UNIVERSITY OF GHANA

THE DYNAMICS OF PUBLIC DEBT, INFLATION AND EXCHANGE RATE IN GHANA: A VECTOR AUTOREGRESSIVE ANALYSIS

AMEYAW EMMANUEL

JULY, 2015

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BY

AMEYAW EMMANUEL

(10274730)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MPhil ECONOMICS DEGREE

JULY, 2015

DECLARATION

I, AMEYAW EMMANUEL, hereby declare that this thesis is the result of my own research and that no part of it has been submitted elsewhere for any degree. It contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Candidate's Signature: ..... Date: .....

SUPERVISOR`S CERTIFICATION

This project has been read and approved as meeting the requirements of the school of Graduate studies, University of Ghana.

Dr Alfred Barimah

Supervisor's signature: ..... Date: .....

Dr William Bekoe

Supervisor's signature: ..... Date: .....

ABSTRACT

The rising trend in Ghana's public debt has sparked some controversies about the relationship and the direction of causality between the public debt and two of its determinants — inflation and the exchange rate. While some argue that public debt affects the exchange rate and inflation, others are of the view that inflation and exchange rate rather affect the public debt.

This study therefore investigates the relationship and the direction of causality between the public debt, inflation and the exchange rate in Ghana. We employ the vector auto-regressive technique to empirically investigate these relationships for the period 1990-2013, both in the short run and the long run. The dynamic interactions are studied with Granger causality tests, impulse response functions, and forecast error variance decompositions.

Using the Johansen approach, the empirical results found a long-run relationship running from inflation and exchange rate to the public debt ratio with no feedback from the public debt to inflation and the exchange rate in the long run. In the short-run, while the study found a negative significant relationship between inflation and the public debt, no strong relationship was found to exist between the public debt and exchange rate in the short run. One channel of unidirectional causality was found in the short run, actively running from inflation to public debt. All the impulse response functions of shocks to the variables were found to be permanent over time which was reinforced by the level effects (estimated using cumulative impulse response functions). The diagnostic test confirmed the validity of the model and CUSUM and CUSUMSQ test revealed the stability of the model. The results from the study imply that policy makers should choose inflation over exchange rate as a policy variable to reduce the public debt in the short-run. Moreover, a higher and rising public debt has no exchange rate risk or inflation risk in the case of Ghana, and hence the government can still borrow in the short run with no negative impact on inflation and exchange.

DEDICATION

This thesis is dedicated to my entire family.

ACKNOWEDGEMENTS

My profound gratitude goes to my supervisors, Dr Alfred Barimah and Dr William Bekoe for their immense contribution to the success of this thesis.

TABLE OF CONTENTS

LISTS OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

AD Aggregate Demand

ADF Augmented Dickey-Fuller

AFRODAD African Forum and Network on Debt and Development

AIC Akaike Information Criterion

AS Aggregate Supply

CEPA Centre for Policy Analysis

CUSUM Cumulative Sum

CUSUMSQ Cumulative Sum of Square

DF Dickey-Fuller

DMP Debt Management Program

DSA Debt Sustainability Analysis

ECOMOG Economic Community of West African States Monitoring Group

FEVD Forecast Error Variance Decompositions

FPE Final Prediction Error

FTPL Fiscal Theory of the Price Level

GDP Gross Domestic Product

HIPC Higher Indebted Poor Countries

HQIC Hannan-Quinn information criterion

IMF International Monetary Fund

IRF Impulse Response Function

LR Sequential Likelihood-ratio

MDRI Multilateral Debt Relief Initiative

NBFI Non-Bank Financial Institutions

OECD Organization for Economic Cooperation and Development

OLS Ordinary Least Square

PWC Price Waterhouse Coopers

SBIC Bayesian Information Criterion

SUR Seemingly Unrelated Regression

VAR Vector Autoregressive

VECM Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Recently in Ghana, one of the most controversial economic issues has been the public debt, as in most emerging and developing economies since the onset of the 2008-09 global financial and economic crises. At least from reading the newspapers, one would think that the economy suffers greatly when the public debt increases. Both the politicians and policy analysts alike have been at each other's throat on this issue in recent times, especially on what is causing the increase in the public debt and also the effects it might have on the economy.

Specifically, there have been debates in recent times as to whether the fast depreciation of the cedi has a role to play in the recent increasing trend of Ghana's public debt. Some economists believe that exchange rate depreciation increases the debt-to-GDP ratio (see Tahir & Tahir, 2012; Mahmood, Rauf & Rehman, 2009; Melecky & Melecky, 2011). On the other hand, some analysts, however, argue that public debt rather affects the exchange rate (see Elwell, 2012; Pastore, Pinotti & Almeida, 2004; Schonerwald da Silva & Vernengo, 2007) and hence the government needs to reduce its debt (especially external debt) in order to halt the fast depreciation of the cedi. Thus, the debate rages on, about the direction of causality between the exchange rate and the public debt.

The other controversy has been the relationship and the direction of causality between inflation and the public debt. Some believe that higher public debt often results in a higher inflation (see Mupunga & Le Roux, 2014; Sargent & Wallace's, 1981; Kwon, McFarlane & Robinson, 2006; Sill, 2005; Cochrane, 2011; Melike & Omer, 2007; Castro, Resende & Ruge-Murcia, 2003; Ahmad, Sheikh & Tariq, 2012), while on the other hand, most

economists believe that inflation can be used to erode or reduce the public debt as postulated by the debt dynamics theory (see Esposito, Paradiso & Rao, 2011; Cherif & Hasanov, 2012; Hall & Sargent, 2010; Aizenman & Marion, 2011). According to Ley (2010), some key variables in the debt dynamics are either endogenous variables, uncertain, or both. Though higher public debt, exchange rate depreciation and inflation quite often occur simultaneously, the linkages between these variables are not well understood especially in the case of Ghana, and hence it is very important to empirically examine the linkages between these three key macroeconomic indicators in order to help resolve these unresolved controversies.

These debates and controversies about the public debt is due to the fact that Ghana has reached the critical 60% mark according to the 2015 budget statement, an IMF and World Bank benchmark for classifying a country's debt stock as dangerously high, and the consequences thereof. Moreover, it is important to note that Ghana's general threshold of public debt is set at 75 percent while a more stringent threshold is set at 60 percent. According to some experts, this is a frightening rate of accumulation of debt by any standard, and that this debt trend might be unsustainable in the near future. It is not surprising that the World Economic Outlook of the IMF projects Ghana's public debt to reach as high as 71.055% of GDP by 2016 (World Economic Outlook Database, 2014). Others even project the growth rate of Ghana's debt to return to pre-HIPC completion point again by 2016.

Figure 1.1 below shows the recent trend in the public debt, inflation and the cedi - dollar exchange rate after the HIPC and MDRI initiatives, from 2006 to 2013. While both the public debt and the exchange rate have generally shown an increasing trend with minor fluctuations, inflation had decreased constantly from 2009 to 2011. However, inflation began to increase again in 2012 (World Economic Outlook Database, 2014).

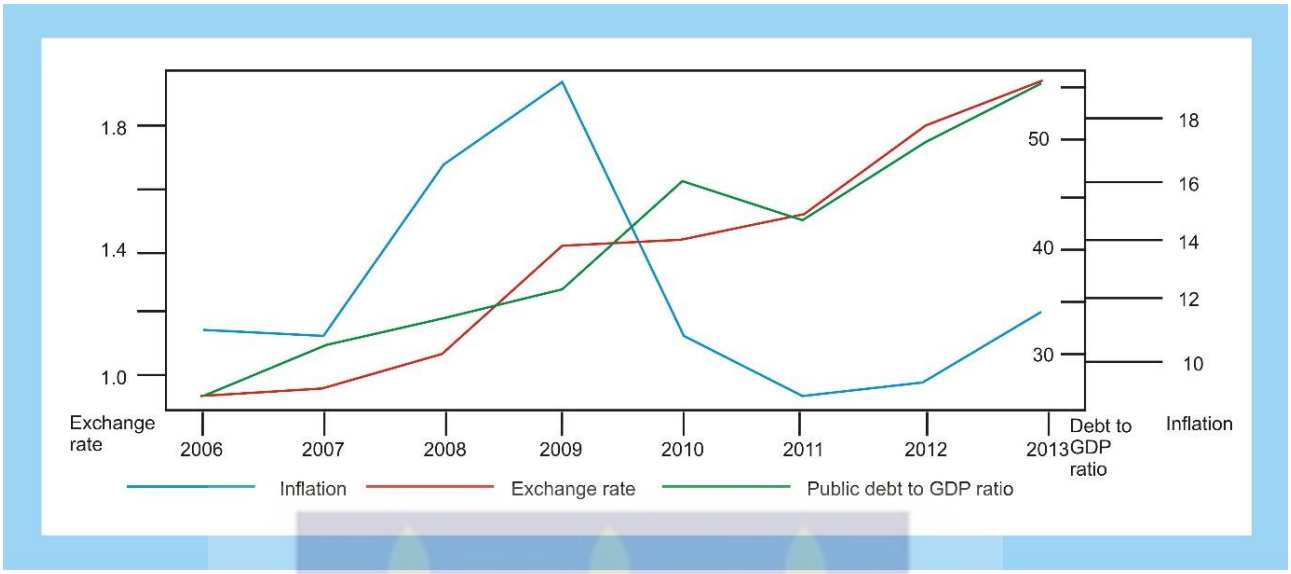

Figure 1.1 — Gross government debt to GDP ratio, the level of inflation and the level of the Cedi - Dollar exchange rate in Ghana, from 2006 to 2013

(Source: Author's construct using data from the World Bank and the IMF)

A few years after the HIPC and MDRI initiatives (which had helped Ghana to reduce its public debt to sustainable levels (21.6% in 2006)), official debt ratios have continued to edge higher, reaching 52% in October 2013, a significant increase from 49.3% in 2012 (PWC Budget highlights, 2013). As at the end of September 2014, the debt stock had reached 60.8 percent. The provisional public debt stock as at the end of September 2014 stood at GH¢69,705.90 million (US$21,733.51 million). This was made up of GH¢40,644.15 million (US$12,678.62 million) and GH¢29,041.75 million (US$9,054.89 million) for external and domestic debt respectively (Budget Statement, 2015).It is not surprising that concerns about the public debt now dominate policy debates in Ghana.

These concerns are being raised because aside inflation and the exchange rate, a rising public debt has fiscal, monetary and other consequences on an economy. According to Nautet & Meensel (2011), high and rising public debt levels pose solvency risk which increases the risk premium on public debt and hence makes it more expensive for countries to borrow and service their debts (Gill and Pinto, 2005). The risk premium which increases the interest rate

and interest payments on government borrowings then leaves little room for the government to see to its fiscal and social responsibilities as seen in these days, especially for developing countries.

On the domestic front, the consequences of such a huge and growing domestic debt are that, first, a sizable portion of government revenue will be channelled to servicing the debt; and second, the likely increase in interest rates will lead to high cost of borrowing by the private sector which will crowd-out private sector investment (AFRODAD, 2011). Also, investor confidence in the country could be dampened by the deteriorating debt-GDP ratio as increased borrowing may further deter international investment and hinder private sector growth (PWC Budget highlights, 2013).

Also, on the external front, an increasing trend of the external debt stock has the implication of not only exacerbating balance of payments problems, but also increase the interest payments on external debt which in turn worsens the fiscal deficit problem, vis-à-vis the public debt through interest payments (Alagidede et al., 2013). This means the possibility for sustained long-term growth could remain slim since important export revenue goes to pay off foreign debt at the expense of capital reinvestment (Meng, 2004). Osei (1995) shares the same view and argues that debt repayment inevitably imposes constraints on a debtor country's growth prospects since it involves the transfer of resources to other countries. Thus, such huge levels of deficits, vis-à-vis public debt not only threaten growth through spending cuts and austerity measures but also impose a drag on the economy through attempts to reduce them (Alagidede et al., 2013).

Though a few studies have been done in this area in the case of Ghana (see, for example, Ansah, 2010), empirical research particularly involving the analysis of inflation, exchange rate and debt dynamics is still much limited. Most economists and researchers in Ghana have

focused on other macroeconomics factors such as the interest rate, the budget deficit and economic growth in their study of the dynamics of the public debt. Also, much of the focus has been on either the external debt or the domestic debt with little empirical studies on the total public debt, which includes both the domestic debt and the external debt (see, for example, Frimpong & Oteng-Abayie, 2006; Sowa, 2002; AFRODAD, 2011).

The purpose of this study is therefore to examine the dynamics of public debt in the context of inflation and exchange rate, and hence help in the resolution of the controversies surrounding the linkages between these macroeconomic indicators in Ghana. To achieve this broad objective, we employ VAR for the period 1990 to 2013, using data from the World Economic Outlook database (2014) and the World Bank database (2014).

1.2 Problem statement

As Ghana moves towards middle-income status, the proportion of concessional aid in external finance will decline and so Ghana has to become more reliant on non-concessional borrowing to meet its external financing needs (Mensah et al., 2014). Also, domestic debt is likely to increase and hence there is the need to critically examine the dynamics of the public debt—its causes and consequences. Although the causes and consequences of a higher and rising public debt are many, this thesis will focus just on inflation and the exchange rate. The reason being that, while most economists in Ghana have often given warnings about interest rate, budget deficit and economic growth in their analysis of the public debt, they have at the same time almost neglected inflation and the exchange rate in Ghana where output disruptions and excess demand pressures from the foreign exchange market have significant feedback effects on the debt stock and its evolution.

This neglect is clearly seen in the fact that the primary focus for most governments in Ghana in managing the public debt has been on using fiscal policy measures (government expenditure and taxes) since it is believed that budget deficit is one of the main contributors to growth in the public debt. This has led to the relegation of some crucial factors such as inflation and exchange rate by most academic and practitioner researchers in their studies on public debt management and dynamics in Ghana. The debt management programme (DMP) developed by the government, as expressed in the 2014 budget statement failed to consider these factors. All the strategies outlined in the 2014 budget statement to manage the debt were fiscal policy measures, to the neglect that there could be monetary consequences as a result of a higher and rising public debt.

However, these two macroeconomic indicators can have a strong relationship with the public debt, that is, they could be a cause or effect of a higher public debt. For example, according to the 2015 Budget Statement of Ghana, the rapid depreciation of the cedi in 2014 contributed largely to the increase in the public debt which stood at 60.8% as at the end of September 2014. Also in 2012, according to the Bank of Ghana Monetary Policy Report (2012), variations in the exchange rate contributed US$16.8 million to the total debt, alongside other factors such as loan disbursements, amortisation and valuation changes totalling US$1,268.8 million. This was due to the fact that, external debt accounted for 49.8% of the total debt and therefore variations in the exchange rate had a huge impact on the external debt, vis-à-vis the public debt. Ncube & Brixiová (2013) made similar observations that the weakening of the cedi played a role in Ghana's debt accumulation in 2012.

Similarly in 2007, Ackah, Aryeetey & Aryeetey (2009) claim that the exchange rate and the sudden withdrawal of foreign capital from the economy did not augur well for Ghana's public debt (which reached $7411.7 million in 2007), as a result of the substantial foreign currency-denominated debts. Furthermore, according to the 2009 debt sustainability analysis (DSA),

the deterioration trend in the debt position was amplified by the resulting balance of payments pressures and currency depreciation. However, from mid-2009, the cedi exchange rate strengthened against the US dollar, ending the year at a more appreciated level than anticipated. This exchange rate outcome reduced the public debt-to-GDP ratio by more than 4 percentage points of GDP relative to the 2009 DSA projection (CEPA, 2012).

On the relationship between the public debt and the exchange rate, it has been established that high public debt can also cause the exchange rate to increase (currency depreciation). The rise in public debt can increase the perception about the probability of a default and country risks, even if that perception is ultimately incorrect. An increase in default and country risks may then lead to a significant outflow of foreign currency and as a result to a large devaluation or depreciation of the exchange rate (Schonerwald da Silva, Vernengo & Matías, 2007). This indicates that the relationship between exchange rate and the public debt is intermediate.

Similarly, the relationship between public debt and inflation is also an intermediate one. In the first quarter of 2014, Fitch, an international rating agency, reported that the Bank of Ghana was printing money to finance the government's budget deficit, threatening to fuel inflation (www.ghanaiantimes.com.gh). This somewhat indicated the difficulty of the government to borrow either domestically or from external sources due to its high and rising public debt and hence it has to resort to monetizing its debt. In the 1980's, the substantial accumulation of public debt led the government to finance most of its deficits through money printing which caused a sharp rise in money supply, resulting in a high rate of inflation. In 2014, an analysis by B&FT revealed that the Bank of Ghana financed 70 percent of the government's budget deficit, an increase from 38 percent in the first half of 2013 (www.myjoyonline.com). Notwithstanding this, inflation can also actually be used to erode the public debt over time (Sowa, 2002).

With the current 'fast' depreciation of the cedi, coupled with the increasing trend in inflation rates, this thesis analyses the dynamics of Ghana's public debt, in the context of high inflation and a fast depreciating cedi, making use of the vector autoregressive (VAR) technique.

1.3 Objectives of study

With the current fast depreciation of the Ghana cedi and the recent increasing trend in inflation and the public debt, it would be interesting to know the relationship between public debt, inflation and the exchange rate in the country. Thus, if high public debt is accompanied by soaring or decreasing inflation and exchange rate depreciation, what is the exact relationship between these variables in Ghana? This study is motivated by these further questions. Do the inflation level and the exchange rate tell us something about the growth of public debt in Ghana, and vice versa? Is high inflation inevitable now that Ghana's debt is growing so big? Can the recent increase in inflation be able to reduce Ghana's public debt? With the current depreciating trend of the cedi, does it mean the government cannot reduce the public debt? Does it mean the exchange rate will depreciate further now that the public debt is growing so big?

In light of these questions, the primary objective of the paper is to develop a VAR model to examine whether exchange rate and inflation significantly affect public debt in Ghana, since the volatility in these three macroeconomic indicators can significantly alter the growth prospects of Ghana both in the short and long run. Thus, the paper examines the relationships and the causal linkages between these three macroeconomic variables in Ghana both in short and long run. The rationale behind the VAR approach used in this study is due to the possibility of a feedback effect from public debt to both inflation and exchange rate. Thus,

while most studies consider just one equation in the VAR model (see, for example, Melecky & Melecky, 2011; Kwon, McFarlane & Robinson, 2006; Cherif & Hasanov, 2012), this study examines all equations in the VAR model.

Furthermore, though public debt dynamics involves decomposing public debt accumulation into the various macroeconomic components, the empirical strategy followed in this paper uses just three of these macroeconomic components and hence uses specifically a three-variable VAR model. Impulse reaction function will be estimated to trace the effect of a shock or innovation in inflation or exchange rate on the public debt if a relationship exists between these variables. The error correction model will also be estimated to ascertain the short and long run effects of changes in inflation and exchange rate on the public debt, and vice versa.

In short, the objectives of this thesis are to trace, estimate and analyse the relationship between public debt, inflation and exchange rate in Ghana.

1.4 Hypotheses of the study

This study aims at examining the dynamic linkages between public debt, inflation and the exchange rate in Ghana. The study, therefore, seeks to test the following null hypotheses.

- There is no relationship between public debt and exchange rate in Ghana.
- There is no relationship between public debt and the inflation rate in Ghana.
- There is no causal linkage between public debt and exchange rate in Ghana.
- There is no causal linkage between public debt and the inflation rate in Ghana.

1.5 Significance of study

Over the years, Ghana has had problems in managing its public debt, and, therefore there is the need to understand the relevant policy variables needed to address this problem. Choosing the optimal tools to reduce the public debt is the main challenge confronting policymakers and hence it is important to understand the underlying interrelationships between exchange rate, inflation and the public debt in the case of Ghana, which is useful from public policy and debt management point of view.

A study by the World Bank (2005) found that fiscal policy response is found to weaken as public debt ratio rises and especially for public debt ratios above 50%, i.e., fiscal policy does not respond to high public debt. This assertion is supported by the IMF World Economic Outlook (2003) that fiscal policy as a countercyclical tool is less effective in countries with high public debt. This means that other factors aside fiscal policy should be equally given due attention in order to reduce the public debt, which is of key importance for assessing a country's macroeconomic environment and private investment climate.

This study is again intended to contribute to the growing body of research on Ghana's public debt management and also provide some guidance for public debt management by making some recommendations concerning the impact exchange rate and inflation dynamics have on the public-debt in Ghana. The causality of a rising public debt on inflation and exchange rate in the case of Ghana is also examined which is very crucial for the choice of policy variables in dealing with both inflation and exchange rate in Ghana. Lastly, it offers a good basis for further research on Ghana's public debt and its determinants.

1.6 Organization of study

The study will be divided into six chapters. After this introductory chapter, Chapter two explores the theoretical literature and empirical evidence surrounding the relationships among the public debt, inflation and the exchange rate. Chapter three contains the overview of public debt, inflation and exchange rate in Ghana. The methodology to be employed in the study, empirical model specification, the theoretical background of the model and the empirical analysis of the adopted tests will be presented in Chapter four. Chapter five will give a presentation of the results of the study while chapter six gives the general summary of the study, major findings, policy recommendations of the study, and a conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical frameworks that have been used to analyse the linkages among the public debt, inflation and the exchange rate. On the theoretical front, the public debt literature is generally separated into two broad categories. Under the first category, public debt affects inflation and exchange rate through the inflation dynamics theories and the exchange rate dynamics theories respectively. For the second, inflation and exchange rate affect the public debt through the debt dynamics theories. In this chapter, first, the debt dynamics theory is presented, followed by a theory of inflation dynamics where public debt leads to higher inflation. Some theories on inflation are also presented. Third, a theory of how public debt affects the exchange rate is discussed, together with a theory of exchange rate determination and finally, some related empirical studies are presented. Lastly, a summary of this chapter is presented.

2.2 Inflation and exchange rate effects on the public debt

In this section, the debt dynamics theory is used to explain the relationship between the public-debt-ratio and each of the two macroeconomic indicators (i.e., inflation and exchange rate). It is also good to note here that a modern version of the debt dynamics theory (which includes the exchange rate) is being discussed in the following sub-section.

2.2.1 The debt dynamics theory

The debt dynamics theory basically decomposes the contribution of drivers of public debt accumulation into the various macroeconomic components such as the nominal interest rate, inflation, the exchange rate, the primary balance, GDP growth, etc. (see Mupunga & Le Roux, 2014; World Bank, 2005). This theory is important for accessing a country's macroeconomic environment and private investment climate. According to the World Bank, if macroeconomic projections result in debt dynamics that lead to a rapidly increasing public debt-to-GDP ratio, then this is evidence that the present mix of fiscal and monetary policies needs to be corrected to ensure solvency (World Bank, 2005).

According a version of this model developed by Nicolescu & Mota (2012), a guarantee of debt reduction and solvency would require that the inflation rate rises whiles the exchange rate appreciates (see also Esposito, Paradiso & Rao, 2011; Martinez & Vergara, 2009). In other words, inflation and exchange rate could change the public debt even without the government contracting any new debt (Mupunga & Le Roux, 2014). The debt dynamics model also posits that increase in the growth rate, a reduction in primary deficits and a decrease in the interest rate will also reduce the public-debt ratio, however, this thesis does not consider these factors.

It is being argued that the inclusion of the exchange rate makes the model a bit complicated as it needs to reflect the effects of both domestic and external debt. Notwithstanding this, economists like Genberg & Sulstarova (2004) still maintain that it is very important to explicitly include it in the analysis when the public debt comprise of a large external debt. In such cases, changes in the exchange rate may be accompanied by a huge capital loss or capital gain on the real net external debt (World Bank, 2005). Moreover, Eichengreen, Hausmann & Panizza (2007) also posit that, sometimes, foreign investors may be more

reluctant to lend to a country in its own currency, which would make it almost impossible for the borrowing country to avoid the impact of exchange rate changes on the public debt. These arguments then make the inclusion of the exchange rate unavoidable.

2.2.1.1 The effect of inflation on the public debt

The effect of inflation on public debt is somewhat obvious, stemming from the fact that high inflation can reduce the real cost of servicing the debt or the real value of outstanding liabilities (see Reinhart & Rogoff, 2010; Niemann, Pichler & Sorger, 2010; Aizenman & Marion, 2009). That is, though the nominal value of the debt remains unchanged, higher inflation makes it easier for the government to pay its debt in money that is worth less. This interplay then diminishes the debt-to-GDP ratio (Lascelles, 2013). In the literature, such interplay is normally referred to as "inflating away the public debt" or "eroding the real value of the public debt" (see for example, Akitoby, Komatsuzaki & Binder, 2014). It is been argued by most economists that inflation needs to be unanticipated for inflation to reduce the public debt (see, for example, Sowa, 2002). However, other economists such as Reinhart & Sbrancia (2011) are of the view that inflation needs not take market participants entirely by surprise and in effect, it needs not to be very high in order for inflation to reduce the public debt.

Now, we have seen that higher inflation can reduce the public debt, it is important to mention also that this can sometimes be a deliberate action by a government. But why would any government want to reduce its public debt through inflation? According to Herz & Tong (2004), for most governments, inflation becomes a necessary tool to reduce the public debt if speculators anticipate depreciation or a devaluation of the exchange rate. This risk of devaluation or depreciation will make investors demand higher interest rates as compensation

from the government. The increase in debt service as a result of a higher interest rate may then lead the government to reduce its public debt through inflation. Sargent & Wallace (1981) shares the same idea and adds that inflation or seigniorage revenue may sometimes be the only way to avoid a costly default and/or adjustments, especially during a debt crisis. This, therefore, makes inflation one of the important variables in the dynamics equation for most governments.

Secondly, inflation becomes a necessary tool to reduce or erode the public debt if fiscal adjustment is postponed by the government (World Bank, 2005). That is, if there are political constraints to fiscal adjustment, the risk arises that inflation will then be the residual tax, meeting the budget constraint through inflationary erosion of the public debt. For instance, if fiscal policy does not ensure debt sustainability by generating sufficient primary surpluses due to political constraints, Akitoby, Komatsuzaki & Binder (2014) argues that inflation is usually raised through monetary policy to help reduce the public debt.

Reducing the public debt through inflation is being used by both developed and developing countries alike. For example, Abbas, Belhocine, El-Ganainy & Horton (2011) mention that inflation contributed significantly to the huge decline of the average debt ratio (to 50 percent by the 1960s) of the advanced G20 economies in the 1960s. Developing countries alike such as Zimbabwe has also used this tool especially in periods of unsustainable public debts to reduce the public debt (see for example Mupunga & Le Roux, 2014).

Though higher inflation may reduce the public debt ratio, the extent of this effect may vary across countries, depending on a number of factors. One of these factors is that the tax base of the country should be much larger. A bigger tax base would lead to bigger seigniorage revenue in times of inflation which can be used to reduce the debt. In this view, the impact of inflation on public debt is more likely to be great in developing countries (which often have a

bigger tax base) than in developed countries (World Bank, 2005). Moreover, the World Bank in their paper further adds that seigniorage revenue could also be substantial in fast-growing economies and economies experiencing sizeable remonetisation than in slow-growing economies.

Also, Reinhart & Sbrancia (2011) argue that inflation is most effective in reducing the public debt when interest rates are not able to respond to the rise in inflation. Guillemette & Strasky (2013) shares a common view with their argument that the implicit average interest rate paid on all outstanding debt rises more slowly than market rates, and more slowly than inflation which allows the implicit average real interest rate paid on government liabilities to go down, slowly eroding the debt ratio. Reinhart & Sbrancia (2011) further continues with their argument that this can occur if: (i) interest rates are either administered or predetermined; (ii) all government debts have fixed rates and long-term maturities and the government moreover has no new financing needs (in order to avoid a rise in the interest rate that would otherwise prevail if short-term maturity debts needed to be rolled over); and (iii) all (or nearly all) debt is liquidated in one "surprise" inflation spike.

The efficacy of the inflation channel is also quite sensitive to the maturity structure of the government debt or bond as argued by Reinhart & Rogoff (2010). Thus, the inflation channel of reducing the public debt will be very weak or almost ineffective if most of the debts issued by the government are short term debts. Akitoby, Komatsuzaki & Binder (2014) argue that short-term debt will need to be refinanced at higher interest rates, which will erode the inflation effect on the public debt. Moreover, higher interest rate on short-term debts is likely to affect other floating rate debts which will also adjust automatically to higher rates and therefore weakening the impact of inflation in reducing the public debt (see also Aizenman & Marion, 2009).

So far, we have seen that the impact of inflation on the public debt may vary across countries depending on certain factors. Notwithstanding this, some economists still believe that even within a particular country, the extent of the effect of inflation on the public debt could be overestimated. Guillemette & Strasky (2013) for example argues that while in reality higher inflation would increase tax receipts (through seigniorage revenue) which would help to reduce the public debt, it would also increase nominal government spending which will partially nullify the inflation effect on the public debt. They further argue that the primary balance will even tend to deteriorate in the event that government spending becomes higher than the seigniorage revenue. This will not just nullify the inflation effect but will cause the public debt to increase (Akitoby, Komatsuzaki & Binder, 2014).

Using inflation to reduce the public debt may be an ideal solution to reduce the debt, however, a deliberate inflation has been criticised by some economists on the grounds that reliance on inflation to erode debt could lead to fiscal dominance with inflation rates drifting even higher as confidence in the future value of money is lost. As a result, inflation expectations could be un-anchored, making it difficult to control inflation (Akitoby, Komatsuzaki & Binder, 2014; Sowa, 2002). Akitoby, Komatsuzaki & Binder (2014) further argues that it may be sometimes difficult to even create higher inflation in some cases, as evidenced by Japan's experience in the last few decades and hence this cannot be a way to reduce the public debt. It is also argued by Cherif & Hasanov (2012) that allowing for a higher inflation target, even temporarily, would require a radical change in monetary policy which can spiral out of control. Kak (2014) also adds to this view that high inflation can have negative repercussions on consumer purchasing power and the currency, and hence using the inflation channel is unlikely to sustainably lower public debt over the long term.

2.2.1.2 The effect of exchange rate on the public debt

The impact or effect of exchange rate on the public debt is also somewhat straightforward as exchange rate depreciation increases the value of the public debt in local currency (Cain et al., 2012). According to Dreher, Herz & Karb (2006), a nominal decrease in the value of a currency would drastically increase costs of carrying the debt and may even cause a debt crisis if the government cannot immediately offset the higher debt level by higher tax revenues. As we have said before, the exchange rate effect is through the external debt, particularly in cases when the external debt is a large component of the total public debt (Mupunga & Le Roux, 2014; Moussa, 2012).

When the external debt is large, there is an increase in risk related to exchange rate fluctuations which could lead to unsustainable debt levels in the event of a currency depreciation or devaluation (Berti & Carone, 2014; Rehman, Adil & Anis, 2012). The converse is also true as Schonerwald da Silva & Vernengo (2007) suggest that, under certain conditions, exchange rate appreciation may lead to a reduction of the public debt. This makes the exchange rate a vital variable in the dynamics of the public debt, especially in countries with an open economy (Schonerwald da Silva & Vernengo, 2007).

According to Ley (2010), exchange-rate movements have three immediate effects on the public debt: (i) they affect the domestic cost of servicing interest of foreign-denominated debt, (ii) they affect the value in domestic currency of the foreign-denominated debt itself, and (iii) they also affect the value of GDP in domestic currency through changes in prices in the tradable sector and hence the debt/GDP ratio. The effect of a higher exchange rate through the tradable sector, however, reduces the public debt instead of increasing it. A depreciation of the exchange rate will increase exports and decrease imports, as exports become cheaper and imports, on the other hand, becomes expensive. This interplay will boost

GDP which will translate to a lower debt/GDP ratio. However, Ley (2010) continues that the tradable sector must be larger than the non-tradable sector in order for this effect to be strong. Hence, in the extreme case where the tradable sector is negligible, exchange rate depreciation will have maximum effects on public debt.

An example of this 'exchange rate channel' is provided by Cain et al. (2012), where the appreciation of the US dollar (against other currencies) added to the burden of repaying US dollar loans given the fact that many countries had their external debt denominated in US dollars. Also, according to Moussa (2012), countries that abandon their fixed exchange rate regime for a flexible exchange rate regime also often experience an increase in their debt-to-GDP ratios as the exchange rate becomes volatile. Thus, under a fixed exchange rate regime, the value of foreign currency denominated debt does not change when measured in the domestic currency. However, under a flexible exchange rate regime, the added volatility from the nominal exchange rate increases the external debt and hence the debt-to-GDP ratio.

Exchange rate volatility has been one of the problems that many emerging and developing countries have faced in both past and recent years. According to Abbas et al. (2011), these countries have high debt/GDP ratios because of the presence of 'original sin' and hence suffers greatly from exchange rate volatility (see also Eichengreen & Hausmann, 2005; Jeanne, 2005). According to Cain et al. (2012), countries in such a situation (i.e., when a country's debt is denominated in a major foreign currency) is in a 'lose-lose' situation since no exchange rate system can prevent an economic disaster in the event of an unfavourable external shock.

This so-called 'original sin' is often committed by emerging markets and developing countries that are usually not able to borrow from the international capital markets in their own currencies. As developing countries typically accumulate net external debt positions and

as their few financial assets are usually at least partly denominated in local currency, the public debt will increase greatly if the exchange rate depreciates (Dreher, Herz & Karb, 2006). However, because of the absence of 'original sin', most European countries do not suffer from exchange rate volatility which increases the public debt (Abbas et al., 2011).

Notwithstanding the negative effect of a currency depreciation on public debt as discussed above, Melecky & Melecky (2011) warn that one needs to recognize that the exchange rate also has both a positive income effect and a negative balance sheet effect on the public debt and hence on the debt-to-GDP ratio. As currency depreciation increases the debt-to-GDP ratio through the local currency value of the foreign currency debt and its associated debt service charges, at the same time though, exchange rate depreciation increases the price competitiveness of the domestic economy, and helps boost net exports, government revenues and GDP which then lowers the debt/GDP ratio. If the latter effect is stronger than the former, then exchange rate depreciation will reduce the debt-to-GDP ratio instead of increasing it.

2.3 Public debt effects on inflation and exchange rate

In this section, some theories are presented to explain the causal relationship running from the public debt to inflation and the exchange rate

2.3.1 The effect of public debt on inflation

According to the available literature, there are two main ways or channels through which public debt affects inflation—the 'monetization effect' channel and the 'wealth effect' channel. Kwon, McFarlane & Robinson (2006) for example postulate that the establishment

of a positive significant relationship between public debt and prices does not necessarily answer whether the link is from the monetization of the debt or the wealth effects. It should be noted here that these channels generate a positive relationship between inflation and the public debt which is in contrast to the negative relationship discussed under the debt dynamics theory. These two main channels are discussed below in turn, beginning with the monetisation effect channel, and followed by the wealth effect channel.

2.3.1.1 The Monetisation channel

According to Niemann, Pichler & Sorger (2010), a rise in the public debt increases the inflation level and this is usually through the domestic debt when it is backed with money (see also Castro, Resende, Ruge-Murcia, 2003). Reinhart & Rogoff (2010) adds to this assertion that in fact, domestic debt is often much larger than the monetary base in the run-up to high inflation episodes, indicating that higher public debt contributes to higher inflation.

This risk of inflation, however, may depend on a number of factors as postulated by Nautet & Meensel (2011). One of such factors is the activeness of fiscal policy (specifically, the response of taxes to debt). Bhattarai, Lee & Park (2012) states that a weaker response of taxes to debt will magnify the increase in inflation as the public debt rises. Ahmad, Tariq & Sheikh (2012) shares this view with their argument that, if the government fails to collect enough revenues through taxes or non-tax sources, current revenues cannot service the debt which will lead to inflationary issuing of money by the government to finance the debt.

In the case where the public debt is monetized by the government, the government usually issues debts which are mandatorily bought by the central bank. The money which the government thus receives from the central bank is used to finance the budget deficit which substantially expands money supply as a result. The increase in money supply then generates

inflationary pressures which may even lead to hyperinflation (see also, Ahmad, Sheikh & Tariq, 2012).

This incentive to monetise the debt, however, depends strongly on the level of the debt as predicted by Sargent and Wallace's (1981) in their paper, "some unpleasant monetarist arithmetic". They argue that an increase in public debt is typically inflationary in countries with large public debts and non-inflationary in countries with smaller public debts. Nevertheless, Niemann, Pichler & Sorger (2010) posit that inflation is generally increasing in the level of debt, irrespective of the size. According to Tahir & Tahir (2012), one of the reasons why the government would monetize its debt is that any increase in government debt moves the demand for loanable funds upwards, which tends to push up interest rates. To keep interest rates unchanged, the government must then "monetize" the debt by expanding the money supply, usually through printing money to buy government debt from the public.

From the discussion above, we can see that the central bank plays a significant role in this process. However, Ahmad, Sheikh & Tariq (2012) posit that even if the government borrows from non-bank financial institutions (NBFIs) instead of the central bank, the result could still be inflationary. That is, if these NBFIs invest hugely by purchasing government securities and then face a shortage of liquidity, they will have no option but to turn to the central bank for help. So, in this case, the central bank then again indirectly provides the link between government borrowing and inflation.

To reduce the monetization of the public debt, Kwon, McFarlane & Robinson (2006) suggests that the central Bank needs to be independent. According to Nuatet & Meensel (2011), this has helped to prevent higher inflation in the European Union. Also Kwon, McFarlane & Robinson (2006) and Nuatet & Meensel (2011), shares a common view that fiscal policy rules could limit the size of the public debt and hence help in safeguarding price

stability. The European Union is one example where the law prohibits monetary financing of the public debt or the budget deficit.

Aside the direct transmission channels already described, it is also believed by many that a greater likelihood of monetisation of the debt could increase inflation expectations, and hence also current inflation — without the actual monetisation even taking place (see for example Nuatet & Meensel, 2011). According to Cochrane (2011), such inflation expectations are formed if people are convinced that the government will print money to cover its intractable debt. Hence, holders of government debt who would normally buy a new debt will instead buy real assets (like commodities). But there are only a few of these real assets around, which then generate inflation.

Lastly, another obvious and mere reason stems from the fact that, as public debt increases, the government may be tempted to reduce it by generating inflation (Nautet & Meensel, 2011). According to Sill (2005), this is often the case when fiscal policy does not adjust to the increasing debt, and hence seigniorage revenue must rise to match the increase in the value of the public debt outstanding. Such an attempt to increase seigniorage revenue will then generate inflation. Moreover, this effect of the public debt on inflation will also be so strong if most of the debts issued by the government are short-term debts, since the government then would have to inflate more aggressively (Reinhart & Rogoff, 2010).

It should be realized that this channel rather generates a positive relationship between public debt and inflation, which is different from the one discussed under the debt dynamics theory (where inflation negatively affected the public-debt ratio).

2.3.1.2 The Wealth effect channel

The Fiscal Theory of the Price Level (FTPL) identifies the wealth effect of government debt as an additional channel of fiscal influence on inflation (Kwon, McFarlane & Robinson, 2006). This theory posits that a higher level of public debt leads to an increase in inflation through a higher wealth effect on households who hold government debt. That is, as the government roll over its debt, bond holders would try to spend down their wealth, which then would force up the price level (see Sims, 2013; Bhattarai, Lee & Park, 2012; Kwon, McFarlane & Robinson, 2006). Bhattarai, Lee & Park (2012) further explain that households usually perceive increases in government debt as increasing their wealth if it is not matched by tax increases.

The wealth effect as discussed above however may be strong or weak, depending on certain factors. Two of such factors are; (i) the maturity structure of the government debt – whether short or long; (ii) the level of taxes and/or the expectations of future spending cuts or future tax increases.

Sims (2013) posits that if economic agents expect future tax increases, they will spend less today which will weaken the impact of the wealth effect and can even lead to deflationary pressures. On the other hand, the expectation of future tax cuts will boost consumption through a stronger wealth effect. Melike & Omer (2007) also add to this assertion that if rational agents expect that the primary surpluses response inefficiently to the domestic debt, the only equilibrium in the price level follows an increasing inflationary path through a magnified wealth effect.

On the issue of the maturity structure, Ahmad, Sheikh & Tariq (2012) posit that short-term securities usually have a high return in the form of interest rate and hence 'rolling over' short-term debts will lead to a strong wealth effect. In addition to this, Melike & Omer (2007)

posits that the maturity of government debts decreases if people expect the government to inflate away the debt. This decrease in the maturity of bonds will increase the interest rate which will then increase the wealth effect and hence inflation. Whiles these bonds or debts issued by the government will increase the public debt, it will at the same time increase inflation through the wealth effect. This then generates a positive relationship between public debt and inflation.

Although the wealth effect under the FTPL assumes money supply to be endogenous, Kwon, McFarlane & Robinson (2006) suggest a possible link between the wealth effect and money supply. They posit that an increase in the price level as a result of the wealth effect will increase money demand and hence money supply will have to increase to accommodate the higher money demand. That is, both effects will then jointly lead to an increase in inflation as a result of a higher public debt.

So, in a nutshell, it can be seen that both the monetisation channel and the wealth effect channel work through consumption and hence aggregate demand (AD). Therefore, in discussing these channels, it will also be worth it to present the demand-side theories of inflation which postulate that inflation is mainly caused by excess demand for goods and services over supply in an economy (see for example, Dewald, 1980; Bayo, 2005). There are two principal theories about the demand-side inflation which are the Keynesian and Monetarist views of inflation. A third theory which is the inflation expectations theory is also sometimes included in the demand-side theories of inflation, where fears of future inflation boost current consumption (Ichiue & Nishiguchi, 2013). This will then increase aggregate demand (AD) and the price level.

2.3.1.3 Demand-side Theories of inflation

The difference between these two principal views is that, although they all accept that the inflation channel is through the aggregate demand (AD), they disagree on what causes the AD to increase. Whiles the monetarists focus on 'long-run' money supply as the sole determinant of the aggregate demand, the Keynesians are of the view that there may be more than one source of aggregate demand such as consumption, investment, public expenditure and net exports (Toader, 2007). However, both theories agree with the assertion that "inflation is always and everywhere a monetary phenomenon" (Mishkin, 2004).

2.3.1.4 The Monetarist View

The monetarist emphasizes the role of money as the principal cause of demand-pull inflation. They contend that inflation is always a monetary phenomenon as postulated by Milton Friedman (1968) (also see Dornbusch and Fischer, 1987, Ch. 17). Given the basic assumptions of this theory that the velocity of money and the level of real output are constant, an increase in money supply will then create excess demand (over supply), which will translate to higher prices and thus inflation (Mishkin, 2004).

2.3.1.5 Keynesian View

Keynes and his followers focused on the increase in aggregate demand (AD) as the source of inflation, usually called 'demand-pull' inflation. Thus, any increase in AD over aggregate supply (AS) will cause inflation even if money supply remains unchanged, with the assumption that there is full employment (Friedman, 1971). Though this view accepts the fact that changes in money supply changes the AD vis-à-vis inflation, it also postulates that other factors such as consumption, investment, exports, etc. affect aggregate demand, and hence

money supply is not the only variable that causes inflation (see Ogbuagu and Ewubare, 2014; Bayo, 2005; Medee and Nenbee, 2012; Hossain, 1990) .

2.3.2 The effect of public debt on the exchange rate

One of the common perceptions in international financial markets is that a rise in the debt-to-GDP ratio often results in a depreciation of the exchange rate. According to Schonerwald da Silva & Vernengo (2007), this perception is often influenced by risk agencies such as Moody's, Standard, Poors, etc.

In the literature, most economists believe that 'expectation' is the main channel through which the public debt affects the exchange rate. As the public debt increases, expectations are formed by international creditors on variables such as the primary surplus, inflation, a recession/slower pace of economic growth, etc., which then affect their portfolio decisions (see Elwell, 2012). Dreher, Herz & Karb (2006) add that the expectation of the ability of the government to convert revenues into foreign exchange also influences the portfolio decisions of international creditors. In periods of high debt ratios, Pastore, Pinotti & Almeida (2004) posit that investors will not only claim back and refuse to roll over the maturing debt of the government, but additionally remove a large part of their portfolio investments from the afflicted economy. Since the exchange rate is highly dependent on capital flows, it then depreciates. However, the government could raise the interest rate on its public debt in order to prevent a depreciation of its currency as argued by Baksay, Karvalits & Kuti (2012)..

From the above discussion, it could be seen that this channel of determining the exchange rate follows the short run modern asset market theories where investors decision to hold financial assets plays a much greater role in exchange rate determination. Also, while foreign investors give up on the afflicted governments' external bonds/debt, local investors also give

up on the domestic bonds/debt in pursuit of a 'more lucrative' foreign debt. The former leads to a shortage of foreign currency due to capital outflows while the latter lead to excess demand of foreign currency. The resultant effect will then be a depreciation of the exchange rate (see Mishkin, 2004; Krugman & Obstfeld, 2003; Krugman, Obstfeld & Melitz, 2012).

2.4 Related empirical studies

The final section of this chapter presents some selected empirical studies on our thesis topic. First, because much of the available empirical studies done in this area is outside the African continent, we examine the relationship between the variables used in the study, that is, public debt, inflation and the exchange rate in some selected non-African countries. Next, we empirically review some related studies in Ghana and some selected African countries.

2.4.1 The relationship between public debt and inflation in non-African countries

Reinhart and Sbrancia (2011) examined the behaviour of inflation during the major debt reduction episodes using the public debt profile data for ten countries, and later broadening their analysis to 28 countries from all regions, from 1970 to 2010. They found that for the United States and the United Kingdom, the annual liquidation of debt via negative real interest rates as a result of higher inflation rates amounted to 3 to 4 percent of GDP on average per year. For other countries such as Australia and Italy which recorded higher inflation rates, the liquidation effect was even larger (around 5 percent per annum). Moreover, they also found that inflation needed not to be 'surprise inflation'. Averaging across 10 countries, they found that only 18 percent of the liquidation years coincide with an "inflation surprise."

Guillemette & Strasky (2013) adopted a small simulation model to evaluate the contributions of three pillars – a higher inflation, fiscal consolidation and growth-boosting structural reforms – that could halt Japan's rising public debt. They found that a two percent rise in inflation coupled with fiscal consolidation amounting to 10% points of GDP and a higher productivity is necessary to reduce Japan's public debt by 2020. They also found out that the maturity structure of Japanese government debt had a role to play in the slow pace at which inflation eroded the debt. They found that almost 30% of the debt matures within a year whiles almost 40% matures within two years. Comparing this to the United Kingdom where less than 15% of debt matures within two years, the study showed that Japan's debt could decline by an additional 20 percentage points by 2035 if Japan's debt maturity structure were the same as that of the UK.

Reinhart & Rogoff (2010) exploited a new multi-country historical dataset on public debt (for 20 advanced and 24 emerging market economies from 1946 – 2009) to search for a systematic relationship between high public debt levels, inflation and growth. On the part of inflation, they found out that there was no systematic relationship between high debt levels and inflation for advanced economies such as Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, etc. In contrast, high public debt levels coincided with higher inflation in emerging markets such as Argentina, Bolivia, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Korea, Malaysia, Mexico, Nigeria, etc.

Aizenman & Marion (2009) using a U.S data from 1946 to 2008 found from their simulation model that eroding the debt through inflation is not farfetched and that a moderate inflation of six percent could reduce the debt/GDP ratio by 20 percent within 4 years. For example, they found that inflation yielded the most dramatic reduction in the debt/GDP ratio—and the real value of the debt—in the immediate post-World War II period. Their model predicted that a five-percent inflation increase starting in 1946, for example, would have reduced the

debt/GDP ratio from 108.6 percent to 59.3 percent, a decline in the debt ratio of 45 percent. Moreover, they found that the lower inflation of 2.3% and a high/long debt maturity (over 9 years) gave room to let inflation rise to 8.3% in 1946. However, they also found that the impact of inflation on debt/GDP was not so strong in the 1970's where debt maturities were shorter (under 3 years by 1974 and a mere 2.67 years in 1975).

Reda & Fuad (2010) used the VAR framework to study the relationship between inflation and the debt-to-GDP ratio, and their main findings indicated that a higher inflation may not always be a way to lower the debt/GDP and that the policy regime of the government is also important. Moreover, they found that a positive shock to inflation would, in fact, increase the debt instead of reducing it. Using different sample periods, they found that the effect of inflation on debt was not robust across the samples. The 1947-1979 sample showed that it takes a few quarters for debt to increase following a positive inflation shock while, in contrast, the 1973-2009 sample showed that debt falls after an inflation shock. The whole 1947-2009 sample, however, indicated that after a positive shock to inflation, debt initially falls for a short period, before it starts rising after 3 years.

Hall & Sargent (2010) also analysed the contributions to the evolution of the debt to GDP ratio made by inflation, nominal returns paid on debts and growth in the U.S. Among the questions they answered was whether U.S inflated away much of the debt by using inflation to pay negative real rates of return. They found that inflation significantly contributed to reducing the debt. From 1945 to 1974, the debt-to-GDP ratio fell from 66.2 percent to 11.3 percent of which 12.5 (20 percent of the decline) was due to negative real returns on debt via inflation. However, this magnitude of reducing the debt through inflation decreased in the 1970s due to the short maturity (around 2 years) nature of the debts, thus, preventing the government from fully benefiting from the negative implicit real interest rate it managed to pay through inflation.

Cherif & Hasanov (2012) using a VAR model and a U.S quarterly data from the second quarter of 1947 to the third quarter of 2011 found that an inflation shock only slightly reduces the debt ratio for a few quarters and then rises afterwards. That is, inflation shocks due to factors such as hikes in crude oil prices would, in fact, increase the debt-to-GDP ratio after a few quarters. Reinhart & Rogoff (2010) using a cross-country dataset on key macroeconomic variables for 64 countries found that the domestic debt was the main channel through which inflation reduced the public debt, however, it varied across episodes and circumstances. Their study revealed that, in fact, domestic debt was often much higher than the monetary base in the run-up to high inflation episodes. However, in contrast, they found that in some cases, the domestic debt was rather eliminated through high inflation.

Krause & Moyen (2013) investigated to what extent and under which conditions a higher inflation target reduces the real value of public debt. Using a New Keynesian model with long-term debt and changing inflation targets on a U.S data, their simulation analysis showed that a temporary four percentage-point increase of the inflation target has a minor effect on real public debt. Thus, temporary changes in inflation have substantially smaller effects on the debt. On the other hand, they found that a permanent increase of the targeted inflation rate from 2 to 6 percent results in a reduction of about 29 percent of the additional real government debt accrued after the crisis. This shows that only a persistent increase in inflation or inflation target can reduce a significant part of the debt. Also, they found that surprise inflation added no additional benefit in reducing the public debt as not much could be gained from misleading the public by attempting an inflationary policy without revealing it.

Hilscher, Raviv & Reis (2014) in their study, measured the effectiveness of how a higher inflation will alleviate the public debt. Using a detailed 2012 U.S data, they estimated that the effects of higher inflation on the fiscal burden were modest, and a more promising route to

inflate away the public debt is to use financial repression. They estimated that a decade of repression combined with inflation could wipe out almost half of U.S's debt. Moreover, they found that, although one ingredient for reducing public debt was inflation, it would take double-digit inflation to reach significant fiscal gains in the U.S. Also their study showed that having debt outstanding of longer maturities would significantly increase the effectiveness of inflation.

Akitoby, Komatsuzaki & Binder (2014) investigated the impact of a low or high inflation on the public debt-to-GDP ratio in the G-7 countries. Their findings showed that seigniorage revenue from higher inflation would play only a limited role in bringing down debt ratios, given the relatively low levels of base money in the G-7 countries. Moreover, with regard to the impact of inflation on the real value of the debt, their simulations suggested that if inflation were to fall to zero for five years, the average net debt-to-GDP ratio would increase by about 5 percentage points over the next five years. On the other hand, raising inflation to 6 percent for the next five years would reduce the average net debt-to-GDP ratio by about 11 percentage points under the full Fisher effect and about 14 percentage points under the partial Fisher effect. A study by Abbas et al. (2013) however found the opposite to be true. They found that inflation has rather played a relatively minor role in a sample of 26 episodes of large debt reversals in advanced economies since the 1980s.

Niemann, Pichler & Sorger (2010) examined the implication of nominal public debt for the dynamics of inflation using a U.S data from 1983 to 2006. They found that a debt-to-GDP ratio close to 30% was associated with an optimal inflation rate of roughly 3% whiles in turn; a debt-to-GDP ratio of 50% was associated with an optimal inflation rate of more than 10%. Thus, the public debt contributed significantly to inflation. Janssen, Nolan & Thomas (2004) also using UK government debt data over almost 300 years (1705 – 1996) however found little econometrics evidence that fiscal policy has affected the course of the price level and

that government debt did not significantly affect the base money stock. Thus, government debt was insignificant in explaining inflation.

Ahmad, Sheikh & Tariq (2012) investigated the impact of domestic debt on inflation in Pakistan for the period 1972 to 2009 and found that domestic debt and domestic debt servicing significantly enhance the price level in Pakistan. Thus, the effect of the volume of domestic debt and domestic debt servicing on price level was found to be positive and statistically significant. Specifically, they found that if the domestic debt goes up by one million, the price level goes up by about 2.95 percent.

Castro, Resende & Ruge-Murcia (2003) studied the interdependence between fiscal and monetary policies, and their joint role in the determination of the price level in some OECD countries using a simple infinite-horizon monetary economy model. Their findings indicated that debt played only a minor role in the determination of the price level in the OECD countries considered under the study. They explained further that this was due to the fact that all outstanding debt was backed by the fiscal authorities instead of the monetary authorities.

Reinhart & Rogoff (2010) in their revised edition of their previous study revealed that domestic debt was the primary component through which the public debt caused inflation. Using a historical data for 64 countries from 1914 to 2010, they found that there are many cases where the hidden overhang of pre-existing domestic public debt was at least the same order of magnitude as base money, and sometimes even a large multiple. For example, they found that when the post–World War I inflation first spiked up to 66 percent in Germany in 1920, domestic debt was almost triple the size of the monetary base while in the case of Brazil, debt was almost 20 times the size of the money base. Similar to their previous study, they also found that in some cases, the domestic debt was actually eliminated through high inflation.

Kwon, McFarlane & Robinson (2006) examined the relationship between public debt, money supply and inflation using a Vector autoregression (VAR) model and then applied it to the case of Jamaica. Their findings supported the predictions of Sargent and Wallace's (1981) "unpleasant monetarist arithmetic" that an increase in public debt is typically inflationary in countries with large public debt (especially, indebted developing countries). In contrast, the study also found this relationship to be weak in other developing countries that were not indebted and the relationship did not exist at all in developed economies. In the case of Jamaica, they found this relationship to be true where the public debt significantly affected inflation.

Melecky & Melecky (2011) analysed the effects of macroeconomic shocks on public debt dynamics in an open economy. Using a VAR (1) model and applying it to the Czech Republic, they found that lagged inflation had only a small positive effect on debt/GDP. They explained further that this could be due to the fact that although inflation could reduce the debt-to-GDP ratio, it also has a negative supply shock and thus it lowers performance of the production side of the economy. This means that if the latter effect outweighs the former effect, then inflation will have a positive effect on debt/GDP ratio. They also found out that an inflation shock first caused the debt/GDP ratio to increase, reaching its first extreme because the economy underperforms as a result of a negative supply shock. However, the response turns significantly negative showing a much greater decrease in debt/GDP at its peak after some 20 periods.

2.4.2 The relationship between public debt and exchange rate in some non-African countries

Casadio, Paradiso & Rao (2012) using the Seemingly Unrelated Regression (SUR) model with annual data for the period 1970 to 2011, following the works of Favero (2002), Favero

and Marcellino (2005) and Hasko (2007) found that, in the case of Italy, the euro/dollar exchange needed not to be too strong in order to reduce the debt-to-GDP ratio. That is, exchange rate volatility had less impact on the public debt. Also, a study by the IMF (2011) found that over the period 1980-2010, currency valuation changes played a negligible role in driving debt dynamics in advanced economies. A possible explanation was that, these economies traditionally have a large share of their total debt being the domestic debt and it is, therefore, plausible that changes in the exchange rate will have less impact on the public debt.

Nicolescu & Mota (2012) estimated a linear regression by OLS using the Newey-West procedure to investigate the public debt dynamics in Romania, decomposing changes of the public debt into the macroeconomic components including the gains and losses on foreign currency denominated debt due to variations in the exchange rate. Using a quarterly data from 2000 to 2011, they found that the leu-euro exchange rate didn't have a significant impact on the variation of the debt to GDP ratio. However, the leu-dollar exchange rate contributed significantly to the reduction of the public debt before the financial crisis, from 2002 to 2008. However, after the crisis, the devaluation of the leu-dollar exchange rate increased the domestic value of the foreign currency denominated debt, leading to an increase in the debt/GDP ratio.

Melecky and Melecky (2011) again in their study of the public debt dynamics in the Czech Republic found out that lagged exchange rate appeared to bear a counter-intuitive sign in the debt dynamics equation. That is, exchange rate depreciation rather reduced the public debt. They explained further that this could be due to the fact that although exchange rate depreciation increases the debt/GDP ratio, at the same time, a depreciation of the exchange rate increases the price competitiveness of the domestic economy, and helps to boost net exports, GDP and government revenues. This would rather lower the debt/GDP, thus, if the latter effect outweighs the former, then a depreciation of the exchange rate would reduce the

debt instead of increasing it. Their impulse reaction functions showed that an unexpected change in the exchange rate depreciation initially reduced the debt/GDP ratio through the positive income effect but later on, the negative balance sheet effect takes over after some ten periods which increase the debt/GDP ratio.

Kak (2014) analysed the components of the public debt-to-GDP ratio in Sri-Lanka, including exchange rate changes, nominal GDP growth and the primary fiscal balance. Their analysis showed that the public debt is most sensitive to changes in the exchange rate and also the primary deficit, reflecting the need to maintain a stable exchange rate and fiscal prudence. According to the study, a continued depreciation of the LKR had been a major factor in keeping the public-debt ratio high over almost 2 decades. That meant that a stable or appreciating LKR could play a critical role in reducing the public debt. Mahmood, Ruaf & Rehman (2009) also examined the debt dynamics and its burden in Pakistan over three decades (1970-2005) and found that exchange rate fluctuations, rising twin deficits and high-interest rate payments are the three core variables responsible for the rise in the public-debt-ratio and debt burden in Pakistan.

Schonerwald da Silva & Vernengo (2007) in their study on some Latin American countries (Brazil, Argentina, Chile and Mexico) found that debt restructuring and the appreciation of many of the countries' currencies against the dollar since 2003 contributed significantly to reducing the debt/GDP ratio, dropping from 60% to almost 45%. Also, Rehman, Adil & Anis (2012) in their study on Pakistan's debt burden found that a depreciation of the Pakistani rupee against foreign currencies significantly increased the debt burden through the external debt. For example, they found that a depreciation of the Pakistani rupee in 1972 from PKR 4.76/$ to PKR 8.68/$ caused an increase of about 85% in the debt burden.

Awan, Asghar & Rehman (2011) studied the relationship between external debt and exchange rate, fiscal deficit and deterioration of terms of trade in Pakistan for the period 1974-2008. Using a Johansen approach, they found that a significant long-run relationship existed between external debt and the exchange rate. However, in the short run, they found no relationship between exchange rate and the external debt. Similarly, Cain et al. (2012) investigated the relationship between the US dollar-denominated government debt and exchange rate movements using an unbalanced panel data cointegration technique on 87 low and middle-income countries over the period 1960 to 2006. Their findings suggested that exchange rate Granger-causes the stock of foreign currency denominated debt, however, they did not find any bidirectional causality between these variables. Moreover, they found that, in the long run, the exchange rate was rather inversely related to the external debt.

2.4.3 Related empirical studies in Ghana and some selected African countries

As it has already been mentioned in chapter one, most of the empirical studies on debt dynamics in Ghana and even in the sub-Sahara region have often given attention to other factors in the debt dynamics equation, with less emphasis on inflation and the exchange rate. For example, one of the few studies that considered the exchange rate is a study by Ansah (2010), where he studied the dynamics of Ghana's public Indebtedness. One of his findings was that foreign debt adjustment (as a result of currency exchange rate distortions) contributed significantly to debt accumulation in Ghana. His analysis showed that foreign debt adjustment was the third highest contributor of public debt accumulation in Ghana from 1960 to 1999.

Also, Mupunga & Roux (2014) empirically investigated the key fiscal and macroeconomic variables that influence public debt dynamics in Zimbabwe using an annual time series data

from 1980-2012. With the concept of intertemporal budget constraint adopted by their study, they found that the exchange rate was a significant contributor to changes in the public debt dynamics under the review period. However, after the adoption of a multicurrency regime, exchange rate variations have played a limited role in influencing Zimbabwe's public debt dynamics. Thus, the country has abandoned the use of its local currency and hence cross exchange rates among the major foreign currencies is less likely to influence the debt.

In an empirical study of Public debt, Economic Growth, and Inflation in 52 Africa economies (including Ghana) by Lopes da Viega, Ferreira-Lopes & Sequeira (2014), they found that between 1950 and 2012, higher levels of public debt led to reduced rates of economic growth and also high levels of inflation. Another study by Feridun & Adebiyi (2005) which sought to forecast inflation in Nigeria found that the domestic debt (including the Treasury bill rate and the money supply) significantly affected inflation.

Ezeabasili, Mojekwu & Herbert (2012) studied the relationship between fiscal deficits and inflation in Nigeria for the period 1970 – 2006 (a period of persistent inflationary trends). Though this is not directly related to this study, it might still be relevant with the view that increase in fiscal deficits will eventually lead to a higher public debt ratio. Their results revealed a positive but insignificant relationship between inflation and fiscal deficit. Moreover, they didn't find any strong evidence linking past levels of fiscal deficits with inflation. In contrast, a study by Anayochukwu (2012) examining the relationship between inflation and fiscal deficits in Nigeria (from 1970-2009) using a causality approach, however, found that fiscal deficits actually cause inflation.

However, most of the available literature almost neglected the exchange rate and inflation in their studies, for example, in a study by Asiama, Akosah & Owusu-Afriyie (2014), using a quarterly time series data spanning the period 2000Q1 – 2014Q1, they found that fiscal

excesses were the main driver of public debt accumulation in Ghana, especially during election years. They, therefore, advised that deliberate fiscal policies such fiscal anchors and a Fiscal Responsibility Act should be implemented to help curtail expenditure overruns, especially during election years. Another study by Ncube & Brixiova (2013) on public debt sustainability in Africa revealed that fiscal policies will need to play a greater role in maintaining debt sustainability in the future for most African countries.

Similarly, a study by Kwakye (2012) for the period 2000 – 2012 stressed the importance of keeping the fiscal deficit under control in order to maintain long-term debt sustainability. Moreover, he suggested that borrowed resources should be used judiciously to generate growth, which can help to sustain the public debt. Also, a debt sustainability analysis by the IMF (2013) on Ghana's public debt revealed that fiscal slippages and expansionary fiscal policies in 2012 worsened Ghana's public debt situation. Moreover, though this study found that Ghana's weak external outlook had contributed to its rising public debt ratios, the weak external outlook was attributed to low export and low export revenue, with no emphasis on the exchange rate. A similar result was found for Cameroon in a similar study in 2011 by the IMF and the International Development Association of Cameroon, where an extreme export shock could lead the public debt ratio to exceed its threshold.

Lastly, a theoretical and empirical examination by Nissanke & Ferrarini (2001) on the debt dynamics of HIPCs (including Ghana) showed that one of the major conditions which have given rise to higher public debt ratios in these countries is their extreme susceptibility to large-scale external shocks such as the terms of trade effects.

2.5 Chapter summary

This chapter reviewed both the theoretical and empirical literature concerning the relationship between the public-debt ratio, inflation and the exchange rate. From the review, we could see that the public-debt ratio - inflation and the public-debt ratio - exchange rate relations are ambiguous. The various empirical studies also showed mixed results, which means that we cannot make any firm decisions concerning the causality between these macroeconomic variables. There is no doubt that the direction of causality could be determined unambiguously if the analysis is confined to data from a single country. We therefore employ Ghanaian data on the three series to determine the dynamic relationship among the public debt, inflation and the exchange rate. The next chapter provides an overview of trends in the public debt, inflation and exchange rate in Ghana over the study period (1990 – 2013).

CHAPTER THREE

TRENDS IN PUBLIC DEBT, INFLATION AND THE EXCHANGE RATE IN GHANA

3.1 Introduction

This chapter throws more light on macroeconomic development in Ghana from 1990 to 2014. Specifically, the discussion will focus on evolution of the public debt, and the various inflation and exchange rate cycles since 1990. The rationale behind the study period is due to the fact that Ghana's exchange rate was fully liberalized in the 1990s (Bhasin, 2004). Moreover, this study period was chosen due to lack of data on Ghana's debt/GDP ratio before the 1990s, which therefore makes this period the longest possible time horizon where data on all the variables is available.

The chapter is divided into three sections. Section one describes the evolution in the public debt over the study period. Section two describes the trends in inflation over the study period whiles section three describes the exchange rate movements over the study period (1990 – 2013). Since Ghana's external debt is expressed in US dollars, the discussion on the exchange rate is focused exclusively on the Cedi-Dollar exchange rate.

Throughout the economic history of Ghana, increasing and higher public debt has always been one of the main economic challenges the economy has faced. More importantly, during these periods of higher public debt, the country has often recorded higher levels of inflation as well as a fast depreciating exchange rate. For instance, in the 1990's, the public debt had increased from 31.979% to a huge 123.346% as at the end of 2000 (IMF World economic outlook, 2014). Over this same period, annual inflation had increased from 10.1% in 1992 to 25.2% in 2000. The year on year inflation had reached a huge 40.5% at the end of 2000. The decade also recorded a continuous depreciation of the cedi, with the cedi depreciating in nominal terms by 57% against the US dollar in 2000. However, this trend has not always

been the case throughout the subsequent years though it seems to be repeating itself in recent years (see Figure 3.1).

A five year-by-year average analysis of the public debt, inflation and the exchange rate shows that the exchange rate has been depreciating on the average since 1990. Public debt has also seen a similar trend with the exception of the period 2005-2009 due to the effects of the HIPC and MDRI initiatives which drastically reduced Ghana's public debt. The public debt has however increased significantly after these initiatives and specifically within the last four years (2010-2013). On the other hand, inflation has been decreasing on a five year-to-year average since 2000, with the exception of 2014 (see Table 3.1).

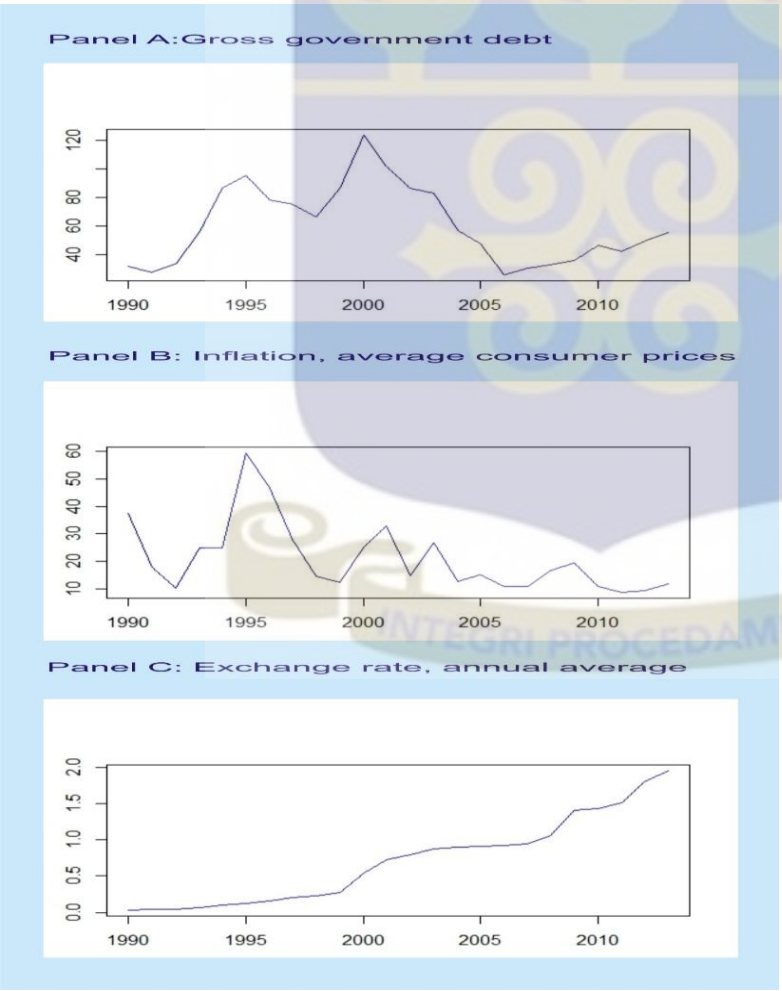

Figure 3.1 — Gross government debt to GDP ratio, the level of inflation and the level of the Cedi – Dollar exchange rate in Ghana, from 1990 to 2013

(Source: Author's construct from *R* using data from the IMF and the World Bank (2014))

Table 3.1: A Five Year-By-Year Average of Public Debt, Inflation and the Exchange Rate

Years	Average Debt (% of GDP)	Average annual Exchange rate	Annual inflation (%)
1990 - 1994	47.085	0.054	23.06
1995 - 1999	80.407	0.196	32.2
2000 - 2004	90.3312	0.764	22.44
2005 - 2009	34.9708	1.048	14.5
2010 - 2013	48.622	1.6725	10.05

(Source: Author's construct using data from the World Bank (2014))

3.2 Trends in public debt from 1990 to 2013

In the 1990's, Ghana's public debt (both domestic and external public debts) had increased substantially. External and domestic debts had risen by 7.6 percent and 30 percent per annum respectively, with external debt constituting about 85 percent of total debt (Fosu, 2001). Domestic debt which was kept at lower levels in the 1980's began to rise again in the 1990's (Meng, 2004). According to Sowa (2000), Ghana's domestic debt is a problem of the 1990's. Gross domestic bonded debt rose sharply from 3 percent of GDP in 1990 to about 25 percent of GDP at the close of the millennium. This evolution of the domestic debt was through fiscal excesses beginning from 1990 such as the peacekeeping operations in Liberia (ECOMOG) in 1990. The fiscal pressures of these unplanned expenditures were exacerbated by the fact that the availability of program aid was very limited in the 1990s and disbursement of project aid had slowed down considerably. The public debt had reached 31.979% of GDP in 1990, declined to 27.7% in 1991 before continuing its increasing trend.

The stock of domestic debt stood at 1,404 real billion cedis at the end of 1996. This represents a growth of about 115% from 1990, and as much as 62% from 1995 alone. This huge growth was associated with the government's intensive efforts at mopping up excess liquidity through the sale of treasury bills. By 1996, the domestic debt had reached 11% of the total domestic and external debt. More in the 1990's, external debt continued to rise. Total external (public) debt as a proportion of GDP rose from about 56 percent in 1990 to as high as 97 percent in 1994, before dropping to 84 percent by 1996 (Fosu, 2001).

Relying on both external loans and domestic borrowing to support its development, Ghana saw its debt rise over the years, reaching over 100% of GDP in 2000 (Kwakye, 2012). The total debt stock of Ghana stood at GH¢4.11 billion (¢41.10 trillion cedis) — 124 percent of GDP. Out of this amount, GH¢3.17 billion (old ¢31.70 trillion or US$5.80 billion) was external and GH¢0.94 billion (old ¢9.40 or US$1.7 billion) was domestic. The ratio of Ghana's external debt stock to its domestic budget revenue was 571%, an excess of the 250% threshold considered as a sustainable limit (Budget Statement, 2001). Thus, the debt situation in Ghana was very unsustainable by the end of the 1990's, attributable to excessive cheap money and high fiscal deficit, among others (Koos de Bruijn & Rehbein, 2011). When the IMF and World Bank introduced the Heavily-Indebted Poor Countries (HIPC) initiative in 1999, Ghana was judged to be a HIPC with unsustainable debt (Kwakye, 2012)

In 2000, Ghana found itself in a debt trap situation which made it join the Heavily Indebted Poor Countries (HIPC) Initiative and declared itself a Highly Indebted Poor Country (HIPC) in April 2001. Thus, the country joined the HIPC initiative to relieve it of its debt and put the economy back on track. The public debt as a percentage of GDP decreased from 124% to 102% in 2001 as a result of these debt reliefs, and a further decrease to almost 87% in 2002 (IMF World economic outlook, 2014). Moreover, in 2002, government also sought to reduce the burden of domestic debt by curtailing excessive public borrowing, so as to reduce

crowding out of the private sector, and lower real interest rates (Budget statement, 2003). This government initiative continued in 2003 as the government again sought to reduce and stabilize the domestic debt by eliminating the reliance on domestic financing. By the end of 2003, the public debt as a percentage of GDP had declined to 83% (Budget statement, 2004).

In July 2004, Ghana reached the Completion Point of the HIPC initiative and as a result, public debt dropped to US$8.35 billion from US$9.09 billion in 2003 (AFRODAD, 2011). The public debt ratio declined to 57% of GDP, partly attributed to the government's ability to reduce the domestic debt from about 30 percent of GDP at the end of 2000 to 17.6 percent of GDP at the end of 2004 (Budget statement, 2005).. The total public debt continued its downward trend to 48% and 26% of GDP in 2005 and 2006 respectively, mainly as a result of the debt relief and fiscal prudence under the enhanced Heavily-Indebted Poor Countries (HIPC) Initiative and the Multilateral Debt Relief Initiative (MDRI) in 2006 (Budget statement, 2006; Budget statement, 2007).

By 2007, the gross total public debt (external and domestic) as a percentage of GDP had risen by about 9.0 percent from the end 2006 figure of US$5,915.6 million to US$6,449.7 million as at the end of September 2007. As a share of GDP, the total public debt increased from 26% in 2000 to 31% in 2007 (Budget statement, 2008). In 2008, the gross public debt rose by about US$600 million to an end year position of US$8,002.5 million, which is about 8.1 percent increase over the 2007 position of US$7,405.5 million. The increase in public debt during the year was mainly driven by about US$400.0 million and US$200.0 million increase in external and domestic debts, respectively. By the end of 2008, public debt consisted of 49 percent and 51 percent of external and domestic debts, respectively (Budget Statement, 2009).

In 2009, the gross public debt rose again by about US$458.7 million to US$8,517.7 million at the end of September 2009 (Budget Statement, 2010). The total public debt continued its increasing trend in 2010 as it increased from US$8,551.7 million in September 2009 to US$11,247.7 million by the end of September 2010, representing an increase of 32.1 percent over the period (Budget Statement, 2011). The total public debt increased from US$11,247.7 million (37.8 percent of GDP) in September 2010 to US$14,766.72 million (38.98 percent of GDP) by end September 2011, representing an increase of 1.1 percent of GDP over the period. As at end September 2011, external debt was US$7,103.41 million, representing 19.1 percent of GDP and 49 percent of the total public debt stock, while domestic debt amounted to US$7,521.59 million, representing 19.9 percent of GDP and 51 percent of the total public debt stock (Budget Statement, 2012).

From about 41 percent of GDP (US$15.35 billion) in 2011, the public debt (including government guaranteed debt) increased by 23 percent to reach a high of 49.4% (US$18.83 billion) by end-December 2012. The domestic debt grew by 30 percent (between 2011 and 2012) to constitute 53 percent of the total public debt, compared to 47 percent for external debt (Budget Statement, 2013). In 2013, as a percentage of GDP, the public debt increased from 49.3 percent at the end of 2012 to 52.0 percent as at the end of September 2013. The lower than expected growth in GDP partly accounted for this increase in the debt ratio. External debt totalled US$10,794.54 million at the end of September 2013 which constituted 45.9 percent of public debt (24.6 percent of GDP). Domestic debt, on the other hand, amounted to US$12,704.22 million (GH¢24,900.3 million) as at end-September 2013, representing 54.1 percent of public debt (28.9 percent of GDP) (Budget Statement, 2014).

3.3 Trends in inflation from 1990 to 2013

In the early 1990's, the recorded rates of inflation turned out to be significantly lower than the rather higher rates recorded in the mid-to-late 1980's (Apaloo, 2001). Period average inflation came down from 50% per annum in the early reform years to 27% for 1987–1993 (Ocran, 2007). In 1992, average inflation was reduced to single-digit levels, largely on account of the good harvests of the previous year and conscious efforts at monetary control (Apaloo, 2001). However, these efforts could not be sustained for long as substantial government expenditure increases in 1992 (an election year) contributed significantly to inflation rates which surged from 10.1% in 1992 to 25% in 1993 and then to 70.8% by December 1995, pulling the average yearly rate to 59.5% in 1995 (Marbuah, 2011).

A high rate of 46.6% was also recorded in 1996 but it declined consistently to 12.4% in 1999, with an average of 25.4% between 1996 and 1999 (Quartey, 2010). In fact, in between January 1996 and May 1999, the inflation rate dropped from 69.20% to 9.40% (Aidoo, 2010). The year 2000 was an election year and many of the macroeconomic fundamentals including inflation were unstable (Quartey, 2010). According to Marbuah (2011), evidence from official sources showed that the end of period inflation at December 2000 had almost tripled to 40.5%, compared with 13.8% for the corresponding month of 1999.

In 2001, considerable progress was made in stabilising the economy. From a peak of 41.9 percent in March 2001, the rate of inflation declined to 21.3 percent by the end of December, representing a 19.2 percent decline. The Government moved away from Central Bank financing of its deficit and resorted more to non-bank financing (Budget Statement, 2002; Marbuah, 2011). Year on year inflation which had been cut by about half in 2001 to 21.3 percent continued to fall to 15.2 percent by the end of 2002. Moreover, the average yearly

inflation consistently declined from a level of 32.9 percent in December 2001 to 14.8 percent in December 2002 (Budget Statement, 2003).

Mainly on the strength of the pass-through effects of fuel price adjustments that were made in January 2003, inflation jumped to 29.4 percent. However, it dropped from its peak of 30.0 percent in April 2003 to 23.6 percent by the end of December 2003. This disinflation process was sustained for seven consecutive months from March to September 2003 (Budget Statement, 2004; Marbuah, 2011). In 2004, though it was an election year, year-on-year inflation declined to 11.8 percent at the end of December 2004 while average inflation declined from 26.7 percent in 2003 to 12.6 percent in 2004 (Budget Statement 2005).

Following the 50 percent upward adjustment in the prices of petroleum products in February 2005, the CPI rate of inflation which surged from 11.6 percent in January to 16.7 percent in March began to trend downwards. Headline inflation rate declined continually from April, except in September, that recorded a marginal increase from 14.7 percent to 14.9 percent (Budget statement, 2006). In 2006, the year-on-year headline inflation as measured by changes in consumer price index declined to 10.5 percent as at the end of October 2006 from 14.8 percent in December 2005. End-of-year average inflation rate stood at 10.7%, on the account of debt reliefs which was used by the central bank to 'buyoff' the otherwise accelerated rates of inflation in the economy (Budget Statement, 2007; CEPA, 2009). The disinflation process continued to April with average prices increasing by 9.5 percent, making it the lowest ever recorded since May 1999. The inflation rate inched up marginally in May 2006 to 10.2 percent as a result of the pass-through effect of the April fuel price adjustment of 10 percent (Supplementary Budget Statement, 2007).

Headline inflation, measured as year-on-year changes in the consumer price index, which was 10.9 percent in January 2007 stood at 10.1 percent at the end of October 2007, after peaking

at 11.0 percent in May 2007 (Budget Statement, 2008). Inflationary pressures however built up rapidly in the first half of 2008. Headline inflation measured as year-on-year changes in the consumer price index increased from 12.8 percent in January 2008 to 18.1 percent in December 2008, after peaking at 18.4 percent in June 2008 (Budget Statement, 2009). Inflationary pressures which characterized the latter part of 2008 and early 2009 continued, reaching a peak of 20.7 percent in June 2009. Inflation however reduced to 18.0 percent at the end of October 2009 (Budget Statement, 2010).

Inflation continued to decline, reaching a single digit of 9.52 percent in June 2010. By October 2010, inflation had further declined to 9.38 percent (Budget Statement, 2011). The downward inflationary trend continued into single digits ending the year 2010 at 8.58%. Inflation however increased marginally to 9.1 percent and 9.2 percent in January and February 2011, respectively. However, it resumed its downward trend in March 2011, declining to 8.4 percent in September 2011. Annual inflation in 2011 stood at 8.7% (Budget Statement, 2012; Marbuah, 2011). In 2012, headline inflation went up marginally from 8.6 percent in 2011 to 8.8 percent at the end of March 2012. Inflation was however sustained for the rest of the year (Budget Statement, 2013).

Since the beginning of 2013, inflation has been on an upward trend, resulting in inflation above single-digit from January through October 2013. Inflation rose persistently from 10.1 percent in January 2013 to 11.8 percent in July, with a marginal decrease to 11.5 percent in August. By October 2013, inflation had reached 13.1 (Budget Statement, 2014).

3.4 Trends in the exchange rate from 1990 to 2013

By the early 1990s, the exchange rate had been fully liberalized with the legalisation of foreign exchange bureaux to operate as legal entities (Bhasin, 2004). In March 1990, the whole sale auction was introduced to replace the weekly-retail auction. The wholesale auction system was however abolished in April 1992 and replaced by the inter-bank market system. The introduction of the interbank market could be seen as the last stage of exchange rate liberalisation and since then, both the commercial banks and the Forex Bureaux have operated in a competitive environment (Bhattarai & Armah, 2005). Thus, the exchange rate in Ghana has been quoted using Interbank and foreign exchange bureau rates since then. The exchange rate continued its upward trend depreciating in 1994 by 33.31 percent over the previous period's rate. The rate of depreciation increased further in 1995 but eased in 1996 (Yemidi, 2010).

At the beginning of the year 2000, the cedi seemed to have stabilized, as the sharp depreciation experienced in the last quarter of 1999 slowed down. However, this was short-lived as the second quarter recorded even sharper depreciation, throwing the foreign exchange market into crisis (Budget statement, 2001). Thus, in 2000, the cedi depreciated in nominal terms by 57 percent against the US dollar, following a 49 percent depreciation in 1999, compared with a 4.1 percent depreciation recorded over 1998 (African Economic Outlook, 2002).

In 2001, the Cedi continued its upward trend in relation to other major trading currencies. On the inter-bank market, the cedi to the US dollar exchange rate increased from ¢7,049.73 (GH¢ 0.7049) at the end of December 2000 to ¢7,312.24 (GH¢ 0.7312) at the end of December 2001, indicating a depreciation of only 3.7 percent for the year (Budget statement, 2002).

For most parts of 2002, the rate of depreciation of the cedi increased further, both on the interbank market and the forex bureaux market as compared to 2001. On the interbank market, the cedi depreciated by 13.2 percent while on the forex bureaux market, the rate of depreciation was 15.7 percent. Shortfalls in donor assistance and increased speculation on the part of market participants were the principal reasons why the rate of depreciation increased (Budget statement, 2003). The cedi continued its depreciating trend in 2003, with the cedi depreciating by 4.7 percent against the US dollar by December 2003 on the interbank market. The behaviour of the cedi on the forex bureaux market broadly mirrored developments on the inter-bank market. For the year, the cedi depreciated by 4.6 percent against the US dollar (Budget statement, 2004).

The rate of depreciation, however, fell consistently from 2003 to 2005, mainly as a result of higher export earnings, debt relief and improving remittances. The exchange rate depreciated by 2.2 percent in 2004 against the US dollar on the interbank market, the lowest since the foreign exchange market was liberalized. On the forex bureaux market, the cedi depreciated by 1.4 percent against the US dollar (Budget statement, 2005). Also in 2005, for the January-September 2005 period, the cedi depreciated cumulatively by 0.4 percent against the US dollar (Budget statement, 2006). Up to the end of September 2006, a moderate depreciation of 0.9 percent was recorded against the US dollar (Budget statement, 2007).

From January to September 2007, the Cedi again lost value to the US Dollar by 2.0 percent (Budget statement, 2008). Despite these gains made over the years, excessive government expenditure in 2008 resulted in the Cedi losing her value against the US Dollar by 20.1 percent on the interbank market. On the forex bureau market, the movement of the Ghana cedi against the US Dollar was similar to the movement on the inter-bank market. It recorded an annual depreciation of 20.6 percent in 2008 (Budget statement, 2009). However in 2009, the cedi appreciated relative to the US Dollar for three consecutive months from August to

October. This helped to partly correct the excessive depreciation in the first quarter of the year (Budget statement, 2010).

The appreciation pressure persisted into the first three-quarters of the following year 2010, up to September 2010. The Cedi traded relatively stronger in the Forex Bureau Market, appreciating by 0.9 percent against the US dollar. In 2011, the Ghana cedi traded weaker on both the Inter-Bank and Forex Bureaux markets during the nine-month period (Jan. – Sept.) of 2011, compared to the corresponding period of 2010. At the inter-bank market, the cedi depreciated by 3.2 percent against the US dollar whiles it depreciated in the forex bureaux market by 6.2 percent (Budget statement, 2012).In 2012, the Ghana cedi continued its depreciating trend in the first five months and on a cumulative basis, it depreciated at the interbank market by 17.5 percent against the US dollar in 2012 compared to 4.97 percent in 2011 (Budget statement, 2013).

From September 2012 to 2013, the Ghana Cedi depreciated by 4.12 percent against the US dollar. The annual depreciation of the cedi was however 14.6 percent (supplementary budget 2014). On the Forex Bureau Market, the Ghana Cedi also traded weaker against the US dollar and recorded a cumulative depreciations of 16.3 percent (Supplementary Budget Statement, 2014).

3.5 Chapter Summary

The chapter reviewed the trends in public debt, inflation and the exchange rate in Ghana from 1990 – 2013. From 1990 to 2000, though some years we recorded a decrease in the public debt, we can say that, generally, the public debt rose through this period. It, however, decreased in the HIPC and MDRI periods before it started to rise again in 2006. Inflation appears to have had a cyclical and declining trend throughout the entire period. Lastly, we

can say that the cedi-dollar exchange rate had depreciated (year by year) over the entire period. Having outlined the general trend observed in these three macroeconomic variables, it would be interesting to establish how their individual movements are interrelated. It would also be important to determine the causality relation among them. These issues are taken up in the next two chapters.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter presents the analytical framework for this study. The theoretical underpinnings of the model used for the estimations are presented in section 4.2. Our estimable equations are derived and presented in section 4.3. We verify the stationarity properties of our data series in section 4.4 and the estimation techniques.

On the estimations, we employ the Vector Autoregressive (VAR) technique to model the relationship between public debt, inflation and exchange rate in Ghana. In a VAR model, each equation in the model has one of the endogenous variables as a dependent variable. The lagged values of all the endogenous variables in the model then become the regressors in each equation. One advantage of the VAR technique over the OLS technique is that it helps to solve the problem of biased and inconsistent parameter estimates. Moreover, applying OLS to endogenous variables could yield spurious results when the variables tend to be non-stationary (Granger and Newbold, 1974). To overcome these problems associated with the OLS technique, the VAR technique is used which does not require that a model should be grounded in any strict economic theory.

4.2 Theoretical Models

To identify that inflation and exchange rate contribute to changes in the public debt-to-GDP ratio, the model used in this study as presented below is based on a model developed by Ra & Rhee (2005), which follows an IMF (2001) proposed framework for carrying out debt sustainability analysis for emerging economies. In addition, the study also draws upon the

model developed by Mahmood, Rauf & Rehman (2006) which incorporate seigniorage as well as external financing as the two important sources of financing fiscal deficit in developing countries. This section further presents a model by Schonerwald da Silva & Vernengo (2007) to show the effect of public debt on exchange rate whiles a model by Kwon, Lavern & Robinson (2006) is presented to show the effect of public debt on inflation.

To begin with the analysis, one first has to state the general formula of nominal debt, separating liabilities in Ghana cedi (GH₵) and in foreign exchanges. The evolution of total public debt can be expressed by the following equation below:

$$D_t = -PB_t + (1 + id_{t-1})ID_{t-1} + (1 + ix_{t-1})(1 + \varepsilon_t)XD_{t-1} + OD_t \qquad (4.1)$$

Where, D_t — Gross government debt in GH₵ at the end of period *t*;

PB_t — Primary balance of general government budget in period *t*, not including interest payments;

ID_{t-1} — Government debt in GH₵ at the end of period *t-1*;

XD_{t-1} — Government debt in foreign exchange at the end of period *t-1*;

id_{t-1} — Interest rate on government debt in GH₵ in period *t-1*;

ix_{t-1} — Interest rate on government debt in foreign exchange in period *t-1*;

ε_t — Nominal depreciation at the end of period *t*;

OD_t — Other items (such as privatisation) in period *t*.

Assume that a_{t-1} is the proportion of government debt recorded in foreign exchanges within the total government debt in period $t-1$. Then, the weighted interest rate of domestic and external debt is defined as follows.

$$1 + i_{t-1} = (1 + id_{t-1})(1 - a_{t-1}) + (1 + ix_{t-1})a_{t-1}, \qquad (4.2)$$

where i_{t-1} – interest rate on government debt in period $t-1$

Hence, transforming the government debt into a simplified form will generate these

equations:

$$D_t = -PB_t + (1 + id_{t-1})(1 - a_{t-1})D_{t-1} + (1 + ix_{t-1})(1 + \varepsilon_t)a_{t-1}D_{t-1} + OD_t \quad (4.3)$$

$$D_t = -PB_t + [(1 + id_{t-1})(1 - a_{t-1}) + (1 + ix_{t-1})(1 + \varepsilon_t)a_{t-1}]D_{t-1} + OD_t \quad (4.4)$$

$$D_t = -PB_t + [(1 + id_{t-1})(1 - a_{t-1}) + (1 + ix_{t-1})a_{t-1} + (1 + ix_{t-1})\varepsilon_t a_{t-1}]D_{t-1} + OD_t \quad (4.5)$$

$$D_t = -PB_t + [(1 + i_{t-1}) + (1 + ix_{t-1})\varepsilon_t a_{t-1}]D_{t-1} + OD_t \quad (4.6)$$

We can then divide equation (4.6) by nominal GDP in period $t(Y_t)$. Moreover, let's indicate the debt-to-GDP ratio, the primary balance and 'other items' by *d*, *pb* and *od* respectively.

$$d_t = -pb_t + [(1 + i_{t-1}) + (1 + ix_{t-1})\varepsilon_t a_{t-1}]\frac{D_{t-1}}{Y_{t-1}}\frac{Y_{t-1}}{Y_t} + od_t \quad (4.7)$$

$$d_t = -pb_t + [(1 + i_{t-1}) + (1 + ix_{t-1})\varepsilon_t a_{t-1}]d_{t-1}\frac{Y_{t-1}}{Y_t} + od_t \quad (4.8)$$

Also, we can replace $\frac{Y_{t-1}}{Y_t}$ with a new formula: $\frac{1}{(1+g_t)(1+\pi_t)}$, where g is real growth rate, and π is inflation. The debt-to-GDP ratio can then be broken down accordingly as follows:

$$d_t = -pb_t + \frac{(1+i_{t-1})+(1+ix_{t-1})\varepsilon_t a_{t-1}}{(1+g_t)(1+\pi_t)}d_{t-1} + od_t \quad (4.9)$$

We can deduct debt in period *t*-1 from debt in period in order to quantify the change in the debt-to-GDP ratio. This is shown below in the following equations:

$$d_t - d_{t-1} = -pb_t + \{\frac{(1+i_{t-1})+(1+ix_{t-1})\varepsilon_t a_{t-1}}{(1+g_t)(1+\pi_t)} - 1\}d_{t-1} + od_t \quad (4.10)$$

$$d_t - d_{t-1} = -pb_t + \{\frac{(1+i_{t-1})+(1+ix_{t-1})\varepsilon_t a_{t-1}-(1+g_t)(1+\pi_t)}{(1+g_t)(1+\pi_t)}\}d_{t-1} + od_t \quad (4.11)$$

$$d_t - d_{t-1} = -pb_t + \{\frac{(i_{t-1})-\pi_t(1+g_t)+(-g_t)(1+ix_{t-1})\varepsilon_t a_{t-1}}{(1+g_t)(1+\pi_t)}\}d_{t-1} + od_t \quad (4.12)$$

$$\Delta d_t = -pb_t + [\frac{i_{t-1}}{(1+g_t)(1+\pi_t)} + \frac{-\pi_t(1+g_t)}{(1+g_t)(1+\pi_t)} + \frac{-g_t}{(1+g_t)(1+\pi_t)} + \frac{(1+ix_{t-1})\varepsilon_t a_{t-1}}{(1+g_t)(1+\pi_t)}]\, d_{t-1} + od_t \quad (4.13)$$

At this point, we can disaggregate equation (4.13) into the various factors that affect the debt-to-GDP ratio. These factors can be quantified in the following equations as follows:

$-pb_t$ – Primary balance;

$(\frac{-g_t}{(1+g_t)(1+\pi_t)})d_{t-1}$ – Real growth;

$(\frac{-\pi_t}{(1+\pi_t)})\ d_{t-1}$ − Inflation;

$(\frac{i_{t-1}}{(1+g_t)(1+\pi_t)})\ d_{t-1}$ − Nominal interest rate;

$(\frac{(1+ix_{t-1})\varepsilon_t a_{t-1}}{(1+g_t)(1+\pi_t)})\ d_{t-1}$ − Change in exchange rate;

od_t − Other items influencing debt

The equations above identify exchange rate and inflation as two of the primary causes of changes in the debt-to-GDP ratio, along with the primary balance, real growth and the nominal interest rate. Equation (4.13) suggests that an increase in inflation reduces the debt-to-GDP ratio whiles exchange rate depreciation increases the debt-to-GDP ratio.

But according to Schonerwald da Silva & Vernengo (2007), to understand the cases where a significant proportion of public debt is denominated in foreign currency as in the case of Ghana, the explanation of how public debt influences exchange rate also turns out to be critical. The dynamics of the exchange rate accordingly is defined as the domestic price (local currency) of foreign currency, determined by three factors including the public debt. This is presented in the following equation:

$$\dot{e} = \sigma(i^* - i) + \theta(\bar{e} - e) + \mu d \qquad (4.14)$$

From equation (4.14), $\dot{e}$ is the change in the exchange rate (where up is depreciation and down is appreciation). It can be seen that a rise in the debt-to-GDP ratio (*d)* leads to a depreciation or devaluation of the exchange rate. Other factors such as interest rate parity and expected exchange rate also affect the exchange rate as it can be seen from the equation; however, our focus is on how the debt-to-GDP ratio (*d)* affects the exchange rate.

Also in a model by Kwon, McFarlane, Robinson (2006), he postulates that public debt has a positive effect on inflation or the price level. Simplifying a model developed by Castro et al. (2003), he developed a model of equilibrium price as follows:

$$p_t = \frac{(1-\beta)(M_{t-1}+\delta \cdot i_{t-1}B_{t-1})}{\gamma c_t}, \quad (4.15)$$

where, M_{t-1} — money supply, B_{t-1} — public debt, c_t — real consumption, δ — monetization factor. This means that if the monetization factor δ reduces to zero, equation (4.15) simplifies into the conventional quantity theory of money. However, if there is full monetization of the debt ($\delta = 1$), then the issuance of public debt influences inflation as strongly as money supply does. Moreover, though the positive relationship between public debt and inflation could be explained by the wealth effect, the above model does not incorporate this effect. Notwithstanding this, the model is still consistent with the predictions of the FTPL. That is, the model acknowledges the fact that public debt can cause inflation through two channels (the wealth effects and monetization of the debt).

4.3 Empirical Model

Based on equations (4.13), (4.14) and (4.15), this study uses a three variable vector autoregressive (VAR) model to empirically explore the relationship between public debt, inflation and the exchange rate. The VAR model is one of the most successful, flexible, and easy to use models for the analysis of multivariate time series, especially if a bi-directional relationship is likely to exist between any two variables. In its basic form, the VAR model in this study consists of a set of three endogenous variables which can be expressed as:

$$\boldsymbol{y_t} = (PB_t, EX_t, INFL_t) \quad (4.16)$$

where $\boldsymbol{y_t}$ is a vector of the endogenous variables consisting of the public debt (PB_t), exchange rate (EX_t) and inflation ($INFL_t$). The basic *p*-order vector autoregressive (VAR (*p*)) process for this three-variable VAR model can then be generally defined as:

$$\boldsymbol{y_t} = A_0 + A_1\boldsymbol{y_{t-1}} + A_2\boldsymbol{y_{t-2}} + \cdots + A_p\boldsymbol{y_{t-p}} + \boldsymbol{u_t}, \quad (4.17)$$

for $t = 1, 2 \ldots T$ where A_i are (3 × 3) coefficient matrices for $i = 1, 2, 3 \ldots p$ and $\boldsymbol{u_t}$ is a 3 × 1 dimensional unobservable zero white noise process with a time invariant positive definite

covariance matrix $E\left(u_t u_t^{/}\right) = \Sigma_u$. The white noise ($\boldsymbol{u_t}$) is sometimes referred to as stochastic error terms or impulses or innovations or shocks in the language of the VAR. Estimating equation (4.17) using VAR solves the endogeneity problem in time series data due to the use of lagged variables of $\boldsymbol{y_t}$. However, as it is being shown in the next chapter, a VECM is more appropriate in examining the relationship between the variables and hence this study use a VECM model instead of a standard VAR model in the estimation process. The details of the VECM model are being explained later on in this chapter.

According to Bardsen & Lutkepohl (2011), due to the desired properties of economic variables in their logarithm (log) forms (such homogeneous variance), this study transforms the original level variables to logarithmic variables before applying the VECM model.

4.4 Estimation/Econometric methods

This section presents a brief explanation of the relevant econometric methods applied to detect the stationarity properties of the three variables (the public debt ratio, inflation and the exchange rate) we used in our estimations. Stata 13 software is being used for all the estimations.

Stationarity

A time-series analysis should begin with conducting a stationarity tests. If the time series has a unit root, Granger and Newbold (1974) argue that it can cause a high explanatory power R^2 and t-statistics that seem significant, but do not convey any economic meaning. This study performs stationarity test by using the augmented Dickey-Fuller (ADF) test.

Cointegration

Two or more non-stationary variables are said to be cointegrated if they are integrated of the same order and the error terms of the estimated regression are stationary. In practice, this indicates that the variables do not drift too far away from each other and, consequently, appear to move together in the long run. This study tests for cointegration using the Johansen method.

The Vector Error Correction Model (VECM)

If cointegration is being detected between series, we know that there exist a long-term equilibrium relationship between them but in the short run, there may be disequilibrium (Gujarati, 2004). This means that we should apply VECM in order to evaluate the short-run properties of the cointegrated series. However, in case of no cointegration, VECM is no longer required and we directly proceed to Granger causality tests to establish causal links between variables. The following VECM regression equations are being estimated in the next chapter, using the first difference of the logs of the variables.

$$\Delta InPB_t = \alpha_0 + a_1 e_{t-1} + \sum_{i=0}^{p} a_{2i}\Delta InPB_{t-i} + \sum_{i=0}^{p} a_{3i}\Delta InINFL_{t-i} + \sum_{i=0}^{p} a_{4i}\Delta InEX_{t-i} + u_{1t} \quad (4.18)$$

$$\Delta InINFL_t = b_0 + b_1 e_{t-1} + \sum_{i=0}^{p} b_{2i}\Delta InPB_{t-i} + \sum_{i=0}^{p} b_{3i}\Delta InINFL_{t-i} + \sum_{i=0}^{p} b_{4i}\Delta InEX_{t-i} + u_{2t} \quad (4.19)$$

$$\Delta InEX_t = c_0 + c_1 e_{t-1} + \sum_{i=0}^{p} c_{2i}\Delta InPB_{t-i} + \sum_{i=0}^{p} c_{3i}\Delta InINFL_{t-i} + \sum_{i=0}^{p} c_{4i}\Delta InEX_{t-i} + u_{3t} \quad (4.20)$$

where "Δ" is the first difference operator and "p" is the lag length.

Short run Granger causality in a VECM

Granger causality actually measures whether current and past values of a variable help to forecast future values of another variable. In other words, the rationale for granger causality test is to find out if lagged values of a particular variable add any information to forecasting the endogenous variable.

Diagnostic Tests

Diagnostic tests are utilized for checking the validity of the fitted model. In this study, VECM based diagnostic tests are reported to check the validity of the fitted model. A Lagrange-multiplier test will be used to investigate a possible serial correlation in the error term. CUSUM and CUSUMSQ will also use to check or test the stability of the estimated parameters in the model.

Impulse responses

Impulse response functions (IRF) are useful to visually study the behaviour of the endogenous variables in response to various shocks in the other variables of the model. Thus, an impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables in the model. We will use this technique to determine how different our variables respond to shocks of equal magnitudes.

Variance Decomposition Analysis

Variance decomposition or forecast error variance decomposition shows the amount of information that each endogenous variable contributes to other endogenous variables in a VAR/VECM. While impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the VAR/VECM, variance decomposition separates the shock in an endogenous variable into component shocks to the VAR/VECM. We will use these two techniques to learn more about the dynamics of shocks that emanate from the same or groups of variables.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 Introduction

This chapter presents the preliminary tests, the results from the estimated regressions and the post estimation results using the econometric techniques discussed in the previous chapter. First, the data used in this study is described and their sources are provided. Next, we examine the stationarity properties of the three variables used in our regressions. Third, cointegration is tested and it is followed by the presentation of the regression results. Causality relationships among the variables of interest are also tested and presented, followed by a series of diagnostic tests of the fitted model. Finally, impulse response functions and variance decompositions are also visually presented. All the estimations are done using the Stata 13 software.

5.2 Data description

We briefly describe in this section the key variables used our estimations. Among the issues to be discussed include the definition of the variables, the sources of the data used and summary statistics of the variables in their original.

5.2.1 Definition of Variables

The debt-to GDP-ratio used in this thesis is the gross government debt as a percentage of GDP. Gross debt consists of all liabilities that require payment or payment of interest and/or principal by the debtor to the creditor at a date or dates in the future. This includes both the domestic debt and the external/foreign debt (World Economic Outlook, 2014). Inflation is

defined in this thesis as percentage changes in the year-on-year average consumer prices index (CPI) (World Economic Outlook, 2014). The exchange rate used in this study is defined as the exchange rate determined by Bank of Ghana. It is calculated as an annual average based on monthly averages (World Bank database, 2014). The relevant bilateral exchange rate is the cedi-dollar exchange rate.

5.2.2 Data source

The data is based on Ghana's macro-level statistics and it is a time series organized annually from 1990 to 2013. The annual data for the study were obtained from two sources namely, the World Economic Outlook database (2014) and the World Bank database (2014) covering the period 1990 – 2013. The debt-to-GDP ratio and the inflation rate were obtained from the IMF's World Economic Outlook database (October 2014), whiles the exchange rate series were obtained from World Bank database. A summary of the variables in their original levels is presented below in the Table 5.1.

Table 5.1 – Summary statistics of the variables in their original levels

Variable	Observation	Mean	Standard Deviation	Min.	Max.
Public debt (*PB*)	24	60.76921	27.01321	26.192	123.346
Exchange rate (*EX*)	24	0.7083333	0.597827	0.03	1.95
Inflation (*INFL*)	24	20.88333	12.81353	8.7	59.5

(Source: Author's construct using data from the World Bank and the IMF)

From table 5.1 above, there are 24 observations for all variables and all the variables have positive values. The debt-to-GDP ratio ranges from 26.192% to 123.346% while the values of the cedi-dollar exchange rate ranges between 0.03 and 1.95. Moreover, the inflation rate ranges between 8.7% and 59.5%. On the average, annual debt-to-GDP ratio is 60.77% for

each of the years under the period of study. Again, on the average, annual inflation is 20.88% in each year under the period of study while exchange rate on the average is 0.7GH₵/US$ annually. The standard deviations of the debt-to-GDP ratio, the exchange rate and inflation are 27.013, 0.597 and 12.814 respectively. Though the standard deviations for debt-to-GDP ratio and inflation are high, it is below their respective means, which indicates a lower variance. This further implies that the series are stable and more uniform, and hence can be used for the estimation.

5.3 Time series characteristics of the variables

From appendix A1, it can be seen from the graph that that only *InINFL* (log of inflation) appears to be stationary. That is, it appears to fluctuate around its mean, suggesting stationarity. The other two variables are however clearly non-stationary. Whiles *InEX* (log of the exchange rate) shows a general upward trend over the entire period, the fluctuations in *InPB* (log of the debt-to-GDP ratio) are clearly not around its mean, suggesting non-stationarity.

On differencing the series once, they all tend to fluctuate around their respective means, suggesting stationarity. Moreover, they tend to exhibit similar behaviour on differencing (see appendix A2). According to Stigler & Sherwin (1985), non-stationary unrelated variables will tend to have a lower correlation coefficient upon differencing. However, if variables are non-stationary but related, they will tend to have a higher correlation coefficient in their differenced form as in the case of $\Delta InPB, \Delta InINFL$ and $\Delta InEX$. This is depicted in appendix A2. Because the eye can be deceptive on some occasions, we sort to a more formal way detecting stationarity in section 5.4 below.

5.4 Stationarity test

This section presents the results of the augmented Dickey-Fuller (ADF) unit root test of the variables. The variables were not tested in the level or difference form without first taking a natural logarithm. Table 5.2 below presents the ADF-tests of the logarithmic levels of the variables.

Table 5.2 – Augmented Dickey-Fuller test

Variable	ADF-Test	Critical value – 5 percent	P-value	Stationary
InPB	-1.639	-3.000	0.4626	No
InINFL	-2.759	-3.000	0.0644	No
InEX	-2.459	-3.000	0.1258	No

Source: Author's construct using Stata.

As Table 5.2 above shows, all the variables in their log levels are non-stationary. The ADF test accepted the existence of unit roots in the variables in their log levels since all the probability values are more than five percent. Also, the results show that the t-test for all the variables in their log levels are less than the critical value at five percent, indicating that the variables in their log levels are non-stationary. Hence using these variables could produce unrelated or spurious regressions. The result for *InEX* is not quite surprising as appendix A1 illustrates that the variable clearly has an increasing mean in time. That is, the log of exchange rate seems to exhibit trended behaviour, suggesting the presence of unit root.

The result for *InPB* is also not surprising as it doesn't appear to fluctuate around its mean. However, the result for *InINFL* is somewhat surprising as it appears to fluctuate around its mean (see appendix A1). One way to make these non-stationary variables stationary is to difference them. The differenced variables are then tested again for unit root using the same ADF procedure. The unit root results for the differenced variables are presented below in Table 5.3.

Table 5.3: Augmented Dickey-Fuller test for Unit Root in the Variables at their Log Difference

Variable	ADF-Test	Critical value – 5 percent	P-value	Stationary
$\Delta InPB$	-3.298	-3.000	0.0150	Yes
$\Delta InINFL$	-5.425	-3.000	0.0000	Yes
$\Delta InEX$	-3.494	-3.000	0.0081	Yes

Source: Author's construct using stata.

The results show that the logs of debt-to-GDP ratio, inflation and the exchange rate do not contain unit roots at their first difference since all the probabilities are less than five percent. In other words, these variables are difference stationary I(1), and thus, it is reasonably safe to estimate the model using them. Moreover, it should also be noted that on differencing, the variables tended to fluctuate more around their means, suggesting that they are stationary as shown in appendix A2.

5.5 Cointegration results

As concluded in the previous section, the first differences of the logs of all the variables are stationary. However, the long equilibrium/relationship between the variables cannot be straightforwardly estimated unless they are cointegrated. In the present section, cointegration of the first difference of the logs of the variables is tested to ascertain whether long run relationship exist between these variables. But before identifying the number of cointegrating vectors or equations, we first have to determine the optimal lag length for the Johansen test and also for the model estimation. The choice of the optimal lag length to be used is presented in Table 5.4.

Table 5.4: Test of Optimal Lag Length

Selection-order criteria
Sample: 1994 - 2013 Number of obs = 20

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-41.371				.01697	4.4371	4.46625	4.58646
1	14.2566	111.26	9	0.000	.000163	-.225662	-.109036	.371777
2	22.5035	16.494	9	0.057	.000189	-.150345	.053751	.895174
3	30.9497	16.893	9	0.050	.000245	-.094972	.196594	1.39863
4	55.5158	49.132*	9	0.000	.000082*	-1.65158*	-1.27255*	.290095*

Note: "*" indicates lag order selected by a criterion

Table 5.4 indicates that four years lag length is the optimal lag length to be used for the Johansen cointegration test and also for estimating the model. This lag length as can be seen from the table was chosen based on five different lag selection criterion – Akaike information criterion (AIC), Hannan-Quinn information criterion (HQIC), Sequential Likelihood-ratio (LR), Final Prediction Error (FPE) and the Bayesian Information Criterion (SBIC), which all chose four lags, indicated by "*" in the table. The results of the Johansen test for cointegration are then presented in table 5.5.

As presented in the table below table 5.5, at 5% critical value, both the trace (λ_{trace}) and maximum (λ_m) test statistics indicate one significant co-integrating vector among the variables, as the null hypothesis, $r \leq 0$ in case of trace statistics and $r = 0$ in the case of maximal eigen value test were rejected. Thus, both test statistics were greater than their respective critical values and hence we strongly reject the first null hypothesis of at most zero co-integration. We, however, accept the second null hypothesis that there is one co-integrating equation in the model. With this evidence, it can be interpreted that Ghana's debt-to-GDP ratio, inflation and the exchange rate moves together in the long-run. The economic reason behind co-integration analysis is that economic variables do not normally drift far

away from each other, and this seems to be the case with the variables concerned in this study as shown in the results below.

Table 5.5: Johansen Co-integration Test

Part A: Trace Statistic			
Null Hypothesis	Alternative Hypothesis	Test Statistic	Critical Value (5%)
Ho: $r \leq 0$	$H_A: r > 0$	83.6823	42.44
Ho: $r \leq 1$	$H_A: r > 1$	24.1281*	25.32
Ho: $r \leq 2$	$H_A: r > 2$	5.5469	12.25
Part B: Maximum Eigen Value Statistic			
Null Hypothesis	Alternative Hypothesis	Test Statistic	Critical Value (5%)
Ho: $r = 0$	$H_A: r = 0$	59.5540	25.54
Ho: $r = 1$	$H_A: r = 1$	18.5814	18.96
Ho: $r = 2$	$H_A: r = 2$	5.5469	12.52

Note: the test statistics are based on a model with four lags and a trend (rtrend). The trend (rtrend) model excludes linear trends in the differenced data but could allow for linear trends in the cointegrating equations.

5.6 Vector Error Correction Model results

Having determined that there is a cointegrating equation among the variables in their log levels, we now estimate the parameters of the three-variable cointegrating VECM. Table 5.6 presents the VECM results for the first equation, i.e., the public debt equation (Equation 4.18 in chapter four).

From the table below, it can be seen that the error correction term is correctly signed and statistically significant at five percent level. This indicates that there is a long-run causality running from inflation and exchange rate to public-debt ratio. The coefficient of the error correction term is —0.9810235 which shows a high speed of adjustment towards long-run equilibrium. This further indicates that, whenever there is any disturbance in the system, in the long run, about 98% correction to disequilibrium will take place in every short period. The implication of this result is that, under the study period, past values of both inflation and

the exchange rate could predict changes in the public debt in Ghana in the long run. We would see later on whether these changes are negative or positive.

Table 5.6: VECM Estimates for the first equation (Δ*InPB*)

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Error correction term($\mathcal{C}_{t-1}$)	-.9810235	.3662831	-2.68	0.007	-1.698925	-.2631219
$\Delta InPB_{t-1}$	1.10162	.3413573	3.23	0.001	.4325715	1.770668
$\Delta InPB_{t-2}$	.2859095	.2751777	1.04	0.299	-.2534289	.825248
$\Delta InPB_{t-3}$	.4505802	.3092895	1.46	0.145	-.1556161	1.056777
$\Delta InINFL_{t-1}$	-.7468871	.2573665	-2.90	0.004	-1.251316	-.2424581
$\Delta InINFL_{t-2}$	-.6286496	.2672611	-2.35	0.019	-1.152472	-.1048275
$\Delta InINFL_{t-3}$	-.7390288	.2168801	-3.41	0.001	-1.164106	-.3139517
$\Delta InEX_{t-1}$	-.2608554	.4435579	-0.59	0.556	-1.130213	.6085021
$\Delta InEX_{t-2}$	.6153144	.5006688	1.23	0.219	-.3659783	1.596607
$\Delta InEX_{t-3}$	.6674086	.3581992	1.86	0.062	-.0346489	1.369466
constant	-.0018342	.1206266	-0.02	0.988	-.2382581	.2345896

Note: The estimation is based on a model with an optimal lag length of four, one cointegrating vector and also rtrend trend using Stata.

Furthermore, the results above show that only the first lagged variable of the debt-to-GDP ratio is statistically significant at five percent which means that it explains changes to the debt-to-GDP ratio in the short run. However, the other two lagged variables of the debt-to-GDP ratio with two and three lags are statistically insignificant and hence do not explain changes to the debt-to-GDP ratio.

Table 5.6 also indicates that all the lagged variables of inflation are significant at five percent and hence each of them explains changes to the debt-to-GDP ratio in the short-run. That is, each of them negatively affects the debt-to-GDP ratio. Moreover, they all have the expected

signs as postulated by the debt dynamics theory, that is, an increase in inflation reduces the public debt ratio. This result is in contrast to the study by Lopes da Viega, Ferreira-Lopes & Sequeira (2014), where higher public debts ratios rather led to high levels of inflation in 52 Africa economies. Comparable to Nigeria which is in the sub-Sahara region, this result contradicts both studies by Ezeabasili, Mojekwu & Herbert (2012) and Anayochukwu (2012) where each study failed to accept that inflation reduces the fiscal deficit/GDP, vis-à-vis the public-debt ratio in Nigeria.

The findings above also support the view of the World Bank that inflating away the public debt is effective in developing countries than in developed countries. In the case of Ghana, this finding indicates that Ghana's tax base is relative large and hence seigniorage revenue is likely to be large in periods of inflation in Ghana, which will then erode part of the public-debt ratio. Not just that, it also signifies that the Ghanaian government has a relatively strong tax administration and is able to collect these tax revenues.

Moreover, the results also indicate that in periods of inflation in Ghana (for the period under the study), the interest rate was generally not able to respond to a rise in inflation. This could be attributed to the fact that interest rate on Ghana's government bonds or debts are solely administered by the government. Another possible deduction from the results above could be that inflation in Ghana does not necessarily increase government spending and hence there is no or low offsetting effect on the impact of inflation on the public debt.

Also from table 5.6, whiles the last two lags of exchange rate had the expected signs as postulated by the debt dynamics theory, the first lag variable rather had a negative sign. However, the results indicate that all the lagged variables of the exchange rate are statistically insignificant at five percent and hence there is no significant short-run relationship with the debt-to-GDP ratio in the case of Ghana.

Next, the result for the second equation, that is, the inflation equation (Equation 4.19 in chapter four) in the VECM is presented and discussed. The results are shown in table 5.7. below.

Table 5.7: VECM Estimates for the second equation (Δ*InINFL*)

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Error correction term(e_{t-1})	2.090729	.6306204	3.32	0.001	.8547359	3.326722
$\Delta InPB_{t-1}$	-.0970912	.5877063	-0.17	0.869	-1.248974	1.054792
$\Delta InPB_{t-2}$	-.4200408	.4737666	-0.89	0.375	-1.348606	.5085247
$\Delta InPB_{t-3}$	-.9678622	.532496	-1.82	0.069	-2.011535	.0758107
$\Delta InINFL_{t-1}$	.9801025	.4431013	2.21	0.027	.1116398	1.848565
$\Delta InINFL_{t-2}$	1.434802	.4601367	3.12	0.002	.5329507	2.336654
$\Delta InINFL_{t-3}$	.5690143	.3733969	1.52	0.128	-.1628303	1.300859
$\Delta InEX_{t-1}$	-.9980985	.7636625	-1.31	0.191	-2.494849	.4986525
$\Delta InEX_{t-2}$	-1.840578	.8619888	-2.14	0.033	-3.530045	-.1511108
$\Delta InEX_{t-3}$	-.146114	.6167025	-0.24	0.813	-1.354829	1.062601
constant	-.0004203	.2076799	-0.00	0.998	-.4074653	.4066248

Note: the debt-to-GDP ratio is the target model and the estimation is based on a model with an optimal lag length of four, one cointegrating vector and also rtrend trend using Stata.

From table 5.7 above, it can be seen that the error correction term is not correctly signed but statistically significant at five percent level. This indicates that there is no long run causality running from debt-to-GDP ratio and exchange rate to inflation in the case of Ghana. Moreover, the results show that none of the lagged variables of inflation, exchange rate and the debt-to-GDP ratio are significant at five percent, except the second lagged variable of inflation.

Since there was no short run effect of the public-debt ratio on inflation, we could say that for most part of the period under the study, the Ghanaian government didn't monetise the public debt. Even if it did monetise the public debt, such monetisation was not large enough to lead to inflation, and one reason could also be that the government recouped back these monies in a form of high taxes. Moreover, this also indicates that the wealth effect is weak or non-existing in the case of Ghana. The reason could be that Ghanaians do not perceive increase in government debt as an increase in their wealth and hence do not increase their spending on goods and services. The expectation of increase in taxes could also be one reason why Ghanaians don't spend too much of their accumulated wealth. As already said, the maturity structure of Ghana's government debt is getting longer which could explain the weakness of the wealth Channel.

Lastly, the results for the last equation, that is, the exchange rate equation (Equation 4.20 in chapter four) in the VECM are presented and discussed. The results are being presented in Table 5.8.

From table 5.8, it can be seen that the error correction term is correctly signed but not statistically significant at five percent level. This indicates that there is no long-run causality running from debt-to-GDP ratio and inflation to exchange rate in the case of Ghana. Moreover, the results also show that none of the lagged variables of inflation, exchange rate and the debt-to-GDP ratio are significant at five percent. This establishes that there is no significant short-run relationship among exchange rate and its determinants.

Table 5.8: VECM Estimates for the third equation ($\Delta InEX$)

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Error correction term(e_{t-1})	-.0193816	.3013244	-0.06	0.949	-.6099665	.5712033
$\Delta InPB_{t-1}$	.379729	.2808191	1.35	0.176	-.1706663	.9301243
$\Delta InPB_{t-2}$	.0222269	.2263762	0.10	0.922	-.4214622	.4659161
$\Delta InPB_{t-3}$	-.0779481	.2544384	-0.31	0.759	-.5766381	.4207419
$\Delta InINFL_{t-1}$	.0115688	.2117236	0.05	0.956	-.4034019	.4265395
$\Delta InINFL_{t-2}$	-.0980412	.2198635	-0.45	0.656	-.5289658	.3328834
$\Delta InINFL_{t-3}$	-.1707739	.1784173	-0.96	0.338	-.5204655	.1789176
$\Delta InEX_{t-1}$	-.1367055	.3648948	-0.37	0.708	-.8518863	.5784752
$\Delta InEX_{t-2}$	.2148959	.4118773	0.52	0.602	-.5923688	1.022161
$\Delta InEX_{t-3}$	.5108735	.2946741	1.73	0.083	-.0666771	1.088424
constant	.0475068	.099234	0.48	0.632	-.1469883	.2420019

Note: the debt-to-GDP ratio is the target model and the estimation is based on a model with an optimal lag length of four, one cointegrating vector and also rtrend trend.

One interpretation from this result is that, in the event of a depreciation of the cedi in the short run, the Ghanaian government should not hastily increase taxes to reduce the debt since the exchange rate has no short-run effect on the public debt. Another indication from the above results could also be that Ghana's tradable sector is indeed not negligible at all. That is, a depreciation of the exchange rate through the export sector could increase GDP such that it offsets most of the negative effect of the exchange rate on the public debt.

Another deduction could be that an increase in Ghana's public-debt-ratio did not affect the portfolio decisions of international creditors in the short run over the period under the study, which could explain why the public-debt to GDP ratio did not have any effect on the exchange rate. In other words, higher public debt in Ghana does not cause much capital outflows that would lead to a depreciation of the cedi. The reason could be that the government raises interest rate in such periods in order to halt capital outflow. Arguably,

another reason could be that international creditors believe in the ability of the Ghanaian government to raise enough taxes and also the ability to convert these revenues into foreign exchange. In a nutshell, we could say that in periods of high public-debt-ratios in Ghana under the study period, international creditors did not expect the Ghanaian government to default on its debt in the short run.

Notwithstanding the discussion above, to get a better idea of how the model fits, we predict the cointegrating equation from the estimation results and graph it over time. This is shown in appendix A3. The predicted cointegrating equation has the right appearance throughout the entire period. That is, the cointegrating equation looks like a stationary series which means that the estimated model is a better model.

5.7 VECM Based Short-run Granger Causality Results

From our results from the cointegration results, we have it that the first difference of log levels of the variables are cointegrated, so we can therefore conclude that there is at least one long-run causal relation among the three variables. We have already seen in the previous section that long-run causality runs only from inflation and exchange rate to the debt-to-GDP ratio. In this section, however, we test for short run causality among the variables. The significance of short-run causality depends on the overall significance of $\Sigma\chi 2$ (i.e., overall chi-square) and sometimes as well as the individual significance of the lagged independent variables (Awan, Asghar, Rehman, 2011). But we have already examined the individual significance of all the lagged variables in the previous section and hence only the results for overall significance are presented in this section. The VECM based granger causality results are presented in Table 5.9 below.

Table 5.9: VECM based Short run Granger Causality Estimates

Null hypothesis	Σχ2 (overall chi-square)	Prob > chi2	Dependent variable	Independent variables	Accept or reject null hypothesis
Inflation does not cause debt/GDP ratio	14.34	0.0025	$\Delta InDebt_t$	All lagged variables of inflation	Reject
Exchange rate does not cause debt/GDP ratio	4.02	0.2591	$\Delta\ InDebt_t$	All lagged variables of exchange rate	Accept
Debt/GDP ratio does not cause inflation	3.88	0.2743	$\Delta\ InINFL_t$	All lagged variables of debt/GDP	Accept
Exchange rate does not cause inflation	6.69	0.0823	$\Delta\ InINFL_t$	All lagged variables of exchange rate	Accept
Debt/GDP ratio does not cause exchange rate	2.21	0.5297	$\Delta\ InEX_t$	All lagged variables of debt/GDP	Accept
Inflation does not cause exchange rate	1.78	0.6195	$\Delta\ InEX_t$	All lagged variables of inflation	Accept

The results show that in case of the first dependent variable Δ ($InDebt_t$), that is the public debt equation; the null hypothesis that the coefficients of all lagged variables of inflation are jointly not different from zero was rejected at the 5 percent level of significance. This means that there is a short run causal link running from inflation to the debt-to-GDP ratio. However, the null hypothesis that the coefficients of all lagged variables of exchange rate are jointly not different from zero was accepted at 5 percent level of significance, indicating that there is no short run causality running from exchange rate to the debt-to-GDP ratio. The reason could be due to the fact that exchange rate depreciation throughout the entire period has been moderate, compared to inflation.

These results help to explain the historical development in the public-debt ratio in Ghana, specifically for the periods 1995-2000 and 2009-2013 where the debt ratio was very high and

seemed unsustainable. In fact, from 1995 to 1999, the inflation rate had decreased from 59.5% to 12.4% before increasing to 25.2% in 2000. It is no secret that this decreasing trend in inflation within this period contributed to the high public-debt ratio. Similarly, from 2009 to 2013, the inflation rate had decreased from19.3% to 11.6% which also contributed to the rising public-debt ratio in that period.

In case of the second dependent variable $\Delta\ InINFL_t$, that is the inflation equation, we couldn't conclude that there was a short run causality running from debt-to-GDP and the exchange rate to inflation. Both the null hypothesis that 'debt does not cause inflation' and 'exchange rate does not cause inflation' in the short run were accepted at five percent significant level. Also, in case of the third dependent variable $\Delta\ InEX_t$, that is the exchange rate equation, both the null hypothesis that 'debt does not cause exchange rate' and 'inflation does not cause exchange rate' in the short run were accepted at five percent significant level. This indicates that there is no short run causal relationship running from debt-to-GDP ratio or inflation to exchange rate.

In summary, under the study period, the following conclusions can be made:

(i) there is a unit directional causality from inflation to the debt-to-GDP ratio;

(ii) debt-to-GDP ratio and exchange rate are independent variables;

(iii) inflation and exchange rate are independent variables.

Also, we could see that the short run causal relationship between public debt and the exchange rate seems to stand in contrast to both the debt-dynamics and the exchange rate dynamics theories presented in chapter two of this thesis. This contradicts the study by Ansah (2010), where foreign debt adjustment (as a result of currency exchange rate distortions) contributed significantly to debt accumulation in Ghana from 1960 to 1999. Comparably to Zimbabwe, the findings of this thesis again contradict the study by Mupunga & Roux (2014)

where exchange rate variations significantly affected the public debt dynamics in Zimbabwe. The unit directional causality from inflation to the debt-to-GDP ratio confirms the overwhelming influence of lower inflation levels on Ghana's public debt ratio. This is clearly seen in the periods 1996-2000 and 2009-2013, where a higher and rising public debt ratio was accompanied by a lower and decreasing level of inflation.

5.8 Diagnostic Tests

Diagnostic tests are performed to check the specification of the model. We first apply the Jarque-Bera test to check the normality of the variables used in the estimation of the VECM. The results of the test are presented in appendix A4. Since all the probability values are greater than five percent, we fail to reject the null hypothesis and conclude that the residuals in the model are normally distributed.

Also, results from the Skewness/Kurtosis tests for Normality confirms that the variables used in the model are normally distributed. The results from these tests are presented in appendix A5.We can strongly accept the null hypothesis of normally distributed errors since all the probability values are greater than five percent. That is, none of the errors is skewed or kurtotic.

Next, we apply the Lagrange-multiplier test to check for serial correlation in the residuals. Appendix A6 shows the results of the test. Since all the probability values are greater than five percent at all lags, we cannot reject the null hypothesis of no autocorrelation, and hence conclude that the model does not suffer from serial correlation.

A CUSUM and CUSUM SQUARED test of stability are also performed to check the stability of the model's parameters over time model. Appendix A7 presents the plots of CUSUM and

CUSUM SQUARED tests. The plots of both the CUSUM and CUSUMSQ did not cross the critical value line, which is an indication of the stability of the estimated parameters and hence these parameters could be used for policy purposes safely. In summary, from the results of all the diagnostic tests, it indicates that we can accept the specification of this model.

5.9 Impulse response functions for VECM

We saw in the previous section that the model is well specified and that the residuals are uncorrelated. This means we can estimate and interpret the impulse response function for the model. First, impulse responses are visually presented and analysed, then the cumulative impulse responses are also visually presented and interpreted.

Appendices A8, A9, and A10 present the impulse response functions to a shock in a variable on itself and other variables in the model using a ten-quarter forecast horizon. Since this study is not interested in the relationship between inflation and exchange rate, the result of this relationship is not presented.

Appendix A8 indicates that an orthogonalized shock to the debt-to-GDP ratio has a permanent effect on itself and also on inflation and the exchange rate. That is, the shock to debt-to-GDP ratio does not die out over time. Moreover, all the responses are positive responses which mean that a positive shock to debt-to-GDP ratio gives rise to an increase in inflation, an increase in the debt-to-GDP ratio and lastly, an increase in the exchange rate (i.e., a depreciation of the cedi). The strength of the responses, however, varies throughout the entire ten quarters, though it remains positive. This result is similar to a study by Kwon, McFarlane & Robinson (2006), where they found that a shock in the public debt had a more lasting positive effect on inflation. Also in Japan, Ida (2013) found that inflation considerably

increase in response to a public debt shock, particularly if the Japanese government put a small weight on controlling the public debt.

This result is critical for Ghana's inflation and exchange rate management. Thus, though anticipated increases in the public-debt-ratio may not be harmful to Ghana's inflation and exchange rate, unanticipated increases in the public debt will, however, lead to inflation and exchange rate depreciation. Therefore, in the case of Ghana, the government would need to manage shocks in the public-debt ratio if it wants to keep inflation and exchange rate at sustainable levels in the long run.

Appendix A9 indicates that an orthogonalized shock to inflation has a permanent effect on itself and also on the debt-to-GDP ratio. It can be seen from these graphs that a shock to inflation does not die out over time and hence it cannot be a temporal shock. Moreover, it can be seen that both inflation and the debt-to-GDP ratio give a negative response to positive shocks in inflation in the third quarter. The responses, however, remain positive for all the other quarters, becoming somewhat stronger immediately after the third quarter. This indicates that the negative impact of an inflation shock on the debt-to-GDP ratio is not immediate. One interpretation could be that the effect of an inflation shock rather strengthens Ghana's economy through a positive supply shock in the third quarter before it dies out over time. This result is similar to the study by Cherif & Hasanov (2012) in the US, where inflation shocks such as hikes in crude oil prices slightly reduced the debt ratio for a few quarters and then rises afterwards. The result is also similar to the study by Reda & Fuad (2010), where a positive shock to inflation reduces the debt ratio for a short period before it starts rising after 3 years.

Appendix A10 shows that an orthogonalized shock to the exchange rate has a permanent effect on itself and also on the debt-to-GDP ratio. Again, it shows that a shock to exchange

rate does not die out over time as expected in a VECM. However, it can be seen that the response of the debt-to-GDP ratio to a shock in the exchange rate dies out in the sixth quarter but bounce back strongly after the seventh quarter and remains positive till the tenth quarter. The permanent positive response means that an unexpected depreciation of the cedi will increase the debt-to-GDP ratio and also lead to a further depreciation of the cedi.

As has been discussed above, all responses to the various shocks are permanent. However, since the model was estimated with the variables in their log-differences, it is possible that they might be transitory in their levels. We can then accumulate the impulse response functions so that they are back in levels. This will help us obtain some view on the level effects. Appendices A11, A12, A13 illustrate the cumulative orthogonalized IRFs (the long-run multipliers).

From appendix A11, we can see that even when the cumulative effects are examined, the cumulative impulse responses of all the variables to a shock in the debt-to-GDP ratio significantly depart from zero. That is, the positive responses of the variables are permanent and increase throughout the entire period. This indicates that the level effects tend to be persistent to shocks in the debt-to-GDP ratio through time which reinforce the previous findings.

From appendix A12, we can see that the cumulative impulse responses of inflation and the debt-to-GDP ratio to a positive shock in inflation is significant, and permanently depart from zero throughout the entire period, indicating that the level effects tend to be persistent through time which also reinforce the previous findings. Moreover, in the case of the debt-to-GDP ratio, the response tends to be very weak for the first three quarters as it is very close to zero.

Again, appendix A13 shows that the cumulative impulse responses of exchange rate and the debt-to-GDP ratio to a positive shock in the exchange rate is also significant, and permanently depart from zero throughout the entire period, indicating that the level effects tend to be also persistent through time. These results again reinforce the previous findings that a positive shock in exchange rate increases the debt-to-GDP ratio and also leads to a further depreciation of the exchange rate.

5.10 Variance Decomposition

This section visually presents the results of forecast error variance decompositions (FEVD) to examine the percentage contribution of shocks emanating from each endogenous variable on itself and also on other endogenous variables. To begin with, we first examine the percentage contribution of shocks emanating from the debt-to-GDP ratio, exchange rate and inflation in forecasting the public debt-to-GDP ratio over ten quarters. It was found that the shock of the debt-to-GDP ratio explains almost 90% of its own forecast error variance, and even 100% in the first quarter before it declines. The shock of inflation explains almost none of it whiles shocks in the exchange rate explain roughly 10%, however for the first two quarters, shocks in both variables do not explain shocks in the debt-to-GDP ratio. This suggests that the debt-to-GDP ratio is likely to be exogenous and that it might not be hugely influenced by the exchange rate or inflation. The implication of this result is that much of the growth in the public debt could still be attributed to growth in the budget deficit, and hence the government will need to implement strong fiscal consolidation measures, alongside other policies in order to sustain the public debt. The results are shown in appendix A14.

Next, we examine the percentage contribution of shocks emanating from the debt-to-GDP ratio, exchange rate and inflation in forecasting inflation over ten quarters. The results are

shown in appendix A15. However, the focus will be on the debt-to-GDP ratio and inflation since the relationship between inflation and the exchange rate is not of interest in this study.

From appendix A15, it was found that the shock of inflation explains less than 20% (a little over 20% in the first quarter) of its own forecast error variance. Shock of the debt-to-GDP ratio explains about 60% (almost 70% in the first quarter) of it while the exchange rate explains almost 30%. This suggests that inflation is likely to be endogenous and that it could be largely affected by the debt-to-GDP ratio.

Lastly, we examine the percentage contribution of shocks emanating from the debt-to-GDP ratio, exchange rate and inflation in forecasting the exchange rate over ten quarters. Here again, we focus on the debt-to-GDP ratio and the exchange rate. The results showed that the shock of exchange rate explains about 60% of its own forecast error variance; however, it explains almost 70% in the first quarter before it declines. The shock of the debt-to-GDP ratio explains almost the other 40% of it. Thus, the exchange rate seems to be endogenous too and thus it is being affected by shocks in the public debt ratio. These results are shown in appendix A16. In managing the exchange rate, this result suggests that shocks in the exchange rate once again play a crucial role.

5.11 Chapter summary

This chapter presented the results of the empirical estimation. The variables were found to be integrated of order one. Moreover, the variables were found to cointegrate, meaning that they move together in the long run. The findings include the following. First, a long-run causality was found running from inflation and exchange rate to the public debt with no feedback effect from the public debt to inflation and the exchange rate. Secondly, while the study found a negative significant relationship between inflation and the public debt in the short-

run, a weak relationship was found to exist between the public debt and exchange rate in the short run. Also, a unidirectional causality was found in the short run, actively running from only inflation to public debt. All the impulse response functions of shocks to the variables were found to be permanent over time, which was reinforced by the level effects (estimated using cumulative impulse response functions). Also, a diagnostic test confirmed the validity of the model whiles the CUSUM and CUSUMSQ test revealed the stability of the model.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents a brief overview of the preceding chapters in this study. It also covers the summary of findings, policy recommendations, limitations of the study and finally, suggestions for further research.

6.2 Research summary

The purpose of this thesis was to study the relationship and the direction of causality between the public debt and two of its determinants — exchange rate and inflation — in Ghana over the period 1990-2013. These variables were chosen because the linkages between them are not quite clear in the case of Ghana, though periods of high public debt have often coincided with high inflation and exchange rate depreciation. In this thesis, it was argued that both inflation and the exchange rate could be either a cause or an effect of a high and rising public debt, however, these facts are widely ignored in most empirical studies on Ghana's public debt by most researchers (see, for example, Asiama, Akosah & Owusu-Afriyie, 2014;Kwakye, 2012)

The theoretical framework of this thesis consisted of some theories on public debt dynamics, inflation dynamics and exchange rate dynamics. The debt dynamics theory hold the view that inflation and exchange rate affects the public debt, whiles the other two theories postulated that public debt rather affects inflation and the exchange rate. In the case of Ghana, the empirical estimation revealed that inflation reduced the public-debt ratio in the short-run with no feedback effect from the public-debt ratio on inflation. On the other hand, the exchange

rate failed to explain changes in the public debt and vice versa in the short run. In the long run, both inflation and the exchange rate were found to affect the public-debt ratio with no feedback effect from the public-debt ratio on inflation and exchange rate. However, in the long-run, shocks to any of the variables had a positive effect and permanent effect on each other.

The following hypotheses were formed based on the theoretical framework:

- There is no relationship between public debt and exchange rate in Ghana.
- There is no relationship between public debt and the inflation rate in Ghana.
- There is no causal linkage between public debt and exchange rate in Ghana.
- There is no causal linkage between public debt and the inflation rate in Ghana.

Based on the theoretical framework, the study chose to use the VAR approach to examine the relationships and the directions of causality among the variables. The analysis began with the examination of the time series properties of the variables in their log levels. The Augmented Dickey-Fuller (ADF) test was performed on the log levels of the variables to determine the order of integration. The test indicated the presence of a unit root and hence the variables were differenced once. The ADF test was again performed on the first difference of the variables which rejected the presence of a unit root. That is, all the variables in their first difference log levels appeared stationary and hence it was concluded that they are integrated of order one.

A cointegrated test was performed which indicated one equilibrium relationship among the variables and hence a vector error correction model (VECM) was used to examine the relationships and the directions of causality among the variables. Next, the impulse response function was estimated to analyze the effect of a shock in a variable on other variables, as well as on itself. Lastly, the forecast error variance of decomposition was estimated to

examine the amount of information that each endogenous variable contributes to other endogenous variables in a VAR/VECM.

6.3 Implication of findings for Ghana

The implications for the main findings of this study can be categorised into long run and short run. In the long run, though the study revealed that changes in the exchange rate affects the public debt, these changes in the exchange rate are largely attributed to shocks. Therefore, to be able to sustain the public-debt ratio in the long run, the Ghanaian government must keep shocks in the exchange rate in check. However, the management of the shocks will depend on where it emanates from. It is normally a difficult task if the shocks to the exchange rate are external shocks. Hence, the government must guard against external shocks that affect the exchange rate in order to sustain the public-debt ratio. Specifically, prudent fiscal policy measures that put the brakes on rising recurrent expenditures in the wake of external shocks should be put in place.

Also, in the long run, though changes in inflation affect the public-debt ratio, inflation shocks would rather increase the public debt in the initial years before it is reduced in subsequent years. In the case of Ghana, this suggests that 'surprise inflation' is not really a good policy for the Ghanaian government to implement if it wants to erode the public-debt ratio through inflation. Moreover, the government should guard against shocks to inflation such as oil price shocks by removing constraints that impede the food production sector. Lastly, though no long run causality was found running from the public debt to inflation and the exchange rate, shocks to the public debt is very vital and crucial for the Ghanaian government in managing both inflation and the exchange rate.

In terms of the short run relationships, one finding was that the Ghanaian government could avoid both inflation and exchange rate depreciation even in the event of a higher and rising public debt since no relationship or causality was found running from the debt-to-GDP ratio to either inflation or the exchange rate. This further indicates that the Ghanaian government could still borrow even in periods of high public debt without any negative impacts on the exchange rate and inflation. Moreover, whiles inflation could also reduce the public-debt ratio in the short run, the exchange rate had no effect on the public-debt ratio in the short run in the case of Ghana.

6.4 Some policy recommendations for Ghana

As it has been shown in this thesis, a combination of a lower public debt and a lower inflation seems to be almost impossible in the short run in Ghana as a negative relationship was found to exist between the public debt and inflation. This study recommends that policymakers should not implement policies targeted at reducing both inflation and the public debt simultaneously in the short run as a lower inflation will actually increase the public debt over time. Moreover, in periods of a high and rising public debt, this study recommends that the government can inflate away the public debt in the short run, alongside several other ways of reducing the debt. In the long run, this study furthermore recommends that inflation initiated by the government aimed at reducing the public debt needs not to be a shock or unanticipated as the study revealed that a positive shock to inflation will not have any 'immediate' negative effect on the public debt. That is, a shock to inflation can only reduce the debt-to-GDP ratio in a later period, probably in the third year after the shock as suggested by the impulse response function.

Another implication of this study is that, in the short run, reliance on exchange rate appreciation to reduce the public debt must not be the focus of the government since exchange rate does not have a significant impact on the public debt. That is, the exchange rate has no major role to play in managing the public debt in the short run so government's attention should be focused on the primary cause of the debt. This study again recommends that public debt should not be a policy variable if the government wants to control inflation or halt the depreciation of the cedi. Considering the choice between taxes and the public debt as a means of controlling inflation, we recommend that the government uses taxes instead of the public debt as a policy variable. Furthermore, since public debt was found to be non-inflationary in the short run, this study suggests that the government or policy makers can still issue debt instruments in the short run even in periods of high inflation if there is the need. In this case, debt creation would be neither anti-inflationary nor inflationary. Similarly, since there is no exchange rate risk as a result of a higher and rising public debt in the short run, this study suggests that the government can still borrow to finance its deficit even in periods when the exchange rate is depreciating. However, these borrowed funds must be used on profitable projects so they can yield returns to be used to retire some of the debts.

Lastly, although this thesis couldn't examine the cause of the shocks to the variables, it is recommended that the government should have plans or policies in place to avoid them as the effects of these shocks seem to be significant and permanent over time. In the event that these shocks do occur, this study recommends that policy makers should have contingency policies that can be employed to offset the effects these shocks would have on the public debt and the other variables.

6.5 Limitations of the study

As with any study, this thesis also has some limitations. The first weakness has to do with the cointegration and the vector error correction model (VECM) used in this study. This methodology often requires a large sample size in order to draw solid inferences for policy simulations. The current sample size used in this study somewhat reduces the confidence in the results obtained. As postulated by Stock & Watson (2001), in such cases, less emphasis should be placed on the regression coefficients and the R^2 statistics, whiles placing more emphasis on the Granger-causality test, the impulse responses and the forecast error variance of decomposition which are more informative in explaining the relationship among the variables.

Also, this study examined only one country – Ghana, and hence the dynamic effects of the public debt, inflation and the exchange rate will vary between countries. This means that the results for this study as many empirical studies cannot be generalised. Moreover, since the variables were used in their logarithm levels, the level effects could not be directly studied. Nevertheless, this thesis examined the level effects indirectly by estimating the cumulative impulse response functions.

This study furthermore did not examine what actually causes the shocks to the debt-to-GDP ratio, inflation and the exchange rate, but only the effects of the shocks on these variables. That is, the study did not focus on different explanations for shocks but rather focused on the interactions among the variables caused by the shocks. Shocks to these variables might come from, for instance, oil price shocks, fiscal shocks, interest rate shocks, etc. Explaining the causes of these shocks is left for future studies and other researchers.

Also, we could see from the theoretical framework that other variables (such as growth rate, the interest rate, money supply, etc.) affect the public debt, exchange rate and inflation,

however, this study considered only three of these variables. This indicates that the estimated relationships among these variables could either be overestimated or underestimated, and hence the regression analysis might not be good for policy purposes. Moreover, by using the VAR/VECM methodology, the study had already assumed that both exchange rate and inflation affect each other. Though this assumption is based on economic theory, this study failed to present any underpinnings to support this assumption.

Again, the HIPC and MDRI initiatives had helped to reduce Ghana's public debt, especially the external debt in 2004 and 2006 respectively. This significant reduction in the public debt is likely to have a significant impact on the regression results, and hence the model might not have a very good predictive power. The study could have been done for two time periods — before and after these initiatives, however, the sample size could not allow the study to do so as it was already small. Lastly, the study was not able to examine a potential negative shock to a variable and the effect on other variables which might generate different responses.

6.6 Suggestion for future research

Firstly, this thesis suggests that more variables, especially those in the debt dynamics equation could be introduced into the model, either as endogenous or exogenous variables. This could yield a more practical and significant results. Secondly, future studies could consider other countries as well which might enhance comparability of the results, especially African countries in the same region. Again, future studies could use a panel data on multiple countries in the estimation which might enhance generalisation of the results. This could be done for countries within a particular region or countries with similar economic characteristics. Thirdly, if much data becomes available, especially after the HPIC and MDRI initiatives, future studies could divide the analysis into two — before and after these

initiatives. This will help to remove the effects that these two initiatives might have on the regression results. Also, monthly data could be used if available. This will help in capturing large variations in the data which is appropriate for cointegration and error correction techniques of estimation. Fourthly, future studies could also examine what actually causes the shocks to the debt-to-GDP ratio, inflation and the exchange rate. Lastly, future studies could consider using other estimation methods to examine the relationship between the public debt and its determinants.

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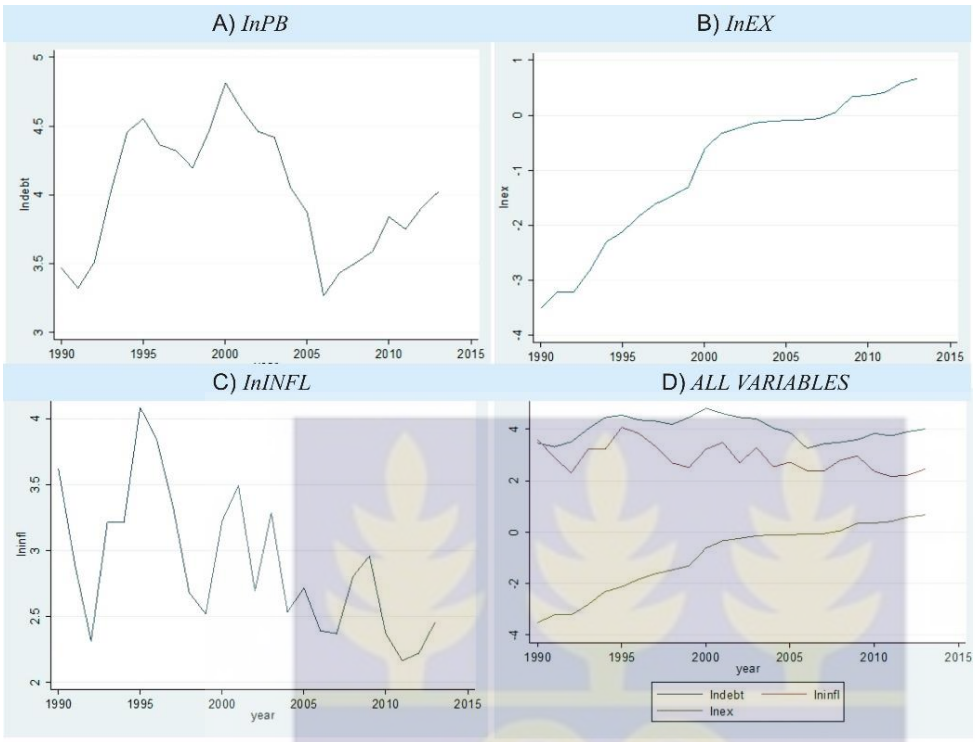
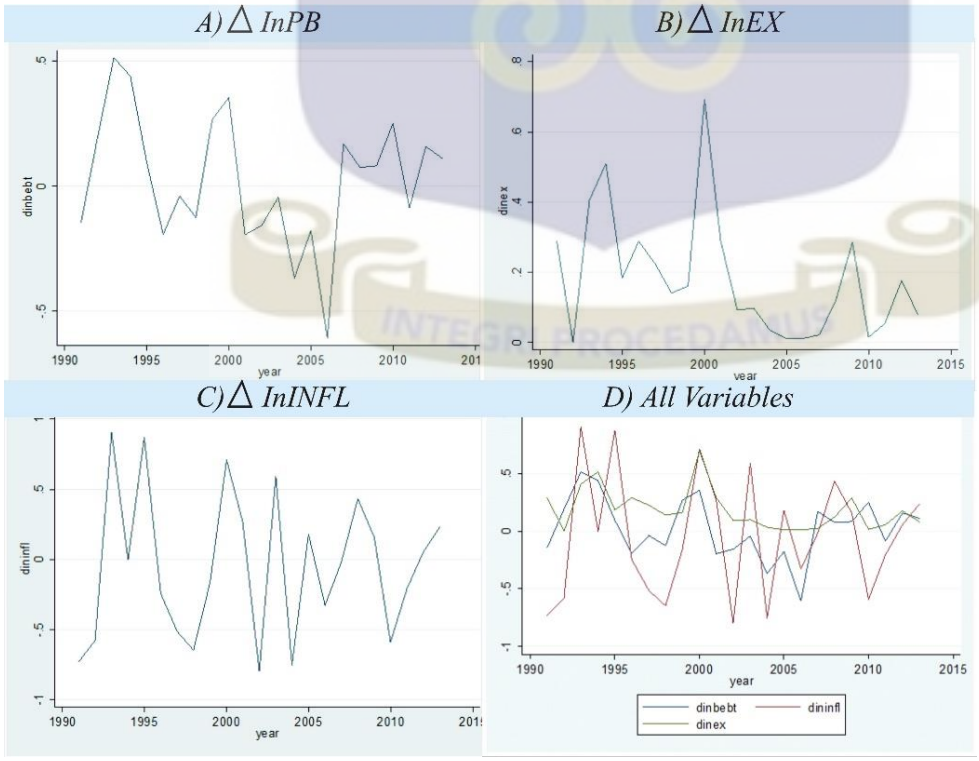
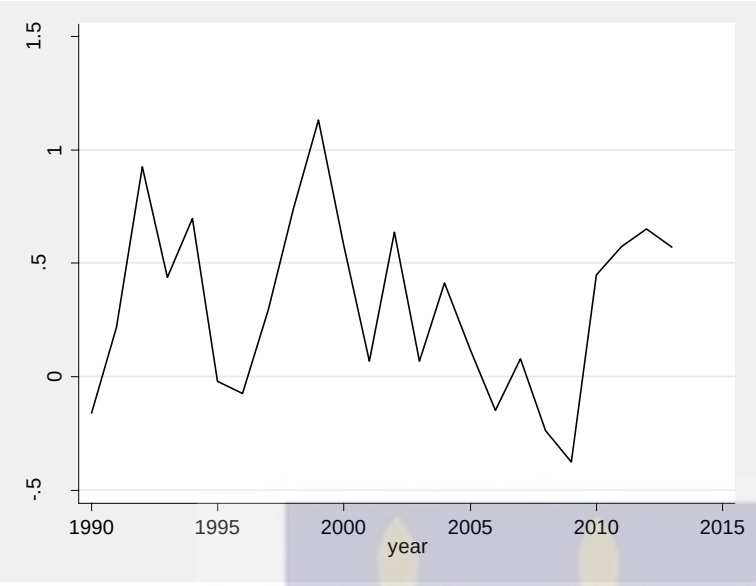
APPENDICES



AppendixA1: The logarithm levels of the variables



Appendix A2: The first difference of the logarithm levels of the variables



Appendix A3: Cointegrating equation

Appendix A4: Jarque-Bera test

Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_lndebt	1.530	2	0.46525
D_lninfl	0.062	2	0.96926
D_lnex	1.838	2	0.39897
ALL	3.431	6	0.75319

Note: H_0: Residual is normally distributed.

Appendix A5: Skewness/Kurtosis tests for Normality

Skewness test

Equation	Skewness	chi2	df	Prob > chi2
D_lndebt	-.4218	0.593	1	0.44124
D_lninfl	.01144	0.000	1	0.98334
D_lnex	.70289	1.647	1	0.19939
ALL		2.240	3	0.52404

Kurtosis test

Equation	Kurtosis	chi2	df	Prob > chi2
D_lndebt	1.9395	0.937	1	0.33298
D_lninfl	3.2728	0.062	1	0.80335
D_lnex	3.4786	0.191	1	0.66217
ALL		1.190	3	0.75536

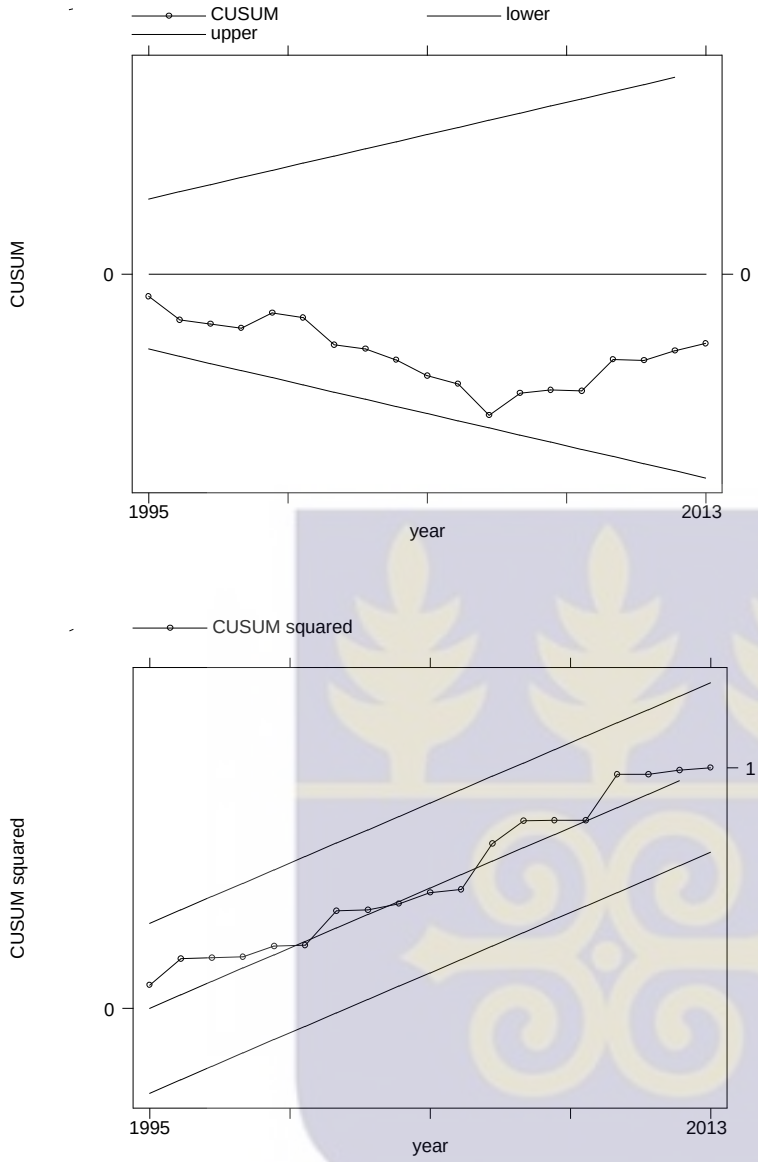
Note: H_0: Residual is normally distributed.

Appendix A6: Lagrange-multiplier test

Lagrange-multiplier test

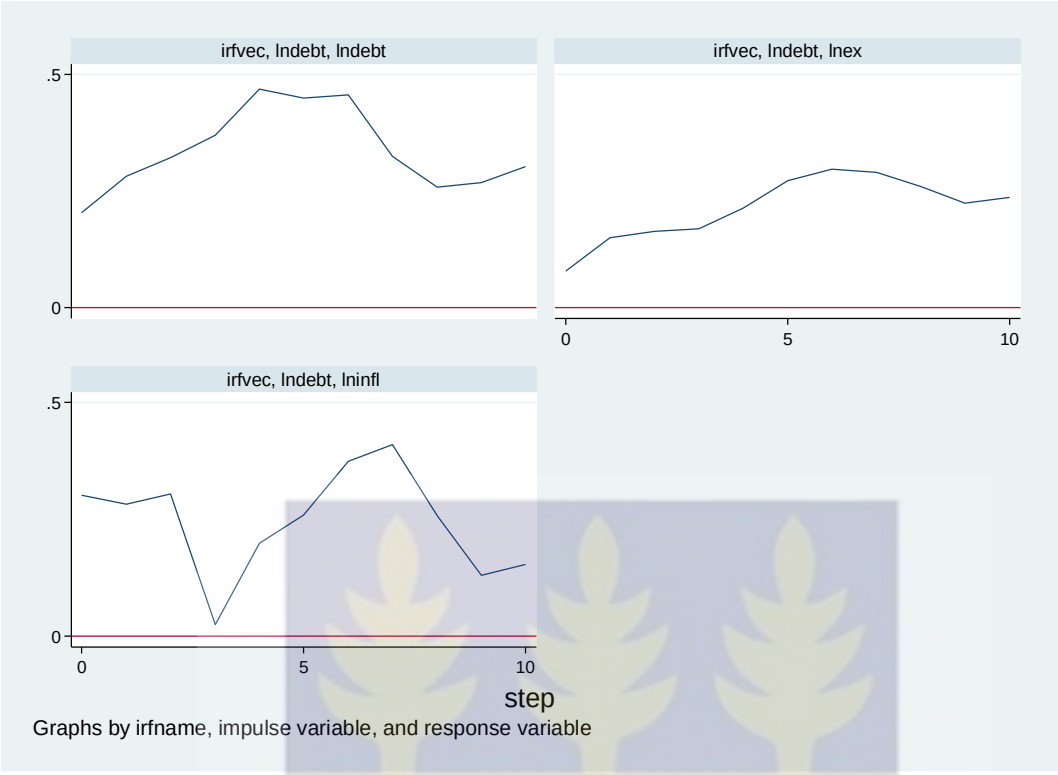
lag	chi2	df	Prob > chi2
1	11.4028	9	0.24911
2	11.1675	9	0.26440
3	7.5155	9	0.58361

Note: H_0: no autocorrelation at lag order



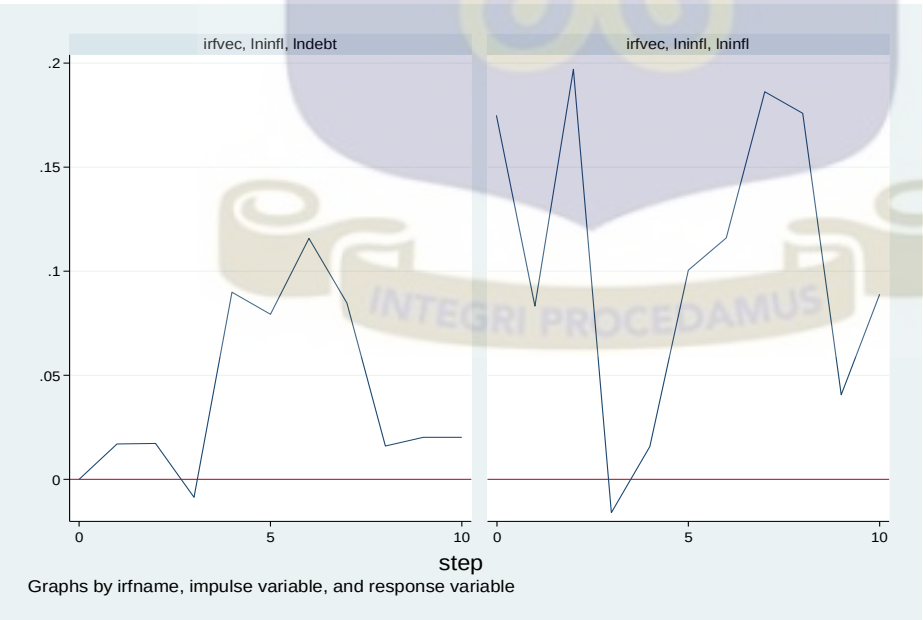
Appendix A7: CUSUM AND CUSUM SQUARED Tests

Note: the test uses five percent significant level



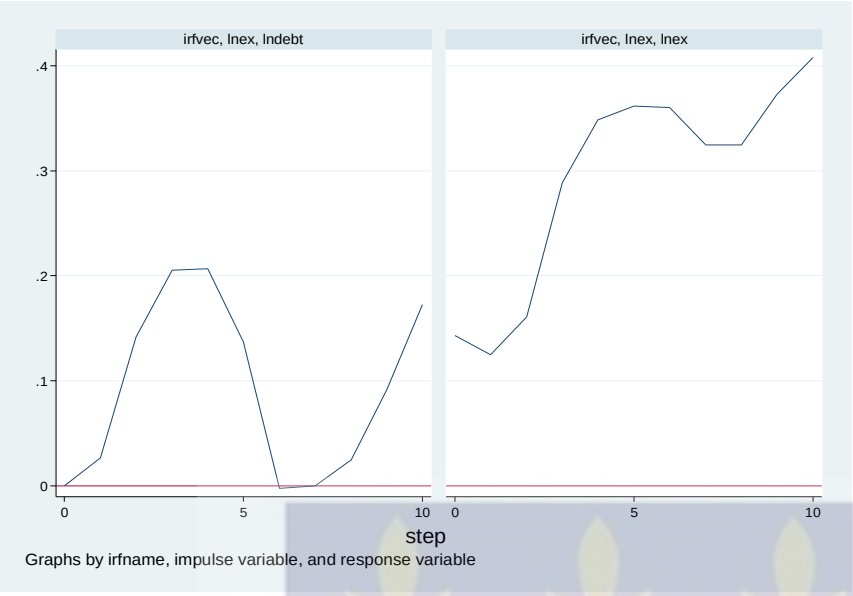
Appendix A8: Impulse response functions to a shock in the debt-to-GDP ratio (*InPB*)

Note: 'oirf' rather than 'irf' was specified because the latter gives impulse responses assuming (counterfactually) that the VAR residuals are uncorrelated.



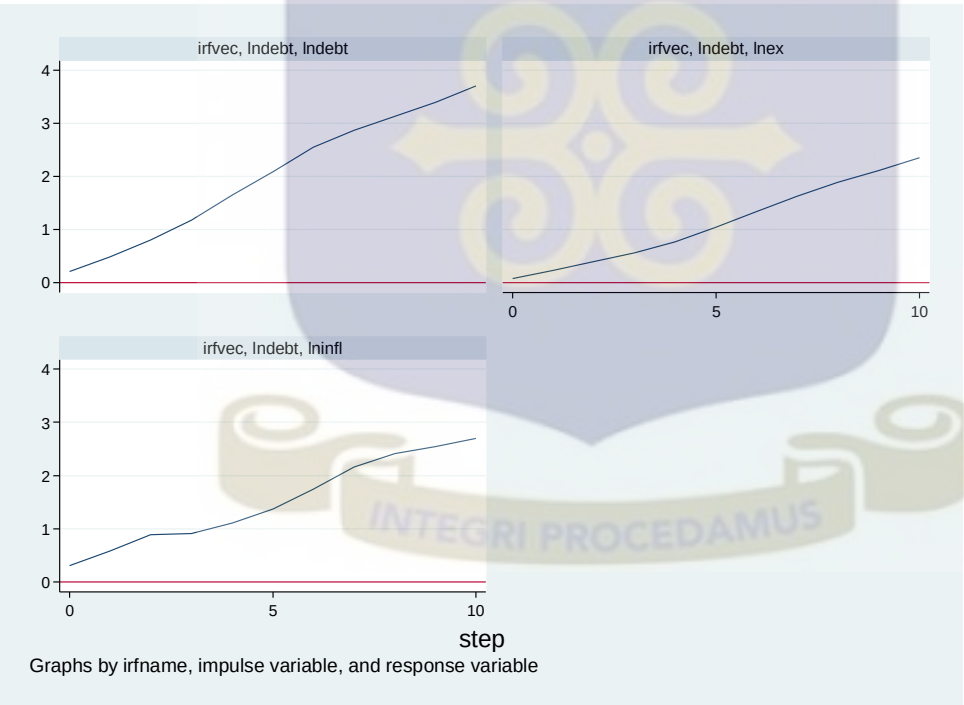
Appendix A9: Impulse response functions to a shock in inflation (*InINFL*)

Note: specify 'oirf' rather than 'irf'.



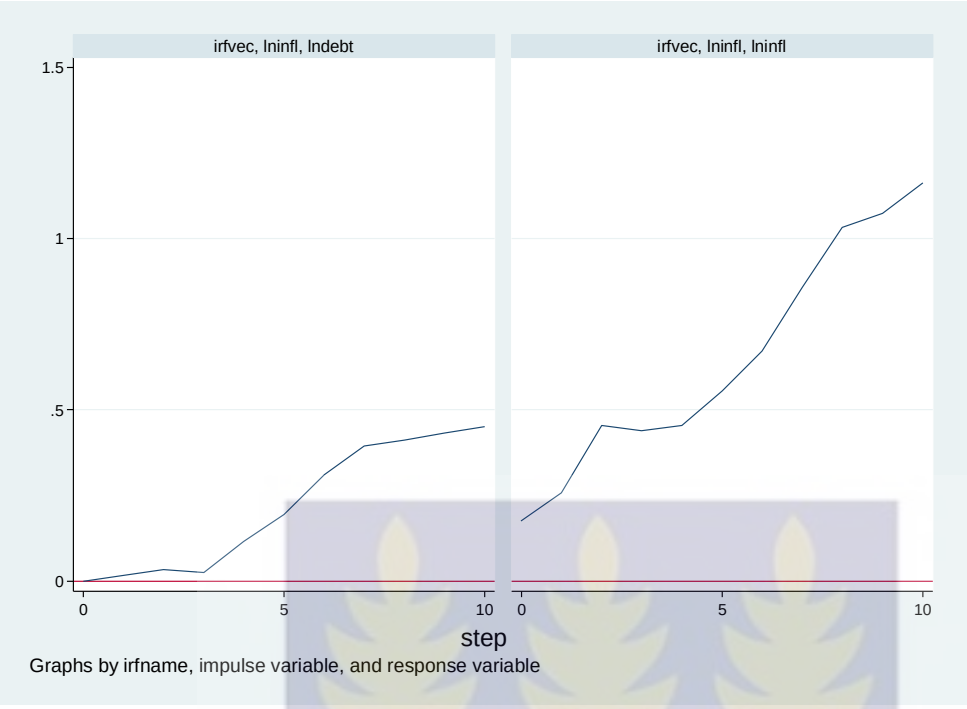
Appendix A10: Impulse response functions to a shock in exchange rate (*InEX*)

Note: specify 'oirf' rather than 'irf'.



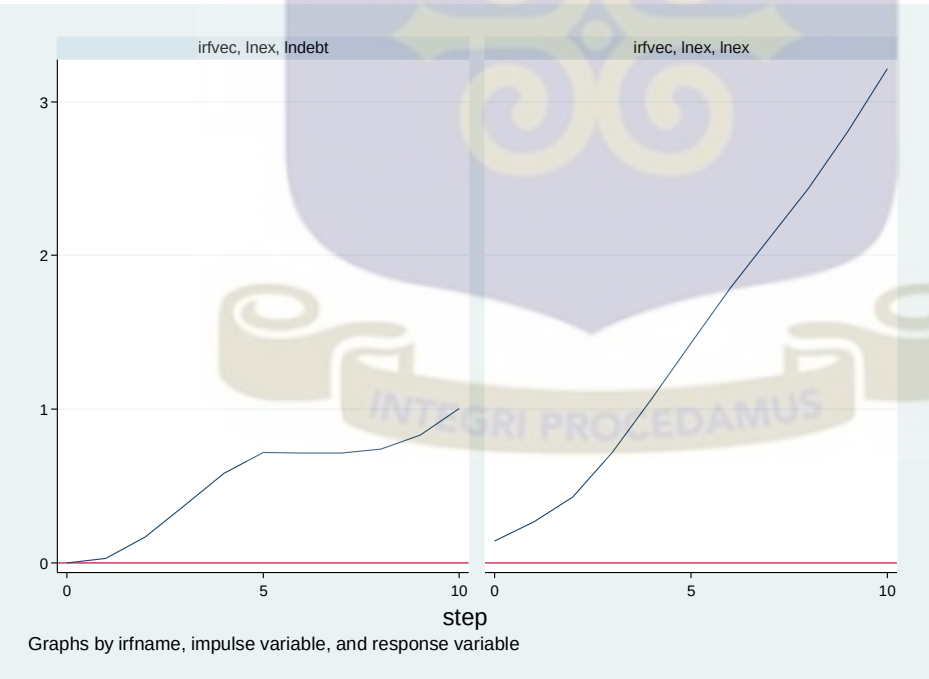
Appendix A11: Cumulative Impulse response functions to a shock in the debt-to-GDP ratio (*InPB*)

Note: specify 'coirf' rather than 'cirf'.



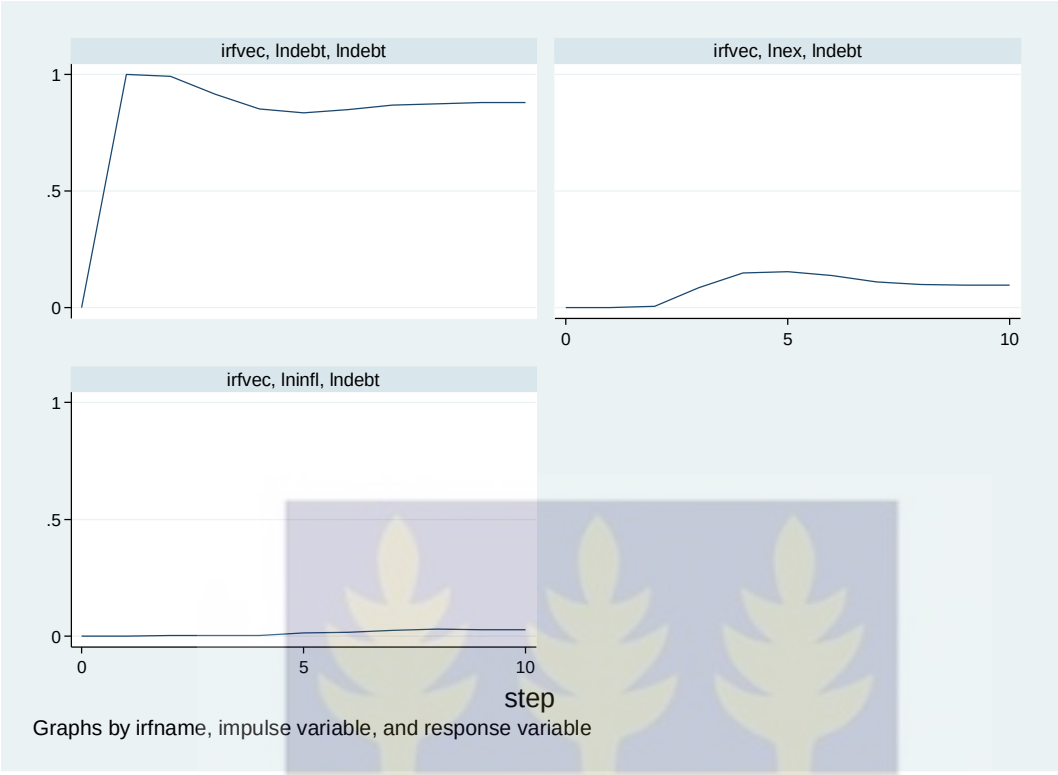
Appendix A12: cumulative Impulse response functions to a shock in inflation (*InINFL*)

Note: specify 'coirf' rather than 'cirf'.

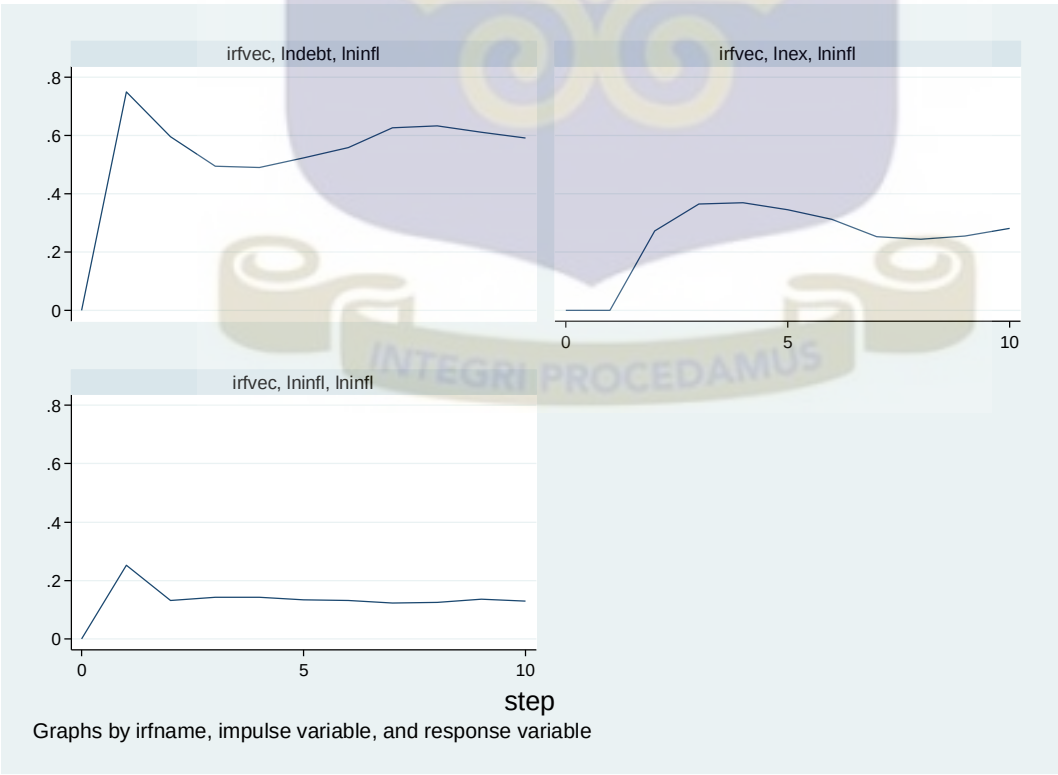


Appendix A13: Cumulative Impulse response functions to a shock in exchange rate (*InEX*)

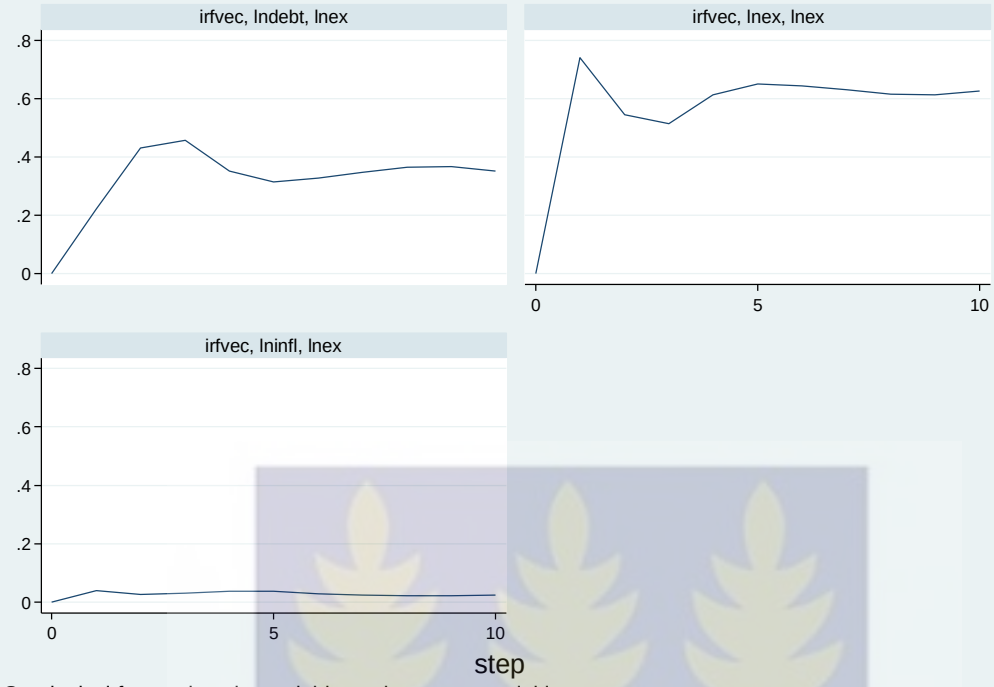
Note: specify 'coirf' rather than 'cirf'.



Appendix A14: Forecast Error Variance Decomposition of the debt-to-GDP ratio



Appendix A15: Forecast Error Variance Decomposition of inflation



Appendix A16: Forecast Error Variance Decomposition of the exchange rate