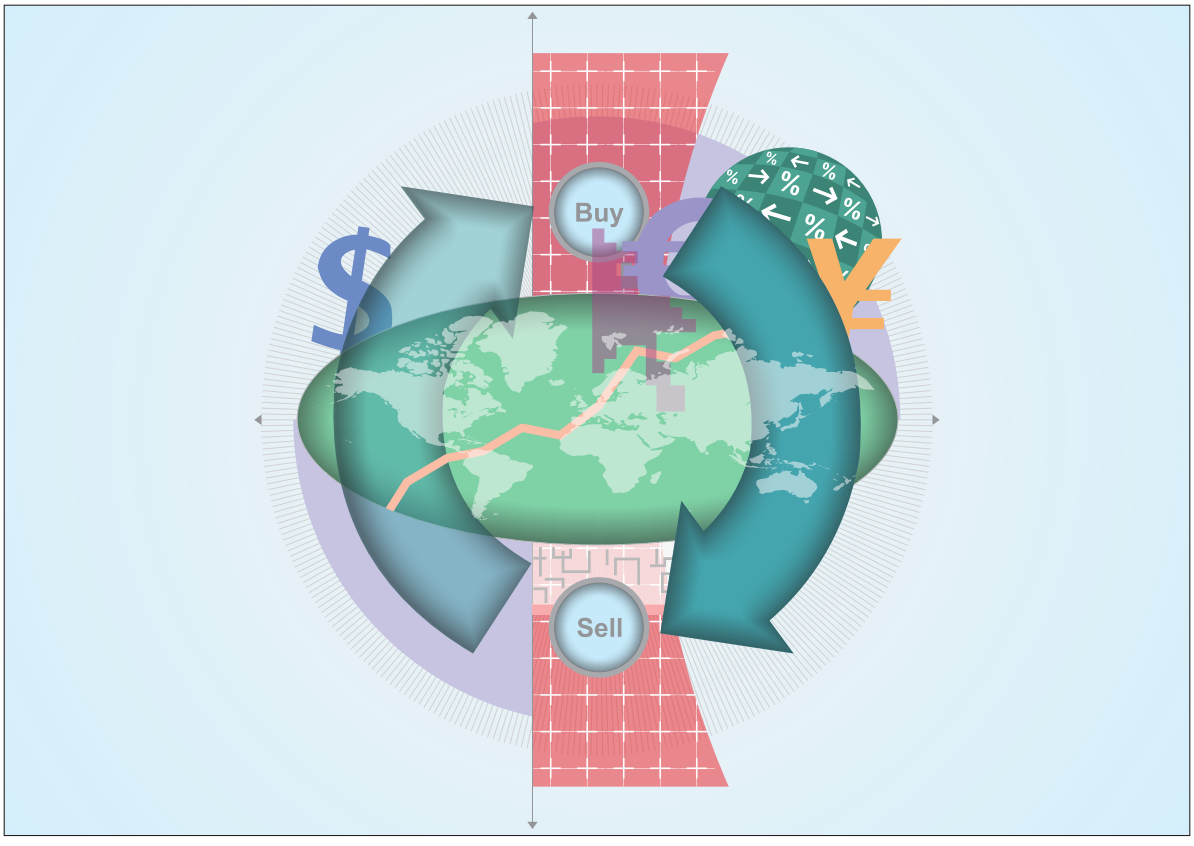

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The Credit Crunch and its Macroeconomic Impacts in Small-Open Developing Economies: A Dynamic Stochastic General Equilibrium Analysis

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Abstract: This study investigates the macroeconomic impacts of the credit crunch on small-open developing economies. A Dynamic Stochastic General Equilibrium (DSGE) model is developed as the theoretical framework, while the methodology is based on simulation and calibration using Markov Chain Monte Carlo (MCMC) techniques. The study establishes that the current credit crunch of 2007-2009 could generate devastating effects in developing economies just as in industrialized economies. The credit crunch could affect developing economies through three main channels the resource-flows channel, global prices channel and macroeconomic shocks channel. Overall, in a typical developing economy, the credit crunch could generate inflationary spiral, exchange rate appreciations, widening current account and budget deficits with increasing domestic borrowings and macroeconomic stagnation as reflected in declines in output, net exports, tax revenue and public investment. The study recommends that developing countries should plan for some kind of stimulus packages to assuage the adverse effects of the crisis on output, inflation, exchange rate and fiscal aggregates. The models developed in this study can be used in analyzing the effects of future external shocks on developing economies, which is a very important study in the field of economics.

Key words: Credit crunch, developing economies, macroeconomic impacts, dynamic stochastic general equilibrium

INTRODUCTION

The 2007-2009 Credit Crunch which began in July 2007 in the United States as a result of loss of confidence in mortgage securities (Hull, 2009; IMF, 2009a) and later spread to Europe and the Far East is having its toll on the global economy currently. The global economy is projected to grow, in purchasing power parity terms, by just 0.5% in 2009, the lowest growth rate since World War II (IMF, 2009b). The impacts of the liquidity crisis in developed economies have been enormous with collapse of many financial institutions, manufacturing firms, especially, the automobile firms and business entities. In both developed and emerging economies, widespread disruptions in credit are constraining household spending and curtailing production and trade (IMF, 2009b). In many industrialized countries today, unemployment rates are on the rise as a result of the massive job losses in several establishments. In the light of these developments, frantic efforts are being made by policymakers of industrialized economies to arrest the crisis and its devastating effects. Monetary and fiscal policy tools have been deployed in this regard. However, it appears the most potent instruments are the fiscal policy tools. The US has programmed, as contained

in the American Recovery and Investment Act of 2009, a stimulus package that seeks to inject US$ 787 billion into the American economy. This package seeks to create, among other things, over 3.6 million jobs in the US. The Chinese stimulus package envisaged investment in infrastructure and social welfare to the tune of US$ 586 billion by end-2010 (IMF, 2009c; World Bank, 2009b). The British Government, in the last quarter of 2008, launched a £500 billion plan to shore up the financial system. Canada, in its 2009 budget, plans a stimulus package of US$ 40 billion. The European Union has also planned injecting some US$ 200 billions into their economies. Besides, Japan has come out with a policy to stimulate its economy with some US$ 150 billion. At a recent crisis summit in London, the Group of 20 Most Industrialized Countries (G-20) has pledged a whopping sum of US$ 1.1 trillion to remedy the crisis globally. Out of this amount, the International Monetary Fund (IMF) and the regional banks, as recommended by the London Summit of April 2, 2009, are to receive US$ 750 billion and US$ 100 billion respectively to lend to developing countries that are hit by the crisis (IMF, 2009d).

In most developing economies, the effects of the crisis are yet to be fully felt. The lagged-effects of the liquidity crises on developing economies are explained by the fact that these economies are not fully-integrated into the global financial market (World Bank, 2009a, b). The signs are already on the wall as it is projected that the growth rate in emerging and developing economies will fall from its 2008 estimated level of 6.25 to 3.25% in 2009 (IMF, 2009a-d). According the World Bank (2009a, b) the effects of the credit crunch in emerging markets can be felt in the following areas: declining commodity prices which tumbled by 69 and 38% in oil and non-oil commodity sectors, respectively between July and December 2008; collapsing global trade that hit negative values during the last quarter of 2008 and is expected to continue due to protectionist backlash and drying up of trade finance; disappearing capital flows as seen in about 100% decline in private capital flows to emerging economies in 2008; and squeezing of aid flows of which uncertainties about donor commitments continue to rise. However, it appears the likely credit-crunch-propelled external shocks to developing regions, especially Sub-Saharan Africa, are not fully appreciated at national and international levels as evidenced by little or no crisis response from the least developed countries (LDCs). Some LDCs even think that the credit crunch is a problem only for key industrialized countries in North America, Europe and South-East Asia and not for peripheral economies such as theirs. Thus, there is very little effort to understand the crisis and its macroeconomic implications for their economies so as to take measures to nip its impact in the bud. This study seeks to examine the channels through which the credit crunch can impact small-open developing economies. It further investigates the macroeconomic shocks that are likely to hit the developing economies as a result of the 2007-2009 liquidity crises. Besides, it tries to unearth the overall economic growth implications of the crises for the developing economies. To give a holistic treatment to these objectives, the study employs an open economy dynamic stochastic general equilibrium model in which the private representative agent's behavior has money-in-utility function characterization and where fiscal and monetary authorities actively fine-tune the economy.

The need to understand the 2007-2009 Credit Crunch and its macroeconomic implications for developing economies stems from the fact that already most developing economies are finding it difficult to mobilize adequate domestic resources to finance pro-growth and development programmes. Traditionally, developing countries have been relying on the industrialized world for their development finance. Available World Bank statistics show that, at least, 40% of the budgets of most LDCs depend on external assistance. In spite of this, poverty reduction and other Millennium Development Goals (MDGs) are becoming

increasingly difficult to achieve, particularly in Africa (Economic Development in Africa, UNCTAD-UN, 2005). The developing regions, notably Sub-Saharan Africa, are lagging behind in the attainment of these MDGs (World Bank, 2009a, b). Before the credit crunch of 2007-2009, there had been calls to scale up external assistance to most of these developing regions. The urgent desire of the industrialized countries to clump down on the crises has the potential of diverting resources that are earmarked for development finance in LDCs. It is becoming increasingly clear that donor countries are likely to renege on their financial commitments to the LDCs. Further, the stimulus packages announced by the industrialized countries contain policy strategies that are likely to hype protectionism across the globe. It is imperative, therefore, to critically analyze the credit crunch and its macroeconomic implications for developing economies. The findings of this study, it is hoped, will inform policy debate on national, regional and international levels.

MATERIALS AND METHODS

The Origin of the Credit Crunch of 2007-2009

The Liquidity Crisis of 2007-2009 is believed by many to be a cataclysmic out turn of varied anomalies of the financial system in America and other industrialized countries. It manifests itself in a form of loss of confidence by investors in the value of securitized mortgages in the United States. The perceived credit risk, as measured by the TED spread, rose sharply in July 2007 signaling the emergence of the credit crunch. It was marked by the collapse of Bear Steam hedge funds in July 2007 (Oxford Economics, 2009a). The sharp rise in financial market volatility continued and reached its peak in October 2008 with the TED spread attaining a record of 4.65%. The crisis worsened in September 2008 as stock markets worldwide crashed and entered a period of high volatility with financial stress indicator attaining a value of about +42 in the last quarter of 2008 (Oxford Economics, 2009b), while several banks, mortgage lenders and insurance companies went bankrupt soon after.

The genesis of the crisis has been attributed to several factors notably the bursting of the American housing bubble; the investment-stimulating monetary policy of the US Federal Reserve; the sharp rise in crude oil prices, sub-prime mortgage lending, lack of regulation and deregulation of the financial system; over-leveraging, credit default swaps and collateralized debt obligations, collapse of the shadow banking system; lack of productive investment channels; and consumerism and low investment culture of the Americans. Truly, the origin of the crisis is so complex and intertwined that it could best be described as a product of many things gone wrong-both policy and institutional wise.

Close tracking of the precursors of the crisis show that financial engineering and innovation in the late 1990s and early 2000s has created a situation where superficial wealth exceeded real wealth and distorted the relationship between monetary instruments and the real sector. The increasing desire to create more wealth out of nothing prompted the enactment of Gramm-Leach-Bliley Act of 1999 that repealed some parts of the Glass-Steagall Act of 1933 which sought to prevent overheating of the stock market by investment in debt instruments. This repeal created a bubble that saw a debt expansion in the US to tune of US14 trillion. The stock market all over the world became overheated (Hull, 2009). By early 2001, the stock markets began to experience downturns. Instead of allowing the excess superficial wealth to wane naturally by either expansion in the real sector or contraction in the financial sector or both, policymakers in the United States decided to treat the natural financial contraction in early 2000s as a recession. The US Federal Reserve resorted to easing monetary policy to avert a possible recession by lowering the Fund rate to as low as 1% by

June 2003 from a high of 6.5% in January 2001. The Fund rate was kept at this level for a year before it began to rise in July 2004 (Oxford Economics, 2009a). Besides, the Gramm-Leach-Bliley Act limited the ability of the Federal Reserve to do thorough supervision (Bernanke, 2009). Monetary conditions indicator hit almost +12 in the first quarter of 2004, indicating a very loose monetary policy. It remained positive until the last quarter of 2005.

This loose monetary policy created by the Fed to stimulate the economy resulted in a prolonged positively sloped yield curve. That is, for well over two years, the interest rate on long-term instruments was higher than the rate on short-term instruments. For instance, by the last quarter of 2003, a three-month Treasury bill yielded 0.88% while a 30-year Treasury bond had a yield of over 5%. This means that it became more profitable investing in long-term instruments. Hence, there emerged two financial bubbles in the US - the housing bubble and the shadow banking bubble. The positively sloped yield curve resulted in rising housing prices but a low general price level. Investors' interest grew in mortgage securities fueling up the rising housing prices. Of course, consumerism of the Americans fueled the increasing interest and the rising prices as more and more Americans spent their superficial stock wealth on new and elegant homes. At the same time, it became lucrative borrowing cheaply at short term and advancing long-term loans at high rates (Hull, 2009). Sub-prime lending to low- and middle-income borrowers by Fannie Mae and Freddie Mac increased. Besides, there emerged a shadow banking system (McCulley, 2009) which saw non-bank financial institutions engaging in cheap short-term borrowing from liquid markets and investing in long-term illiquid and risky instruments.

The overheating of the housing and stock markets in the US as well as protectionist reactions to US trade deficits with China and the rest of the world began to cause a rise in the general price level in the global market. The Fed picked the signal and slowly adjusted upwards the Feds Fund rate in July 2004. This tightening of monetary policy continued until short-term Fund rates hit 5.25% in June 2006. The yield curve became flat by October 2006 with no difference between a three-month Treasury bill and a 30-year Treasury bond rates. By this time, housing prices began to fall, while investment in mortgage securities was no longer lucrative. Investors, encouraged by the rapid growth with rising energy demand in the Far East notably China and India, started moving out of the US housing market to the commodity market which was largely dominated by crude oil. The housing prices fell further prompting a decline in yields on long-term financial instruments. By March 2007, the decline of yields on long-term instruments resulted in the yield curve becoming sufficiently inverted, bringing about the bursting of the housing bubbles (Gray and Stella, 2008; Oxford Economics, 2009b).

The commodity bubbles that were created after the collapse of the housing market were initially seen in the crude oil market (Gary, 2008) where crude oil prices rose from about US$ 25 per barrel in the last quarter of 2002 to US$ 55 by end-2005. With the inversion of the yield curve and subsequent bursting of the housing bubbles, crude oil prices shot up to US$ 147.30 per barrel by July 2008 (Masters and White, 2009). The Organization of Petroleum Exporting Countries (OPEC) attributed this astronomical rise in crude oil prices not to supply shortages resulting from its periodic cuts in crude oil supply, but to activities of speculators in the oil market reacting principally to geopolitical tensions in the Middle East and ethnic agitations in the Niger Delta of Nigeria. The rising crude oil prices sent inflationary signal throughout the global economy, where, oil-importing countries suffered from cost-push inflation and oil-exporting countries experienced non-sterilized monetary policy demand-pull inflation. This fed into other sectors of the economy with the global food crisis of 2008 as its

prominent outcome. Food prices especially that of rice rose astronomically and created food crisis in over 40 developing countries (United Nations, 2009).

The energy crisis resulting from the oil bubble adversely affected production, income and economic growth. Firms and companies hard hit by the energy crisis especially in the area of manufacturing and aviation began to lay-off their staff resulting in rising unemployment. The ensuing job losses and general dwindling income levels compelled home owners and debtors to default on their obligations. Thanks to financial engineering and technology, the players in the financial sector quickly find an antidote to this by parceling debt into instruments (toxics) and trading these among themselves. The banks and investors were oblivious of the inherent risks associated with the unregulated collateralized debt obligations and credit default swaps. Estimates put the total of collateralized debt obligations of asset-backed securities (ABS) issued between last quarter of 2005 and mid-2007 at US$ 450 billion (Federal Reserve Statistical Release, 2009; Securities Industry and Financial Markets Association, 2009). With the collapse of the shadow banking system as result of the inversion in the yield curve, it became clear that bank and non-bank financial institutions are just recycling debt instead of creating credit. These institutions began to lose confidence in one another as their risk levels rose. This led to a rise in the London Inter-Bank Offered Rate (LIBOR), the rate at which banks lend to one another. Subsequently, the TED increased with falling Fed funds rate and rising LIBOR. In reaction to sub-prime mortgage crisis and the resultant increasing risk, the US Congress passed the Emergency Economic Stabilization Act of 2008 that permitted the US government to purchase illiquid mortgage backed securities or *toxic* assets from financial institutions up to the tune of US$ 700 billion. However, the Emergency Economic Stabilization Act of 2008 allowed the Fed to pay interest on banks' reserves. This caused the banks, given the increasing risk, to deposit their funds at the Fed rather than lend them to the public. This brought the banking sector and whole financial system to its knees as the credit crunch saw many institutions going bankrupt.

Economic facts lost on policymakers and economic agents: Policymakers forget that macroeconomic policymaking is discriminatory with respect to economic agents. A policy that favors firms may hurt households. The presence of middlemen in the delivery of economic activity always creates a problem as they tend to appropriate to themselves the greater portion of economic gains and less of economic losses. Cyclical downturns in economic activity are just natural normalization or realignment of the real sector activities with the monetary and financial sectors of the economy. A barter system is the most stable system of economic transaction such that the greater the deviation from the barter system, the more unstable and vulnerable the system becomes.

The Effects of the Credit Crunch in Industrialized Economies

The liquidity crisis has had tremendous impact on the global economy. Countries hard hit by the crisis are those of the G7, Euro Zone and OECD. Emerging markets in South-East Asia, Eastern Europe and Latin America and Caribbean are not spared either. The impacts of the crisis are beginning to emerge in less developed economies (LDCs) too. The negative effects of the crisis across the globe were varied and many. For instance, the crisis led to the collapse of trade and industrial production, job losses and rising unemployment rate, volatile stock markets and falling asset prices, credit contraction and dwindling consumer demand, deflation and stunted economic growth and collapse of financial institutions, automotive, insurance and hospitality industries across the world.

The impacts of the crisis on trade and industrial production have been adversely enormous. Fixed investment dropped more than 5% in the final quarter of 2008 in the US, with

2-3% falls in the UK, Euro-Zone and Japan (Oxford Economics, 2009b). Between January 2008 and January 2009, industrial output declined by 31% in Japan, 26% in Korea, 16% in Russia, 15% in Brazil, 14% in Italy and 12% in Germany. The Baltic Dry Index which measures shipping volume fell from an all time high of 11,440 points in June 2008 to 715 points on November 31, 2008 due to difficulties in obtaining letters of credit by exporters (Sengupta and Tam, 2009). The growth rate of world trade fell from 6.3% in 2007 to 4.4% in 2008 principally due to a decline in US imports. In terms of volume, world trade grew by 2% in September 2008 compared to 9.1% growth rate in July 2007. Oil prices recorded a steep decline of 60% between July and November 2008 (United Nations, 2009). Prices of other commodities such as cocoa, coffee, diamond and other minerals are also on the decline except gold whose price rose by 30% between mid-2007 and end-2008 (Mohr, 2009). Botswana, the world's leading producer of diamond planned cutting production level by 50% and laying-off over 1000 employees in the diamond mines.

The job losses and the ensuing unemployment problem emanating from the crisis have also been phenomenal. In the US, the unemployment rate is up 4% points from its low levels and payrolls have fallen more than 4 million or 3%, representing the biggest drop since the 1981-1982 recession (Oxford Economics, 2009b). In November 2008, 533,000 job losses were recorded in the United States alone, making it the biggest monthly job losses in the US since 1974. According to the International Labor Organization (ILO), the credit crunch will have created at least 20 million job losses mostly in construction, real estate, financial services and automotive industries by the end of 2009 (ILO, 2009; Islam and Shamchiyeva, 2009).

Besides, the crisis has brought about increasing volatility in the stock market with periodic daily crashes and put asset prices under severe downward pressure. By end-2008, major stock price indices have fallen some 20%, to stand 50-60% below their 2007 peaks. While US house prices were 27% below their 2007 peaks, UK house prices stood some 20% below their peaks of 2007. The scale of the drop in asset prices is beginning to resemble that seen in earlier financial crises, where the average fall in equity prices was around 55% and in real house prices around 35% (Oxford Economics, 2009b). Within the first-three quarters of 2008, volatility in the stock market measured by Standard and Poor's (S and P) 500 surged with stocks in North America, Europe and Asia-Pacific Region falling by about 30%. Dow Jones Industrial Average (DJIA) Index fell by 37% during the same period. S&P 500 declined by 18.62% within the first-two months of 2009, while Dow Jones recorded a more-than-50% fall between mid-2008 and March 2009. Considering its best and poorest performances in the 2000s, the Dow Jones recorded a decline of 54.5% as it fell from 14,164 points (record high of US stock market) on October 9, 2007 to 6440 points (its lowest level since) on March 9, 2009 (Tradingcharts.com, 2009). This exceeded the DJIA's decline of 53% during the Great Depression, from September 1929 to March 1931.

A host of financial institutions, automotive, insurance and hospitality industries collapsed or came under severe stress in the wake of the credit crunch. In the United States and Europe financial institutions such as Lehman Brothers and Washington Mutual went bankrupt. Several others such as Fannie Mae and Freddie Mac which held about US$ 5 trillion worth of mortgage loans and American International Group (AIG) which operates in over 100 countries with more than US$ 1 trillion in assets came under severe stress. Fannie Mae and Freddie Mac were put under the conservatorship of the US government with support from the Treasury. AIG received about US$ 150 billion in a bailout scheme from the US government in exchange for 80% of its equity ownership. The US government also had to invest directly US20 billion and back about US$ 306 billion in loans and securities of the Citigroup (United Nations, 2009). In Iceland, three major banks with assets worth more than

the country's GDP had collapsed. Many other banks such as Dutch-Belgian Bank Fortis, the French-Belgian Dexia, the British mortgage lender Bradford and Bingley, Germany's Hypo Real Estate, as well as the Dutch bank and insurance company ING and the Dutch insurance giant Aegon were on the brink of collapse and had to be shored-up by multi-billion bailout schemes. The effects of the crisis were also felt in emerging countries such as Hungary, Ukraine, Serbia, Belarus and Pakistan (United Nations, 2009). The stock markets in Nigeria and Ghana also experienced severe downturns which reflected in low indexes in both countries.

There had been widespread recession in the industrialized and emerging economies in the last quarter of 2008. All the advanced economies together registered an output decline of -1.1% in the fourth quarter of 2008. During the same period, US economy grew by -0.7%, Germany by -1.2%, Italy by -1.5%, Japan by -3.0%, United Kingdom by -1.8% and the newly industrialized Asian economies together by -3.4%. Among the emerging economies that escaped recession in the fourth quarter of 2008 were China with 6.8% growth, India with 5.1% growth, the ASEAN-5 with 4.1% growth and Brazil with 4.3% growth (IMF, 2009b). Global growth prospects are looking very gloomy for 2009 as result of the crisis. According to Oxford Economics (2009a) the world GDP would decline by almost 1.5% (and more than 2% at 2000 constant US dollars) with the G7 GDP falling by almost 4% while emerging market GDP grows at just 0.7%, dragged down by the weakness of the major economies. Under the drag of falling export demand and financing, lower commodity prices and much tighter external financing constraints, growth in emerging economies and LDCs is expected to slow sharply from 6.5% in 2008 to 3.25% in 2009 (IMF, 2009b). The overall implications of the credit crunch for developing countries would be varied across the regions in mode and intensity depending on the economic policies of the various governments. Generally, LDCs would be affected by the crisis-induced declining global trade, crowding out of small- and medium-scale enterprises, disappearing private capital flows, dwindling workers' remittances and squeezing of ODA flows (World Bank, 2009a).

Review of the Link between the Real and Financial Sectors of the Economy

For a long time, macroeconomic analyses have narrowly considered the financial sector in almost all relationships. The Keynesian revolution that gave birth to macroeconomics simply dichotomized the economy into two sectors, 1) real and monetary sectors, 2) captured by the IS and LM curves, respectively. Since then, financial sector has been lumped together and represented by the monetary sector in the analyses of macroeconomic relationships. In most multi-sectoral macroeconomic models where attempts have been made to give a broader definition, the financial sector is crudely divided into only two – the market for money and the market for everything else (Gauthier and Li, 2005) often referred to simply as the bond market. The key equations that form the centerpieces of dynamic macroeconomics are the equation of savings to investment, the equation of marginal rates of substitution to marginal rates of transformation and the allocation of consumption and investment across time and states of nature (Cochrane, 2006). All these equations are carried out in asset markets which act as intermediaries between any two real sectors. Thus, lumping the asset markets together only allows for summarizing simultaneous equilibriums in these markets into a single LM curve but hides the structure needed to understand how the financial markets and the real economy are interrelated (Gauthier and Li, 2005).

The relationship between the financial sector and the real economy can adequately be analyzed from a general equilibrium perspective whereby, the financial sector impacts upon

the real sector and the real sector in turn impacts upon the financial sector. Real investment decisions may certainly cause financial constraints and on the other hand, those financial constraints may slow down or prevent expansion plans (Von Kalckreuth, 2005). Concerns have been raised about the direction of causality between the two sectors. Whether financial development precedes economic development or vice versa has been a "chicken and egg" problem that the literature has to contend with. The development and stability of the financial sector has been noted as crucial to strong macroeconomic performance. However, monetary authorities tend to relegate the health of the financial system to the background, while traditionally focusing on the process of inflation and growth. Recently, however, financial stability has gained greater prominence on central bankers' agenda (Tsatsaronis, 2005) with the creation of financial stability divisions to monitor the performance of the financial sector and the interactions between the health of financial institutions and macroeconomic stability.

Nonetheless, it is becoming clear that monetary policy formulation is not proactive enough in incorporating the rapid changes occurring in the financial markets due to dynamics of technology and innovation within the financial system. Concerning how central banks should respond to large asset price fluctuations of the 1980s and 1990s, most policymakers and researchers are of the view that monetary authorities should take into account asset price movements only as far as these fluctuations have an impact on expected future inflation and output (Bernanke and Gertler, 2000; Greenspan, 2002; Smets and Wouters, 2005). In responding to concerns about the large inflows of remittances and their implications for the Ghanaian economy in the early 2000s, the Bank of Ghana was of the view that since most of these remittances do not pass through the banking system, they would have very little impact, if at all, on the economy. Generally, it appears that policymakers lock themselves up in the dungeon of policy tradition without making policy be abreast with, if not on top of, the rapid developments occurring in the financial markets.

The Impacts of Financial Sector on the Real Sector

The financial sector could affect the real economy on two fronts: the demand side and supply side. Financial markets serve as intermediaries and have the potential of expanding or retarding the growth of the real sector. Household consumption decisions and business investment decisions are greatly influenced by the health and stability of the financial sector. On the demand side, according to Tsatsaronis (2005) underlying financial conditions of economic agents are critical underpinnings of production and consumption decisions. Extension of credits in asset markets could enhance production and consumption leading to expansion in overall economic growth. However, high levels of debt that are not backed by robust income flows can limit the absorption capacity of the private sector and become a drag on economic expansion or even result in an economic slump.

Hernando and Martínez-Carrascal (2005) note that excessive indebtedness of the corporate sector might adversely affect investment spending and prompt sharp portfolio switching in the presence of unexpected shocks. To them, the financial position of the corporate sector may influence the performance of the real economy and the stability of the financial system through its contribution to aggregate demand and its links to the banking system and capital markets. In assessing the relative importance of different financial variables in explaining the real decisions of firms, they established that financial position is important in explaining corporate decisions on fixed investment and employment. Besides, several financial indicators turn out to be significant in the estimated equations. Measures of the debt service burden, in particular, remain significant when additional financial indicators are incorporated and their coefficients are quite robust.

On the supply side, sound financial conditions are key factors in determining the terms on which external funding is granted. Information asymmetry between suppliers and demanders of funds generally places external funding beyond the reach of firms and households. Thus, in the world of information asymmetry, external funding becomes quite sensitive to the perceived and actual financial strength of economic agents. The situation is crucial for those who have less of a track record and less security to offer, such as smaller firms, which typically do not have access to capital markets and low income earners with little or no property (Tsatsaronis, 2005). How supply of funds affect the real economy has been well-articulated in the various channels of monetary transmission theory. The credit channel is supposed to condition and amplify the relative price effects of interest rate changes on firm activity. Through the bank lending channel, monetary policy may affect the ability of banks to finance firms, while by the balance sheet channel monetary policy may influence firms' ability to attract external finance by affecting the value of their equity. Besides, financial constraints on real activities constitute a crucial link that determines the real consequences of financial imbalances such as banking crises, asset price bubbles, or government debt. Moreover, financial constraints due to information asymmetry are especially important for those future-oriented activities that deal with generating new knowledge such as research, development and the introduction of innovative products and processes that are fundamental to the long-run performance of any economic system (Von Kalckreuth, 2005).

Alfaro *et al.* (2005) point out the possible undermining of the credit channel by the Irrelevant Hypothesis which suggests that the capital structure of the firm was mostly irrelevant. This view received a buttress from the strong and robust correlation between money and real variables found in the empirical literature of the 1960s, which indicated that the main transmission mechanism for monetary policy is the interest rate channel. Thus, given that monetary policy works principally through changes in the cost of capital and their impact on investment, importance of banks emanated solely from their money creation ability. It was not until the advent of information economics in the 1970's that the credit channel was recognized as one of the means by monetary policy could affect the real economy. Alfaro *et al.* (2005) concluded that the bank lending channel operated as a monetary policy transmission mechanism in Chile during the period 1990-2002, with an independent and significant effect in terms of macroeconomic activity.

Further, asset prices play a key role in the process of equilibrating savings and investment, consumption and production on both the demand and supply sides. This is just part of the generally accepted paradigm of the price mechanism as an invisible hand that determines what, how and to whom to produce. Prices of financial and real assets contain expectations of economic agents and reflect the extent of any excessive optimism or pessimism of market participants. Besides, they have a direct impact on the ability of the private sector to obtain financing, at least since a borrower's wealth is a common source of security for lenders. Asset price fluctuations, therefore, can have an important effect on determining macroeconomic outcomes through their impact on balance sheets (Tsatsaronis, 2005). This suggests that the slow and passive attitude of monetary authorities towards price development in asset markets should give way to more comprehensive and pragmatic monetary and financial policies that are adequately informed by these developments. In the view of Borio and Lowe (2002) central banks should lean against large run-ups in asset prices, even if these risks undershoot the short-term inflation objective, since excessive asset price booms may lead to a sudden collapse, undermining the stability of the financial system and leading to large negative knock-on effects on output and prices. It has been observed that the policy-controlled interest rate may only be a very blunt instrument in the hands of

monetary authorities to control asset price bubbles and their inherent risks for future financial stability. Also, policymakers may have no comparative advantage in trying to identify whether asset prices are driven by fundamentals or not (Smets and Wouters, 2005). The genesis of the credit crunch can be traced to the non-adherence of the policy advice embedded in these observations.

The Impacts of the Real Sector on the Financial Sector

The impacts of the real sector on the financial sector can be seen well over the business cycle. Tsatsaronis (2005) notes that the state of the business cycle has an important influence on incomes, profits and by extension, the balance sheets and creditworthiness of economic agents. During periods of boom, the balance sheets of households and firms are strengthened as their incomes increase. Conversely, the creditworthiness of borrowers deteriorates during periods of economic slowdown, which are typically associated with thinning income cushions and greater financial strains. Besides, the rise in default rates during recessions tends to spread those strains to net lenders of funds. These developments reduce the profitability and balance sheet strength of financial intermediaries.

The link between the real economy and the financial sector can also be examined from productivity-inflation relationship. The literature suggests that the causality in this relationship could be bi-directional. One view is that causality runs from productivity to inflation. That is, a slowdown in productivity growth may reduce aggregate supply and, other things equal, lead to a rise in the aggregate price level. If the rise in the general price level is seen as emanating from changes in economic fundamentals, financial markets will respond by expanding to meet the growing demand. Others see causality running in the opposite direction. According to this view, a rise in inflation could distort incentives and lead to adverse changes in employment, savings, investment and trade. Besides, higher inflation could increase aggregate uncertainty, which could then disrupt business plans. This has a potential of retarding the growth of the financial sector. Some empirical evidence supports the view that causality goes from inflation to productivity. Either way, there would be implications for monetary policy. If policymakers believe that productivity growth generates downward pressure on prices, policy will be informed by current changes in productivity so as to avoid over- or under-reaction. Where policymakers believe that inflation lowers productivity growth, they would have an added impetus to control inflation, although the information content of productivity would be less of a factor (Estrella, 2005).

It must be noted however that periods of economic expansion can be associated with financial imbalances due to developments in the various assets markets. Evjen *et al* (2005) point out that financial imbalances can build up even in a low-inflation environment. Policy credibility and commitment to price stability may promote stable inflation expectations and enhance price rigidity at the mean level. Consequently, overall inflation may be under control even in a macroeconomic environment with high and increasing demand that hikes asset prices and credit growth. Supply side developments may exert similar downward pressure on the general price level in spite of increasing demand and rising prices in some asset markets. It becomes imperative that monetary authorities pursuing inflation-targeting monetary policies should more explicitly consider developments in financial variables such as equity and bond prices, credit and property prices when setting interest rates. This suggests that central banks' key interest rates should also respond to these variables in situations where inflation pressures seem to be under control. Besides, financial imbalances may build up in a low-inflation environment without threatening the short and medium term inflation targets. These imbalances may, however, pose a threat to nominal stability in the somewhat longer

run when a burst of the bubble could imply strong deflationary pressure and bring inflation below target. Thus, monetary policy in some situations should adopt a somewhat longer policy horizon permitting inflation to undershoot the target for some time in order to dampen credit growth and the hike in asset prices. This may reduce the risk of a burst of the bubble which may threaten an even more substantial undershoot of the inflation target in the future. Evjen *et al*. (2005) further notes that the build up of financial imbalances may also constrain the use of monetary policy. This is because high levels of debt and overvalued asset prices may prevent the central bank from taking adequate steps because of the risk of turmoil in the financial sector.

Theoretical Framework

This study develops a Dynamic Stochastic General Equilibrium (DSGE) model which is an economy-wide inter-temporal dynamic framework with a representative agent characterization. According to Schubert (2002) the Representative Agent Model (RAM) of an open economy derives all behavioral relationships from inter-temporally optimizing agents. This approach is in line with the New Keynesian School of thought on macroeconomic modeling whereby macro models are built on sound microeconomic foundations. Unlike traditional and rational expectations models that are based on arbitrarily specified behavioral relationships, the RAM calls for derivation of the macro behavioral relationships from inter-temporal optimization of microeconomic agents (Turnovsky, 2000). The choice of dynamic analysis in this study is further informed by the fact that economic activities are dynamic in nature since economic realizations are essentially products of inter-temporal decisions of economic agents.

The Representative Agent's Behavior

This study adopts the Money-In-Utility Function (MIUF) approach in modeling the behavior of the representative agent since in developing economies people have some sort of satisfaction if they have money in their pockets. While, most past studies use MIUF models with composite consumption good, labor as the only factor of production and monetary shocks; this study develops a representative agent MIUF which is separable in consumption, labor supply and real balance holdings in the spirit of Sidrauski (1967), Turnovsky (2000) and Walsh (2003). The model has two consumption goods (one domestically produced, the other foreign), leisure hours, foreign and domestic real balance holdings and foreign and domestic bond holdings as its arguments. Fiscal and monetary authorities implement active policies to fine-tune the workings of the economy where both private and public investments occur.

To fully characterize the behaviour of the representative agent, the study further assumes that the economy is small and open; hence, it cannot affect its terms of trade. In addition, the domestic and the international financial markets are not fully integrated such that participants demand some amount of risk premium above the international interest rate in order to hold domestic financial assets. Besides, the critical factors of production are capital and labour with the public sector creating an enabling environment. The individuals have imperfect foresight and a constant rate of time discount. Further, current production makes use of last year's capital stock. The representative agent holds both domestic and foreign currency balances. All asset holdings by the representative agent are at the end of the period, after having purchased consumption goods. Finally, the representative private agent of this economy is a consolidated household and firm.

Given the afore-mentioned assumptions, the representative agent's inter-temporal problem can be specified as follows:

$$\underset{(x,z,l,m,f,b,b^*,k)}{\text{Max}} \sum_{t=1}^{\infty} \beta^t \left[u(x_t, z_t) + v(1-l_t) + \phi(m_t, f_t) \right] \tag{1}$$

subject to:

$$m_t + b_t + \sigma_t (f_t + b_t^*) = w_t + y_t^d - x_t - \sigma_t z_t - \iota_t \text{ (Wealth constraint)} \tag{2}$$

$$k_t = \iota_t + \left(\frac{1-\delta}{1+\pi_t} \right) k_{t-1} \text{ (Capital accumulation constraint)} \tag{3}$$

Where:
β^t = Time discount factor
X_t = Amount of home good consumed by the individual in period t
z_t = Amount of imported good consumed by the individual in period t
l_t = Total labor supply by the individual in period t
m_t = Real domestic balances held by the individual in period t
f_t = Real foreign balances held by the individual in period t
b_t = Domestic bond holdings by the individual in period t
b_t^* = Foreign bond holdings by the individual in period t
k_t = Capital accumulation by the individual at the end of period t
i = Total net investment

$$w_t = \left(\frac{1}{1+\pi_t} \right) m_{t-1} + \left(\frac{\sigma_t}{1+\pi_t} \right) f_{t-1} + \left(\frac{1+i_{t-1}}{1+\pi_t} \right) b_{t-1} + \sigma_t \left(\frac{1+i_{t-1}^*}{1+\pi_t} \right) b_{t-1}^*$$

is total financial wealth of the individual at the beginning of period t, noting that this initial wealth will lose its purchasing power as a result of a rise in the general price level in period t.

$$\sigma_t = \frac{e_t p_t^*}{p_t} = \frac{e_t (1+\pi_t^*)}{(1+\pi_t)}$$

is the real exchange rate in period t, with p_t^*: foreign price level, p_t = Domestic price level and e_t = Nominal exchange rate at time t. $1+\pi_t = p_t/p_{t-1}$, $1+\pi_t^* = p^*/p^*_{t-1}$, i_t = Nominal domestic interest rate and i_t^* = Nominal international interest rate at time t. $y_t^d = (1-\tau_t)\, y_t - h_t$ = Total disposable income per capita in period t where τ = income tax rate and h = lump-sum tax per capita.

Policymaker's Behavior

The behavior of the policymaker is reflected mostly in the type of policies pursued. Hence, the behavior of fiscal authorities is captured by fiscal policies while monetary authorities' behavior is reflected by monetary and exchange rate policies. From the flow of funds perspective, money supply relationship can be specified as:

$$m_t - \left(\frac{1}{1+\pi_t} \right) m_{t-1} = \left[b_t - \left(\frac{1}{1+\pi_t} \right) b_{t-1} \right] - \sigma_t \left(\Delta b_t^* - \Delta b_t^{*g} - \Delta f_t - a_t^* \right) \tag{4}$$

where, a^* is foreign aid/ODA

$$\Delta b_t^* = \left(b_t^* - \frac{1}{1+\pi_t} b_{t-1}^*\right), \Delta b_t^{*g} = \left(b_t^{*g} - \frac{1}{1+\pi_t} b_{t-1}^{*g}\right), \Delta f_t = \left(f_t - \frac{1}{1+\pi_t} f_{t-1}\right)$$

(Gowland, 1991). Note that Eq. 4 is an accounting identity which states that the change in money supply is given by the change in domestic borrowings plus change in foreign reserves. The relationship between change in real money balances and the monetary base can also be outlined as follows:

$$m_t - \left(\frac{1}{1+\pi_t}\right) m_{t-1} = \theta_t \left[m_t^b - \left(\frac{1}{1+\pi_t}\right) m_{t-1}^b\right] \text{(Behavioral relationship)} \quad (5)$$

where, θ_t = the money multiplier associated with the monetary base at time t. This is appropriate since the model assumes away the role of the commercial banking sector.

Monetary policy constraint is specified (Appendix) such that the total disbursements to the government by the central bank must come from interest payments received by the central bank from the treasury and monetary base adjustment. It is assumed that monetary authorities adjust the monetary base using Taylor-type monetary policy rule. The rule is, however, modified substantially to reflect the general view that the simple Taylor rule is sub-optimal when applied in small open developing economies. Ball (1998) observes that, in open economies, inflation targets and Taylor rules are sub-optimal unless they are modified in important ways. He suggests that the appropriate policy instrument to focus on is the 'monetary conditions index' which is a weighted average of interest rate and exchange rate. Svensson (2003) notes that the simplicity of instrument rules such as the Taylor's one makes commitment and policy credibility technically feasible. Besides, simple monetary policy rules may be relatively robust across models. He, however, identifies three problems associated with a Taylor-type rule. First, if there are other important state variables than inflation and output gap, the rule may not be optimal. For smaller and more open economies (than the US), the real exchange rate, the terms of trade, foreign output and foreign interest rate seem to be the minimum essential state variables that have to be added.

Thus, the modified Taylor-type monetary policy rule adopted follows Sanchez-Fung's (2000) formulation as specified in Eq. 6 below:

$$m_t^b = \left(\frac{1}{1+\pi_t}\right) m_{t-1}^b + \partial_1 e_t^g + \partial_2 y_t^g \quad (6)$$

where, e_t^g = the difference between the equilibrium exchange rate and the official exchange rate; y_t^g = the output gap in the economy at time t and ∂_1, ∂_2 are exchange rate and output gap adjustment coefficients, respectively.

Under this policy scenario, there will be both direct and indirect monetary policy shocks from monetary base adjustments and changes in money multiplier respectively. The direct monetary policy shock will emanate from exchange rate and output gaps in the economy. Here, monetary policy may be time dynamically inconsistent in the short run but not in the long run. Equation 6 is consistent with the general view that instruments frequently used in advanced countries, such as the interest rate, are less likely to be implemented in developing economies, given the different transmission mechanism of monetary policy in such economies. Thus, the most likely demand management instrument to be used by monetary authorities in developing economies is the monetary base.

Foreign currency supply relationship states that the real change in foreign currency holdings by the individual is given by the excess of exports over imports. The economy-wide foreign currency supply is given by net exports, change in net foreign bond holdings and net official development assistance flows (Appendix). With regard to exchange rate policy, it must be noted that under flexible exchange rate regime, the balance of payments will be zero. Also, the central bank has full control over the conduct of monetary policy, implying the above monetary policy rule can be implemented. Another characteristic of this regime is that the nominal exchange rate is an endogenous variable. With these in mind, appropriate restrictions are placed on the relevant equations when operating under flexible exchange rate regime.

The fiscal policy of the government relates to government revenue mobilization and expenditure. Government revenue can come from taxes, official development assistance and total direct receipt from the central bank, which is made up of foreign exchange earnings from international trade and interest receipts from the central bank's holdings of domestic and foreign bonds. Government expenditure goes to its consumption of foreign and domestic goods, investment and interest payments on domestic and foreign debts. Thus, the fiscal policy constraint states that the fiscal deficit after aid (secondary fiscal deficit) is financed by borrowing from domestic and external sources (Appendix).

As stated in the Appendix, the consolidated budget constraint relates the sum of total domestic and external borrowings to the excess of total government expenditure (on domestic good, foreign good, interest payment on domestic debt and interest payment on foreign debt) over total government revenue (made up of tax revenue, net inflows of official development assistance and revenue from money creation). Thus, the constraint says that the consolidated budget deficit is financed by domestic public sector and foreign sector borrowings. Further, the balance of payments constraint states that net foreign claims (reserves) are given by net exports less net investment plus net transfers plus official flows. Besides, the economy-wide resource constraint says that net foreign claims in the economy must equal net foreign inflows (interest on net foreign claims plus foreign aid inflows) less net money creation (change in real money balances less change in high powered money injections) less net investment.

The System of Equilibrium Equations under Flexible Exchange Rate Regime

The objective function and the various constraints were solved using dynamic programming. First, the Bellman Equation is formed from the representative agent's utility maximization problem. Various Euler equations are then derived from the Bellman equation. Solving the various Euler equations and combining it with policy and economy-wide resource constraints produce the following system of equilibrium equations for the flexible exchange rate regime with modified Taylor-type monetary policy rule. In all, 29 equilibrium equations are derived.

$$u_{x_t} = \phi_{m_t} + \left(\frac{1}{1+\pi_{t+1}}\right)\beta E_t u_{x_{t+1}} \tag{7}$$

$$u_{z_t} = \phi_{f_t} + \left(\frac{1}{1+\pi_{t+1}}\right)\beta E_t u_{z_{t+1}} \tag{8}$$

$$v_{l_t} = u_{x_t}(1-\tau_t)y_{l_t} \tag{9}$$

$$u_{x_t} = \beta E_t R_t u_{x_{t+1}} \tag{10}$$

$$u_{z_t} = \beta E_t R_t \left(\frac{\sigma_t}{\sigma_{t+1}}\right) u_{z_{t+1}} \tag{11}$$

$$R_t = (1-\tau_t) y_{k_t} + \left(\frac{1-\delta}{1+\pi_{t+1}}\right) \tag{12}$$

$$\frac{\phi_{f_t} u_{x_t}}{u_{z_t} \phi_{m_t}} \equiv \left(\frac{a_1 x_t^{-\nu}}{a_2 z_t^{-\nu}}\right)\left(\frac{a_4 f_t^{-\mu}}{a_3 m_t^{-\mu}}\right) = \left(\frac{i^*}{1+i^*}\right)\left(\frac{1+i}{i}\right) \tag{13}$$

$$y = \exp(g)\left(\frac{1}{1+\pi_t}\right)^{1-\vartheta} l_t^{\vartheta} k_{t-1}^{1-\vartheta} \tag{14}$$

$$k_t = w_t + (1-\tau_t) y_t - h_t - x_t - \sigma_t z_t + \left(\frac{1-\delta}{1+\pi_t}\right) k_{t-1} - m_t - b_t - \sigma_t \left(f_t + b_t^*\right) \tag{15}$$

$$w_t = \left(\frac{1}{1+\pi_t}\right) m_{t-1} + \left(\frac{\sigma_t}{1+\pi_t}\right) f_{t-1} + \left(\frac{1+i_{t-1}}{1+\pi_t}\right) b_{t-1} + \sigma_t \left(\frac{1+i_{t-1}^*}{1+\pi_t}\right) b_{t-1}^* \tag{16}$$

$$\Delta b_t + \sigma_t \Delta b_t^{*g} = x_t^g + \sigma_t z_t^g + \left(\frac{i_{t-1}}{1+\pi_t}\right) b_{t-1} + \frac{\sigma_t i_{t-1}^*}{1+\pi_t} b_{t-1}^{*g} - \left(tax_t + \sigma_t a_t^* + \Delta m_t^b\right) \tag{17}$$

where, $tax_t = \tau_t y_t + h_t$ under distortionary tax regime or tax $= h_t$ under non-distortionary tax regime.

$$\Delta b_t + \sigma_t \Delta b_t^{*g} = a_6 y_t \tag{18}$$

$$m_t - \left(\frac{1}{1+\pi_t}\right) m_{t-1} = \left[b_t - \left(\frac{1}{1+\pi_t}\right) b_{t-1}\right] - \sigma_t \left(\Delta b_t^* - \Delta b_t^{*g} - \Delta f_t^p - a_t^*\right) \tag{19}$$

$$m_t - \left(\frac{1}{1+\pi_t}\right) m_{t-1} = \theta_t \left[m_t^b - \left(\frac{1}{1+\pi_t}\right) m_{t-1}^b\right] \tag{20}$$

$$m_t^b = \left(\frac{1+\gamma+\gamma^{e-g}+\gamma^{y-g}}{1+\pi_t}\right) m_{t-1}^b \tag{21}$$

$$\sigma_t \left(f_t^p - \frac{1}{1+\pi_t} f_{t-1}^p\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t \left(z_t + z_t^g\right) \tag{22a}$$

$$\sigma_t \left(f_t - \frac{1}{1+\pi_t} f_{t-1}\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t \left(z_t + z_t^g\right) - \sigma_t \left(\Delta b_t^* - \Delta b_t^{*g} - a_t^*\right) \tag{22b}$$

$$\sigma_t \left(z_t + z_t^g\right) = a_7 + a_8 y_t^d \tag{23}$$

$$\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t\left(z_t + z_t^g\right) - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] - \Delta m_t + \Delta m_t^b - \sigma_t \Delta f_t + \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^* \tag{24a}$$

$$\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) = \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^* + \Delta m_t^b - \Delta m_t - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] \tag{24b}$$

$$i_t^* = i_t - \left(\frac{e_t - e_{t-1}}{e_{t-1}}\right) - \tilde{e}_t \tag{25}$$

$$\sigma_t = \frac{e_t\left(1+\pi_t^*\right)}{\left(1+\pi_t\right)} \tag{26}$$

$$g_t = \lambda_1 g_{t-1} + \lambda_2 x_{t-1}^g + \lambda_3 \sigma_t z_{t-1}^g + \varepsilon_t^g \tag{27}$$

$$\theta_t = \eta_1 \theta_{t-1} + \eta_2 g_{t-1} + \varepsilon_t^\theta \tag{28}$$

$$\tau_t = \alpha_1 \tau_{t-1} + \varepsilon_t^\tau \tag{29}$$

$$x_t^g = \alpha_2 x_{t-1}^g + \varepsilon_t^{x^g} \tag{30}$$

$$a_t^* = \alpha_3 a_{t-1}^* + \varepsilon_t^{a^*} \tag{31}$$

$$\pi_t^* = \alpha_4 \pi_{t-1}^* + \varepsilon_t^{\pi^*} \tag{32}$$

$$\tilde{e}_t = \alpha_5 \tilde{e}_{t-1} + \varepsilon_t^{\tilde{e}} \tag{33}$$

$$\gamma_t^{e-g} = \alpha_6 \gamma_{t-1}^{e-g} + \alpha_7 e\_g_{t-1} + \varepsilon_t^{e-g} \tag{34}$$

$$\gamma_t^{y-g} = \alpha_8 \gamma_{t-1}^{y-g} + \alpha_9 y\_g_{t-1} + \varepsilon_t^{y-g} \tag{35}$$

The equilibrium Eq. 7-11 are the marginal utility functions that show the changes in the representative agent's discounted lifetime utility resulting from unit changes in the consumption of commodity bundles. Equation 12 is the expression for the equilibrium real rate of return. It states that, in equilibrium, the real rate of return equals the marginal product of capital net of tax plus future real rate of net investment. Equation 13 expresses the relationship between the product of the marginal utilities of foreign currency holdings and domestic good consumption on one hand and the product of the marginal utilities of domestic currency holdings and foreign good consumption on the other hand. More succinctly, Eq. 13 states that, at the optimal level, the marginal rate of substitution between foreign currency holdings and domestic good consumption on the one hand and domestic money holdings and foreign good consumption on the other hand must equal the relative adjustments in international and domestic interest rates. Equation 14 shows the equilibrium output of the economy as a function of yesterday's capital stock, today's labor supply and public investment. The capital accumulation constraint is highlighted in Eq. 15. Equation 16

represents the initial wealth of the consumer. It is given as the sum of domestic and foreign money and bond holdings. Equations 17-23 are equilibrium public sector or policy equations. The domestic and external sector linkages are contained in Eq. 24-26.

Equations 27-35 describe the exogenous relationships in the model of flexible exchange rate regime with Friedman-type monetary policy rule. From these exogenous relationships emanate the system's macroeconomic shocks. Equation 27 depicts the public investment relationship where public investment today relates to public investment yesterday, public expenditure yesterday on domestic and foreign goods and a disturbance (shock) term. In Eq. 28, the money multiplier is related to its own previous value, the past level of public investment and a disturbance term. Equation 29 shows the relationship of the rate of distortionary taxation in which the past level of the rate of distortionary tax and a disturbance term explain the current level of distortionary tax rate. The relationship of public expenditure on domestic good is captured in Eq. 30 where public expenditure today on domestic good is given by public expenditure yesterday on domestic good and a disturbance term. Equation 31 describes the relationship of official development assistance in which official development assistance today is explained by official development assistance yesterday and a disturbance term. In Eq. 32, the relationship of global inflation rate is highlighted such that current global inflation rate is explained by its own past values and a disturbance term. Equation 33 depicts the relationship of risk premium in the real exchange rate equation. Here current risk premium is related to its own past values and a disturbance term. Equation 34 relates the current foreign-exchange-gap-money-supply growth rate to its own past value, the past level of foreign exchange gap and a disturbance term. In Eq. 35, the today's output-gap-money-supply growth rate is given by yesterday's output-gap-money-supply growth rate; yesterday's output gap and a disturbance term. Given the above-mentioned nine exogenous relationships, therefore, the model of flexible exchange rate regime with Taylor-type monetary policy rule has nine different macroeconomic shocks.

Methodology

The methodological framework of this study hinges on calibration and simulation techniques. The commonly used method of calibrating a model is that of simulated moments (MSM) following McFadden (1989), Pakes and Pollard (1989), Gouriéroux and Monfort (1997), Ackerberg (2000) and Hostland (2001). The basic idea of this method is to fit the model to the data by matching moments of variables simulated by the model to empirical moments observed in the data. Irrespective of the degree of complication of the model, what is needed is the ability to generate simulated data according to that model. Moments of these simulated data can then be matched to moments of the true data in an estimation procedure. The value of the parameters that sets the moments of the simulated data closest to the moments of the actual data is an MSM estimate. In less technical terms, according to Cooley and Prescott (1995) the steps in calibrating a model can be outlined as follows (Mark, 2001):

- Generate a set of sample moments such as the mean, standard deviation, autocorrelations and cross-correlations between the time series from real-world data
- Give values to the deep parameters in the solutions to the various models specified in the study. These values may be either those estimated by others or those that are reasonably consistent with the models' underpinnings
- Simulate the equilibrium models, as derived in above, to generate new time-series of the variables under consideration
- Generate a new set of sample moments such as the mean, standard deviation, autocorrelations and cross-correlations between the simulated time series

- Compare the sample moments of the new simulated time-series with those of the actual time-series to see how well the models specified in the study fit the real-world data
- If the moments of the real-world data are close to their counterparts of the simulated series, the models are said to mimic the real world. Hence, the models' parameters can be varied under different scenarios to predict or forecast variables of interest

The simulation and calibration are carried out using the DYNARE (Dynamic Rational Expectations) program. The program helps in generating the steady state values of the various system variables. Besides, the program generates first and second moments of the system variables, policy and transition functions, a matrix of correlations, autocorrelations, variance decompositions and impulse response functions. To simulate the model, forty deep parameter values are chosen based on developing economy characteristics. However, the shock parameters are carefully chosen to ensure the stability of the system as well as to reflect the reality. The values of parameters such as the time discount rate, relative risk aversion coefficients and coefficients of elasticity are taken from the literature. The study considers the peculiarities of a developing economy in deciding on the values of parameters like budget deficit-GDP ratio, marginal propensities to import and the shares of commodities and financial services. The DYNARE Program employs the Blanchard-Khan (BK) condition to check the stability of the system. According to the BK condition, the solution of a rational expectations model is unique if the number of unstable eigenvectors of the system is exactly equal to the number of forward-looking (control) variables.

This study was done during the second quarter of the year 2009 in Accra, Ghana.

PRESENTATION OF RESULTS

The simulation of the DSGE model for the flexible exchange rate regime with modified Taylor-type monetary policy rule produces several results such as steady state values, contemporaneous correlations, dynamic impacts of the system variables, impulse response functions and variance decomposition of the system's macroeconomic shocks, among others. This study reports just few relevant steady state values and the system dynamics as contained in the policy and transition functions. The credit crunch, from the policy and transition functions of the DSGE model, is expected to work through three main channels: resource flows channel, external price developments channel and macroeconomic shocks channel. The resource flows channel comprises portfolio outflows, portfolio inflows and official development flows. The external price developments channel consists of global inflation and international interest rate. The macroeconomic shocks channel involves public investment, ODA, global inflation, risk premium, exchange rate gap and output gap shocks. There is also an implicit trade channel through which the credit crunch could affect developing countries. However, this may be felt more in relative price adjustments rather than volumes of trade since the economies under consideration are explicitly assumed to be small-open economies. Thus, though the DSGE model developed in this study does not capture terms of trade explicitly, trade implications can be drawn from the results. The growth and inflationary effects of these channels are presented in Table 1.

These results are on the dynamic impact of resource flows, external price developments and macroeconomic shocks on output, domestic inflation, nominal and real exchange rates. In a typical small-open developing economy, at the steady state, output per capita will be $0.5360 with domestic rate of inflation standing at 3% and nominal and real exchange rates attaining values of 1.3600 and 1.3204. Considering output dynamics, an increase in portfolio

Table 1: Growth and inflationary impacts of resource flows, price developments and shocks in small-open developing economies

Category	Variables	Output	Inflation	Nominal Exc. rate	Real Exc. rate
	Steady State Value	0.5360	0.0300	1.3600	1.3204
Resource flows	Portfolio outflows (-1)	-0.0205	0.0412	-0.0617	-0.1128
	Portfolio inflows (-1)	0.0069	-0.0324	0.0506	0.0906
	ODA (-1)	-0.0044	0.1532	-0.1112	-0.3044
External developments	Global inflation (-1)	-0.0257	0.1400	0.2853	1.2199
	International interest rate (-1)	-0.1911	-0.3096	0.5174	0.8993
Macroeconomic shocks	Public investment shock	0.5402	-0.2955	0.4501	0.8158
	ODA shock	-0.0052	0.1803	-0.1308	-0.3581
	Global inflation shock	-0.0303	0.1647	0.3356	1.4351
	Exchange rate gap shock	0.0205	2.4339	-3.5370	-6.5542
	Output gap shock	0.0205	2.4339	-3.5370	-6.5542

Source: Author's computations

outflows, portfolio inflows and ODA flows will induce output growth of -2, 0.6 and -0.4%, respectively. Overall, if the current credit crunch squeezes external resource inflows and exacerbates resource outflows such that there are 100% increase in portfolio outflows, complete stop of portfolio inflows and 100% increase in ODA outflows, output in a typical developing economy will decline by roughly 3.18%.

Portfolio outflows and ODA flows will generate positive impact on domestic inflation, while portfolio inflows influence it negatively. An increase in portfolio outflows and ODA flows will induce 4 and 15% increases in domestic inflation rate, respectively. A rise in portfolio inflows will generate 3% decline in domestic inflation. If the credit crunch, working through the resource flows channel, causes complete stop of portfolio inflows and intensifies portfolio outflows and ODA flows by 100%, domestic inflation rate will increase by 16.2%. Portfolio outflows and ODA flows will cause both nominal and real exchange rates to appreciate in dynamic terms. Portfolio inflows will cause the domestic currency to depreciate both in nominal and real terms. This is explained by the fact that the model assumes that portfolio outflows are private sector claims on foreigners, while portfolio inflows are foreigners' claims on the domestic economy. Thus, while portfolio outflows add to the country's foreign reserves, portfolio inflows deplete reserves. The model, therefore, captures explicitly the potential of financial crises associated with portfolio flows. ODA inflows appreciation of the nominal and real exchange rates seems to be consistent with theory. Considering the steady state value of ODA, the appreciation of the exchange rates could be attributed to repayment of loans by other debtor nations. This suggests that, though the squeezing of resource flows as a result of the credit crunch poses contemporaneous challenges to the developing economies, exchange rates will appreciate dynamically overall by 12.23 and 32.66% in nominal and real terms, respectively.

Turning to external price development channel, a rise in global inflation will generate negative impact on output but positive impacts on domestic inflation and exchange rates. Increasing international interest rates will induce declines in output and inflation rates but appreciation of the exchange rates. The credit crunch has caused global inflation and interest rates to fall drastically. Thus, if the credit crunch causes global inflation and interest rates to fall by 100%, output will increase by 21.68%; domestic inflation will go up by 16.96%; and nominal and real exchange rates will appreciate by 80.27 and 211.92%, respectively.

Of the macroeconomic shocks, ODA shock will reduce output by 0.0052%, increase inflation by 0.1803% and appreciate the nominal and real exchange rates by 0.1308 and 0.3581%, respectively. Global inflation shock, from a depression perspective, will cause output to grow by 0.0303%, inflation to fall by 0.1647% and nominal and real exchange rates to appreciate by 0.3356 and 1.4351%, respectively. Exchange rate gap shock will generate

Table 2: Fiscal policy impacts of resource flows, price developments and shocks in small-open developing economies

Category	Variables	Tax revenue	Public investment	Public exp on foreign good	Domestic borrowings
	Constant	-0.2584	0.2138	-0.0540	-1.7381
Resource flows	Portfolio outflows (-1)	-0.0882	-0.0027	-0.0647	0.0657
	Portfolio inflows (-1)	0.1159	0.0022	0.0320	-0.0606
	ODA (-1)	-0.9066	-0.0074	0.1688	1.4566
Price developments	Global inflation (-1)	0.3012	0.0296	0.1290	-0.0953
	International interest rate (-1)	2.9634	0.0218	-0.4325	-0.9804
Macroeconomic shocks	Public investment shock	0.4774	1.0198	0.3757	-0.4724
	ODA shock	-1.0666	-0.0087	0.1986	1.7136
	Global inflation shock	0.3543	0.0349	0.1517	-0.1121
	Exchange rate gap shock	-9.4805	-0.1592	-1.1244	4.5007
	Output gap shock	-9.4805	-0.1592	-1.1244	4.5007

Source: Author's computations

0.0205% growth in output, 2.4339% increase in domestic inflation, 3.536 and 6.5542% appreciation of the nominal and real exchange rates, respectively. Output gap shock also induces same impacts on output, inflation and exchange rates. This is so because both exchange rate gap and output gap shocks operate through the same monetary policy medium which is the Taylor-type monetary policy rule. Indeed, these effects can only be realized if monetary authorities accurately factored these gaps into their monetary policy rule. Public investment shock is an indirect fiscal policy shock of the credit crunch which impacts significantly on output inflation and exchange rates. From credit crunch depression perspectives, public investment shock will decrease output by 0.5402%, increase domestic inflation by 0.2955% and appreciate nominal and real exchange rates by 0.4501 and 0.8158%, respectively. All the macroeconomic shocks will appreciate the nominal and the real exchange rates in dynamic terms, implying loss of international competiveness and subsequent fall in exports and worsening of the trade balance.

Apart from the growth and inflationary effects, sectoral policy effects of the credit crunch can also be identified. This paper examines just the fiscal policy impacts since, more or less, monetary policy is completely redundant in the current crisis situation. The effects of the credit crunch through the three identified channels on fiscal policy aggregates are presented in Table 2. The key policy variables of interest are tax revenue, public investment, public expenditure on foreign good and domestic borrowings. At the steady state, non-distortionary tax revenue will be -$0.2584 with public investment amounting to $0.2138, public expenditure on domestic good attaining a value of -$0.0540 and domestic borrowings reaching -$1.7381 per capita. These values show that, at the steady state, a typical developing economy will turn a welfare state where non-distortionary taxation gives way to transfers to households and domestic indebtedness are cleared.

Taking the resource flows channel, a rise in portfolio outflows will generate a negative impact on tax revenue, public investment and public expenditure on foreign good but a positive impact on domestic borrowings. An increase in portfolio inflows will have positive impacts on these variables except domestic borrowings. A surge in ODA flows will lower tax revenue and public investment, while it increases public expenditure on foreign good and domestic borrowings. Thus, the credit crunch working through the resource flows "channel" in the reverse will reduce the tax revenue by 111.07% overall. This means that the credit-crunch-induced squeeze of inflows and exacerbation of outflows will require a compensatory increase in tax revenue by 111.07%. The overall impact of the resource flows channel on public investment will be a decline of 1.23%. Public expenditure on foreign good and domestic borrowings will increase overall by 7.21 and 158.29%, respectively.

From the external development channel, a rise in global inflation will increase all the four fiscal aggregates except domestic borrowings. An increase in international interest rate will generate upward adjustments in tax revenue and public investment but declines in public expenditure on foreign good and domestic borrowings. From the depression perspectives of the credit crunch, external price development channel will cause tax revenue and public investment to increase by 326.46 and 5.14%, respectively. Public expenditure on foreign good and domestic borrowings will decline by 30.35 and 107.57% on the whole through the price development channel.

Through the macroeconomic shocks channel, ODA shock will exert 1.0666% and 0.0087% declines in tax revenue and public investment, respectively. It will also cause public expenditure on foreign good and domestic borrowings to increase correspondingly by 0.1986 and 1.7136%. Global inflation shock, from depression point of view, will generate 0.3543, 0.0349 and 0.1517% declines in tax revenue, public investment and public expenditure on foreign good. Domestic borrowings will increase by 0.1121% as a result of downward global inflation shock. Exchange rate gap and output gap shocks will each generate 9.4805, 0.1592 and 1.1244% reductions in tax revenue, public investment and public expenditure on foreign good, respectively. Domestic borrowings will increase by 4.5007% in the presence of both exchange rate gap and output gap shocks. The indirect downturn public investment shock will exert declines of 0.4774, 1.0198, 0.3757% and a rise of 0.4724% on tax revenue, public investment, public expenditure on foreign good and domestic borrowings, respectively.

Aside the economy-wide macroeconomic and fiscal policy impacts, the study takes a look at the private sector or household impact of the credit crunch. Private consumption of domestic and foreign goods and capital accumulation are the key variables considered. At the steady state in a typical developing economy, private consumption of domestic and foreign goods and capital accumulation will stand at 0.1763, 0.3024 and $0.8588 per capita respectively. The effects of resource flows, external price development and macroeconomic shocks on private consumption and capital accumulation are presented in Table 3. Resource flows channel indicates that portfolio outflows will generate positive impacts on all the three private sector variables, while portfolio inflows will induce negative impacts on all of them. These results are explained by the fact that outflows and their returns constitute a portion of the individual's wealth. Thus, in dynamic terms as wealth increases the individual will be able to consume more goods whether domestic or foreign. However, the individual will consume more foreign goods than domestic goods in proportionate and absolute terms. In the same way, private inflows constitute the wealth of foreigners, hence, the negative impact on consumption and capital accumulation. ODA flows will induce negative influences on consumption of domestic good and capital accumulation but a positive impact on the

Table 3: Private sector impacts of resource flows, price developments and shocks in small-open developing economies

Category	Variable	Domestic good cons.	Foreign good cons.	Capital accum.
	Constant	0.1763	0.3024	0.8588
Resource flows	Portfolio outflows (-1)	0.0070	0.1038	0.0673
	Portfolio inflows (-1)	-0.0023	-0.0779	-0.0680
	ODA (-1)	-0.0077	0.1276	-0.0147
Price developments	Global inflation (-1)	-0.0207	-0.4452	-0.0607
	International interest rate (-1)	0.0702	-0.5728	-0.7397
Macroeconomic shocks	Public investment shock	0.0887	-0.5126	0.0210
	ODA shock	-0.0091	0.1501	-0.0172
	Global inflation shock	-0.0243	-0.5237	-0.0714
	Exchange rate gap shock	-0.0448	4.8761	6.6502
	Output gap shock	-0.0448	4.8761	6.6502

Source: Author's computations

consumption of foreign good. This can also be rationalized by the steady state fact that the extension of official development assistance to others will affect consumption of domestic goods and capital accumulation but not necessarily consumption of foreign goods. Overall, the effects of the credit crunch squeezing resource inflows and exacerbating outflows will induce 0.16 and 30.39% rise in consumption of domestic and foreign goods, respectively and 12.06% rise in capital accumulation.

Turning to external price development variables, a rise in global inflation will induce reductions in all the three private sector aggregates. International interest rate generates negative impacts on the consumption of foreign goods and capital accumulation but positive impact on the consumption of domestic goods. This is probably due to the fact that increases in international interest rates imply high returns on private bond holdings, leading to increases in individual's wealth which are partly spent on the consumption of domestic goods. Generally, from depression perspectives of external price developments, the credit crunch will generate 4.95% decline in the consumption of domestic goods, 101.8% and 80.04% increases in the consumption of foreign goods and capital accumulation.

ODA shock will induce 0.0091 and 0.0172% declines in the consumption of domestic goods and capital accumulation but 0.1501% rise in the consumption of foreign goods. Global inflation shock, from deflationary perspectives, will generate 0.0243, 0.5237 and 0.0714% increases in the consumption of domestic and foreign goods and capital accumulation, respectively. Exchange rate gap and output gap shocks will each reduce the consumption of domestic good by 0.0448%, while increasing the consumption of foreign goods and capital accumulation by 4.8761 and 6.6502%, respectively. Public investment shock, form recession perspective, will reduce the consumption of domestic goods and capital accumulation by 0.0887 and 0.021%, respectively. The consumption of foreign goods will increase by 0.5126% in the presence of downturn public investment shock.

RESULTS AND DISCUSSION

It appears that an increase in ODA inflows will result in a Dutch disease problem in developing economies at the steady state. This is due to the fact that, at the steady state, a typical developing economy will cease to be aid-dependent and become an aid-donor. Within the context of the credit crunch, as a typical developing economy extends more aid to the rest of the world, its output will decline. Alternatively, if aid is defined as project and program loans, the negative ODA value at the steady state could be interpreted as repayment of the loans. Hence, as a developing country is called upon to repay more of its loans leading to negative net aid flows, its output will fall.

Summarizing the above findings, it is clear that through the resource flows channel, the credit crunch will have depressing effect on output but favorable impact through the external price development channel. The impacts of the credit crunch on output through the macroeconomic shocks are relatively small. Overall, the direct impact of the credit crunch on economic growth is negative but relatively small compared to the impacts on other macroeconomic aggregates. Further, the rate of domestic inflation will increase generally in all the channels. This could be explained by, first, the dislocations that are likely to occur in domestic production process as result of the direct impact of the credit crunch on domestic production and secondly, by sub-optimality in monetary policy adjustments that are likely to occur as result of adherence to the Taylor-type monetary policy rule in the face of unpredictable international financial developments imposed by the credit crunch.

Besides, nominal and real exchange rates will also appreciate through all the channels in dynamic terms. This, however, does not rule out contemporaneous nominal and real depreciation of the local currencies in developing economies. The dynamic appreciation of the nominal and real exchange rates could be rationalized by the probable rise in inflationary rates in developing economies as noted above. Alternatively, the dynamic appreciating exchange rates could be attributed to the reversal of the current resource or capital outflows from developing economies. In an attempt to solve the problems created by the financial crises, the developed economies have rolled out several stimulus-fiscal packages which would thrive mostly on both domestic and international issuing of bonds. In the short term, this could lead to further outflows of capital from developing economies. Contemporaneously, this is likely to prompt exchange rate depreciations in developing economies. However, in the long term, as industrialized economies purchase their bonds, external resources will flow to developing economies and thereby leading to exchange rate appreciations in these economies in dynamic terms. Further, the exchange rate impacts of the credit crunch are quite strong in the price development and shocks channels, especially the exchange rate gap and output gap shocks. This suggests that the trade sector, in dynamic terms, will be adversely affected, leading to the widening of the current account deficits in developing economies.

Synthesizing the fiscal policy impacts of the credit crunch, it is obvious that the impact will be very severe on tax revenue and domestic borrowings through the resource flows channel. Through the external price development channel, however, the impact will be favorable on all the four fiscal aggregates. The exchange rate gap and output gap shocks of the macroeconomic shocks channel will also exert severe stress on all the four fiscal aggregates. Thus, despite the favorable impacts of the credit crunch through the external price development channel, the overall fiscal impacts will be deteriorating tax revenue and rising domestic borrowings. The macroeconomic shocks channel is the dominant channel as far as the fiscal policy effects are concerned. The explanations for these developments are not far-fetched. As domestic output declines, inflation increases, trade sector shrinks and job losses occur as a result of the credit crunch, tax revenue will decline and thereby, impose severe stress on the government budget that will consequently lead to rising domestic borrowings. This situation will be aggravated by the dwindling or cessation of international resource inflows brought about by the credit crunch. Thus, developing countries will be facing herculean task of balancing their budgets. Overall, it is expected that the fiscal deficits will rise substantially in most developing countries as a result of the credit crunch.

Further, from the simulation results, the dominant private sector impacts of the credit channel in small-open developing countries will be through the price development and macroeconomic shocks channel, especially the exchange rate gap and output gap shocks. Generally, the dynamic impacts of the credit crunch on private consumption and capital accumulation through all the three channels in developing economies will be favorable. This could be explained by the fact that the depressing effect of the credit crunch on global prices will benefit import-dependent developing economies. The classical example of this was the reduction in crude oil price from over $140 per barrel to below $50 per barrel during the first-quarter of 2009. So long as the rate of depreciation of the local currency in a typical developing economy does not exceed the rate of decline in international prices, private consumption of imported goods will increase, other things remaining constant. As global prices decline, especially with respect to prices of imported raw materials and capital goods, the cost of production will decline in dynamic terms leading to increase profit margins by domestic companies. These profits could be ploughed back into industrial expansion and infrastructural developments that will lead to increase capital accumulation in dynamic terms.

These findings are, by and large, consistent with many of the predictions of the multilateral international financial institutions regarding the macroeconomic impacts of the current credit crunch in developing economies. According to the World Bank (2009a) the current financial crisis threatens growth, employment and balance of payments stability even in those countries that have made significant improvements in macroeconomic management in recent years. The Bank's projections point to economic slowdown in many developing economies that will emanate principally from declining commodity prices, collapsing global trade, dwindling aid flows, falling foreign direct investment and diminishing workers' remittance flows. The Bank also notes that given the unprecedented severity of the crisis, few countries will be able to avoid heavy pressures on their fiscal and external positions. The results of the dynamic stochastic general equilibrium model developed in this study have not only confirmed these projections but have also given details of the channels through which the credit crunch would affect most developing economies and the magnitudes of these impacts. However, unlike most of the predictions of international, regional and local organizations which mostly point to the adverse impacts of the credit crunch, the findings of this study suggest that the credit crunch could be a blessing to most developing economies in the area of private consumption and capital accumulation. Thus, in an attempt to neutralize the likely adverse impacts of the credit crunch, developing countries should not forget to take measures that reinforce the favorable macroeconomic impacts of the crisis on their economies.

CONCLUSIONS

This study sets out to find the likely impacts of the credit crunch in small-open developing economies. It gives a detailed background to the crisis, touching on the genesis as well as the immediate impacts in industrialized economies. It reviews the literature on the linkage between the financial sector and the real economy. It goes on to develop a Dynamic Stochastic General Equilibrium (DSGE) model for a flexible exchange rate regime with modified Taylor-type monetary policy rule. The simulation results indicate, among others, that the credit crunch is likely to impact developing economies significantly through three main channels: resource-flows channel, external price development channel and macroeconomic shocks channel. The implicit trade channel is also identified. The likely impacts of the credit crunch are examined with respect to economy-wide macroeconomic indicators such as output, inflation, exchange rate, fiscal policy aggregates, investment and private sector consumption.

The study finds that the credit crunch will have depressing effect on output through the resource flows channel but favorable impact through the external price development channel. It also establishes that the impacts of the credit crunch on output through the macroeconomic shocks will be relatively small. The rate of domestic inflation will increase generally, while nominal and real exchange rates will appreciate through all the channels. The trade impacts of the real exchange rate appreciation may be significant, leading to the widening of the current account deficits in developing economies.

Concerning the fiscal policy impacts of the credit crunch, the study establishes that the impact will be very severe on tax revenue and domestic borrowings through the resource flows channel. Through the external price development channel, however, the impact will be favorable for tax revenue, public investment, public expenditure on foreign good and domestic borrowings. Of the macroeconomic shocks channel, exchange rate gap and output gap shocks will strongly adversely affect all the four fiscal aggregates. The overall fiscal

impacts will be deteriorating tax revenue, declining public investment, expanding public expenditure on foreign good and rising domestic borrowings.

The private sector impact analysis show that the dominant private sector impacts of the credit channel in small-open developing economies will be through the price development and macroeconomic shocks channel, especially the exchange rate gap and output gap shocks. Generally, the impacts of the credit crunch on private consumption and capital accumulation through all the three channels in developing economies will be favorable in dynamic terms. This does not, however, preclude the possibility of adverse contemporaneous effects on the private sector.

With the foregoing findings, policymakers in developing economies should begin to put in place some stimulus packages to assuage the adverse effects of the credit crunch and adopt measures to neutralize the unfavorable macroeconomic shocks, while simultaneously implementing policies to reinforce the impacts of the favorable shocks. Overall, fiscal policy implications are quite enormous. Domestic resource mobilization should be intensified and policy credibility and appropriateness should be enhanced. Monetary policy should be conducted in such a way as to reflect international developments and remove unnecessary distortions and reduce the risk level in the economy. Generally, developing countries should pursue sound and prudent domestic macroeconomic management policies that are consistent with the constraints imposed by the global financial crisis. Moreover, multilateral financial institutions such as the IMF and the World Bank should assist developing economies with adequate funds to set up stimulus packages. The donor community should not only concentrate on fixing their own problems but also engage in finding global solutions to the crisis. Regional financial institutions and economic blocs in the developing world should seize the opportunity to strengthen and consolidate their positions so as to provide adequate assistance in solving the crisis in their respective regions.

Indeed, a lot has been said about the likely impacts of the current credit crunch on developing economies but there is little or no rigorous study that tries to establish the impact of the credit crunch on developing economies and channels through which developing economies could be affected. This study is, therefore, the first of its kind to establish quantitatively how the current credit crunch would affect developing economies, the magnitude and the direction of the impacts and the relative importance of the possible channels through which the credit crunch could affect developing economies. However, future studies should attempt modeling the financial and trade sectors explicitly in order to unearth more channels through which a global financial crisis like the current one can affect developing economies.

APPENDIX

Preference Relations, Production and Policy Functions

Preference Relation for Consumption Goods

$$u(x_t, z_t) = \frac{1}{1-\psi}\left(a_1 x_t^{1-v} + a_2 \sigma_t z_t^{1-v}\right)^{\frac{1-\psi}{1-v}} \quad (1)$$

Note: $\mu(\bullet)$ is Edgeworth complementary; ψ = coefficient of relative risk aversion in substituting imports for exports; v = elasticity of substitution across consumption goods; $a_1 = 1\text{-}a_2$, where, a_2 = the share of imported good in total consumption.

Preference Relation for Financial Services

$$\phi(m_t, f_t) = \frac{1}{1-\Theta}\left(a_3 m_t^{1-\mu} + a_4 \sigma_t f_t^{1-\mu}\right)^{\frac{1-\Theta}{1-\mu}} \quad (2)$$

where, $\phi(\bullet)$ is also Edgeworth complementary; Θ = coefficient of relative risk aversion in substituting real domestic money balances for real foreign money balances; μ = elasticity of substitution across financial services; $a_3 = 1-a_4$ where, a_4 = the share of foreign currencies in total of real money balances.

Preference Relation for Leisure

$$v(1-l_t) = \frac{a_5 (1-l)^{1-\varphi}}{1-\varphi} \quad (3)$$

φ = coefficient of relative risk aversion in substituting labor for leisure; a_5 = disutility coefficient.

Production Function

The production function assumes the form of a Cobb-Douglas production function with the two traditional factors of production and a productivity shock emanating from public investment.

$$y = \exp(g_t) l_t^{\delta} \left(\frac{1}{1+\pi_t}\right)^{1-\delta} k_{t-1}^{1-\delta} \quad (4)$$

It must be noted that the capital stock used in production is the one that begins period t. The production function exhibits constant returns to scale and satisfies all the Inada conditions.

Fiscal Policy Constraint

$$\Delta b_t^g + \sigma_t \Delta b_t^{*g} = x_t^g + \sigma_t z_t^g + \left(\frac{i_{t-1}}{1+\pi_t}\right) b_{t-1}^g + \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right) b_{t-1}^{*g} - \left(tax_t + \sigma_t a_t^* + drc_t\right) \quad (5)$$

Monetary Policy Constraint (Central Bank's Flow of Funds Constraint)

$$\left[b_t^c - \left(\frac{1}{1+\pi_t}\right) b_{t-1}^c\right] + drc_t = \left(\frac{i_{t-1}}{1+\pi_t}\right) b_{t-1}^c + \left[m_t^b - \left(\frac{1}{1+\pi_t}\right) m_{t-1}^b\right] \quad (6)$$

Consolidated Government Flow Budget Constraint

$$\Delta b_t + \sigma_t \Delta b_t^{*g} = x_t^g + \sigma_t z_t^g + \left(\frac{i_{t-1}}{1+\pi_t}\right) b_{t-1} + \frac{\sigma_t i_{t-1}^*}{1+\pi_t} b_{t-1}^{*g} - \left(tax_t + \sigma_t a_t^* + \Delta m_t^b\right) \quad (7)$$

Foreign Currency Supply Relationship

$$\sigma_t \left(f_t - \frac{1}{1+\pi_t} f_{t-1}\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t \left(z_t + z_t^g\right) \quad (8)$$

Import Function

$$\sigma_t\left(z_t + z_t^g\right) = a_7 + a_8 y_t^d \tag{9}$$

International Linkages

The domestic and foreign trade sectors are linked by the real exchange rate which is defined as

$$\sigma_t = \frac{e_t p_t^*}{p_t} = \frac{e_t\left(1+\pi_t^*\right)}{\left(1+\pi_t\right)} \tag{10}$$

The international capital market equilibrium is given by the uncovered interest parity condition as follows:

$$i_t^* = i_t - \left(\Delta e_t / e_{t-1}\right) - \tilde{e}_t \tag{11}$$

where, $(\Delta e_t/e_{t-1})$ = dynamic expectation of exchange rate adjustments at time t and $\tilde{e}_t$ = risk premium associated with exchange rate adjustments.

Balance of Payments and Economy-wide Resource Constraints

$$\begin{aligned}\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) &= y_t - \left(x_t + x_t^g\right) - \sigma_t\left(z_t + z_t^g\right) - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] - \Delta m_t + \Delta m_t^b \\ &\quad - \sigma_t \Delta f_t + \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^*\end{aligned} \tag{12}$$

$$\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) = \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^* + \Delta m_t^b - \Delta m_t - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] \tag{13}$$

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