1.8 billion with average real GDP per capita being US$900 within the same period. In 2018, the country recorded a real GDP value of about US$2.9 billion and GDP per capita value of approximately US$1,400 (World Bank, 2019).

2.3 Growth Performance, Inflation Dynamics, and Financial Development

This section discusses the real GDP growth rate of the four countries as well inflation dynamics and financial development trends. Figure 2.1 (see appendix) shows the annual real GDP growth rate from 1985 to 2018 for each of the countries. It can be seen that with the exception of Gabon which has been experiencing economic downturns from 1985 to 1988 and from1998 to 2008, the rest of the countries have had a stable growth rate from 1985 onwards. The downturn performance of Gabon has largely been attributed to the 'Dutch Disease' (the discovery of oil which shrank production in other sectors of the economy) and the swings in world oil price (Zafar, 2004). However, the economy recovered after 2008 and registered an (average) annual growth rate of about 3.7% from 2009 to 2018.

Ghana's growth performance has been respectable after 1985, depending significantly on the agriculture and services sectors. From 1985 to 2018, Ghana's real GDP growth averaged 5.4% annually. The discovery of offshore and the production of oil in 2007 enhanced growth prospects considerably. Evidently, in 2011 the Ghanaian economy saw an economic boom and registered annual growth rate of 14%. Also, from 2009 to 2018 the economy grew by an average of about 7%. Although there was a sluggish growth from 2014

to 2016 with an average growth rate of 2.8%, real GDP growth recovered to 8.1% and 6.2% in 2017 and 2018, respectively.

The macroeconomic performance of Mauritius and Lesotho has rather been stable over the years. While real GDP growth rate averaged about 4.9% from 1985 to 2018 for Mauritius, Lesotho's real GDP growth rate averaged 3.8% within the same period. However, the economy of Lesotho contracted after 2014 and from 2014 to 2018, the economy grew by a small 1.7%.

Regarding inflation movements or dynamics, Figure 2.2 (see appendix) shows the annual consumer price inflation of those four countries from 1985 to 2018. It can be seen that, among the four countries, Ghana has performed poorly in terms of achieving lower levels of inflation. The economy experienced high levels of inflation from 1985 to 2002, and recorded an average inflation rate of about 27%. However, after 2002 inflation slowed down, and registered an average value of 13% from 2014 to 2018 and 9.8% in 2018. The slowdown of inflation after 2014 was due to aggressiveness of the Central Bank of Ghana (BOG) who perused contractionary monetary policy through the interest rate channel by increasing the monetary policy rate from 16% in 2014 to 25.5% in 2017.

Gabon's inflation rate has remarkably remained low as compared with Ghana and the other two countries. As evidenced by Figure 2.2, between 1987 and 1992, the country recorded a deflation with an average value of about -3%. Although inflation rate stood as high as 36% in 1994, it quickly recovered to 0.7% in 1996 and remained almost constant thereafter with an average inflation rate of 1.9% (i.e. from 1996 to 2018). Also, Lesotho and Mauritius have seen a stable inflation rate over years. Both countries recorded nearly an equal

inflation rate over the sample period. Thus, from 1985 to 2018, the average inflation rate stood at about 6% for both countries.

Turning on to financial sector development, Figure 2.3 (see appendix) shows the trends of financial development measured by domestic credit to the private sector as a percentage of GDP from 1985 to 2018 for the four countries. Clearly, financially sector performance in Mauritius outperforms financial development in the rest of the three countries. This suggests that, among the four countries, Mauritius's financial sector is well developed. Specifically, domestic credit to the private sector as a percentage of GDP averaged 63% over the sample period. The performance in the financial sector has been increasing steadily from about 28% in 1985 to 103% in 2017 but dropped thereafter to 78% in 2018.

Unlike financial development in Mauritius, domestic credit to the private sector as a percentage of GDP for Ghana, Gabon, and Lesotho has been stable and relatively small over sample period. From 1985 to 2018, financial development averaged about 10%, 12%, and 15% for Ghana, Gabon, and Lesotho, respectively. Thus, financial sector development is similar across those three countries.

2.4 Overview of Financial Inclusion

According to the World Bank, financial inclusion is an initiative that ensures that formal and/ or informal financial services are available, affordable, and are easily accessible to individuals, households, and businesses of a society. That initiative helps economic agents to receive financial products and services that meet their needs in terms of savings, credit, transactions, and payments in exchange for goods and services. An all-inclusive financial

system is not limited to only the operations of formal financial institutions such as commercials but also encompasses that of semi-formal and informal financial institutions such as rural and community banks, microfinance institutions, credit unions and cooperative societies, insurance companies, mobile money, among others (Demirgüç-Kunt et al, 2015).

While financial inclusion could be beneficial at the micro-level, it could as well be important at the macro-level. At the micro-level, it could help individuals and households to meet up with unforeseen expenses such as payment of health costs, funeral, or wedding expenditures, through borrowing and/or reliance on savings, and to cope with poverty. Also, financial inclusion could provide access to liquidity, allowing households to manage their financial risks and to insure against any idiosyncratic shocks. In addition, small and medium enterprises could obtain funds in a form of loans from financial institutions to overcome cash constraints to start a new business or expand their existing businesses. At the macro-level, financial inclusion, through savings mobilization leading to investment and employment, could boost economic growth. That is, financial inclusion could help to increase economic productivity potentials of national economies through provision of quality education and health care, and human capital development.

Amidst the potential benefits associated financial inclusion, its concept has attracted greater recognition by many developmental bodies and policy makers, recently. Huge gaps in access to finance have engender policymakers in more than 60 countries to set targets formally for financial inclusion. Internationally, financial inclusion is prominent in the reform agenda. For instance, financial inclusion is mentioned under several of the United Nations Sustainable Development Goals (SDGs) (United Nations, 2014 (as cited in Sahay et

al, (2015)). Also, at the June 2012 G20 Leaders' Summit in Los Cabos, G20 heads of state committed to taking "concrete actions to overcome the barriers hindering women's full economic and social participation and to expand economic opportunities for women" (Sahay et al, 2015; Demirgüç-Kunt et al, 2015). Again, in October 2013, the World Bank Group proposed the global goal of universal access to basic transaction services as an important momentous towards full financial inclusion (a society where everyone has access to financial services and can use them to capture opportunities and reduce vulnerability (World Bank, 2014 (as cited in Sahay et al, 2015)).

To that end, various governments and leaders around the world including African economies and for that matter, Ghana, have pushed the financial inclusion agenda to promote access to finance by their citizenry to achieve larger financial inclusion.

2.5 Financial Inclusion Commitment in Ghana

To promote the financial inclusion agenda in Ghana, the Government of Ghana, through the Central Bank of Ghana (BOG), has made several reforms over the years in the financial sector and the banking industry to increase the drive for financial inclusiveness in the country. For instance, a comprehensive Financial Sector Adjustment Program (FINSAP) was launched in 1988. The FINSAP involved interest rates liberalization, institutional restructuring, and enhancement of the legal and regulatory framework for banking operations. The program was, however, carried out in three phases: FINSAP-1 covered the period 1988-1991, FINSAP-2 is from 1992-1995, and FINSAP-3 started in 1995. The main objectives of FINSAP-1 were to review the legal and regulatory environment and amend the existing Banking Acts and Laws, restructure the banking sector to make the banks viable and efficient;

and to revitalize the financial sector by creating new financial institutions. Also, the goal of FINSAP-2 and 3 were to ensure continual of the restructuring of the financial sector (Bawumia, 2010).

Furthermore, in 1989, The Banking Law (PNDCL 225) of Ghana was revised to tighten the limits of risk exposure, establish a tighter capital adequacy ratios, strengthen the accounting standards and to make them uniform for all banks, broaden the scope for audits of banks, impose stringent reporting requirements, and to improve on-site and off-site supervision of banks by the BOG. In addition, in order to bring more financial institutions under the supervision of BOG, financial institutions (Non-Banking) Law (PNDCL 328) was also enacted in 1993. The law covered the activities of microfinance institutions, savings and loans companies, and credit unions and cooperatives, discount houses, finance houses, acceptance houses, building societies, leasing and hire-purchase companies, venture capital funding companies, and mortgage financing companies (Bawumia, 2010).

Recently, in 2008, a branchless banking regulation was issued by BOG to enable banks to take advantage of digital technologies for the acceleration of financial inclusion. In continuance to the existing guidelines, the government of Ghana signed the 'Maya Declaration' in 2012 which is committed to achieving specific goals. These goals includes revision of the regulatory framework of branchless banking to achieve 70% financial inclusion by the year 2017, implementation of interoperability in the mobile financial services sector (mobile money), among others. Also, as part of the financial inclusion agenda, the government of Ghana later joined the 'Better than Cash Alliance' (BTA) in 2014 to help Ghana move towards becoming a cashless economy, expand access to electronic payments

and to reduce time and costs associated with business and economic transactions (Boateng, 2018).

The above reforms and strategies have led to an increase in the number of financial institutions and has enhanced financial inclusion to some extent in the country. Table 2.1 show the number of financial institutions from 2004 to 2018. It can be seen that the total number of financial institutions increased from 428 in 2004 to 1,198 in 2015 but later dropped by a small number to 1,111 in 2018. In particular, the number of credit unions and cooperatives increased steadily (more than doubled) from 277 in 2004 to 566 in 2018. Also, the number of other banks, apart from commercial banks, saw an increase from 131 to 209 within the same period. The increase in the number of commercial banks has, however, been marginal (the number increased by 10 from 2004 to 2018). The emergence of microfinance institutions (MFIs) has also been respectful. Deposit taking and non-deposit taking microfinance institutions saw a massive growth: the number has increased from 90 MFIs in 2012 to 253 MFIs in 2018 (almost tripled).

Lastly, the financial inclusion agenda has led to a dramatic development in the mobile money industry. From Table 2.1, the total number of registered and active mobile money agents significantly increased by about 2962% from 5,900 in 2004 to 180,664 in 2018. In addition, the number of registered and active mobile money users (mobile money account holders) have seen a significant growth. That is, from 2004 to 2018 the growth rate of the

number of account holders averaged about 93%. The number of active mobile money users accounts for more than one-third of the country's population[1].

[1] This explanation must, however, be taken with caution due to the possibility of multiple mobile money account holdings.

CHAPTER 3

MONETARY POLICY AND FINANCIAL EXCLUSION IN AN ESTIMATED DSGE MODEL OF SUB-SAHARAN AFRICAN ECONOMIES

3.1 Introduction

It is generally argued that financial access allows households to smooth consumption and build capital over time so as to promote business creation, which in turns helps to improve the livelihood of members of society (Demirguc-Kunt & Levine, 2009). The role of formal financial services accessibility may be better appreciated if consideration is given to the fact that most businesses in SSA are microenterprises that are subject to household uncertainties. When households are faced with temporary fluctuations in their real income (income shocks), those with access to formal financial services could smooth consumption. One form of income shock is a change in nominal interest rate (monetary policy shock) by central banks. A rise in this rate has the potential to decrease not only inflation but also production and employment. Consequently, the consumption of both financially included and excluded households are vulnerable to such policy alteration, through its negative impact on disposable income, although the consumption of financially excluded households is not directly affected. Admittedly, since the former could tap into their previous savings, their consumption profiles are less likely to be affected. That is, financially included households could adjust their savings and investment decisions to partially protect their consumption from the volatility of their (real) income in a way that financially excluded households are not positioned to do (Mehrotra & Nadhanael, 2016).

However, it may have to be conceded that even with limited or no access to the formal financial sector, financially excluded households could also smooth consumption through semi-formal and informal financial sources as the financially included ones. As a consequence, and in a rather unsurprising fashion, the extant literature is replete with accounts of mechanisms and ways through which financially excluded households faced with income shocks can also smooth consumption. Several mechanisms have been identified. As discussed by Mehrotra and Nadhanael (2016), the emergence and adoption of mobile money technology in SSA have allowed the financially excluded households to perform various financial transactions including borrowing and savings accumulation. Besides, financially excluded households are also able to obtain loans from microfinance institutions, informal lenders, family, and friends allowing for consumption smoothing, although the interest rate on those loans can be relatively higher. As another medium for fending-off income volatilities, financially excluded households can accumulate savings in the form of land or jewelry. As noted by Rosenzweig and Woldpin (1993), livestock and other farm assets could also be traded in a way that allow for consumption smoothing.

Despites all the above characterizations, the reality is that a sizable portion of population in SSA are effectively excluded from the financial sector. For these group, they neither save nor borrow through formal, semi-formal, or informal means. In effect, the population in this group simply live by 'hand-to-mouth' and on subsistent basis. The implication of such a situation is that they may not be able to smooth consumption when they

are faced with income shocks[2]. Table 3.1 (see Appendix) shows the saving and borrowing behavior and financial account holding of adult population who are within the labor force bracket in Ghana, Gabon, Lesotho, and Mauritius and SSA as a whole. It can be seen that, clearly, a sizable portion of these adult population have no savings in these countries, almost between 44% and 64%. Also, about 33% percent of these adult population in SSA have neither borrowed not saved. Moreover, with the exception of Mauritius, a considerable proportion of those population (between 59% and 71%) in Ghana, Gabon, and Lesotho hold no account at a bank or any other type financial institution. Those with bank account, about 13% of them have neither saved nor borrowed.

Given the above insights, it seems natural to expect that more studies would have analyzed the welfare (measured in terms of consumption) of these distinct groups of households when they are faced with income shocks. However, very few studies (both theoretical and empirical) have specifically analyzed the implications of monetary policy shock for these households. Those that did, including Conenen and Straub (2005), Ratto et al. (2009), Di Bartolomeo et al. (2011) and Iyer (2016), studied regions outside of SSA, where financial exclusion appears to be the norm rather than the exception. Moreover, most of these studies tend to place emphasis on only aggregate variables rather than disaggregate variables including consumption, although those studies do report and display the heterogeneous dynamics. These observations motivate the focus of this paper to examine the resilience of financially excluded and included households in SSA when they are faced with income-

[2]Even, in response to the prospects of such persons falling on non-cash savings during income shocks, Mehrotra and Nadhanael (2016) were unequivocal when they suggested that, if there are greater negative shocks to an economy, savings in the form of assets other than cash may not even be helpful to smooth consumption much.

related shocks, especially monetary policy shock. The first research question here then is: how does monetary policy shock affect the consumption of financially excluded households, compared with that of financially included ones?

In addition to those observations and related questions on the nature and conditions of households, the presence of financially excluded households in an economy in itself is also important in the way monetary policies are conducted. For instance, as Mankiw (2000) suggested, economic models that allow for the presence of financially excluded households (basically, 'hand-to-mouth' households) are to be preferred over economic models with representative households. By extension, policymakers need to be interested in differentiated households and how they affect the conception of their policy interventions. Following this proposal, which has mostly been received favorably, many studies including Gali et al. (2004), Conenen and Straub (2005), Gali et al. (2007), Bilbie (2008), Forni et al. (2009), among others have attempted to incorporate financially excluded households. A fundamental limitation of these genre of literature has been the limited focus on the implications of financially excluded households for the conduct of monetary policy (Galí et al., 2004). As noted by Galí et al. (2004), the inclusion of financially excluded households in an otherwise standard dynamic sticky price models can change the properties of the widely used interest rate rules in the pursuit of monetary policy. They noted that the presence of financially excluded households in such models requires the inflation weight in a Taylor-type monetary policy rule to be well above unity. In other words, central banks are expected to be tough-nosed in tackling inflation. We thus, also intend to empirically verify this theoretical prediction in this paper for the case of SSA where financially exclusion is largely in existence.

Moreover, the effectiveness of monetary policy could also be affected by the presence of financially excluded households in an economy. In both developed and developing countries most central banks use standard new-Keynesian macroeconomic models for policy analysis and forecasting. In such models the transmission mechanism of monetary policy (a Taylor type monetary policy) largely depends on private investment being interest elastic. Thus, an increase in the monetary policy interest rate induces a decrease in private investment and vice versa. In the end, real economic activities (real output) and inflation are affected. Therefore, if there are a large share of financially excluded households in an economy, the interest elasticity of private spending would be reduced (Brownbridge et al., 2017).

The combined effect of the above characterizations of monetary policy framework is that when a sizable portion of the population is excluded from the financial sector, the interest rate channel of monetary policy is likely to be weak due to low-interest elasticity of private investment. As a result, monetary policy could be ineffective. Thus, it is imperative to determine whether monetary policy is effective or not in such an environment. These observations lead us to our second research question: what is the role of monetary policy in an economy where a sizable fraction of the population is financially excluded?

The contribution of this paper is in twofold. We apply NK-DSGE model to [1] perform a detailed analysis of heterogeneous dynamics with specific reference to monetary policy shock as well as other structural shocks, and [2] to analyze the effectiveness of monetary policy in an economy where as sizable proportion of the population is financially excluded. The result is an empirical exploration of the above research questions through the lens of an estimated DSGE model that has financially excluded ('hand-to-mouth')

households coexisting with financially included ('optimizing') ones. We estimate this model for four middle-income (developing economies) countries in SSA, namely: Ghana, Gabon, Lesotho, and Mauritius. The choice of these four countries is primarily in response to data convenience. We reason here that these countries are categorized as middle-income countries with similar economic characteristics and thus face similar inflation and business cycle movements. This provides a basis for a distinguishable statistical differentiation between the effects of monetary policy on key macroeconomic variables.

We identify and examine the role/effectiveness and the impact of monetary policy shock on households in these SSA economies. Specifically, we analyze the impacts of monetary policy shock on financially included and excluded households and identify the role that monetary policy generally plays in these economies. Observation from our literature review suggests that few studies have estimated such models to pursue those goals for SSA[3].

The remainder of this chapter is structured as follows: section 3.2 reviews related literature on the current topic. Section 3.3 presents the model which we proceed to estimate. Section 3.4 explains the Bayesian estimation procedure and the data used. Section 3.5 discusses the results, and Section 3.6 concludes.

3.2 Literature Review

This section reviews existing literature on DSGE models that feature financially included and excluded households and the role that monetary policy plays in such models. Several papers, through calibration and estimation, have explored how the inclusion of

[3] To the best of our knowledge, our paper is the first to estimate that model for Ghana, Gabon, Mauritius, and Lesotho.

financially excluded households in DSGE models have impacted the effectiveness of monetary policy. The following reviews related literature on DSGE models with financial exclusion for monetary policy analysis.

On the calibration side, a seminal paper by Gali et al. (2004) is the first to explore the implications of rule-of-thumb (hand-to-mouth or financially excluded) consumers for the properties of interest rate monetary policy rules. They point out that the existence of stabilization force to ensure unique equilibrium is no more guaranteed by the Taylor principle under contemporaneous interest rate rules when the share of rule-of-thumb consumers exceeds 57%. Rather, the monetary authorities would have to be tough-nosed in the pursuant of ant-inflationary policy. That is, a larger change in interest rate would be required to stabilize inflation when a sizeable proportion of the population is are financially excluded.

Drawing on the seminal paper by Gali et al. (2004), several researchers have further analyzed the implications of monetary for the presence of financially excluded households. Di Bartolomeo and Rosi (2007) find that monetary policy is more effective when a larger proportion of the population is financially excluded. In their framework, the indirect effect of an increase in interest rate reduces the consumption and real wage of financially excluded households through its negative impact on the consumption of financially included households. They call this the 'Keynesian' effect. Thus, monetary policy becomes more effective as the share of financial excluded households increase as this 'Keynesian' effect dominates the impact of inter-temporal allocation on the consumption financially excluded.

Bilbiie (2008) introduces limited asset markets participation in DSGE and develops a simple analytical framework for monetary policy analysis. He shows that a moderate level

of asset market participation strengthens the role of monetary policy. On the other hand, when asset market participation is low enough the 'Taylor principle' is inverted. That is, as the degree of households who cannot smooth consumption increase, nominal interest rate increases less than inflation. In related work, Bilbiie and Straub (2013) show that at low level of asset market participation the 'standard aggregate demand logic' is also inverted. That is, a contractionary monetary policy has an expansionary effect on output and therefore welfare is maximized even if monetary policy is passive.

Colciago (2011) uses similar model but introduced nominal-wage stickiness in the standard DSGE model. He finds that when wages are sticky the Taylor Principle is re-established as the necessary condition for equilibrium determinacy. In a related work, Ascari, Colciago and Rossi (2017) show that limited asset market participation (LAMP) becomes irrelevant for the design of monetary policy when wages are sticky. That is, with the presence of small degree of wage stickiness LAMP does not generally affect the trade-offs faced by a welfare maximizing monetary authority. They argue that, LAMP does not basically alter the design of optimal simple rules and optimal monetary policy.

Amato & Laubach (2002) investigate the implications of rule-of-thumb behavior of consumers or price setters for optimal monetary policy and simple interest rate rules. They explain that the rule-of-thumb behavior leads to endogenous persistence in output and inflation and alters the policymaker's welfare objective. Their main finding is that a passive monetary policy is optimal regardless of the share of financially excluded households. Motta & Tirelli (2010) show that the combination rule-of-thumb consumers and consumption habits dramatically affects the dynamic performance of DSGE models. In particular, it resurrects

Bilbiie's (2008) inverted Taylor principle. They also show that it is more important for optimal monetary policy to stabilize the wage gap, a variable that drives consumption variability of financially excluded households, when a larger portion of the population are financially excluded. Again, he finds that when the share of financially excluded households is sufficiently large "unconventional" impulse-response functions are generated by optimal monetary policy. In particular, a positive productivity shock is followed by a positive output and by an increase in inflation.

McManus (2013) develops a small-scale NK-DSGE model to test whether individuals suffer to similar degrees during recessions. In effect, his study tests the common political mantra 'we are all in this together'. He does this by having financially excluded households coexisting with financially included households. He finds that, in terms of aggregate welfare, an adverse shock is small but has a differentiated impact; it significantly worsens the welfare of financially excluded households. He also finds that there is a redistribution of welfare from financially excluded households to financially included households following the shock, and notes that the latter are found to gain at the expense of the former.

Mehrotra and Yetman (2014) introduce a welfare maximizing monetary authority into Gali et al. (2004) model. Their results indicate that, as the share of financially included households in an economy increases, the ratio of output volatility to inflation volatility increases when monetary policy is conducted optimally. They show that optimal monetary policy implies a positive relationship between the ratio of output variability to inflation variability and the share of financially included households.

Iyer (2017) analyzes the implications of financially excluded households in a small open economy for optimal monetary policy. He finds that if monetary policy is set optimally to stabilize output, financially excluded households are also able to smooth consumption. This is because such an optimal monetary policy stabilizes the income of financially excluded households. He indicates, however, that inflation targeting only approximates optimal monetary policy when financial exclusion is low. He notes that targeting the exchange rate is appropriate if financial exclusion is large. He results show that nominal exchange rate stability could help to stabilize the import component of financially excluded households' consumption baskets, which then could allow them to smooth consumption.

On the estimation side, Marto (2014) estimate a New Keynesian DSGE model for Portugal allowing for the presence of financially excluded households and using Bayesian maximum likelihood. The share of financially excluded household is estimated to be 58% for the Portuguese economy. With this share of financially exclude households, he finds that the effect of a positive monetary policy shock on inflation and output is almost insignificant but curiously, there is still a small decrease of both variables upon the impact of the shock. He explains that these results may indicate that the presence of financially excluded households has as an indirect effect on the financial markets which make the financially excluded households bear the costs of that positive monetary policy shock.

Coenen and Straub (2005) estimate a similar DSGE model for the Euro area to analyze the effects of government spending shocks on private consumption. Although the effects of monetary policy shock on the consumption of financially excluded households was not the main goal, they find that a contractionary monetary policy marginally reduces the

consumption of financially excluded households more than that of their included counterparts. In addition, the share of financially excluded households is estimated to be from 35% to 37% for four different fiscal rules specified in their model.

Ratto et al. (2009) develop a DSGE model for an open economy and estimate it for Euro Area using Bayesian estimation techniques. Their model features both price and wage rigidities, as well as financial frictions in the form of financially excluded households. To analyze the effectiveness of stabilization policies, they introduce active monetary and fiscal policy rules into their model. Their estimation results show that the share of financially excluded households in the euro area is between 35% and 37%. They find that a contractionary monetary policy significantly reduces inflation, output, consumption, investment, and employment. Also, the results from their impulse response functions show that a rise in nominal interest rate almost has the same negative effect on the consumption of both financially included and excluded households.

Di Bartolomeo et al, (2011) extend the standard NK-DSGE model to also include financially excluded households and external consumption habits. They evaluate their model by stochastic simulations that were obtained from Bayesian parameters estimates for the Group of Seven (G7) economies, namely: USA, Japan, Germany, France, UK, Italy, and Canada. Their estimation results indicate that the share of financially excluded households are 7.5% (Germany), 9% (Italy), 9.5% (Japan), 33.9% (Canada), 35.4% (US), 43.3% (UK), and 44.2% (France). Also, the results from their simulations show that a positive monetary policy shock significantly reduces both inflation and real activity in all the countries, although the magnitude of the impacts are felts differently among the countries. Further, with

the exception of the US, they find that the sensitivity of output to positive monetary policy shock is stronger in those countries with higher levels of financial exclusion.

Mohimont (2018) evaluates the welfare cost of business cycles and the effects of stabilization policies in an estimated New-Keynesian DSGE model for South Africa. He incorporates heterogeneous households that differ with respect to access to financial and capital market. He estimation results show that financially excluded households are more vulnerable to business cycle fluctuations. This is because the former are unable to insure against labor market idiosyncratic risks. Further, he finds that monetary policy interest rate rules that respond aggressively to inflation improve the general welfare of the South African economy. He also finds that although financially excluded households gain more from monetary policy rules that responds aggressively to output their welfare costs is of considerable importance.

The above literature review indicates that few studies have endeavored to use DSGE model that features heterogeneous households to analyze the dynamic impact of monetary policy on the consumption of these households and on key macroeconomic variables. Clearly, most of those studies only analyzed the impact of monetary policy shock on aggregate variables with very few looking at it from the disaggregated levels to examine the differentiated impact of monetary policy on financially included and excluded households. Also, studies that used estimation or even calibration to undertake those goals for SSA economies and Ghana in particular are largely non-existent and even none has focused on the four countries we consider in our paper. This gap in the literature is what we intend to fill.

3.3 The Model

The model adopted here closely follows a standard New-Keynesian DSGE model featuring the so-called 'rule-of-thumb' or 'hand-to-mouth' consumers developed by Furlanetto and Seneca (2012). The model originally has only one structural shock (i.e., productivity shock). So, we augment it by introducing four (4) additional structural shocks, namely: monetary policy shock; preference shock; labor supply shock; and price mark-up shock. It is important to note that except for the structural shocks all the first-order conditions, as well as the log-linearized equations are the same as in Furlanetto and Seneca (2012) and Gali et al. (2007).

3.3.1 Households

There are two kinds of households: a fraction λ of the households are financially excluded. These households do not have access to the formal financial market (and are indexed by fe). They neither save nor borrow: they simply spend their disposable income in each period. The remaining fraction $(1-\lambda)$ of the households are financially included: that is they have access to the financial and capital markets (and are indexed by fi). This group of households chooses plans for consumption, saving, investment, and bond holdings to maximize their lifetime utility. Each household maximizes a lifetime identical inter-temporal utility function given by:

$$E_t \sum_{k=0}^{\infty} \beta^k U_{t+k}^i$$

where $\beta \in (0,1)$ is the subjective discount factor, and the identical instantaneous utility function is given by:

$$U_t^i = \varepsilon_t^b \left(\log(C_t^i - hC_{t-1}^i) - \frac{\varepsilon_t^l}{1+\phi}(N_t^i)^{1+\phi} \right), \quad (3.1)$$

where $i \in (FI, FE)$ denotes the type of households. Here, C_t^i represents the household's real consumption at time t, C_{t-1}^i is aggregates consumption at time $t-1$, N_t^i is the hours worked at time t, and $\phi > 0$ denotes the inverse of the Frisch labor elasticity. The level of consumption habit is represented by the parameter h and is external to the households.

3.3.1.1 Financially included household's utility maximization

Financially included households maximize their utility given by:

$$U_t^{fi} = \varepsilon_t^b \left(\log(C_t^{fi} - hC_{t-1}^{fi}) - \frac{\varepsilon_t^l}{1+\phi}(N_t^{fi})^{1+\phi} \right),$$

subject to the following budget constraint:

$$P_t(C_t^{fi} + I_t^{fi}) + (1+R_t)^{-1} B_{t+1}^{fi} = W_t N_t^{fi} + R_t^k K_t^{fi} + B_t^{fi} + D_t^{fi} - P_t T_t^{fi} - F_t \quad (3.2)$$

as well as capital accumulation expressed as:

$$K_{t+1}^{fi} = (1-\delta)K_t^{fi} + \Phi\left(\frac{I_t^{fi}}{K_t^{fi}}\right)K_t^{fi} \quad (3.3)$$

Here, P_t denotes the price level, I_t^{fi} is real investment, B_t^{fi} is holdings of one-period bonds that yield a gross risk-free interest rate $(1+R_t)$, W_t is nominal wage, K_t^{fi} is real capital holdings, R_t^k is the nominal rental rate on the stock of capital rented by the households, D_t^{fi} is the dividend stream from firms, T_t^{fi} is the real lump-sum tax paid by the households, and F_t is a union membership fee. Also, ε_t^b and ε_t^l represent preference shock (a shock which

affects the inter-temporal substitution of households) and labor supply shock, respectively. Both ε_t^b and ε_t^l are respectively assumed to follow a first-order autoregressive (AR (1)) process with an independently and identically distributed (i.i.d) normal error term as in Smets and Wouters (2003) given by $\varepsilon_t^b = \rho_b \varepsilon_{t-1}^b + u_t^b$, and $\varepsilon_t^l = \rho_l \varepsilon_{t-1}^l + u_t^l$. Moreover, δ is the depreciation rate and $\Phi(.)$ is capital adjustment cost function, which has the following properties: $\Phi(\delta) = \delta$, $\Phi' > 0$, $\Phi'(\delta) = 1$, and $\Phi'' \leq 0$.

The first order conditions for the financially included household's problem can be written as:

$$1 = (1 + R_t) E_t \left\{ \Lambda_{t,t+1} \right\}, \tag{3.4}$$

$$P_t Q_t = E_t \left\{ \Lambda_{t,t+1} \left[R_{t+1}^k + P_{t+1} Q_{t+1} \left((1-\delta) + \phi_{t+1} - \left(\frac{I_{t+1}^{FI}}{K_{t+1}^o} \right) \phi'_{t+1} \right) \right] \right\} \tag{3.5}$$

$$Q_t = \frac{1}{\Phi'(I_t^{fi} / K_t^{fi})} \tag{3.6}$$

$$\Lambda_{t,t+1} = \beta \left\{ \frac{\varepsilon_{t+1}^b}{\varepsilon_t^b} \frac{P_t}{P_{t+1}} \frac{(C_t^{fi} - hC_{t-1}^{fi})}{(C_{t+1}^{fi} - hC_t^{fi})} \right\}, \tag{3.7}$$

where $\phi_{t+1} \equiv \Phi(I_{t+1}^{fi} / K_{t+1}^{fi})$, $\phi'_{t+1} \equiv \Phi'(I_{t+1}^{fi} / K_{t+1}^{fi})$, $\Lambda_{t,t+1}$ is the stochastic discount factor, and Q_t is the (real) shadow value of capital (Tobin's Q). Here, the elasticity of investment-capital ratio with respect to Q is given by $-(1/(\Phi''(\delta)\delta)) = \eta$.

3.3.1.2 Financially excluded household's utility maximization

Financially excluded households are unable to smooth consumption in the face of fluctuations in their labor income. Thus, at each period they solve a static problem and therefore maximize their period utility, given by:

$$U_t^{fe} = \varepsilon_t^b \left(\log(C_t^{fe} - hC_{t-1}^{fe}) - \frac{\varepsilon_t^l}{1+\phi}(N_t^{fe})^{1+\phi} \right),$$

subject to the following budget constraint:

$$P_t C_t^{fe} = W_t N_t^{fe} - P_t T_t^{fe} - F_t \qquad (3.8)$$

The first order condition for the financially excluded households yields:

$$C_t^{fe} = \frac{W_t}{P_t} N_t^{fe} - T_t^{fe} - \frac{F_t}{P_t} \qquad (3.9)$$

3.3.2 Aggregation

Aggregate consumption, hours worked, and tax are given as a weighted average of the corresponding variables for each type of households, as follows:

$$C_t = \lambda C_t^{fe} + (1-\lambda) C_t^{fi} \qquad (3.10)$$

$$N_t = \lambda N_t^{fe} + (1-\lambda) N_t^{fi} \qquad (3.11)$$

$$T_t = \lambda T_t^{fe} + (1-\lambda) T_t^{fi} \qquad (3.12)$$

Also, aggregate capital stock, investment, bonds, and dividends are given respectively as $K_t = (1-\lambda)K_t^{fi}$, $I_t = (1-\lambda)I_t^{fi}$, $B_t = (1-\lambda)B_t^{fi}$, and $D_t = (1-\lambda)D_t^{fi}$.

3.3.3 Firms

Firms are divided into two groups of producers: final goods producer firms and intermediate goods producer firms. The goods from the intermediate firms are used as inputs by the perfectly competitive final goods producer firms.

3.3.3.1 Final goods producer firms

Final goods producer firms produce a final good Y_t and sell it in a perfectly competitive market. The final good is a composite of a continuum of differentiated intermediate goods $X_t(j)$, $j \in [0,1]$ with a constant returns technology given by:

$$Y_t = \left(\int_0^1 X_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

where $X_t(j)$ denotes the quantity of the intermediate good j, and $\varepsilon > 1$ represents the elasticity of substitution between differentiated intermediate goods. The final goods producer firms choose the optimal amount of each intermediate good to maximize their profit, which is the difference between revenues and costs taken as given price of the final good P_t given by:

$$\prod_t = P_t Y_t - \int_0^1 P_t(j) X_t(j) dj$$

where $P_t(j)$ is the price of j^{th} intermediate good. The solution of the firm's profit maximization yields the set of demand function:

$$X_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon} Y_t$$

and a zero-profit condition expressed as:

$$P_t = \left(\int_0^1 P_t(j)^{1-\varepsilon} dj \right)^{\frac{1}{1-\varepsilon}}$$

3.3.3.2 Intermediate goods producer firms

All intermediate goods producer firms use the same production function. The production function for producing an intermediate good j is given by:

$$Y_t(j) = K_t(j)^{\alpha} (A_t N_t(j))^{1-\alpha} \tag{3.13}$$

where A_t is labor-augmenting technology shock, $K_t(j)$ and $N_t(j)$ respectively represent capital and labor services hired by firm j, and $0 \leq \alpha \leq 1$ is the share of capital to output. The technology shock is assumed to follow an AR (1) process with an i.i.d normal error term given by $a_t = \rho_a a_{t-1} + u_t^a$. Firm's cost minimization problem implies an optimality condition written as:

$$\frac{K_t(j)}{N_t(j)} = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{W_t}{R_t^k} \right) \tag{3.14}$$

Thus, real marginal cost, which is common to all firms, can be written as:

$$MC_t = \frac{1}{\Theta} \left(\frac{R_t^k}{P_t} \right)^{\alpha} \left(\frac{W_t}{P_t A_t} \right)^{1-\alpha} \tag{3.15}$$

where $\Theta = (1-\alpha)^{1-\alpha} \alpha^{\alpha}$

3.3.4 Price Setting

In each period, the intermediate goods producer firms in the economy set nominal prices according to a stochastic time dependent rule proposed by Calvo (1983). A fraction of

the firms is able to set a new price P_t^* with probability $1-\theta$ in each period. Thus, only a fraction $1-\theta$ of the firms are able to reset their prices while the prices of the remaining fraction θ are unchanged. The maximization problem of a j^{th} firm is given by:

$$\max_{P_t^*} E_t \sum_{k=0}^{\infty} \theta^k E_t \left\{ \Lambda_{t,t+k} Y_t(j) \left[P_t^* - \varepsilon_{t+k}^p P_{t+k} MC_{t+k} \right] \right\},$$

subject to:

$$Y_{t+k}(j) = X_{t+k}(j) = \left(\frac{P_t^*}{P_{t+k}} \right)^{-\varepsilon} Y_{t+k}$$

The first order condition for the firm's problem can be written as:

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ \Lambda_{t,t+k} Y_{t+k}(j) \left[P_t^* - \frac{\varepsilon}{\varepsilon - 1} \varepsilon_{t+k}^p P_{t+k} MC_{t+k} \right] \right\} = 0 \qquad (3.16)$$

where ε_{t+k}^p is price mark-up shock common to all firms; it is assumed to follow an AR (1) process with an i.i.d normal error term given by $\varepsilon_t^p = \rho_p \varepsilon_{t-1}^p + u_t^p$. Finally, aggregate price level equation is described by:

$$P_t = \left[\theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \qquad (3.17)$$

3.3.5 Labor Union

Nominal wages are set by a continuum of labor unions, index by $z \in [0,1]$, each representing a continuum of workers. A fraction λ of the workers are financially excluded and a fraction $(1-\lambda)$ are financially included. The wage rate for the members of each union is set by that union. The same type of labor services is provided by all workers in the union.

The aggregate of labor services of members in the union is the labor service supplied by each union, $N_t(z)$. Also, any firm's production function is a Dixit–Stiglitz aggregate of the labor services provided by the unions (Furlanetto & Seneca, 2012). Thus, any union faces the following demand schedule:

$$N_t(z) = \left(\frac{W_t(z)}{W_t} \right)^{-\varepsilon_w} N_t^d \qquad (3.18)$$

where N_t^d is total demand for labor and ε_w denotes the elasticity of substitution between different types of labor. The aggregator for household hours worked $N_t \equiv \int_0^1 N_t^d(z)dz$ can be combined with equation (18) to yield the total amount of hours supplied for any household:

$$N_t \equiv N_t^d \int_0^1 \left(\frac{W_t(z)}{W_t} \right)^{-\varepsilon_w} dz \, .$$

An equal share of the wage-adjustment cost is covered by each member of the union in a form of a union membership fee, (F_t). The wage adjustment cost faced by unions is assumed to be convex, following Rotemberg (1982). Therefore, a member of the union at any time t pays a nominal fee given by:

$$F_t(z) = \frac{\phi_w}{2} \left[\frac{W_t(z)}{W_{t-1}(z)} - 1 \right]^2 W_t N_t \qquad (3.19)$$

where $\phi_w > 0$ is the size of the wage-adjustment costs parameter.

A representative union in each period chooses $W_t(z)$ to maximize the following:

$$\max_{W_t(z)} E_t \sum_{k=0}^{\infty} \beta^k \left[\lambda U_{t+k}^{fe} + (1-\lambda) U_{t+k}^{fi} \right]$$

subject to the two budget constraints above (equations 3.2 and 3.8), labor demand function (equation 3.18), and the aggregate union fee $F_t = \int_0^1 F_t(z)dz$, where $F_t(z)$ is given by equation 3.19. The equilibrium condition, imposing a symmetry so that $W_t(z) = W_t$ and $N_t(z) = N_t$ for all z, can be written as:

$$0 = (MRS_t)^{-1} \frac{W_t}{P_t} \left[(1-\varepsilon_w) - \phi_w (\Pi_t^w - 1)\Pi_t^w \right] N_t^{1+\phi} + \varepsilon_w N_t^{1+\phi}$$
$$+ \beta \phi_w E_t \left\{ (MRS_{t+1})^{-1} (\Pi_{t+1}^w - 1)\Pi_{t+1}^w \frac{W_{t+1}}{P_{t+1}} N_{t+1}^{1+\phi} \right\} \qquad (3.20)$$

where $\Pi_t^w = W_t / W_{t-1}$ and MRS_t is the weighted average of the marginal rate of substitution between labor hours and consumption of each type of household or worker given by:

$$(MRS_t)^{-1} = \lambda (MRS_t^{fe})^{-1} + (1-\lambda)(MRS_t^{fi})^{-1} = (\varepsilon_t^l N_t^{\phi})^{-1} \left[\lambda (C_t^{fe} - hC_{t-1}^{fe})^{-1} + (1-\lambda)(C_t^{fi} - hC_{t-1}^{fi})^{-1} \right]$$

Labor services (hours worked) is assumed to be identical across all households implying that both types of households supply the same amount of labor, that is, $N_t = N_t^{fi} = N_t^{fe}$.

3.3.6 The Central Bank (Monetary Policy)

There is a monetary authority who controls monetary policy by setting the nominal interest rate r_t according to a Taylor (1993) rule expressed as:

$$\frac{R_t}{R_{ss}} = \left(\frac{R_{t-1}}{R_{ss}} \right)^{\rho_r} \left[\left(\frac{\Pi_t}{\Pi_{ss}} \right)^{\phi_\pi} \left(\left(\frac{Y_t}{Y_{ss}} \right) \Big/ \left(\frac{Y_{t-1}}{Y_{ss}} \right) \right)^{\phi_y} \right]^{(1-\rho_r)} \varepsilon_t^m \qquad (3.21)$$

where, ρ_r denotes the degree of interest rate smoothing, ϕ_π and ϕ_y are the weights the central bank places on inflation and output growth respectively, and ε_t^m represents a monetary policy shock which is assumed to be exogenous with an i.i.d normal error term written as $\varepsilon_t^m = u_t^m$.

3.3.7 Equilibrium

Goods market clearing condition requires aggregate output to be equal to aggregate demand (the sum of aggregate consumption, investment, government spending and union fee), expressed as:

$$Y_t = C_t + I_t + G_t + F_t \tag{3.22}$$

where $G_t = \gamma_G Y_t$ represents government spending, and $\gamma_G = G/Y$ is the steady state ratio of government spending to output. It is to be noted that there are adjustments of taxes in every period that guarantee government budget balancedness.

3.3.8 Log-linearized equilibrium conditions

Here, the log-linearized versions of the equilibrium conditions are presented. The first-order Taylor approximation around a zero-inflation steady state is used for some conditions whereas other conditions precisely hold. Note that lower case letters or variables with "^" represent log-deviation with respect to the corresponding steady state values. The following log-linearized equations summarizes the equilibrium dynamics of the model.

3.3.8.1 Households

The financially included households' consumption optimality conditions with equations 3.4 and 3.7 combined can be written as:

$$c_t^{fi} = \frac{h}{1+h} c_{t-1}^{fi} + \frac{1}{1+h} E_t(c_{t+1}^{fi}) - \frac{1-h}{1+h}(r_t - E_t(\pi_{t+1})) + \frac{1-h}{1+h}(\hat{\varepsilon}_t^b - E_t(\hat{\varepsilon}_{t+1}^b)) \quad (3.23)$$

The investment equation (equation 3.6) and it relationship with the equation which describes the dynamics of Tobin's Q (equation 3.5) can respectively be written as:

$$i_t - k_t = \eta q_t \quad (3.24)$$

$$q_t = -[r_t - E_t(\pi_{t+1})] + [1 - \beta(1-\delta)]E_t(r_{t+1}^k - p_{t+1}) + \beta E_t(q_{t+1}) \quad (3.25)$$

The log-linearized version of the capital accumulation equation (equation 3.3) can be written as:

$$k_{t+1} = (1-\delta)k_t + \delta i_t \quad (3.26)$$

The financially excluded households' consumption optimality condition (equation 3.9) can be written as:

$$c_t^{fe} = \frac{WN}{PC}(w_t - p_t + n_t) - \frac{T^{fe}}{C} t_t^{fe} \quad (3.27)$$

Here, it is assumed that the steady consumption is the same for all households i.e. $C = C^{fi} = C^{fe}$ and as stated before, $n_t = n_t^{fi} = n_t^{fe}$ likewise $N = N^{fi} = N^{fe}$. The log-linearization of aggregate variables (real consumption and labor hours) implies that:

$$c_t = \lambda c_t^{fe} + (1-\lambda)c_t^{fi} \quad (3.28)$$

$$n_t = \lambda n_t^{fe} + (1-\lambda)n_t^{fi} \quad (3.29)$$

3.3.8.2 Firms

The familiar equation (New Keynesian Phillips Curve) describing the dynamics of price inflation as a function of the deviations of the average logarithm of mark-up from its steady state level can be obtained from equations 3.16 and 3.17 written as:

$$\pi_t = \beta E_t(\pi_{t+1}) + \kappa_p(mc_t + \hat{\varepsilon}_t^p) \tag{3.30}$$

where, $\kappa_p = \frac{(1-\beta\theta)(1-\theta)}{\theta}$, $\pi_t = p_t - p_{t-1}$ is price inflation and mc_t is real marginal cost and using equation 15, we obtain:

$$mc_t = (w_t - p_t) - (y_t - n_t) \tag{3.31}$$

Additionally, cost minimization implies the ratio of inputs (capital to labor ratio) given by equation 3.14 can be written as:

$$k_t - n_t = (w_t - p_t) - (r_t^k - p_t) \tag{3.32}$$

Also, log-linearization of the production function (equation 3.13) yields:

$$y_t = \alpha k_t + (1-\alpha)(a_t + n_t) \tag{3.33}$$

3.3.8.3 Labor unions

The optimality condition following the union's problem (equation 3.20) yields the familiar New Keynesian Phillips Curve for wage inflation as given below:

$$\pi_t^w = \beta E_t(\pi_{t+1}^w) + \kappa_w[mrs_t - (w_t - p_t)] \tag{3.34}$$

where, $\kappa_w = \frac{\varepsilon_w - 1}{\phi_w}$, $\pi_t^w = w_t - w_{t-1}$ is wage inflation, and mrs_t is given by:

$$mrs_t = \frac{\lambda}{1-h}(c_t^{fe} - hc_{t-1}^{fe}) + \frac{1-\lambda}{1-h}(c_t^{fi} - hc_{t-1}^{fi}) + \phi n_t + \hat{\varepsilon}_t^l \tag{3.35}$$

3.3.8.4 Equilibrium

Log-linearizing the market clearing condition (equation 3.22) yields:

$$(1-\gamma_G)y_t = \gamma_C c_t + \gamma_I i_t \tag{3.36}$$

where, $\gamma_C = \frac{C}{Y}$, and $\gamma_I = \frac{I}{Y}$ are the ratio of steady states of real consumption and investment to output, respectively.

3.3.8.5 Monetary Authority

Log-linearization of the monetary policy rule (equation 3.21) yields:

$$r_t = \rho_r r_{t-1} + (1-\rho_r)[\phi_\pi \pi_t + \phi_y (y_t - y_{t-1})] + \varepsilon_t^m \tag{3.37}$$

3.3.8.6 Shock processes

All shock processes in the set-up are given in a log-linearized form and are assumed to follow an AR (1) process (except for the monetary policy shock) with an i.i.d normal distribution error term with zero mean and its own variance, δ_e^2 (i.e. $u_t^e \sim N(0, \delta_e^2)$, where e is the shock type) written below:

Households' preference shock:

$$\hat{\varepsilon}_t^b = \rho_b \hat{\varepsilon}_{t-1}^l + u_t^b \tag{3.38}$$

Labor supply shock:

$$\hat{\varepsilon}_t^l = \rho_l \hat{\varepsilon}_{t-1}^l + u_t^l \tag{3.39}$$

Price mark-up shock:

$$\hat{\varepsilon}_t^p = \rho_p \hat{\varepsilon}_{t-1}^p + u_t^p \quad (3.40)$$

Productivity shock

$$a_t = \rho_a a_{t-1} + u_t^a \quad (3.41)$$

Monetary policy shock

$$\varepsilon_t^m = u_t^m \quad (3.42)$$

It, therefore, follows from the above that equations 3.23 to 3.37, and the shock processes (equations 3.38 to 3.42) summarize the equilibrium in the economy.

3.3.9 Steady states

The main steady state equations as implied by the model as in Furlanetto and Seneca (2012) and Gali et al (2007) are summarized below:

$\frac{WN}{PC} = \frac{(1-\alpha)}{u^p}\gamma_C$, where, $u^p = \frac{\varepsilon}{\varepsilon - 1}$,

$\gamma_C = \frac{C}{Y} = (1-\gamma_G) - \frac{\delta\alpha}{(\rho+\delta)u^p}$, where, $\rho = \frac{1}{\beta} - 1$

$\gamma_I = \frac{I}{Y} = 1 - \gamma_G - \gamma_C$

$\frac{T^{fe}}{C} = \frac{WN}{PC} - 1$

3.4 Bayesian Estimation of the Model

The Bayesian inference method combines information from observed data and initial beliefs (priors) regarding the model's parameters to perform an estimation, resulting in a posterior distribution (estimates). That is, the posterior distribution of the parameters of the

model (based on its log-linear state-space representation) are obtained by means of this method. Below, we briefly describe the procedure of this method, the data, the prior distribution used, and calibration.

3.4.1 Bayesian Inference Method

For a formal set up of the Bayesian method, let $p(\theta_{\mathrm{M}} \mid \mathrm{M})$ denote the prior distribution of the parameter vector θ_{M} for some model. Let the likelihood function of the observed data conditional on the model and its parameters be represented by $L(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M}) \equiv p(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})$. Here, $p(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})$ is the density of the data, Y are observations until period T, and $p(\bullet)$ stands for probability density function (pdf), e.g. gamma, beta, generalized beta, normal, inverse gamma, shifted gamma, and uniform function (Griffoli, 2013). Also, let the marginal density function of the data conditional on the model be written as:

$$p(Y_T \mid \mathrm{M}) = \int_{\theta_{\mathrm{M}}} p(\theta_{\mathrm{M}}; Y_T \mid \mathrm{M}) d\theta_{\mathrm{M}} = \int_{\theta_{\mathrm{M}}} p(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M}) d\theta_{\mathrm{M}}$$

Then, using Bayes theorem, the posterior density $p(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M})$ can be expressed as the product of the likelihood function and the prior density, written as:

$$p(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M}) = \frac{p(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M})}{p(Y_T \mid \mathrm{M})}$$

$$p(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M}) = \frac{L(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M})}{\int_{\theta_{\mathrm{M}}} p(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M}) d\theta_{\mathrm{M}}}$$

From the above, the posterior kernel corresponds to the numerator of the posterior density, given as $\kappa(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M}) \equiv L(Y_T \mid \theta_{\mathrm{M}}, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M})$. Also, the posterior distribution of

the parameter vector θ_{M} for model M is directly proportional to the posterior density. This can be written as:

$$p(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M}) \propto L(\theta_{\mathrm{M}} \mid Y_T, \mathrm{M})\, p(\theta_{\mathrm{M}} \mid \mathrm{M})$$

The above distribution is characterized by standard measures of central tendency, such as the mean, mode, or median; and measures of dispersion, such as the standard deviation, or some selected percentiles. When the model and data of observables are given, the likelihood function can be calculated using the Kalman filter or other particle filters for non-linear models. By relying on the Metropolis-Hastings (MH) algorithm, the parameter values are drawn and used to plot a histogram of the posterior distribution.

3.4.2 Data

Estimation of the parameters of the DSGE model presented above use quarterly time series data spanning 1985Q1 to 2016Q4 on real Gross Domestic Product (GDP), real households' consumption expenditure, Consumer Price Index (CPI), and nominal interest rate (monetary policy rate/discount rate) for four countries: Ghana, Gabon, Lesotho, and Mauritius.

Following Smets and Wouters (2007), log first difference of real GDP, real consumption, and CPI multiplied by 100 are taken to represent output growth, consumption growth, and inflation respectively. Thus, our observed variables include: output growth, consumption growth, inflation, and interest rate. It is to be noted that quarterly series for real GDP and real consumption are interpolated from their annual, following the technique described in Chow and Lin (1971).

All series are seasonally adjusted except the nominal interest rate. Series on CPI and nominal interest rate are obtained from IMF International Financial Statistics database, whereas, series on real GDP and real consumption are sourced from the World Bank's World Development Indicators database (2018). The start and period of the dataset is chosen on the basis of data availability. Using the World Bank's classification, the four countries were selected from among the middle-income SSA countries, based on data availability.

3.4.3 Calibration

Four of the model's parameters were fixed while one steady state variable was calibrated. We fixed those ((ε, η, and ε_w) parameters because we found that estimating them together with the remaining parameters distorted the convergence diagnostics of the Metropolis-Hastings (MH) algorithm and chose these four parameters. Moreover, they were not of major interest to us. Thus, we set $\varepsilon = 6$, $\eta = 1$, and $\varepsilon_w = 4$ using the calibrated values from Furlanetto and Seneca (2012). Also, γ_G, which is the steady ratio of real government expenditure to real GDP, was calibrated using an observed data for each of the country. That is, we computed the long-run average of the ratio of real government expenditure to real GDP from 1985 to 2016 yielding 0.14, 0.18, 0.26, and 0.13 for Ghana, Gabon, Lesotho, and Mauritius respectively. Series on real government expenditure is sourced from the World Bank's World Development Indicators database (2018).

3.4.4 Priors

The third, fourth, and fifth columns of Tables 3.2 and 3.3 (see Appendix) give a synopsis of our assumptions on the prior distribution of 24 parameters for each of the four

countries. In choosing the priors, in some cases, the calibrated values of the parameters from Furlanetto and Seneca (2012) and Gali et al. (2007) were used as prior means with an assumed standard deviation, while in other cases we followed the standard literature. Note that the priors are the same for all the countries unless otherwise stated. In Table 3.2, the priors in parentheses are for Gabon whereas in Table 3.3 the priors in the parentheses are for Lesotho.

In particular, the discount factor and the depreciation rate are assumed to follow a Beta distribution with means 0.99 and 0.025, and standard deviations 0.002 and 0.003, respectively. The parameters governing the share of financially excluded households and consumption habit also follow a Beta distribution with means 0.5 and 0.7, respectively and standard deviations of 0.025 for all the countries, except for Gabon which has a standard deviation of 0.02 each. The prior mean for the fraction of the financially excluded households is consistent with the ones used by Marto (2014), Di Bartolomeo, et al. (2011), Forni, Monteforte, and Sessa (2009) and Coenen and Straub (2005) but differs in standard deviation.

A Gamma distribution is assumed for the coefficient of Frisch labor elasticity with a mean value of 0.5 and a standard deviation equal to 0.01 for Ghana and Gabon, and 0.1 for Lesotho and Mauritius. Similarly, the parameter governing the wage-adjustment cost follows a gamma distribution with a mean value of 174 and a standard deviation equal to 0.1 for all the countries. The parameters governing the share of capital to output and Calvo price stickiness are both assumed to follow a Beta distribution and fluctuate around 0.33 and 0.75, respectively. The standard deviation for the former is 0.1 for all the countries, while the later has a standard deviation of 0.01 for Ghana and Gabon, 0.015 for Mauritius, and 0.1 for

Lesotho. The standard errors of all the innovations are assumed to follow inverse gamma distribution with mean 0.1 and standard deviation of 2, except for the standard error of the monetary policy shock, which has a mean value of 0.01 for Lesotho. Further, a Beta distribution is assumed for all the persistence parameters of shock, processes with mean 0.5 and standard deviation 0.1, except that of the technology shock which has a mean of 0.95 and a standard deviation value of 0.002. Also, the standard deviation of preference shock is 0.01 for Lesotho.

Finally, the degree of interest-rate smoothing parameter is assumed to follow Beta distribution which centers around 0.69 with standard deviation 0.1. As in Smets and Wouters (2003), the parameters governing the weight the central bank places on inflation and output growth are both normally distributed with means 1.7 and 0.26, and standard deviations 0.25 and 0.015, respectively for Ghana, Gabon, and Mauritius. Similarly, both are normally distributed with means 1.7 and 0.26 but with standard deviations 0.25 and 0.025, respectively for Lesotho.

3.5 Results and Discussion

The posterior estimation results of the model's parameters and the five exogenous shocks, are reported in Tables 3.2 and 3.3 for pairs of countries: Ghana vs. Gabon, and Lesotho vs. Mauritius. Given our priors, we estimate the posterior distributions of the parameters using the Metropolis-Hastings algorithm. We run two independent Markov chains with five hundred thousand (500,000) draws and perform the Brooks and Gelman (1998) convergence diagnostics. These results together with the trace plots suggest that the two chains have converged according to both the univariate and multivariate convergence

diagnostics. Appendix 3A displays the trace plots of some selected parameters. We report the Bayesian posterior mean estimates of the parameters for the four countries under consideration in the last two columns of Tables 3.2 and 3.3. As shown in Appendix 3B, some of the parameters have their posterior estimates closer to their prior means (and similar across countries), indicating consistency between the priors (initial guess) and the information contained in the data. However, other parameters saw the posterior estimates moving far from their priors (and varying across countries), indicating an additional gain of employing the data in our Bayesian technique.

3.5.1 Posterior Estimates

The estimates of the fraction of financially excluded households' parameter range from approximately 35%t to 42%. Specifically, Lesotho registered the lowest estimated value of 34.62%, followed by Ghana and Mauritius, recording 35.10% and 36.04%, respectively with Gabon registering the highest value of 41.89%. The variations in the estimates of this parameter for these countries may be explained by the different levels of financial development (financial inclusion) in these countries. In comparison with the findings in the literature, the estimates obtained for all the countries are larger than those estimated by Campbell and Mankiw (1991) for the UK (20.3%), Canada (22.5%), and Japan (3.5%), and than the ones found by Di Bartolomeo et. al, (2011) for Germany (7.5%), and Italy (9%). Also, the estimates are close to those of Coenen and Straub (2005), Forni, et al., (2009), and Ratto et al. (2009) for the euro area (35% to 37%) and those obtained by Di Bartolomeo et. al, (2011) for the USA (35.4%), and France (44.2%). However, they are considerably lower than that of Marto (2014) found for Portugal (57.8%) It is, therefore, not unreasonable to

confirm statistical regularity of our estimates as they lie within the range of findings in the empirical literature.

Moreover, considering the parameter governing habit persistence formation of financially included households, the estimated values range from about 0.53 to 0.69. In particular, Mauritius recorded the highest estimated value, approximately 0.69, followed by Gabon and Ghana (0.68 and 0.66, respectively) with Lesotho registering the lowest estimated value, 0.53. The point estimates for all four countries are close to those found by Smet and Wouters (2003), Christiano et al. (2005), and Marto (2014).

The following is a discussion of the parameters characterizing the Taylor rule (Monetary policy). The estimates of the parameter representing the degree of interest-rate smoothing registered a minimum value of about 0.53 and a maximum value of about 0.9. Particularly, Ghana recorded the lowest value for degree of interest-rate smoothing (approximately 0.53), with Gabon registering the highest value (approximately 0.9). Also, the estimate for Mauritius is approximately 0.65 and that for Lesotho is about 0.67. Overall, we find evidence of a moderate degree of interest-rate smoothing for all the countries except for Gabon, which saw a higher degree of interest-rate smoothing.

Again, the response of interest rate to inflation is far greater than unity in the long-term for all the countries; this satisfies the condition noted by Galí e. al., (2004), and is broadly in line with that proposed by Taylor (1993). We find that the central banks in all the countries pursue strict anti-inflationary policies with an inflation coefficient value of about 3.2. Comparatively, the Central Banks of Ghana and Lesotho are the most aggressive towards anti-inflation, followed by Mauritius and Gabon with an estimated value of 3.15 and 3.10,

respectively. The finding that Central Bank of Ghana is one of the two countries who are most aggressive towards anti-inflation is not surprising, as Ghana is the only country among the four which is officially operating under inflation targeting monetary policy. This finding is, however, not consistent with the finding by Cantah and Ahiakpor (2017). The authors used Markov Switching model to examine the conduct of monetary policy in Ghana and conclude that the Central Bank of Ghana has not been attentive to price stability, which is the direct opposite of our finding.

Also, the estimates of the response of interest rate to output growth are greater than zero (similar across countries) and are consistent with the one suggested by Taylor (1993). In comparison, the estimated values suggest that the Central Bank of Ghana is the most aggressive towards output growth, followed by Gabon, and Mauritius with Lesotho being the least. Specifically, the coefficient of output growth saw an estimated value of about 0.25 for Ghana, 0.244 for Gabon and Mauritius, and 0.232 for Lesotho. Overall, it can be concluded that central banks in SSA countries have been aggressive towards targeting lower levels of inflation relative to output growth.

Moreover, the estimate of the contribution of capital to output is small for all the countries, approximately 0.05. Also, the depreciation rate parameter had an estimate which is approximately close to its prior mean for all the countries with little significant variations among the countries; the same can be said for the parameter for discount factor as well as that for the degree of price stickiness. The degree of price stickiness is found to be modest, and the estimates suggest that the time between re-optimizations is around three quarters. Also, the inverse of the Frisch labor elasticity parameter estimate is similar among the four

countries with an average of about 0.5. This average value (0.5) implies that labor-supply elasticity with respect to real wage is in the neighborhood of 2. This means that households in these SSA economies largely adjust their labor supply to small changes in their real wage.

In addition, the estimates of all the stochastic processes show considerable degree of persistence and they are similar for all the countries as captured by the autocorrelation parameters. These high and modest persistence estimates for the shocks are consistent with the findings of Smet and Wouters (2003), Coenen and Straub (2005), among others. A notable exception is Lesotho where the autocorrelation parameters estimate of price mark-up shock is less persistence (ρ_p = 0.13). These large (small) estimates indicate that when these economies are faced with the structural shocks, as considered in the model, the impacts would resonate long (soon) after the shock ends.

Finally, the magnitude of the estimates for the standard deviations of the innovations varies considerably among the countries. This means that the relevance of these shocks differs significantly among the four countries. Monetary policy shock saw a larger standard deviation estimates when the model was applied to Ghana (6.07), Lesotho (5.65), Mauritius (4.48), and Gabon (1.09), whereas the standard deviation of the price mark-up shock registered bigger estimate when applied to Lesotho (138.14), Gabon (71.65), Ghana (43.40), and Mauritius (20.72). Also, the standard deviation for preference shock registered larger estimates when the model was applied to Lesotho (31.31), Gabon (25.19), Ghana (19.50), and Mauritius (10.96). Furthermore, the standard deviation estimates for technology shock were 16.72, 9.56, 7.78, and 6.84 for Gabon, Ghana, Lesotho, and Mauritius, respectively. It can be observed that it is only the standard deviation estimates for labor supply shock which

had a relatively low variance irrespective of the country the model was applied to. These dynamics in the variance may emanate from differences in the information contained in the data, and the relevance of each structural shock in each of the countries.

3.5.2 Bayesian impulse response analysis

In this section, we examine the impact of each of the structural shocks on selected macroeconomic variables and, most importantly, analyze the role of monetary policy shock in the four economies and its impact on the consumption of financially included and excluded households. Revealingly, the impulse response functions are very similar across the four countries, although there is some degree of country-level heterogeneity. Evidently, the responses of output, inflation, consumption, and interest rate to a positive monetary policy shock are displayed in Figure 3.1 (see Appendix) for Ghana, Gabon, Mauritius, and Lesotho. It can be seen that a contractionary monetary policy induces a fall in inflation, output, and consumption in all four countries. Thus, despite a sizable estimate of the share of financially excluded households in these economies, monetary policy is seen to be still effective, although the magnitude and the impacts of the shock are felt differently by country. Also, the consumption responses of financially included and excluded households to a positive monetary policy shock are displayed in Figure 3.2 (see Appendix). It can be seen that in all the countries, a rise in interest rate reduces the consumption of the financially excluded households more than that of their included counterparts. This is because the latter are able to mitigate the negative effect of the monetary policy shock through their savings in the financial sector, an action which the former are not positioned to undertake.

Furthermore, we perform a policy experiment by fixing the fraction of financially excluded households to different values to analyze the response of output and inflation to a rise in interest rate. The results are displayed in Figures 3.3 and 3.4 (see Appendix), respectively for output and inflation. In all the countries, it can be seen that the output and inflation sensitivities to monetary policy shock is stronger at higher levels of financial exclusion. The transmission mechanism is explained as follows: a rise in interest rate reduces investment and aggregate consumption, which lowers aggregate demand. The fall in demand leads to a reduction in output production and working hours, which reduces real wages, and therefore, real disposable income falls. Consequently, the consumption of both households reduces. However, the consumption of financially excluded households reduces more than that of included ones (as we explain in detail in the next two paragraphs). Therefore, as the fraction of households who cannot participate in the financial markets increases, the demand for real output falls further. Also, the lower demand for real output translates into a fall in inflation (see Figure 3.4). Hence, the effectiveness of monetary policy in improved. This finding concurs with the theoretical model predictions and empirical findings by Di Bartolomeo and Rossi (2007) and Di Bartolomeo et al., (2011).

Given that the responses of the other variables to all the structural shocks in the model are similar across the four countries, we select the following impulse response functions as representative for all the countries so as to analyze their impact in those economies. The transmission mechanisms are fully explained. All dynamic responses of the variables depict a one standard deviation shock to all innovations and percentage-point deviations from their

steady state. The blue lines represent the mean impulse responses, while the gray areas indicate the 90% Highest Posterior Density Intervals (HPDI), the 90% confidence band.

The response of the selected macroeconomic variables to a contractionary monetary policy shock are displayed in Figure 3.5 (see Appendix). That shock leads to a rise in nominal interest rate of about 0.83 percentage points and gradually decreases to its baseline line value after about 14 quarters. The shock has a negative effect on the economy: that is, the increase in interest rate crowds out investment and aggregate consumption, leading to lower aggregate demand, and the reactions are hump-shaped due to the habit formation parameter in the model. There is an immediate fall in output and inflation of about 3.21 and 0.34 percentage points, respectively. The lower aggregate demand is accompanied by lower employment leading to a fall in disposable income by both financially included and excluded households. This reduction in disposable income translates into lower consumption of both types of households. However, because the financially included households have access to the formal financial market and thus have access to their previous savings, they are able to mitigate the fall in their consumption more than the financially excluded households. It can be seen that the consumption of financially included households decreases by about 1.72 with a peak of 2.08 percentage points as against about 3.56 with a peak of 3.78 percentage points decrease in consumption of the financially excluded households. In this sense, the former is able to smooth consumption better than the latter, following that shock. It can be concluded that contractionary monetary policy decreases the consumption of financially excluded households more than that of financially included ones.

Further, Figure 3.6 (see Appendix) displays the impulse response functions of those variables to a positive labor-augmenting total factor productivity shock. That positive shock surges production and immediately causes a drop in employment, because firms hire less amount of labor to produce the same quantity of output. Consequently, capital become more productive which motivates financially included households to accumulate more of that leading to an increase in investment. A fall in marginal cost, ceteris paribus, due to the positive technology shock leads to a decrease in inflation and a rise in output while real wage increases due to the deflation. The reduction in employment significantly decreases the disposable income of financially excluded households, inducing a reduction in their consumption of about 6.48 percentage points but increases thereafter to a peak of about 15.02 percentage points. However, the consumption of financially included households stays positive or immediately increases by about 6.04 percentage points, peaking at 15.74 percentage points. Consequently, aggregate consumption immediately rises by only 0.81 percentage points on impact. It can be observed that, the monetary authorities become aggressive in accommodating the shock by decreasing the interest rate, leading to a rise increasing aggregate demand to increase employment, though the increase in employment is short-lived. That is, after initial quarters, employment starts rising causing a rise in disposable income leading to an increase in consumption of financially excluded households. Aggregate consumption then rises with a maximum value of about 15.8 percentage points after the sixth quarters.

Moreover, Figure 3.7 (see Appendix) presents the impulse responses of the select variables to a rise in the price mark-up innovation. Inflation rises and output falls on impact

following that shock. The monetary authorities respond to the rise in inflation by raising the nominal interest rate according to the Taylor rule. Also, the presence of inflation and/or high interest rate cause a reduction in consumption of both types of households and a fall in aggregate consumption. Whereas the consumption of financially included households decreases by about 4.45 percentage points that of financially excluded households decreases by about 20.67 percentage points after the second quarter where it reached a peak of about 26.33 percentage points below the steady sate value. The lower aggregate demand induces lower employment in the short-run as evidenced by a reduction in employment of about 13.07 percentage points, while real wage falls due to the rise in inflation. The consumption of financially excluded households is contracted further by lower real wage and employment.

In addition, the impulse responses of those macroeconomic variables to a positive labor supply shock are shown in Figure 3.8 (see Appendix). That shock raises the marginal disutility of labor and plays a parallel role as wage mark-up shock. The shock raises the real wage to a peak of about 0.002 percentage points above its baseline value, inducing lower level of employment. Consequently, disposable income decreases leading to a reduction in the consumption of both types of households, though that of the financially excluded households saw an initial rise. It can be observed that, the difference between their consumption levels is, however, not quantitatively large. Also, the increase in wage raises the marginal cost causing a rise in inflation. The monetary authorities through the Taylor rule moderate the inflationary pressures by increasing the nominal interest rate, inducing lower investment and a fall in output.

Furthermore, Figure 9 (see Appendix) shows the effect of a positive preference (demand) shock. The exogenous increase in demand immediately increases output, consumption, and employment but crowds out investment. Consumption of both types of households increases, however, a larger rise in the consumption of financially excluded household is seen. This is because those households tap into their savings to increase consumption during, for example Christmas season (preference/demand shock). In particular, the consumption of financially included households immediately increases by about 6.69 percentage points and continues to rise until the third quarter, peaking at 9.2 percentage points above its steady state value. Similarly, the consumption of financially excluded households saw a rise of about 4.329 percentage points, continuing to surge until the third quarter where it reached a peak of about 6.19 percentage points. The increase in aggregate demand exerts upward pressure on the prices of inputs, and goods and services. Thus, nominal wage and inflation increase. However, the rise in nominal wage outweighs the rise in inflation. This is evidenced by a rise in real wage. Again, the monetary authorities control the inflationary pressures by increasing the nominal interest rate by about 0.16 percentage points, to a maximum of about 0.56 percentage points above its steady value as implied by the Taylor rule.

Finally, we perform an experiment to examine whether the wage-adjustment cost parameter plays a role in the SSA economies, with specific reference to monetary policy shock. To that end, we set the parameter governing wage-adjustment cost to different values and simulate the model. The results are displayed in Figure 3.10. Clearly, the responses of output, consumption, employment, and inflation to a positive monetary are similar to those

presented above. Thus, wage-adjustment costs play no role in influencing the impact of monetary policy shock on the key macroeconomic variables on the SSA economies.

3.5.3 Forecast Error Variance Decomposition

Variance decomposition is performed to analyze the contribution of each of the structural shocks to the variations in output, consumption, employment, and inflation in the economy as a whole. The results at different horizons are reported in Tables 3.4 and 3.5 (see Appendix) for each of country, with Table 3.4 for Ghana and Gabon, and Table 3.5 for Lesotho and Mauritius. Following Smet and Wouters (2003), we define 1-4 quarters (one year) as the short run, 10 quarters (2.5 years) as the medium run, and 100 quarters (25 years) as the long run. It can be seen that the contribution of each of the structural shocks to the fluctuations in the real variables and inflation differ greatly among the countries. However, two conclusions stand out: whereas monetary policy shock appears to be moderately important in all countries at all horizons, labor supply shock contributes nothing to the variations in all the real variables and inflation in each country at all horizons.

In particular, the key drivers of output in the short, medium, and long term are technology, price mark-up, and monetary policy shocks in Ghana and in all the other countries. However, technology shock is seen to the main driver of output in all the countries at all horizons (about 70%) except Lesotho, where price mark-up shock is the driver of output in the short and medium terms (about 60%). Also, monetary policy shock moderately drives output in all countries at all horizons, usually ranging from 5% to 18% on average. In the short-run, it largely contributes to variations in output in Mauritius. Similar analysis and conclusion pertain to the fluctuations in consumption for all the countries.

With regard to the determinants of employment, monetary policy shock and price mark-up shock are found to be the most important drivers of employment in Ghana, Lesotho, and Mauritius but not Gabon, which has technology and price mark-up shocks dominating the driving of employment at all horizons. Among these three countries (Ghana, Lesotho, and Mauritius), monetary shock is the most contributor to employment variability in Mauritius, followed by Ghana and Lesotho. It can also be seen that the major drivers of employment at all horizons in Ghana are monetary policy and price mark-up shocks, with monetary policy shock less dominating.

Finally, considering the variability in inflation, monetary policy shock seems to be less important than price mark-up, technology, and preference shocks in all the countries at all horizons. Specifically, price mark-up and technology stocks are the most important contributors to inflation in all the countries at all horizons with the price mark-up shock largely dominating. It can be seen that price mark-up shock contributes the most to inflation variability in Ghana, about 78% and 76% in the medium and the long term, respectively.

3.6 Conclusion

In this chapter, we analyze the role and the impact of monetary policy shock along with other structural shocks on the consumption of financially included and excluded households in SSA economies. We adopt the standard New Keynesian DSGE model featuring both types of households, developed by Furlanetto and Seneca (2012). We introduce four structural shocks in addition to the productivity shock that is initially considered in the model to aid our analysis. Further, and in order to achieve our objective, we estimate the DSGE model using Bayesian inference methods for four middle-income SSA

countries, namely: Ghana, Gabon, Lesotho, and Mauritius. This approach combines information from [1] the data from these countries over the period 1985 to 2016 and [2] our initial beliefs (priors) regarding the model's parameters for undertaking the estimation. The posterior estimates, the Bayesian impulse response functions, and the variance decomposition reveal several interesting insights regarding behavioral parameters, key macroeconomic variables, and structural shocks.

First, the estimates of the fraction of financially excluded households show that, comparatively, Ghana and Lesotho both have a higher level of financial inclusion than Mauritius and Gabon, i.e. about 65% of their citizens participate in the financial sector, followed by Mauritius (64%). At the tail end is Gabon which has a relatively low level of financial inclusion (about 58%). Overall, the fraction of financially excluded households is estimated to be relatively small.

Second, the parameter estimates in the Taylor rule suggest that monetary authorities in all the countries have been more aggressive towards inflation than output growth. Comparatively, monetary authorities in Ghana and Lesotho place relatively greater emphasis on inflation while Ghana, Gabon, and Mauritius place relatively larger emphasis on output growth. In addition, a considerable degree of interest-rate smoothing is estimated for Ghana and the other three countries.

Third, the Bayesian impulse response results are similar for all the countries and the analysis show that monetary policy shock negatively affects the consumption profile of financially excluded households more than financially included households. That is, a contractionary monetary policy decreased the consumption of financially excluded

households more as compared with their counterparts, a finding which promotes or supports full financial inclusion agenda. Also, our monetary policy experiment results show that the effectiveness of monetary policy is improved at higher levels of financial exclusion.

Fourth, the analysis of all the other four structural shocks signal that financially excluded households suffer more from 'unfavorable innovations" but benefit less from 'favorable innovations': the reverse is true for financially included households. For example, a positive technology shock initially reduces the consumption of financially excluded households except with the passage of time (after about three quarters) that puts their consumption in a positive domain, while their financially included counterparts saw an immediate increase in their consumption. Thus, we have empirically confirm that, when households are faced with shocks financially excluded households experience higher volatility in their consumption than financially included ones.

Fifth, the variance decomposition analysis empirically confirms the importance of monetary policy in these economies. That is, the analysis has shown that monetary policy shock plays a rather key role in explaining the dynamics of the variations in key macroeconomic variables including output, consumption, employment, and inflation. However, price mark-up and technology stocks are the most important drivers of these variables, with labor supply shock not being important at all.

Finally, monetary policy plays a significant role (and is still effective) in SSA economies despite a sizeable fraction of the population being financially excluded. The impulse response analysis has evidenced the dynamics of the unfurling of monetary policy shock in these economies. Then, in line with economic theory and empirical evidence, a rise

in the nominal interest rate brings about a fall in inflation and in all the real variables including output, employment, consumption, and investment.

CHAPTER 4

MACROECONOMIC IMPACT OF FISCAL POLICY IN GHANA: ANALYSIS OF AN ESTIMATED DSGE MODEL WITH FINANCIAL EXCLUSION

4.1 Introduction

The 2007-2009 financial crisis has brought about a renewal of emphasis on fiscal policy as a stabilization policy instrument. The aftermath of the crisis, i.e. recession, has forced many governments, in both developed and developing countries, to utilize fiscal policy as a stabilization policy tool to stimulate macroeconomic variables. One argument in favor of the use of fiscal policy as a stabilization tool has been the limited financial market participation in many economies. As argued by Furlanetto (2011), if a section of the population does not participate in the financial market, and therefore, consumption cannot not be smoothed, fiscal policy becomes relevant. In that environment, a fiscal stimulus (e.g. increased government spending) can induce an expansionary effect in an economy by increasing the current income of households who are excluded from the financial market. According to that argument, financially included ("optimizing") households who anticipate an increase in taxes, intended to finance the increase in government spending, reduce their consumption and tend to work more to smooth consumption; this may result in a reduction in aggregate demand. However, households who cannot smooth consumption ("hand-to-mouth" or financially excluded households) simply consume their income to increase aggregate demand without changing their employment decisions. Such a behavior by the "hand-to-mouth" households may help to prompt an expansionary effect of government

spending on key macroeconomic variables, especially on consumption and output. In favor of this argument, Spilimbergo et al. (2008), IMF staff, as cited in Furlanetto (2011), recommend increased public spending, and reduced taxes, or transfers towards households who cannot smooth consumption as a fiscal package for many countries.

In light of the above, many researchers have attempted to analyze, both theoretically and empirically, the macroeconomic effects of fiscal policy in various economies. Most of such studies applied variants of macroeconomic models such as Vector Autoregressive (VAR), Structural VAR (SVAR) and Markov Switching[4]. However, because of the limited capacity of those macroeconomic models to account for the presence of households who cannot participate in the financial market, consideration has been given to the use of dynamic stochastic general equilibrium (DSGE) models. The standard New Keynesian DSGE model, which only incorporates infinitely lived representative agents, who are assumed to enjoy full financial inclusion and, therefore, optimize their choices inter-temporally to smooth consumption, has been augmented to include those households who are financially constrained[5]. Despite this development, theoretical and empirical accounts of DSGE models on the expansionary effects of fiscal policy on key macroeconomic variables, especially on consumption and output, is still widely debated. In particular, findings regarding the effects of government spending on aggregate consumption have been mixed and hence inconclusive.

[4] These models have been used to generate positive consumption multipliers of government spending shock in many economies. We confirm these results with the observed data we use in this study (see Figure 4B6 at the appendix).

[5] In the literature, they are referred to as "non-Ricardian", "hand-to-mouth, or "rule-of-thumb" consumers. In this study, we call them "financially excluded" households.

Following suggestion by Mankiw (2000), Gali, et al. (2004) were the first to introduce "hand-to-mouth" households into their DSGE model. In a related study, Gali, et al. (2007) analyze the effect of government spending on consumption using a similar model with lump-sum taxes. They find that an increase in government spending has an expansionary effect on real economic variables including aggregate consumption and output. Following these seminal studies many studies have included various market frictions and nominal rigidities to critically examine the effects of various fiscal policies. While some of those studies find contradictory evidence to that of Gali, et al. (2007), others find supportive evidence. The strand of the literature finds a positive response of consumption following a positive government spending shock (Conenen and Straub (2005), López-Salido and Rabanal (2006), Jakab and Világi (2008), Furlanetto and Seneca (2009), Iwata (2011), Colciago (2011), Furlanetto (2011) Céspedes et al. (2013), González et al. (2014), and Babecký et al. (2018)). On the other hand, some find a negative consumption multiplier of government spending shock (Jakab and Világi (2008), Ratto et al. (2009), Forni et al. (2009), Stähler and Thomas (2012), Malik (2013), Bhattarai and Trzeciakiewicz (2017)).

The differences among those findings have been attributed to the presence (or absence) of various market frictions and rigidities that are featured in DSGE models, including size of financially excluded households, price and wage stickiness, and habit persistency. For instance, whereas Conenen and Straub (2005) document that a large share of financially excluded households (above 35%) is required to generate a positive consumption and output multipliers of government spending shock for the Euro Area, Iwata (2011) finds a positive consumption multiplier with a relatively small share of such

households (25%) in the Japanese economy. Also, Ratto et al. (2009) introduce sticky wage into their model and find that government spending shock crowds-out consumption. However, Furlanetto (2011) and Colciago (2011) find that the crowding-in effect of consumption observed in Gali et al. (2007) is preserved even when wages are sticky.

Furthermore, as noted by Iwata (2009), the dynamic responses of macroeconomic variables to a government spending shock in DSGE models largely depend on the financing behavior of fiscal authorities. Thus, a set of realistic tax rules that are practiced and used by fiscal authorities in the real world is of utmost importance. For example, the importance of including distortionary taxes in DSGE model analysis of fiscal policy effectiveness has been ossified by Bilbiie and Straub (2004). They show that distortionary taxes decrease after-tax wages and make it more difficult to generate a positive consumption multiplier of government spending shock. However, Linnemann (2004) shows that government spending shock can crowd-in consumption even when distortionary taxes are present, explaining that this is possible when labor supply is elastic given that the tax base is widened by unemployment benefits (Iwata, 2009)[6]. These insights suggest that fiscal policy analysis ought to be carried out in models that feature distortionary taxes, which are major fiscal instruments on the revenue side of government budget[7] in lieu of the lump-sum taxes that are considered in most of the models mentioned above.

[6] Some of the papers that consider distortionary taxation in their DSGE models with financial exclusion include Forni et al. (2009), Iwata (2011), Dagher et al. (2012), Stähler and Thomas (2012), Drautzburg and Uhlig (2015), González et al. (2014), and Babecký et al. (2018).

[7] Indeed, many developing countries, including Ghana, use distortionary taxation rather than lump-sum taxation. For instance, prior to use of Value-Added Tax (VAT) system in Ghana, there was a sales tax which was replaced by the government in 1995 as a policy change to remedy the deficiencies in the sales tax to generate much revenue for the government.

A number of studies have used DSGE framework to model the Ghanaian economy (e.g. Ahortor & Olopoenia, 2010; Houssa et al., 2010; Dagher et al., 2012; Bondzie et al., 2013; and Bondzie et al., 2014). Among these studies very few, if ever existed, analyze the macroeconomic impact of fiscal policy shocks in Ghana. Moreover, most of those studies consider only a representative household with full access to the financial and the capital markets[8]. However, a common characteristic of a developing country like Ghana is the predominance of financially excluded households; therefore, any macroeconomic policy modelling for this economy ought to consider these excluded group of households. Further, most of those studies use calibration rather than estimation to undertake their goals. Evidently, Table 4.1 shows the savings behavior and financial account holdings of adult population, who are within the labor force bracket, in Ghana. It can be seen that a sizable fraction of those adult population has no savings in Ghana, about 48%. Moreover, a considerable fraction of the population (around 60%) in the economy holds no account at a bank or any other type financial institution. The above indicators evidence the presence of financially excluded households in the Ghanaian economy.

This study addresses the above shortcomings, and thus contributes to the debate on effectiveness of fiscal policy by developing and estimating a closed economy DSGE model, which is rich in frictions and nominal rigidities and considers distortionary taxation, for the Ghanaian economy[9]. In particular, the model considers heterogeneous households: financially included and financially excluded households. As well, it introduces price

[8] The only exception is the paper by Dagher et al. (2012).
[9] Our study shares many features with Dagher et al. (2012); however, while we estimate our model, they just use calibration.

stickiness, flexible and sticky wage dynamics, and two distortionary taxes: consumption and labor income taxes. We estimate this model using Bayesian techniques to examine the macroeconomic impacts of fiscal policy shocks in the Ghanaian economy. Specifically, we: [1] analyze the impacts of government spending shock on key macroeconomic variables; [2] examine the effects of consumption tax and labor income tax shocks on the consumption and employment decisions of both financially excluded and included households by considering those shocks as income shocks; and [3] explore the interaction between fiscal and monetary policies in the economy.

The rest of this chapter is organized as follows: section 4.2 describes the model. Section 4.3 explains the Bayesian estimation procedure and the data used. Section 4.4 discusses the results, and Section 4.5 presents conclusions and policy implications.

4.2 The Model

The model adopted here closely follows a standard New-Keynesian DSGE model featuring the so-called 'hand-to-mouth' households developed by Furlanetto and Seneca (2012). We, however, deviate from lump-sum tax considered in their model and introduce distortionary taxes including consumption and labor income taxes. Also, we introduce a fiscal authority (government) who collect those taxes from the households and issues debt to finance its expenditures. As a result, we introduce three fiscal rules: consumption tax rule, labor income tax rule, and government spending rule. In addition, we depart from labor union

who negotiates wages in the labor market on behalf of the households and introduce a perfectly competitive and a monopolistically competitive labor market[10].

4.2.1 Households

There are two kinds of households: a fraction λ of the households are financially excluded. These households do not have access to the financial market (and are indexed by fe). They neither save nor borrow and therefore, simply spend their disposable income in each period. The remaining fraction $(1-\lambda)$ of the households are financially included: that is, they have full access to the financial market (indexed by fi). This group of households chooses plans for consumption, saving, investment, and bond holdings to maximize their lifetime utility. Each household maximizes a lifetime identical inter-temporal utility function given by:

$$E_t \sum_{k=0}^{\infty} \beta^k U_{t+k}^i$$

where $\beta \in (0,1)$ is the subjective discount factor, and the identical instantaneous utility function is given by:

$$U_t^i = \left(\log(C_t^i - hC_{t-1}^i) - \frac{1}{1+\phi}(N_t^i)^{1+\phi} \right)$$

where $i \in (FI, FE)$ denotes the type of households. Here, C_t^i represents the household's real consumption at time t, C_{t-1}^i is aggregate consumption at time $t-1$, N_t^i is the hours worked

[10] The perfectly competitive labor wage setting is as in Gali et al. (2007), whereas the monopolistically competitive wage setting is as in Junior (2016).

at time t, and $\phi > 0$ denotes the inverse of the Frisch labor elasticity. The level of consumption habit is represented by the parameter h and it is external to the households.

4.2.1.1 Financially included household's utility maximization

Financially included households maximize the following utility:

$$U_t^{fi} = \left(\log(C_t^{fi} - hC_{t-1}^{fi}) - \frac{1}{1+\phi}(N_t^{fi})^{1+\phi} \right)$$

subject to a budget constraint:

$$(1+\tau_t^c)C_t^{fi} + I_t^{fi} + \frac{B_t^{fi}}{R_t P_t} = (1-\tau_t^n)\frac{W_t}{P_t}N_t^{fi} + \frac{R_t^k}{P_t}K_t^{fi} + \frac{B_{t-1}^{fi}}{P_t} + \frac{D_t^{fi}}{P_t}$$

as well as capital accumulation, expressed as:

$$K_{t+1}^{fi} = (1-\delta)K_t^{fi} + \Phi\left(\frac{I_t^{fi}}{K_t^{fi}}\right)K_t^{fi} \qquad (4.1)$$

Here, P_t denotes the price level, I_t^{fi} is real investment, B_t^{fi} is holdings of one-period bonds that yield a gross risk-free interest rate R_t, W_t is nominal wage, K_t^{fi} is real capital holdings, R_t^k is the nominal rental rate on the stock of capital rented by the households, D_t^{fi} is the dividend stream from firms, τ_t^c and τ_t^n are consumption and labor income taxes, respectively, paid by the households. Also, δ is the depreciation rate and $\Phi(.)$ is capital adjustment cost function, which has the following properties: $\Phi(\delta) = \delta$, $\Phi' > 0$, $\Phi'(\delta) = 1$, and $\Phi'' \leq 0$.

The first order conditions for the financially included household's problem can be written as:

$$\lambda_t^{fi} = \frac{1}{(1+\tau_t^c)(C_t^{fi} - hC_{t-1}^{fi})} \tag{4.2}$$

$$Q_t = E_t\left\{\Lambda_{t,t+1}\left[\frac{R_{t+1}^k}{P_{t+1}} + Q_{t+1}\left((1-\delta) + \phi_{t+1} - \left(\frac{I_{t+1}^{fi}}{K_{t+1}^{fi}}\right)\phi'_{t+1}\right)\right]\right\} \tag{4.3}$$

$$Q_t = \frac{1}{\Phi'(I_t^{fi}/K_t^{fi})} \tag{4.4}$$

$$E_t(\Lambda_{t,t+1}) = \beta E_t\left\{\frac{\lambda_{t+1}^{fi}}{\lambda^{fi}}\right\} = \frac{E_t(P_{t+1})}{R_t P_t} \tag{4.5}$$

where $\phi_{t+1} \equiv \Phi(I_{t+1}^{fi}/K_{t+1}^{fi})$, $\phi'_{t+1} \equiv \Phi'(I_{t+1}^{fi}/K_{t+1}^{fi})$, $\Lambda_{t,t+1}$ is the stochastic discount factor, λ_t^{fi} is the Lagrange multiplier, and Q_t is the (real) shadow value of capital (Tobin's Q). Here, the elasticity of investment-capital ratio with respect to Q is given by $-(1/(\Phi''(\delta)\delta)) = \eta$.

4.2.1.2 Financially excluded household's utility maximization

Financially excluded households are unable to smooth consumption in the face of fluctuations in their labor income. Thus, at each period they solve a static problem and therefore maximize their period utility, given by:

$$U_t^{fe} = \left(\log(C_t^{fe} - hC_{t-1}^{fe}) - \frac{1}{1+\phi}(N_t^{fe})^{1+\phi}\right),$$

subject to the following budget constraint:

$$(1+\tau_t^c)C_t^{fe} = (1-\tau_t^n)\frac{W_t}{P_t}N_t^{fe}$$

The first order conditions for the financially excluded households yield:

$$\lambda_t^{fe} = \frac{1}{(1+\tau_t^c)(C_t^{fe} - hC_{t-1}^{fe})} \tag{4.6}$$

$$C_t^{fe} = \frac{(1-\tau_t^n)}{(1+\tau_t^c)} \frac{W_t}{P_t} N_t^{fe} \tag{4.7}$$

4.2.2 Aggregation

Aggregate consumption and hours worked are given as a weighted average of the corresponding variables for each type of households, as follows:

$$C_t = \lambda C_t^{fe} + (1-\lambda) C_t^{fi} \tag{4.8}$$

$$N_t = \lambda N_t^{fe} + (1-\lambda) N_t^{fi} \tag{4.9}$$

Also, aggregate capital stock, investment, bonds, and dividends are given respectively as $K_t = (1-\lambda)K_t^{fi}$, $I_t = (1-\lambda)I_t^{fi}$, $B_t = (1-\lambda)B_t^{fi}$, and $D_t = (1-\lambda)D_t^{fi}$.

4.2.3 Firms

Firms are divided into two groups of producers: final goods producer firms and intermediate goods producer firms. The goods from the intermediate firms are used as inputs by the perfectly competitive final goods producer firms.

4.2.3.1 Final goods producer firms

Final goods producer firms produce a final good Y_t and sell it in a perfectly competitive market. The final good is a composite of a continuum of differentiated intermediate goods $X_t(j)$, $j \in [0,1]$ with a constant returns technology given by:

$$Y_t = \left(\int_0^1 X_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

where $X_t(j)$ denotes the quantity of the intermediate good j, and $\varepsilon > 1$ represents the elasticity of substitution between differentiated intermediate goods. The final goods producer firms choose the optimal amount of each intermediate good to maximize their profit, which is the difference between revenues and costs, taken as given the price of the final good P_t given by:

$$\prod_t = P_t Y_t - \int_0^1 P_t(j) X_t(j) dj$$

where $P_t(j)$ is the price of j^{th} intermediate good. The solution of the firm's profit maximization yields the set of demand function:

$$X_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon} Y_t$$

and a zero-profit condition expressed as:

$$P_t = \left(\int_0^1 P_t(j)^{1-\varepsilon} dj \right)^{\frac{1}{1-\varepsilon}}$$

4.2.3.2 Intermediate goods producer firms

All intermediate goods producer firms use the same production function. The production function for producing an intermediate good j is given by:

$$Y_t(j) = K_t(j)^{\alpha} (A_t N_t(j))^{1-\alpha} \qquad (4.10)$$

where A_t is labor-augmenting technology shock, $K_t(j)$ and $N_t(j)$ respectively represent capital and labor services hired by firm j, and $0 \le \alpha \le 1$ is the share of capital to output. The technology shock is assumed to follow an AR (1) process with an i.i.d normal error term

given by $a_t = \rho_a a_{t-1} + u_t^a$. Firm's cost minimization problem implies an optimality condition written as:

$$\frac{K_t(j)}{N_t(j)} = \left(\frac{\alpha}{1-\alpha}\right)\left(\frac{W_t}{R_t^k}\right) \tag{4.11}$$

Thus, real marginal cost, which is common to all firms, can be written as:

$$MC_t = \frac{1}{\Theta}\left(\frac{R_t^k}{P_t}\right)^{\alpha}\left(\frac{W_t}{P_t A_t}\right)^{1-\alpha} \tag{4.12}$$

where $\Theta = (1-\alpha)^{1-\alpha}\alpha^{\alpha}$

4.2.4 Price Setting

In each period, the intermediate goods producer firms in the economy set nominal prices according to a stochastic time dependent rule proposed by Calvo (1983). A fraction of the firms are able to set a new price P_t^* with probability $1-\theta$ in each period. Thus, only a fraction $1-\theta$ of the firms are able to reset their prices while the prices of the remaining fraction θ are unchanged. The maximization problem of a j^{th} firm is given by:

$$\max_{P_t^*} E_t \sum_{k=0}^{\infty} \theta^k \left\{ \Lambda_{t,t+k} Y_t(j) \left[P_t^* - \varepsilon_{t+k}^p P_{t+k} MC_{t+k} \right] \right\},$$

subject to:

$$Y_{t+k}(j) = X_{t+k}(j) = \left(\frac{P_t^*}{P_{t+k}}\right)^{-\varepsilon} Y_{t+k}$$

The first order condition for the firm's problem can be written as:

$$\sum_{k=0}^{\infty}\theta^{k}E_{t}\left\{\Lambda_{t,t+k}Y_{t+k}(j)\left[P_{t}^{*}-\frac{\varepsilon}{\varepsilon-1}\varepsilon_{t+k}^{p}P_{t+k}MC_{t+k}\right]\right\}=0 \qquad (4.13)$$

where ε_{t+k}^{p} is price mark-up shock common to all firms; it is assumed to follow an AR (1) process with an i.i.d normal error term given by $\varepsilon_{t}^{p}=\rho_{p}\varepsilon_{t-1}^{p}+u_{t}^{p}$. Finally, aggregate price level equation is described by:

$$P_{t}=\left[\theta P_{t-1}^{1-\varepsilon}+(1-\theta)(P_{t}^{*})^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \qquad (4.14)$$

4.2.5 Labor Market

For wage dynamics in the economy, we consider two labor markets: a perfectly competitive and a monopolistically competitive labor market. Under both markets, there is no difference between the wages among the households.[11]

4.2.5.1 Perfectly competitive market

Each household chooses the number of hours worked, taken as given the market wage rate. Thus, the real wage is equated to the marginal rate of substitution between consumption and hours worked. From the households' utility maximization problem, the wage setting for financially included and excluded households can, respectively, be written as:

$$\frac{W_{t}}{P_{t}}=\frac{(N_{t}^{fi})^{\phi}(C_{t}^{fi}-hC_{t-1}^{fi})(1+\tau_{t}^{c})}{(1-\tau_{t}^{n})} \qquad (4.15)$$

$$\frac{W_{t}}{P_{t}}=\frac{(N_{t}^{fe})^{\phi}(C_{t}^{fe}-hC_{t-1}^{fe})(1+\tau_{t}^{c})}{(1-\tau_{t}^{n})} \qquad (4.16)$$

[11] That is, both financially included and excluded households receive the same wage rates.

4.2.5.2 Monopolistically competitive market

The wage setting under this market directly follows the one in Junior (2016). Households supply differentiated labor services, ($N_{t,j}$), in a monopolistically competitive market structure, and these labor services are sold to a representative firm. The representative firm then aggregates these different types of labor service into a single type of labor input, N_t is given by:

$$N_t = \left(\int_0^1 N_{j,t}^{\frac{\varepsilon_w - 1}{\varepsilon_w}} dj \right)^{\frac{\varepsilon_w}{\varepsilon_w - 1}}$$

where ε_w denotes the elasticity of substitution between different types of labor. The representative firm then chooses the optimal amount of each labor service to maximize its profit taken as given the wage rate, W_t , written as:

$$\prod_t = W_t N_t - \int_0^1 W_{j,t} N_{j,t} dj$$

where $W_{j,t}$ is the wage of j^{th} labor service and $\prod_t$ is the profit. The solution of the firm's profit maximization yields the set of demand function:

$$N_{j,t} = \left(\frac{W_t}{W_{j,t}} \right)^{\varepsilon_w} N_t$$

and aggregate wage level equation expressed as:

$$W_t = \left(\int_0^1 W_{j,t}^{1-\varepsilon_w} dj \right)^{\frac{1}{1-\varepsilon_w}}$$

Additionally, in each period a fraction, $1-\theta$, of the households, chosen randomly and independently, optimally define their wage by choosing $W_{j,t}^{*}$. This fraction of the households know that by optimally choosing $W_{j,t}^{*}$ for period t, they face a probability of θ_w^N which leads to those wages remaining the same for N periods. On the other hand, the remaining fraction, θ, of the households follow a wage stickiness rule proposed by Calvo (1983), which maintains the same wage by equating current period wage to the previous one ($W_{j,t} = W_{j,t-1}$). Therefore, considering the taxes on their labor income, the maximization problem of household i can be expressed as:

$$\max_{W_{j,t}^{*}} E_t \sum_{k=0}^{\infty} (\beta\theta_w)^k \left\{ -\frac{(N_{j,t+k}^{i})^{1+\phi}}{1+\phi} - \lambda_{t+k}^{i} \left[-W_{j,t}^{*} N_{j,t+k}^{i} (1-\tau_{t+k}^{n}) \right] \right\}$$

subject to:

$$N_{j,t}^{i} = \left(\frac{W_t}{W_{j,t}} \right)^{\varepsilon_w} N_t^{i}$$

This can be written as:

$$\max_{W_{j,t}^{*}} E_t \sum_{k=0}^{\infty} (\beta\theta_w)^k \left\{ -\frac{1}{1+\phi} \left[N_{t+k}^{i} \left(\frac{W_{t+k}}{W_{j,t}^{*}} \right)^{\varepsilon_w} \right]^{1+\phi} + \lambda_{t+k}^{i} \left[W_{j,t}^{*} N_{t+k}^{i} \left(\frac{W_{t+k}}{W_{j,t}^{*}} \right)^{\varepsilon_w} (1-\tau_{t+k}^{n}) \right] \right\}$$

The first order condition of the above problem yields:

$$W_{j,t}^{*} = \left(\frac{\varepsilon_w}{\varepsilon_w - 1} \right) E_t \sum_{k=0}^{\infty} (\beta\theta_w)^k \left[\frac{(N_{j,t+k}^{i})^{\phi}}{\lambda_{t+k}^{i} (1-\tau_{t+k}^{n})} \right] \qquad (4.17)$$

Finally, the aggregate wage level equation is described by:

$$W_t = \left[\theta_w W_{t-1}^{1-\varepsilon_w} + (1-\theta_w)(W_t^*)^{1-\varepsilon_w} \right]^{\frac{1}{1-\varepsilon_w}} \tag{4.18}$$

4.2.6 The Central Bank (Monetary Policy)

There is a monetary authority who controls monetary policy by setting the nominal interest rate r_t according to a Taylor (1993) rule expressed as:

$$\frac{R_t}{R_{ss}} = \left(\frac{R_{t-1}}{R_{ss}} \right)^{\rho_r} \left[\left(\frac{\Pi_t}{\Pi_{ss}} \right)^{\phi_\pi} \left(\left(\frac{Y_t}{Y_{ss}} \right) \Big/ \left(\frac{Y_{t-1}}{Y_{ss}} \right) \right)^{\phi_y} \right]^{(1-\rho_r)} \exp(\varepsilon_t^{\,r}) \tag{4.19}$$

where, ρ_r denotes the degree of interest-rate smoothing, ϕ_π and ϕ_y are the weights the central bank places on inflation and output growth, respectively, and ε_t^r represents a monetary policy shock which is assumed to be exogenous with an i.i.d normal error term written as $\varepsilon_t^r = u_t^r$.

4.2.7 Fiscal Authority (Fiscal Policy)

There is a fiscal authority (government) who collects taxes from households and issues debt to finance his spending. The government budget constraint is written as:

$$\frac{B_t}{P_t R_t} + \tau_t^c C_t + \frac{\tau_t^n W_t N_t}{P_t} = \frac{B_{t-1}}{P_t} + G_t \tag{4.20}$$

The government possesses one fiscal policy instrument on the expenditure side (G_t) and two fiscal policy instruments on the revenue side: τ_t^c and τ_t^n. These instruments follow the same fiscal policy rules as in Junior (2016) and Forni, et al. (2009). They are respectively written as:

$$\frac{G_t}{G_{ss}} = \left(\frac{G_{t-1}}{G_{ss}}\right)^{\rho_g} \left(\frac{B_{t-1}}{Y_{t-1}P_{t-1}} \frac{Y_{ss}P_{ss}}{B_{ss}}\right)^{\phi_g(1-\rho_g)} \exp(\varepsilon_t^g) \quad (4.21)$$

$$\frac{\tau_t^c}{\tau_{ss}^c} = \left(\frac{\tau_{t-1}^c}{\tau_{ss}^c}\right)^{\rho_{\tau c}} \left(\frac{B_{t-1}}{Y_{t-1}P_{t-1}} \frac{Y_{ss}P_{ss}}{B_{ss}}\right)^{\phi_{\tau c}(1-\rho_{\tau c})} \exp(\varepsilon_t^{\tau c}) \quad (4.22)$$

$$\frac{\tau_t^n}{\tau_{ss}^n} = \left(\frac{\tau_{t-1}^n}{\tau_{ss}^n}\right)^{\rho_{\tau n}} \left(\frac{B_{t-1}}{Y_{t-1}P_{t-1}} \frac{Y_{ss}P_{ss}}{B_{ss}}\right)^{\phi_{\tau n}(1-\rho_{\tau n})} \exp(\varepsilon_t^{\tau n}) \quad (4.23)$$

Here, G_t is government spending, B_t is government debt, ε_t^g , $\varepsilon_t^{\tau c}$, and $\varepsilon_t^{\tau n}$ are government spending shock, consumption tax shock, and labor income tax shock, respectively. All those shocks are assumed to be exogenous with an i.i.d normal error term.

4.2.8 Equilibrium

Goods market clearing condition requires aggregate output to be equal to aggregate demand (the sum of aggregate consumption, investment, government spending) expressed as:

$$Y_t = C_t + I_t + G_t \quad (4.24)$$

4.2.9 Log-linearized equilibrium conditions

Here, the log-linearized versions of the equilibrium conditions and the first order conditions are presented. The first-order Taylor approximation around a zero-inflation steady state is used for some conditions whereas other conditions precisely hold. Note that lower case letters or variables with "^" represent log-deviation with respect to the corresponding steady state values. The following log-linearized equations summarize the equilibrium dynamics of the model.

4.2.9.1 Households

The financially included households' consumption optimality conditions with equations 4.2 and 4.5 combined yields:

$$c_t^{fi} = \frac{h}{1+h} c_{t-1}^{fi} + \frac{1}{1+h} E_t(c_{t+1}^{fi}) - \frac{1-h}{1+h}(r_t - E_t(\pi_{t+1})) + \left[\frac{1-h}{1+h}\right]\left[\frac{\tau_{ss}^c}{1+\tau_{ss}^c}\right](E(\hat{\tau}_{t+1}^c) - \hat{\tau}_t^c) \quad (4.25)$$

$$\hat{\lambda}_t^{fi} = -\frac{\tau_{ss}^c}{1+\tau_{ss}^c}\hat{\tau}_t^c - \frac{1}{1-h} c_t^{fi} + \frac{h}{1-h} c_{t-1}^{fi} \quad (4.26)$$

The investment equation (equation 4) and it relationship with the equation which describes the dynamics of Tobin's Q (equation 4.3) can respectively be written as:

$$i_t - k_t = \eta q_t \quad (4.27)$$

$$q_t = -[r_t - E_t(\pi_{t+1})] + [1-\beta(1-\delta)]E_t(r_{t+1}^k) + \beta E_t(q_{t+1}) \quad (4.28)$$

The log-linearized version of the capital accumulation equation (equation 4.1) can be written as:

$$k_{t+1} = (1-\delta)k_t + \delta i_t \quad (4.29)$$

The financially excluded households' consumption optimality condition (equations 4.6 and 4.7) can respectively be written as:

$$\hat{\lambda}_t^{fe} = -\frac{\tau_{ss}^c}{1+\tau_{ss}^c}\hat{\tau}_t^c - \frac{1}{1-h} c_t^{fe} + \frac{h}{1-h} c_{t-1}^{fe} \quad (4.30)$$

$$c_t^{fe} = w_t + n_t^{fe} - \frac{\tau_{ss}^c}{1+\tau_{ss}^c}\hat{\tau}_t^c - \frac{\tau_{ss}^n}{1-\tau_{ss}^n}\hat{\tau}_t^n \quad (4.31)$$

The log-linearization of aggregate variables (real consumption and labor hours) implies that:

$$c_t = \lambda c_t^{fe} + (1-\lambda) c_t^{fi} \tag{4.32}$$

$$n_t = \lambda n_t^{fe} + (1-\lambda) n_t^{fi} \tag{4.33}$$

Here, it is assumed that the steady consumption and labor supply is the same for all households i.e. $C_{ss} = C_{ss}^{fi} = C_{ss}^{fe}$ and $N_{ss} = N_{ss}^{fi} = N_{ss}^{fe}$.

4.2.9.2 Firms

The familiar equation (New Keynesian Phillips Curve) describing the dynamics of price inflation as a function of the deviations of the average logarithm of mark-up from its steady state level can be obtained from equations 4.13 and 4.14 written as:

$$\pi_t = \beta E_t(\pi_{t+1}) + \kappa_p(mc_t + \hat{\varepsilon}_t^p) \tag{4.34}$$

where, $\kappa_p = \frac{(1-\beta\theta)(1-\theta)}{\theta}$, $\pi_t = p_t - p_{t-1}$ is price inflation and mc_t is real marginal cost and using equation 12, we obtain:

$$mc_t = w_t - y_t + n_t \tag{4.35}$$

Additionally, cost minimization implies that the ratio of inputs (capital to labor ratio) given by equation 4.11 can be written as:

$$r_t^k = w_t - k_t + n_t \tag{4.36}$$

Also, log-linearization of the production function (equation 4.10) yields:

$$y_t = \alpha k_t + (1-\alpha)(a_t + n_t) \tag{4.37}$$

4.2.9.3 Labor Market

The log-linearization of the wage equation under perfectly competitive market (equations 4.15 and 4.16) gives:

$$w_t = \phi n_t^{fi} + \frac{1}{1-h} c_t^{fi} - \frac{h}{1-h} c_{t-1}^{fi} + \frac{\tau_{ss}^c}{1+\tau_{ss}^c} \hat{\tau}_t^c + \frac{\tau_{ss}^n}{1-\tau_{ss}^n} \hat{\tau}_t^n \tag{4.38}$$

$$w_t = \phi n_t^{fe} + \frac{1}{1-h} c_t^{fe} - \frac{h}{1-h} c_{t-1}^{fe} + \frac{\tau_{ss}^c}{1+\tau_{ss}^c} \hat{\tau}_t^c + \frac{\tau_{ss}^n}{1-\tau_{ss}^n} \hat{\tau}_t^n \tag{4.39}$$

where τ_{ss}^n and τ_{ss}^c are steady state labor income tax and consumption tax rates, respectively.

Also, the optimality condition following the household's wage setting problem under monopolistically competitive market structure (combining equations 4.17 and 4.18) yields the familiar New Keynesian Phillips Curve for wage inflation for each type of households as given below:

$$\pi_t^w = \beta E_t(\pi_{t+1}^w) + \kappa_w[\phi n_t^{fi} + \frac{\tau_{ss}^n}{1-\tau_{ss}^n} \hat{\tau}_t^n - \hat{\lambda}_t^{fi}] \tag{4.40}$$

$$\pi_t^w = \beta E_t(\pi_{t+1}^w) + \kappa_w[\phi n_t^{fe} + \frac{\tau_{ss}^n}{1-\tau_{ss}^n} \hat{\tau}_t^n - \hat{\lambda}_t^{fe}] \tag{4.41}$$

where, $\kappa_w = \frac{(1-\beta\theta_w)(1-\theta_w)}{\theta_w}$, $\pi_t^w = w_t - w_{t-1} + \pi_t$ is wage inflation.

4.2.9.4 Monetary Authority

The log-linearization of the monetary policy rule (equation 4.19) gives:

$$r_t = \rho_r r_{t-1} + (1-\rho_r)[\phi_\pi \pi_t + \phi_y(y_t - y_{t-1})] + \varepsilon_t^r \tag{4.42}$$

4.2.9.5 Fiscal Authority

The log-linearization of the government budget constraint (equation 4.20) leads to:

$$\frac{B_{ss}}{Y_{ss}}\beta(b_t - r_t) = \frac{B_{ss}}{Y_{ss}}(b_{t-1} - \pi_t) + \gamma_G g_t - \tau^c_{ss}\gamma_C(c_t + \hat{\tau}^c_t) - \tau^n_{ss}\frac{W_{ss}N_{ss}}{Y_{ss}}(\hat{\tau}^n_t + w_t + n_t) \quad (4.43)$$

Also, log-linearization of the three fiscal policy rules, equations 4.21, 4.22, and 4.23, respectively gives:

$$g_t = \rho_g g_{t-1} + (1-\rho_g)\phi_g(b_{t-1} - y_{t-1}) + \varepsilon^g_t \quad (4.44)$$

$$\hat{\tau}^c_t = \rho_{\tau c}\hat{\tau}^c_{t-1} + (1-\rho_{\tau c})\phi_{\tau c}(b_{t-1} - y_{t-1}) + \varepsilon^{\tau c}_t \quad (4.45)$$

$$\hat{\tau}^n_t = \rho_{\tau n}\hat{\tau}^n_{t-1} + (1-\rho_{\tau n})\phi_{\tau n}(b_{t-1} - y_{t-1}) + \varepsilon^{\tau n}_t \quad (4.46)$$

4.2.9.6 Equilibrium

Log-linearizing the market clearing condition (equation 4.24) yields:

$$y_t = \gamma_C c_t + \gamma_I i_t + \gamma_G g_t \quad (4.47)$$

where $\gamma_C = \frac{C_{ss}}{Y_{ss}}$, $\gamma_I = \frac{I_{ss}}{Y_{ss}}$, $\gamma_G = \frac{G_{ss}}{Y_{ss}}$ are the ratio of steady states of real consumption, investment, and government expenditure to output, respectively.

4.2.9.7 Shock processes

All shock processes in the set-up are given in a log-linearized form and are assumed to follow an AR (1) process (except for the four policy shocks which are assumed to be

exogenous) with an i.i.d normal distribution error term and with zero mean and its own variance, δ_e^2 (i.e. $u_t^e \sim N(0, \delta_e^2)$, where e is the shock type) written below:

Price mark-up shock:

$$\hat{\varepsilon}_t^p = \rho_p \hat{\varepsilon}_{t-1}^p + u_t^p \quad (4.48)$$

Productivity shock

$$a_t = \rho_a a_{t-1} + u_t^a \quad (4.49)$$

Monetary policy shock

$$\varepsilon_t^r = u_t^r \quad (4.50)$$

Government spending shock

$$\varepsilon_t^g = u_t^g \quad (4.51)$$

Consumption tax shock

$$\varepsilon_t^{\tau c} = u_t^{\tau c} \quad (4.52)$$

Labor income tax shock

$$\varepsilon_t^{\tau n} = u_t^{\tau n} \quad (4.53)$$

It, therefore, follows from the above that equations 4.25 to 4.47, and the shock processes (equations 4.48 to 4.53) summarize the equilibrium in the economy. We consider two models here: Model 1 is the case where we consider flexible wage dynamics, whereas Model 2 considers sticky wage dynamics.

4.2.9.8 Steady states

The main steady state equations as implied by the model are summarized below:

$$\frac{W_{ss}N_{ss}}{Y_{ss}} = \frac{(1-\alpha)}{u^p}, \text{ where, } u^p = \frac{\varepsilon}{\varepsilon - 1},$$

$$\gamma_C = \frac{C_{ss}}{Y_{ss}} = (1-\gamma_G) - \frac{\delta\alpha}{(\rho+\delta)u^p}, \text{ where, } \rho = \frac{1}{\beta} - 1$$

$$\gamma_I = \frac{I_{ss}}{Y_{ss}} = 1 - \gamma_G - \gamma_C$$

$$\frac{B_{ss}}{Y_{ss}} = (\gamma_G - \tau_{ss}^c \gamma_C - \tau_{ss}^n \frac{W_{ss}N_{ss}}{Y_{ss}}) \frac{1}{\beta - 1}$$

4.3 Bayesian Estimation of the Model

4.3.1 Bayesian inference method[12]

4.3.2 Data

Estimation of the parameters of the DSGE model presented above uses quarterly time series data spanning 1985Q1 to 2017Q4 on real Gross Domestic Product (GDP), real household consumption expenditure, Consumer Price Index (CPI), real government expenditure, and nominal interest rate (monetary policy rate/discount rate) for Ghana.

Following Smets and Wouters (2007), log first difference of real GDP, real consumption, real government expenditure, and CPI multiplied by 100 are taken to represent output growth, consumption growth, government expenditure growth and inflation, respectively. Thus, our observed variables include: output growth, consumption growth, government expenditure growth, inflation, and interest rate. It is to be noted that quarterly

[12] Please, see pages 45 and 46 of Chapter 3.

series for real GDP, real consumption, and real government expenditure were interpolated from their annual counterparts.[13]

All series are seasonally adjusted except nominal interest rate. Series on CPI and nominal interest rate were obtained from IMF's International Financial Statistics database, whereas series on real GDP, real consumption, and real government expenditure were sourced from the World Bank's World Development Indicators database (2019).

4.3.3. Calibration

Three of the model's parameters were fixed whiles three steady state variables were calibrated; the remaining parameters were estimated. We fixed those parameters (because the data points were insufficient) and chose these three parameters (ε, η, and ε_w). We found that estimating them together with the other parameters distorted the convergence diagnostics of the MH algorithm, so, we set $\varepsilon = 6$, $\eta = 1$, $\varepsilon_w = 4$ using the calibrated values from Furlanetto and Seneca (2012). Also, γ_G, which is the steady ratio of real government expenditure to real GDP, was calibrated using our observed data and was set at 0.14. Also, the steady state values for consumption tax rate (ι_{ss}^{c}) and labor income tax rate (ι_{ss}^{n}) were set at 0.14 and 0.25, respectively.

4.3.4 Priors

The third, fourth, and fifth columns of Table 4.2 (see Appendix) give a synopsis of our assumptions on the prior distribution of 25 parameters. In choosing the priors, in some

[13] This interpolation was performed following Chow and Lin (1971).

cases, we used the calibrated values of the parameters from Furlanetto and Seneca (2012) and Gali et al., (2007) as prior means with an assumed standard deviation, while in other cases we followed the standard literature.

Particularly, the discount factor and the depreciation rate are assumed to follow a Beta distribution with means 0.99 and 0.025, and standard deviations 0.002 and 0.003, respectively. The parameters governing the share of financially excluded households and consumption habit also follow a Beta distribution with means 0.5 and 0.7, respectively and standard deviation of 0.025 for both.

A Gamma distribution is assumed for the coefficient of Frisch labor elasticity, with a mean value of 0.5 and a standard deviation equal to 0.01. The parameters governing the share of capital to output and Calvo price and wage stickiness are all assumed to follow a Beta distribution and fluctuate around 0.33 and 0.75, respectively. The standard deviation for the share of capital to output is 0.015, while both Calvo price and wage stickiness have a standard deviation of 0.01. The standard errors of all the innovations are assumed to follow inverse gamma distribution with mean 0.1 and standard deviation 10. Further, a Beta distribution is assumed for the price mark-up shock process with mean 0.5 and standard deviation 0.1, and that of the technology shock having a mean of 0.95 and a standard deviation value of 0.002.

Moreover, as in Iwata (2009), the degree of government spending, consumption tax, and labor income tax smoothing parameters all follow Beta distribution with mean 0.5 and standard deviation 0.075. Also, the parameter weight of government spending, consumption tax, and labor income tax on debt-to-output ratio are assumed to follow a normal distribution with mean 0.1 and standard deviation 0.05.

Finally, the degree of interest-rate smoothing parameter is assumed to follow a Beta distribution with mean 0.69 and standard deviation 0.1. As in Smets and Wouters (2003), the parameters governing the weight placed by the central bank on inflation and output growth are both normally distributed with means 1.7 and 0.26, and standard deviations 0.25 and 0.015, respectively.

4.4 Results and Discussion

The results of the posterior estimation of the model's parameters and the six exogenous shocks are reported in Table 4.2 (see Appendix) for Model 1 (flexible wage dynamics) and Model 2 (sticky wage dynamics). Given our priors, we estimate the posterior distributions of the parameters using the Metropolis-Hastings algorithm. We run two independent Markov chains with five hundred thousand (500,000) draws and perform Brooks and Gelman (1998) convergence diagnostics. These results together with the trace plots suggest that the two chains have converged for both the univariate and multivariate convergence. Appendix 4A displays the trace plots of some selected parameters. We report the Bayesian posterior mean estimates of the parameters in the sixth and seventh columns of Table 4.2 for models 1 and 2, respectively. As shown in Appendix 4C, the posterior estimates of some of the parameters are close to the prior means (similar for both models), indicating consistency between the priors (our initial guess) and the information contained in the data. However, other parameters saw the posterior estimates moving far from their prior means indicating an additional gain from employing the data in our Bayesian technique. Below, we

discuss the estimates of some selected parameters for models 1 and 2. Admittedly, the standard deviation estimate of the shocks are significantly large[14].

4.4.1 Posterior Estimates

The estimates of the fraction of the financially excluded household's parameter is found to be 35% in model 1 and 52% in model 2. The parameter governing habit persistence formation is estimated to be around 0.81 and 0.83 for models 1 and 2, respectively. Further, the estimate of the contribution of capital to output is modest, approximately 0.29 and 0.32 for models 1 and 2, respectively. The degree of price and wage stickiness are also found to be modest (0.75). Also, the inverse of the Frisch labor elasticity parameter estimate is found to be similar (about 0.47 and 0.50) in the two models.

Concerning the monetary policy rule, the parameter representing the degree of interest-rate smoothing (ρ_r) had estimated values of 0.68 and 0.72. Also, the response of interest rate to inflation is closer to unity in the long-term in both models. We find that the Central Bank of Ghana (BOG) pursues strict anti-inflationary policies with an inflation coefficient (ϕ_π) value of about 3.2 for both models. That is, for every one percentage point increase in inflation, BOG responds by raising the nominal interest rate by about 0.96 percentage points[15]. This finding is not surprising as BOG operates under inflation targeting monetary policy. Also, the parameter governing the weight BOG places on output growth (ϕ_y) is estimated to be around 0.26. This suggests that for every one percentage point increase

[14] We tried reducing the standard deviations of the shocks by changing the priors. However, this often resulted in numerical problems for the MH algorithm, such as non-convergence.

[15] Note that the coefficient of the inflation in the Taylor rule is multiplied by (1- ρ_r) as shown in equation 4.42.

in output growth, BOG increases the nominal interest rate by approximately 0.078 percentage points. This finding suggests that BOG has been less aggressive in achieving greater output growth in the Ghanaian economy.

In addition, the estimated values of the parameters characterizing all three fiscal policy rules indicate that the fiscal authority reacts modestly to debt-to-output ratio. Specifically, the parameter characterizing the response of government spending to debt-to-output ratio (ϕ_g) had estimated values of 0.039 and 0.173, respectively for models 1 and 2. Using the estimates from model 2, it can be seen that a one percentage point increase in debt-to-output ratio induces an increase of about 0.02 percentage points in government spending. That is, as output decreases or debt increases the fiscal authorities adjust their budget accordingly to increase their expenditure.

Finally, the parameter governing the response of consumption tax to debt-to-output ratio ($\phi_{\tau c}$) registered estimated values of 0.24 and 0.14, respectively for models 1 and 2. Thus, from the estimation results in model 2, for every one percentage point increase in debt-to-output ratio, consumption tax rate increases by about 0.018 percentage points[16]. Similarly, the parameter governing the response of labor income tax to debt-to-output ratio ($\sigma_{\tau n}$) registered an estimated value of about 0.1. This suggests that a one percentage point increase in debt-to-output induces about 0.05 percentage points increase in labor income tax rate. These results suggest that the government finances its debt-to-output ratio through an increase in consumption and labor income tax rates. Overall, the response of income tax rate

[16] Note that the coefficients of debt-to-output ratio in the fiscal policy rules is multiplied by one minus the smoothing parameters as shown in equations 4.44 to 4.46.

to debt-to-output ratio is found to be the largest among those of the three fiscal policy instruments considered in the model.

4.4.2 Bayesian impulse response analysis

In this section, we examine the impact of government spending, consumption tax, labor income tax, and monetary policy shocks on key macroeconomic variables. We also examine how each of the fiscal shocks affect the consumption and working hours by financially included and excluded households. Finally, monetary policy response to an increase in government spending is also analyzed. It is to be noted that all dynamic responses of the variables depict a one standard deviation shock to all innovations and percentage-point deviations from their steady state. The blue lines represent mean impulse responses, while the gray areas indicate the 90% posterior probability band. Also, note that we discuss the results from our two models for government spending and monetary policy shocks. However, for the remaining shocks, we only discuss the results from model 2, using the log data densities of both models as the criteria, but report that from model.

4.4.2.1 Government spending shock

The impulse response functions of key macroeconomic variables to a positive government spending shock are displayed in Figures 4.1 and 4.2 for models 1 and 2, respectively. In Figure 4.1 (see Appendix), it is observed that an exogenous increase in government spending immediately leads to an increase in output, consumption (crowd-in consumption), and employment, and hence, aggregate demand increases. The fiscal authorities finance the increase in government spending through borrowing, as one of the means, and as a result public debt immediately balloons. The increase in aggregate demand

exerts upward pressure on the prices of inputs, and goods and services. Thus, inflation increases by approximately 0.16 percentage points. However, because nominal wage setting is flexible, the wage rate immediately adjusts upwards by about 0.6 percentage point following the rise in demand for labor. As a result, although inflation increases, real wage increases on impact (about 0.6 percentage points increase). Even though the increase in real wage is counterfactual, the increase in not substantial. The increase in real wage and employment raise the (real) disposable income of both households.

It can also be seen that although aggregate consumption increases, the consumption of financially included households drops by about 0.19 percentage points at maximum but that of financially excluded households increases by about 0.88 percentage points. This is because monetary authorities respond actively to rises in inflation caused by increased in government spending through an increase in the nominal interest rate (by about 0.27 percentage points). Thus, financially included households take advantage of the rise in interest rate to save and to accumulate more capital and, therefore, reduce their consumption or substitute saving for consumption. This explanation supplements what has been documented in the literature. It is argued that financially included households anticipate government spending increase, financed by increased taxes and, therefore, reduce their consumption and rather increase their working hours. On the other hand, finically excluded households simply spend all of the increase in their (real) disposable income as they lack access to the financial market, which prevents them from saving to accumulate wealth.

Moreover, from Figure 4.2 (see Appendix), the analysis and the transmission mechanism following expansionary fiscal policy (increased government spending) are

similar to the ones described above for model 1. However, several differences between the two results should be pointed out. In particular, exogenous increase in government spending leads to increase in output, inflation, and employment but crowds-out consumption in the second model. Also, because nominal wage setting is sticky, the rise in inflation outweighs the slow increase in nominal wage. As a result, real wage decreases by about 0.05 percentage points on impact. As before, BOG through the Taylor rule moderates the inflationary pressures by increasing the nominal interest rate. The combined effect of these (a rise in nominal interest rate and a fall in real wage) led to a fall in aggregate consumption. However, although aggregate consumption falls, the consumption of financially excluded household increases by about 0.054 percentage points, whereas that of financially included households decreases by 0.18 percentage points on impact. Surprisingly, the estimated share of financially excluded households increased considerably, from 3.5% in model 1 to 5.2% in model 2; therefore, one would expect that the weighted average of consumption of the two households would have generated a rise in aggregated consumption in the second model. However, the opposite is found. Arguably, this negative consumption multiplier of government spending shock could be explained by two factors: [1] the active response of BOG to the rise in inflation through an increase in the nominal interest rate, and [2] the sticky wage dynamics that induces a fall in real wage and (real) disposable income.

By comparing the consumption of financially included and excluded households across the two models, the rise in consumption of the latter is larger under flexible wage dynamics than under sticky wage dynamics. Specifically, expansionary fiscal policy (increased government spending) increased the consumption of financially excluded

households by about 0.9 percentage points and 0.05 percentage points, respectively, under flexible and sticky wage dynamics. However, the fall in the consumption of financially included household is approximately the same on impact across the two models. On the effect of government spending on output and inflation, a slightly larger increase in both variables is found under flexible wage dynamics than under sticky wage dynamics. However, the output multiplier under both models are almost less than one. Thus, fiscal policy is more effective when the labor market is perfectly competitive and when wage setting is flexible.

4.4.2.2 Policy experiment of government spending shock

Here, we perform fiscal policy experiment to analyze the responses of consumption and output to increased government spending shock at different levels of financial exclusion in models 1 and 2. To that end, we identity the role of financial exclusion and sticky wage dynamics in generating positive or negative consumption and output multipliers of government spending shock. The results are displayed in Figure 4.3 (see Appendix). The upper panel shows that consumption responses in model 1 and 2 while the lower panel shows output responses in the same models. For model 1 where wages a flexible, a fraction as low as 25% or 35% of financially excluded households generates a crowd-in effect on consumption following government spending shock, although after 3rd or 4th quarters consumption starts to fall but increases again after 11th quarter. It can be seen that with a fraction of 50% of financially excluded households in the economy consumption increases on impact. That is, the consumption multiplier of government spending shock remains positive.

However, when sticky wages are introduced (model 2) a fraction of 50% of financially excluded households leads to a negative consumption multiplier of government spending shock. Even when the proportion of those households is increased to 75%, the expansionary effect of government spending shock on consumption last for only about 1.5 quarters, after which consumption starts to fall. This suggests that the sticky wage dynamics in the economy is crucial in generating an expansionary effect of government spending shock on consumption, although the fraction of financially excluded households matters to some extent.

Regarding the impact of government spending shock on output, it can be seen that output increases on impact in both models, regardless of the fraction of financially excluded households in the economy. However, the increases in output are generally larger in model 1 than in model 2. This suggests that, generally, the expansionary effects of government spending shock on consumption and output are dampened by the sticky wage dynamics in the economy.

In addition, we fix the level of sticky wage parameter to different values to examine and to confirm the role played by sticky wage in the Ghanaian economy. Figure 4.4 displays the dynamic responses of output and inflation to government spending shock at difference levels of sticky wages. It can be observed that, at lower levels of sticky wage, consumption decreases less than at higher levels of sticky wage, although the output, generally, do not change. This finding re-enforces our initial conclusion that sticky wages in the economy is to a greater extent responsible for generating a negative consumption multiplier of consumption spending shock.

4.4.2.3 Monetary policy shock

In this session, we analyze the effectiveness of monetary policy under both sticky wage and flexible wage settings. The responses of output, inflation, consumption, and employment to a positive monetary policy shock are displayed in Figure 4.5 (see Appendix) for models 1 and 2. It can be seen that, a contractionary monetary policy induces a fall in inflation, output, consumption, and employment. Although monetary policy is seen to be effective under both models, the magnitude and the impacts of the shock on the four macroeconomic variables are somewhat different. Evidently, the response of all the four variables to a rise in nominal interest are seen to be greater in a situation where wages are flexible than when wages are sticky. For example, whereas a contractionary monetary policy induces a fall in inflation and output by about 1.1 and 2.15 percentage points, respectively under flexible wage setting environment, it leads to a fall in the far variables by approximately 0.77 and 1.75 percentage points, respectively. Thus, it can be concluded that monetary policy is more effective in an economy where wages are flexible than where wages are sticky.

4.4.2.3 Consumption tax shock

The responses of the key macroeconomic variables to a positive consumption tax shock (contractionary fiscal policy) are shown in Figure 4.6 (see Appendix). This shock has negative effects on the economy. The hike in consumption tax rate reduces aggregate consumption and output. Also, the reduction in aggregate demand exerts downward pressure on the prices of inputs and goods and services. Thus, inflation falls leading to an increase in real wage. The decrease in aggregate demand translates into a reduction in employment. As

a result, aggregate employment immediately falls by about 1.15 percentage points and peaking at 3.02 percentage points below its steady state value. It can be seen that the consumption of both households decreases on impact. To mitigate the damping effect on their consumption, financially excluded households increased their working hours by about 6.24 percentage points. That is, due to lack of access to the financial sector and savings, the only alternative is to increase their hours of work to increase disposable income. However, their included counterparts, having full access to financial sector, to some extent mitigate the fall in their consumption by tapping into their previous savings and rather decreased their hours of work by about 9.18 percentage points. Sadly, despite the increase in working hours of financially excluded households and the decrease in working hours of financially included ones, the former saw a larger reduction in their consumption than the latter. Specifically, the consumption of financially excluded household falls by nearly 2.07 percentage points, continued to fall until the fifth quarter, peaking at 4.54 percentage points. However, the consumption of financially included households saw a fall of about 0.76 percentage points, reaching a minimum of only 1.64 percentage points in the fifth quarter. These results suggest that financially excluded households are less resilient in terms of absorbing shocks than their included counterparts.

4.4.2.4 Labor income tax shock

Figure 4.7 (see Appendix) presents the impulse responses of the select variables to a rise in labor income tax innovation. The rise in labor income tax (contractionary fiscal policy) discourages working and as a result aggregate employment decreased by about 0.003 percentage points on impact. Consequently, disposable income decreased, leading to a

reduction in consumption and output. It can also be seen that the consumption of both financial included and excluded households was negatively affected. In particular, the fall in the disposable income induces a reduction in the consumption of financially excluded households by approximately 0.005 percentage points, whereas that of financially included ones was reduced by 0.0002 percentage points. Again, to insulate their consumption from the rise in labor income tax, financially excluded households had no option except to increase their working hours. That is, they increased their working hours by 0.024 percentage points. On the other hand, financially included households had their working hours reduced by approximately 0.033 percentage points. With access to the financial sector and availability of savings, they respond negatively to the rise in the labor income tax, but, still their consumption fell less than that of financially excluded households. In short, conditions grew worse for financially excluded households.

4.4.2.5 Robustness Checks

In the following, we perform series of robustness checks to the analysis above to examine the dynamic responses of the macroeconomics variables to a positive government spending shock. First, we consider two alternative tax-financing schemes: (a) a labor income tax-financing scheme, where the labor income tax alone adjusts to stabilize debt; and (b) a consumption tax-financing scheme, where the consumption tax alone adjusts to stabilize debt. Specifically, in considering labor income tax-financing scheme, we set $\rho_{tc} = \phi_{tc} = 0$ whereas, in considering consumption tax-financing scheme, we set $\rho_{tn} = \phi_{tn} = 0$. Second, we estimate an alternative government spending rule where government spending reacts to its lag and lag

of output gap. Third, we increase the parameters governing AR (1) of consumption and labor income taxes, (i.e., we set $\rho_{tc} = \rho_{tn} = 0.99$). Lastly, we divide the sample of our data into two and estimate the model using data from 2001Q1 to 2017Q4.

Figure 4.8 displays the dynamic responses of consumption, output, employment (working hours), and inflation to a positive government spending shock. It can be observed that the dynamic responses of all those macroeconomic variables to government spending shock are similar to the ones we have analyzed above, confirming the robustness of our results. In particular, consumption falls on impact while output, employment, and inflation increase on impact following the government spending shock for all the alternative robustness checks. Note that R1 is for the case of consumption-tax financing scheme, R2 for labor income-tax financing scheme, R3 for the alternative government spending rule, R4 for the AR (1) parameters, and R5 for the division of sample period.

We also simulated our model using the estimated parameters to simulate data for the observed variables in our model. We then compare the moments from our observed data with that from the simulated data. The results are displayed in Table 4.3. The standard deviations obtained from the simulated data are however, generally larger than the one from the actual data.

4.4.3 Forecast Error Variance Decomposition

In this section, we carry out variance decomposition analysis from the estimated model to examine the drivers of business cycle in the Ghanaian economy. In particular, we analyze the contribution of each of the shocks in the model to the variations in output, consumption, employment, and inflation. Table 4.4 (see Appendix) reports the results at

different horizons for those four variables. We follow Smet and Wouters (2003), and define 1-4 quarters (one year) as the short run, 10 quarters (2.5 years) as the medium run, and 100 quarters (25 years) as the long run. At a glance, it can be seen that whereas consumption tax shock appears to be an important driver of those four variables in the Ghanaian economy at all horizons, government spending and labor income tax shocks are less important in driving those variables.

In the very short term (one year), the key drivers of output are found to be price mark-up, technology, consumption tax, and monetary policy shocks. At that horizon, price mark-up shock was the main driver of output, contributing to about 45% variation in output, followed by technology shock (29%), consumption tax shock (19%), and monetary policy shock (5%). However, after the initial four quarters, technology shock overtook price mark-up shock to be the main driver of output in both medium and long terms. Specifically, it contributes to about 73% in the variability of output in the long-run, followed by consumption tax shock (18%), and price mark-up shock (8%).

Turning to the drivers of consumption in the Ghanaian economy, it can be seen that price mark-up shock, technology shock, consumption tax shock, and monetary policy shock are the most important. In terms of their contributions to the fluctuation in consumption, price mark-up contributes largely (about 52%) in the short run, followed by consumption tax shock (32%), technology shock (10%), and monetary policy shock (6%). The medium and long runs, however, had technology and consumption tax shocks dominating in driving consumption in the economy.

With regard to the determinants of employment, price mark-up, technology, and consumption tax shocks are found to be the main drivers at all the horizons. In particular, on average, price mark-up shock is seen to be the main and most important driver of employment among the four shocks, accounting for about 58%, 37%, and 24% in the short, medium, and long terms, respectively. Also, technology and consumption tax shocks moderately drive employment at all horizons in the Ghanaian economy.

Finally, similar results are found regarding the determinants of inflation. That is, price mark-up, technology, consumption tax, and monetary policy shocks are found to be main contributors to the fluctuation in inflation at all the horizons. In terms of their quantitative importance, price mark-up shock dominates, accounting for 59% in the long-run, followed by technology shock (31%), with consumption tax and monetary policy shocks moderately influencing inflation in the long-run.

4.5 Conclusion

In this chapter, we examine the impacts of fiscal policy shocks on key macroeconomic variables in the Ghanaian economy, where a substantial portion of the population are financially excluded. Specifically, we analyze the effects of government spending, consumption tax, and labor income tax shocks on both aggregate and disaggregate consumption, on employment, and on other macroeconomic variables. To do that, we adopt a traditional New Keynesian DSGE model which features heterogeneous households: financially included and excluded households. We redesign the model by introducing two distortionary taxes, namely: consumption and labor income taxes. In addition, we consider two alternative labor markets: perfectly and monopolistically competitive labor markets. In

short, we consider flexible wage and sticky wage dynamics in parallel. We then estimate the model's parameters through a Bayesian approach for the Ghanaian economy, using quarterly time series data from 1985Q1 to 2017Q4 on consumer price index, nominal interest rate, real household consumption expenditure, real GDP, and real government expenditure. We then analyze [1] the posterior mean estimates, [2] the Bayesian impulse response functions, and [3] the forecast error variance decomposition.

To begin with, the estimate of the fraction of financially excluded households yielded slightly different values. That is, estimates of 35% and 52% were found under the two alternative models, respectively. Also, the parameter estimates in the Taylor rule suggest that BOG has responded more aggressively to inflation than output growth. Further, the estimates of the parameters governing the three fiscal policy rules indicate that the response of income tax rate, as a fiscal policy instrument, to debt-to-output ratio is the largest, followed by government spending and consumption tax rate.

Moreover, the results from the Bayesian impulse response analysis show that increased government spending has an expansionary effect on consumption, output, employment, and inflation, but turns to crowd-out consumption when wages are sticky. The output multipliers are found to be almost less than one under both flexible wage and sticky wage dynamics. At the aggregate level, the response of output and inflation to expansionary fiscal policy (increased government spending) is somewhat stronger in a market where wages are perfectly competitively determined. Under both flexible and sticky wage dynamics, an increase in government spending has a decreasing effect on the consumption of households who enjoy full financial inclusion but has an expansionary effect on that of financially

excluded ones. The excluded group is found to experience a decrease in their consumption due the increase in the interest rate. Also, the sticky wage in the model induces a fall in real wage which also exerts a downward pressure on their consumption.

Furthermore, a hike in consumption and labor income taxes (contractionary fiscal policy) discourages working and, thus, leads to a decreased employment, output, and consumption. At the disaggregated level, the results signal that lack of access to the financial sector and savings leave financially excluded households with alternative to increase their working hours in order to mitigate the negative effect of those shocks on their consumption. On the contrary, households that are financially included use the financial sector mechanism for tapping into their savings to insulate themselves from those shocks and rather reduce their working hours. Sadly, despite those inter-temporal optimal decisions by both households, both shocks decrease the consumption of the former more than that of the latter. This finding supports the full financial inclusion agenda. Thus, we have empirically confirmed that when households are faced with shocks financially excluded households experience higher volatility in their consumption than financially included ones. Moreover, financially exclude households are less resilient in absorbing those shocks than their included counterparts.

In addition, a contractionary monetary policy leads to a significantly fall in inflation and other real variables including output, employment, and consumption. The impulse analysis shows that the response of those variables to a positive monetary positive shock is stronger under flexible wage dynamics than under sticky wage dynamics. Thus, monetary policy is found to be more effective in achieving its targets when the labor when wages are flexible.

Finally, the results of the variance decomposition analysis show that, from non-policy shocks side, technology and price mark-up shocks are the most important drivers of key macroeconomic variables including output, inflation, employment, and consumption in the Ghanaian economy. In terms of policy shocks, consumption tax shock emerges as the main driver of output, inflation, employment, and consumption in the economy with monetary policy shock playing a minor role.

CHAPTER 5

EFFECTS OF A HEALTH SHOCK ON WORKING HOURS AND HEALTH CARE USAGE: THE ROLE OF FINANCIAL INCLUSION IN GHANA

5.1 Introduction

Idiosyncratic health shocks, including illness and/or injury, are among the most debilitating economic shocks affecting the economic opportunities of many households in both developed and developing countries. However, the effects of health shocks on the welfare of households are likely to be greater in developing countries because insurance markets and their associated services are underdeveloped, which make most households more vulnerable and less capable of insulating themselves against health shocks (Islam & Maitra, 2012). An understanding of the impact of health shocks is crucial, but to ensure the appropriateness of policy interventions, that understanding must be in the context of the dire economic consequences (economic costs) that health shocks impose on households. These economic costs associated with health shocks come in two forms: [1] the increased health expenditures required to treat such illness and/or injury; and [2] a reduction in income due to lost hours of work and the subsequent decline in productivity (Gertler & Gruber, 2002). Intuitively, it can be argued that those health shocks are as threatening economically to the wellbeing of the individual as they are to the general health (in terms of labor productivity), and to the growth and development of national economies.

A number of empirical studies have examined the effects of health shocks on household outcomes—consumption, hours worked, health care utilization, and health and

non-health consumption expenditures—in developing countries. In particular, those studies have focused on examination of the ability of households to protect their income (or consumption) from health shocks, mainly through a risk sharing mechanism. However, the results of most of those studies are inconclusive. For example, whereas Islam and Maitra, (2012), Kochar (1995) and Townsend, (1994) found that household consumption is not responsive to health shocks in developing countries, Gertler and Gruber (2002) and Wagstaff (2007) found that health shocks have a decreasing and significant effect on household income and consumption. Regarding labor supply response to health shocks, Zucchelli et al., (2010) found that while health shocks increase the risk of men becoming unemployed, they also increase the risk of an early exit for women in the labor market. Pohl, et al. (2014) and García-Gómez, et al. (2013) report a similar finding from which they conclude that health shocks reduce employment.

In the absence or limited presence of formal and/or informal insurance mechanisms and schemes, the severity of the impacts of health shocks is even more profound (Islam & Maitra, 2012). One way to mitigate those impacts is to make different insurance instruments readily available so as to improve households' ability to respond to insure themselves against health shocks. Given the structural weaknesses in the financial systems of developing countries, however, financial inclusion (as prescribed by many mainstream economists including those working for the World Bank) emerges an alternative means by which households could protect themselves against health shocks. One way that households could use the financial sector as an instrument for self-insurance against health shocks is through borrowing (e.g. loan acquisition or overdraft) and/or reliance on savings. These loans or

savings could increase household access to credit and funds, which would enable access to timely diagnosis, prevention and treatment of diseases, which in urns could be beneficial to their employment decisions (Ahmed & Cowan, 2019).

Since financial inclusion has recently gained currency in development discourse, a number of recent studies have explored the role that financial inclusion plays in assisting households to insure themselves against health shocks. Surprisingly, many of those studies focused on food and non-health consumption smoothing by households (e.g. Annim, et al., 2011; Jack and Suri, 2014; Carlson, et al., 2015; Mitra et al., 2016, Riley, 2018), and have paid little attention to the relevance of labor supply, which is a critical factor underlying income and asset accumulation, and leading in turn to consumption smoothing. A literature search found no studies analyzing the potential effects of financial inclusion on household working hours during health shocks in developing countries such as Ghana. This lack of attention to this important phenomenon motivates the study.

Given that many developing countries are working to achieve full financial inclusion and universal health coverage (Giedion et al., 2013), and to increase production (high economic growth), a full understanding of health care utilization and labor supply responses to health shocks, and the role of financial inclusion during health shock periods is essential. A number of empirical studies have found health shocks to be one of most common income shocks and a cause of poverty in many households in developing countries (Atake, 2018). In Ghana for instance, poor health has been shown to have rendered many households vulnerable to poverty and to have distressing effects on individual and household productivity, and on economic growth (Novignon et al., 2012). In recognition of the above

considerations, this study examines the potential effects of financial inclusion on household working hours and health care utilization during health shocks in Ghana.

We conduct our analysis at the household level rather than the individual level. We argue that when a household member suffers illness and/or injury (health shock periods), it is possible that other members of the household will assume 'care-taking', which requires adjustment of their working hours during such periods. Consequently, not only would the working hours of the victim be affected, but also those of other members of the household, which could have a ripple effect on the working hours of the entire household. In the first section of our analysis, we examine the effects health shocks on two outcome variables: working hours and health care usage. We further identify the role played by financial inclusion during health shocks, if any. Finally, we explore the mechanism by which financial inclusion plays such a role. Recognizing that financial inclusion could be potentially endogenous, we use three estimation techniques here with one of them addressing such endogeneity concern: ordinary least squares (OLS), fixed effects (FE), and instrumental variable with fixed effects (IV-FE). Interestingly, the estimation results from all these three techniques are consistent and lead to the same conclusion, suggesting robustness of our results.

The remainder of this chapter is structured as follows: section two describes the data used with its summary statistics. Section three presents in detail the empirical framework, including empirical model specifications and identification strategy. Section four discusses the results, and section five presents conclusions and implications for policy-makers.

5.2 Data and summary statistics

The data used in this study comes from the sixth round of Ghana Living Standards Survey (GLSS-6) implemented by Ghana Statistical Service (GSS) and conducted in 2012-2013. The survey covers 18,000 households in 1,200 Enumeration Areas (EAs), and designed to be nationally representative. With a response rate of 93.2%, 16,772 out of the 18,000 households were successfully enumerated. Using a two-stage stratified sampling design, the 1,200 EAs were selected at the first stage to form a Primary Sampling Units (PSUs). These PSUs were then allocated into 10 regions using probability that is proportional to the population size. Further, the EAs were categorized into rural and urban settlements. Within each EAs, an average of 15 households were systemically selected to form a Secondary Sampling Units (SSUs). The survey included detail questions on education, health, employment and time use, migration and tourism, housing conditions, household agriculture, access to financial services and asset ownership, household demographic characteristics, community characteristics, and households' perception on governance, peace and security in Ghana.

We combine these data sets by household to measure financial inclusion, a health shock, working hours, health care usage and borrowing (loan acquisition) at the household level. We define hours worked as total working hours of the entire household during the past one week prior to the survey. Financial inclusion is measured as a binary variable where 1 indicates whether any household member has a bank account or is contributing to a loan or saving scheme, and 0 otherwise. Similarly, a health shock is an indicator variable equal to 1 if any household member has suffered from illness or injury or both in the past two weeks

prior to the survey, and 0 otherwise. Also, health care usage equal to 1 if any household member has consulted a health practitioner or a traditional healer or has visited a health facility during the past two weeks, and 0 otherwise; while borrowing is a binary variable where 1 indicates whether any household member has applied for or acquired a loan in the past twelve months, and 0 otherwise.

The summary statistics of the variables are shown in Table 5.1. From Table 5.1, about 48% of the households, on average, are financially included. Also, on average, approximately 41% of the households experienced a health shock. At the disaggregated level about 41% and 40% of financially included and financially excluded households, respectively, reported to have experienced a health shock during the past two weeks prior to the survey. Furthermore, the average working hours of each household is about 91.3 hours per week, while about 27% of the households have engaged in health care utilization and 12% of the households borrowed a year prior to the survey. The highest educational level of the household is secondary education, constituting about 62% of the households with households 'with no education' being the least, representing 1.2% of the households. In addition, approximately 80% of the households have either registered for or are covered by health insurance. The average number of adults aged 18 years and above per household are 2 while the average number of children who are below 18 years per household are also 2. Regarding the characteristics of household heads, the average age of a household head within our sample is 45.8 years and about 72% of the households are headed by a male. Also, close to 60% of the household heads are married with approximately 50% of the household heads engaging in farming activities. Furthermore, 67% of the household heads are Christians, 26% of them are

Muslims, with those without any religion accounting for 6.9%, while the Traditionalists representing only 0.1%. In addition, we inferred from our sample that about 56% of the households are located in rural areas and the remaining 44% of the households are living in urban areas.

5.3 Empirical Framework

In this section, we present our empirical model specifications and our identification strategy for examination of the effects of a health shock on working hours and health care utilization. Our analysis also composes those effects on financially included and excluded households under a health shock. That is, we examine the role that financial inclusion plays in moderating the effects of an idiosyncratic health shock on household working hours and health care utilization. In addition, we, elucidate the mechanism of that moderating role of financial inclusion.

5.3.1 Empirical model specification

To test the relationship between a health shock and working hours and health care usage, we estimate the following econometric equation:

$$y_{id} = \alpha + \rho Hshock_{id} + \boldsymbol{\varphi}\mathbf{X_{id}} + \lambda_d + \varepsilon_{id} \qquad (5.1)$$

where y_{id} is (a) total working hours or (b) health care usage of household *i* in location or district d . $Hshock_{id}$ is the health shock: a dummy variable equal to 1 if any household member has suffered illness or injury or both in the past 2 weeks, and 0 otherwise. This measure of health shock was used by Islam and Maitra (2012). λ_d is location or district fixed effects, and ε_{id} is the error term. Without the location or district fixed effects, the regression

may yield bias estimates due to a possible correlation between an omitted or unobserved location or district characteristics and the error term. $\mathbf{X_{id}}$ is a vector of household head characteristics: age, marital status, farming, employment type, industry type, and religion; and household characteristics: education, household size, income, health insurance coverage, and rural location, as shown in Table 5.1. For specification (a), where working hours is the outcome variable, we exclude income from the control variables to avoid simultaneous causality. Note that the definitions of the variables in the above equation are those in the previous section under data and summary statistics. For a health shock to have a relationship or an effect on the outcome variables, we a priori expect $\rho < 0$ for (a) and $\rho > 0$ for (b).

Now, to examine the potential effect or role of financial inclusion in enabling households to insure against an idiosyncratic health shock, we estimate an extended version of Equation (1)[17]:

$$y_{id} = \alpha + \rho Hshock_{id} + \psi FiN_{id} + \beta FiN_{id} * Hshock_{id} + \boldsymbol{\varphi}\mathbf{X_{id}} + \boldsymbol{\theta}\mathbf{X_{id}} * Hshock_{id} + \lambda_d + \varepsilon_{id} \quad (5.2)$$

where FiN_{id} is financial inclusion of household i in location or district d. The other variables in equation (2) are the same as explained above. We interact the shock variable with financial inclusion ($FiN_{id} * Hshock_{id}$) to examine the role of financial inclusion during a health shock. The parameter of interest is β. We would expect a priori that $\beta > 0$. To control for observed factors that could both (1) be correlated with financial inclusion and (2) help households to insure against a health shock, we also interact the health shock variable with

[17] This specification is a time-invariant version in that of Jack and Suri (2014).

all the control variables ($\mathbf{X_{id}} * Hshock_{id}$). This technique minimizes the potential bias in the estimate of our parameter of interest.

Furthermore, financially included households could use the financial sector to insure against a health shock in two ways: [1] they could tap into their savings and [2] they could borrow from the financial sector to pay for a visit to a health clinic or the purchase of medicine during a health shock, for faster recovery. That opportunity is not available for financially excluded households. To examine the impact of financial inclusion on loan acquisition (borrowing) during a health shock, we test the second mechanism or channel by estimating the equation (3).

$$loan_{id} = \alpha + \rho Hshock_{id} + \psi FiN_{id} + \beta FiN_{id} * Hshock_{id} + \boldsymbol{\varphi}\mathbf{X_{id}} + \boldsymbol{\theta}\mathbf{X_{id}} * Hshock_{id} + \lambda_d + \varepsilon_{id} \qquad (5.3)$$

where $loan_{id}$ is a dummy variable equal to 1 if household i in location or district d applied for or acquired a loan in the past 12 months[18], and 0 otherwise. As previously, we would a priori expect $\beta > 0$. The rest of the variables in equation (3) are the same as those explained earlier.

5.3.2 Identification strategy

The identification of the causal effects of financial inclusion on working hours and health care usage during a health shock, captured by the interaction term ($FiN_{id} * Hshock_{id}$), requires that the health shock variable be exogenous and be equally likely to affect both

[18] Our data does not include questions on whether households applied for or acquired a loan during the past two weeks (i.e. during the period they experienced a health shock). However, our thesis is that they might have suffered illness during the previous period and applied for or acquired a loan. Even if that is not the case, a loan acquired in a previous period before a health shock could be used for the same purpose.

financially included and excluded households. Health shocks have been shown empirically using household-level panel data in Africa and other developing countries to be exogenous (Jack & Suri, 2014; Ahmed & Cowan, 2019) and not persistent or anticipated (Islam & Maitra, 2011; Gertler & Gruber, 2002). Socioeconomic status such as income and educational levels are related to health status of households in the health economics literature. In particular, Braveman, at al. (2010), for example, document that the risk for chronic diseases such as heart disease, diabetes, and obesity are be higher among households with the lowest income and educational levels. Recognizing this, we control for household income and other socioeconomic variables in our regression equation. Thus, there is a good reason to assume that health status of financially included and excluded households are similar. Therefore, we follow Carlson et al., (2015) in considering our health shock variable to be exogenous or uncorrelated with the error term.

Another concern regarding our identification strategy is the potential endogeneity of the financial inclusion variable (FiN_{id}). This potential endogeneity stems from self-selection by households to be either financially included or excluded. Consequently, the financial inclusion variable may be correlated with both observed and unobserved household characteristics, which are also correlated with our outcome variables. Therefore, we deal in part with the endogeneity problem by controlling for observed household characteristics which may be correlated with financial inclusion in all the regressions. Since the focus of our analysis is on the coefficient of the interaction term ($FiN_{id} * Hshock_{id}$), i.e. β , we are much more concerned about selection into the financial sector being correlated with household ability to deal with a health shock. That is, the interaction term being correlated with the error

term (ε_{id}) conditional on location or district fixed effects and other covariates in the regression model. Thus, we fully address the potential endogeneity issue by performing an instrumental variable with fixed effects (IV-FE) analysis using a 2 stage-least-squares (2SLS) estimator.[19]

Given that we have two potential endogenous variables, financial inclusion (FiN_{id}) and its interaction with the health shock variable ($FiN_{id} * Hshock_{id}$), we need at least two instruments. Those instruments would need to be correlated with financial inclusion (relevant condition) but must not be correlated with any of our outcome variables (exogeneity condition). Indeed, distance to nearest bank is correlated with financial inclusion because the closer a bank is to a household, the greater the accessibility will be. Furthermore, distance to nearest bank per se would not be correlated with any of our outcome variables. Therefore, we use distance to the nearest bank (measured in kilometers) and its interaction with the health shock variable as instruments in our IV-FE estimation. Similar instrument(s) of that nature have been used extensively in previous studies.[20]

5.4 Results and Discussion

This section discusses the results of the examination of [1] the effect of a health shock on working hours and on health care usage; [2] the role of financial inclusion in enabling households to insure themselves against an idiosyncratic health shock; and [3] the mechanism through which households use the financial sector to insure themselves against a health shock.

[19] In our IV estimation, we used ivreg2 with first option command in STATA to generate the first-stage F-statistic values.
[20] See Jack and Zuri, (2014) and Riley, (2018).

5.4.1 Effects of health shock on working hours and health care usage

Tables 5.2 and 5.3 show the results of the analysis of the impact of a health shock on household working hours and health care usage, respectively. Columns 1 and 2 of each table show the results of OLS and FE estimations for the full sample, while columns 3 and 4 show the results of the same estimations at the heterogeneous level, i.e. rural and urban sub-subsamples. The results of both OLS and FE estimations show that a health shock negatively affects household working hours but positively affects health care utilization. In particular, it can be seen in column 2 of Table 5.2 that, on average, a health shock significantly reduces household working hours by approximately 2.95 hours per week. This is because the coefficient of the health shock variable is negative and statistically significant at 1% level of significance. Also, the results in column 2 of Table 5.3 indicate that a health shock increases the probability of health care usage by about 56 percentage points. That is, the coefficient of the health shock variable is positive and statistically significant at 1% level of significance. The latter finding is consistent with that of Ahmed and Cowan, (2019), for East Africa, while the former finding is in line with that of García-Gómez et al. (2013), Bradley et al. (2012) and Cai et al. (2008) for Netherlands, USA, and Australia, respectively. The findings indicate that households in Ghana are not able to fully insure themselves against idiosyncratic health shocks.

Looking at the heterogeneous effects of a health shock for rural and urban households, from the results in columns 5 and 6 of Table 5.2 it be seen that whereas the effect of health shock on households working hours is negative and statistically significant for rural households, that on urban households working hours is insignificant, although the coefficient

is negative. Specifically, health shock reduces rural household working hours by approximately 4 hours per week. The insignificant effect of health shock on urban household working hours could be accounted for by the fact that households in urban areas are likely to have access to health-related training facilities (gymnasium) which may afford them an advantage in terms of maintaining a healthy lifestyle over rural households. As a result, a health shock may not have a long-lasting effect on urban household's health status and hence, would not affect their working hours much. However, in columns 5 and 6 of Table 5.3 it can be seen that a health shock significantly increases the probability of health care utilization for both rural and urban households, with the magnitude of the effect being approximately the same. In particular, a health shock increases the probability of both rural and urban households visiting a health clinic or consulting a medical practitioner by about 6 percentage points.

5.4.2 The role of financial inclusion

Having established that a health shock significantly affects household working hours and health care utilization, and that households are not able to fully insure themselves against a health shock, we then examine the potential role of financial inclusion during a health shock. The results of OLS, FE, and IV-FE estimations for the full sample are shown in Table 5.4. The results in columns 1 to 3 are for the case where working hours is the dependent variable, while those in columns 4 to 6 are for the case where health care usage is the dependent variable. The results for all the three estimation techniques are consistent in terms of significance level and the sign of our parameter of interest, except in terms of magnitude where the IV-FE results show slightly higher estimates than both OLS and FE estimates. The

consistency of these estimation techniques indicates the robustness of our estimates. To save space, we do not report the first-stage results of the IV-FE estimations but we do show their corresponding F-statistic values. Thus, we interpret the results for the second stage only. First, we test whether or not our instruments are weak/valid by showing the F-statistic from the first stage estimation in columns 3 and 6 of Table 5.4, columns 2, 4, 6, and 8 of Table 5.5, and column 3 of Table 5.6. From the results, the F-statistic values obtained for all specifications are well above the Stock and Yogo critical values. Also, all of the associated probability values are well below 1% suggesting that the instruments are valid or at least not weak.

As for the estimates of our parameter of interest, the results in column 3 of Table 5.4 show that financial inclusion plays a significant role in helping households to mitigate the negative effect of a health shock on their working hours. Evidently, the coefficient of the interaction term is positive and statistically significant at 5% level of significance. The positive coefficient value of 8.3 is of an economically meaningful magnitude, it indicates that when households are faced with a health shock, those with no access to the financial sector (financially excluded households) see their working hours reduced by about 8.3 hours per week more than those with full access to the financial sector (financially included households). We argue that those with access to the financial sector could tap into their savings or borrow for a visit to a health clinic or a consultation with a doctor, which helps to speed healing and return to work, —an opportunity that is less available to financially excluded households.

We examine the latter explanation by estimating an equation where health care utilization is the dependent variable. The results of the IV-FE estimation are shown in column 6 of Table 5.4. It can be seen that the coefficient of the interaction term is positive and statistically significant at 10% level of significance. This positive coefficient value of 0.0415 suggests that the probability of financially included households, who experienced a health shock, using health care increases by 4.2 percentage points more than financially excluded households who experienced a health shock. That is, financially included households are about 4.2 percentage points more likely to pay a visit to a health facility or consult a health practitioner during a health shock as compared to financially excluded households. This finding is consistent with the finding by Ahmed and Cowan (2019) for Kenya. The authors, however, measured financial inclusion with mobile money use which is a recent technology by many developing countries to enhance financial inclusion. The above finding provides evidence on the role of financial inclusion in increasing health care utilization during periods of injury or illness.

Also, we analyze the heterogeneous effects by decomposing our sample into rural and urban sub-samples to understand differences in the role of financial inclusion at these two centers. The results are displayed in Table 5.5. Columns 1, 2, 5 and 6 show the results for the rural sub-sample while, columns 3, 4, 7 and 8 show the results for the urban sub-sample. It can be seen in column 2 that the coefficient of the interaction term is positive and statically different from zero at the 1% level of significance. The results show that, in rural areas, when households experience a sudden illness or injury, the working hours of those households who are financially constrained decrease by about 10.54 hours per week more than those who

enjoy full financial inclusion. However, in urban areas, the coefficient of the interaction term is not statically different from zero at any of three conventional levels of significance, although it is positive. This suggests that in urban centers financial inclusion has no impact on the working hours of households faced with a health shock. Thus, the role of financial inclusion in mitigating the negative effect of a health shock on household working hours is pronounced in rural areas but not in urban areas.

Moreover, for impact of financial inclusion on household health care utilization, the coefficients of the interaction term are not statistically significant at any of three conventional levels of significance (see columns 6 and 8 of Table 5.5), although their economic importance is preserved (i.e. the coefficients are positive). This means that there is no significant difference between the impact of financial inclusion both on health care utilization of households in rural areas and on health care utilization of households in urban areas when they experience a health shock. These results might be the result of our definition of health care utilization, which includes formal, semi-formal and, informal health care utilization.[21] Whereas households in urban areas are likely to utilize formal or semi-formal health care, those in rural areas are equally likely to visit a traditional healer or use informal health care when they suffer from illness and/or injury

5.4.3 Mechanism

In this section, we analyze our second explanation of borrowing as a mechanism through which households can insulate themselves against a health shock. We estimate

[21] Our related data does not allow us to analyze these three levels of health care utilization because the question on that was asked in a composite manner. That is, whether any household member has consulted a health practitioner or a traditional healer or visited a health facility during the past two weeks.

equation (3) above, where loan acquisition is the dependent variable. Table 5.6 reports the results of the role of financial inclusion in the likelihood of a household acquiring a loan during health shocks. The results in column 3 re-support the validation of our explanation during health shocks. Evidently, the coefficient of the interaction term is positive and statistically significant at 5% percent level of significance. In particular, the coefficient value of 0.0412 indicate that when households are faced with a health shock, financially included households are about 4 percentage points more likely to acquire a loan or borrow than financially excluded ones. This suggests that borrowing is one of the mechanisms through which the probability of health care utilization can be increased during health shocks and consequently, working hours of households can be increased as well. Again, this finding is consistent with that of Ahmed and Cowan (2019) for Kenya.

5.4.4 Heterogeneous health shocks effects analysis

Here, we decompose the shock to the household into two: shocks to children who are below 18 years (whether any child in the household suffered from illness and/or injury), and shocks to adults who are 18 years and above (whether any adult in the household suffered from illness and/or injury). This will allow us to identify the type of shock that is driving our main analysis. The results of the effects of those shocks on household working hours are displayed in Table 5.7. It can be seen in column 2 that adult-health shock significantly reduces household working hours by about 2 hours per week, and the coefficient is statistically significant at 10% level of significance. However, the coefficient on child-health shock is not significant at any of the three conventional levels of significance. This finding is intuitive because children do not generally contribute to labor productivity and as a result

their health status may not significantly affect household working hours. However, since an adult member in a household would usually assume 'care-taking' of a sick child, which would require adjustment of his/her working hours, the working hours of the household could be negatively related to child-health shock: the reason the coefficient on the child-health shock is negative.

Also, the results of the effect of financial inclusion on household working hours during a health shock are shown in Tables 5.8 and 5.9. Whereas the results in Table 5.8 show the estimation results where we undertake the estimation separately for adults' health shock and children' health shock, the results in Table 5. 9 show the case where we combine the two health shocks in the same regression equation. It can been seen that the conclusion from the results in Table 5.8 and 5.9 are the same. Specifically, from columns 3 and 6 of Table 5.8, it is can be observed that whereas the coefficient on the interaction between financial inclusion and adult-health shock is positive and statistically significant at 1% level of significance, that on the interaction between financial inclusion and child-health shock is statistically insignificant, although the coefficient is positive. In particular, when an adult member in the household experience a health shock, households who are financially excluded see their working hours reduce by about 12 hours per week more than those households who are financially included. However, that role played by financially inclusion is not at present when a child in the household experience a health shock.

5.4.5 Further Analysis

This section offers a robustness checks and explanation of the main results obtained. First, it sheds lights on the finding that financially included households utilize healthcare

more than financially excluded ones during a heath shock which affords them the opportunity to heal faster and go back to work. We estimate a variant of equation 5.2 where the financial inclusion variable is replaced with health care usage and the outcome variable being working hours by grouping the sample into financially included and excluded households. The FE estimation results are shown in Table 5.10. Column 1 shows the results for financially included households while column 2 show the results for financially excluded ones. It can be seen that in column 1 the coefficient of the interaction term (*Healthcare*Health shock*) is positive and statistically significant at 10 percent level of significance. However, in column 2 that coefficient is not statistically significant and it is even negatively signed. These results suggest that utilization of health care during a health shock improves the health status of financially included households which leads to an increase in their working hours. Health care utilization during a health by financially excluded households, however, does not improve their health status and as a result those households' working hours are not significantly affected.

As a robustness check, we estimate equation 5.2 and included distance to nearest health facility in the control variables. Table 5.11 displays the OLS, FE and IV-FE estimation results. It can be seen that the coefficients of the interaction term are all statistically significant. Thus, the results obtained from our main analysis are robust, as the results from both the main results and the robustness check estimation results lead to the same conclusion.

Also, we estimate equation 5.1 where health care usage is the dependent variable separately for financially included and financially excluded households. The OLS and FE estimation results are displayed in Table 5:12. The results in columns 2 and 4 of Table 5.12

indicate that while a health shock increases the probability of health care usage by about 0.58 percentage points for financially included households, it increases the probability of health care usage by about 0.53 percentage points for financially excluded households. This suggests that, financially included households are more likely to pay a visit to a health facility during health shock periods than the excluded households. It is worthy to note that health care services provision in Ghana are heterogeneous, ranging from services provided by private health practitioners, public health practitioners, pastoral healers, and traditional healers. Also, although there is health insurance in Ghana, there is a co-payment. In addition, the health insurance does not cover all illness and injuries. Thus, lack of funds for financially excluded households could leave them with no alternative to visiting traditional and pastoral healers (or less quality health care providers) during health shocks for medication. Those services may not be effective in healing them to go back to work early to increase their working hours.

5.5 Conclusion

Idiosyncratic health shocks tend to have negative affect on the health status of households, in turn affecting their ability to fully engage in economic activities to generate income. Naturally, households would visit a health facility, buy medicine or consult a health practitioner in order to recover from illness and/or injury and return to income-generating activities. However, more often than not, the insurance market in developing countries is not well-developed and, as a result, may fail to help households to adequately insure themselves against a health shock.

In this chapter, we empirically examine the role of financial inclusion as a means by which households could address a health shock in terms of its effects on household working hours and health care utilization. Using data from the sixth round of Ghana's Living Standard Survey (GLLS-6) and applying three estimation techniques, we show that, health shocks decrease household working hours and increase the probability of health care utilization. Our results indicate that, generally, households in Ghana are not able to fully insure themselves against health shocks. In particular, we find that illness or injury decreases household working hours by an average of about 2.95 hours per week, and increases the probability of health care utilization by approximately 56 percentage points. Also, out results shows that health shocks to adult members in the household significantly reduces household working hours. However, the effect is insignificant when children in the household experience health shocks. At the disaggregated level, we find that rural households suffer a loss of working hours more than households in urban areas. In fact, we find that the effect of a health shock on the working hours of the urban households is statistically insignificant, although the effect was negative whereas households in the rural households had their working hours significantly reduced by about 3.7 hours per week, on average. However, the effect of a health shock on health care utilization is of approximately the same in magnitude for both rural and urban households. More specifically, we find that injury or illness increases the probability of health care utilization by households in both rural and urban areas by an average of about 6 percentage points.

Regarding the role of financial inclusion, our estimates show that, when households are faced with a health shock, those with access to the financial sector experience less

reduction in their working hours than those without access to the financial sector. In particular, when households are faced with a health shock, financially excluded households see their working hours reduce by about 7.2 hours per week more than financially included ones. In particular, the role of financial inclusion in mitigating the negative effects of health shocks on household working hours is more pronounced when adults in the household experience health shocks than when children experience such shocks. In addition, the probability of health care utilization increases by 4.2 percentage more for financially included households than financially excluded households during a health shock. Furthermore, our heterogeneous analysis show that in rural areas the working hours of financially excluded households decreased significantly more than the working hours of financially included ones, during a health shock. However, in urban centers, financial inclusion has no impact on the working hours of both households, when faced with a health shock. These findings suggest that the role of financial inclusion in mitigating the negative effect of a health shock on household working hours is more pronounced in rural areas than in urban centers. Also, we find no significant difference between the impact of financial inclusion on health care utilization of households in rural areas and on that of households in urban areas during a health shock.

Finally, we find that, one mechanism through which households address a health shock is loan acquisition or borrowing. Thus, during a health shock, financially included households are about 4 percentage points more likely to acquire a loan than financially excluded households.

CHAPTER 6

CONCLUSION AND POLIY IMPLICATIONS

6.1 Introduction

The chapter presents the conclusions and policy implications of the studies in this dissertation. The conclusion presents a summary of the research objectives, methodology and main findings, whereas the policy implication provides policy recommendations based on the findings. The chapter furthermore provides limitations of the studies and gives direction for future research.

6.2 Conclusion

Many households in developing countries are exposed to various income shocks that affect their livings conditions, resulting in welfare loss. The income shocks may either be adverse policy shocks or idiosyncratic non-policy shocks. Faced with those income shocks, households are left with options that could help them insulate themselves. There are several options that households could use to insulate themselves against those shocks. For instance, households could sell off their assets, adjust their human capital investment, tap into their previous savings or borrow from the financial sector, among others.

In this dissertation, we emphasize the use of the financial sector by households as a means to insulate themselves against two policy shocks and one non-policy idiosyncratic shock. These shocks include monetary policy, fiscal policy, and health shocks. In addition, we evaluate the implications of limited financial market participation for the conduct of monetary and fiscal policies in Ghana and other three countries in SSA. The main hypothesis

is that access to financial services (financial inclusion) could serve as a means by which households could mitigate the negative effects of those economic shocks on their consumption and employment decisions.

In chapter 3**,** we analyze the role and the impact of monetary policy shock along with other structural shocks on the consumption of financially included and excluded households in SSA economies. We adopt the standard NK-DSGE model featuring both types of households, developed by Furlanetto and Seneca (2012). We introduce four structural shocks in addition to the productivity shock that is initially considered in the model to aid our analysis: monetary policy, price mark-up, labor supply, and preference shocks. Further, we estimate the DSGE model using Bayesian inference methods for four middle-income SSA countries, namely: Ghana, Gabon, Lesotho, and Mauritius and using quarterly time series data over the period 1985 to 2016.

The estimation results show that the share of financially excluded households in these economies is relatively small, usually between 35% and 42%. Also, our results indicate that monetary authorities in SSA countries have targeted inflation more aggressively than output growth. Further, the results of our Bayesian impulse response analysis suggest that a positive monetary policy shock does perform its intended role of significantly reducing inflation and output, despite a sizeable fraction of the population is financially excluded. Generally, we find that monetary policy becomes more effective as the fraction of households who participates in the financial markets falls.

Additionally, we find that a contractionary monetary policy tends to have differentiated impacts; it decreases the consumption of financially excluded households more

than that of financially included ones. The results reveal that financially included households are able to absorb shocks, and thus can smooth consumption more effectively than financially excluded households.

In chapter 4, we examine the impacts of government spending, consumption tax, and labor income tax shocks on household consumption and working hours in Ghana, using NK-DSGE model. We also apply the model to examination of the effects of fiscal policy shocks on key macroeconomic variables in the Ghanaian economy. The model features heterogeneous households of two types, financially excluded and financially included, and considers two labor markets: perfectly and monopolistically competitive labor markets. We use quarterly time series data from 1985Q1-2017Q4 to estimate the model's parameters using a Bayesian approach.

The results show that a positive government spending shock has an expansionary effect on the consumption of financially excluded households but has a decreased effect on that of fully financially included ones. Overall, increased government spending has a positive effect on consumption, output, employment, and inflation but turns to crowd-out consumption when wages are sticky. The results also show that the presence of sticky wage dynamics requires high degree (75%) of households who cannot participate in the financial markets in order to generate rather a short-lived positive consumption multiplier of government spending shock. We find that sticky wage in the economy dampens the expansionary effect of government spending shock on consumption and output. Furthermore, we find that positive consumption and labor income tax shocks decrease consumption by financially excluded households more than that by financially included ones. Our results

suggest that lack of [1] access to the financial sector and [2] savings leave financially excluded households with no alternative to increasing their working hours in order to mitigate the negative effect of those shocks on their consumption. On the contrary, households that are financially included use the financial sector as a mechanism for tapping into their savings to insulate themselves from those shocks, and hence reduce their working hours.

Finally, in chapter 5 we empirically examine the role of financial inclusion in helping households to address health shocks in terms of the effects it has on their working hours and health care utilization. We use round six of the Ghana Living Standard Survey (GLSS-6) data and employ ordinary least squares (OLS), fixed effects (FE), and instrumental variable with fixed effects (IV-FE) estimation techniques to undertake the task. We find that a health shock does decrease household working hours and increase the probability of health care utilization. This suggests that households in Ghana are not able to fully insure themselves against a health shock. At the disaggregated level, we find that rural households suffer a loss in their working hours more than households in urban areas. However, the effect of a health shock on health care utilization are approximately the same in magnitude for both rural and urban households.

Our analysis also indicates that, when households are faced with a health shock, those with see a less reduction in their working hours as compared to those without access to the financial sector. In addition, with financial inclusion, the probability of health care utilization increases more when households are faced with a health shock. Furthermore, our heterogeneous analysis shows that, in rural areas, working hours of financially excluded households significantly decreased more than working hours of financially included ones,

when faced with a health shock. Additionally, we find that, the mechanism by which households address a health shock, using the financial sector, is loan acquisition or borrowing.

6.3 Policy Implications

Generally, the findings from the three empirical studies in this dissertation support the financial inclusion agenda of policymakers in Ghana and many other countries. In particular, there is a need for ongoing enhancement of financial inclusion in rural areas by the Government of Ghana and other stakeholders to help rural people deal with health shocks, while not neglecting that in urban areas. Thus, efforts to ensure full financial inclusion are necessary. Those efforts will increase the probability of households using the financial sector as a means of insulating themselves against the effects of adverse economic shocks.

In addition, monetary authorities in developing countries need to place greater emphasis on output growth relative to inflation. This could support the stabilization of income, which would enable financially excluded households to smooth consumption. It is to be noted when the Government of Ghana embarks on expansionary fiscal policy (increases government spending) to boost the economy (specifically to increase consumption), the labor markets (i.e. wage settings) need to be seriously taken into consideration. In particular, efforts to ensure less sticky wages in the Ghanaian economy are necessary for effective fiscal policy. Also, effective coordination between the fiscal and monetary authorities is necessary to help design an optimal policy mix that can foster growth and improve the livelihood of the citizenry.

Finally, the finding that productivity and price mark-up (costs-push) shocks drive the key macroeconomic variables in the Ghanaian economy suggests that those shocks affect the

transmission mechanisms of both fiscal and monetary policies. Thus, the government of Ghana needs to make frantic efforts to reduce the cost of production for firms and to also embark on technological research. For example, the Ghanaian economy has experienced electricity power outages over the past decade: one way to reduce the cost of production for firms is for the government to improve the electricity power supply to limit the power shortages, as power outages serve as a positive cost-push shock to the economy.

6.4 Limitations and Direction for Future Research

It is worthy to note that, while we believe that the analysis and results presented in this dissertation are sufficiently robust to serve as a guide for policy makers in Ghana and elsewhere working to strengthen the financial inclusion agenda, we acknowledge that our analysis is not without limitations. One limitation of the studies in chapters 3 and 4 is that the models used assumed that Ghana, Gabon, Lesotho, and Mauritius are closed economies. Although these countries do not heavily depend on trade, the recognition that the external sector may be quite important for the analysis in this study is worth mentioning. However, by introducing the external sector which comes with exchange rate dynamics the consumption response of financially included and excluded households to monetary and fiscal policy shocks will not be affected. This is because exchange rate will influence prices equally for both households. Another limitation is that the models assumed full employment and thus, ruled out unemployment in those economies. Regarding the study in chapter 5, one limitation is that the analysis assumes that the health shock variable is exogenous. Also, the data used does not contain information on severity of illness or injury as well as the initial health conditions of households to allow us to investigate the likelihood of both households

experiencing different severe illness or injury which could have consequences on their working hours.

By dwelling on the above limitations, future research could develop a small-open economy for the Ghanaian economy. Also, future research could introduce unemployment and informal sector in their models. In addition, financial frictions in the models could be modelled in a more rigorous way. For example, the models could feature savers and borrowers where borrowing could be limited by collateral constraints. Also, fiscal news shock could be introduced in the model, following a variant of the news shock in Fujiwara, Hirose and Shintani (2011), for fiscal policy analysis. Furthermore, a different data set (preferably panel data) that contains information on severity of illness or injury as well as the initial health conditions of households could to be used.

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Appendix

List of Tables

Table 2.1: Number of Financial Institutions in Ghana

	Financial Institutions						Active Mobile Money	
Year	Commercial Banks	Other Banks	Credit Unions and Cooperatives	Microfinance	Insurance Companies	Total	Agents	Account Holders
2004	20	131	277	-	-	428	-	-
2005	21	133	306	-	-	460	-	-
2006	24	135	341	-	-	500	-	-
2007	24	140	375	-	-	539	-	-
2008	26	144	399	-	-	569	-	-
2009	27	152	402	-	-	581	-	-
2010	26	154	402	-	-	582	-	-
2011	28	154	402	-	-	584	-	-
2012	26	135	402	90	-	653	5,900	345,434
2013	27	196	455	114	45	837	10,404	991,780
2014	28	198	476	364	-	1,066	20,722	2,526,588

2015	29	196	504	421	48	1,198	56,270	4,868,569
2016	30	196	519	401	46	1,192	107,415	8,313,283
2017	33	206	529	355	51	1,174	151,745	11,119,376
2018	30	209	566	253	53	1,111	180,664	13,056,978

Source: Author's construction using IMF's Financial Access Survey (FAS) Data

Table 3.1: Summary Statistics of Savings, Borrowing, and Account Ownership in SSA

	No Savings (%)	Neither Saved nor Borrowed (%)	Bank Account (%)	No Bank Account (%)
SSA	50.54 [103,988]	32.21 [103,915]	29.06 [104,002]	70.94 [104,002]
Ghana	48.3 [3,000]	33.50 [3,000]	40.4 [3,000]	59.6 [3,000]
Gabon	46.24 [3,008]	33.08 [3,008]	31.95 [2,000]	68.05 [2,000]
Lesotho	64.2 [2,000]	37.15 [2,000]	28.91 [1,999]	71.09 [1,999]
Mauritius	43.78 [2,988]	33.31 [2,988]	85.75 [2,996]	14.25 [2,996]

Source: Authors' computation from 3 rounds of individual-level survey data (2011, 2014, and 2017) for 41 countries in SSA sourced from the Global Financial Inclusion database (Global Findex) of the World Bank. Note that the values in brackets are the sample size.

Table 3.2: Bayesian Estimation results for Ghana and Gabon

Estimated Parameters		Prior			Posterior	
		Both countries			Ghana	Gabon
		Distribution	Mean	St. Dev	Mean	Mean
Households						
Financially excluded	λ	Beta	0.5	0.025 [0.02]	0.3510	0.4189
Consumption habit	h	Beta	0.7	0.025 [0.02]	0.6586	0.6834
Discount factor	β	Beta	0.99	0.002	0.9907	0.9935
Depreciation Rate	δ	Beta	0.025	0.003	0.0249	0.0168
Firms/Labor Union						
Share of capital	α	Beta	0.33	0.1	0.0422	0.0501
Degree price stickiness	θ	Beta	0.75	0.01	0.7499	0.7502
Frisch labor elasticity	ϕ	Gamma	0.500	0.01	0.4988	0.4993
Wage-adjustment cost	ϕ_w	Gamma	174	0.1	173.998	173.998
Monetary Policy (Taylor Rule)						
Degree of interest-rate smoothing	ρ_r	Beta	0.69	0.1	0.5348	0.8951
Inflation	ϕ_π	Normal	1.7	0.25	3.2511	3.0974
Output growth	ϕ_y	Normal	0.26	0.015	0.2479	0.2440
Shocks						
		Persistence				
Technology	ρ_a	Beta	0.95	0.002	0.9551	0.9560
Preference	ρ_b	Beta	0.5	0.1	0.8915	0.7344
Price mark-up	ρ_p	Beta	0.5	0.1	0.4756	0.5653
Labor supply	ρ_l	Beta	0.5	0.1	0.4979	00.4994
		St. Dev of shocks				
Technology	σ_a	inv_gamma	0.1	2	9.5692	16.7177
Monetary policy	σ_m	inv_gamma	0.1	2	6.0677	1.0904
Preference	σ_b	inv_gamma	0.1	2	19.5045	25.1920
Price mark-up	σ_p	inv_gamma	0.1	2	43.4014	71.6542
Labor supply	σ_l	inv_gamma	0.1	2	0.1024	0.0939

Table 3.3: Bayesian Estimation results for Lesotho and Mauritius

Estimated Parameters		Prior			Posterior	
		Both countries			Lesotho	Mauritius
		Distribution	Mean	St. Dev	Mean	Mean
Households						
Financially excluded	λ	Beta	0.5	0.025	0.3462	0.3604
Consumption habit	h	Beta	0.7	0.025	0.5325	0.6936
Discount factor	β	Beta	0.99	0.002	0.9919	0.9903
Depreciation	δ	Beta	0.025	0.003	0.0206	0.0271
Firms/Labor Union						
Share of capital	α	Beta	0.33	0.1	0.0308	0.0553
Degree price stickiness	θ	Beta	0.75	0.015 [0.1]	0.7508	0.7500
Frisch labor elasticity	ϕ	Gamma	0.5	0.1	0.3437	0.4983
Wage-adjustment cost	ϕ_w	Gamma	174	0.1	174.00	173.9989
Monetary Policy (Taylor Rule)						
Degree of interest-rate smoothing	ρ_r	Beta	0.69	0.1	0.6715	0.6518
Inflation	ϕ_π	Normal	1.7	0.25	3.2615	3.15478
Output growth	ϕ_y	Normal	0.26	0.015 [0.025]	0.2319	0.2439
Shocks						
Persistence						
Technology	ρ_a	Beta	0.95	0.002	0.9524	0.9566
Preference	ρ_b	Beta	0.5	0.1	0.9514	0.7573
Price mark-up	ρ_p	Beta	0.5	0.1	0.1291	0.4178
Labor supply	ρ_l	Beta	0.5	0.1	0.4952	0.4993
St. Dev of shocks						
Technology	σ_a	inv_gamma	0.1	2	7.7741	6.8314
Monetary policy	σ_m	inv_gamma	0.1 [0.01]	2	5.6515	4.4834
Preference	σ_b	inv_gamma	0.1	2	31.3097	10.9615
Price mark-up	σ_p	inv_gamma	0.1	2	138.1471	20.7158
Labor supply	σ_l	inv_gamma	0.1	2	0.0742	0.0888

Table 3.4: Forecast Error Variance Decomposition (in percent) for Ghana and Gabon

	Output		Consumption		Employment		Inflation	
Shocks	GH	GA	GH	GA	GH	GA	GH	GA
Forecast horizon: 1st Quarter								
Monetary Policy	22.44	5.15	22.48	3.79	29.53	3.53	0.26	0.19
Technology	28.05	12.40	16.87	0.63	5.69	40.14	12.97	14.02
Price Mark-up	49.14	75.53	57.86	75.87	64.28	51.68	86.08	85.42
Preference	0.38	6.91	2.79	19.71	0.51	4.66	0.69	0.37
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 4th Quarter								
Monetary Policy	11.83	2.74	11.29	2.37	25.49	3.72	0.49	0.48
Technology	57.06	36.36	50.64	25.66	7.86	14.01	18.73	19.14
Price Mark-up	30.71	54.63	33.46	57.41	65.78	73.76	78.68	79.57
Preference	0.40	6.27	4.61	14.56	0.87	8.51	2.09	0.81
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 10th Quarter								
Monetary Policy	7.30	1.83	6.58	1.68	23.85	4.03	0.52	0.58
Technology	73.86	61.35	70.21	53.96	14.60	15.16	18.74	18.11
Price Mark-up	18.38	32.96	18.30	35.44	59.98	72.20	77.30	80.47
Preference	0.46	3.86	4.91	8.93	1.58	8.61	3.44	0.84
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 100th Quarter								
Monetary Policy	5.47	1.27	4.81	1.17	23.46	4.03	0.52	0.58
Technology	80.16	73.41	77.42	68.54	14.79	16.01	18.72	18.12
Price Mark-up	13.96	22.67	13.60	24.21	59.99	71.47	76.63	80.45
Preference	0.41	2.65	4.17	6.08	1.76	8.49	4.13	0.85
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: GH stands for Ghana whereas GA stands for Gabon

Table 3.5: Forecast Error Variance Decomposition (in percent) for Lesotho and Mauritius

	Output		Consumption		Employment		Inflation	
Shocks	LES	MAU	LES	MAU	LES	MAU	LES	MAU
Forecast horizon: 1st Quarter								
Monetary Policy	18.35	49.94	16.09	49.55	20.18	59.29	0.14	1.64
Technology	9.36	27.74	5.14	13.61	0.45	14.23	1.94	26.93
Price Mark-up	71.25	20.57	77.45	25.25	78.21	24.42	97.71	70.41
Preference	1.04	1.75	1.31	11.60	1.15	2.06	0.21	1.02
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 4th Quarter								
Monetary Policy	18.00	27.05	16.63	25.85	24.88	58.00	0.32	3.12
Technology	29.86	57.64	25.06	49.82	3.44	8.96	3.11	35.76
Price Mark-up	51.33	12.04	54.37	13.31	70.57	25.92	95.85	58.72
Preference	0.81	3.27	3.93	11.01	1.11	7.12	0.73	2.40
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 10th Quarter								
Monetary Policy	14.23	15.77	13.13	14.49	24.51	53.36	0.36	3.41
Technology	45.36	75.29	41.93	71.52	6.34	15.93	3.16	35.61
Price Mark-up	38.92	6.40	39.63	6.50	66.69	21.85	95.11	58.02
Preference	1.48	2.53	5.31	7.49	2.46	8.87	1.38	2.96
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forecast horizon: 100th Quarter								
Monetary Policy	12.12	11.12	11.18	9.97	23.57	52.81	0.35	3.41
Technology	51.20	82.50	48.62	80.30	6.31	16.37	3.15	35.75
Price Mark-up	33.56	4.57	34.20	4.53	64.94	21.93	94.38	57.86
Preference	3.13	1.80	6.01	5.20	5.18	8.89	2.11	2.99
Labor Supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: LEs stands for Lesotho and MAU stands for Mauritius.

Table 4.1: Financial inclusion/exclusion indicators

	Savings (%)	No Savings (%)	Neither Saved nor Borrowed (%)	Bank Account (%)	No Bank Account (%)
2011	44.80	55.20	36.7	38.50	61.50
2014	55.70	44.30	31.4	36.00	64.00
2017	54.60	45.40	32.4	46.70	53.30
All	51.70	48.30	33.50	40.40	59.60

Source: Authors' computation from 3 rounds of individual-level survey data (2011, 2014, and 2017) sourced from the Global Financial Inclusion database (Global Findex) of the World Bank.

Table 4.2: Bayesian Estimation results

Parameters		Prior			Posterior	
		Distribution	Mean	S. D.	Mean	
					Model 1	Model 2
Households						
Financially excluded	λ	Beta	0.5	0.025	0.350	0.521
Consumption habit	h	Beta	0.7	0.025	0.8112	0.830
Discount factor	β	Beta	0.99	0.002	0.994	0.994
Depreciation rate	δ	Beta	0.025	0.003	0.012	0.012
Firms						
Share of capital	α	Beta	0.33	0.015	0.286	0.323
Degree price stickiness	θ	Beta	0.75	0.01	0.750	0.750
Frisch labor elasticity	ϕ	Gamma	0.5	0.01	0.473	0.504
Degree wage stickiness	θ_w	Beta	0.75	0.01	-	0.750
Monetary Policy (Taylor Rule)						
Interest-rate smoothing	ρ_r	Beta	0.69	0.1	0.658	0.715
Inflation	ϕ_π	Normal	1.7	0.25	3.261	3.263
Output growth	ϕ_y	Normal	0.26	0.015	0.255	0.258
Fiscal Policy Rules						
Gov. spend. smoothing	ρ_g	Beta	0.5	0.075	0.878	0.881
Cons. tax smoothing	ρ_{tc}	Beta	0.5	0.075	0.850	0.865
Inc. tax smoothing	ρ_{tn}	Beta	0.5	0.075	0.488	0.486
Gov. spending debt	ϕ_g	Normal	0.1	0.05	0.039	0.173
Consumption tax debt	ϕ_{tc}	Normal	0.1	0.05	0.235	0.135
Labor income tax debt	ϕ_{tn}	Normal	0.1	0.05	0.103	0.096
Shocks						
		Persistence				
Technology	ρ_a	Beta	0.95	0.002	0.956	0.955
Price mark-up	ρ_p	Beta	0.5	0.1	0.537	0.780
		St. Dev of shocks				
Technology	σ_a	inv_gamma	0.1	10	23.147	51.259
Price mark-up	σ_p	inv_gamma	0.1	10	54.942	99.170
Monetary policy	σ_m	inv_gamma	0.1	10	4.483	3.809
Government spending	σ_g	inv_gamma	0.1	10	7.057	7.680
Consumption tax	σ_{tc}	inv_gamma	0.1	10	114.62	68.820

Labor income tax	σ_{in}	inv_gamma	0.1	10	0.086	0.094
Log data density					-2047.4	-2021.3

Table 4.3: Standard Deviation results from the observed data and simulated data

	Standard Deviation	
	Data	Model
Output	0.4999	6.0086
Consumption	0.4759	6.6037
Government spending	0.4944	6.3096
Interest rate	2.2991	3.2914
Inflation	2.8588	1.5865
Consumption tax rate	-	16.1205

Table 4.4: Forecast Error Variance Decomposition (in percent)

Shocks	Output	Consumption	Employment	Inflation
Forecast horizon: 1st Quarter				
Technology	29.39	10.15	24.98	23.39
Price mark-up	44.63	51.63	57.54	67.63
Monetary policy	5.43	6.47	7.61	2.78
Government spending	1.22	0.05	0.65	0.06
Consumption tax	19.33	31.69	9.21	6.14
Labor income tax	0.00	0.00	0.00	0.00
Forecast horizon: 4th Quarter				
Technology	46.38	35.97	9.07	30.20
Price mark-up	26.71	29.21	58.08	59.88
Monetary policy	1.46	1.63	3.97	3.63
Government spending	0.40	0.01	0.34	0.08
Consumption tax	25.05	33.18	28.54	6.21
Labor income tax	0.00	0.00	0.00	0.00
Forecast horizon: 10th Quarter				
Technology	64.39	58.53	25.74	30.53
Price mark-up	11.96	0.57	36.90	59.49
Monetary policy	0.58	12.40	2.17	3.59
Government spending	0.21	0.00	0.20	0.08
Consumption tax	22.87	28.50	34.98	6.31
Labor income tax	0.00	0.00	0.00	0.00
Forecast horizon: 100th Quarter				
Technology	73.35	70.75	49.40	30.88
Price mark-up	7.96	7.69	23.63	59.12
Monetary policy	0.53	0.46	1.40	3.57
Government spending	0.18	0.03	0.14	0.08
Consumption tax	17.97	21.07	25.44	6.36
Labor income tax	0.00	0.00	0.00	0.00

Table 5.1: Summary statistics

Variables		Obs.	Mean	Std. Dev
Financial inclusion		16,760	0.479	0.500
Health shock	Financially Included	8,022	0.411	0.492
	Financially Excluded	8,730	0.401	0.490
	Full Sample	16,764	0.406	0.491
Outcome variables				
Working hours		15,359	91.309	69.784
Health care usage		16,763	0.269	0.443
Loan (Borrowing)		16,760	0.117	0.321
Household head characteristics				
Male (dummy)		16,772	0.718	0.450
Age		16,772	45.839	15.893
Age Squared		16,772	2,354	1,640
Married (dummy)		16,772	0.591	0.492
Farmer (dummy)		16,118	0.503	0.500
Employment type (categorical)		16,772	1.705	0.589
Industry type (categorical)		16,772	1.912	1.247
Religion (categorical)		16,767	1.188	0.543
Household level characteristics				
Education(categorical)		15,439	1.974	0.796
Children		16,772	2.001	2.012
Adults		16,772	2.261	1.291
Health insurance coverage (dummy)		16,751	0.796	0.403
Log of household income		16,549	8.125	1.406
Rural (dummy)		16,772	0.556	0.497

Table 5.2: Results of the effect of a health shock on working hours

	Full sample		Rural	Urban	Rural	Urban
	OLS	FE	OLS	OLS	FE	FE
	(1)	(2)	(3)	(4)	(5)	(6)
Health Shock	-3.065***	-2.950***	-3.010*	-2.265*	-3.656***	-2.182
	[1.166]	[0.958]	[1.573]	[1.351]	[1.299]	[1.348]
Constant	-8.087	1.197	-31.4**	6.432	-16.51	5.266
	[9.721]	[9.231]	[14.80]	[11.16]	[17.89]	[11.18]
Observations	14,076	14,076	7,889	7,820	6,256	7,820
R-squared	0.384	0.388	0.405	0.406	0.337	0.410
Controls included	YES	YES	YES	YES	YES	YES
Location or District FE	NO	YES	NO	NO	YES	YES

Note: Dependent variable is total working hours. All regressions include full set of controls. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.3: Results of the effect of a health shock on health care usage

	Full sample		Rural	Urban	Rural	Urban
	OLS	FE	OLS	OLS	FE	FE
	(1)	(2)	(3)	(4)	(5)	(6)
Health Shock	0.566***	0.559***	0.554***	0.581***	0.536***	0.574***
	[0.0126]	[0.0115]	[0.0150]	[0.0195]	[0.0115]	[0.0177]
Constant	-0.0698	-0.0600	-0.0457	0.0347	-0.0248	0.0559
	[0.0761]	[0.0728]	[0.127]	[0.113]	[0.175]	[0.102]
Observations	14,679	14,679	8,190	6,489	8,190	6,489
R-squared	0.406	0.392	0.388	0.430	0.358	0.414
Controls included	YES	YES	YES	YES	YES	YES
Location or District FE	NO	YES	NO	NO	YES	YES

Note: Dependent variable is health care usage. All regressions include full set of control variable. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.4: Results of the role of financial inclusion

Dep. Variable	Working hours			Health care usage		
	OLS	FE	IV-FE	OLS	FE	IV-FE
	(1)	(2)	(3)	(4)	(5)	(6)
Health Shock	-14.24	-12.50	-9.869	0.138	0.124	0.103
	[21.38]	[22.27]	[21.78]	[0.179]	[0.178]	[0.191]
FiN	4.134**	2.540*	-1.340	0.0118**	0.0127**	0.0236***
	[1.676]	[1.502]	[2.404]	[0.00522]	[0.00580]	[0.00878]
*FiN*Health Shock*	5.082**	5.721**	8.307**	0.0378**	0.0272*	0.0415*
	[2.484]	[2.390]	[3.576]	[0.0151]	[0.0144]	[0.0212]
First-Stage F-Statistics:						
FiN			7278.95***			4880.45***
FiN*Health Shock			3803.63***			2348.78***
Observations	14,067	14,067	11,690	14,668	14,668	12,164
R-squared	0.388	0.366	0.398	0.412	0.398	0.397
Controls included	YES	YES	YES	YES	YES	YES
Shock*Controls included	YES	YES	YES	YES	YES	YES
Location or District FE	NO	YES	YES	NO	YES	YES

Note: All regressions include full set of controls variables and their interaction with health shock. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.5: Results of heterogeneous effects

Dependent Variable	Working hours				Health care usage			
	Rural		Urban		Rural		Urban	
	FE	IV-FE	FE	IV-FE	FE	IV-FE	FE	IV-FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health Shock	9.804	7.753	-20.51	9.731	-0.0200	-0.0211	0.183	-0.00348
	[34.06]	[32.36]	[30.16]	[54.57]	[0.336]	[0.352]	[0.254]	[0.384]
FiN	0.466	-0.922	4.980***	-5.114	0.0234***	0.0209**	-0.000347	-0.107
	[2.593]	[2.742]	[1.535]	[33.54]	[0.00860]	[0.0106]	[0.00798]	[0.180]
*FiN*Health Shock*	8.806**	10.54***	1.761	1.828	0.0229	0.0350	0.0175	0.120
	[3.549]	[4.041]	[2.514]	[44.11]	[0.0188]	[0.0233]	[0.0257]	[0.188]
First-Stage F-Statistics:								
FiN		6854.61***		11.56***		6622.00***		13.81***
FiN*Health Shock		4097.46***		14.77***		3967.05***		20.14***
Observations	7,817	7,299	6,250	4,410	8,187	7,656	6,481	4,508
R-squared	0.377	0.378	0.346	0.347	0.384	0.381	0.418	0.431
Controls included	YES	YES	YES	YES	YES	YES	YES	YES
Shock*Controls included	YES	YES	YES	YES	YES	YES	YES	YES
Location or District FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: All regressions included full set of controls variables and their interaction with health shock. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.6: Mechanism: Borrowing (Loan)

	Loan		
	OLS	FE	IV-FE
	(1)	(2)	(3)
Health Shock	-0.0353	-0.0617	-0.0824
	[0.146]	[0.137]	[0.160]
FiN	0.0772***	0.0676***	0.0882***
	[0.00994]	[0.00963]	[0.0134]
*FiN*Health Shock*	0.0416**	0.0446***	0.0412**
	[0.0177]	[0.0171]	[0.0206]
First-Stage F-Statistics:			
FiN			4882.43***
FiN*Health Shock			2350.14***
Observations	14,669	14,669	12,165
R-squared	0.055	0.049	0.048
Controls included	YES	YES	YES
Shock*Controls included	YES	YES	YES
Location or District FE	NO	YES	YES

Note: All regressions include full set of controls variables and their interaction with health shock. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.7: Results of heterogeneous health shock effects on working hours

	OLS	FE	OLS	FE
VARIABLES	(1)	(2)	(3)	(4)
Health Shock (adults)	-2.690*	-2.008*		
	[1.536]	[1.129]		
Health Shock (children)			-2.082	-1.215
			[1.273]	[1.224]
Constant	-8.704	0.657	-8.685	-6.763
	[9.322]	[8.739]	[9.382]	[9.164]
Observations	14,076	14,076	14,076	14,076
R-squared	0.384	0.388	0.384	0.362
Controls included	YES	YES	YES	YES
Shock*Controls included	YES	YES	YES	YES
Location or District FE	NO	YES	NO	YES

Note: All regressions include full set of controls variables and their interaction with health shock. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.8: Results of heterogeneous health shock effects: the role of financial inclusion

	OLS	FE	IV-FE	OLS	FE	IV-FE
	(1)	(2)	(3)	(4)	(5)	(6)
FiN	4.176***	3.032**	-0.677	6.212***	4.524***	0.0936
	[1.572]	[1.441]	[2.215]	[1.722]	[1.558]	[2.531]
Health Shock (adults)	-21.38	-25.41	-21.92			
	[30.93]	[32.95]	[41.06]			
*FiN*Health Shock*	8.900***	8.355***	12.15***			
	[3.042]	[2.749]	[4.002]			
Health Shock (children)				-13.93	-3.793	3.505
				[22.93]	[22.23]	[20.95]
*FiN*Health Shock*				0.278	1.543	8.338
				[3.030]	[2.910]	[5.755]
First-Stage F-Statistics:						
FiN			7214.21***			7271.48***
FiN*Health Shock			1849.90***			1227.57***
Observations	14,067	14,067	11,690	14,067	14,067	11,690
R-squared	0.390	0.367	0.398	0.388	0.366	0.397
Controls included	YES	YES	YES	YES	YES	YES
Shock*Controls included	YES	YES	YES	YES	YES	YES
Location or District FE	NO	YES	YES	NO	YES	YES

Note: All regressions include full set of controls variables and their interaction with health shock. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.9: Heterogeneous health shock effects: the role of financial inclusion

	OLS	FE	IV-FE
	(1)	(2)	(3)
Health Shock (adults)	-18.78	-22.57	-25.19
	[30.91]	[32.92]	[40.77]
Health Shock (children)	-16.57	-5.998	4.846
	[23.14]	[22.29]	[20.72]
FiN	4.496***	2.886*	-1.680
	[1.684]	[1.526]	[2.358]
*FiN*Health Shock (adults)*	8.769***	8.107***	11.69***
	[3.052]	[2.767]	[3.984]
*FiN*Health Shock (children)*	-0.804	0.533	3.538
	[3.101]	[2.963]	[3.867]
First Stage F-Statistics			
FiN			4822.38***
Fin*Hshock (adult)			1232.38***
Fin*Hshock (children)			1483.00***
Observations	14,067	14,067	11,690
R-squared	0.392	0.369	0.399
Controls included	YES	YES	YES
Shock*Controls included	YES	YES	YES
Location or District FE	NO	YES	YES

Note: All regressions include full set of controls variables and their interaction with health shock. Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

Table 5.10: Effects of health care usage on working hours during a health shock

	Financially Included	Financially excluded
	FE	FE
	(1)	(2)
Health Shock	12.87	-29.65
	[34.24]	[39.83]
Health Care	-1.465	4.186
	[3.459]	[5.934]
*Healthcare*Health Shock*	7.175*	-7.967
	[4.239]	[6.281]
Constant	14.12	-3.293
	[17.21]	[30.47]
Observations	7,240	6,826
R-squared	0.359	0.410
Controls included	YES	YES
Shock*Controls included	YES	YES
Location or District FE	YES	YES

Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively at 1%, 5%, and 10% respectively.

Table 5.11: Effects of financial inclusion on working hours and health care usage

Dep. Variable	Working hours			Health care usage		
	OLS	FE	IV-FE	OLS	FE	IV-FE
	(1)	(2)	(3)	(4)	(5)	(6)
Health Shock	11.72	13.85	19.10	-0.196	-0.206	-0.358
	[41.52]	[38.47]	[35.93]	[0.471]	[0.489]	[0.479]
FiN	2.466	0.979	-1.240	0.0219**	0.0216**	0.0138
	[2.866]	[2.482]	[3.251]	[0.00842]	[0.0105]	[0.0114]
*FiN*Health Shock*	6.064*	7.918**	11.60**	0.0490**	0.0451**	0.0734***
	[3.627]	[3.510]	[4.768]	[0.0241]	[0.0227]	[0.0262]
First-Stage F-Statistics:						
FiN			5361.5***			4461.90***
FiN*Health Shock			2946.3***			2306.12***
Observations	5,867	5,867	5,741	6,284	6,284	6,157
R-squared	0.416	0.385	0.388	0.391	0.383	0.382
Controls included	YES	YES	YES	YES	YES	YES
Shock*Controls included	YES	YES	YES	YES	YES	YES
Location or District FE	NO	YES	YES	NO	YES	YES

Note: All regressions include full set of controls variables and their interaction with health shock. Control includes distance to nearest health facility (in km). Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively.

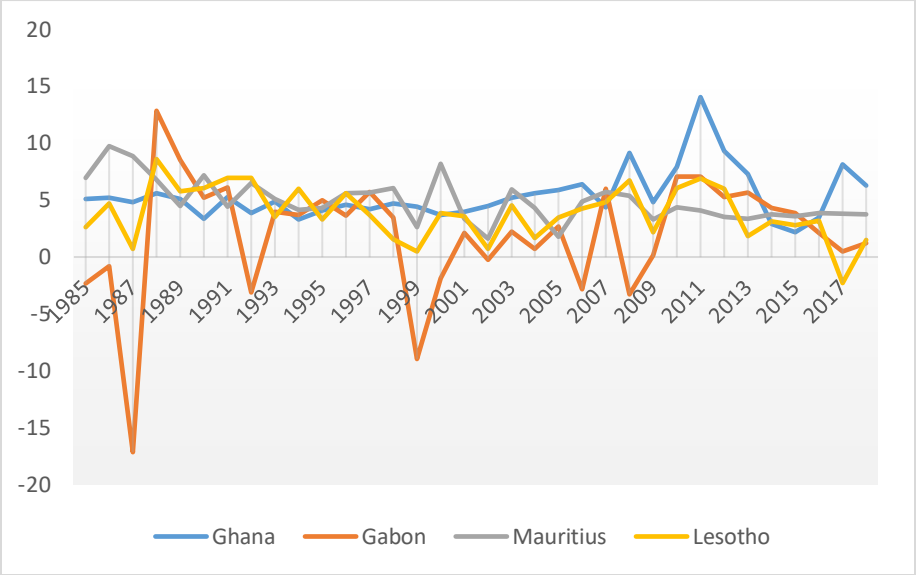
Table 5.12: Effects of health care usage on healthcare usage during a health shock

	Financially Included		Financially Excluded	
	OLS	FE	OLS	FE
	(1)	(2)	(3)	(4)
Health shock	0.593***	0.582***	0.535***	0.533***
	[0.0152]	[0.0147]	[0.0161]	[0.0154]
Constant	-0.0276	-0.0284	-0.0415	-0.0210
	[0.129]	[0.126]	[0.115]	[0.118]
Observations	7,414	7,414	7,254	7,254
R-squared	0.429	0.407	0.385	0.377
Controls included	YES	YES	YES	YES
Location or District FE	NO	YES	NO	YES

Note: Robust standard errors in brackets. ***, **, and * indicate significance levels at 1%, 5%, and 10% respectively at 1%, 5%, and 10% respectively.

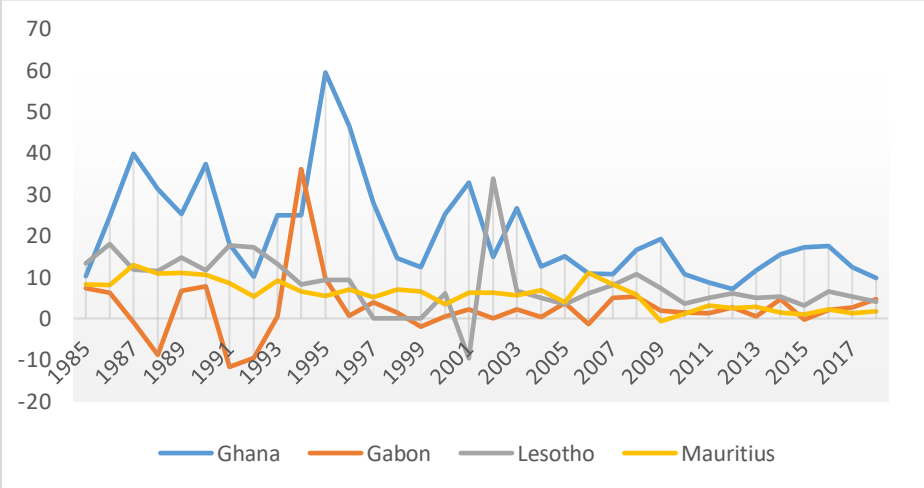
List of Figures

Figure 2.1: Trends of GDP growth rate (1985-2018)



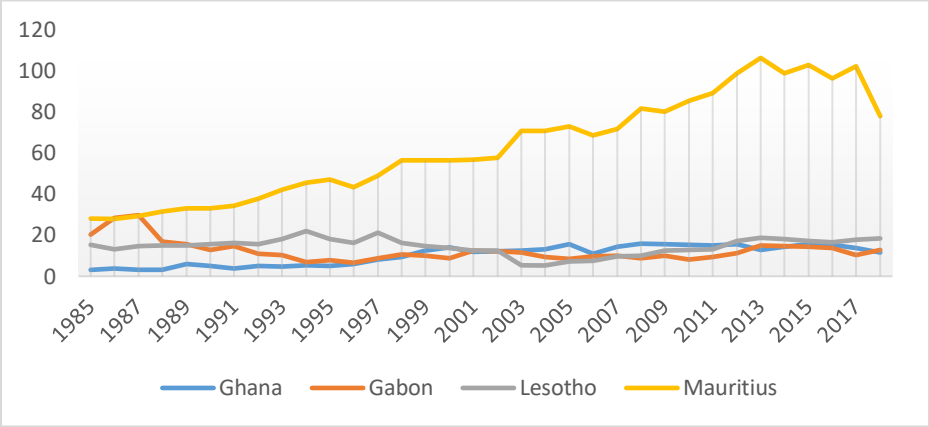
Source: Authors' computation using data from World Bank's World Development Indicators, 2019.

Figure 2.2: Inflation rate dynamics (1985-2018)



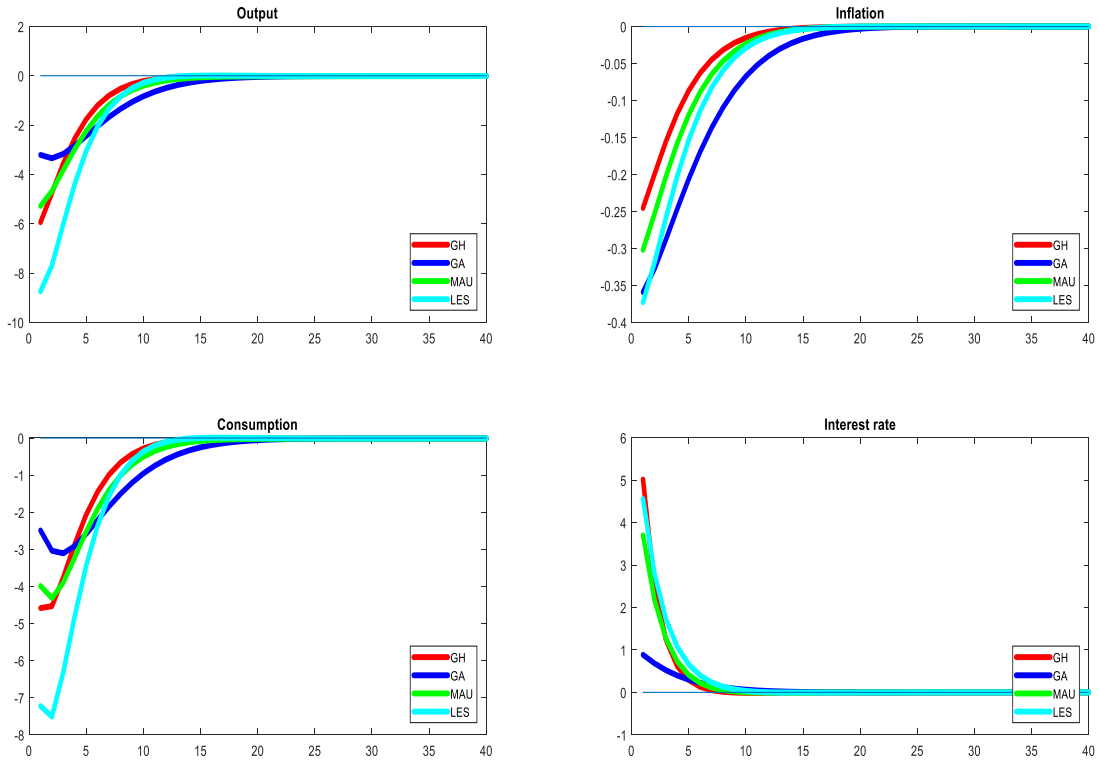
Source: Authors' computation using data from World Bank's World Development Indicators, 2019.

Figure 2.3: Trends of financial sector development (1985 -2018)



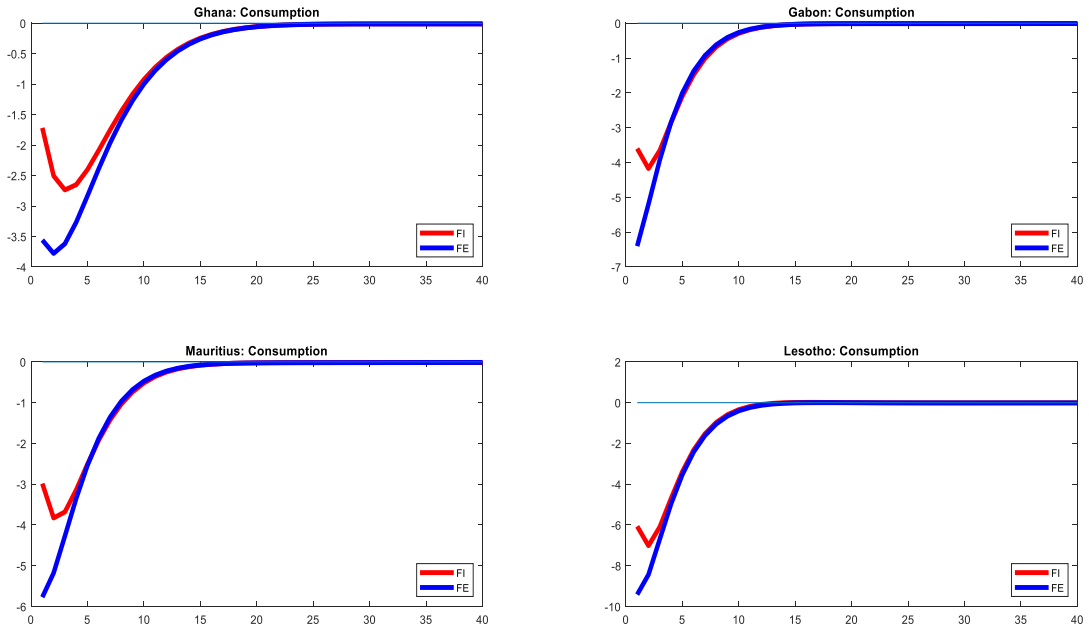
Source: Authors' computation using data from World Bank's World Development Indicators, 2019.

Figure 3.1: Response of output, inflation, and consumption to monetary policy shock (the plots are the posterior means).



Note: GH, GA, MAU, and LES stand for Ghana, Gabon, Mauritius, and Lesotho respectively

Figure 3.2: Response of the consumption of financially included and excluded households to a monetary policy shock (the plots are the posterior means).



Note: FI and FE stand for financially included and financially excluded households, respectively.

Figure 3.3: Response of output to monetary policy shock at different levels of financial exclusion (lambda)

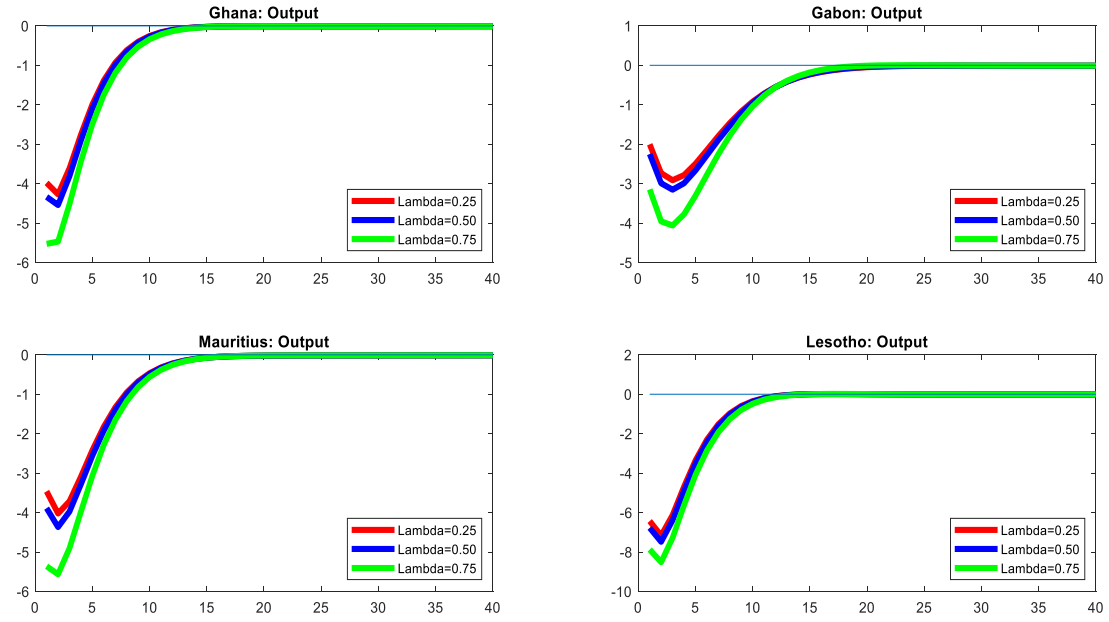


Figure 3.4: Response of inflation to monetary policy shock at different levels of financial exclusion.

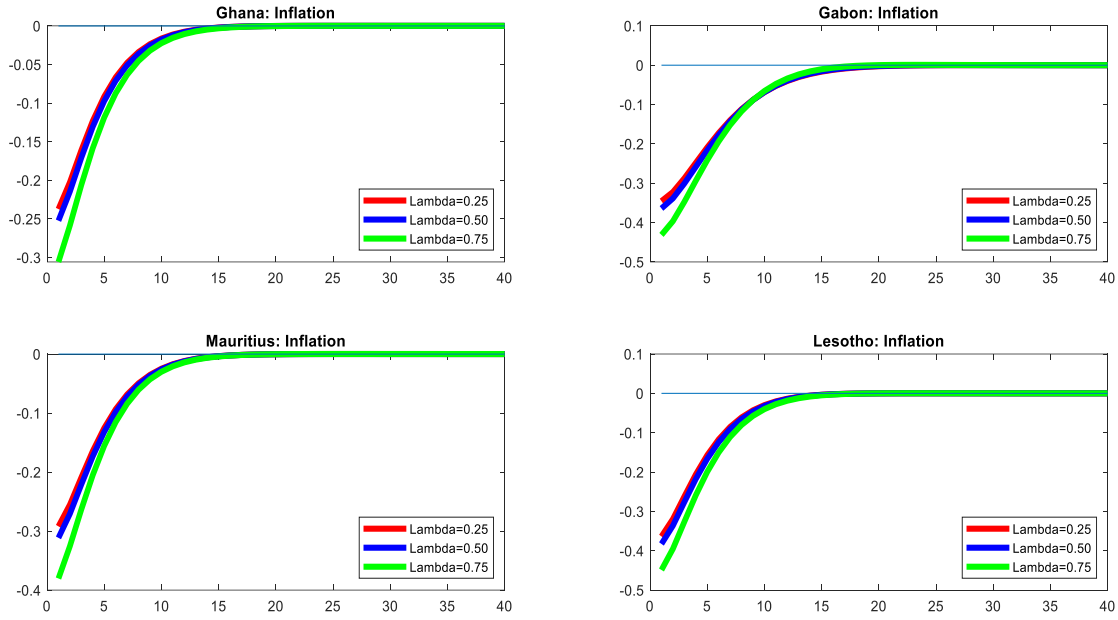


Figure 3.5: Monetary policy shock

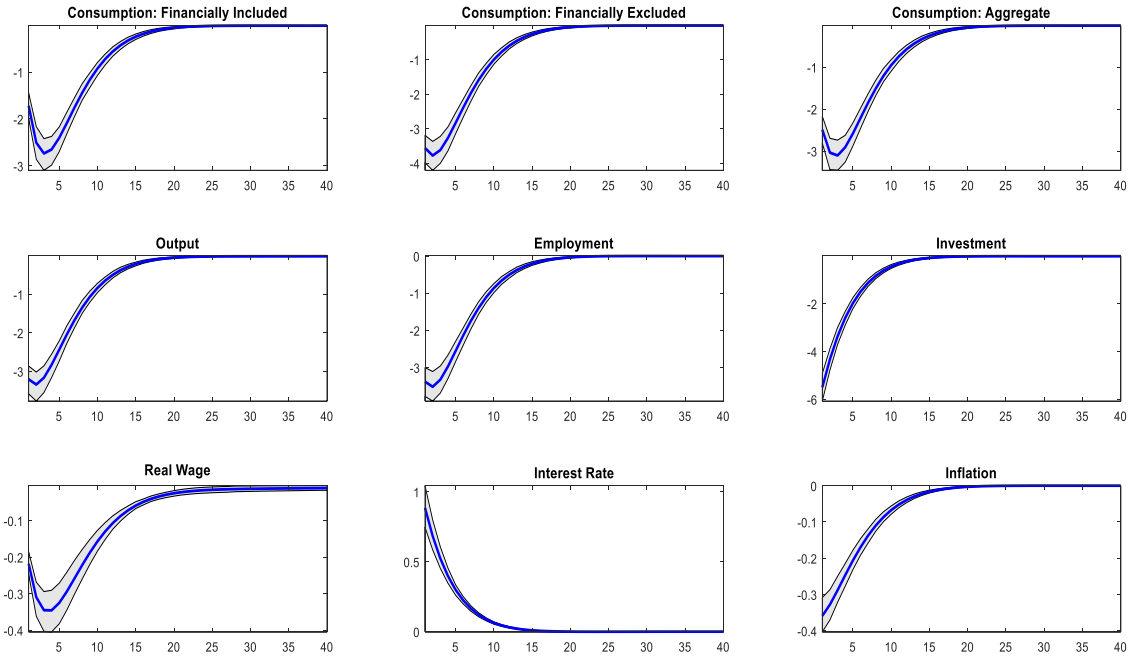


Figure 3.6: Technology shock

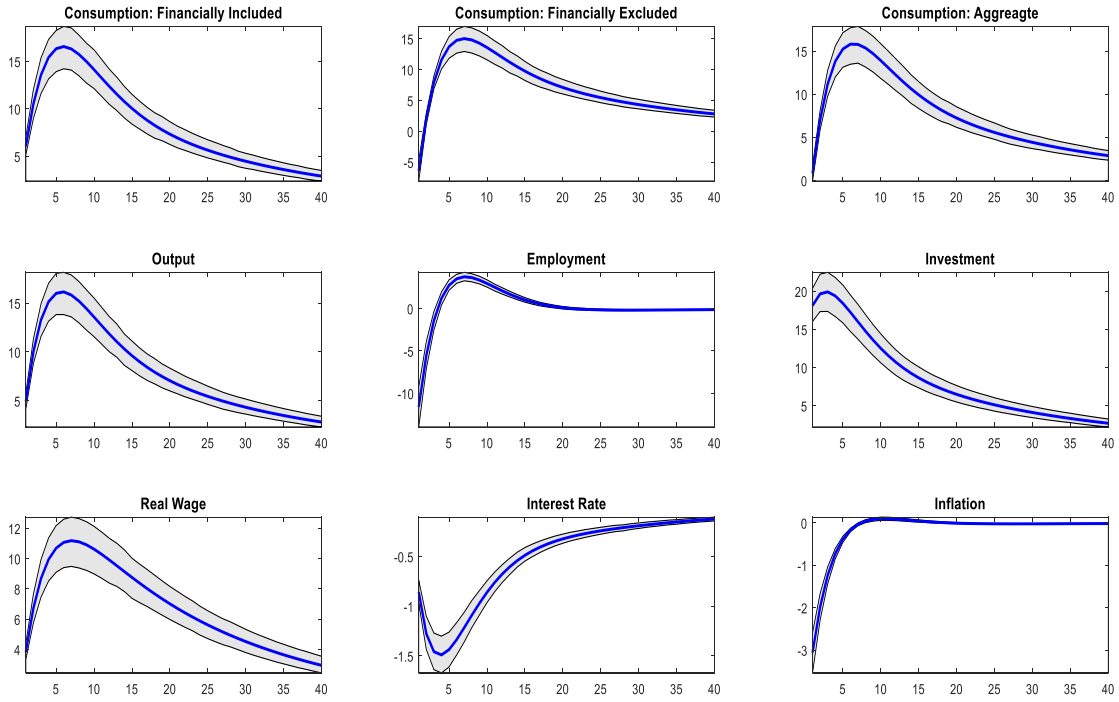


Figure 3.7: Price mark-up shock

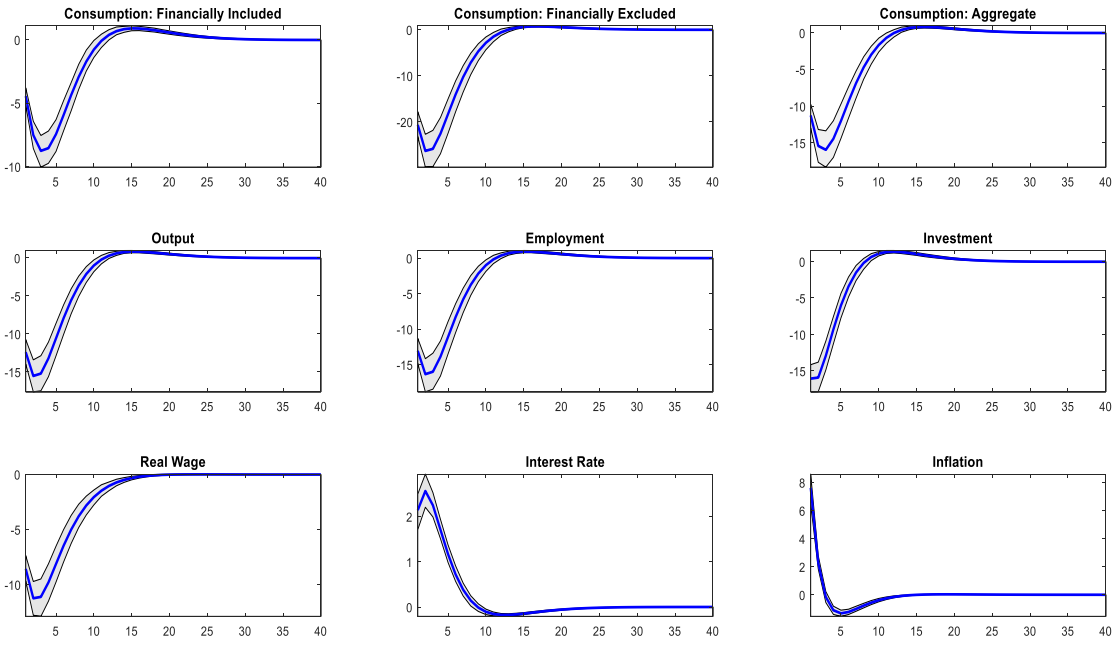


Figure 3.8: Labor supply shock

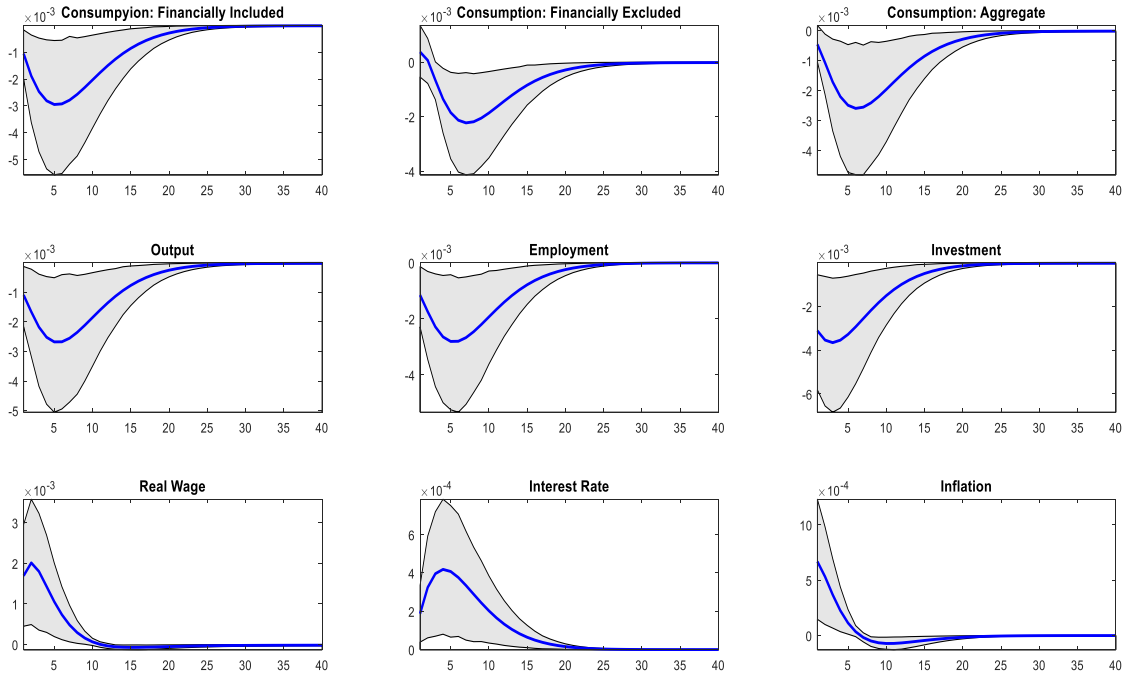


Figure 3.9: Preference shock

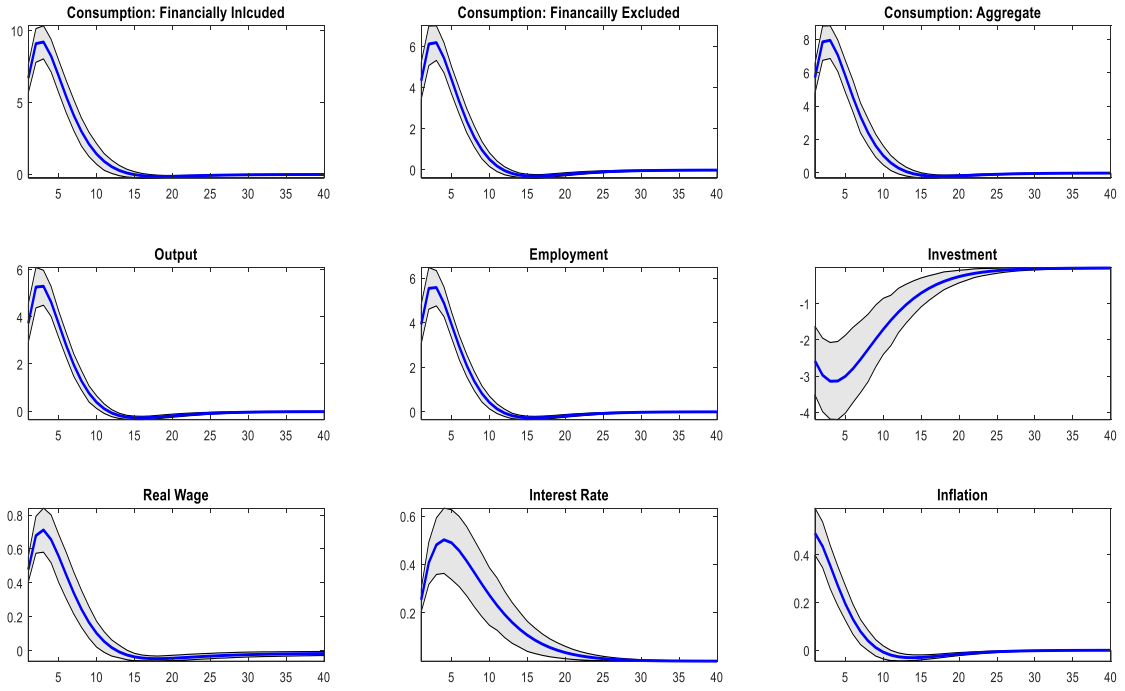


Figure 3.10: Response of macroeconomic variables to monetary policy shock at different levels of wage adjustment cost.

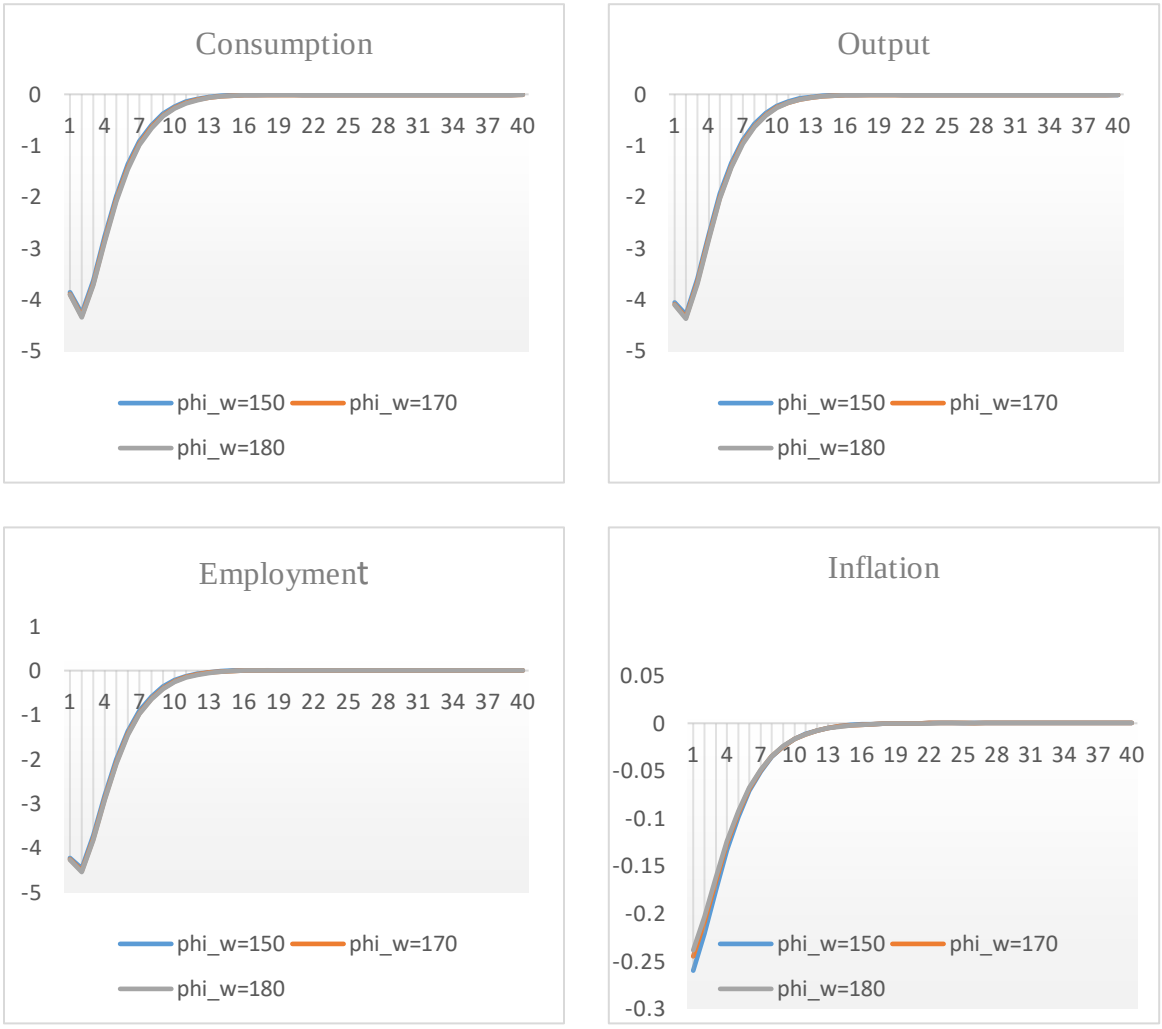


Figure 4.1: Response of macroeconomic variables to government spending shock (Model 1: Flexible wage dynamics).

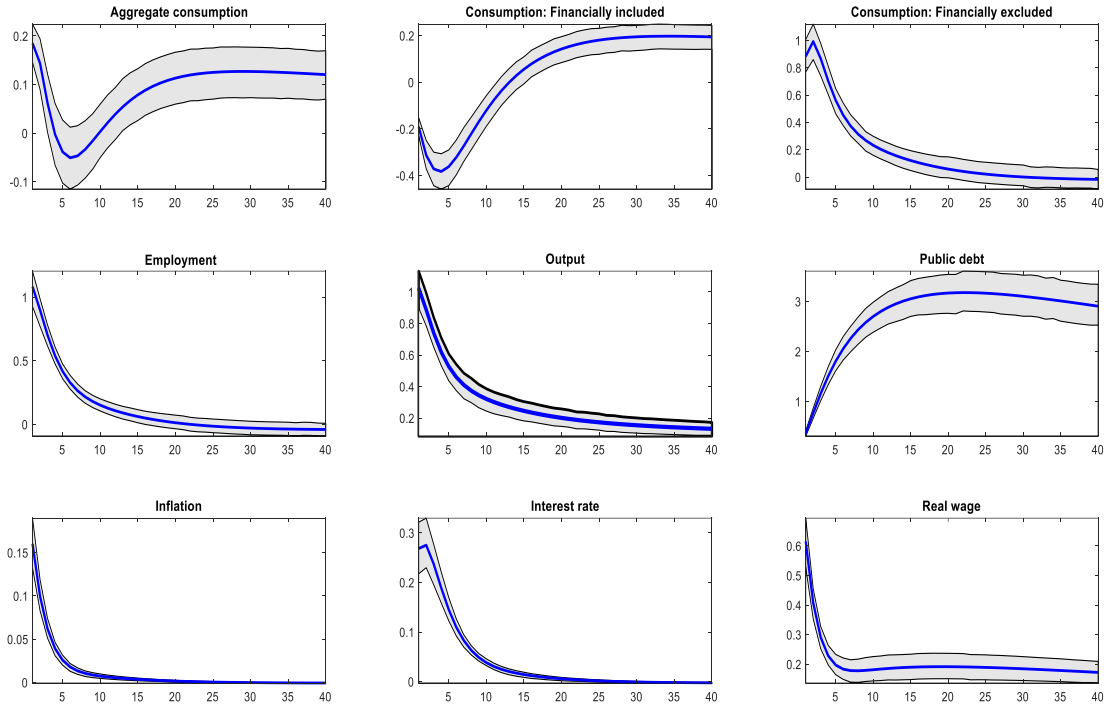


Figure 4.2: Response of macroeconomic variables to government spending shock (Model 2: Sticky wage dynamics)

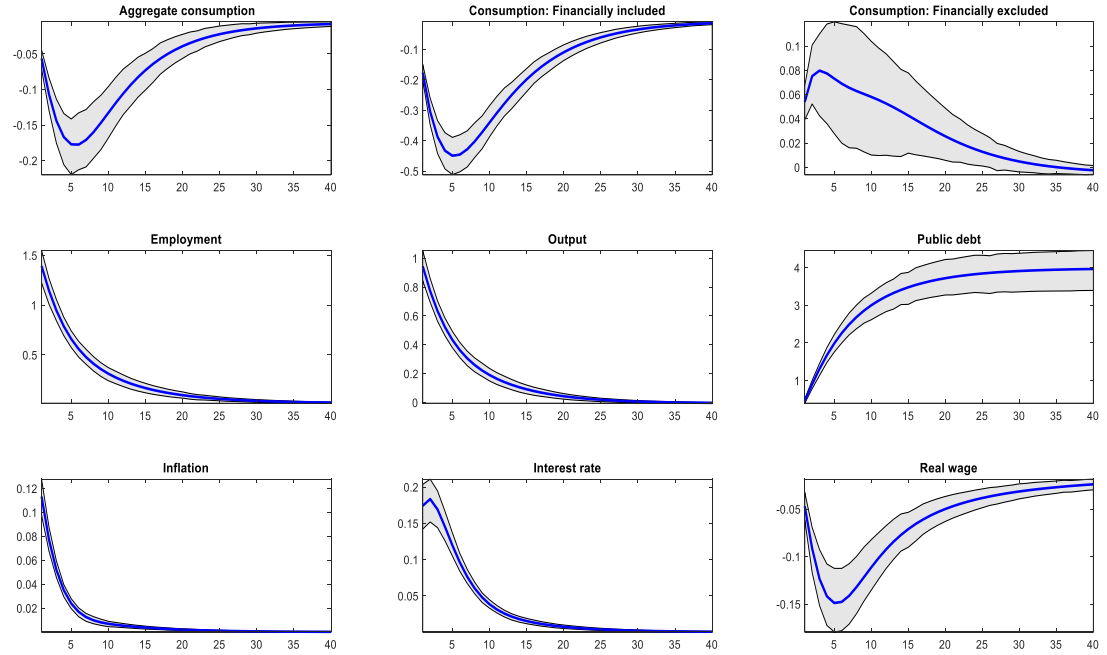
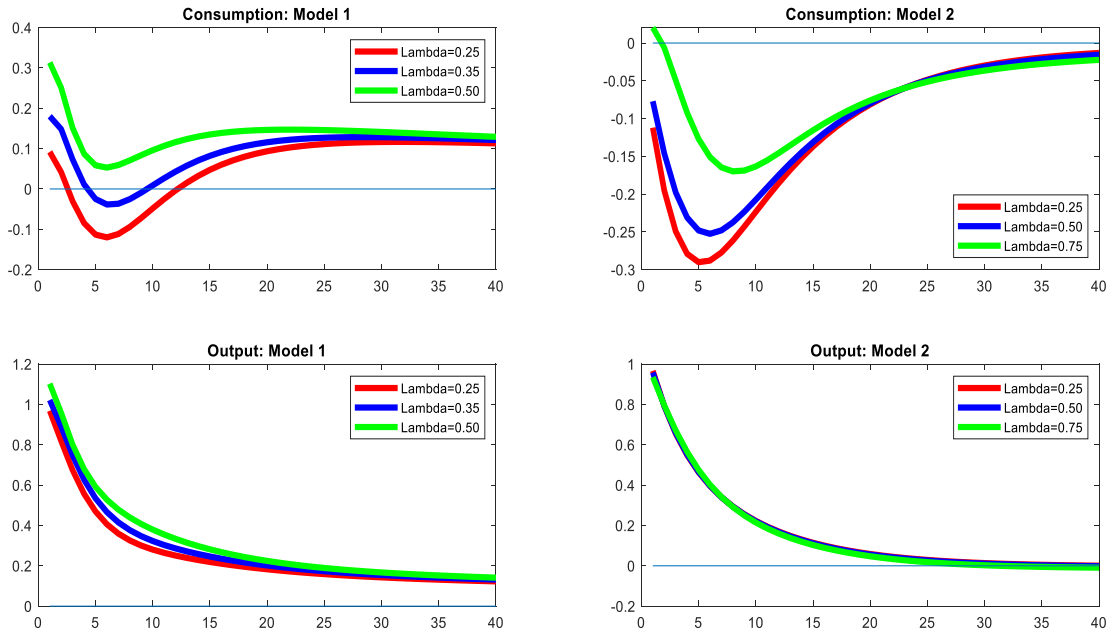
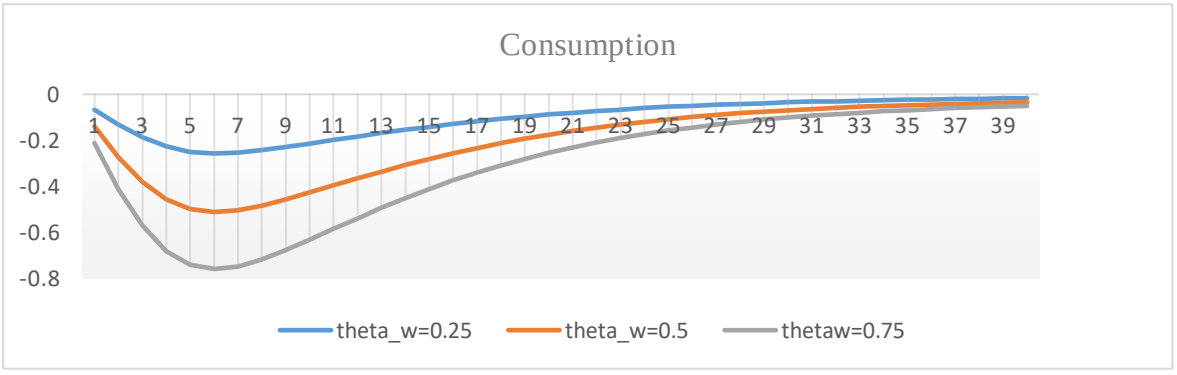


Figure 4.3: Response of consumption and output to government spending shock at different levels of financial exclusion.



Note: Lambda measures the degree of financial exclusion

Figure 4.4: Response of consumption and output to government spending shock at different levels of wage stickiness.



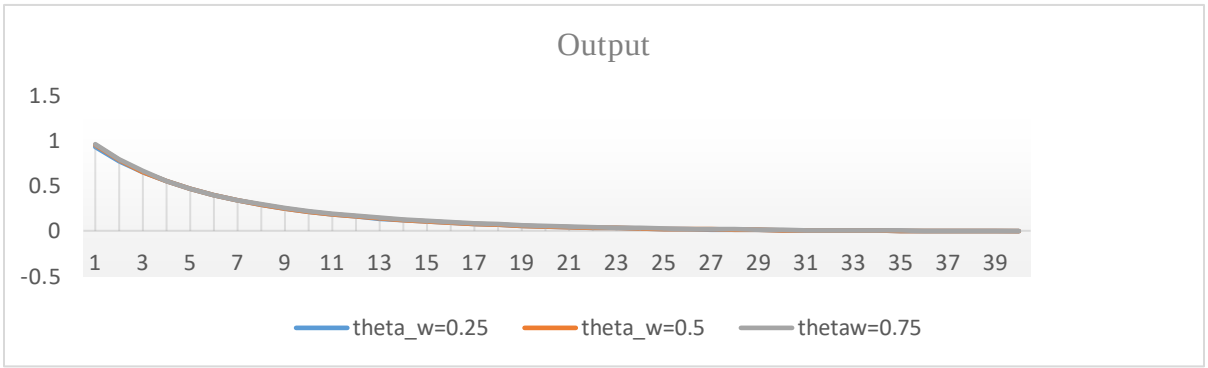


Figure 4.5: Response of output, inflation, consumption, and employment to monetary policy shock (the plots are the posterior means for models 1 and 2)

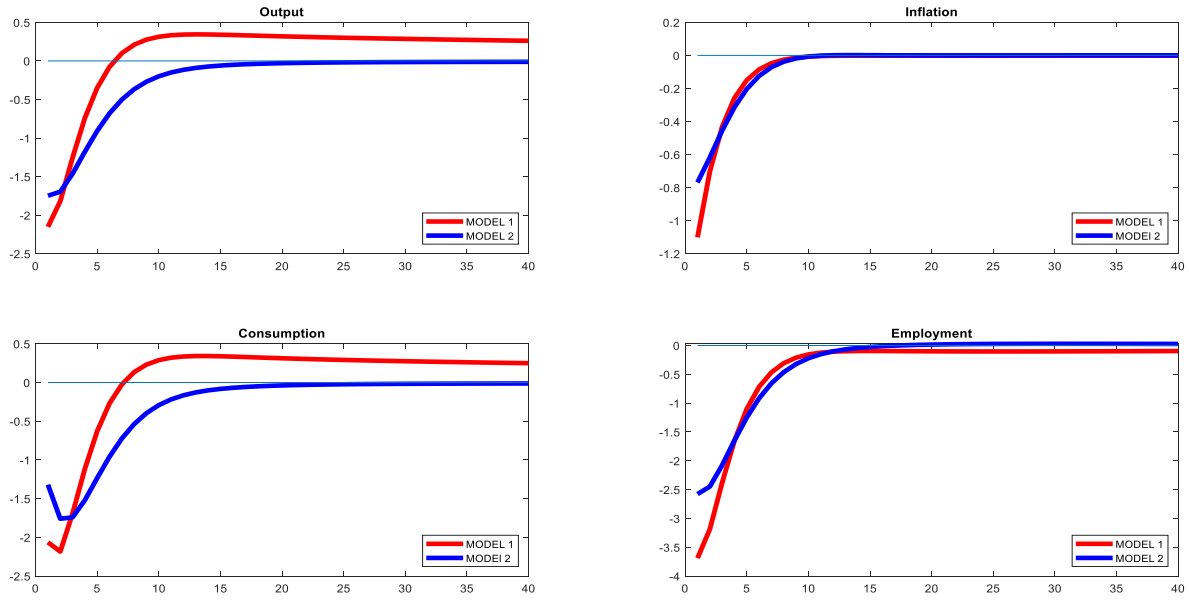


Figure 4.6: Response of macroeconomic variables to consumption tax shock (Model 1)

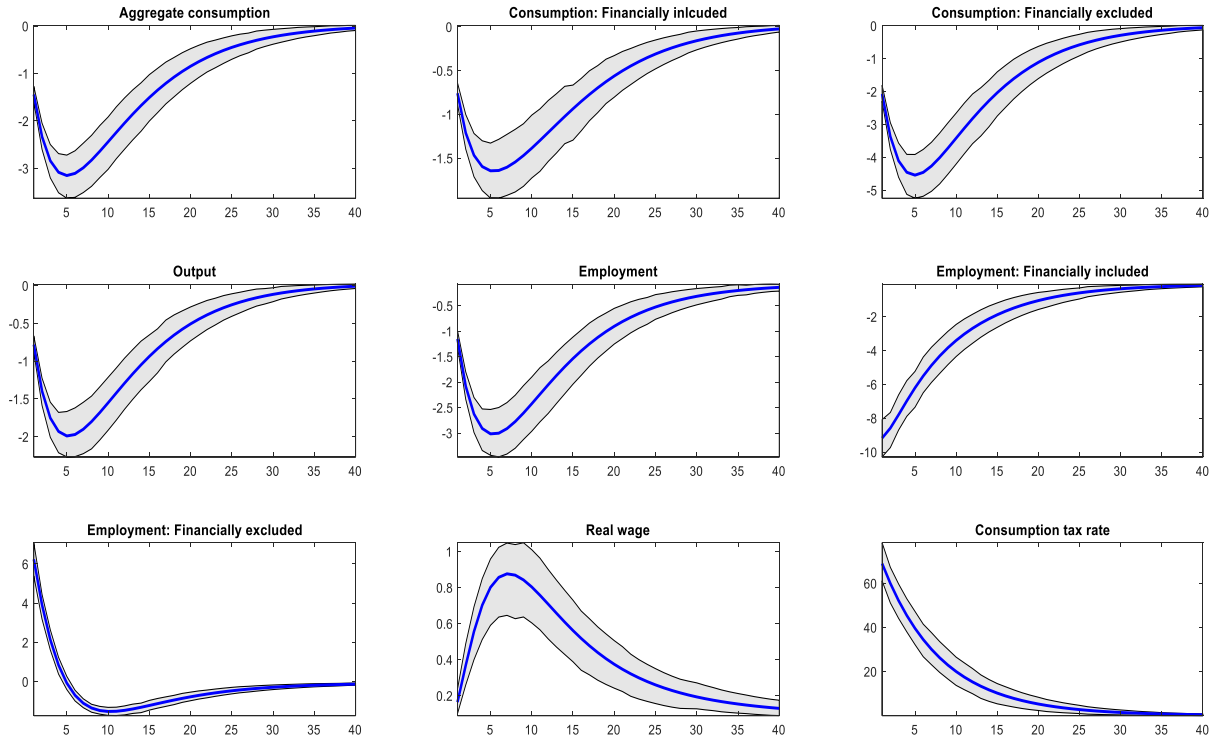


Figure 4.7: Response of macroeconomic variables to labor income tax shock (Model 1)

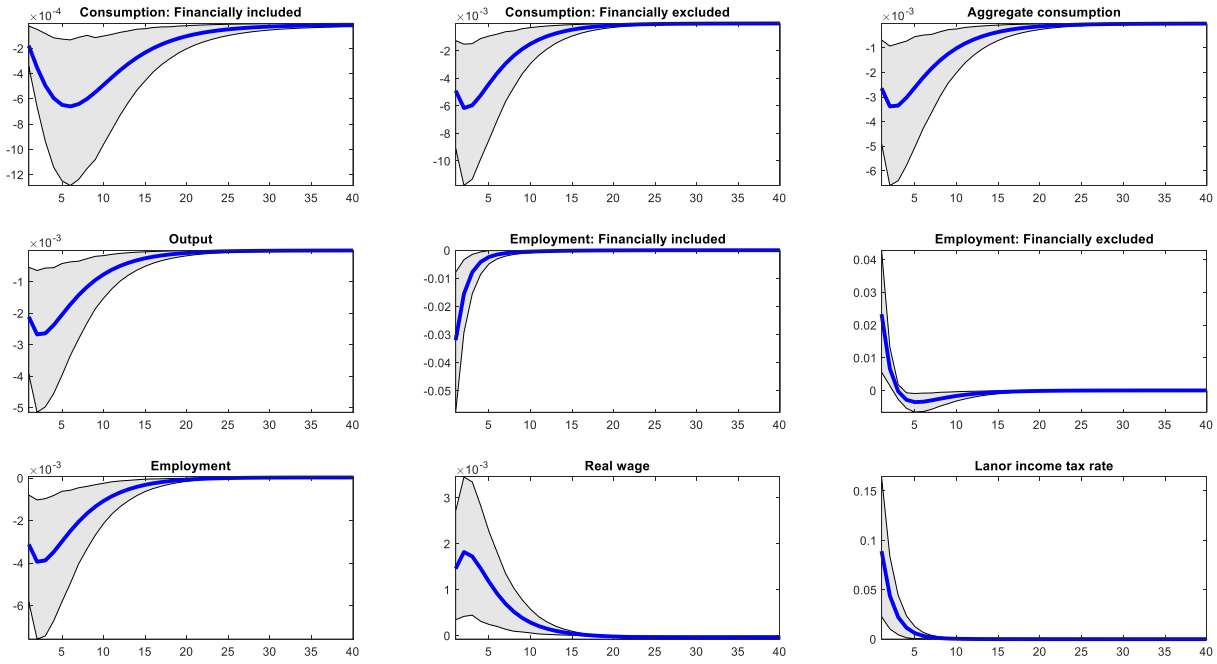
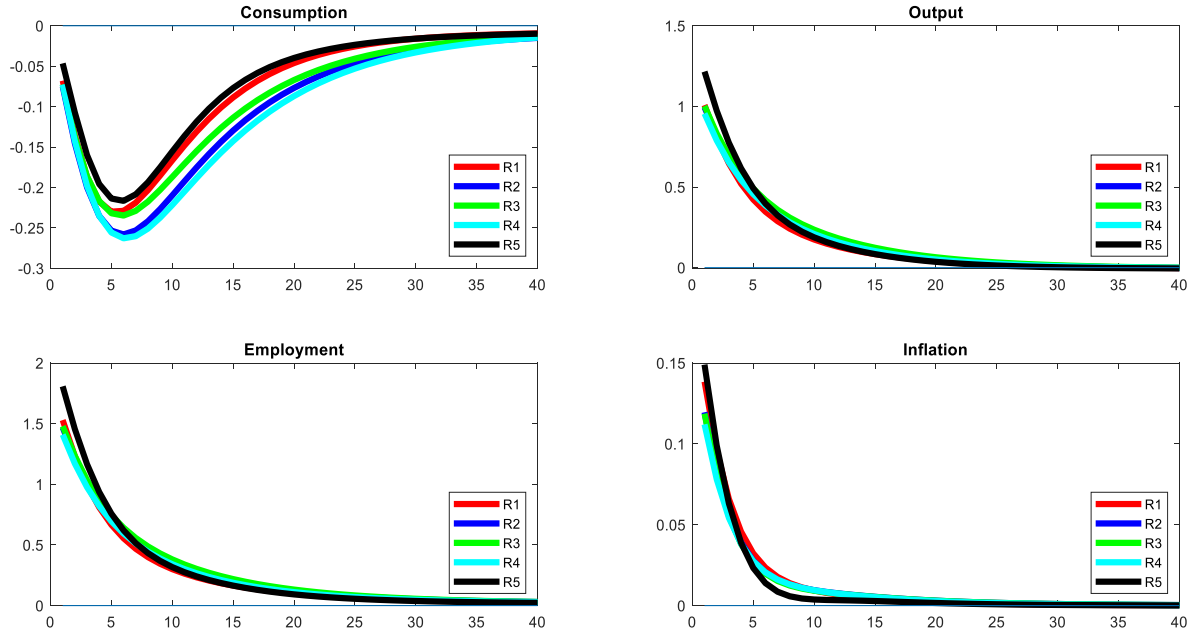


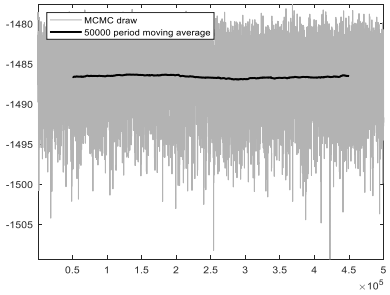
Figure 4.8: Response of consumption, output, employment, and inflation to government spending shock under alternative scenarios.



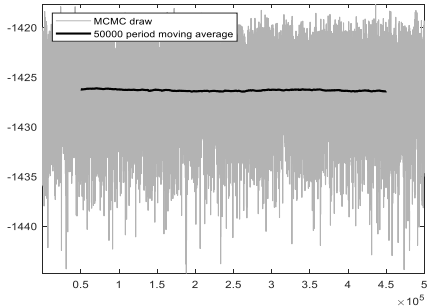
Appendix 3A

Trace Plots of some selected parameters

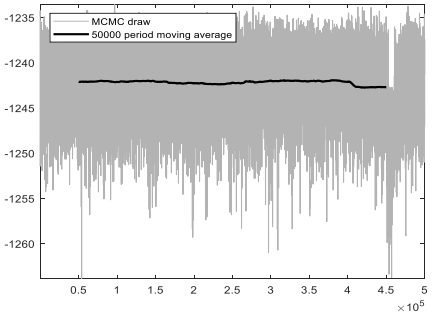
Posterior density (Ghana)



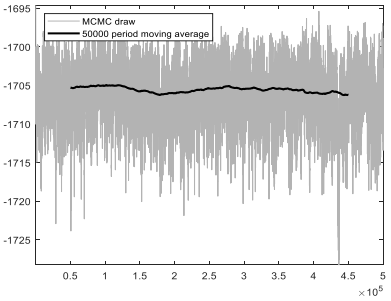
Posterior density (Gabon)



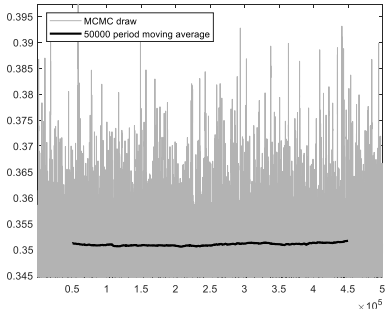
Posterior density (Mauritius)



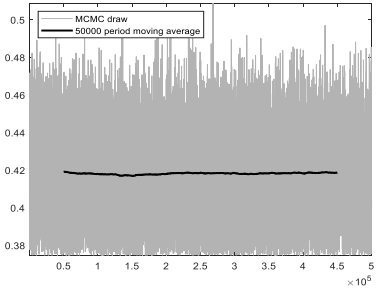
Posterior density (Lesotho)



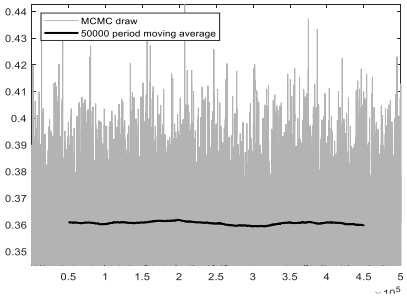
lambda (Ghana)



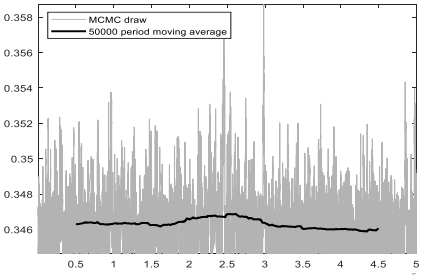
lambda (Gabon)



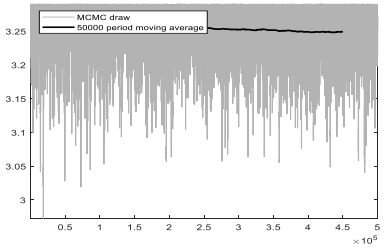
lambda (Mauritius)



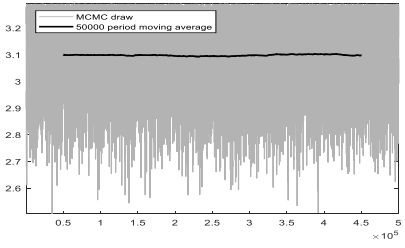
lambda (Lesotho)



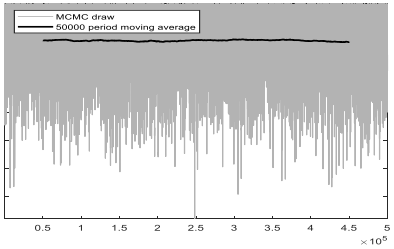
phi_pi (Ghana)



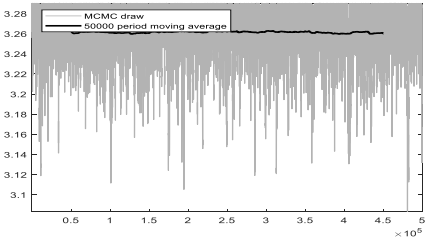
phi_pi (Gabon)



phi_pi (Mauritius)

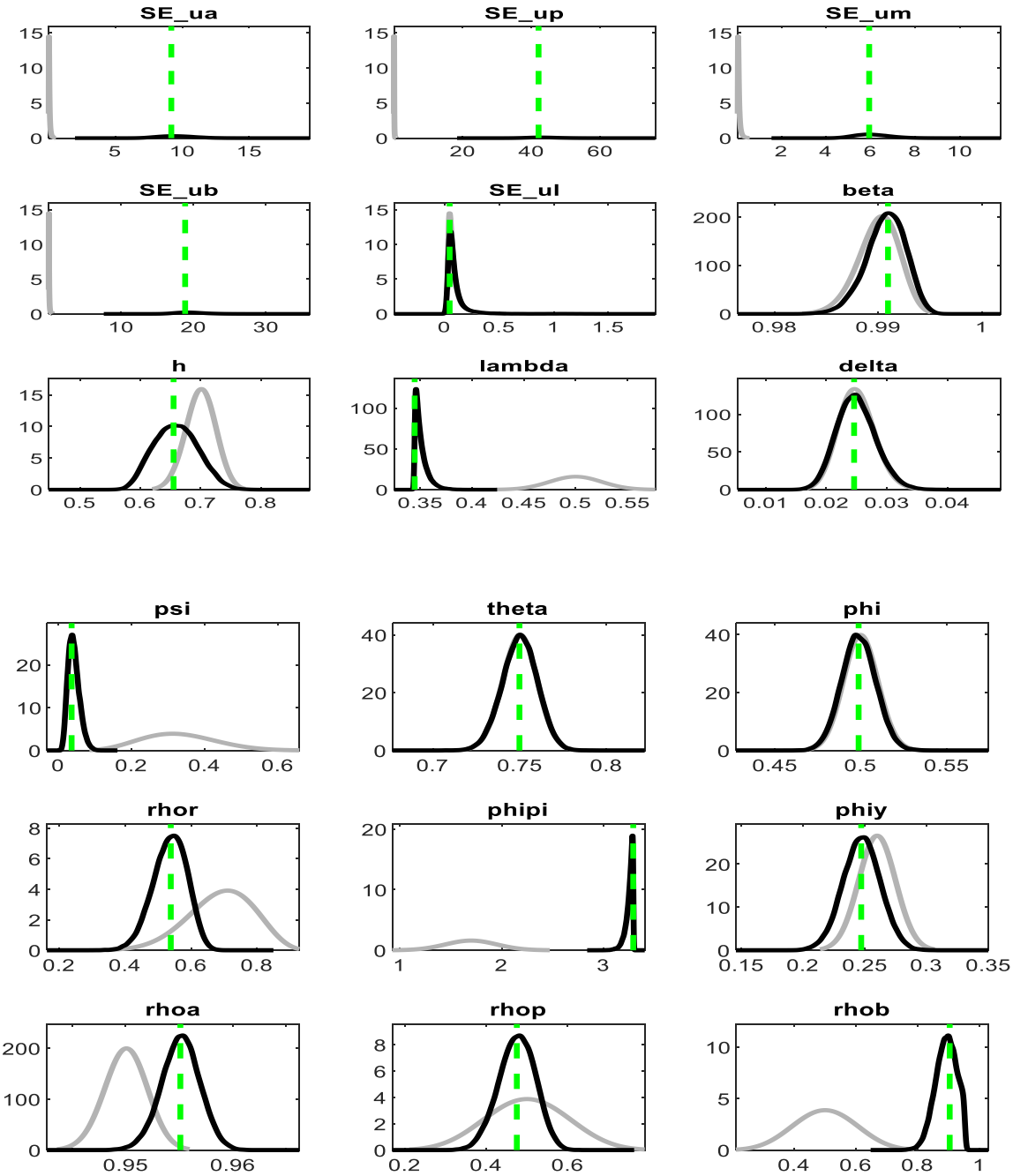


phi_pi (Lesotho)



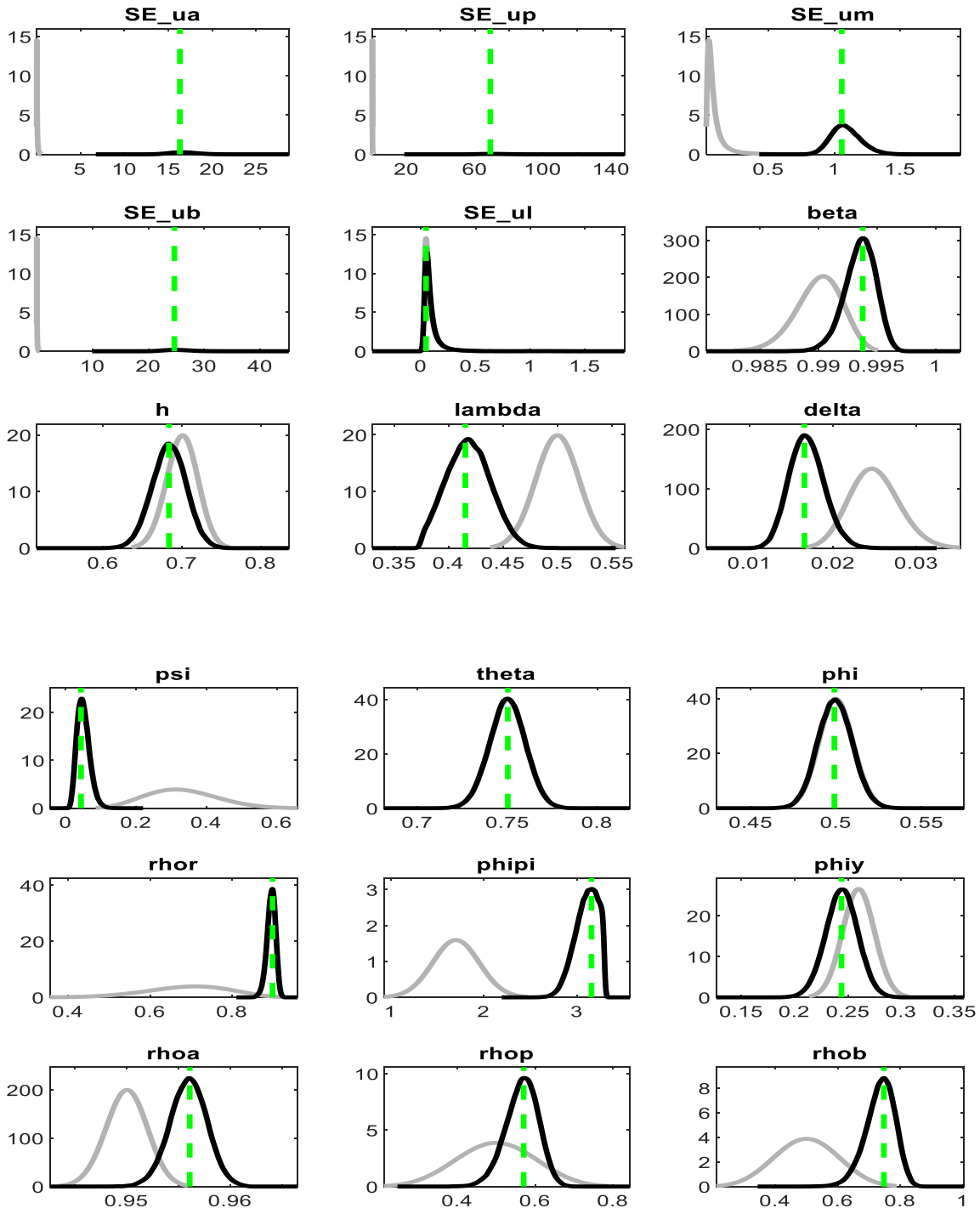
Appendix 3B

Prior and Posterior Densities
Ghana



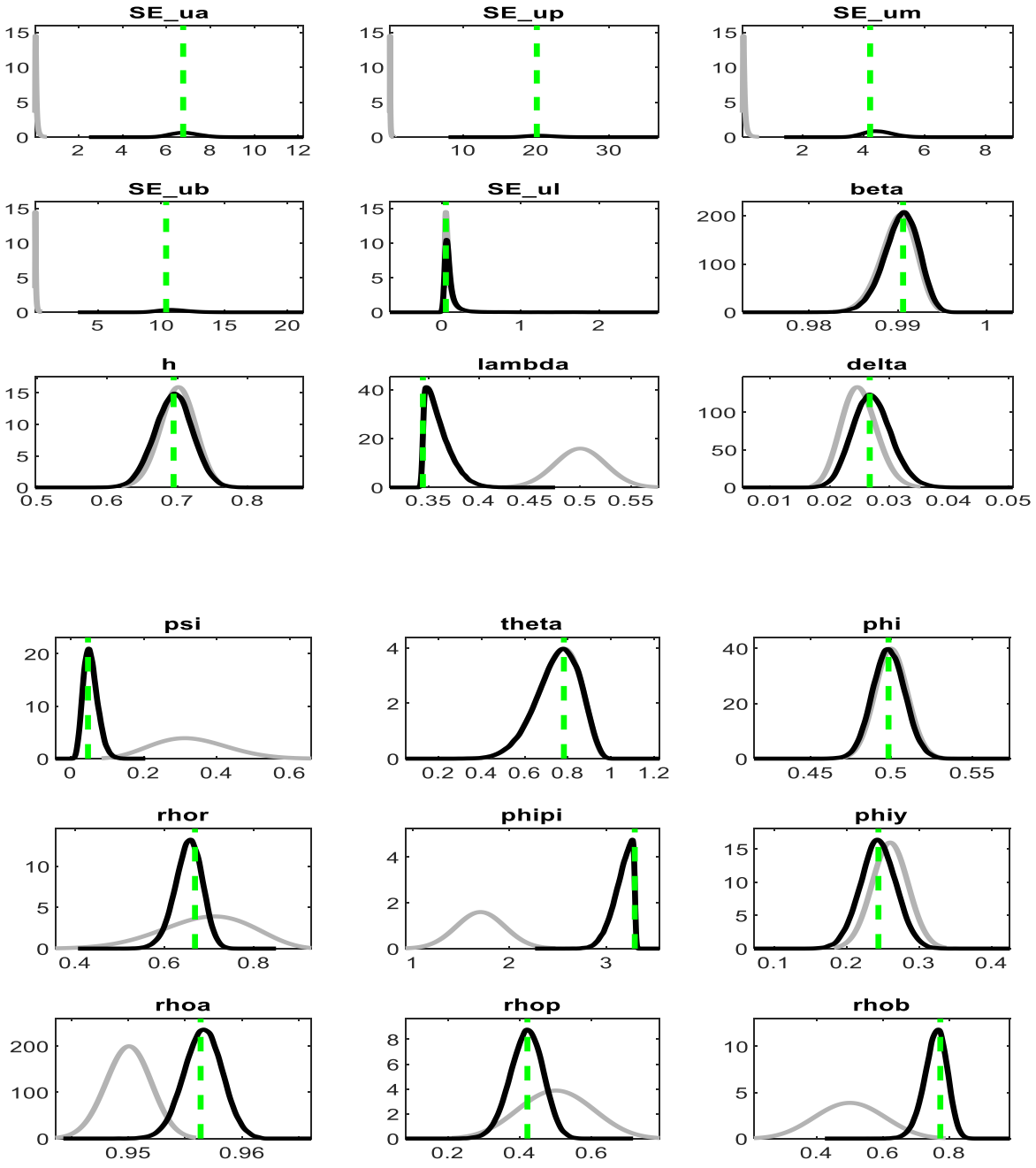
Appendix 3B continues

Gabon



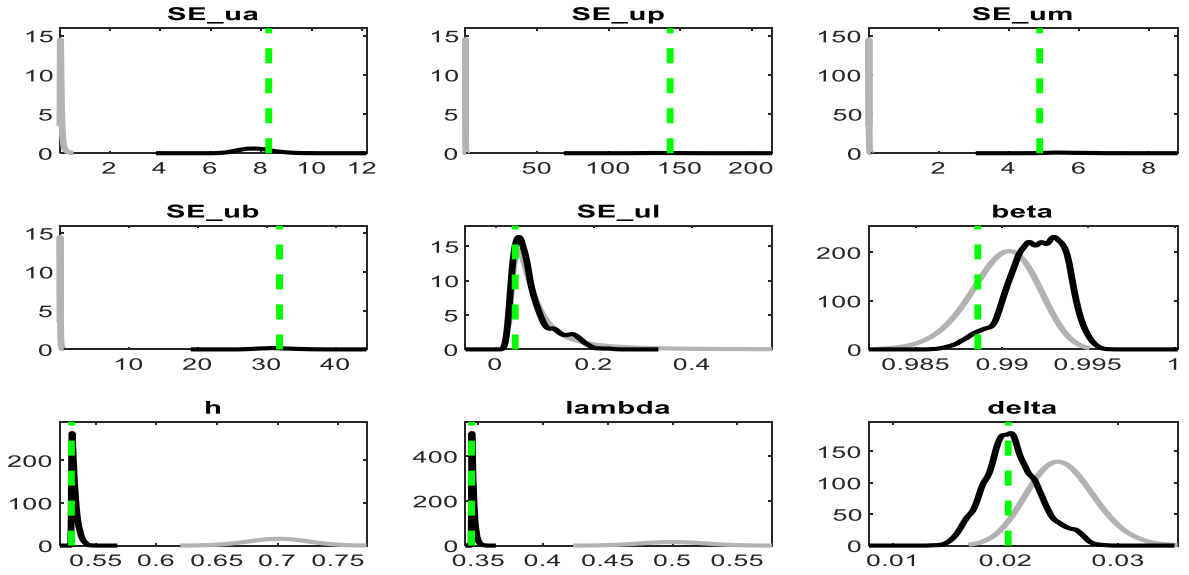
Appendix 3B continues

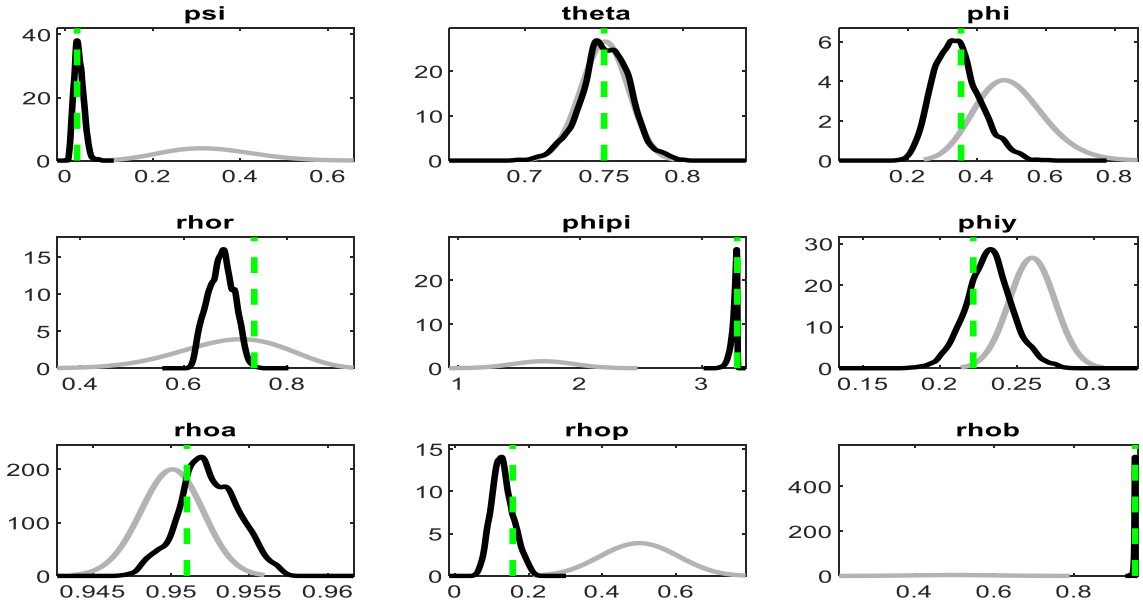
Mauritius



Appendix 3B continues

Lesotho

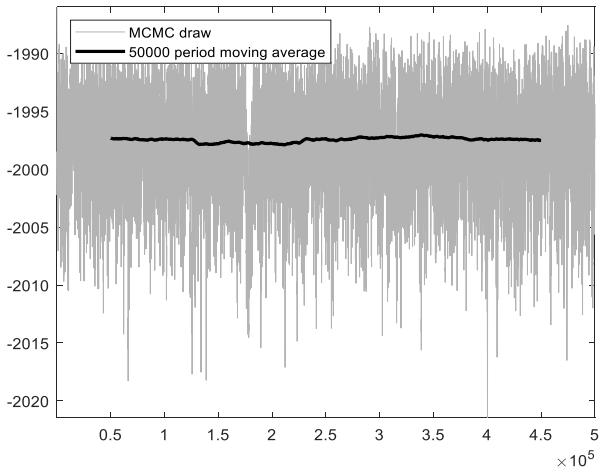




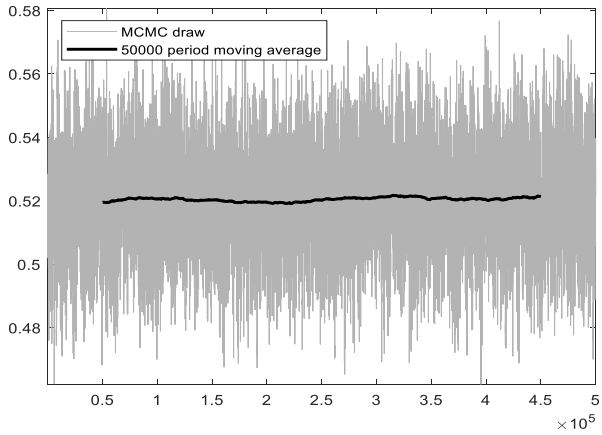
Appendix 4A

Trace Plots of some selected parameters

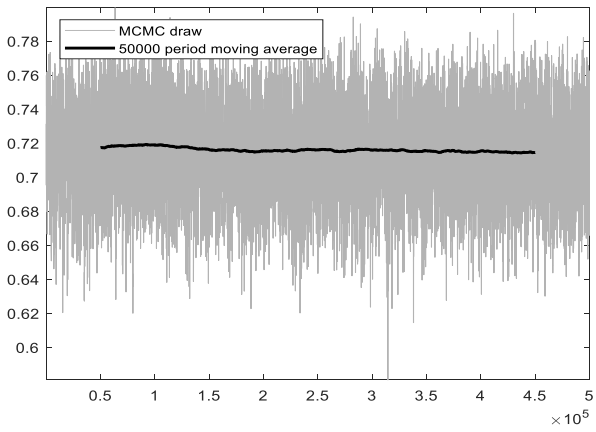
Posterior density (Model 1)



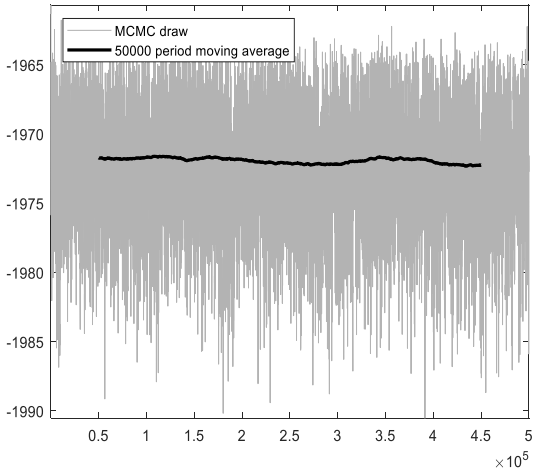
lambda



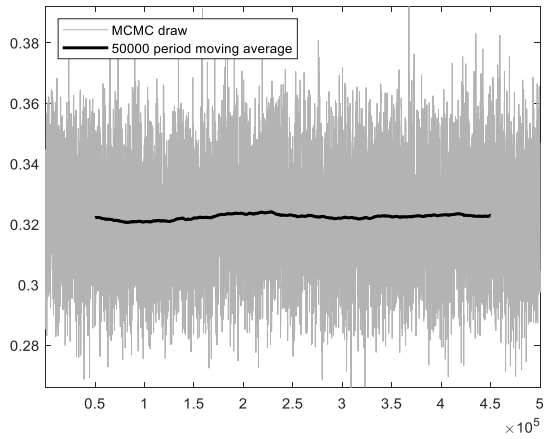
rho_r



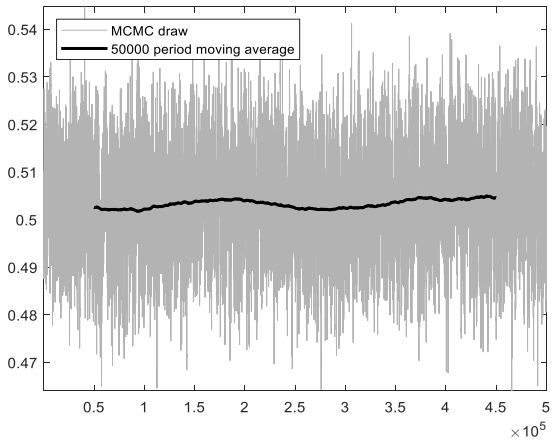
Posterior density (Model 2)



alpha

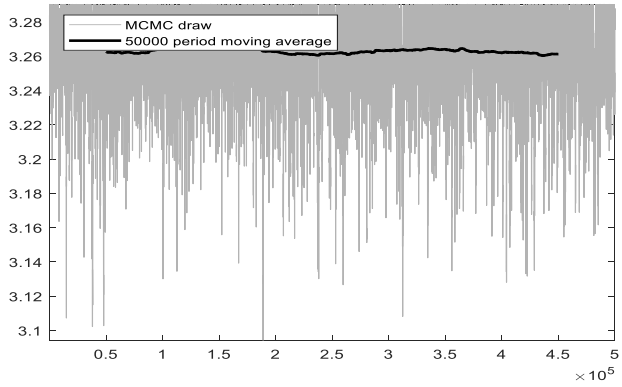


phi

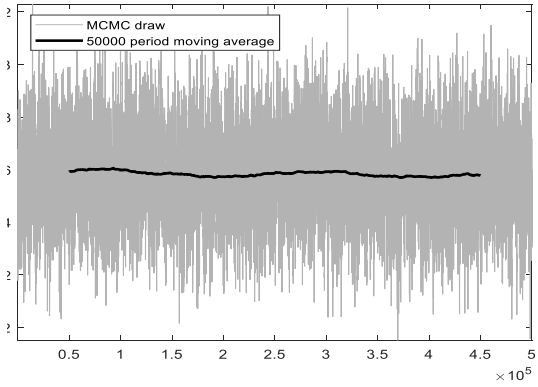


Appendix 4A continues

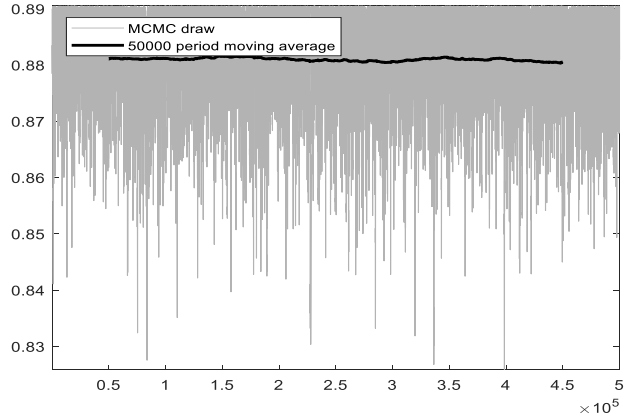
phi_pi



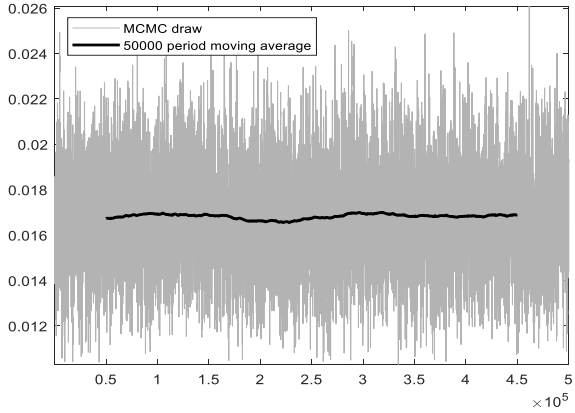
phi_y



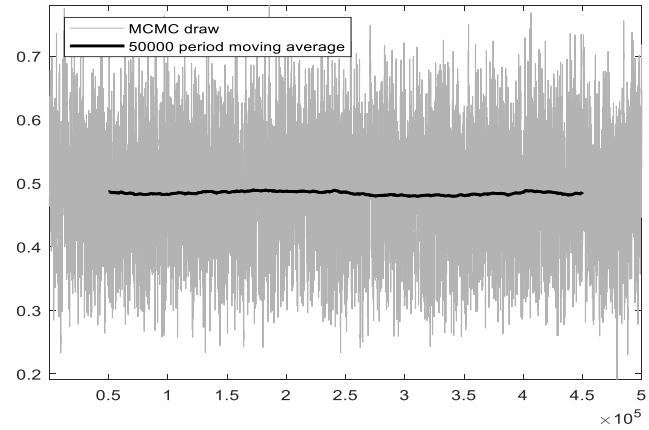
rho_g



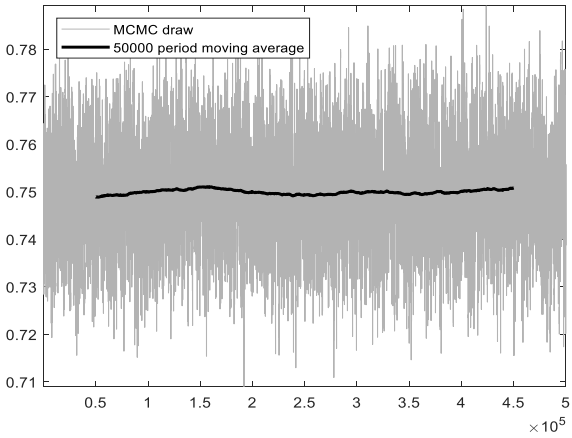
theta



rho_tau_n



theta_w



Appendix 4B

Impulse responses functions from model 1.

Figure 4B1: Consumption Tax Shock

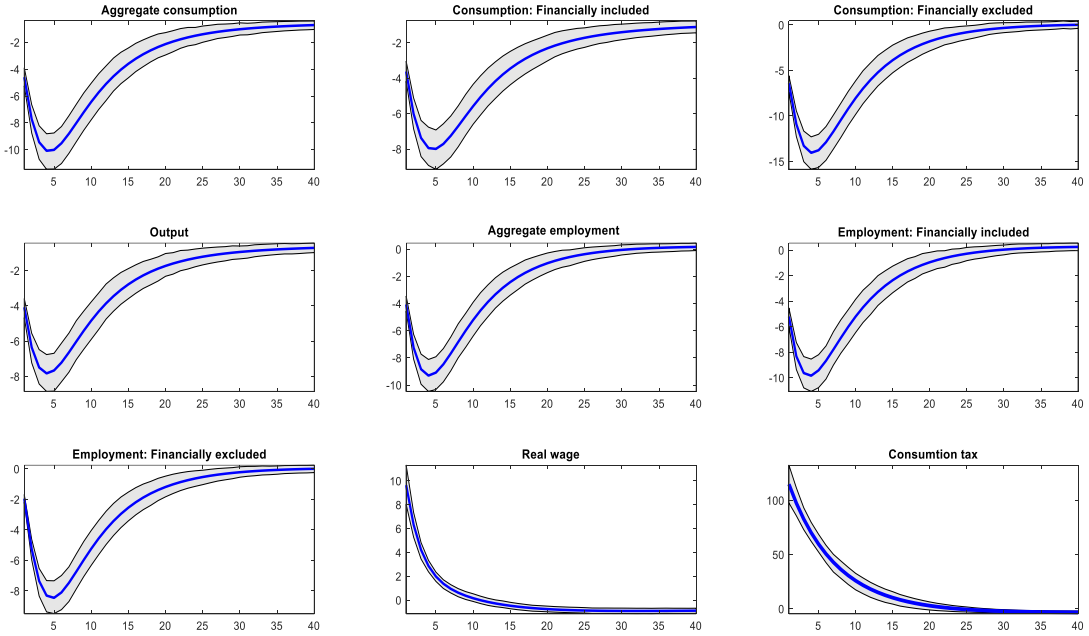


Figure 4B2: Labor Income Tax Shock

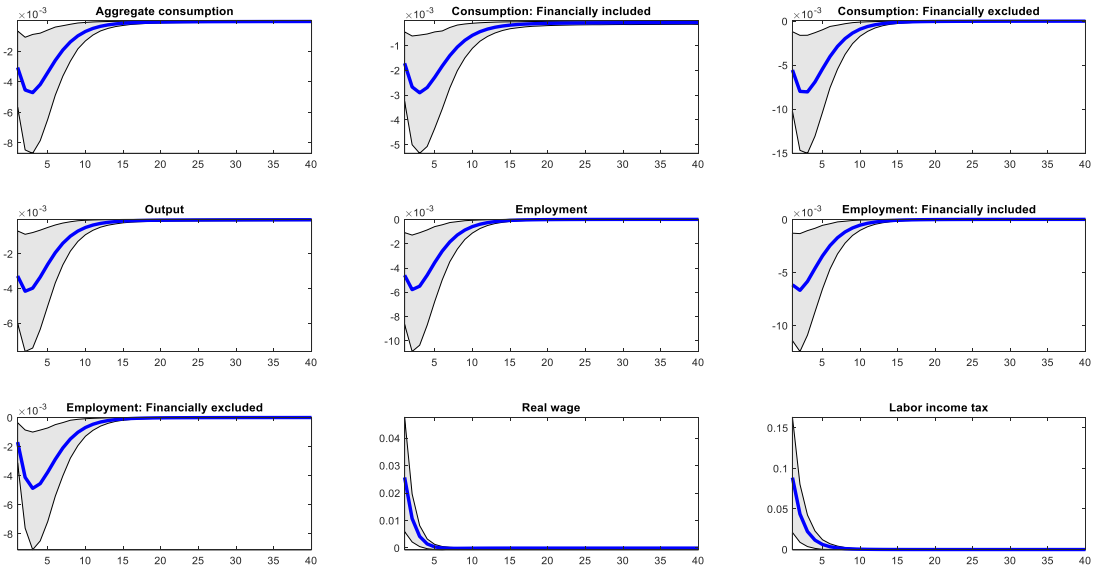


Figure 4B3: Monetary Policy Shock

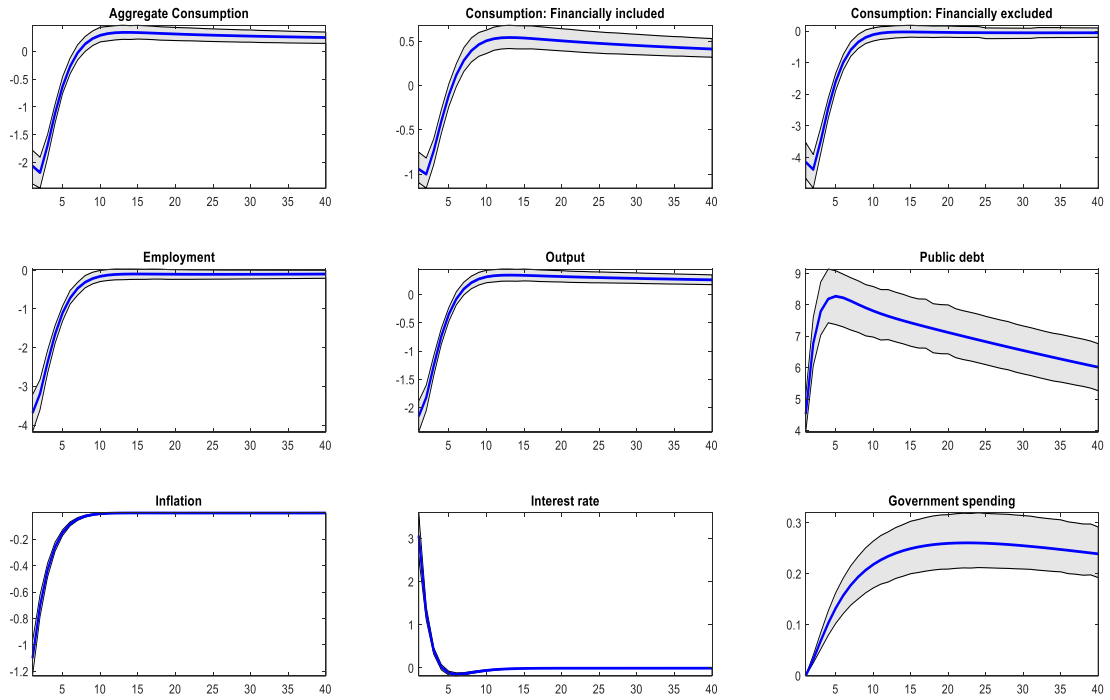


Figure 4B4: Technology Shock

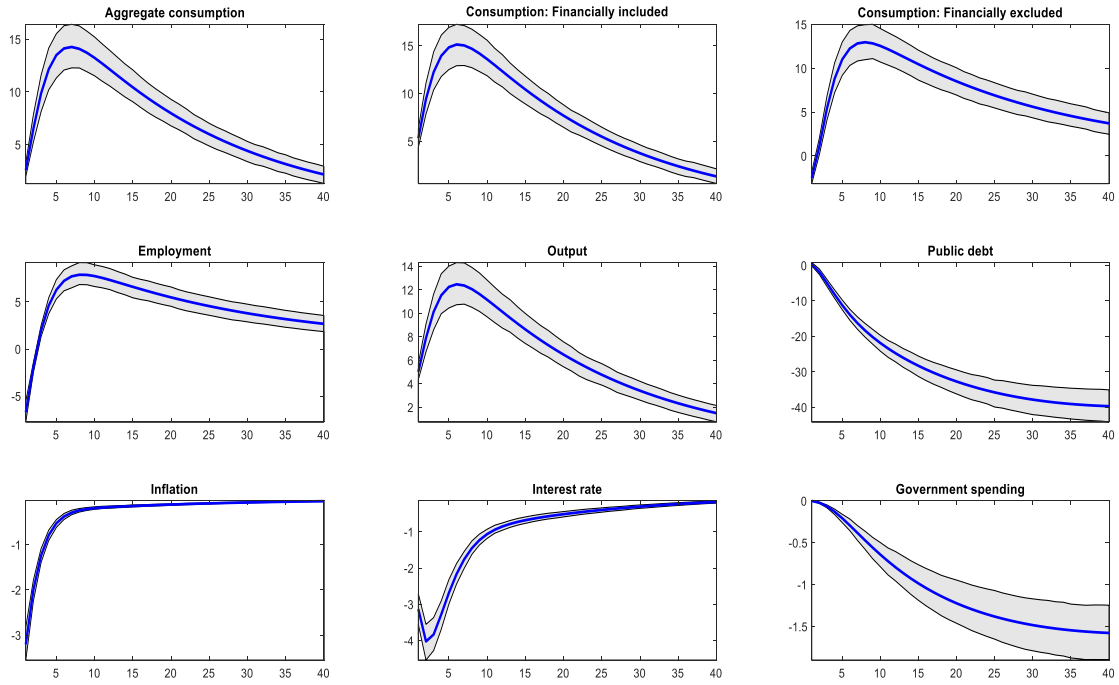


Figure 4B5: Price Mark-up Shock

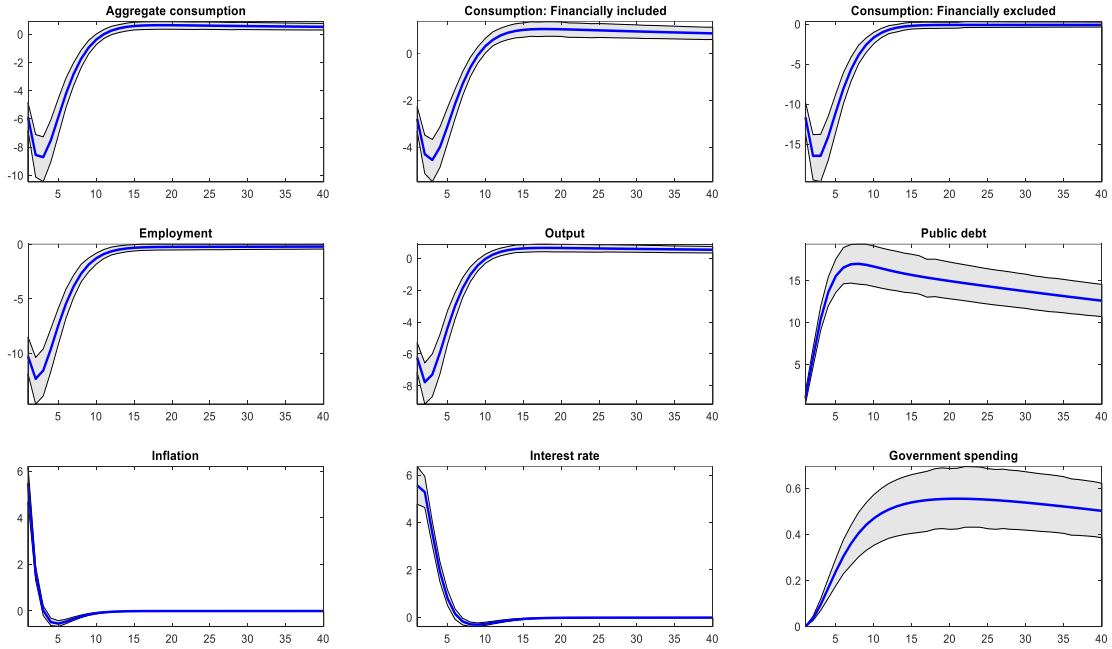
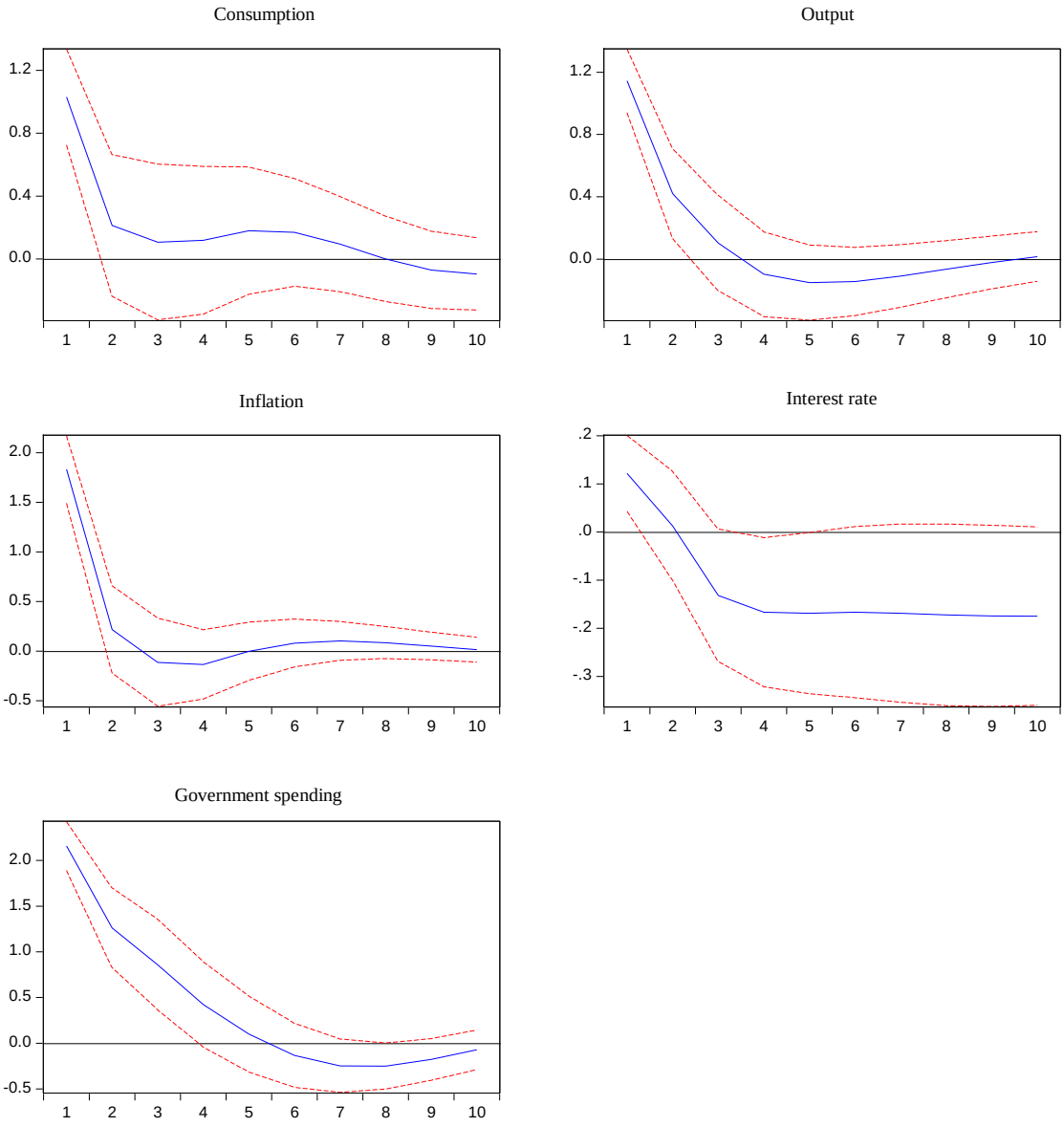


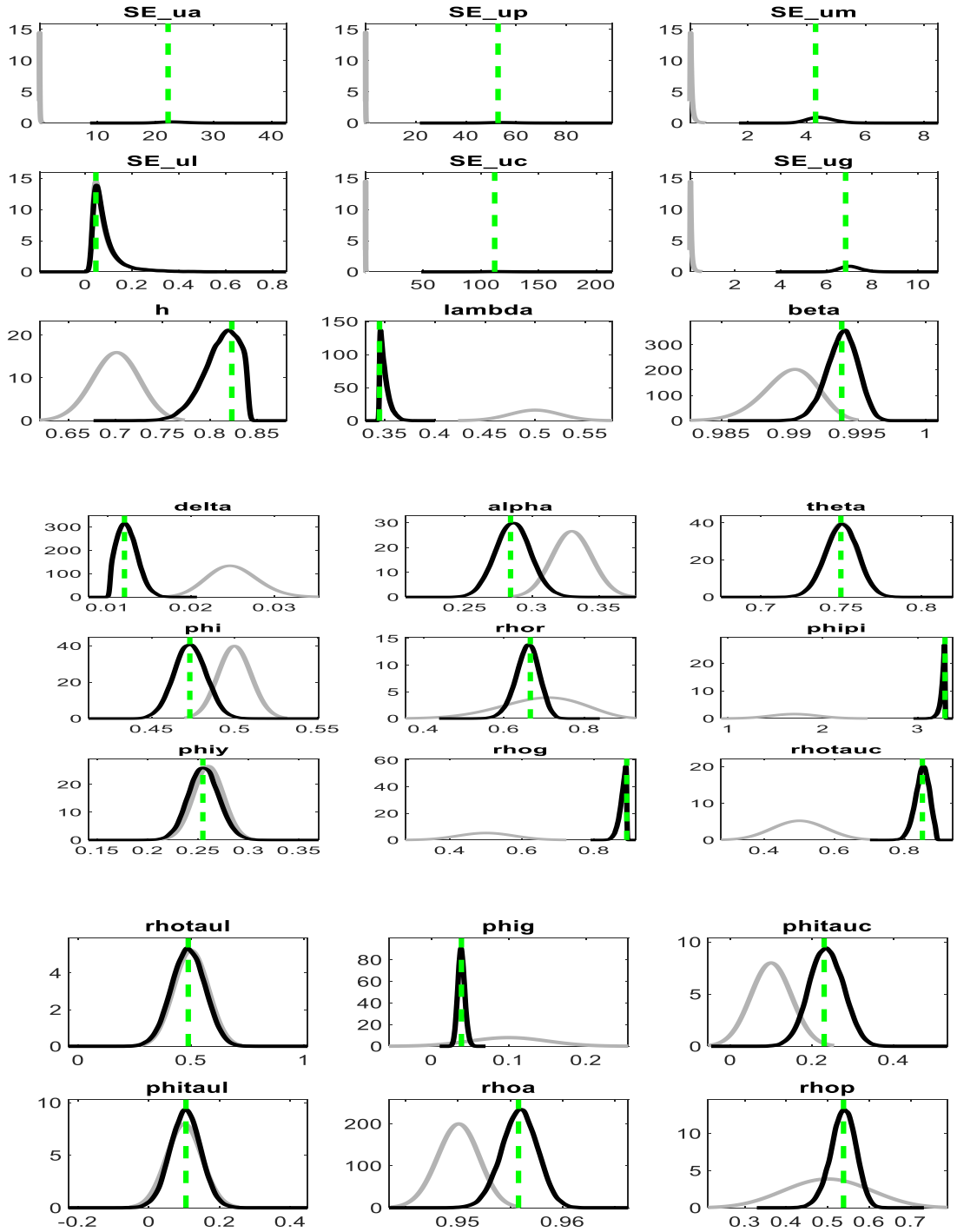
Figure 4B6: Response of consumption, output, inflation, and interest rate to government spending shock using VAR with Cholesky ordering.



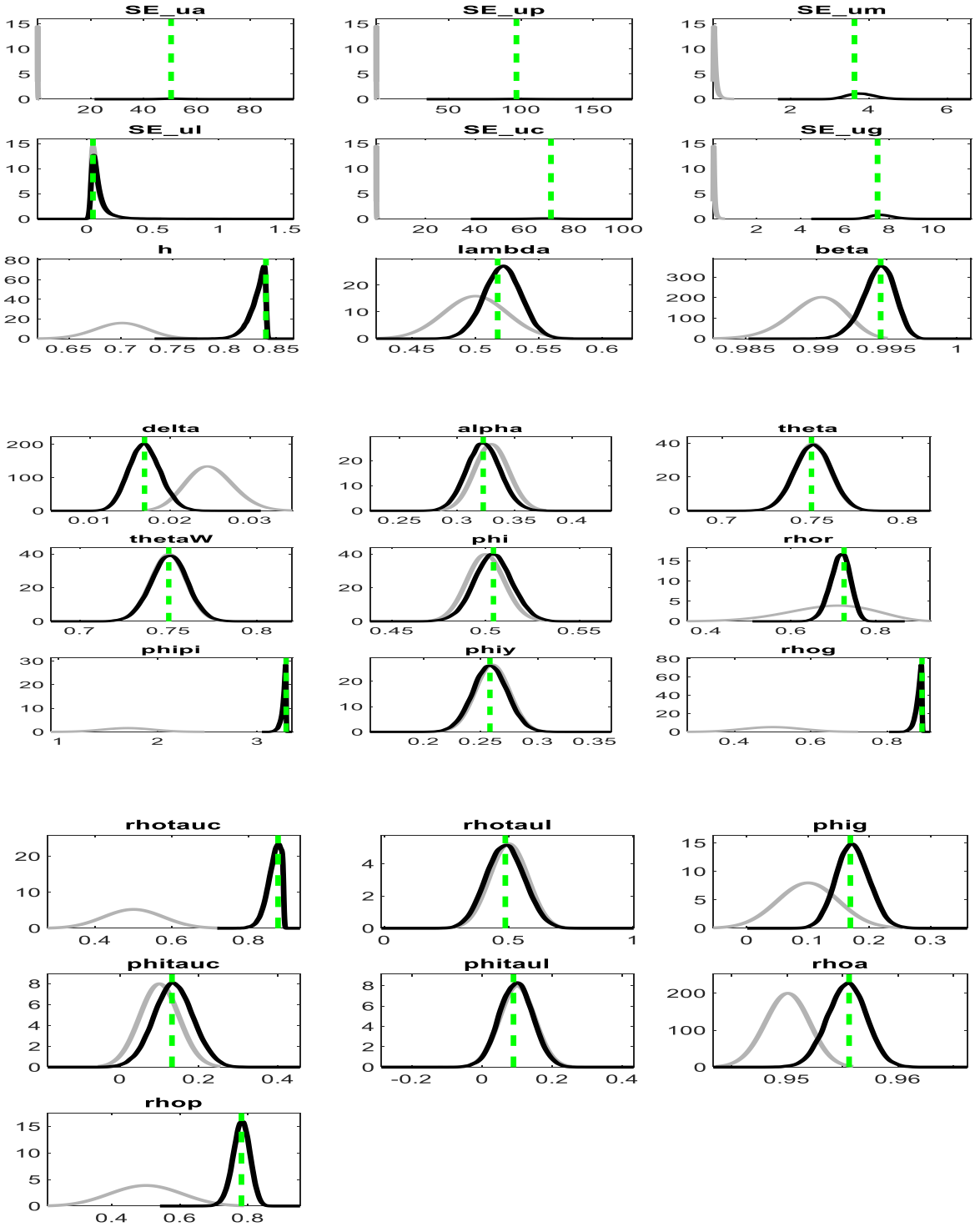
Appendix 4C

Prior and Posterior Densities

Model 1



Model 2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thetaW
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