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Determinants of Portfolio Flows to Ghana: A Dynamic Stochastic General Equilibrium Analysis

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Abstract: The dwindling and erratic official capital inflows to Ghana have necessitated attraction of private capital inflows. Although, efforts have been made in this regard very little is known about the factors that influence portfolio flows and the policy environment that will enhance inflows to Ghana. This study, therefore, investigates the determinants of portfolio flows to Ghana and outlines policy measures that will influence these flows. A Dynamic Stochastic General Equilibrium (DSGE) model is developed as the theoretical framework. The methodology is based on simulation and calibration using Markov Chain Monte Carlo (MCMC) techniques. Ghana-specific simulations are done to derive the policy and transition functions of the DSGE model. From the results, eight categories of determinants of portfolio flows to Ghana are identified. Increasing capital stock accumulation, international interest rate, public investment and its related shock and inflow dynamics will have positive impacts on both portfolio inflows and outflows with net portfolio inflows. However, increases in real domestic money balances, domestic interest rate, public expenditure on foreign good, distortionary tax rate and global inflation rate will generate appreciable negative impacts on both portfolio inflows and outflows. Capital flow dynamics and macroeconomic shocks generate the most significant impacts on portfolio flows. The findings suggest that appropriate fiscal and monetary policy coordination can help attract portfolio flows to Ghana.

Key words: Portfolio flows, monetary policy, fiscal policy, dynamic stochastic general equilibrium, calibration and simulation

INTRODUCTION

Inadequate domestic resource mobilization continues to hamper long-term development in Africa. Poverty reduction and other Millennium Development Goals (MDGs), therefore, are looking increasingly difficult to achieve on the continent by 2015 (UNCTAD-UN, 2005). It has become imperative to attract foreign capital flows to augment the continent's resources for rapid socio-economic development. Indeed, among various developing regions of the world, the need for external financing is nowhere more pressing than in Africa, particularly in Sub-Saharan Africa, where income levels are too low to generate adequate domestic resources for the attainment of even modest rates of investment and growth (UNCTAD-UN, 2000). As an African country, Ghana shares all the characteristics with the continent with regard to inadequate domestic resource mobilization and minimal capital inflows. Overseas Development Assistance (ODA) inflows to Ghana are becoming increasingly erratic, while revenue mobilization remains below what is required to execute the country's developmental agenda. For example, official inflows per head declined from US$ 49.8 in 1991 to US$28.12 in 2000 (Bawumia, 2005) and US$16.75 in 2008. It is therefore, not surprising that Ghana's economy over the last two decades grew at an annual average rate of 5% instead of the 8% or more required for the attainment of a middle-income status by the year 2020 (This is the object of Ghana Vision, 2020 which was later revised to Vision 2015 but changed again to vision 2020 by the new political administration in 2009). The economy remains agrarian and fragile in the face of external and internal macroeconomic shocks. The current account and fiscal balances continue to record negative values. These and other structural bottlenecks from both the supply and demand sides (such as poor and inadequate socio-economic infrastructure, low morale of workers resulting from lack of incentives and mismanagement and misplacement of priority areas) are hampering economic take off.

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Thus, frantic efforts are being made by the authorities to attract foreign private capital. For instance, Ghana has entered the international bond market to raise capital to undertake her development projects. In September, 2007, the country issued US$ 750 million Euro-dollar bonds which were oversubscribed. The European Investment Bank also issued Euro 15 million cedi-denominated bonds on behalf of Ghana in October 2007. But for the current credit crunch of 2008-2009, Ghana would have issued more bonds in 2008 and 2009 to finance her developmental programs (World Bank, 2009). Portfolio equity flows remain very negligible. To what extent can Ghana attract portfolio loans and equity flows? There are very few studies on private capital flows to Ghana. Most of these focus only on the FDI component of private capital flows. Tsikata *et al.* (2000) for instance, analyzed the factors influencing FDI inflows to Ghana and attributed the generally low level of FDI in the Ghanaian economy to political instability and harsh macroeconomic environment. Little or no attention is given to portfolio flows (defined as investments in bonds and stocks issued by governments and corporations (Dodd, 2004)) to Ghana probably because these flows are recent developments in the country's financial history. The problem, therefore, is that the determinants of portfolio flows to Ghana are not clearly known. Specifically, the current capital flows literature on Ghana is deficient of studies that look at the determinants of portfolio investment and short-term flows to Ghana.

In view of the research problem, this study seeks broadly to find the determinants of portfolio flows to Ghana. More specifically, it examines the influences of both policy and macroeconomic variables on the flows. To do this the study undertakes an in-depth review of the literature and sets out an inter-temporal dynamic optimization theoretic framework using a Dynamic Stochastic General Equilibrium (DSGE) model with open economy Money-in-Utility Function (MIUF) representation. The analytical framework employs calibration and simulation methodology in view of inadequate historical data. From the findings, recommendations are made for policymakers' consideration and for furtherance and deepening of research in this area in Ghana and other developing regions.

The justification of this study emanates largely, first, from the fact that there is a yawning gap in the literature on determinants of portfolio flows to Ghana, which needs to be filled. As noted above, there is virtually no study on the subject with specific reference to Ghana. Secondly, private capital flows have outstripped official flows as a source of development finance. Over the past twenty years, the volume of private flows has become much greater than public flows. The average annual net official flows were US$26.7 billion over the period 1980-1990 and then declined to an average of US$21.3 billion over the period 1991-2003. Meanwhile, net private flows were US$20 billion and US$118 billion over the same periods respectively (Dodd, 2004). Thirdly, determinants of international capital flows have been one of the most important issues in the international macroeconomics literature (Alfaro *et al.*, 2005; Prasad *et al.*, 2003). However, there is no consensus in the literature principally because different researchers focus on different samples of countries, different time-periods and different forms of capital flows (Alfaro *et al.*, 2005). This suggests that investigations into the determinants of private capital flows should be an ongoing process in view of the dynamics of economic systems.

The study draws its relevance from the following facts: First, Ghana needs to attract substantial private capital flows to compensate for the perennial widening deficit in the current account. Secondly, private capital flows are needed to augment domestic resources in order to accelerate the growth rate of the Ghanaian economy for the attainment of the MDGs and Ghana Vision, 2020. Thirdly, private capital flows can increase welfare by enabling households to smooth out their consumption overtime and achieve higher levels of consumption (Calvo *et al.*, 1996). Also, there have been calls on both national and international levels to attract private capital flows to developing countries in general considering the aid fatigue and fiscal pressures in industrial/donor countries and the resultant decline in ODA flows (Montiel and Sharma, 1997).

MATERIALS AND METHODS

Trends in capital flows to Ghana: Foreign aid was quite insignificant during the immediate post independence years due to the presence of substantial foreign reserves bequeathed to the country by the British colonial masters and the suspicion that Nkrumah had for likely donors (Harrigan and Younger, 2000). Official Development Assistance (ODA) per capita (1987 constant US dollars) in 1960 was $1.44, rising to $8.55 in 1964. Nkrumah's government's interest in foreign aid was aroused after the 1965 balance of payments crisis that resulted from the falling primary commodity prices on the international market. The National Liberation Council (NLC) that took over the leadership mantle after the overthrow of Nkrumah decided to approach the IMF for support in the face of mounting external debt. Thus, ODA per capita rose from US$18.73 in 1965 to US$24.28 in 1969. ODA as a

proportion of GDP rose from 0.002 in 1960 to 0.036 in 1969: a level, which was above the ODA-GDP ratios for Sub-Saharan Africa and low-income developing countries (Harrigan and Younger, 2000; Bawumia, 2005).

The increasing trend of ODA in the 1960s was reversed during the first half of the 1970s. In fact, ODA per capita reached its lowest level (US$7.43) in a decade in 1974 when the ruling National Redemption Council (NRC) decided to repudiate some of Ghana's commercial debts on the grounds that they were contracted improperly. During the second half of the 1970s, however, aid inflows increased, with per capita ODA rising to US$20.93 in 1979. Multilateral aid constituted a significant component of the external inflows of this time. However, for the period 1960-1981, bilateral aid constituted over 50% of total external inflows. By 1980, total external debt rose to US$1,404 million creating debt-servicing problems. By 1983, ODA per capita declined to US$9.35 due principally to the political turmoil and collapse of social and public sector institutions during the early part of PNDC rule.

The launch and implementation of the Economic Recovery Program (ERP) received the blessings of the multilateral institutions and later of bilateral donors. Consequently, there was enormous injection of foreign aid into the Ghanaian economy. The ODA per capita increased from US$17.22 in 1984 to US$ 49.79 in 1991. There was a hold-up in the disbursement of aid in 1992 due to slippage on economic reforms emanating from the democratization process of the time. However, since 1992, ODA per capita has been hovering around US$30. The ODA-GDP ratio reached a peak of 13.7% in 1989. An interesting feature of external inflows during the post ERP era of 1983-1992 is that, on average, over 50% of total external inflows came from multilateral sources notably the IMF and the World Bank. (A detailed review of the aid-flow literature on Ghana is contained in the lead author's unpublished M. Phil. Thesis of 2003). However, private flows to Ghana are not significant. For instance, portfolio equity flows were completely absent until 1990 when the Ghana Stock Exchange was established. In terms of portfolio loans, both the private and public sectors were not prepared to access the international capital market. However, of recent, the government has gone into the global financial market to raise US$750 million. The only form of private capital flows to Ghana for the period 1984-2004 was the short-term commercial flows. Most of the commercial flows were in respect of export-import trade and domestic cocoa purchases. The trends in official development assistance, foreign direct investment and short-term commercial flows (PFL) to Ghana between 1984 and 2004 are shown in Fig. 1.

Theories of determinants of portfolio flows: The direction of private capital flows is explained by two classes of theories namely push factor and pull factor theories (Calvo *et al*., 1993; Chuhan *et al*., 1998; Hernandez and Rudolph, 1994; Taylor and Sarnio, 1997; Montiel and Rudolph, 2001; Haynes, 1988; Ul-Haque *et al*., 1997). Initially, the surge in private capital flows was thought to be a function of domestic developments such as sound policies and strong economic performance. However, it became clear that global factors such as cyclical movements in interest rates were the driving force behind

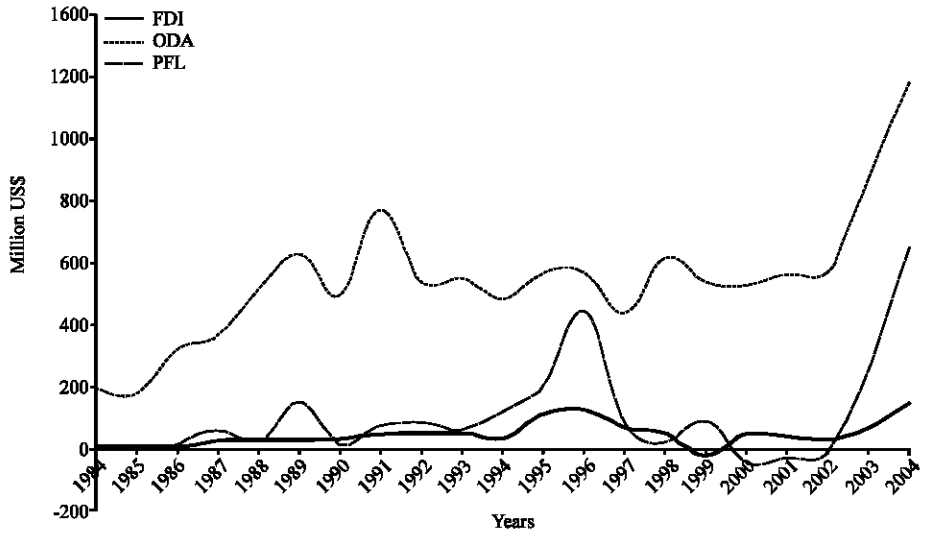

Fig. 1: Trends in ODA, FDI and short-term Private Flows (PFL) 1984-2004

international capital mobility (Calvo *et al*., 1996). Thus, push factor theories attribute direction of capital flows to what happen on the international front such as falling international interest rates, business cycles in industrial countries and the rising trend toward international diversification (Calvo *et al*., 1996; Calvo and Reinhart, 1998). Indeed, one of the most accepted paradigms in international finance is the relationship between capital movements and interest rate differentials (Haynes, 1988).

Pull factor theories, on the other hand, trace the causes of capital flows to such domestic factors as autonomous increases in the domestic money demand function, increases in the domestic productivity of capital (Ul-Haque *et al*., 1997) increasing integration of domestic capital markets with global capital markets (Agénor and Montiel, 1999), improvement in external creditor relations, adoption of sound fiscal and monetary policies and neighbourhood externalities (Calvo *et al*., 1996).

The key postulations on determinants of capital flows emerge from models such as Return and Creditworthiness Model (RCM) by Fernandez-Arias and Montiel (1996), International Capital Assets Pricing Model (ICAPM) by Bohn and Tesar (1996), Money Demand and Productivity (MDP) Framework by Ul Haque *et al*. (1997) and Portfolio Allocation Model (PAM) by Fedderke (2002).

The RCM decomposes factors influencing capital flows into domestic and global factors. Domestic factors are mainly two: a project level expected return which is a function of net flows and creditworthiness of the recipient country which is determined by end-of-period stock of liabilities. The product of these two factors gives total expected returns. From a zero-arbitrage condition where total expected returns are equated to the opportunity costs of asset holdings, the RCM postulates that long- and short-run changes in equilibrium capital flows are due to the initial stocks of liabilities, changes in pull factors such as domestic economic environment and push factors such as external financial conditions.

The ICAPM explains the determinants of capital flows from the perspectives of portfolio rebalancing effect and return-chasing motive. It assumes that an investor purchases market indexes of domestic and foreign equities. Net purchases of an asset are given by the changes in investor's desired portfolio and portfolio rebalancing effect. Thus, according to the ICAPM, capital flows reflect what is required to maintain constant portfolio weights (portfolio rebalancing effect) and the extent to which investors adjust portfolio weights as the portfolio is re-optimized overtime (return-chasing effect). The MDP essentially traces the causes of capital flows to changes in money demand function, productivity of domestic capital and external factors such as international interest rates. In this framework, an upward shift of the money demand function and increases in productivity of domestic capital will generate capital inflows, ceteris paribus and vice versa. These pull factors usually result in sustained capital flows. Falling international interest rates, other things equal, will elicit inflow of capital while rising rates will cause outflows. Flows associated with this push factor are usually temporary.

Portfolio allocation theory says that capital flows are driven by two classes of determinants namely rates of return and risk factors, with positive responses to rates of return and negative responses to risk. The PAM is a dynamic optimization model in which the individual seeks to maximize the present value of his utility derived from expected return on a portfolio of capital assets. Solution to the PAM using calculus of variations approach indicates that equilibrium capital flows are driven by three components namely initial divergence effect, impetus effect and time path effect. The initial divergence effect is given as the ratio of initial divergences between the starting levels of capital stock (foreign and domestic) and the inter-temporal equilibrium holdings of foreign assets and domestic assets respectively. The stronger the divergence between where agents find themselves in their initial asset holdings and where they would wish to be in inter-temporal equilibrium the stronger the flow of funds toward that particular destination-domestic or foreign. Thus, the stronger the divergence is in foreign asset holdings the greater will be capital outflows. Similarly, the wider the divergence is in domestic asset holdings the greater will be capital inflows. The impetus effect depends crucially on the strength of the social rate of time discounting, marginal rate of return, marginal costs of adjustment and expropriation risk factors which are due to harsh domestic macroeconomic and policy environment. It serves to either enhance or dampen the divergence effect. The time path effect characterizes the optimal mix of flows of funds to foreign and domestic assets as they approach their inter-temporal equilibrium values. It also reinforces either positively or negatively the first-two effects.

Empirical evidence on the determinants of portfolio flows: Empirical evidence indicates that foreign factors have played an important role in private capital inflows to ten Latin American countries in the early 1990s (Calvo *et al*., 1994). In a study of ten Latin American countries, Calvo *et al*. (1993), using principal component analysis to determine the degree of co-movement among foreign reserves and real exchange rates as well as Structural Vector Autoregressive (SVAR) models to determine

causal influences, find that both reserves and real exchange rate series have large bivariate correlation with several US financial return variables. Further, variance decomposition and impulse response functions show that foreign factors played a large role in accounting for reserve and real exchange rate movements. They also establish that, depending on the country, foreign factors accounted for 30 to 60% of the variance in real exchange rates and reserves. However, Claessens *et al.* (1998) find that increases in international interest rates and higher OECD-growth rates were associated with increased capital flows to Central and Eastern Europe in the 1990s. They point out that increases in OECD-growth rates might have enhanced supply of foreign savings available for these countries.

Chuhan *et al.* (1998) study nine Latin American and nine Asian countries over the period January 1988 to July 1992. They employ panel regression method with explanatory variables such as country credit rating, price of debt on the secondary market, stock market price earnings ratio, black market premium, external (US) interest rates and industrial activity. They find that both domestic and external factors have equal impact on capital flows to Latin America. Foreign factors explained about 50% of bond and equity flows from the US to Latin American countries. However, in Asia, domestic factors have greater influence.

Conducting a study on 13 developing countries, Fernandez-Arias (1994) adopts a panel regression after decomposing portfolio flows into portions attributable to credit worthiness, domestic environment and expected return. He establishes, among others, that international interest rates are the dominant factors explaining surges in capital inflows. Sixty three percent of variations in capital inflows are attributable to international interest rate, 25% to creditworthiness and 12% to domestic investment climate. Dooley *et al.* (1994) study 13 developing economies using panel regression to explain capital flows indirectly using the influence of domestic secondary-market prices on debt. They conclude, inter alia, that almost all the variations in portfolio inflows are due to credit worthiness and international interest rate and that domestic investment improvement explains virtually nothing.

In a study of 22 developing economies, Hernandez and Rudolf (1994) employ a panel regression with explanatory variables such as lagged domestic consumption and investment rates, external interest rates, net external debt to GDP, real exchange rate variability and Brady bond deal. Their findings are that there are significant influences of domestic worthiness indicators on portfolio flows but insignificant impact of international interest rate. In a World Bank (1997) study of 12 emerging markets in East Asia and Latin America over the years 1990-95, principal component analysis is firstly done to determine the degree of co-movement among foreign reserves and real exchange rates. The principal components generated are secondly correlated with portfolio flows. It is found that the first principal component of quarterly portfolio flows was negatively correlated with US asset returns during the period 1990-93. Over the years 1993-95, the correlation became weaker and positive, implying domestic factors may have played a bigger role in the later years.

Montiel and Rudolph (2001) study private capital flows to 15 emerging markets over 1990-96 period. In the first part of their study, a panel regression is undertaken to investigate countercyclical policies and composition of flows, using sterilization proxy, capital control proxy and US interest rate as explanatory variables. They find that US interest rates significantly negatively influenced overall private capital flows and portfolio flows as a percent of GDP. They failed, however, to explain FDI and short-term flows. The capital control proxy exerted insignificant influence in almost all cases. The sterilization proxy had significant positive influence on overall volume of flows/GDP, short-term flows/GDP and FDI flows as a share of total flows. In the second part of their study, a panel regression is done to investigate the link between financial sector and capital flows. In addition to the previous explanatory variables were finance variables such as market capitalization, number of listed stocks and trading value. The findings are that the number of listed stocks had significantly positive impact on total capital flows but market capitalization and trading value did not. Further, portfolio flows were impacted upon positively by market capitalization and number of listed stocks. However, none of the stock market variables explained short-term flows.

Gordon and Gupta (2003) examined the fundamentals that drive portfolio flows into India. They find that domestic, regional and global variables exert significant influences on portfolio equity flows to India. More specifically, they establish from their regression analysis that, with regards to global variables, international interest rates (LIBOR) had a significant negative influence on portfolio equity flows to India during the study period. However, the lagged return on NASDAQ had an insignificant negative impact on the equity flows. Concerning domestic variables, lagged domestic stock market return had a significant negative influence on the equity flows, which is contrary to theoretical postulations. Gordon and Gupta (2003) explain this to be the result of global investors being bargain hunters who buy on the

dips or allocate a fixed share of their portfolios to India and match their selling and buying with market rises and falls, respectively. Their analysis also indicates that the depreciation of the Indian Rupee in the previous month repelled equity flows into India. Credit rating downgrades were also found to have retarded portfolio equity flows. However, the authors point out that since credit rating downgrades were announced after periods of major economic or political developments, third party effects might be at work in this case, though political event dummies were not significant. The emerging market variable considered is the lagged return in emerging markets, which had significant positive coefficient. This, they claim, lends support to the hypothesis that portfolio investment in India is not independent of events in other emerging markets.

Further, De-Vita and Kyaw (2008) study the determinants of Foreign Direct Investments (FDI) and portfolio flows to 32 developing countries between 1990 and 2004, using a panel cointegration analysis. They examine the impacts of international variables such as economic activity in industrialized countries and international interest rates, as well as domestic factors such as domestic productivity and money growth. Their findings are that domestic productivity growth is the dominant determinant of FDI flows, while domestic money growth is the major factor that attracts portfolio flows to developing countries.

Turning to Sub-Saharan Africa, Montiel and Sharma (1997) notes that portfolio equity flows to Africa have been quite small, though, there are encouraging signs of growing investor interest. For instance, since 1994, more than 12 African-oriented funds have been established with a total size of more than $1 billion. The key factor attracting portfolio equity inflows into Africa is openness to foreign investors. Factors constraining equity inflows are political instability and weak macroeconomic fundamentals, notably structural weaknesses and high transaction costs arising from corruption and others. However, inflows of portfolio loans have been on a decline for several countries in Sub-Saharan Africa. Commercial bank lending remains negative or at very low levels due to low levels of creditworthiness resulting from high political risk, weak growth and export performance, macroeconomic instability and high levels of indebtedness. Another important factor constraining commercial bank lending, which should not be glossed over, is the deliberate steps taken by most Sub-Saharan African countries to reduce commercial borrowings.

Further, according to Montiel and Sharma (1997) the general theory underlying any empirical specification is that long-term private capital flows into a particular country are determined by relative rates of return at home and abroad and the relative risks associated with such investments. Rates of return and risk perception of foreign investors and the climate for foreign investment are influenced by the host country's domestic characteristics and those of the international environment. Notable among the domestic characteristics are the growth rate of the economy, the rate of investment, the openness of the economy, the ratio of external debt to GDP and the volatility of the real effective exchange rate. The key international factor is the international interest rate, which provides a proxy for the opportunity cost of investing funds in developing countries.

From the empirical review, most of the studies on the determinants of private capital flows employed panel regression methodological framework. Some used principal component analysis, while others adopted Vector Autoregressive (VAR) modeling technique. None of these methodological frameworks is relevant for this study in that most of the panel regression and principal component analysis models are static partial equilibrium models while the VAR models, though dynamic, do not have any microeconomic foundations and are limited, in terms of the number of variables they can accommodate at a time, by the non-availability of adequate data. Further, the key determinants of private capital/portfolio flows identified by the above empirical studies range from macroeconomic through institutional to structural variables. This study, however, concentrates on macroeconomic determinants of portfolio flows to ease construction of the theoretical framework.

Theoretical framework: The existing theoretical frameworks on determinants of portfolio flows as reviewed earlier are considered inadequate for a detailed analysis of portfolio flow determinants since most of them are partial equilibrium relationships with little or no policy direction. This study, therefore, develops an economy-wide inter-temporal dynamic framework with a representative agent characterization. The representative agent model of an open economy derives all behavioral relationships from inter-temporally optimizing agents (Schubert, 2002). This approach is consistent with the New Keynesian view of giving macroeconomic models sound microeconomic foundations. This view holds that the behavioral relationships that are specified in macro models should be derived from the inter-temporal optimization of microeconomic agents. Traditional macroeconomic models as well as rational expectations models have been criticized on the grounds that they are based on arbitrarily specified behavioral relationships

(Turnovsky, 2000). The choice of dynamic analysis in this study is not only in support of the New Keynesians view but is also informed by the fact that, first, an economy is a continuum of activities and events and secondly, economic realizations are essentially products of inter-temporal decision-making, hence, their analyses require the use of inter-temporal models.

The representative agent's behavior: This study adopts the Money-in-Utility Function (MIUF) approach in modeling the behavior of the representative agent. Indeed, most developing economies including Ghana are yet to graduate from money base to credit base or cashless economies. Thus, MIUF approach in this study is quite appropriate. It must also be noted that there are varieties of the MIUF model in an open-economy setting. However, most of these models have been developed using composite consumption good, labor as the only factor of production and monetary shocks. This study, in developing the model that will be able to capture a wide-range of determinants of capital flows, adopts for the representative agent an open-economy MIUF which is separable in consumption, labor supply and real balance holdings, following Sidrauski (1967), Turnovsky (2000) and Walsh (2003). This MIUF has two consumption goods (one domestically produced and one foreign good), leisure hours, foreign and domestic real balance holdings and foreign and domestic bond holdings. The individual lives in an economy where both private and public investments occur and fiscal and monetary authorities implement active policies to fine-tune the workings of the economy. The models presented here and their equilibrium solutions in Appendix I are parts of an elaborate framework developed for five different exchange rate and monetary policy regimes by the lead author in his 2008 doctoral thesis.

The representative agent seeks to solve the following inter-temporal problem:

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

subject to:

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

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

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

ι_t : Total net investment

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

$\sigma_t = \frac{e_t p_t^*}{p_t} = \frac{e_t(1+\pi_t^*)}{(1+\pi_t)} \equiv$ The real exchange rate in period t, with $p_t^* \equiv$ Foreign price level, $p_t \equiv$ Domestic price level and $e_t \equiv$ Nominal exchange rate at time t. $1+\pi_t \equiv p_t/p_{t-1}$, $1+\pi_t^* \equiv p_t^*/p_{t-1}^*$, $i_t \equiv$ Nominal domestic interest ate and $i_t^* \equiv$ Nominal international interest rate at time t.

$y_t^d \equiv (1-\tau_t)y_t - h_t \equiv$ Total disposable income per capita in period t where $\tau \equiv$ income tax rate and $h \equiv$ lump-sum tax per capita.

Policy relationships: The behavior of the policymaker reflects 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. Money supply relationship from the flow-of-funds perspective can be specified as:

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

where, $a^* \equiv$ 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.

Under the simple Friedman-Type monetary policy rule, the monetary base is adjusted according to the following rule:

$$m_t^b = \left(\frac{1+\gamma}{1+\pi_t}\right)m_{t-1}^b \quad (6)$$

where, γ ≡ The nominal growth rate of the monetary base. Note that the central bank has no direct control over real money balances but can control effectively the monetary base. Thus, a Friedman-Type monetary rule essentially concerns adjustments in the monetary base. It must be noted that here monetary policy is time dynamically consistent. Hence, no direct monetary policy shock emanates from monetary base adjustments. However, there will be indirect monetary policy shock emanating from changes in the money multiplier. Monetary policy constraint is specified (Appendix 1) 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.

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 1). 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 1).

As stated in Appendix 1, 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 solution to the models and resulting equilibrium equations are in Appendix 1.

Simulation and calibration techniques: Calibration in macroeconomics involves simulation of dynamic models and comparing them to historical data. This type of comparison can be seen as a test of the model. If the correspondence between some aspect of the model and the historical record is deemed reasonably close, the model is viewed as satisfactory. If the distance between the population and the historical moments is considered too great, the model is rejected. This method naturally concerns the distribution of the sample moment under the null hypothesis that the model is true. For fully parameterized models in economics, one can use repeated simulations to estimate the probability of falsely rejecting a true economic model and to construct confidence intervals using comparisons of moments (Gregory and Smith, 1991).

In calibrating a model, the commonly used method 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. Regardless of the degree of complication of the model, one only needs 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. Such estimators typically have nice properties such as consistency and asymptotic normality, even for a finite amount of simulation draws.

Summarizing in less technical terms, following Cooley and Prescott (1995), the general calibration technique can be applied according to the following steps (Mark, 2001):

- Generate a set of sample moments such as the mean, standard deviation, autocorrelations and cross-correlations between the time series from the actual (real-world) data
- Assign values to the deep parameters in the solutions to the various models specified in the study. These values essentially can either be those estimated by others or those that are reasonably consistent with the models' underpinnings
- Simulate the solved models of the study to generate new time-series of the variables under consideration
- Generate a 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
- Given that the models performed well, the models' parameters can be varied under different scenarios to predict or forecast variables of interest

Model solution and estimation in DYNARE: This study employs the DYNARE (Dynamic Rational Expectations) program to solve the model and to estimate its parameters. The solution stage in DYNARE refers to the stage where series of simulations are done to compute new steady state values for the system variables, first and second moments of the system variables, policy and transition functions, matrix of correlations, autocorrelations, variance decompositions and impulse response functions. The estimation stage in DYNARE involves using observed stationary variables to calibrate country-specific parameters which are used later for country-specific simulations. The system of equilibrium equations in Appendix 1 are solved and estimated using manually computed steady state values. Every 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. This study depends on the literature for values of the time discount rate, relative risk aversion coefficients and coefficients of elasticity. For budget deficit-GDP ratio, marginal propensities to import and the shares of commodities and financial services, the study considers the peculiarities of a developing economy in deciding on their values. To check whether the system has a stable steady state solution, DYNARE employs the Blanchard-Khan (BK) condition which requires the number of unstable eigenvectors of the system to be exactly equal to the number of forward looking (control) variables for the unique solution of a rational expectations model.

To estimate the model for country-specific parameter values, DYNARE employs Metropolis-Hastings (MH) algorithm to generate sequence of samples from a probability distribution that is used in Markov Chain Monte Carlo (MCMC) simulations to approximate the distribution or to compute expected values. In DYNARE, the sequence of samples can be generated from the following distributions: normal, gamma, beta, inverted-gamma and uniform distributions. This study chooses the normal distribution for the model parameters and the inverted-gamma distribution for the standard errors of the system shocks. The normal distribution was chosen to allow for both negative and positive values while the inverted-gamma distribution was chosen to allow the shocks to die quickly overtime. In estimating the model, the study makes use of inflation and money supply (per capita) monthly series obtained from International Financial Statistics for the period 1984(1)- 2008(12).

This study was carried out in Ibadan, Nigeria and Cape Coast, Ghana between November 2008 and June 2009

PRESENTATION OF RESULTS

The policy and transition functions (Appendix 3) of the DSGE model produce eight categories of determinants. These are money demand, capital accumulation, money supply, foreign exchange market, fiscal policy, external factors, capital flow dynamics and macroeconomic shocks categories. The impacts of these determinants are summarized in Table 1. In each case, the impact is due to a 100% rise in the corresponding determinant, ceteris paribus, above the steady state level.

Portfolio inflows and outflows, at the steady state, will amount to ¢2.200690 and ¢1.718350 per capita,

Table 1: Determinants of private capital flows in ghana under the flexible exchange rate regime with friedman-type monetary policy rule

		Impact				
Category	Variables	Outflows	Inflows	Net flows	Value ¢ per capita	Percentage age of equi. net flows
Money demand	Domestic money	-	-	Outflows	-0.0802	-16.63
	Foreign money*	-	-	Outflows	-0.0313	-6.49
Capital accumulation	Capital stock*	+	+	Inflows	0.0467	9.68
Money supply	Monetary base	-	-	Outflows	-0.0172	-3.57
	Dom interest rate*	-	-	Outflows	-0.1475	-30.58
	Money multiplier	-	-	Outflows	-0.0369	-7.65
Exchange rate mkt.	Nom exchange rate	-	-	Outflows	-0.0516	-10.70
Fiscal policy	Domestic good exp	-	-	Outflows	-0.0227	-4.71
	Foreign good exp	-	-	Outflows	-0.1964	-40.72
	Investment*	+	+	Inflows	0.195	40.43
	Tax rate	-	-	Outflows	-0.1868	-38.73
	Domestic borrowings*	-	-	Outflows	-0.0042	-0.87
External factors	Inter'nal interest rate*	+	+	Inflows	0.4412	91.47
	Global inflation	-	-	Outflows	-0.0915	-18.97
	Risk premium	-	-	Outflows	-0.0271	-5.62
Capital flow dynamics	Past portfolio outflows*	+	-	Outflows	-1.717	-355.97
	Past portfolio inflows*	+	+	Inflows	2.1784	451.63
	Past ODA flows	-	-	Outflows	-2.0678	-428.70
Shocks	Public investment**	+	+	Inflows	0.2674	55.44
	Money multiplier	-	-	Outflows	-0.0923	-19.14
	Income tax	-	-	Outflows	-0.2197	-45.55
	Public expenditure	-	-	Outflows	-0.2626	-54.44
	ODA**	-	-	Outflows	-2.4327	-504.35
	Global inflation	-	-	Outflows	-0.1077	-22.33
	Risk premium**	-	-	Outflows	-0.0319	-6.61

*Refers to factors having strong static correlations with private capital flows; **Denotes high percentage variance decomposition

respectively. This means that the steady state net portfolio flows will be ¢0.48234 per capita. This represents 89.24% of the steady state output of ¢0.540505 per capita. That the Ghanaian economy will be attracting such a huge net portfolio inflows is explained by the fact that the economy, according to the simulation results (Appendix 2), will cease to be aid-dependent at the steady state. Indeed, the results indicate that Ghana will become an aid-donor at the steady state.

Considering the money demand factors in Table 1, increases in both demands for domestic and foreign currencies will dampen both private capital outflows and inflows with corresponding per capita net outflows of ¢0.0802 and ¢0.0313. These values amount to 16.63 and 6.49%, respectively of the steady state net inflows. However, from the matrix of correlations in Appendix 4, the contemporaneous relationships between domestic money balance on the one hand and portfolio outflows and inflows on the other hand are weakly negative. The static correlations between foreign currency balances and portfolio flows are strongly positive.

With regard to capital accumulation, a rise in capital stock above its steady state level, all other things being equal, will have positive dynamic impact on both portfolio outflows and inflows with net inflows of ¢0.0467 per capita, representing 9.68% of the steady state net inflows. Contemporaneously, portfolio outflows and inflows decline with an increase in capital stock. These static negative correlations are quite strong.

Of the money supply instruments, an upward adjustment in monetary base will induce dampening effect on both portfolio outflows and inflows with net outflows of ¢0.0172 (3.57% decline in equilibrium net inflows) as indicated in Table 1. An increase in domestic interest rate also dampens portfolio outflows and inflows with net outflows of ¢0.1475 or 30.58% fall in steady state net inflows. A rise in money multiplier induces negative impact on both portfolio outflows and inflows with net outflows of ¢0.0369, representing 7.65% reduction in equilibrium net inflows. Judging from the correlation coefficients presented in Appendix 4, the static correlations between the monetary base and portfolio outflows and inflows are weakly negative. Between the domestic interest rate and portfolio flows, there are strong positive correlations. The money multiplier relates strongly negatively to portfolio outflows but weakly negatively to the inflows.

In the foreign exchange market, depreciation of the domestic currency reduces both portfolio outflows and inflows with net outflows of ¢0.0516. This corresponds to 10.70% decline in steady state net inflows. Portfolio flows tend to move negatively with the nominal exchange rate in static terms. However, this static correlation is not strong.

Considering the fiscal policy category, the greater public expenditure on domestic good is the lesser will be portfolio outflows and inflows. There will be net outflows of ¢0.0227 or 4.71% decline in equilibrium net inflows at

the instance of an increase in public expenditure on domestic good. A net outflows of ¢0.1964 (40.72% reduction in steady state net inflows) will be generated by a rise in public expenditure on foreign good. A rise in public investment induces increases in both portfolio outflows and inflows with net inflows of ¢0.1950 or 40.43% increase in equilibrium net inflows. An upward adjustment in the tax rate induces reduction in portfolio outflows and inflows with net outflows of ¢0.1868, representing 38.73% fall in equilibrium net inflows. An increase in domestic borrowings dampens both private capital outflows and inflows with net outflows of ¢0.0042 or 0.87% decline in equilibrium net inflows. The static relationships between public expenditure on domestic good on the one hand and portfolio flows on the other hand are weakly negative; those between public expenditure on foreign good and portfolio flows are weakly positive; those of public investment are strongly negative; those of distortionary taxation are weakly negative; and those of domestic borrowings are strongly negative.

With respect to external factors, a rise in global inflation rate impacts portfolio outflows and inflows negatively with net outflows of ¢0.0915, corresponding to 18.97% decline in steady state net inflows. There will be net inflows of ¢0.4412 or 91.47% rise in equilibrium net inflows at the instance of an increase in international interest rate. Portfolio holdings decline when risk premium rises, thus, generating net outflows of ¢0.0271, representing 5.62% reduction in equilibrium net flows. Contemporaneously, all the three external factors have positive correlations with portfolio flows but only the relationship between international interest rate and portfolio outflows is strong.

Turning to capital flows dynamics, the past level of portfolio outflows impacts positively on itself but negatively on portfolio inflows with net outflows of ¢1.7170 (355.97% decline in steady state net flows). The past level of private capital inflows has negative effects on both outflows and inflows with net inflows of ¢2.1784 (451.63% increase in equilibrium net flows). Official development assistance inflows will impact negatively on both private capital outflows and inflows and generate net inflows of ¢2.0678 or 428.70% fall in equilibrium net flows. In static terms, there is a strong positive correlation of 0.9225 between private capital outflows and inflows. This means that, in static terms, a rise in private capital outflows that drain the domestic economy of funds will be compensated for by an increase in private capital inflows.

From Table 1, apart from public investment shock, all the macroeconomic shocks have dampening effects on portfolio outflows and inflows. Public investment shock will induce net portfolio inflows of ¢0.2674, representing 55.44% increase in equilibrium net flows. Money multiplier, distortionary tax, public expenditure on domestic good, ODA, global inflation and risk premium shocks will generate net private capital outflows of ¢0.0923, ¢0.2197, ¢0.2626, ¢2.4327, ¢0.1077 and ¢0.0319, respectively. The corresponding percentage declines in equilibrium net inflows are 19.14, 45.55, 54.44, 504.35, 22.33 and 6.61.

DISCUSSION

The results show that the major determinants of portfolio flows are the ODA shock, past flow dynamics, international interest rate, public investment and public expenditure on domestic good shocks. These findings, to a very large extent reflect the Ghanaian situation in particular and the developing economy characteristics in general. Clearly, dwindling ODA will compel authorities to attract more private inflows and vice versa. Since, the late 1990s when per capita aid flows started to decline, efforts have been made by the Ghanaian authorities to attract private capital flows. Initial efforts were directed at foreign direct investment. However, overtime, it became clear that the foreign direct investments were not forthcoming as expected and the focus was redirected at attracting portfolio flows. This was the case in 2007 when the government of Ghana decided to wean itself off the multilateral financial institutions and went to the international financial market to raise over US$750 million. This means that though the dwindling and erratic flows of foreign aid may have adverse effects on the Ghanaian economy in the short run, their long-run impact may be positive as the authorities explore other areas of external development finance. The 2007 bond experience of Ghana indicates that larger amounts of development finance could be obtained from portfolio loans. The fact that most of the multilateral aid coming from international financial institutions such as the World Bank and IMF have conditionalities attached and those from bilateral sources are mostly tied should encourage Ghana to attract more private capital flows.

The influence of past flow dynamics on portfolio flows to Ghana corroborates the existing views in the literature that private flows continue to go to their pre-existing destinations. Indeed, the gap between the dominant and weak recipients of portfolio flows continues to widen. The findings of this study regarding past flow dynamics exerting significant influence on portfolio flows corroborates the assertion by Calvo *et al.* (1996) that

neighborhood externalities constitute one of the determinants of private capital inflows. The implication of the past flow dynamics is that Ghana should position itself as an attractive destination of portfolio flows. Efforts must be made to build confidence of the international financial community in the Ghanaian economy by way of improving upon the creditworthiness of the country and making it a highly productive economy with high- return generating prospects. This requires that portfolio inflows obtained are channeled into productive sectors of the economy with emphasis on removal of bottlenecks in both supply- and demand-sides of the economy, notably non-existent and dilapidated socio-economic infrastructure.

The findings on international interest rate are also quite interesting. Studies like Montiel and Sharma (1997), Gordon and Gupta (2003), Montiel and Rudolf (2001), Hernandez and Rudolf (1994), Fernandez-Arias (1994) and Dooley *et al*. (1994) assert the significance of international interest rates as a determinant of private capital flows. Contrary to this popular view in the literature that an increase in international interest rate relative to the domestic interest rate will induce portfolio outflows, a rising international interest rate would result in net portfolio inflows to Ghana. The apparent conflict between the interest rate literature and the simulation results of this study is due to the fact that while the existing literature dwells on static partial relationship, this study captures a dynamic general equilibrium relationship between portfolio flows and international interest rates. Technically, the simulation results are not different from the existing views of the literature but rather broaden these views by saying that both portfolio outflows and inflows could occur as results of a rising international interest rate. Indeed, from the results, a rise in international interest rate will induce an increase in not only portfolio outflows but also in inflows. As international interest rate rises, portfolio flows (mainly from the private sector) increase to take advantage of the relatively higher return created. This confirms the identified partial static relationship existing in the literature. However, as portfolio outflows occur in the presence of a rising international interest rate, domestic funds available for borrowing by government decline. All other things being equal, this will compel the government to go to the international financial market for portfolio loans at the higher international interest rate. The players in this market would be too glad to lend to the government (probably because of its low risk) resulting in a situation where the portfolio inflows coming to the domestic public sector exceed the outflows from the domestic private sector and thereby, creating net portfolio inflows. Thus, the simulation results of this study do not only confirm the existing views of the literature but also expanded the existing literature by examining a completely new dimension of the relationship between portfolio flows and international interest rate. It must be quickly pointed out, however, that the issue is not just the capability of Ghana attracting portfolio inflows in the face of rising international interest rate but also her ability to put whatever amount of portfolio inflows obtained to productive use for rapid expansion of her economy.

Further, the reasons for the strong impacts of public investment and public expenditure on domestic good shocks are not far-fetched. The desire to rapidly expand socio-economic infrastructure in the face of inadequate domestic resources will prompt the authorities to attract portfolio/private inflows. Conversely, the increased investment will cause output to increase leading to a rise in private sector income and money balance holdings. This will cause the private sector to purchase more foreign bonds leading to an increase in portfolio outflows. The net effect of public investment, however, on portfolio flows is a positive one. Certainly, this presupposes that the Ghanaian economy is properly dissected for the establishment of sectoral inter-linkages and its current difficulties properly diagnosed for proper planning and management. With regard to public expenditure on domestic good shock, the net effect is portfolio outflows. On the surface, one could argue that as government spends more on domestic goods, the individual producers and households that supply labor will generate more income which they will probably spend on purchases of foreign bonds. However, going by the details of the results, public expenditure on domestic good shock reduces both portfolio outflows and inflows. This may be due to the fact that as government spends more on domestic goods, output increases leading to increasing income and high revenue for the government. This suggests that there is no need for the government to look for development funds from external sources which implies less desire for portfolio inflows. On the other hand, the increased profitability resulting from the increased government spending on domestic goods means the private sector can invest their money balances in the domestic economy which will consequently reduce portfolio outflows. However, the reduction in inflows will exceed the reduction in outflows giving the overall net effect of public expenditure shock as portfolio outflows.

Besides, the impacts of the fiscal and monetary policy aggregates such as domestic interest rate, public expenditure on foreign good, public investment and distortionary tax rate on portfolio flows are quite

substantial, suggesting that policy variables can be used to influence portfolio flows. However, given the Friedman-type monetary policy rule in operation, monetary policy will be less effective than fiscal policy in attracting portfolio flows. For instance, monetary authorities cannot use the monetary base as a tool to influence portfolio flows. The domestic interest rate may be used but not as a direct policy tool as a result of the prevailing Friedman-type monetary policy rule. With regards to fiscal policy, a wide range of fiscal tools such as public investment, public expenditure on domestic and foreign goods and distortionary tax rate could be deployed to shape and direct portfolio inflows and outflows.

Generally, the theoretical postulations are that both push and pull factors are responsible for both portfolio outflows and inflows. The findings of this study confirm this and go further by giving a comprehensive list of these factors. With regard to empirical evidence, the findings of this study compares favorably. For instance, Calvo *et al*. (1993) find from variance decomposition and impulse response functions analysis that foreign factors played a large role in accounting for reserve and real exchange rate movements; Fernandez-Arias (1994) finds that international interest rates are the dominant factors explaining surges in capital inflows and according to Montiel and Rudolph (2001), US interest rates significantly negatively influenced overall private capital flows and portfolio flows as a percent of GDP. This study, however, presents a more detailed general equilibrium analysis of determinants of portfolio flows. It does not only confirm most of the static partial equilibrium relationships but also examines other areas which were hitherto unexplored.

CONCLUSIONS

The analysis and synthesis carried out in the previous section suggest that direct and indirect policy measures can be undertaken to increase portfolio flows to Ghana. Direct policy measures relate to the manipulation of those tools directly under the purview of policymakers. Monetary authorities could (with limitation) use the domestic interest rate to influence the flows. In this vein, domestic interest rate should be progressively lowered over time from its current double-digit to single digit level, perhaps to the steady state level of 5.35%. The reduction in domestic interest rate may appear to at variance with existing theory and practice but it will prove to be a prudent policy of first, stabilizing the domestic financial market and second, integrating it into the global financial market where the current levels of interest rate are far below the domestic rate. Of course, this can only be done if steps are taken to reduce the rate of domestic inflation and the high risks associated with financial transactions in the economy. Monetary base, however, cannot be adjusted to affect portfolio flows since, the prevailing Friedman-type monetary policy rule would not allow adjustments beyond the rule. Money multiplier cannot be used either to influence portfolio flows since, it is outside the control of the authorities. The best the monetary authorities can do is to neutralize/ reinforce the negative/ positive impacts of the money multiplier shock. Fiscal authorities, on the other hand, can use tools such as public expenditure on foreign good, public investment and distortionary tax rate to influence the flows. Public expenditure on foreign good should be lowered, while public investment should be increased in order to enhance net portfolio inflows. Distortionary tax rate should also be reduced for increased net portfolio inflows. The authorities should also take steps to neutralize (enhance) the negative (positive) effects of public investment, public expenditure on domestic goods and distortionary tax shocks. Public expenditure on domestic good and domestic borrowings could also be used to affect portfolio flows but their impact may be insignificant in dynamic terms. Indirect policy measures involve those tools that do not fall under the control of the fiscal and monetary authorities but can be influenced by coordinated efforts of the government and private sector. Here, measures should be taken to portray Ghana as a country that is ready for substantial portfolio inflows. This would require strengthening of not only financial and economic but also administrative institutions. Creditworthiness and policy credibility should be improved. In the face of dwindling and erratic official inflows, greater efforts should be made to attract private capital inflows, especially, portfolio flows which are on the rise globally. The flows should be attracted to strategic investment areas of the economy to facilitate growth. It must be noted that portfolio flows will bypass the country if measures are not taken to convince the investor community that Ghana is ready for scaling up of portfolio inflows. Overall, this study has unearthed macroeconomic determinants of portfolio flows to Ghana. It has also thrown light on policy measures that can be taken to enhance net portfolio inflows to the country. The study has been able to do this in the face of inadequate historical data. However, the results, though close to reality, should be taken more as theoretical and speculative rather than empirically-tested historical relationships. Future research in this area should consider modeling the behaviors of the financial and industrial sectors. This may be very challenging but capable of delivering in-depth and interesting results.

APPENDIX

Appendix 1: Utility, production and policy functions and equilibrium relationships.

Preference relation for consumption goods:

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

Note: u(•) is Edgeworth complementary; $\psi \equiv$ coefficient of relative risk aversion in substituting imports for exports; $\nu \equiv$ elasticity of substitution across consumption goods; $a_1 = 1\text{-}a_2$, where, $a_2 \equiv$ 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; $\Theta \equiv$ coefficient of relative risk aversion in substituting real domestic money balances for real foreign money balances; μ = elasticity of substitution across financial services; $a_3 = 1\text{-}a_4$, where, $a_4 \equiv$ the share of foreign currencies in total of real money balances.

Preference relation for leisure:

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

$\varphi \equiv$ coefficient of relative risk aversion in substituting labour for leisure; $a_5 \equiv$ 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.

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

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:

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

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

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

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

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

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

Balance of payments and economy-wide resource constraints:

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

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

The system of equilibrium equations under flexible exchange rate regime: In all, 27 equilibrium equations are derived.

Marginal utilities block:

$$u_{x_t} = \phi_{m_t} + \left(\frac{1}{1+\pi_{t+1}}\right)\beta E_t u_{x_{t+1}} \quad (14)$$

$$u_{z_t} = \phi_{f_t} + \left(\frac{1}{1+\pi_{t+1}}\right)\beta E_t u_{z_{t+1}} \quad (15)$$

$$v_{l_t} = u_{x_t}(1-\tau_t)y_{l_t} \quad (16)$$

$$u_{x_t} = \beta E_t R_t u_{x_{t+1}} \quad (17)$$

$$u_{z_t} = \beta E_t R_t \left(\frac{\sigma_t}{\sigma_{t+1}}\right) u_{z_{t+1}} \quad (18)$$

$$R_t = (1-\tau_t)y_{k_t} + \left(\frac{1-\delta}{1+\pi_{t+1}}\right) \quad (19)$$

$$\frac{\phi_{f_t} u_{x_t}}{u_{z_t}\phi_{m_t}} \equiv \left(\frac{a_1 X_t^{-\nu}}{a_2 Z_t^{-\nu}}\right)\left(\frac{a_4 f_t^{-\mu}}{a_3 m_t^{-\mu}}\right) = \left(\frac{i^*}{1+i^*}\right)\left(\frac{1+i}{i}\right) \quad (20)$$

Production equations block:

$$y = \exp(g)\left(\frac{1}{1+\pi_t}\right)^{1-\phi} l_t^{\phi} k_{t-1}^{1-\phi} \quad (21)$$

$$k_t = w_t + (1-\tau_t)y_t - h_t - x_t - \sigma_t z_t + \left(\frac{1-\delta}{1+\pi_t}\right) k_{t-1} - m_t - b_t - \sigma_t\left(f_t + b_t^*\right) \quad (22)$$

$$w_t = \left(\frac{1}{1+\pi_t}\right)m_{t-1} + \left(\frac{\sigma_t}{1+\pi_t}\right)f_{t-1} + \left(\frac{1+i_{t-1}}{1+\pi_t}\right)b_{t-1} + \sigma_t\left(\frac{1+i_{t-1}^*}{1+\pi_t}\right)b_{t-1}^* \quad (23)$$

Policy equations block:

$$\Delta b_t + \sigma_t \Delta b_t^{*g} = x_t^g + \sigma_t z_t^g + \left(\frac{i_{t-1}}{1+\pi_t}\right)b_{t-1} + \frac{\sigma_t i_{t-1}^*}{1+\pi_t} b_{t-1}^{*g} - \left(tax_t + \sigma_t a_t^* + \Delta m_t^b\right) \quad (24)$$

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

$$\Delta b_t + \sigma_t \Delta b_t^{*g} = a_6 y_t \quad (25)$$

$$m_t - \left(\frac{1}{1+\pi_t}\right)m_{t-1} = \left[b_t - \left(\frac{1}{1+\pi_t}\right)b_{t-1}\right] - \sigma_t\left(\Delta b_t^* - \Delta b_t^{*g} - \Delta f_t^p - a_t^*\right) \quad (26)$$

$$m_t - \left(\frac{1}{1+\pi_t}\right)m_{t-1} = \theta_t\left[m_t^b - \left(\frac{1}{1+\pi_t}\right)m_{t-1}^b\right] \quad (27)$$

$$m_t^b = \left(\frac{1+\gamma}{1+\pi_t}\right)m_{t-1}^b \quad (28)$$

$$\sigma_t\left(f_t^p - \frac{1}{1+\pi_t}f_{t-1}^p\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t\left(z_t + z_t^g\right) \quad (29a)$$

$$\sigma_t\left(f_t - \frac{1}{1+\pi_t}f_{t-1}\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t\left(z_t + z_t^g\right) - \sigma_t\left(\Delta b_t^* - \Delta b_t^{*g} - a_t^*\right) \quad (29b)$$

$$\sigma_t\left(z_t + z_t^g\right) = a_7 + a_8 y_t^d \quad (30)$$

External sector linkages block:

$$\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) = y_t - \left(x_t + x_t^g\right) - \sigma_t\left(z_t + z_t^g\right) - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] - \Delta m_t + \Delta m_t^b - \sigma_t \Delta f_t + \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^* \quad (31a)$$

$$\sigma_t\left(\Delta b_t^* - \Delta b_t^{*g}\right) = \left(\frac{\sigma_t i_{t-1}^*}{1+\pi_t}\right)\left(b_{t-1}^* - b_{t-1}^{*g}\right) + \sigma_t a_t^* + \Delta m_t^b - \Delta m_t - \left[k_t - \left(\frac{1-\delta}{1+\pi_t}\right)k_{t-1}\right] \quad (31b)$$

$$i_t^* = i_t - \left(\frac{e_t - e_{t-1}}{e_{t-1}}\right) - \tilde{e}_t \quad (32)$$

$$\sigma_t = \frac{e_t(1+\pi_t^*)}{(1+\pi_t)} \quad (33)$$

Macroeconomic shocks block:

$$g_t = \lambda_1 g_{t-1} + \lambda_2 x_{t-1}^g + \lambda_3 \sigma_t z_{t-1}^g + \varepsilon_t^g \quad (34)$$

$$\theta_t = \eta_1 \theta_{t-1} + \eta_2 g_{t-1} + \varepsilon_t^{\theta} \quad (35)$$

$$\tau_t = \alpha_1 \tau_{t-1} + \varepsilon_t^{\tau} \quad (36)$$

$$x_t^g = \alpha_2 x_{t-1}^g + \varepsilon_t^{x^g} \quad (37)$$

$$a_t^* = \alpha_3 a_{t-1}^* + \varepsilon_t^{a^*} \quad (38)$$

$$\pi_t^* = \alpha_4 \pi_{t-1}^* + \varepsilon_t^{\pi^*} \quad (39)$$

$$\tilde{e}_t = \alpha_5 \tilde{e}_{t-1} + \varepsilon_t^{\tilde{e}} \quad (40)$$

Appendix 2: steady state values

Variables	Steady state value
x (domestic good)	0.179250
z (foreign good)	0.242799
l (labour supply)	0.307941
m (domestic money balance)	0.936775
f (foreign currency holding)	1.155260
b (domestic borrowings)	-1.736120
b_w (foreign bond holdings)	1.718350
b_w_g (government bonds held by foreigners)	2.200690
k (capital stock)	0.865912
y (output)	0.540505
sigma (real exchange rate)	1.632160
pi (domestic inflation rate)	0.030000
R (real return on investment)	1.011120
m_b (monetary base)	7.989150
w (initial wealth)	3.833020
e (nominal exchange rate)	1.681130
i (nominal domestic interest rate)	0.053494
g (public investment)	0.201040
theta (money multiplier)	0.117271
tau (distortionary tax rate)	-0.000006
h (lump-sum tax)	-0.257385
x_g (government expenditure on domestic good)	-0.000007
z_g (government expenditure on foreign good)	-0.041066
a_w (official development assistance)	-0.000006
pi_w (foreign inflation rate)	0.000000
i_w (international nominal interest rate)	0.053494
e_r (risk premium)	0.000000
Model summary	
No. of variables	27
No. of stochastic shocks	7
No. of state variables	18
No. of jumpers	7
No. of static variables	4

Source: Author's Computations

Appendix 3: Policy and transition functions

Variables	Portfolio outflows	Portfolio inflows
Constant	1.718	2.201
m (-1)	-0.174	-0.173
f (-1)	-0.061	-0.062
b (-1)	-0.009	-0.009
b_w (-1)	0.879	-0.094
b_w_g(-1)	0.077	1.050
k (-1)	0.014	0.032
m_b (-1)	-0.038	-0.037
e (-1)	-0.071	-0.079
i (-1)	-0.316	-0.314
theta(-1)	-0.076	-0.076
x_g (-1)	-0.006	-0.015
z_g (-1)	-0.432	-0.426
a_w (-1)	-0.424	-1.271
pi_w (-1)	-0.138	-0.149
i_w (-1)	0.821	0.841
e_r (-1)	-0.103	-0.093
g (-1)	0.433	0.426
tau (-1)	-0.423	-0.415
ei_g (public investment shock)	0.588	0.580
ei_theta (money multiplier shock)	-0.191	-0.191
ei_tau (distortionary tax shock)	-0.497	-0.488
ei_x_g (public expenditure on	-0.525	-0.530
domestic good shock) ei_a_w (ODA shock)	-0.499	-1.495
ei_pi_w (global inflation shock)	-0.162	-0.176
ei_e_r (risk premium shock)	-0.122	-0.110

Source: Author's Computations

Appendix 4: Matrix of correlations

Variables	m	f	b	b_w	b_w_g	y	sigma	pi	e	i
x	0.819	-0.621	0.580	-0.447	-0.357	0.411	0.544	-0.225	0.537	-0.849
z	0.603	-0.496	0.485	-0.442	-0.402	0.471	0.062	-0.128	0.043	-0.877
l	-0.020	-0.026	0.007	-0.210	-0.204	0.723	-0.735	0.719	-0.641	0.175
m	1.000	-0.419	0.327	-0.356	-0.189	0.556	0.228	0.137	0.272	-0.646
f	-0.419	1.000	-0.909	0.952	0.875	-0.510	-0.558	-0.179	-0.632	0.748
b	0.327	-0.909	1.000	-0.850	-0.932	0.441	0.443	0.129	0.499	-0.648
b_w	-0.356	0.952	-0.850	1.000	0.923	-0.556	-0.384	-0.305	-0.472	0.657
b_w_g	-0.189	0.875	-0.932	0.923	1.000	-0.469	-0.287	-0.240	-0.355	0.543
k	0.681	-0.661	0.573	-0.673	-0.560	0.954	-0.075	0.508	0.023	-0.606
y	0.556	-0.510	0.441	-0.556	-0.469	1.000	-0.236	0.582	-0.135	-0.384
sigma	0.228	-0.558	0.443	-0.384	-0.287	-0.236	1.000	-0.421	0.983	-0.464
pi	0.137	-0.179	0.129	-0.305	-0.240	0.582	-0.421	1.000	-0.251	0.197
R	-0.414	0.349	-0.266	0.452	0.340	-0.708	0.302	-0.949	0.134	0.081
m_b	0.691	-0.593	0.512	-0.354	-0.233	0.248	0.717	-0.181	0.730	-0.696
w	0.149	-0.254	0.251	-0.035	-0.025	-0.469	0.913	-0.615	0.851	-0.298
e	0.272	-0.632	0.499	-0.472	-0.355	-0.135	0.983	-0.251	1.000	-0.457
i	-0.646	0.748	-0.648	0.657	0.543	-0.384	-0.464	0.197	-0.457	1.000
g	0.748	-0.689	0.613	-0.596	-0.488	0.832	0.252	0.280	0.325	-0.616
theta	0.678	-0.481	0.417	-0.496	-0.395	0.841	-0.024	0.523	0.080	-0.385
tau	-0.100	-0.103	0.059	-0.141	-0.112	0.033	-0.031	0.152	-0.003	-0.121
h	-0.548	0.665	-0.580	0.528	0.427	-0.165	-0.581	0.246	-0.572	0.876
x_g	-0.053	-0.083	0.068	-0.049	-0.038	0.034	0.029	-0.055	0.019	-0.070
z_g	-0.327	0.377	-0.371	0.241	0.229	0.187	-0.575	0.649	-0.485	0.766
a_w	-0.109	-0.152	0.208	-0.199	-0.255	-0.025	-0.019	0.204	0.021	-0.001
pi_w	-0.022	0.018	-0.016	0.015	0.014	-0.006	0.023	0.028	-0.014	0.028
i_w	-0.597	0.687	-0.571	0.570	0.444	-0.232	-0.573	0.338	-0.545	0.977
e_r	-0.488	0.522	-0.489	0.374	0.329	-0.024	-0.607	0.609	-0.526	0.879

Source: Author's Computations

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