CHAPTER ONE

Introduction

1.1 Problem statement

Sustainability of fiscal policy emerged as a major economic issue in Ghana following the high levels of debt experienced in the 1980s. Suffice it to say that Ghana is ranked among the most Heavily Indebted Poor Countries (HIPC) in the world. The country's high public debt and debt servicing impair the capacity of the economy to achieve desired growth and development. A major threat to the national government's fiscal position is the large stock of government national debt and the associated costs of servicing the debt. The growth of public debt has been high, averaging 126.2% of Gross Domestic Product (GDP) between 1993 and 2003, and this improved tremendously to 42.4% of GDP in 2006 and has since been on the ascendancy. The national government's total outstanding debt stood at GHc14,405.6 million representing 66.2% of GDP in 2009.

Fortunately, Ghana is on the verge of becoming an oil rich country. Recently, crude oil was discovered off the shores of her Western Atlantic coast. The estimated reserves as of October 2009 amounted to 490 million barrels of high quality oil and justify commercial exploitation. Because oil revenues are large and in most countries accrue to governments, fiscal policy choices have a significant impact on economic performance indicators such as inflation, economic growth and current account balances. Fiscal policy in oil exporting countries is facing a lot of challenges and this stems from the fact that, oil revenues, which constitute the bulk of government revenues are volatile, unpredictable, exhaustible and largely originate from external demand.

It is however, important to note that large revenue generated from oil leads paradoxically to economic stagnation. In many countries such as Iraq, Nigeria, Sierra Leone, Venezuela, former Zaire and Zambia, enormous oil or mineral wealth has not translated into economic and social well-being for the majority of the population (Collier and Hoeffler, 1998).

This paradox of mineral wealth now generally referred to as "resource curse"[1] has encouraged scores of studies in mineral rich countries in the developing world. These countries have underperformed their mineral poor counterparts owing to a variety of economic and political indicators. It has been well established that the more intense a country relied on mineral exports (measured as a percentage of GDP) during the period 1960 - 1990, the more slowly its economy grew (Auty and Gelb, 2001, Sachs and Warner, 2005). From 1960 to 1990, GDP per capita in mineral-rich countries increased by 1.7% as compared to 2.5% to 3.5% in mineral-poor countries. Similarly, from 1970-1993, mineral-rich countries grew by only 0.8% as compared to 2.1% to 3.7% in mineral-poor countries.

As noted, oil revenue poses challenges both in the short and the long term. In the long term, the channels centre on the exhaustibility of oil reserves and concerns about intergenerational equity and fiscal sustainability. Of concern in the short term are macroeconomic management and fiscal planning. Also, there is uncertainty about the future path of oil prices, oil reserves and its future extraction costs. Fiscal policy in oil producing countries tends to be procyclical. There is difficulty of maintaining fiscal expansions after a boom with concomitant political and social costs. Fiscal expansions typically follow booms, it is the difficulty associated with reducing spending during busts that relates to the political and social costs alluded to here.

Despite the macroeconomic progress made, the economy has come under stress since 2006. Ghana's real GDP growth rate declined sharply from 6.0% to a low of 4.1% in 2009. On the other hand, inflation rose from 11.0% to 19.0% in 2009. The macroeconomic situation deteriorated sharply with regard to both domestic and external shocks. The economy of Ghana in 2006/2007, suffered a severe energy crisis as a result of severe drought, leading to a shift from a predominantly hydro-power generation to thermal power in an era of escalating crude oil prices, with adverse economic impact. The global food and fuel price increases in 2007-08 adversely impacted most sub-Saharan African countries, including Ghana.

[1] The resource curse is the phenomena whereby a country with an export-driven, natural resources sector, generating large revenues for government, leads paradoxically to economic stagnation and political instability.

As with government expenditure, Ghana's problems are mostly homegrown. The government had an expansionary fiscal policy in 2008 ahead of the national elections, with the fiscal deficit expanding to 15% of GDP. In the context of these global shocks and the 2008 elections, public sector spending increased substantially and raising the fiscal deficit from 7.5% of GDP in 2006 to 14.5% of GDP in 2008. This exceeded the projected fiscal deficit of 10.0% in 2009 (IMF, 2008).

This boosted inflation and eroded her international reserve position from 2.218 billion to 2.014 billion U.S. dollars. A slump in foreign exchange inflows linked to the global financial crisis made things worse. At the government's request, the IMF considered a three-year lending arrangement of $600 million in mid-2009 to strengthen Ghana's international reserves. Alongside the pursuit of tighter budget policies, this worked well and Ghana's currency recovered its strength, and inflation began to fall (IMF, 2010).

Directing policy toward expenditure management in 2009, the deficit was substantially reduced to 3.7% of GDP. Currently, the public debt is still rising rapidly, and heavy borrowing from the banking system to finance budget deficit is keeping interest rates high and taking money away from potential corporate investment. While Ghana has benefited from the Heavily Indebted Poor Countries (HIPC) debt relief initiative in 2002 to restore macroeconomic balance, new debt has started to accumulate recently, because of rapidly increasing fiscal deficits. The problem stated above leads to the following research questions:

i. Is the current fiscal stance appropriate from a long term growth and development perspective?

ii. How should the country plan the time path of fiscal operations to ensure her fiscal sustainability in the long run?

iii. What framework is required to enable the country to manage appropriately the impending "oil shock" effects?

1.2 Objectives of the study

The general objective of this study is to establish a sustainable fiscal profile for the economy of Ghana. The specific objectives are to:

i) analyse the implications of the current fiscal stance for sustainable economic growth and development.

ii) conduct a simulation on the likely effects of oil revenue earnings on the fiscal profile of Ghana.

iii) develop a fiscal framework for purposeful management of the fiscal effects of oil revenue in the Ghanaian economy.

1.3 Justification of the study

Concern about fiscal sustainability analysis has been at the centre stage of macroeconomic analysis in developing and emerging economies. In the Millennium Development Goals (MDG) context, fiscal sustainability issues are addressed under Goal number 8, dubbed *Develop a Global Partnership for Development*. Meanwhile, the IMF's fiscal sustainability analysis is based on a Debt Sustainability Analysis (DSA) framework. This framework is based on rules and ratios consisting of some macroeconomic indicators expressed as ratios of GDP. The decision rule for sustainability is whether debt to GDP ratio will converge or remain stable over time.

The study by the Bank of Ghana used the primary gap approach proposed by Blanchard (1990) and applied by Edwards (2002). In this study, constant debt-to-GDP ratio was merely used as a benchmark for fiscal sustainability. The main interest of the study was to compute a primary balance to GDP ratio that is consistent with changes in public sector debt that might be considered sustainable. It computes the primary balance needed to stabilize the debt-to-GDP ratio, and is the difference between the required augmented surplus ratio to GDP and the actual augmented surplus ratio to GDP. The study set restrictions on the growth rate of domestic and external debt viz a viz the growth of the economy. A net present value (NPV) of external debt expressed as a ratio of GDP at 50% was considered sustainable over the long run. This rule is based on the condition that donor communities will continue to give concessionary assistance in the post HIPC-MDRI era. The study concluded that fiscal policy would be sustainable in the future.

However, the definition of sustainability does not require specifying a target debt-to-GDP ratio, and any target set, is potentially arbitrary, especially if it is not subject to adjustment in light of new circumstances. Large debts can be paid back, yet small debts may not be sustainable if future income is insufficient. Moreover, government debt may remain high for decades and experience large fluctuations over time. Specifying ratios deal only with the solvency dimension of fiscal sustainability.

This study fills this gap by considering the discovery of oil and the impact of oil revenue on fiscal sustainability. Based on the theoretical framework, this study puts in perspective a sustainability profile to evaluate the past fiscal record of the economy in an ex post sense. The effect of oil revenue is modelled to determine the likely path of fiscal sustainability if oil revenue is injected into the budget**.** This profile is constructed in line with Ariyo (1993) and Rutayisire (1990). A simulation of the effect of expected oil revenue on the profile is examined. Furthermore, sensitivity of fiscal sustainability in new and changing circumstances of fiscal and macroeconomic uncertainties analysis is accomplished.

Further justification of this study is the design of socially optimising government expenditure framework with the allocation of oil revenue to the budget. This defines a utility maximising optimal level of spending and deficit rule for the attainment of sustainability in the long run. Also an investigation of declining aid and increasing debt on optimal expenditure path is paramount because this is imminent. The focus is whether current fiscal policy can be continued into the future without jeopardising stability and growth. The discovery of oil in Ghana poses a central question around the management of natural resource revenues; what to spend and what to save. Controlling the rate of expenditure in the face of windfall revenues is needed to avoid ‘stop-go’ public spending, unsustainable ‘boom-based’ foreign borrowing and Dutch disease effects.

Also, an extension of the basic framework to include oil revenue incorporates the efficiency of government capital spending. This made possible by using the incremental capital output ratio (ICOR) to investigate the sensitivity of capital investment given GDP. This is imperative since oil revenue would be used to finance public capital for the benefit of citizens. This is based on the fact that developing countries have low infrastructure development. The fiscal impact of allocating various amounts of oil revenue to the budget viz a viz changing macroeconomic conditions is required for future stability and growth.

Moreover, the 2011 budget implicitly assumed that 30% of total oil revenue would be saved in the Stabilization and Heritage Funds, and 70% would be used to fund the annual budget and activities of Ghana National Petroleum Council. Also, The Petroleum Revenue Management Act (PRMA) permits the use of the Annual Budget Funding Account (ABFA) as collateral for debts and other liabilities of Government for a period of not more than 10 years after the commencement of the Act. An important policy question that arises from the above discussion or observation is whether it would be advisable to encourage government to borrow or squander oil revenue, given the country's initial conditions. This study therefore will be valuable to policy makers on the sustainability implications of oil revenue and the impact of allocating oil revenue to the budget under future and changing conditions.

1.4 Scope of the study

The study focuses on fiscal policy rules in Ghana. Major fiscal variables such as debt, government expenditure and revenue are used. Macroeconomic variables such as output, inflation and seignorage are considered as they have an impact on the performance of the budget, and therefore fiscal sustainability. The period of study spans 1980 to 2009 to capture the influence of the Economic Recovery Programme (ERP). The period prior to the study period, was characterised by economic decline and growing political instability.

1.5 Organization of the study

This thesis is organized as follows: chapter two describes the background to the study. Chapter three presents the review of relevant literature comprising theoretical concepts, methodological and empirical reviews; chapter four discusses the data and addresses methodological issues related to fiscal sustainability, it constructs a dynamic sustainable fiscal profile and a framework to manage the fiscal effects of impending oil revenues. A discussion of the results from a number of econometric tests, presentation of forecasting and simulation results are presented in chapter five and chapter six includes an application of results to the analysis of fiscal sustainability, it also presents an overview of the main findings and the policy implications of those findings.

CHAPTER TWO

Background to the Study

2. 1 Fiscal operations in Ghana

2.1.1 Revenue and expenditure trend

Government expenditure according to the Medium-Term Expenditure Framework (MTEF), is divided into discretionary and statutory components. Discretionary expenditure consists of those payments over which the government can exercise some judgement with respect to the quantum of resources provided for such items. Statutory expenditure, on the other hand, are obligatory for the government to undertake since they are usually defined by legislative instrument and or backed by some legal authority.

Also, sources of government revenue are characterised as tax and non-tax revenue. The tax component of government revenue comprises direct and indirect taxes. Whereas direct taxes are levied on income and property of individuals and business units, indirect taxes are levied on goods and services consumed in Ghana, regardless of the origin of these goods and services. These taxes include value added tax (VAT), international trade taxes, petroleum taxes and excise duties. The non-tax revenues, on the other hand, include incomes and fees charged by the public sector for the use of state resources, revenue from grants, loans and unrequited transfers from other countries and international institutions. The remaining are receipts from the divestiture of state assets and Non-performing Assets Recovery Trust (NPART).

In this perspective, Ghana, like other developing countries has experienced inadequate revenue vis-a-vis rising expenditure trend. Observably, the level of government spending has been on the ascendency. This expenditure trend for most part is greater than government domestic revenue. This is depicted in Panel A of Figure 2.1. The incidence of electoral cycles[2] is marked by severe

[2] A surge in government spending usually accompanied by widening fiscal imbalances immediately prior to elections has been a prominent macroeconomic shock in Ghana over the last 16 years.

deficits in 1992, 1996, 2000 and 2008 as portrayed in panel B of Figure 2.1. These unsurpassed deficits are usually recorded in the election years preceding change of government.

The higher spending relative to revenue stems from the fact that various governments desire to increase output and also to enhance the socio-economic wellbeing of her people. Total government expenditure peaked to a high of GH¢ 8,009.8 million representing 46.8% of GDP in 2008. However, there was a reduction in expenditure by 6.5% of GDP in 2009. This increased expenditure resulted from the hotly contested presidential elections in 2008. The resulting fiscal deficits have been resolved by both domestic and external financing. The domestic financing of the deficits have usually come from banking and non banking sectors.

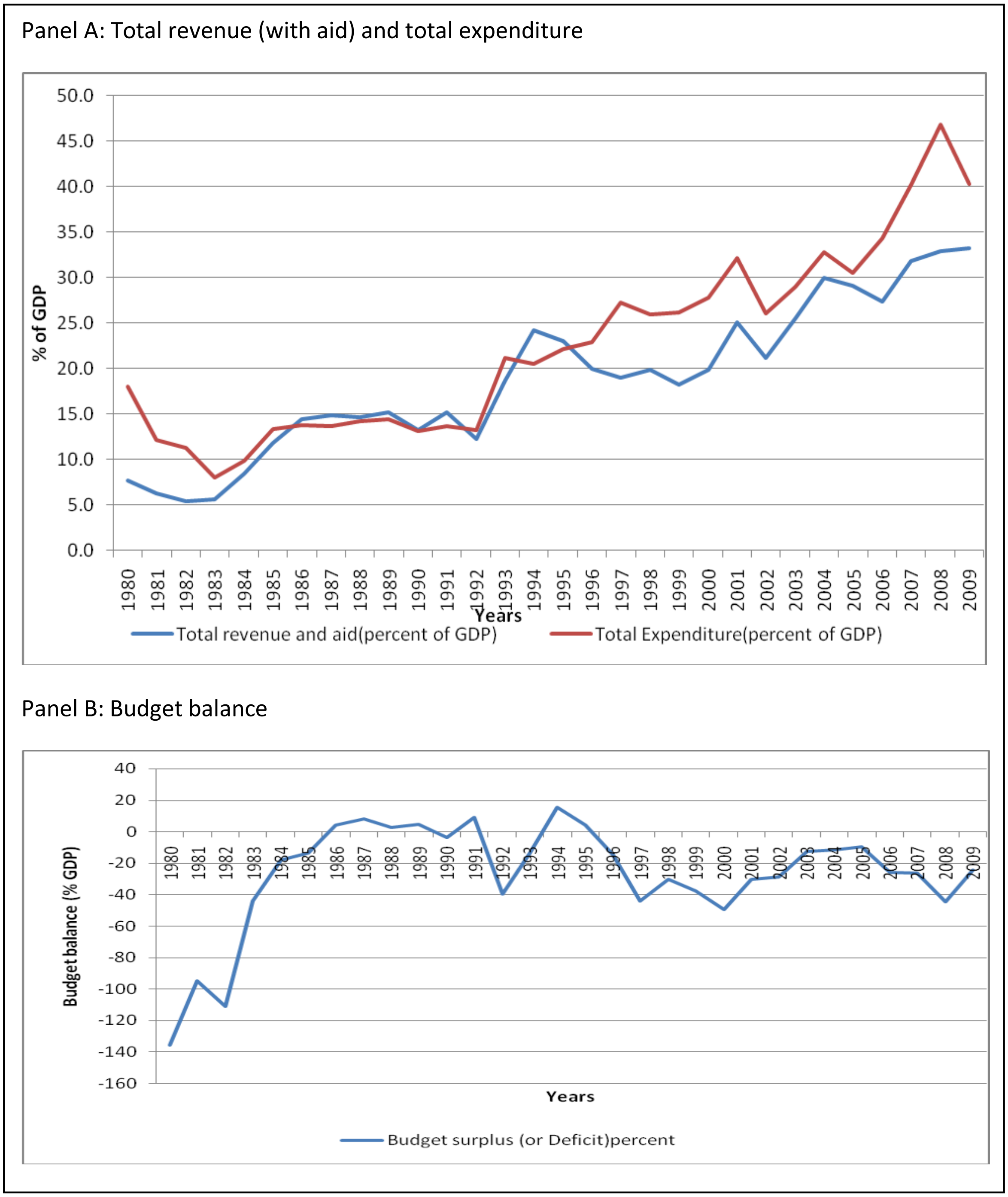

Figure 2.1. The Revenue and Expenditure and Overall Budget Balance (percent of GDP) trend in Ghana from 1980 - 2009

Source: Author's construct from Ghana Statistical Service, Bank of Ghana annual Reports.

2.1.2 Fiscal diagnostics of the economy

The overall fiscal balance has recorded deficits up to the year 1986. It remained fairly stable until 1991 beyond which a deficit of approximately 5% was recorded in 1999. There was a record surplus of 3.7% of GDP in 1994. From then onwards, deficits have been recorded. In the year 2000, the deficit was 8.5% of GDP. This steadily improved to a deficit of approximately 2% of GDP by the end of 2005. The political business cycles remain, but with decreasing amplitude – the overall fiscal deficit of 8.5% of GDP for 2000 is much higher than the deficit of 3.2% recorded for 2004. The deficit situation improved from 13.8% of GDP to 7% of GDP as shown in panel A of figure 2.2. Increasingly, government is relying less on domestic sources to finance the deficits. The reliance on domestic sources for financing the deficits has been particularly low over the last three years of the sample, culminating in a net repayment of approximately 1.6% of GDP in 2005.

Similarly, chronic deficits marked the Ghanaian fiscal position since the early years of its development. From 1980 to 1985, fiscal deficit averaged 4.6% of GDP. There was a brief respite thereafter when the government's fiscal position improved to register a surplus of less than 1% for the period 1986 to 1991. Thereafter, the fiscal balance has been in the negative plane and plummeted to 13.8% of GDP in 2008, the deficit stood at 13.7% of GDP in 2009. With the inclusion of divestiture receipts, the fiscal balance improved to 11.5% of GDP. This is shown in figure 2.2. The deterioration of the fiscal balance as evidenced by widening fiscal deficits is mostly due to increases in government expenditure.

As a result, government expenditure increased from GHc13,557.5 million to average of GHc15,803,537 million which far exceeds revenue increases within the same period. The trend perpetuates thereafter to 2009. There is pressure on government to increase wages and salaries through the Single Spine Pay Policy (SSPP) which dates back to January 1, 2010. At implementing the SSPP, the Fair Wages and Salaries Commission (FWSC) successfully negotiated a 20% increase in the base pay for the Single Spine Salary Structure (SSSS) in 2011. A total of 460,853 public sector employees, representing 98% of the public sector workforce were migrated wre migrated onto the SSSS (ISSER, 2012).

Aid as a component of revenue within the period of study has experienced an upward surge from an average of GHc232 million in 1984 to GHc2,556,969 million in 2004. In 2009, this figure stood at GHc12,243,448.4 million as shown in panel B of figure 2.2. Tax revenue increased continually and has been the leading source of government revenue in the economy. Non tax revenue accounted for 15.3% of total revenue in 2009. This improved performance of non-tax revenue can be attributed to the significant improvement in incomes, fees and grants. The contribution of non-tax revenue peaked in 1994 and declined thereafter. There has been an increasing trend in the contribution of aid from the year 2000 to 2009. The primary balance, defined as the difference between domestic revenue and primary expenditure. The primary balance deteriorated from 2006 to 2008 but improved marginally in 2009.

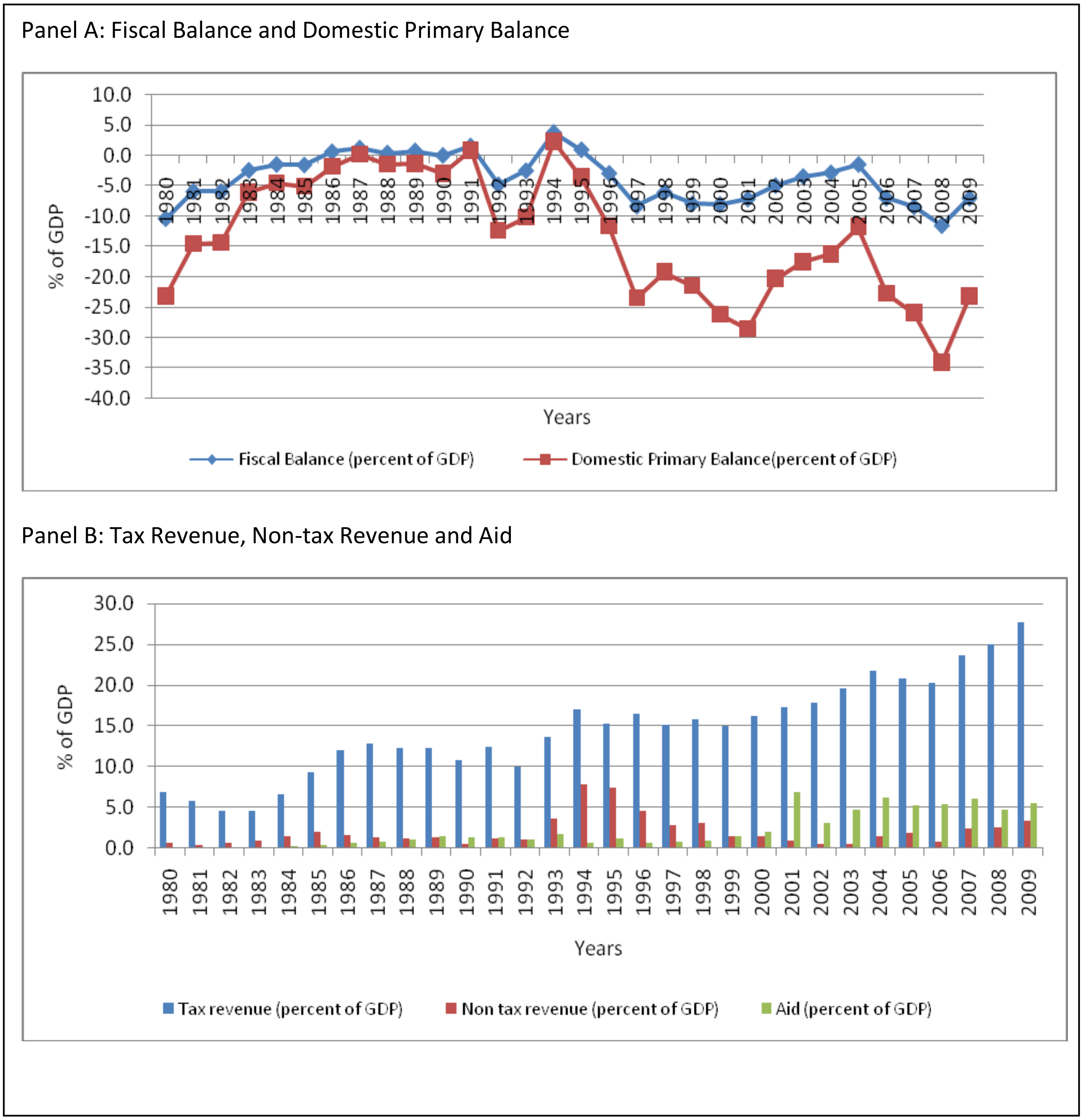

Figure 2.2. The Domestic Primary Balance, Revenue and Aid trend in Ghana: 1980 - 2009

Source: Author's construct from Ghana Statistical Service, Bank of Ghana annual Reports.

2.1.3 Debt profile of Ghana

Suffice it to say that Ghana has secured various forms of external financing to supplement domestic sources. For instance, there was an issue of US$ 750 million sovereign bond which Ghana secured in 2007, and that increased Ghana's debt considerably. Also, Ghana has obtained loan from both bilateral and multilateral sources to finance expenditure.

Consequently, public debt registered in Ghana at end of 2008 was an estimated 58% of GDP. This is shown in figure 2.3. This compares with a projection of 51% of GDP in the 2008 Debt Sustainability Analysis (DSA). The less favourable starting position for the current DSA reflects larger than previously assumed fiscal deficit in 2008 (14% of GDP, or 4 percentage points higher than previously projected), as well as the impact of currency depreciation on the foreign debt-to-GDP ratio in 2008. Public sector external and domestic debts were similar in scale at end-2008, both close to US $4 billion representing 29% of GDP.

Besides, the huge public debt in Ghana around 2000 was GHc5,806.4 million representing 186% of GDP, raised serious concerns about the Ghanaian government to manage its debt obligations and the long run sustainability of fiscal policy. Total public debt declined thereafter following prudent fiscal policy measures to a low of 42% in 2006. External debt has risen rapidly since 2006 from 17 to 33% of GDP in 2009. This reflects Ghana's $750 million Eurobond issue at end-2007, together with new concessional bilateral financing, and new borrowing contracted from the International Development Assistance (IDA) since 2006, following the Multilateral Debt Reduction Initiative (MDRI). Total debt as well increased close to 20 percentage points in 2009.

What is more, the sharp rise in Ghana's external (and total) public debt during 2006-09 illustrates the risks to the fiscal sustainability. Fiscal slippages in 2006 were attributed to excessive government expenditures on the Golden Jubilee celebrations, energy crisis and public sector wage increases. Nevertheless, rising domestic debt levels and widening budget deficits suggest that fiscal balance and its contribution to macroeconomic stability needs firm consolidation. A highly expansionary fiscal position financed by external borrowing triggered a very rapid deterioration in the DSA.

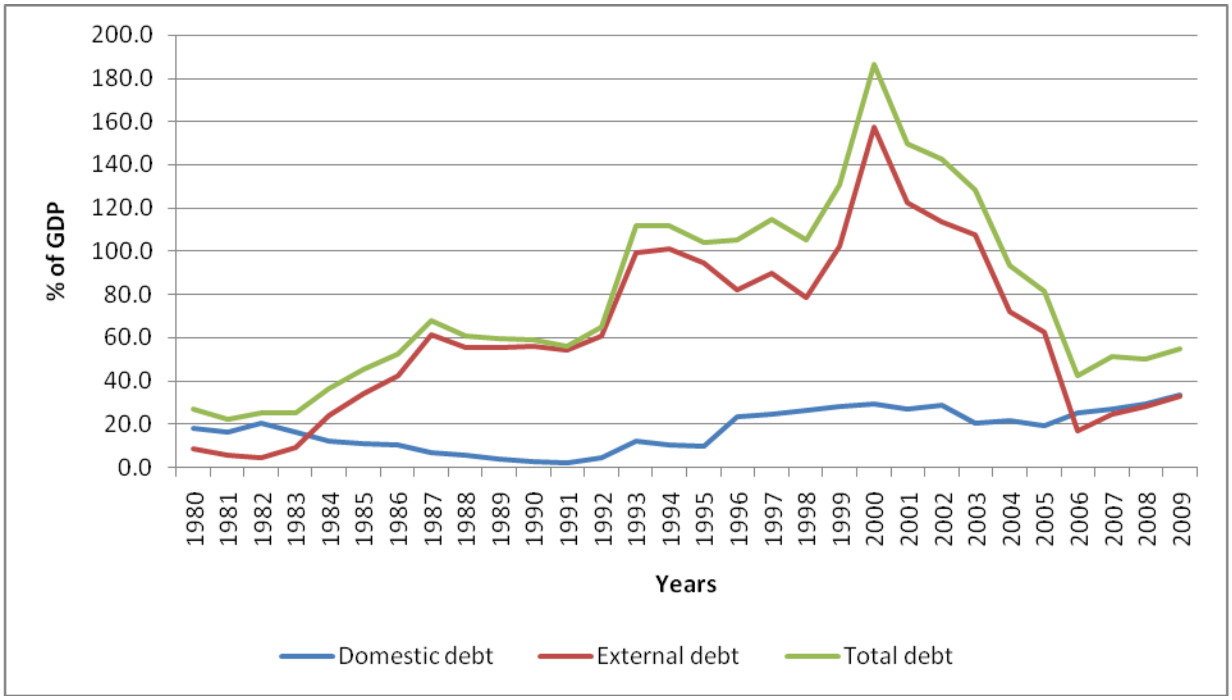

Figure 2.3. The Domestic debt, External debt and Total debt trend in Ghana: 1980 -2009

Source: Constructed from Ghana Statistical Service, Bank of Ghana Annual Reports

This trend was amplified by the resulting balance of payments pressures and currency depreciation, which led to the revaluation of foreign currency-denominated claims relative to domestic GDP. This debt surge was effectively stemmed when Ghana's access to market financing was closed off as a result of the global financing crisis. To avoid such future episodes of debt deterioration will require more determined fiscal management as well as more cautious debt management policies. Domestic debt and money supply have since 1996 assumed an increasing trend up to the year 2009.

Moreover, fiscal management in 2007 improved due to the introduction of Public Financial Management (PFM) reform. This involved the installation of a computerised budget and public expenditure management system; the deployment of a new computerised payroll management system and the integration into the budget process of agencies that depend on government subsidies; the enhancement of cash management systems; and the development of a single treasury account. The new Public Expenditure Tracking Surveys in the education and health sectors also helped to improve expenditure management. All of this fiscal restraint contributed to the “crowding-in” of private investment through net domestic debt repayment, while also increasing fiscal resources for development. The policies were largely successful since the net domestic public debt/GDP ratio continued to fall, from approximately 24% in 2002 to approximately 12% in 2007.

Further, Ghana’s external current account deficit widened to 19% of GDP in 2008 from 12% of GDP a year earlier. This largely reflected a 33% increase in non-oil imports values, driven by strong domestic demand. Financing was provided through an increased external capital account surplus, buoyed by Ghana Telecom privatization proceeds (5.5% of GDP), and a draw-down of gross international reserves from $2.8 billion to $2.0 billion. Reflecting the latter, gross reserve cover declined from 2.7 to 2.2 months of projected import cover. In the first quarter of 2009, exports have remained buoyant, but private remittances fell by 18% from a year earlier.

2.2 Fiscal institutions and policy: revenue and expenditure management

2.2.1 Fiscal responsibility law

The government of Ghana proposed a legislation of a Fiscal Responsibility Law (FRL) to strengthen its commitment to fiscal discipline and debt sustainability. This raises a fundamental question with respect to whether such an act will promote fiscal discipline similar to how BOG Act 612 has strengthened the formulation of credible and transparent monetary policies[3]. This law would ensure that the government's medium-term fiscal framework (MTFF) is open to public scrutiny (e.g., by publishing an annual fiscal strategy report); that comprehensive fiscal information on central and local governments, decentralized agencies and state-owned enterprises are made available; that reporting and financial oversight arrangements are strengthened; and that appropriate enforcement mechanisms are put in place to deal with cases where public funds are misused or misappropriated. As part of the MTFF, the law might include a numerical fiscal rule in the form of a debt ceiling (under current circumstances, a prudent level of debt might be 45% of GDP). Without such a fiscal anchor, debt is likely to increase well beyond prudent levels.

According to ISSER (2012) on the State of the Ghanaian Economy, the medium term expenditure framework (MTEF), is divided into discretionary and statutory components. It is noted that the discretionary expenditure rose from GHc6,829 million in 2009 to GHc13,0838 millio in 2010 but fell to GHc12,502 million in 2011, a 4% decrease. Expenditure on HIPC-related projects and programmes and Multilateral Debt Relief Initiative financed investment ceased in 2011. Allocations to the Ghana Education Trust Fund (GETFUND) decreased by 81 percent.

2.2 Tax policy and tax administration

In the 1990s, the Government of Ghana reformed its revenue administration and tax policy with some success. It created new administrative structures, introduced the value-added tax, and made

[3] Finance minister Kwadwo Baah-Wiredu announced in his 2008 budget that the government will introduce a Fiscal Responsibility Law (FRL) based on the experience of implementing such laws in other countries.

changes to the personal income tax schedule in order to increase the incentives to work and save. A decade and a half later, the tax system is beginning to face new challenges emanating especially from *ad-hoc* changes to parent acts and the adoption of *ad-hoc* exemptions, and discretionary waivers. Against this background, the government requested IMF technical assistance on tax policy and revenue administration which was provided in April-May 2009. Their recommendations were to inform the new directions for Ghana's tax system.

2.2.3 Revenue administration

Ghana's three tax revenue agencies operate independently, share no activities and have very little exchange of information at the operational level. This results in high compliance cost for tax payers, high administrative costs for government, and high opportunities for tax evasion. The government intends to consolidate and to centralize management of the three agencies with a specific objective to merge the Value Added Tax (VAT) and income tax services into a single, integrated tax administration. A modernization strategy for this and other aspects of revenue administration are to be developed and approved by Cabinet before end-2009. Efforts will also be directed toward closing the various leakages from the tax system. Leakages have been associated with customs valuation and invoicing, transit goods, free zone exemptions and bonded warehousing facility; VAT collection and payment to the VAT office; and management of the withholding tax by the Internal Revenue Service (IRS). Preventive services of the Customs, Excise and Preventive Service will be strengthened to reduce smuggling and the abuse of the transit goods arrangement.

In December 2009, the three tax revenue agencies, the Customs, Excise and Preventive Service (CEPS), the Internal Revenue Service (IRS), the Value Added Tax Service (VATS) and the Revenue Agencies Governing Board (RAGB) Secretariat were merged in accordance with Ghana Revenue Authority Act 2009, Act 791. The Ghana Revenue Authority (GRA) thus replaces the revenue agencies in the administration of taxes and customs duties in the country. The Ghana Revenue Authority (GRA) has been established to: Integrate the management of Domestic Tax and Customs, modernise Domestic Tax and Customs operations through the review of processes and procedures and integrate Internal Revenue Service (IRS) and Value Added Tax Service (VATS) into domestic tax operations on functional lines.

2.2.4 Fiscal policy measures in 2009

Fiscal policy for 2009 sought to reverse the deteriorating fiscal position with a view to attaining long term fiscal sustainability. There were a number of fiscal policy measures implemented in 2009. The major polices included the following:

- A reduction in taxes of petroleum products.
- Government provision of an amount of GH¢17.2 million for the implementation of the free school uniforms and free exercise books for pupils in basic schools.
- An increase in the capitation grant provided to basic schools by 50.0% from GH¢3.00 per pupil to GH¢4.50 per pupil

2.2.5 Oil revenue management

Revenues from oil production activities are expected to come on board by 2011. Like all oil-producing economies, Ghana is faced with a number of challenges, including how much of the oil revenues should be saved, how to insulate fiscal policy from fluctuations in oil prices, and how to protect the economy from possible exchange rate appreciation (the so-called Dutch Disease[4]). The goal is to ensure a cautious phasing of petroleum revenues into the economy. This will be guided by the country's absorptive capacity, by the balance between how much to spend to accelerate growth and reduce poverty, and by how much to save for the future. In this perspective, the government intends to continue with the national dialogue on the use of oil revenues and with the ongoing work on the technical details of oil revenue management. Work on a petroleum regulatory bill and an oil revenue management bill are ongoing. Public consultations on the allocation of petroleum revenues and on the guidelines for the management of the funds will be held prior to legislation. In this regard, the government intends to ensure that

[4] Dutch disease generally refers to the consequences on the non-resource economy of real effective exchange rate appreciation associated with foreign exchange flows (usually from resource revenues). The exchange rate appreciation and the competition for domestic resources cause a reduction in the competitiveness of the non-oil sectors and reduce both their production and exports

oil revenues are fully and transparently included within the budget[5]. To further ensure the transparent treatment of oil and gas revenues, the government intends to extend Ghana's participation in the Extractive Industry Transparency Initiative (EITI) to cover this sector as well as fishing.

On enhancing fiscal responsibility, recent experience suggests that maintaining fiscal discipline remains a major challenge in fiscal management. As a first step to instituting fiscal responsibility laws, the government intends, in the short-term to lay out some fiscal rules that will strengthen fiscal discipline and help ensure desired fiscal policy outcomes. These rules will also provide a solid institutional foundation for managing the oil revenues that are projected to come on stream in 2011.

The total oil revenue received at the end of received at the end of 2011 was GHc666.2 million which was far lower than the forecast of GHc1,250 million. This represents a shortfall of GH¢583 million, which the Jubilee partners have attributed to the inability of the Jubilee field to produce the estimated 120 barrels of oil daily. The amount received was allocated to the various allowable sources in accordance with the Petroleum Revenue Management Act[6] (PRMA), Act 805, 2011. The amount allocated to the annual budget, stabilization fund and heritage fund was less than the targets of GH¢395,980,000.7, GH¢111,915,435 and GH¢613,195,95 respectively. Meanwhile, the law has given the Minister for Energy the discretion to use and manage Ghana's

[5]On the 2nd of March 2011, Ghana's Parliament unanimously approved the long-awaited Petroleum Revenue Management Bill. The bill also has strong provisions for governance and accountability, including rigorous rules for reporting on oil fund assets and investments. The Petroleum Revenue Management Act, 2011 (Act 815) accords the Energy Minister a discretion to disburse the funds generated from the country's hydro-carbons endowments. At the roundtable on "Policy-Legislation Coherence in Ghana's Oil and Gas Sector," organised by Publish What You Pay-Ghana and supported by the World Bank, Mr Bishop Akolgo, Executive Director of Integrated Social Development Centre (ISODEC), a leading advocacy Non-Governmental Organisation, decried the extensive discretionary powers Act 815 gives to the Minister to oversee the management of oil and gas revenue.

oil and gas revenues. This has come under criticism for undermining transparency and accountability in the petro-chemical industry.

Furthermore, as part of its fiscal consolidation policy, a biometric registration exercise for active employees and pensioners on government payroll was carried out. This exercise would form the basis for rationalising future payments of wages, salaries and pensions in the public sector.

2.3 Macroeconomic performance in Ghana

The selected macroeconomic indicators considered are exchange rate, GDP growth rate and interest rate. The remaining are money supply, inflation rate and Gross Domestic Product. These indicators are considered, because their variations have implications for fiscal sustainability. The first three are macroeconomic indicators whiles the remaining are fiscal variables. The most critical macro indicators to fiscal sustainability issues are real interest rate and the growth rate.

Moreover, the economy of Ghana registered negative real GDP growth rate between 1981 and 1983. Real GDP growth rate has been positive since, but continuously below the real interest rate from 1997 to 2001. Notably, real interest rate dipped to a negative 110% in 1983 due to an abysmally high inflation rate. Real interest rate peaked in 1999 and declined way down to 2009. This is evident from panel A of figure 2.4. Interest rate trends moved in the same direction as inflation trends. The interest rate on 91-day Treasury Bills rose from 18.2% in 2008 to 23.8% in 2009 whiles the demand deposits rate fell marginally from 4.6% in 2008 to 3.6% in 2009.

However, investment performance continues to improve significantly. In 2007, there was a sharp increase in both public and private capital formation. Reductions in the stock of external debt and domestic public debt over the last few years have improved the savings-investment balance and the growth dynamics of the country, with savings from debt relief increasingly pushing up investments rather than consumption. In 2007, debt reduction enabled the government to commit more resources to capital expenditure, with the volume of public capital formation rising by 25%.

Moreover government's public capital expenditure has a link with growth rate of GDP, and by its scale, can be used as budgetary measure to influence fiscal policy. Panel B of figure 2.4 provides the estimates of the investment rates (measured as proportion of investment to GDP), Incremental Capital Output Ratio (ICOR) and GDP growth rate in Ghana between 1980 and 2009 in nominal terms and these rates are calculated with different definitions. Investment rate is calculated with the data of investment that is referred to as the Gross Fixed Capital Formation. Investment rate for the period averaged 19% of GDP. This peaked to 43% of GDP in 2008 accompanied by a high real GDP growth rate of 7%. The ICOR on the other hand for the period averaged 4.2, but this reached an abysmal high level of 8 in 2009. The real GDP growth rate dropped from 7% in 2008 to 4% in 2009. The ICOR for most periods correlated positively with the investment rate except for 2009.

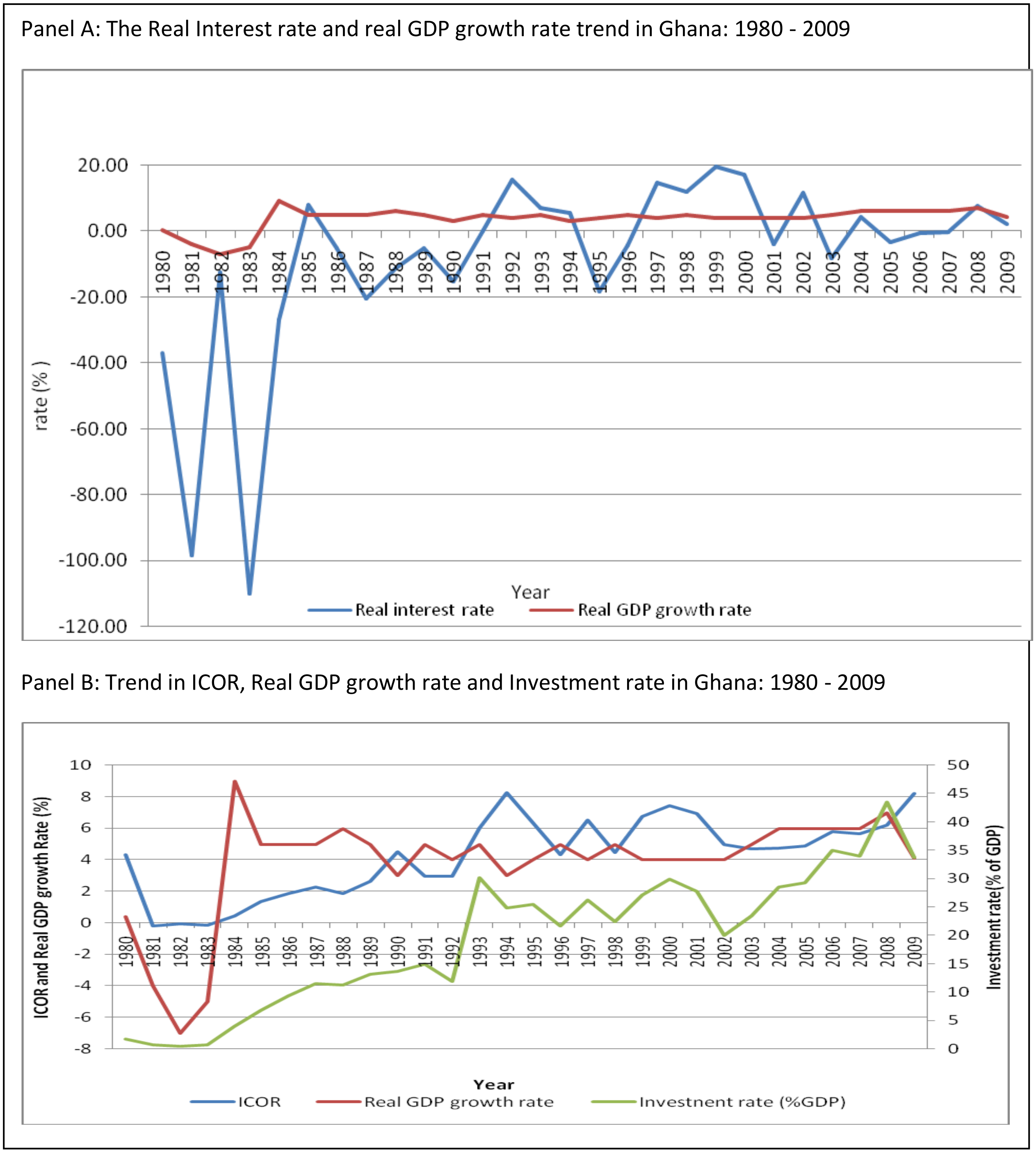

Figure 2.4. Trend in selected Macroeconomic Developmental Indicators in Ghana: 1980 - 2009

Source: Author's construct from Ghana Statistical Service and Bank of Ghana

The domestic output of the economy measured by Gross Domestic Product was GHc 42,852 million in 1980. This sustained a gradual increase to GHc 21,746.8 in 2009. Inflation rate within the period under study peaked to a record high of 123.0%. This increase was the result of money creation as the option available for deficit financing. Consequently, Ghana was blacklisted by the international community for debt repudiation in the 1970's.

In addition, exchange rate increased since mid-2008. This reflects Ghana's macroeconomic imbalances; the exchange rate depreciated close to 50.0% against the US dollar during 2008 and the first half of 2009. Exchange rate developments were relatively stable during 2009, though the domestic currency recorded quite high rates of depreciation against major currencies. In year-on-year terms, the Ghana Cedi as at December 2009 depreciated by 14.8%, 22.4% and 16.2% against the U.S. Dollar, Pound Sterling and Euro respectively. Much of this adjustment was offset, however, by Ghana's high inflation rate and the appreciation of the dollar in the context of the global financial crisis. Accordingly, the real effective exchange rate in April 2009 was merely 8% more than it depreciated in 2007. Over the recent period, illiquidity in the foreign currency market has been associated with a decline in interbank trading and a widening of spreads.

Other relevant indicators are the growth rate of money supply and the rate of inflation. Growth rate of money supply slowed down in 2009 compared to the previous year in 2008. The relatively lower growth in money supply was a result of a contraction of net domestic assets of the banking system due to reduced lending to the private sector. Also, the tight fiscal policy pursued during 2009 affected the growth of money supply. The rate of inflation experienced a downward pressure which reflected a combination of the favourable seasonal food harvest and some price stabilisation measures put in place to check inflation. Non-food inflation was consistently higher than food inflation in 2009. The 19.3% inflation rate recorded in 2009 was caused by changes in prices of the following subsectors: hotels, cafes and restaurants (28.2%), entertainment (89%), health (43.4%), household goods and equipment (34.7%) and alcoholic beverages and tobacco (27.4%). Averages of these indicators are shown in Table 2.1.

Table 2.1. Selected Macroeconomic Indicators of economic performance in Ghana: 1980 - 2009

YEAR	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009
GDP (¢ M)	131,305.90	813,770	3,338,600	14,216,140.00	52,026,190	148,854,908.10
Exchange rate	10.61	155.66	600.76	2,257.20	8,142.40	10,899
Inflation rate	70.4	26.2	22.8	32.2	22.6	14.7
Money supply (¢ M)	14,055	97,210.60	391,553	1,712,922.80	8,198,766	28,735,140.00

Source: Calculated from Bank of Ghana Annual Reports

2.3.1 Magnitude of nominal effective exchange rate movement

Under a flexible exchange rate regime, the domestic currency, and by extension the exchange rate, are said to depreciate when the cedi price of the dollar increases, that is, when the exchange rate rises. Conversely, the domestic currency, and thus the exchange rate, appreciates when the exchange rate falls. Under a fixed exchange rate regime, the rise and fall of the exchange rate are referred to as exchange rate devaluation and revaluation respectively. There was a fixed exchange rate regime for the period 1980 to 1982. From 1983, the exchange rate depreciated throughout the period, though in a volatile manner.

As illustrated by figure 2.5, exchange rate volatility was highest in 1984 following the adoption of a flexible exchange rate system. A total of 9 major episodes of nominal exchange rate appreciation occurred in the period. Among these, the largest exchange rate event comprised a 43% appreciation of the nominal exchange rate following a 51% change in exchange rate. Worthy of note is the fact that between 2008 and 2009, there was an appreciation of the exchange rate. These events have implications for macroeconomic for policy.

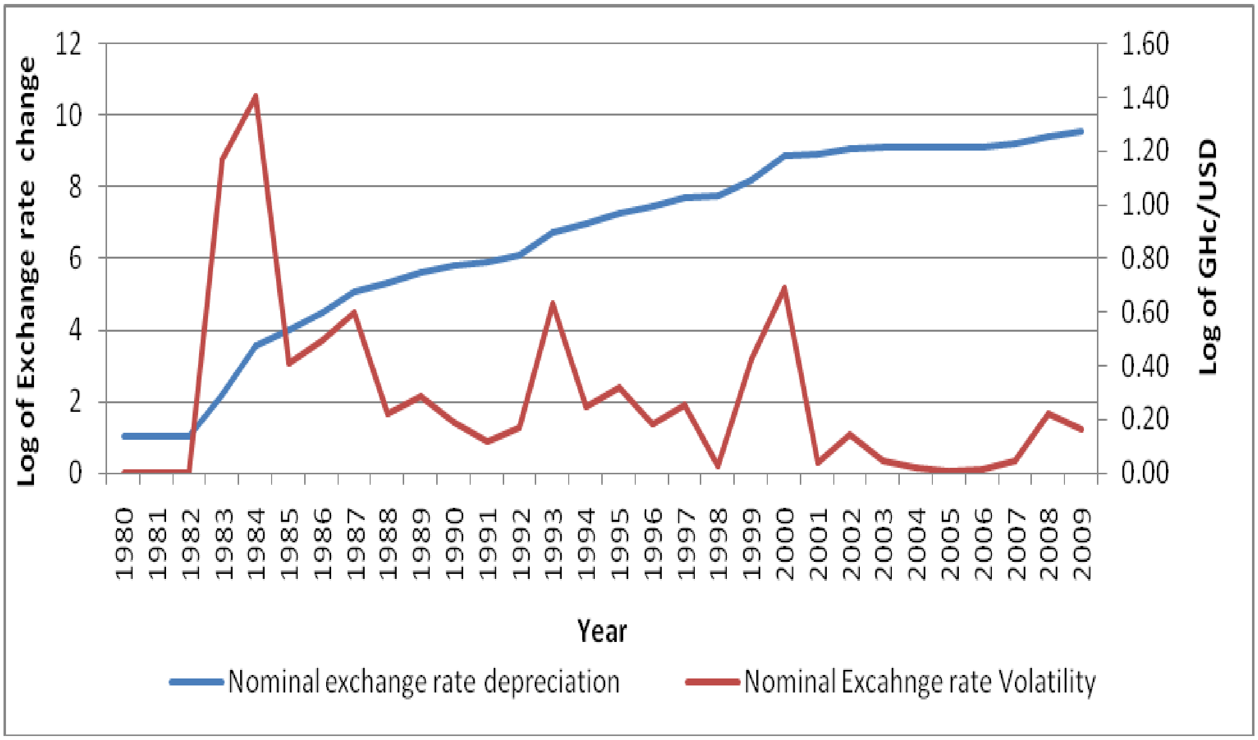

Figure 2.5. The Exchange rate depreciation and Exchange rate volatility in Ghana: 1980 - 2009

Source: Author's construct from Ghana Statistical Service, Bank of Ghana annual Reports.

2.4 Challenges of fiscal institutions and policy

2.4.1 Aid dependency

Recently, The Group of Eight (G8) and Organisation for Economic Cooperation and Development (OECD) committed to increase aid levels to poor countries. This comes at a time when some poor countries have discovered non-renewable natural resources. Ghana, an aid dependent country, is among some of the countries that have discovered oil and will thus face the daunting challenge of oil rents. Aid as a proportion of government expenditure clearly positions the discussion in context of the relevance of aid. A sharp increase in aid from 1983 to 1989 is shown in figure 2.5. There was an irregular decline in aid until 1996 when aid began rising again. This proportion rose to 21% in 2001, representing the highest in the study period.

In this connection, the 1983 to 1989 era of Economic Recovery Programme witnessed a substantial inflow of foreign aid to the economy. This shows the economy’s expenditure was foreign aid-driven. According to Killick (2010), a substantial amount of foreign aid received in the ERP period was loan from the IMF, World Bank and other multilateral institutions, as well as from some bilateral donors. He noted further that this foreign aid issue introduces the influence of external indebtedness and debt relief.

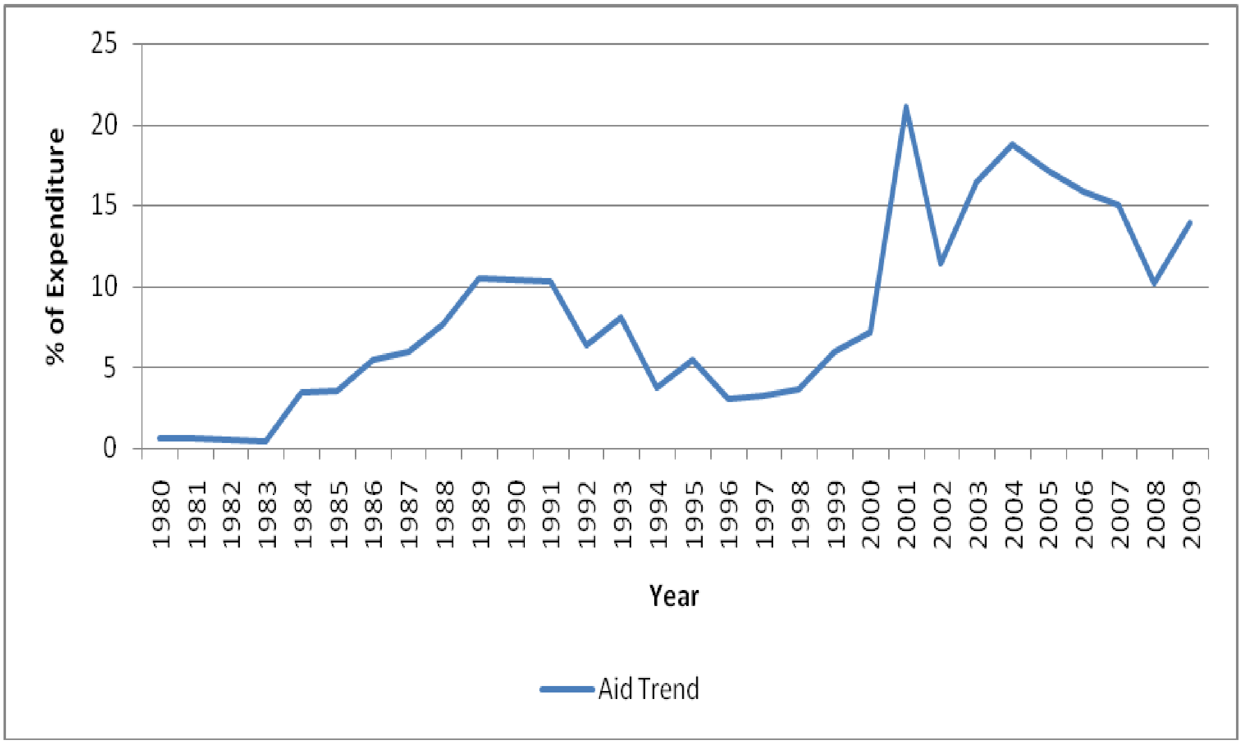

Figure 2.6. The trend in Aid as a percentage of Total Expenditure in Ghana: 1980 - 2009

Source: Author's construct from Ghana Statistical Service, Bank of Ghana annual Reports.

2.4.2 Actors and institutions

Institutional arrangements affect incentives that govern the size, allocation and use of budgetary resources[7]. The presence of electoral cycles negatively influences political cooperation around budget outcomes. Vote seeking politicians tend to favour greater government spending before an electoral event, and postpone fiscal adjustment until after the elections (Drazen 2000, Persson and Tabellini 2005: 253). This is evident from figure 2.1 where jumps in government expenditure occurred in election years between 1992 and 2008.

Therefore, in 1992 after the democratically elected government took office, government spending rose from the average of 14% of GDP which had prevailed in the ERP period to 25% in 1992. The loss of fiscal prudence resulted in excessive spending by the government. This spending was financed partly by foreign aid since aid increased that year after a sharp decline in 1991. A Series of strike actions in 1992 contributed to the surge in government spending; doctors went on strike in May, nurses in June and railway and civil servants in September. The government thus granted large salary increases, which worsened macroeconomic imbalances.

Furthermore, there is an increasing pressure on government from trade unions for increase in wages. The National Tripartite Committee has pegged the new minimum wage at GH¢3.73 from the previous GH¢3.11. After weeks of stalled negotiations, the committee was able to increase the figure by 20 %, from 3.11 to 3.73 Ghana cedis.

2.4.3 High and increasing trend in borrowing

The Government of Ghana has confirmed its decision to collaterise reserves from the country's oil revenue to secure loans or funds for infrastructural development in the country. The Petroleum Revenue Management Act (PRMA) permits the use of the Annual Budget Funding Account (ABFA) as collateral for debts and other liabilities of Government for a period of not more than 10 years after the commencement of the Act. On the other hand, the Act prohibits

[7] Wildavsky (1961) in a seminal paper notes that perhaps the study of budgeting is just another expression for the study of politics. He noted further, in this sense, that budget institutions can be considered as a subset of political institutions which shape and regulate the process of generating and allocating public resources for carrying out government functions broadly conceived.

every form of borrowing against the amount in the Petroleum Holding Fund (PHF) earmarked for transfer into the Ghana Petroleum Funds. According to government, the cost of development increases every day, hence the need for massive infrastructural investment now rather than saving money for the future.

2.5 Summary of issues from background to the study

Rising government expenditure with inadequate fiscal revenue has resulted in chronic fiscal deficits for the study period. Notably, the primary balance which provides a measure of the current fiscal effort has been in deficit throughout the study period. This signals the case of potentially unsustainable rising indebtedness.

Furthermore, the incidence of electoral cycles is marked by severe deficits. These unprecedented deficits are usually recorded in the election years preceding change of government. Moreover, the pursuit of prudent debt management has always been the goal of government. However, total debt continues to grow in spite of the significant debt relief the country has enjoyed since 2005, when the country reached HPC completion point. The total debt stock has quadrupled from the year 2000 to 2011.

The long-awaited Petroleum Revenue Management Bill was unanimously approved by Parliament. The bill also has strong provisions for governance and accountability, including rigorous rules for reporting on oil fund assets and investments. The Petroleum Revenue Management Act, 2011 (Act 815) accords the Energy Minister the discretion to disburse the funds generated from the country's hydro-carbons endowments. Meanwhile, the law has given the Minister for Energy the discretion to use and manage Ghana's oil and gas revenues. This has come under criticism for undermining transparency and accountability in the petro-chemical industry.

CHAPTER THREE

Literature Review

3.1 Review of concept and theories of fiscal sustainability

3.1.1 Concept and definitions

Fiscal sustainability is a multi-dimensional concept that incorporates an assessment of solvency, stable economic growth, stable taxes, and intergenerational fairness. It has not only financial implications but also social and political ones related to both present and future generations (OECD, 2009). Fiscal sustainability, according to Alvarado et al. (2004) is often used without a clear definition[8]. Drawing on an analogy with household behaviour, a country's policies are defined as fiscally sustainable if they lead to a situation in which the country can satisfy its budget constraint. However, Mendoza and Oviedo (2003) suggests that this is an imprecise definition. They point out that the true budget constraint is an accounting identity that, by definition is always satisfied.

With respect to the above, Buiter (1985) notes that fiscal sustainability is primarily concerned with identifying a fiscal profile that ensures the attainment of a desired state for the nation and her citizens. It is therefore aimed at ensuring the solvency (long-term financial survival) of the country as a necessary condition for meeting the collective wishes and aspirations of the people. In view of this concern, it is now recognized that feasible fiscal policies must be considered in a framework in which the government is subjected to an inter-temporal budget constraint in one form or another. This feasibility test requires that the level of a country's fiscal deficit be sustainable.

Further, Zee (1988) noted that a necessary condition for stability is that the growth rate of the economy be greater than the interest rate. With a constant positive per capita debt, the level of

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[8] While the intuition is clear; a sustainable policy must avoid bankruptcy, the analytical and operational definition of sustainability is not straight forward. The theory has proposed different conditions for sustainability. See respectively Domar (1944) and Blanchard (1990).

public debt allows the economy to converge to a steady state; such that the level of government expenditure maximises the steady-state utility level of a representative leading to fiscal sustainability. This view of steady state equilibrium or convergence of the economy to a steady state conforms to Diamond's (1965) growth model. It states that steady-state stability requires that at the minimum, the cost of debt service be equated with the rate of growth of the economy. It is also consistent with Blinder-Solow's aggregate demand model, which requires the marginal increase in government budget deficit, due to additional debt obligation to be equal to the marginal increase in output and, consequently, increase in tax revenue (Blinder and Solow, 1974).

Moreover, a distinction is sometimes made between strong and weak conditions of sustainability according to Quintos (1995). The strong condition corresponds to stationarity of the debt process. On the other hand, the weak condition requires that the growth rate of debt to be lower than the growth rate of the economy. As mentioned earlier, the contemporary literature defines sustainability in terms of necessary and sufficient conditions. The necessary condition is akin to the Domar stability condition[9]. The sufficient condition explains that the debt/GDP ratio stability may not serve as an appropriate indicator of sustainability. If rate of interest exceeds growth rate of the economy, even with primary balance the interest burden on the existing debt might be translated into a perpetual enlargement in debt/GDP ratio. In such an instance, adequate primary surplus is required to offset the gap between rate of interest and rate of growth of the economy and to stabilise debt/GDP ratio.

On the use of fiscal indicators, Blanchard (1990) notes that sustainability indicators may be backward or forward looking depending on the translation and operationalisation of inter-temporal budget constraint in the *ex ante* and *ex post* sense. The *ex post* analysis explains the indicators of sustainability with a backward looking approach while the analysis on the *ex ante* basis pertains to forward looking indicators. The backward looking indicators help to evaluate a

[9] Domar was one of the first to deal with the burden of debt and the national income. The condition for stability is stated as follows: $b_\infty = \frac{d}{g}$ for $g > 0$. b is debt-to-GDP ratio, d is deficit-to-GDP ratio and g is GDP growth rate. This condition implies a simple rule for sustainability. It states that the deficit to GDP ratio must equal the nominal growth of GDP times the debt-to-GDP ratio.

fiscal consolidation programme, while the forward looking indicators are useful in assessing the sustainability over medium term and long-term, relative to a chosen base year.

In addition, an important tool for fiscal sustainability practice is a fiscal rule. Fiscal rules[10] are statutory or constitutional restrictions that set specific limits on fiscal indicators such as budgetary balance, debt, government spending, or taxation (Kennedy and Robbins, 2001). Primarily, fiscal rules seek to disengage fiscal policy from government influence much like the separation of monetary policy embodied in inflation-targeting frameworks. They also impose greater accountability on government finances, drive expectations and enhance transparency of the overall budgetary framework. A fiscal rule can be useful for ensuring the credibility of government policy over time. Stated differently, a major advantage of rule based fiscal policies over discretionary approach is time consistency[11].

Again as noted by Brunila (2002), such rules help tackle a country's predisposition to budget deficits[12] by pre-empting possible spending overruns and thereby help to address the political and institutional tendencies to raise expenditures during economic booms. According to Kopits and Symansky (1998), much of the recent interest in fiscal rules has been prompted by the need to achieve or maintain long-run fiscal sustainability. Among the numerous fiscal rules that have been implemented, there are probably two distinct broad classes that may serve as potential models; deficit-and-debt-based rules, and expenditure rules[13]. Deficit-and-debt-based rules generally operate through numerical limits on the amount of the annual deficit – either a limit denominated in terms of currency, such as zero, or a limit set as a percentage of the GDP.

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[10] According to Buchanan and Wagner (1977), the balanced budget rule is necessary to restrain the politically rational behaviour of policy makers-reflected in the deficit bias in response to the electorate's failure to understand the intertemporal budget constraint.

[11] As shown in Kydland and Prescott (1977) in a dynamic two period context, rule based policies are time consistent and lead to a higher level of welfare than discretionary policies, given the likely reaction of private agents with rational expectations to the incentive of governments to deviate from previously announced policies under discretion.

[12] According to Buchanan and Wagner (1977), the balanced budget rule is necessary to restrain the politically rational behaviour of policy makers-reflected in the deficit bias in response to the electorate's failure to understand the intertemporal budget constraint.

[13] The key characteristic of the expenditure or spending rule is that it aims to limit policy-induced increases in spending and reductions in taxes rather than to focus directly on the deficit.

Examples of this type of fiscal rule include the European Union's Stability and Growth Pact[14], and the United States Gramm-Rudman-Hollings[15] system.

3.1.2 Theories of fiscal sustainability

Writing about the public debt problem faced by France in the 1920s, Keynes (1923) highlighted the need for the French government to conduct a sustainable fiscal policy in order to satisfy its budget constraint. He stated further that the absence of sustainability would be evident when the State's contractual liabilities have reached an excessive proportion of the national income. The first among the theories that examined the fiscal behaviour of governments by the way they work or function is Lerner's (1943) theory of Functional Finance. Functional Finance is an economic theory based on effective demand principle and Chartalism[16]. It states that government should finance itself to meet explicit goals, such as taming the business cycle, achieving full employment, ensuring growth and low inflation.

The building blocks of the theory of functional finance are government intervention, economic objective of ensuring a prosperous economy, money management and budget management and its impact on the economy. The remaining are: government spending should be matched with the level of economic activity; taxes should be levied for their economic impact rather than to raise revenue and the principle of sound finance.

Lerner (1943) postulated three rules that should govern fiscal policy. These rules explain the principal ideas already mentioned before as building blocks. They are:

- maintaining a reasonable level of demand at all times by the government. If there is too little spending and, thus, excessive unemployment, the government shall reduce taxes or

[14] The Stability and Growth pact sets a maximum deficit of 3% of GDP.
[15] The U.S. system was based on statutory dollar deficit limits, gradually falling to zero.

[16] Chartalism is a descriptive economic theory that details the procedures and consequences of using government-issued tokens as the unit of money, i.e. fiat money. The name derives from the Latin *charta*, in the sense of a token or ticket. The modern theoretical body of work on chartalism is known as Modern Monetary Theory (MMT).

increase its own spending. If there is too much spending, the government shall prevent inflation by reducing its own expenditures or by increasing taxes;

- government can borrow money when it wishes to raise the rate of interest and by lending money or repaying debt when it wishes to lower the rate of interest, the government shall maintain that rate of interest that induces the optimum amount of investment;
- if either of the first two rules conflicts with principles of 'sound finance' or of balancing the budget, or of limiting the national debt, so much the worse for these principles. The government press shall print any money that may be needed to carry out rules 1 and 2.

Furthermore, the tax smoothing hypothesis by Barro (1979) focuses on the government's desire to minimise the distortions associated with obtaining revenue from taxes. He derives the tax smoothing model by assuming that the government finances its expenditures through two methods: current taxation and public debt issue.

Barro (1979), has focussed on the public debt issue and notes that the growth rate of debt would be independent of the debt-income ratio. And also that the growth rate of debt would be affected at most in a minor way by the level of government expenditure. In the same vein, he noted that the public debt issue has it that the volume of real government expenditure, aside from interest payments on the public debt, during period *t* is denoted by *Gt* and is assumed to be exogenous. Future values of *G* and of other exogenous variables are treated as though known with certainty. Real tax revenue obtained by the government in each period is designated by tY_t, and aggregate real income (treated as exogenous) by *Yt*. The real stock of public debt outstanding at the end of period t is denoted by bt, where this debt can be assumed at this stage to take the form of one-period, single-coupon bonds that are issued at par. Barro (1979) assumes that the initial price level, *P*, is constant over time, and the real rate of return on public and private debts, r, is also constant. The government's budget equation in each period is given as:

$$G_t + rb_{t-1} = \tau_t + \left(b_t - b_{t-1}\right) \tag{3.1}$$

where interest payments during period t are assumed to apply to the stock of debt outstanding at the beginning of the period. The government's budget equation at each date t, together with an additional condition that rules out perpetual debt finance, implies the overall budget constraint is:

$$\sum_{1}^{\infty}[G_t/(1+r)^t]+b_0=\sum_{1}^{\infty}[\tau_t/(1+r)^t] \qquad (3.2)$$

This condition which equates the present value of government expenditure (aside from interest payments) plus initial debt to the present value of taxes, follows from the budget equation as long as debt, *b*, is constrained to grow asymptotically at a rate below the interest rate, *r*. The sum of the present value of government expenditure and the initial debt level, which appears on the left side of equation (2) is exogenously given and also determines the present value of government tax receipts.

Barro (1979) derives that tax smoothing model by assuming that the costs of revenue collection per period are given by a time-invariant first degree homogenous function of tax collection and the level of output. He notes that for the case of direct collection costs for administration, enforcement, and so on, let *Z*, represent the real cost incurred and Y_t the real national income in period *t*. He assumes that *Z*, depends positively, with a positive second derivative, on the total net tax take for the period T_t and negatively on the pool of contemporaneously taxable resources Y_t, but not on the values of taxes or incomes in other periods. He further neglected any special relation of collection costs to the contemporaneous government spending level G. He assumed finally that the homogeneity condition that a doubling of net tax collections τ_t and potential tax pool Y_t doubles the collection cost Z_t. Therefore, the collection cost for period t can be written as:

$$Z_t=F(\tau_t,Y_t)=\tau_t f(\tau_t/Y_t) \qquad (3.3)$$

wheref' > 0, and the functions is assumed to be invariant over time. The present value of collection costs is then given by:

$$Z = \sum_{1}^{\infty} \tau_t f(\tau_t / Y_{t)} /(1+r)^t \qquad (3.4)$$

He noted further that the present value of collection costs is minimized subject to a given path of government spending, G_t, and the government budget constraint. At the present time t, the government is confronted by an exogenous series of planned expenditures, $G_1, G_2, \ldots$, which it must finance at each date; by a series of (anticipated) real income values, $Y_1, Y_2, \ldots$; at an interest rate r and an initial stock of debt, b_0. Given this present value, the government's objective is taken to be the minimization of the present value of the resources consumed by the process of revenue generation, Z, as shown in the present value equation.

Moreover, the Ricardian equivalence proposition presented in Ricardo (195l) posits that a cut in taxes that increases disposable income would automatically be accompanied by an identical increase in saving. In the theorem, households recognize that, for any given path of spending, a higher debt level today implies higher taxes in the future, and save accordingly. Under similar assumptions, it can be shown that government borrowing or taxation to finance expenditure has the same effects on consumption. The proposition here is that, deficit finance is no different from taxation because individuals fully take into account the future taxes they would have to pay. Essentially, for any change in the government debt composition, households are able to choose an appropriate portfolio of assets that preserves their original consumption plan. Taking into account the implied increase in future taxes, the consumer saves the amount required to pay them. If this hypothesis holds, budget deficits do not affect national savings, interest rates or the balance of payments, nor does the method of financing social security affect the accumulation of capital. Despite the sharpness of its predictions, it has not been possible to reject Ricardian Equivalence sufficiently to persuade proponents to change their views. Reviewing and extending the theory, Bernheim (1987) argued strongly against the Ricardian Equivalence. In the same vein, Haque and Montiel (1987) reject Ricardian Equivalence for fifteen out of a sample of sixteen developing countries.

Furthermore, Woodford's (1995) Fiscal Theory of Price Determination describes policy rules such that the price level is determined by government debt and the present and future tax and spending plans. The theory argues that the government's choice of how to finance its debt plays a crucial role in the determination of the time path of the inflation rate. According to the theory, fiscal policy affects inflation rates if and only if the government can behave in a fundamentally different way from households (Kocherlakota and Phelan, 1999). Households must satisfy intertemporal budget constraints, no matter what price paths they face. Woodford (1995) argues that the government does not face the same requirement. The government can follow non-Ricardian fiscal policies under which the intertemporal budget constraint is satisfied for some, but not all price paths.

Besides explaining the Fiscal theory of Price Determination, Canzoneri et al. (1998) note that price level can be determined in two different ways. They considered the fiscal dominant regime and the money dominant regime in the determination of price level. In a Ricardian regime or fiscal dominant regime, fiscal policy has discipline in the sense that current and/or future primary surpluses are actively adjusted to satisfy the government's Present Value Budget Constraint for any real value of current government liabilities. In this regime, monetary policy provides the nominal anchor, and the price level is determined in a conventional manner. On the other hand they assert that, in a non-Ricardian regime or money dominant regime, primary surpluses are not actively adjusted to guarantee fiscal solvency; for present purposes, the surpluses are regarded as surpluses being determined by an exogenous political process. In this regime, the price level is determined by the PVBC, the central bank targets the nominal interest rate, and the money supply adjusts to maintain equilibrium in the money market. The non-Ricardian regimes lack fiscal discipline in the sense that the fiscal authority does not actively try to satisfy its Present Value Budget Constraint, but they do not necessarily imply that fiscal policy is irresponsible.

In addition, the focal point of Woodford’s (1995) Fiscal Theory of Price Determination, as pointed out by Breuss (1998), uses modern dynamic optimizing models based on the Present Value Budget Constraint. It states that the real value of existing public sector liabilities must be equal to the present value of current and expected future primary surpluses.

3.2 Methodological review

Domar-Tobin Formula, according to Breuss (1998) is one strand of literature that provides justification for the fiscal criteria. He notes that Domar (1944) was one of the first to deal with the burden of the debt and the national income. The framework was used to answer concerns about how continuous government borrowing results in an ever rising public debt, the servicing of which will require higher taxes. He noted that the latter will eventually destroy the economy or result in outright repudiation of the debt. He started from the assumption of a constant deficit ratio (total deficit in percent of nominal GDP) which is defined as:

$$B_t - B_{t-1} = dY_{t-1} \tag{3.5}$$

B_t is the nominal value of the debt; Y_t is the nominal GDP at time *t*. Domar further assumed that the rate of growth of nominal GDP be constant and defined as:

$$g = Y_t - Y_{t-1} / Y_t \tag{3.6}$$

Defining the government debt-to-GDP ratio as $b_t = B_t / Y_t$, one arrives at a difference equation describing the evolution of the debt GDP ratio over time (t) :

$$b_t - b_{t-1} = -\frac{g}{1+g} b_{t-1} + \frac{d}{1+g} \tag{3.7}$$

After an infinite period, i.e. as $t \to \infty$, yields a limit value

$$b_\infty = \frac{d}{g} \quad \text{for } g > 0 \tag{3.8}$$

This condition implies a very simple rule for sustainability. It states that the deficit to GDP ratio must equal the nominal growth of GDP times the debt to GDP ratio.

Accordingly, Tobin (1984) draws the same conclusions as Domar (1944). Here, the assumption was a constant primary deficit to GDP ratio where the primary deficit (PD), is the difference between public expenditures (G) and taxes (T). According to Tobin (1984), if all components are divided by nominal GDP (Y), the ratio of the primary deficit to GDP; $pd = g - t$ where $g = G/Y$ is expenditure to GDP ratio and $t = T/Y$ is thetax revenue. Interest payments for the public debt defined as $R_t = iB_{t-1}$ where i is the nominal rate of interest. In this formulation, the deficit is defined as the accumulation of debt by;

$$B_t - B_{t-1} = G_t - T_t + R_t \tag{3.9}$$

Substituting expenditures and taxes as ratios to GDP and interest payments on public debt, the dynamics of public debt in ratios of GDP becomes:

$$b_t - b_{t-1} = (g - t) + i b_{t-1} \tag{3.10}$$

For $g - i > 0$, the solution is

$$b_n = \frac{(g-t)}{g-i} + \left(b_0 - \frac{(g-t)}{g-i} \right) \left(\frac{1+i}{1+g} \right)^n \tag{3.11}$$

The solution for equation 3.11 is stable for $g - i > 0$ and has the same limit as the Domar (1944) formula, namely

$$b_\infty = \frac{d}{g} \tag{3.12}$$

The necessary condition for this result, however, is $g - i > 0$, namely that the growth rate of nominal GDP is greater than the nominal interest rate.

In conformity with the above, Cronin and McCoy (2000) also stated that the predominant analytical framework used to assess fiscal sustainability is based on the intertemporal budget dynamics introduced by Domar in the 1940s. They expressed the government budget constraint as:

$$D = G - T = \Delta B + \Delta M \tag{3.13}$$

Where D is the government deficit

G is government expenditure

B is government debt

T is tax receipts

M is the money supply

The constraint expressed above states that the budget deficit can be financed by issuing money or by issuing debt through bonds. In their arithmetic of fiscal sustainability, they arrived at two conclusions. The first one expressed in ratios of GDP conforms to Domar's conclusion as:

$$d = bg \tag{3.14}$$

It implies a very simple rule for sustainability that the deficit to GDP ratio must equal the nominal growth of GDP. The representation above illustrates the role of economic growth in assessing fiscal sustainability. Highlighting the importance of the relationship between the economy's interest rate and the growth rate, they further separated interest payments on the debt from the budget balance which they regarded has a richer economic interpretation. Thus:

$$-p = (i - g)b \tag{3.15}$$

The above connotes that the requirements for fiscal sustainability depend on the rate of interest (or the intertemporal price) and the rate of growth which conforms to Tobin's conclusion. Such that;

- If $i > g$ then $p < 0$ (primary surpluses) required
- If $i < g$ then $p > 0$ possible in the medium term, but not sustainable in the long term

Furthermore, addressing the issues of government solvency and debt sustainability, Croce and Juan-Ramon (2003) assert that a set of policies is unsustainable if it leads to insolvency. They defined solvency as a situation in which the future paths of spending and revenue satisfy the intertemporal budget constraint. Montes-Negret (2001) in Ariyo (2002), observed that the public sector is said to be solvent if its outstanding debt does not exceed the discounted (present) value of its anticipated net future revenue. He contended that for a single period model, this implies that:

$$D^e_{t+1}\delta_t + D_{t+1} = \delta_{t-1}D^e_t(I_t + I^e_t)(I_t + d\delta_t) + D_t(I_t + I^e_t) - (T_t - G_t) + (H_{t+1} - H_t) \qquad 3.16$$

where: D^e and D are foreign-and domestic-currency-denominated debts outstanding at the beginning of the period *(t+1)*, respectively; δ is the exchange rate in units of domestic currency per unit of foreign currency, and $d\delta$ is the proportional rate of depreciation of the domestic currency; I^e and I are the foreign and domestic interest rates, respectively; T stands for total net tax collections; G stands for nominal government non-interest expenditures; and H stands for the outstanding base money.

Manipulating the above equation into an infinite period, converted to GDP ratios, and assuming that the interest parity condition is met in the long-run, the author observed that the long-run sustainable growth of the debt-over-GDP ratio is given by

$$(r-g)/(1+g) \tag{3.17}$$

where *(r)* is the long-run real rate of interest and g is the long-run growth rate of real GDP. Montes-Negret (2001), noted further that the policy implication of this result is that in the event of a large and widening gap between the real interest rates and the real rate of output growth *(i.e.; r>>g)*, the debt-over-GDP ratio could move to an explosive trajectory unless the primary surplus rises further to counter this tendency. He noted further the threat of an explosive debt-to-GDP ratio is heightened if the starting point for the ratio is very high. Policy-wise, fiscal sustainability states that equation 3.17 should never be greater than zero. This implies that real GDP growth should never be less than real interest rate.

In addition, Rutayasire (1990) notes that steady-state stability implies that the national debt should not be allowed to accumulate at a rate faster than the rate of increase in debt-service capability. Consistent with this view, he suggested a simple model for assessing the sustainability of fiscal deficit for developing countries. It also enables us to identify the various components of the fiscal resource profile of the country in relation to the mix and rate of accumulation of its debt obligations. The model defines

$$F_p = G - (T + C + fE_{-1} + eX + nB) \tag{3.18}$$

where F_p is fiscal profile; G is total government expenditure; T is total government revenue; C refers to government capital expenditure; f is inflation rate; E_{-1} government capital expenditure lagged one period; e is change in nominal exchange rate; X defines net foreign obligations denominations in foreign currency; B is budget deficit; and n is the growth rate of output of the economy.

Further, employing the methodology above, Ariyo (1993) modified and adapted the above equation for the Nigerian Economy. The need for the modification was informed by the fact that there was a build up of fiscal deficit. Hence instead of averaging as Rutayisire (1990) did, actual annual data of the relevant items were used. He did not make use of inflation adjusted lagged values of recurrent expenditure because inflation affects not only recurrent but capital expenditure.

In view of the above, the following modified version of the equation was adopted for the analysis.

$$F_p = T + nB - (G - C) - (D + X) \qquad (3.19)$$

Where D represents the outstanding total annual internal debt, X represents net annual external obligations (i.e. excess of external liabilities over total external assets for each year denominated in local currency), and $F_p < 0$ refers to unsustainable fiscal deficit. Equation 3.19 may further be restructured as

$$F_p = NW - NF \qquad (3.20)$$

where NW (net worth) is $\left[T + nB + (G - C)\right]$ and NF (net financial obligation) refers to $(D + X)$. Surplus from internal operation, denoted by NW, is a proxy for the country's real long-term capability for debt service (Rutayisire, 1990). Ariyo (2002) adopted two approaches for measuring fiscal sustainability. The first approach compared the real rate of interest with the real GDP growth rate. The second adopted an approach termed the net worth approach.

A similar study by Bebi (2000) on sustainability of fiscal deficits in Namibia shows the actual and sustainable values of the primary surplus for the period 1991 through 1999. Bebi (2000), represented the public sector constraint as:

$$-pd = (r-g)d_0 - (\pi + g)m(\pi) \tag{3.21}$$

where: g is the economy's rate of growth of real GDP in Namibia, π is the rate of inflation in Namibia, r is the long term real interest rate for South Africa (as Namibia during the period under review borrowed largely from South Africa), m is the inverse of base money velocity corresponding to the inflation rate (proxied by seignorage as a percentage of GDP).

Operationalising fiscal policy sustainability, Talvi and Vegh (1998) derived an indicator of fiscal policy sustainability. To render the definition operational, they defined the concept of permanent primary deficit, d_t, as that deficit, constant over time, whose present discounted value is equal to the planned trajectory of the primary deficit. Defined in such a way, one can calculate the permanent fiscal deficit for a sustainable fiscal policy as:

$$d_t^* = -\left(\frac{r-g}{1+g}\right)b_{t-1}, \tag{3.22}$$

which says that the permanent fiscal deficit should be equal to the effective interest payments on the initial public debt. It can be shown that when the above is satisfied, the stock of public debt remains constant over time as a fraction of GDP.

Finally, Talvi and Végh (1998) define the indicator of fiscal sustainability I^* as:

$$I_t^* \equiv \left(\frac{r-g}{1+g}\right)b_{t-1} + d_t^* \tag{3.23}$$

To operationalise the definition above, If $I_t^* < 0$ then the planned fiscal policy from t onward is sustainable in an ex-ante sense because the permanent primary deficit is no greater than the effective payment of interest on the initial stock of public debt. In contrast, if $I^* > 0$, then the planned fiscal policy is unsustainable. In this case the permanent primary deficit that is planned from t onward is not enough to cover the effective interest payments on the initial stock of public debt and therefore it violates the intertemporal budget constraint of the public sector.

In addition, the Sudden Stop approach proposed by Calvo et al. (2003) takes into consideration the effects of real exchange rate depreciation on fiscal sustainability. In this regard they propose an indicator which incorporates the currency composition of the debt and GDP. The interpretation given for the relationship posits that if exchange rate depreciates, then the value of debt stock will increase. Sudden stop occurs in a period in which a country's net capital flow declines by at least 5% of GDP and government is forced to substantially adjust its current account. A substantial current account deficit raises a question about the country's capability of continually financing such an imbalance. In a small open economy tradable prices are taken as a given which implies that the real exchange rate (RER) must adjust. This adjustment will generate valuation effects on the debt-to-GDP ratio, which, in turn, affect fiscal sustainability. They emphasize that debt composition, as well as output composition, matter a great deal for sustainability analysis, because mismatches between debt and output composition can lead to substantial differences in valuation of the debt/GDP ratio following real exchange rate depreciation.

Nevertheless, the use of Sudden Stops to model large unexpected shocks, it is difficult to tell whether the predictions of particular models are robust to changes, allowing agents to act on expectations of sudden stops. Precautionary savings theory suggests that this can be a flaw since, when faced with possible catastrophic events, agents build a buffer stock of savings to lower the long-run probability of these outcomes. Also, in using the debt-to-GDP ratio to determine sustainability, the theory is implicitly assuming that resources can easily be directed from the rest of the economy to the tradable goods sector to generate the required foreign exchange. Often the majority of public debt is denominated in foreign currency.

Moreover, the Probabilistic model is an approach to assessing fiscal sustainability proposed by Mendoza and Oviedo (2003). The guiding principle of the model is that of Credible Repayment Commitment (CRC). The model seeks to determine whether government can credibly commit to repay its debt in any circumstance. They define debt sustainability as one in which the government is able to repay its debt and maintain the credit relationship. This implies that the government cannot accumulate more debt than it can service. The probability model determines a threshold debt level, and produces estimates for the number of periods it will take to hit the debt threshold. Mendoza and Oviedo (2003) develop a complete dynamic stochastic general equilibrium model where the behaviour of utility maximizing individuals and profit-maximizing firms determines government revenues endogenously. These assumptions lead to a simple formulation of the CRC, where the threshold value for the debt-to-GDP satisfies equation 3.24. This is in line with the traditional approaches to assess debt sustainability based on deterministic steady-state estimates or empirical application of the intertemporal[17] government budget constraint. The probabilistic model defines a threshold debt to GDP ratio beyond which debt is deemed unsustainable. The threshold debt or the natural debt limit is defined as b^*, such that

$$b_{t-1} \leq b^* = \frac{\tau^{\min} - g^{\min}}{r_t - \gamma_t} \tag{3.24}$$

where b^* is the threshold value for the debt to GDP ratio, $t^{\min}$ is the minimum level of government revenue that can sustain the state, $g^{\min}$ is the minimum level of ratio of outlays to GDP, r_t is the interest rate and γ_t is the GDP growth rate. The Mendoza-Oviedo (2003) method aims to provide an explicit dynamic equilibrium model of the mechanism by which macroeconomic shocks affect government finances. It models explicitly the nature of government forward looking commitment to remain solvent.

Notwithstanding, Mendoza and Oviedo (2003) do not do define a policy target (i.e. expressed as the primary balance-to-GDP) needed to stabilize the economy. Their model defines the “maximum” debt level and not a “target” debt level (to be achieved through policy adjustment). The maximum debt level is not the equilibrium or optimal debt level. Therefore, the task of government is to strengthen fundamentals so that the probability of hitting the upper limit of government debt remains low. However, the debt level limit does not imply that governments with the debt levels at or below the limit are default-free. The possibility of default can still occur in the case where the inability to pay arises due to large unexpected shocks to either government revenues or outlays.

[17] The idea behind the intertemporal budget constraint is to determine what the combinations of consumption are in period zero and period one that may be achieved with period one’s income. Symbolically, $Y_0 = C_0 + \frac{1}{1+r} C_1$, where $\frac{1}{1+r}$ (the discount factor) is the price of consumption at period one.

Furthermore, the human development approach to debt sustainability advocated by Sachs (2002)[18] is based on the premise that human needs should be a priority before debt repayments. It advocated that poor indebted countries should be allowed to allocate funds to development programmes such as health and education before making debt payments. The steps involved in the human development approach are threefold. Firstly, the determination of the resource envelope is required. This includes all revenues and grants from domestic and foreign sources. Secondly, costing the human development expenditure is carried out. These expenses include those for social sector development (health, education, etc.), and basic infrastructure. The final step entails determining the net revenue available. This approach maintains that if the net revenue is less than zero, then debt is unsustainable or otherwise sustainable[19].

Nevertheless, there are limits to the human needs approach. Firstly, it is not designed for all countries but specifically for those economies which are highly impoverished. The approach therefore has limited applicability. Additionally, this approach does not pay adequate regard to domestic debt nor private sector debt. Private sector liabilities can become government debt if guaranteed by government. Lastly, this methodology allows countries to pursue their most basic human development needs in terms of health and education. However, essential needs for human development are not limited to these two areas.

Moreover, another set of approaches known as Accounting Approaches are based on gap analysis used to establish fiscal sustainability. They are primary balance gap, tax gap and net worth gap indicators (Buiter, 1985, Blanchard 1990, Blanchard, Chouraqui, Hageman and Sarto,

[18]Sachs' (2002) paper summarizes the inconsistency of the approaches discussed, noting that "it is perfectly possible, and indeed is currently the case, for a country or region to have a 'sustainable debt' (and significant debt servicing) according to IMF macroeconomic criteria, while millions of people within the country are dying of hunger or disease". One of the key principles of Sachs' approach is that human development is imperative and should take precedence over debt payments. As a consequence, developing countries should be able to set aside as much fiscal revenue as are needed to reach these goals and only then use the remainder for debt service. Debt sustainability here is linked to the achievement of the millennium development goals.

[19] Net revenue available for all other expenditures, including recurrent expenditure, personal emoluments, external debt service, etc. is obtained by deducting the total human development expenditure (in Step 2) from total available revenue (in Step 1). In a situation where net revenue is below zero, it would mean that debt service is non-payable, warranting total debt cancellation and increased grant aid. If the amount is above zero, then one would proceed to assess external debt against net revenue.

1990). The definitions of these indicators are essentially the same. A sustainable fiscal policy is one that ensures that the debt to GDP ratio converges back toward its initial level. These indicators differ from a statistical point of view[20] only.

These measures are based on the intertemporal budget constraint expressed as

$$b_t - b_{t-1} = b_{t-1} i_t - \left(T_t - G_t\right) \tag{3.25}$$

where b_t is the current debt stock, i_t is interest rate, T_t and G_t are government revenue and expenditure respectively.

The primary objective of these measures is to indicate the kind of fiscal policy adjustments that would be needed in order to maintain a sustainable debt level. The tax gap considers the difference between sustainabletax revenue and currenttax revenue. The difference between the two shows the adjustment required in order to avoid excessive debt accumulation. For the primary gap, if the current primary deficit is higher than the sustainable deficit, the debt ratio will rise without limits and fiscal policy can be called unsustainable. These gaps show the fiscal adjustment that is required to achieve a debt target in a particular year.

On use of the accounting methodologies for ascertaining fiscal sustainability in Caribbean economies, Scott (2008) argued that the most appropriate methodologies were the primary gap indicators and the econometric approaches. The justification for the adoption of these methodologies were that the primary gap indicators, apart from the fact that they are simple tools as guides toward a path of sustainability, they also signal both the timing and the size of the adjustment that is needed.

Further, the Primary Gap indicator was first proposed by Blanchard (1990) and further developed by Buiter et al. (1993). It computes the primary balance needed to stabilize the debt-to-GDP ratio, and is the difference between the required augmented surplus ratio to GDP and the actual

[20] The primary gap measures the distance from the sustainable primary balance. The tax gap expresses the difference between the actual and the sustainable revenue-to-GDP ratio. The net worth indicator measures what the government may temporarily need to keep its gross debt from rising by using its assets to finance the deficits.

augmented surplus ratio to GDP. The starting point of this approach is the one-period government budget identity which is defined as: Hence the one period primary gap indicator, which is the difference between the required augmented surplus ratio to GDP and the actual augmented surplus ratio to GDP, is an indicator of fiscal sustainability (Blanchard, 1990; Buiter, 1995)

Hence, a negative gap indicates that the required primary surplus is lower than the actual primary surplus, implying downward pressure on the debt-to- GDP ratio. If the indicator is positive, then the required primary surplus is higher than the actual primary surplus, suggesting that government must embark on fiscal adjustment programmes to ensure that the debt-GDP ratio does not increase.

Also, Blanchard (1990) defines sustainability as stability in the debt to GDP ratio and suggests a number of indicators (short, medium and long-term) that can be used to evaluate the sustainability of fiscal programmes implemented by government. Blanchard looked at the change in policies required to maintain the debt to GDP ratio constant. In this regard, he proposed the application of a "tax-gap" indicator. The tax gap indicates the increase in tax ratio (tax effort and/or the cut in expenditure) required for public debt sustainability.

Furthermore, Dinh (1999) used the instantaneous view of the budget constraint to investigate fiscal sustainability and solvency. He identified three possible sources of financing the primary fiscal deficit; domestic borrowing, external borrowing and money financing when it is consistent with seigniorage. He defined the primary surplus needed to achieve debt sustainability for the public sector. To assess the progress of fiscal sustainability, the primary surplus defined needs to be compared to the actual fiscal deficit. Fiscal sustainability adjustment is therefore defined as the difference between the sustainable primary balance defined and the actual primary balance. A positive number indicates the need for fiscal adjustment and a negative number indicates no adjustment required for fiscal sustainability.

In addition, the primary gap and tax gap indicators were used by Marini and Piergallini (2007) on the U.S. economy to measure fiscal sustainability. They also employed tests of solvency based on the present value budget constraint. The primary fiscal gap used by Aleksander (2008) for the Mediterranean countries made projections of macro indicators. A combination of primary gap indicators and cointegration were employed by Wright, A. et al. (2009) for studies on Jamaica on evaluating fiscal sustainability.

Moreover, a recent study by Bank of Ghana (2006) used the primary gap to compute a primary balance compatible with a sustainable debt-to-GDP ratio. Debt was categorised into three: concessional debt, non-concessional debt and domestic debt. They assumed that only resident's hold domestic debt, all types of debt are dominated in U.S. dollar and the economy assumed to be in a steady state. The objective of the study was to compute the primary balance to GDP ratio that is consistent with fiscal sustainability at any point in time. This sustainable primary balance has become an increasingly important disbursement criterion for the International Monetary Fund. The bank's analysis is based on the net present value of the country's external debt at its steady state level relative to GDP. Dynamic simulations of the fiscal variables to GDP ratios were performed up to 2025. They estimated various primary balance surpluses and the corresponding debt-to-GDP ratios.

Despite the wide usage of these indicators, there are setbacks. The gap approaches rely on accounting indicators, and usually set a constant debt-to-GDP ratio as a benchmark for the sustainability of fiscal policies. These approaches do not identify the level of debt which might be considered sustainable. They merely seek to stabilize the debt ratio. Additionally, the exclusive emphasis which this approach puts on the relationship between GDP growth and increases in debt does not capture the important role that lenders ultimately play in determining what debt strategies are sustainable. Furthermore, the absence of any reference to the structure of the debt and particularly the existence of external debt and the possible impact of exchange rate movements are other weaknesses of many gap approaches.

In addition, the Econometric Approach is another method used to measure fiscal sustainability. This approach is based on the assumption that fiscal sustainability exists when government policies satisfy the Present Value Budget Constraint. The methodology examines whether the fiscal data (revenue, expenditure excluding interest payment of debt) are consistent with the NPG condition. The basic idea behind the methodology is that these variables might grow over time; hence, a stable equilibrium (cointegrating) relationship should exist between them. If there is no long-term or equilibrium relation between them, then government is violating its intertemporal budget constraint.

What is more, this methodology is concerned with the statistical testing of the sustainability of past budgetary policies. The sustainability definition adopted in these studies is the second condition proposed by Blanchard et al. (1990)[21]. These studies aim at verifying whether when a government runs a deficit, it is making an implicit promise to creditors that it will run offsetting surpluses in the future or not (Hamilton and Flavin, 1986). The answer to this question would shed light on the soundness of the hypothesis of Ricardian equivalence in macroeconomic modelling. Aschauer (1985) and Seater and Mariano (1985) tested the hypothesis that governments' receipts must equal expenditures in present-value terms jointly with a permanent income hypothesis. Barro (1984) tested the hypothesis that government is subject to the present value budget constraint jointly with the assumption that taxation and deficit policies have historically been optimal. Hamilton and Flavin (1986) were probably first in testing the present value budget constraint per se.

Again, Hamilton and Flavin (1986) considered only the interest bearing share of the debt and measure it at market values in real terms. Strictly speaking, their debt measure is neither net nor gross as they take into account one category of government assets (gold holdings). The deficit measure is adjusted accordingly[22] (mainly to include capital gains/losses and to obtain figures in real value terms). Based on these data, Hamilton and Flavin use a Dickey-Fuller test for unit roots to check for the stationarity of the primary balance. Having rejected non stationarity, they note that for any stationary process when the discounted value of debt equals zero, public debt will be stationary, whereas for the discounted value of debt greater than zero, public debt will not be stationary, they applied the Dickey-Fuller test to public debt and rejected the hypothesis of non stationarity. They also run other tests based on the direct estimations, making different assumptions about the information set underlying the formation of expectations about future

[21] The one based on the inter-temporal discounted discounted budget constraint. This constraint is a crucial tool in modelling Ricardian Equivalence.

[22] Mainly to include capital gains /losses and to get figures in real value terms.

surpluses. Also these tests point to consistency between the data and solvency as defined on the basis of a present-value budget constraint.

This exercise has three main drawbacks: (a) the use of a very small sample (annual data for the period 1960-1984) is not suited for the implementation of the asymptotic tests used by the authors; (b) the assumption of a constant interest rate might imply a misspecification.

The Econometric approach consists of two main tests. The first, "test for stationarity", uses unit root tests such as Dickey and Fuller, Phillips and Perron, tests to assess the statistical properties of revenue and expenditure. Test for Stationarity was developed and applied by Hamilton and Flavin (1986). These unit root tests require large samples, and do not guarantee robust results in small samples. The second test uses co-integration techniques to determine the relationship between the coefficients of revenue and expenditure. Given that the coefficients are both stationary, Hakkio and Rush (1991) define cointegration between these variables as a necessary condition for the present value budget constraint to hold. From the inter-temporal budget constraint, tests of fiscal sustainability can be derived using the concept of co-integration.

This method is based on a regression equation of the form:

$$R_t = \alpha + \beta\left(G_t + iB_{t-1}\right) + \varepsilon_t \tag{3.26}$$

where R_t is revenue, $\left(G_t + iB_{t-1}\right)$ is total expenditure including interest payments on debt, B_t is debt stock and i_t is interest rate. With this approach, sustainability is determined based on stationarity and cointegration tests.

Further, using the econometric methods, Bohn (1995, 1998) and Ball et al. (1998) noted that cointegration analysis has drawbacks as a methodology for determining fiscal sustainability. They assert that persistent deficits and the accumulation of debt do not necessarily imply that the debt is unmanageable and, hence that, fiscal processes are unsustainable. Bohn (2005) using unit tests on the U.S. economy on real series also performed stationarity tests on real variables. Sustainability was judged based on the expected value of the budget constraints. The government has the option to change the historical pattern it has been following. It may not borrow and so it will not run a Ponzi scheme in the future.

Meanwhile, Bohn (2007) levied a further criticism of sustainability tests based on unit root testing and cointegration. Specifically, he suggested that rejections of sustainability based on stationarity and cointegration tests are invalid because in an infinite sample, any order of integration of debt is consistent with a transversality condition, which in turn implies that intertemporal budget constraint is always satisfied. Bohn (1998, 2007) argues that more emphasis should be put on the economics of the IBC and proposes an alternative means of testing the sustainability of fiscal policy, based on the responsiveness of the primary surplus to the debt-GDP level, where a positive response parameter is seen as consistent with fiscal probity.

Hence the standard approach to testing whether government adheres to its intertemporal budget constraint — a cointegration analysis — does not provide sufficient criteria for determining whether the fiscal process is truly sustainable. Kia (2005) applied cointegration and multicointegration techniques to analyse fiscal process on sustainability for Egypt, Turkey and Iran. A model based on Barro's (1979) tax smoothing was developed for Iran because it is an Oil producing country. Analysing government budget deficits and trade deficits, Ahmed and Rogers (1995) carried out studies for the U.K. and the U.S. using extensive time series data. They performed tests of whether tax revenue, expenditure and real interest rate payments are cointegrated with vector (-1, 1, 1).

Moreover, writing on a new evidence of the Ricardian Equivalence Theorem, Leachman (1996), uses a more articulate set of criteria for determining whether a country exhibits a sustainable budgeting process or not. His criteria for sustainability are based on the multicointegration approach first presented by Granger and Lee (1989). Recently, Leachman et al. (2005) use the one-step multicointegration approach which was developed by Engsted et al. (1997). Multicointegration can ensure that a country's budgeting strategy is also sustainable in 'bad' states of nature, that is, when the rate of economic growth falls short of the real interest rate on sovereign debt.

Despite the popularity of the econometric approach, data on government spending and revenue to determine the existence of co-integration is of concern to the test of historical time series. The historical time series data requires the use of long data sets, a requirement that may be unrealistic in many developing countries. This is because data are relatively poor and limited with respect to time span and accuracy. Also, this technique captures only long-term sustainability but does not capture problems of short and medium-term sustainability.

Furthermore, using fiscal rules to ensure fiscal sustainability in the long run, Mackiewicz (2003) examines the problem of choice of an optimal fiscal rule. He intimated that an ideal rule would typically assure fair distribution of utility over generations, while allowing maintaining the sustainable fiscal position. Of the fiscal rules available, he employed three types: debt, deficit and expenditure rules. The deficit rules can be implemented using balanced budget laws. The debt rules also operate via debt ceilings and expenditure rules through ceilings of some types of public expenditure.

Some strand of literature has studied fiscal sustainability by applying a dynamic stochastic general equilibrium (DSGE) model. Mendoza and Oviedo (2004, 2006) develop small open economies to investigate how macroeconomic shocks affect government finances and estimate the amount of sustainable public debt in emerging market economies. Sakuragawa and Hosono (2009) develop a closed economy model of an exchange economy to test fiscal sustainability of the Japanese economy. They evaluated sustainability by testing whether the expected debt-to-GDP ratio stabilizes or increases without bound. The simulated debt-to-GDP ratio depends on the intermediation cost, the elasticity of intertemporal substitution, the projected growth rate, and on the specified fiscal policy rule. If the fiscal policy rule estimated over the past 30 years goes over in the future, the debt-to-GDP ratio will increase without bound, and in this sense the fiscal policy is not sustainable.

3.3 Empirical review

Using primary gap and tax gap indicators alongside tests based on present value budget constraint, Marini and Piergallini (2007) found negative values for these indicators. The implication of this is that U.S. fiscal policy is on sustainable path. On the present value budget constraint, a positive relationship between surplus and debt was sufficient for sustainability. Aleksander (2008) with studies on the Mediterranean also used the primary fiscal gap and projections of macroeconomic indicators. The results indicated that fiscal sustainability seems to be a problem in many Mediterranean countries. Wright et al. (2009) using primary gap indicators and cointegration to evaluate fiscal sustainability in Jamaica found negative values for the primary gap and the results showed that the fiscal position was sustainable.

Similarly, the use of the primary gap indicators by the Bank of Ghana (2006) to investigate fiscal sustainability in the Ghanaian economy spanned up to 2025. The main objective of the study was to ascertain whether the government's future fiscal policy is consistent with debt sustainability in the post HIPC era. They estimated the expected primary balance and the corresponding debt. The study observed that the required fiscal adjustment diminishes over time as the primary surplus declined consistently. A net present value (NPV) of external debt expressed as a ratio of GDP at 60% was considered sustainable over the long run. This rule is based on the condition that donor communities will continue to give concessionary assistance in the post HIPC-MDRI era. The study concluded that fiscal policy would be sustainable in the future[23].

In addition, the use of cointegration methodology by Wu (1998) on the data of Taiwan, for instance, finds the fiscal policy of Taiwan sustainable. A similar finding was revealed by Green et al. (2001) for Poland's fiscal policy. Furthermore, Bravo and Silvestre (2002) find that the fiscal process in Austria, France, Germany, Netherlands and the UK is sustainable. The process of empirical work on fiscal sustainability focusing on the time-series Behaviour of tax revenues and expenditures as well as debt series is consistent with the intertemporal budget balance. Specifically, an intertemporal budget balance holds if the stock of debt and the flow of deficits are cointegrated. The empirical results of the existing literature vary depending on the sample period and the methodology used.

Empirical analysis of the Sudden Stop approach was conducted by Calvo et al. (2003). They considered the effects of a depreciation of the RER of 50% on debt valuation and fiscal

[23] By this definition, an economy is said to have achieved fiscal sustainability when the ratio of public sector debt-to-GDP is stationary and consistent with the primary balance compatible with a sustainable and stable debt to GDP ratio.

sustainability for Argentina, Brazil, Chile, Columbia and Ecuador for the year 1998. They found that the RER depreciation had a substantially negative effect on Argentina's fiscal performance.

Trehan and Walsh (1988) proved that stationarity of the first difference of the stock of debt is sufficient for fiscal sustainability, as is the stationarity of the overall deficit. For example, Trehan and Walsh (1991)[24], Martin (2000) and Cunado et al. (2004) failed to reject intertemporal budget balance for the United States. Others based their sustainability conditions on cointegration theory. In Haug (1991) fiscal sustainability requires that debt and primary deficit be cointegrated. Cointegration between revenues and total expenditures, along with unitary cointegrating parameter on the latter suffice for sustainability. Hakkio and Rush (1991a) suggest that cointegration between real government revenue and real government spending (inclusive of real interest rate payments) is a necessary condition for the intertemporal budget constraint to be satisfied. They find evidence of cointegration for the US (from 1950 to 1988), although evidence is less clear cut for a later sample (1976–1988), which suggests violation of the government's intertemporal budget constraint. This suffices the 'strong'sustainability condition defined by Quintos (1995)[25]. Meanwhile other studies, including Hamilton and Flavin (1986), Wilcox (1989) and Hakkio and Rush (1991b) rejected it.

Ahmed and Rogers (1995) considererd the present value constraint for the US and the UK, by examining a cointegrating vector that includes G_T and T_T where the former includes interest payments. Using over a 100 years of annual data and, taking account of breaks using dummies in the estimated relationship, they find evidence that the constraint holds. Considering government budget deficits and trade deficits for the U.S and the U.K, they tested whether government tax revenue, expenditure and real interest rate payments are cointegrated with vector (-1, 1, 1). For

[24] They emphasise that with constant expected real interest rates a necessary and sufficient test of the intertemporal budget constraint is cointegration of debt and the primary surplus and a quasi-difference stationary primary surplus. Intuitively, if primary surplus and debt are cointegrated the government has some concern with debt levels when deciding fiscal policy.

[25] Quintos (1995) makes a distinction between weak and strong forms of fiscal sustainability. Weak fiscal sustainability implies that there is a relationship between government spending and revenue, without necessarily having evidence of cointegration between the two fiscal variables. Strong fiscal sustainability is a one-to-one relationship between spending and revenue and the existence of a cointegrating relationship, and relates to Trehan and Walsh's approach.

both countries, a cointegrating relationship with vector (-1, 1, 1) was found implying that fiscal policy for the two countries are sustainable.

Furthermore, they showed that, under some very general conditions cointegration between total revenue and total expenditures is necessary and sufficient for sustainability even in a stochastic environment. Leaving aside the 'weak' condition by Quintos (1995)[26], total revenues and expenditures, if not stationary in their levels, should be cointegrated with a vector (1, -1) to claim fiscal sustainability in the 14 countries of the European Union. Kia (2005), using cointegration and multicointegration to analyse fiscal process sustainability for Egypt, Iran and Turkey found that the fiscal budgeting process in Egypt and Turkey were weakly sustainable, but not Iran.

Luporini (2002) argues that the efficiency of cointegration analysis is constrained by its assumptions on real interest rate and the stochastic process that drives deficit. He applied Bohn's (1998) approach to investigate the response of Brazil's budget surplus to its variation of debt-income ratio and found Brazil had an unsustainable fiscal structure, in contrast to the result found earlier by Issler and Lima (1997) who adopted a cointegration approach.

Applying the fiscal sustainability adjustment rule, using the primary fiscal deficit, Dinh (1999) used a framework to evaluate the fiscal performance of Argentina, India and Zambia, each with a different income level and located on a different continent. The results showed that at the end of 1997, Zambia's fiscal balance remained far from the level required for sustainability. A fiscal adjustment equivalent to approximately 25.3% of GDP prevailed. That is a huge adjustment beyond the ability of any government to undertake. For India, the public sector would have required 1.6% primary surplus adjustment for sustainability.

Similarly, investigating the sustainability of fiscal deficits in Namibia, Bebi (2000) developed a model and used to estimate the sustainable values of the Primary Surplus for 1991 through 1999. He found that no substantial fiscal adjustments were required in 1991 (with a sustainable primary surplus of 1.5% of GDP), to preserve the public sectors solvency. For the period 1995 through 1999, it was established that fiscal adjustments were necessary, with the required primary surplus above 4.5% of GDP. He concluded that the public deficit is sustainable, if it is funded without

[26] As mentioned earlier under subsection 3.1.1-concepts and definitions.

increasing the level of debt (relative to GDP), under feasible growth rates, real interest rates and inflation. This is supported by the estimation for 1991 which had a high growth rate and low total debt as a percentage of GDP and showed that no substantial fiscal adjustments were required during that period.

Furthermore, findings by Ariyo (2002) on fiscal sustainability in Nigeria indicate that Nigeria's fiscal profile was only sustainable for seven (7) out of the 31 years covered by the study (that is 1974 - 1979 and 2000). The sustainability from 1974 - 1979 could be attributed to the impact of the second oil boom of 1974 which led to an episodic jump in the nation's total revenue, and the sharp reduction in capital expenditure hitherto warranted by the post civil war, reconstruction and rehabilitation efforts.

The fiscal rule as used by Mackiewicz (2003) rule required that government's policy should aim at keeping the debt-to-GDP ratio constant over the economic cycle. The analysis is extended by taking into account the specific situation of the developing countries. An optimum fiscal constraint is then the Modified Golden Rule, according to which the public assets-to-GDP ratio should be held constant over the cycle. The modified deficit rule says that the deficit in each period should be set at the level which causes the relative debt level to remain constant. Applying this rule does not require knowledge of the long run parameters. It requires only a constant monitoring of the debt level and current corrections of expenditure so that the public debt-to- GDP ratio remains constant. This solution, with the assumption that the monitoring system is efficient enough, allows achieving the socially optimal fiscal policy[27], without any risk in the long run. This rule is, in fact, similar to another widely used class of fiscal rules; public debt rules.

Using a dynamic stochastic general equilibrium model to investigate the fiscal sustainability of the Japanese economy, Sakuragawa, M. and Hosono, K. (2010) introduced intermediation costs into the model. They explained the observed relationship between the interest and GDP growth rates, which is crucial in testing for sustainability. When the projected real growth rate is 2.5%,

[27] Rules can be implemented either as stand-alone, or in the context of a broader legal context. For example Fiscal Responsibility laws.

the average real interest rate becomes 2.57%, and the debt-to-GDP ratio gradually increases stochastically so that government debt is not sustainable. To recover sustainability, the primary surplus must be 0.2% of GDP.

3.4 Gaps in the literature

Apart from contributing to the knowledge and debate on fiscal sustainability in the Ghanaian economy, the study specifically fills two gaps in the literature.

Firstly, an extension and of the indicator of fiscal sustainability that outlines the fiscal resource profile of an economy. Following Rutayasire (1990), Ariyo (1993) and Talvi and Vegh (1998), this study constructs a more elaborate characterisation of a fiscal sustainability indicator for an economy. Further, the effect of windfall oil revenue on fiscal sustainability is modeled through exchange rate movements.

Secondly, the arbitrary determination of fiscal rules by IMF and the Maastricht treaty do not consider the initial conditions of these economies and the welfare implications of the rules. The Treaty of Maastricht defines sustainability as non-violation of arbitrarily predetermined parametric standards. This research gap is filled by computing a utility maximizing expenditure and deficit rule using optimization techniques. The optimal rules determined also considered the injection of oil revenue into the budget and the required levels of expenditure and deficit that would lead to the attainment of the desired state.

A working definition of fiscal sustainability informed by the study is given as a growth and development path of an economy, which would not lead to major fiscal corrections in the long run.

CHAPTER FOUR

Theoretical Framework and Methodology

4.1 Description of key variables

In the study of fiscal sustainability in the Ghanaian Economy, annual data for the period 1980 to 2009 were used. Government revenue consists of taxes, social contributions, grants receivable, and other revenue. Revenue increases government's net worth, which is the difference between its assets and liabilities. Transactions that merely change the composition of the balance sheet do not change the net worth position, for example, proceeds from sales of nonfinancial and financial assets or incurrence of liabilities.

Government total expenditure (g) consisting of Gross national expenditure (formerly domestic absorption) is the sum of household final consumption expenditure (formerly private consumption), general government final consumption expenditure (formerly general government consumption), and gross capital formation (formerly gross domestic investment). This includes total expenses on goods and services, interest payments on loans including the net acquisition of nonfinancial assets. On an accrual basis, total expenditure takes the disposals of nonfinancial assets into account. This is expressed as a percentage of Gross Domestic Product.

Primary balance as a percentage of GDP is computed from total revenue, total expenditure and Interest payments. The primary balance equals government total revenue minus total expenditure other than net interest. By excluding net interest, the primary balance provides a direct measure of the claim of the government on resources.

Gross Domestic Product (Current Prices) is expressed in millions of national currency units. Gross domestic product (GDP) measures the total output of goods and services for final use occurring within the territory of the country, regardless of the allocation to domestic and foreign claims. GDP Growth rate consists of annual percentages of constant price GDP and these are based on year-on-year changes.

Aid expressed as a percentage of GDP, as used refers to foreign assistance in the form of grants from bilateral and multilateral agencies. This might come in as financial flows, technical assistance, and commodities. This aid is separated from concessionary loans component which together comprise foreign aid.

Real interest rate is calculated using the 91 day Treasury bill rate. In this case, the nominal 91 day Treasury bill interest rate does not take into consideration the effects of inflation; it is the rate at which money is compounded. On the other hand, real interest rate is the opposite because inflation has already been factored in. It is equal to nominal interest minus the inflation. Real interest rates are normally lower than nominal interest rates since inflation rates are often positive values. Inflation is calculated as end of year percentage change. The data for inflation are end of the period, not annual average.

The nominal effective exchange rate is the price of a foreign currency unit in terms of domestic currency units as adopted in the IMF's International Financial Statistics. The measurement unit is therefore Cedi per Dollar. Data are from the International Monetary Fund, International Financial Statistics (2009), Washington DC.

Total Government Gross Debt as a percentage of GDP comprises the stock (at year-end) of all government gross liabilities (both to residents and non-residents). To avoid double counting, the data are based on a consolidated account (eliminating liabilities and assets between components of the government, such as budgetary units and social security funds).

Domestic debt refers to the debt owed to creditors resident in Ghana and dominated in local currency. External debt is debt owed to non-residents of a repayable in foreign currency, goods, or services. It is the sum of public, publicly guaranteed, and private non-guaranteed long-term debt, use of IMF credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. Long-term debt includes all debt having a maturity of more than one year. This includes debt owed to private commercial banks, governments or international financial institutions.
Capital investment is measured by gross fixed capital (formerly gross domestic fixed investment) formation expressed as a percentage of GDP. This includes land improvements (fences, ditches,

drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.

The data described is obtained from various issues of the Bank of Ghana's annual reports and the Ghana Statistical Bulletin. Another important source of data was the World Development Indicators/Global Development Finance report 2010.

4.2 Theoretical framework

The theoretical framework for analysing fiscal sustainability in the Ghanaian economy has its underpinning on the theory of Functional Finance by Lerner (1943). The basis for erecting the theoretical framework on the theory of functional finance is dictated by the fact that it is a theory of purposeful financing to meet explicit goals, including full employment. The theory has it further that no taxation is designed solely to fund expenditure or finance investment. In the theory of Functional Finance, the government may find itself collecting more in taxes than it is spending, or spending more than it collects in taxes. In the former case, it can keep the difference in its coffers or use it to repay some of its national debt, and in the latter case, it would have to provide the difference by borrowing or printing money.

From an analytical perspective, the issue of fiscal policy sustainability can be presented in a government budget constraint framework (Chalk and Hemming, 2000). Hence, the intertemporal budget constraint is the indispensable starting point for analysing fiscal sustainability[28]. In this regard, as noted by Cronin and McCoy (2000), the analytical framework used to assess fiscal sustainability is based on the intertemporal budget dynamics introduced by Domar in the 1940s. This arithmetic of sustainability is centered on the relationship between government budget balances and debt levels. In this framework of fiscal sustainability, the role of aid and seignorage financing will not be unrecognized since they are a major source of financing budgets in developing countries.

[28] Chalk and Hemming (2000), Ley (2003)and Burnside (2005) provide concise treatments intertemporal budget constraint arithmetic.

4.3 Dynamic sustainable fiscal profile for the economy of Ghana

In view of the above, the analytical framework for fiscal sustainability is the current period budget constraint. The current period budget constraint is an expression that equates the flows of government revenues and expenditures with changes in stock of public debt and the monetary base. Algebraically, the budget constraint is expressed as:

$$D = G - T = \Delta B + \Delta M \tag{4.1}$$

Where D is the government deficit, G is government expenditure, B is government debt, T is tax receipts and M is the money supply. It says that budget deficit can be financed by issuing money or by government debt through the issue of bonds.

This formulation finds support from many others among which are Cronin and McCoy (2000), Alvarado et al. (2004), Chalk and Hemming (2000) and Burnside (2004).

Following Burnside (2004), the government's budget constraint can be expressed as:

net issuance of debt = interest payments – primary balance – seignorage

The net issuance of debt is gross receipts from issuing new debt minus any amortization payments made in the period. The identity can be written as

$$B_t - B_{t-1} = I_t - PD_t - (M_t - M_{t-1}) \tag{4.2}$$

The subscript t indexes time, measured in years, B_t is the stock of public debt at the end of period t, I_t is interest payments, PD_t is the primary balance (revenue minus non interest expenditure) and M_t is the monetary base at the end of period t. This is modified as

$$I_t = (1 + i_t^d) B^d{}_{t-1} + e(1 + i_t^f) B_t^f \tag{4.3}$$

where i_t^d is domestic interest rate, i_t^f is foreign interest rate and e ,is nominal exchange rate. Where $B^d{}_{t-1}$ and B_t^f are domestic debt and foreign debt respectively. The primary balance can be expressed as

$$PD_t = G_t - T_t \tag{4.4}$$

where G_t is government expenditure and T_t is revenue. The government budget constraint can be expressed as:

$$G_t - T_t + I_t = \left(D_{t+1} - D_t\right) + \left(M_{t+1} - M_t\right) \tag{4.5}$$

Where $G_t - T_t + I_t$ = PD, is the primary balance.

Building on the above, the study extends further the framework to differentiate domestic debt from foreign debt, the government budget constraint for period t in terms of domestic currency is

$$PD_t = (B_t^d - B_{t-1}^d) + e(B_t^f - B_{t-1}^f) + (M_t - M_{t-1}) \tag{4.6}$$

Interest payments on both domestic and external debt are separated to give the formulation a richer economic meaning as surmised by Rutayasire (1990) where PD is the government primary balance for period t, which is to be financed by seignorage, net domestic and external indebtedness. Interest payment, (I_t) on both domestic and foreign debt is $I_t = i_t^d B_t^d + e i_t^f B_t^f$. A further extension of the framework is the incorporation of aid. This modification is informed by the fact that aid has become a major component of the budget of Ghana especially after 2000 till 2009. Following the formulation by Dinh (1999), aid as a component of foreign aid can be used to isolate concessionary debt to have an effect on change in debt levels. Taking into consideration the Domar (1944) framework[29] and therefore substituting interest payments from equation (4.3), the government budget constraint for period t in domestic currency can be expressed as:

[29] This implies a simple rule for sustainability that the deficit to GDP ratio must equal the nominal growth rate of GDP times the debt to GDP ratio. Algebraically, $d = b.g$ as found in equation 3.14.

$$G_t - T_t + i_t^d B_t^d + e i_t^f (1 - A_t) B_t^f = \Delta B_t^d + e \Delta B_t^f (1 - A_t) + \Delta M_t \tag{4.7}$$

Where ΔB_t^d is the change in domestic debt, ΔB_t^* is change in external debt and ΔM_t is change in the monetary base. Aid is represented by A_t. All other variables are as explained before. Normalise equation (4.7) by dividing by nominal income, $P_t Y_t$. Where P_t is the price level and Y_t is real GDP. First, expressing it in real terms by dividing by P_t yields:

$$\frac{G_t}{P_t} - \frac{T_t}{P_t} + \frac{i_t^d B_t^d}{P_t} + \frac{e i_t^f (1 - A_t) B_t^f}{P_t} = \frac{\Delta B_t^d}{P_t} + \frac{e \Delta B_t^f (1 - A_t)}{P_t} + \frac{\Delta M_t}{P_t} \tag{4.8}$$

And simplifying,

$$g_t - \tau_t + i_t^d b_t^d + i_t^f (1 - A_t) b_t^f = (\Delta b_t^d + b_t^d \pi) + (1 - A_t)[\Delta b_t^f - b_t^f (\Delta e - \pi^f)] + (\Delta m_t + m\pi) \tag{4.9}$$

Where $\frac{B_t^d}{P_t} = b_t^d$ and $\frac{eB_t^f}{P_t} = \frac{B^f}{P_t} = b_t^f$ and $\frac{M_t}{P_t} = m_t$,

Then,

$$\frac{\Delta B_t^d}{P_t} = \Delta b_t^d + b\pi \ , \ \frac{e_t \Delta B_t^f}{P_t} = \Delta b_t^f - b_t (\Delta e - b\pi^f) \ \text{and} \ \frac{\Delta M_t}{P_t} = \Delta m_t + m_t \pi \ ,$$

Where small case letters represent real values, and π is the inflation rate.

Expanding equation (4.9) and group like terms yields:

$$\begin{aligned} &g_t - \tau_t + i_t^d b_t^d - \pi_t^d b_t^d + i_t^f (1 - A_t) b_t^f + \\ &(1 - A_t) b_t^f (\pi^f - \Delta e) = \Delta b_t^d + (1 - A_t) \Delta b_t^f + (\Delta m_t + m_t \pi) \end{aligned} \tag{4.10}$$

Simplifying further,

$$\begin{aligned} &g_t - \tau_t + b_t^d (i_t^d - \pi_t^d) + (i_t^f - \pi^f + \Delta e)(1 - A_t) b_t^f = \\ &\Delta b_t^d + (1 - A_t) \Delta b_t^f + (\Delta m_t + m_t \pi) \end{aligned} \tag{4.11}$$

Noting that $r^d = i^d - \pi^d$ and $r^f = i^f - \pi^f$

$$pd_t + r_t^d b_t^d + (r_t^f + \Delta e)(1-A_t)b_t^f = \Delta b_t^d + (1-A_t)\Delta b_t^f + (\Delta m_t + m_t\pi) \quad (4.12)$$

It is useful to express the above in percentage of GDP[30], divide through by Y_t in order to obtain expressions for Δb_t^d and Δb_t^f such that

$$\frac{pd_t}{Y_t} + \frac{r_t^d b_t^d}{Y_t} + \frac{(r_t^f + \Delta e)b_t^f(1-A_t)}{Y_t} = \frac{\Delta b_t^d}{Y_t} + \frac{\Delta b_t^f}{Y_t}(1-A_t) + \frac{\Delta m_t}{Y_t} + \frac{m_t\pi}{Y_t} \quad (4.13)$$

From earlier manipulation

Let $\frac{b_t^d}{Y_t} = \beta_t^d$ and $\frac{b_t^f}{Y_t} = \beta_t^f$ and defining

$$\frac{\Delta b_t^d}{Y_t} = \Delta\beta_t + \beta_t^d g \text{ , } \frac{\Delta m_t}{Y_t} = \Delta m_t + m_t g \text{ and } \frac{\Delta b_t^f}{Y_t} = \Delta\beta_t^f + \beta_t^f g$$

Substituting into equation (4.13)

$$\frac{pd_t}{Y_t} + r_t^d\beta_t^d + (r_t^f + \Delta e)\beta_t^f(1-A_t) = \Delta\beta_t^d + \beta_t^d g + \left(\Delta\beta_t^f + \beta_t^f g\right)(1-A_t) + \Delta m_t + m_t(g+\pi) \quad (4.14)$$

Rearranging the above and simplifying ,

$$g_t - \tau_t = \Delta\beta_t^d + \beta_t^d(g - r_t^d) + \beta^f(g - r_t^d - \Delta e)(1-A_t) + \Delta\beta_t^f(1-A_t) + \Delta m_t + m_t(g+\pi) \quad (4.15)$$

With a bit of rearrangement, the above becomes a dynamic fiscal profile for Ghana. In this regard, the Fiscal Profile, FP, for the economy is expressed as:

$$\begin{aligned} FP = \tau_t - \{g + [\beta_t^d(r_t^d - g) + \beta^f(r_t^f + \Delta e - g)(1-A_t)]\} - \\ [\Delta\beta_t^d + \Delta\beta_t^f(1-A_t)] - [\Delta m_t + m_t(g+\pi)] \end{aligned} \quad (4.16)$$

[30] The budget constraint equation is usually normalised by some measure of the government's ability to service and repay its debt (Ley, 2003, p. 2) or the government's capacity to tax (Kremers, 1989). Scaling by gross domestic product is a common research standard.

The above framework separates the different factors that determine the fiscal profile of the country. It indicates that the fiscal position is influenced by government revenue, government expenditure, interest payments on public debt, revenue from seignorage. The remaining are the level of aid, real stocks of both domestic and external debt and automatic debt dynamics, which includes factors such as real domestic interest rate, and external interest rate. The rest are exchange rate changes, growth rate of GDP and seignorage revenue. The term ($r_t^d - g$) is the growth adjusted real interest rate. The cost of servicing external debt ($r_t^f + \Delta e - g$) captures the effects of international real interest rates. Monetary seignorage is defined as Δm_t and $m_t(g+\pi)$ is the growth adjusted inflation tax and equals the real value of the nominal increase in base money, where π equals the rate of inflation.

4.4 Effect of oil revenue allocation to the budget on the fiscal stance

As a small open economy, oil revenue is likely to have a sustained impact on the fiscal stance of the economy. Assuming the case where the exchange rate is pegged or heavily managed, increased public spending falls partly on traded goods, whose prices are given, and partly on non-traded goods, whose prices consequently tend to rise. The pressure of public spending can therefore cause the real exchange rate to become over-valued. The relative price change switches the excess demand associated with oil revenue toward foreign goods. This will lead an appreciation of the exchange rate.

In this perspective, Eastwood and Venables (1982) modelled the macroeconomic effect of a resource discovery in an open economy. This was considered as a foreign exchange increment to the national wealth. They defined oil revenue as the infinite term annuity of the increment whose impact would in turn affect demand. Following this idea, the allocation of oil revenue into the budget and a nominal exchange rate shock in tandem, would capture the effect of oil revenue on the fiscal stance of the economy.

4.3.1 Identifying nominal effective exchange rate appreciation episodes

It is thus imperative to identify episodes of exchange rate appreciation as shocks to the economy.

Following Kappler et. al. (2011), the identification of episodes of nominal effective exchange rate appreciation is performed with modifications to suit. An appreciation of nominal effective exchange rate is defined as an event if the nominal effective exchange rate is revalued relative to the preceding level. The one horizon allows the capture of only one-time step revaluations. An appreciation event is defined when the nominal effective exchange rate appreciates.[31] Algebraically, this is expressed as:

$$\log e_t - \log e_{t-1} > \log e_{t-1} - \log e_{t-2} \tag{4.17}$$

Where, e is the nominal effective exchange rate.

4.5 Framework for management of fiscal effects of the pending oil revenue in the Ghanaian economy

4.5.1 The effect of future oil revenue on expenditure

Two assumptions are invoked here. They are intertemporal optimization and a representative agent. The government as a representative agent chooses an expenditure policy over time, which maximises a social welfare function subject to an intertemporal budget constraint. Considering a felicity function, the government chooses a tax and spending policy to maximise a social welfare function subject to an intertemporal budget constraint and a transversality condition or no-ponzi game conditions. The problem is to maximise:

$$W = \max_{G_s} \sum_{s=1}^{\infty} \beta^{s-t} U\left(G_t\right) \tag{4.18}$$

subject to

$$B_t = RB_{t-1} + G_t - T_t - A_t - M_t \tag{4.19}$$

$$\underset{s\to\infty}{Lim} B_{t+s} = 0 \tag{4.20}$$

Where B_t is government debt at the end of the period t,

[31] The nominal exchange rate appreciation must lead to sustained real appreciation as employed by Kappler et al. (2011)

R, is the interest rate (R=1+r) r being the long run interest rate, assumed to be constant

G_t is primary government expenditure

T_t is government revenue

A is aid

M is seignorage financing.

The above assumptions imply that fiscal policy variables, revenue and expenditure (T – G), do not affect other macroeconomic variables which are assumed to be constant and exogenous. In this respect, equation (4.19) suggests that only the primary balance matters for the evolution of government debt.

Setting the lagrangean for the governments problem gives

$$L = \sum_{s=1}^{\infty} \beta^{s-t} U\left(G_t\right) + \lambda(B_t - RB_{t-1} - G_t + T_t + A_t + M_t) \qquad (4.21)$$

The first order conditions employing direct calculus of the above is;

$$\frac{\partial L}{\partial G_t} = U^{'}(G) - \lambda = 0 \qquad (4.22)$$

$$\frac{\partial L}{\partial \lambda} = B_t - RB_{t-1} - G_t + T_t + A_t + M_t = 0 \qquad (4.23)$$

Following a closed form solution yields the following Euler equation;

$$U'\left(G_t\right) = \beta R U'\left(G_{t+1}\right), \qquad (4.24)$$

Invoking the assumption that $\beta = \frac{1}{R}$, $U^{'}(G)$ denotes the marginal utility of spending. The Euler equation above implies that government spending is constant, thus;

$$G_t = G_{t+1} = G^*$$

Solving for the optimal level of government spending, G, and invoking the no ponzi condition yields;

$$G^{*} = T_t + A_t + M_t - r.B_{t-1} \tag{4.25}$$

Introducing GDP growth rate by normalising variables does not change the essential form of the solution. Assume GDP, Y_t, grow at a rate, γ, that is, $Y_{t+1} = (1+\gamma)Y_t$. Therefore $g = \frac{G}{Y}$ is the ratio of spending to GDP and the budget constraint becomes

$$b_t = \frac{R}{1+\gamma} b_{t-1} + g_t + \tau_t - A_t - m_t \tag{4.26}$$

Where τ denotes the ratio of revenue to GDP and b the ratio of debt to GDP. Utility is also expressed in terms of GDP so that $U = U(g)$. Solving the model with GDP growth:

$$\frac{G^{*}}{Y_t} = \frac{T_t}{Y_t} + \frac{A_t}{Y_t} + \frac{M_t}{Y_t} - \frac{rB_{t-1}}{(1+\gamma)Y_{t-1}} \tag{4.27}$$

Simplifying the above and denoting the normalised variables yields a utility maximizing spending level of GDP as;

$$g^{*} = \tau_t + A_t + m_t - \frac{r}{1+\gamma} b_{t-1} \tag{4.28}$$

The intuitive appeal of this framework is that it is a simple measure that can easily be implemented because forecasted values can be fit in it for policy guidance.

The framework indicated by equation (4.28) dictates the estimation of an expenditure equation. Among other factors that influence expenditure, government expenditure function is given as:

$$\ln g_t = \alpha_0 + \alpha_1 \ln t_t + \alpha_2 \ln A_t + \ln m_t - \ln rb_{t-1} + \ln g_{t-1} \tag{4.29}$$

All variables as explained earlier. The lag of expenditure G_{t-1} is included to capture persistence since it is usually difficult for governments to cut down expenditures. Equation (4.29) will capture the impact of an exogenous disturbance on government expenditure.

As noted by Collier and Venables (2008), linking windfall revenues to development has both microeconomic and macroeconomic components. At the macroeconomic level, public spending is concerned with the capacity to manage change, manage the balance between public consumption and investment, combating the Dutch disease and linking spending to a strategic vision. They therefore suggested that an implementable macroeconomic strategy is to impose a ceiling on the rate of increase in spending.

Forecasting of variables that constitute the utility maximizing level of expenditure would reveal the effect oil revenue on expenditure. Box and Jenkins (1970) introduced a methodology to fit data using Autoregressive Integrated Moving Average (ARIMA) model. Autoregressive Integrated Moving Average or ARIMA (p,d,q) models are extensions of the Autoregressive (AR) model that uses three components for modelling the serial correlation in time series. The Autoregressive (AR) is one where the current value of the variable is a function of its past values plus an error term. The AR(p) model uses the *p* lags of the series in the equation of the form:

$$\left.\begin{aligned} Y_t &= f(Y_{t-1}, Y_{t-2}, \ldots, Y_{t-p}) \\ Y_t &= a_0 + a_1 Y_{t-1} + \ldots + a_p Y_{t-p} + e_t \end{aligned}\right| \text{ or } \qquad (4.30)$$

where Y_t is the variable being forecasted, *p* is the number of the past values used and e_t is the error term. The second component is the integration, *d*, order term. Each integration order corresponds to differencing the time series for stationarity. *I(d)*means differencing the data *d* times. The third component is the Moving Average (MA) term. A moving average process assumes the current value of the variable Y_t is a function of the past values of the error term plus a constant. The MA(q) model uses *q* lags of the forecast errors to improve the forecast. An MA(q) model is expressed as:

$$\left.\begin{aligned} Y_t &= f(\varepsilon_{t-1}, \varepsilon_{t-2}, ..., \varepsilon_{t-q}) \\ Y_t &= b_0 + b_1\varepsilon_{t-1} + ... + b_p\varepsilon_{t-q} + e_t \end{aligned}\right| \text{ or} \tag{4.31}$$

To create an ARIMA (p,d,q), model, the two specifications are combined into one equation with no independent variable as:

$$Y_t = a_1 Y_{t-1} + ... + a_p Y_{t-p} + e_t + b_1\varepsilon_{t-1} + ... + b_q\varepsilon_{t-q} \tag{4.32}$$

where *a* and *b* are the coefficients of the ARIMA.

Equations 4.16, 4.28, 4.29 and ARIMA models shown in Table 4.1 will be used for the analysis. The lag length selection is based on the Akaike and Shwartz criteria.

Table 4. 1. ARIMA Models for Revenue, Aid, Seignorage and Interest payments

1. Revenue

$$T_t = a_0 + a_1 T_{t-1} + \dots a_p T_{t-p} + e_t + b_1 \varepsilon_{t-1} + \dots + b_q \varepsilon_{t-q}$$

2. Aid

$$A_t = a_0 + a_1 A_{t-1} + \dots a_p A_{t-p} + e_t + b_1 \varepsilon_{t-1} + \dots + b_q \varepsilon_{t-q}$$

3. Interest payments

$$IP_t = a_0 + a_1 IP_{t-1} + \dots a_p IP_{t-p} + e_t + b_1 \varepsilon_{t-1} + \dots + b_q \varepsilon_{t-q}$$

4. Seignorage

$$\gamma_t = a_0 + a_1 M_{t-1} + \dots a_p M_{t-p} + e_t + b_1 \varepsilon_{t-1} + \dots + b_q \varepsilon_{t-q}$$

Source: Author’s construct from ARIMA Theory

4.5.2 Optimal fiscal policy and oil revenue

Realising the influence on expenditure, and of allocating varying amounts of oil revenue to the budget, it is imperative to determine an optimal spending path. This framework will assure a fair distribution of utility across generations while allowing the economy to maintain a sustainable fiscal stance in the long run.

By using the equation of motion of public debt following Mackiewicz (2003), in the form of an intertemporal budget constraint, the movement of public debt is presented as

$$\dot{B} = G + rB - T \tag{4.33}$$

Critical to the analysis is that the considered state should be solvent. Buiter (1998) shows that, the necessary and sufficient condition for solvency is that the average long-run debt growth is lower than the average long-run interest rate. Thus, there is no-ponzi financing. Formalizing this condition is

$$\lim_{t\to\infty} B_{(t)} e^{-rt} = 0 \tag{4.34}$$

Equation (1) may be transformed into $G - T = \dot{B} - rB$. By multiplying both sides by e^{-rt} and integrating gives

$$\int_0^\infty (G-T)e^{-rt}dt = \int_0^\infty \dot{B}e^{-rt}dt - \int_0^\infty rBe^{-rt}dt \tag{4.35}$$

But, $$\int_0^\infty \dot{B}e^{-rt}dt = \int_0^\infty rBe^{-rt}dt + \left[Be^{-rt} \right]_0^\infty \tag{4.36}$$

Substituting equation (4.34) into equation (4.36) and subsequently into equation (4.35), and bit of rearrangement, gives

$$\int_0^\infty G(t)te^{-rt}dt = -B(0) + \int_0^\infty T(t)e^{-rt}dt \tag{4.37}$$

This is the long-term form of the intertemporal budget constraint. Where B(0) is the initial debt in period zero. This condition says that the sum of future discounted income, T, is sufficient to finance the sum of future discounted primary expenditure, G, and the initial public debt.

The objective of fiscal policy in the framework is to maximise long-run social utility of government expenditure, U_G, equal to the sum of future discounted monetary utilities $U_G(t)=\int_0^{\infty} U_G(t)e^{-\rho t}dt$, where $\rho > 0$ is the discount rate of future utility. It is assumed here that the monetary utility is a growing function of the primary government expenditure with decreasing marginal utility. The framework employs the Constant Relative Risk Aversion (CRRA) utility function outlined here as $U_G(t)=\frac{G(t)^{1-\theta}}{1-\theta}$[32]. Thus, the objective of the government is to maximise the long-run utility function as

$$U_G(t)=\frac{G(t)^{1-\theta}}{1-\theta}e^{-\rho t} \tag{4.38}$$

The optimization problem is to find the expenditure path, G(t), that maximises the long-run utility while satisfying the long-term intertemporal budget constraint. To obtain the solution, the Pontryagin's Maximum Rule is applied[33]. Here, the first order condition requires the choice of U_G to maximize the Hamiltonian, H at every point in time. The Hamiltonian is stated as

$$H(t,B,G^*,\lambda)\geq H(t,B,G,\lambda) \text{ for all } t\in[0,T] \tag{4.39}$$

such that $H=U_G(t)+\lambda\dot{B}$. Stating the Hamiltonian for this model becomes

$$H=\frac{G^{1-\theta}}{1-\theta}+\lambda\left(rB+G-T\right) \tag{4.40}$$

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[32] Θ is the Coefficient of Relative Risk Aversion (CARA) and determines the government's willingness to shift expenditure between different periods.

[33] The maximum principle is attributed to L. S. Pontryagin and his associates and is the main tool for solving problems of optimal control. This method is analogous to a more common Lagrange's procedure of finding conditional extremum (Chiang, A., 2005)

Aside for the state variable B and the costate variable λ, the statement of the maximum principle also stipulates how B and λ change over time, via a state equation as well as a costate equation. Summing up the preceding, the components of the maximum principle can be stated for equation (4.39) as

$$G' = \frac{\partial H}{\partial G} = G^{-v} + \lambda = 0 \tag{4.41}$$

$$B' = -\frac{\partial H}{\partial B} + \rho\lambda = -\lambda r + \rho\lambda = \dot{\lambda} \tag{4.42}$$

$$\lambda' = \frac{\partial H}{\partial \theta} = rB + G - T = \dot{B} \tag{4.43}$$

and the transversality condition

$$\lambda(T) = 0 \tag{4.44}$$

From equation (4.40), $G^{-v} = -\lambda$, and $v\left(\dot{G}/G\right) = -\dot{\lambda}/\lambda$. From equation (4.41) it follows that the multiplier is negative and grows at a fixed rate, $\frac{\dot{\lambda}}{\lambda} = \rho - (r + \pi)$. Thus

$$\frac{\dot{G}}{G} = (r - \rho)/v \tag{4.45}$$

Equation (4.45) shows that the the expenditure G, grows in the long run with a fixed rate equal to the difference between the real interest rate and the discount rate multiplied the inverse of the parameter v. This differential equation defines a group of expenditure paths.

The next is now to choose an expenditure path that G(t) which satisfies the long-term intertemporal budget constraint in equation (4.37). From the assumption that income increases with the fixed rate equal to GDP growth rate: $T(t) = T(0)e^{gt}$. It can then be assumed that, at least in the long run, the growth rates of primary expenditure and product are equal. It means that $\dot{G}/G = g$ must hold and $(r-\rho)/v = g$ implied.

Therefore, the budget constraint can be defined as

$$\int_0^\infty G(0)e^{(g-r)t}dt + B(0) = \int_0^\infty T(0)e^{(g-r)}dt \tag{4.46}$$

Transforming the above becomes

$$\frac{G(0)}{r-g} + B(0) = \frac{T(0)}{r-g} \tag{4.47}$$

Expressing expenditure and tax income as ratios of GDP, $g(t) \equiv g(0)$, that is constant since $\dot{G}/G = g$,

$$\frac{g}{r-g} + b(0) = \frac{\tau}{r-g} \tag{4.48}$$

The relative primary expenditure that level that maximises the social utility and satisfies the budget constraint, which is the socially optimal level equals

$$g_s^* = \tau - (r-g)b(0) \tag{4.49}$$

Defining the relative debt and deficit level, b and d respectively as shares of GDP, $d = g + (r+\pi)b - \tau$ holds and therefore, the socially optimal deficit level is given as

$$d_s^* = (g+\pi)b \tag{4.50}$$

Equation (4.49) says that the optimal deficit equals the product of the public debt level and the nominal level of economic growth.

Expressing equation (4.49) in nominal terms and plugging equation (4.50) into it, gives the optimal level of expenditure as

$$g_s^{\ *} = \tau + d_s^* - (r+\pi)b \qquad (4.51)$$

Deriving the growth rate of debt as a ratio of GDP overtime reveals that $\dot{b} = \partial\left(\frac{B}{Y}\right)/\partial t = d - (n+\pi)b$. Comparing this with equation (4.50) suggests that if the government conducts the socially optimal fiscal policy that maximizes utility, then the public debt remains constant ($\dot{b} = 0$) in relation to GDP.

4.5.3 Public capital financing from oil revenue

Public capital is included in the framework to capture the peculiar characteristics of developing countries with regard to high investment needs. A consequence of including the public capital in the analysis is changing the definition of the socially optimal policy, which is connected with different nature of advantages brought by the capital. The current expenditure utility is immediate as opposed to the investment expenditure utility which is spread in time during the whole period of using the assets. Therefore, the social benefits resulting from the government's activity may be defined as the sum of transfers G_T, the government consumption G_C and the capital benefits. The level of the latter should be considered separately.

Also, denoting the real public capital level as K, and the capital depreciation rate as δ. Since there are no reasons to assume that the public capital productivity is significantly higher or lower than the average capital productivity in the economy, under assumption of perfect capital markets, the gross (i.e. including depreciation) income from capital will be r +δ. The distinctiveness of the public capital is that at least a part of its income is distributed among the society at no cost (as e.g. the access to public roads), whereas the other part may be paid for and increase the government income. If the government income of the public capital is εK, then the free of charge social benefits from the public capital are (r + δ-ε)K.

The overall social benefits connected with the fiscal activities may be, thus, presented as the sum of transfers, public consumption as well as the benefits connected with free access to the public capital $Z = G_T + G_C + (r + \delta - \varepsilon)K$. Analogically to the previously presented simplified approach, the socially optimal policy will be defined as the one which provides constant rate of the so defined benefits Z to GDP. The optimality criterion is, thus, satisfied by such an expenditure path where

$$z = g_t + g_c + (r + \delta - \varepsilon)k \qquad (4.52)$$

The previously discussed model is extended with an additional equation of movement for the public capital, which is increased through the public investment and decreased through depreciation:

$$\dot{K} = G_I - \delta K \qquad (4.53)$$

As previously considered, the relative capital change is according to the equation:

$$\dot{k} = g_I - (\delta + g)k \qquad (4.54)$$

On the income side besides taxes, the public capital income εK, is included. The relative deficit level (defined as the difference between the budget income and expenditure) is then expressed as:

$$d = g_T + g_C + g_I + (r + \pi)b - \tau - \varepsilon k \qquad (4.55)$$

The deficit equation at this stage will be modified by assuming that, levels of public capital, g_I, will be financed in the economy by using oil government investment income and oil revenue, denoted as R. The deficit equation d_{oil} will thus be formulated as

$$d_{oil} = g_T + g_C + g_I + (r + \pi)b - \tau - \varepsilon k - R \qquad (4.56)$$

This expression modifies the initial definition of deficit as $d = g + (r + \pi)b - \tau$: the difference between total real expenditure and income. Oil revenue and government investment income can thus be used to find deviations of government spending from the optimum.

4.5.4 Analysis of appropriateness of public capital spending from a long-term growth and development perspective

Among alternative spending channels of resource revenues in low income countries as noted by Collier and Venables (2008), is an increase in public spending, either on public consumption or the construction of public assets. If investment in infrastructure, therefore, seems to be the more viable consideration for the government, the question arises concerning the efficiency and quality of investment. Allocation of a large tranche of oil revenue in capital expenditure could have significant consequences for the long-run evolution and sustainability of public finances.

In this section, consideration is given to how budgetary policy, in particular, government investment policy could enhance long term growth prospects in a growing, catching-up economy such as Ghana. This could in turn impact on future fiscal outturns.

To this end, a key economic indicator that needs to be monitored is the Incremental Capital Output Ratio (ICOR). Patel (1968) opined that the incremental capital output ratio (ICOR) is often used to assess the actual performance of an economy and to compare with that of other countries, or to estimate at a macro level the broad requirements of capital formation in order to attain a particular rate of growth, or to derive the growth rate once the resource position is given.

By its scale, public investment impacts economic growth. Government might use investment as a budgetary measure to encourage private investment or to dampen demand. In the Keynesian economic paradigm, these effects of government expenditure are termed *crowding in* and *crowding out* (of private investment).

The ICOR is defined as the ratio between investment in some previous period or periods and the growth in output in the subsequent period. It is the average annual share of investment in GDP. A low ICOR implies that a higher level of investment has to take place to reach the same rate of growth in GDP. Thus, at low levels of ICOR, higher GDP growth rates require high levels of investment, which can be elusive in cases where the bulk of public sector spending is on consumption or recurrent expenditure.

The transmission mechanism of public investment shows that, as public investment increases, the demand for resources (including production factors such as capital and labour) also rises. This leads to an increase in interest rates and supply of capital and labour inputs, which, in turn, directly affect the cost of private investment, thus, crowding it out of the money market. In this sequence of events, a cost increase for private investment might result in reduced output (GDP) caused by a fall in private investment. Hence, an increase in public investment might result in reduced economic growth (Aromdee, Rattananubal & Chai-anant 2005). The authors confirm Aschauer's (1989) claim that the majority of public investment can have a negative effect on the level of private investment, that is, the crowding out aspect.

On the contrary, Agenor and Montiel (1996) state that in the case of developing countries, government budget deficits have a minimal effect on interest rates and the crowding out effect is thus minimised. The authors claim that public investment authorities in developing economies are more concerned with identifying funding sources than the interest rates involved. Public investment in developing countries may therefore have little crowding out effect on private investment (Rama 1993). The crowding in effect occurs when public investment directly stimulates economic growth by increasing national income which in turn induces the private sector to increase investment. Moreover, public investment, especially in infrastructure, also creates a better investment environment for private investors by providing opportunities to increase production efficiency and raise the return on capital (Aromdee, Rattananubal & Chai-anant 2005).

Given strategic injections of capital investment, stocks of capital can be upgraded and augmented to desired levels of economic growth and development.A simple growth model, specified along the Harrod-Domar line, is used. The Harrod-Domar equation is given by

$$g = \left(\frac{1}{k}\right)\frac{I}{Y} = \frac{\Delta Y}{Y} = \left(\frac{1}{k}\right)\frac{\Delta K}{Y} \tag{4.57}$$

where: g is the growth rate, k the incremental capital-output ratio (ICOR) and I/Y is the investment (I) to GDP (Y) ratio. Based on the projection of I/Y, it is straightforward to compute expected GDP. Assuming that a time lag between investment and related increase in output of one period, the ICOR can be derived for the economy as:

$$ICOR = {I_{t-1}}\Big/{\left(GDP_t - GDP_{t-1}\right)} \tag{4.58}$$

The above method smoothes out periods of extremely high or low levels investments. A direct and simple measurement of investment efficiency at aggregate level, however, might be carried out by calculating its so-called ICOR, which is the reciprocal of the marginal productivity of capital stock:

$$ICOR = \frac{I}{\Delta GDP} = \frac{I/Y}{\Delta Y/Y} \tag{4.59}$$

Accordingly, equation (1) may be written as:

$$Y_{t+1} - Y_t = \frac{1}{k} I_t \tag{4.60}$$

Since,

$$Y_{t+1} = (1+g)Y_t \tag{4.61}$$

then,

$$Y_{t+1} - Y_t = gY_t \tag{4.62}$$

If the target rate of growth is specified as ‘g’, the level of investment (I*) required for achieving a desired growth rate will be given by

$$I^* = gkY_t \tag{4.63}$$

4.6 Data and estimation techniques

The data used for the study consists of annual observations. Data set is obtained from Bank of Ghana. In interpreting the results of an ARIMA model, most of the specifications are identical to multivariate regression analysis. The time series properties of the variables were explored as data cleaning techniques to avoid the occurrence of spurious results. This requires testing the stability of the series, beginning with unit root tests because, when the series under investigation are not stable, then the estimated results are not valid. This would involve the use of Dickey-Fuller (1981) and Phillips-Perron tests for unit roots in each of the series. However, there are several additional sets of results specific to the ARIMA analysis. The first is the Akaike Information Criterion (AIC) and Schwarz Criterion (SC) which are often used in ARIMA model selection and identification[34]. Lastly, Theil's test statistics was considered to evaluate the forecasting abilities of the ARIMA models estimated.

Furthermore, Univariate Autoregressive Integrated Moving Average (ARIMA) models are estimated and used for forecasting. The ARIMA model is preferred to common time series analysis and multivariate regressions because of serial correlation. As the error residuals can help to predict current error residuals, ARIMA takes the advantage of this information to form a better prediction of variables using ARIMA. Also ARIMA can fix biased and inconsistent estimates resulting from setting lagged dependent variables as regressors. Simulation and sensitivity analysis are used to explore alternative solutions under different scenarios.

[34]Details and results of the lag length selection criteria of the ARIMA models are shown in appendix 5.

CHAPTER FIVE

Results and Discussion

5.1 Unit root tests

In order to estimate the expenditure function, equation 4.26 and ARIMA models of Table 4.1 derived from equation 4.29, the time series properties of the variables were ascertained. In this regard, tests to detect non-stationarity and also to determine the order of integration of the variables were executed using the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests. Unit root test results are presented in appendices 1 and 2. The ADF test reveals that all the variables are first difference stationary, that is *I*(*1)* at one percent significance level. Their use will not lead to spurious results. The Phillips-Perron test, on the other hand, reveals that the regression without trend rendered revenue stationary at levels, which is *I(0)*. However, the regression with trend and intercept revealed that the variables were first difference stationary. The ADF and the PP tests differ mainly in how they treat serial correlation in test regressions.

5.2 Fiscal profile of the economy of Ghana

5.2.1 Fiscal stance of the economy: 1980- 2009

This section presents and discusses the result of the fiscal sustainability calculations. This approach to the evaluation of fiscal sustainability goes beyond providing summary positions of the fiscal stance, but identifies the fiscal and microeconomic variables that give rise to the profile. Two simulations were carried out on the base case: First, to capture the effects of spending oil revenue on the fiscal stance and also the effect of debt increases on the profile. A simultaneous increase in: government revenue by 50.0%, government expenditure by 15.0% and 43.0% appreciation of the nominal effective exchange rate captures the effect of oil revenue spending on fiscal stance. Secondly, 50.0% increase in debt also shows the effects of debt increase on the fiscal stance. The results of the simulations reveal that the path of fiscal policy changes under different assumptions from the baseline. Therefore, sensitivity analysis is conducted on the model parameters for an exposition of their influence on the profile. These percentages were chosen to highlight the influence of alternative expenditure and revenue trends on the path of the fiscal profile in retrospect.

The results from the fiscal profile shown in figure 5.1 reveal that for the most part, fiscal stance was unsustainable. Ghana's fiscal profile has been unsustainable for 17 years in the study period. The points that lie below the zero line are unsustainable and vice versa. The period from 1983 to 1887 was sustainable due to policy reform shock of the Economic Reform Programme (ERP) that experienced heavy capital flows. However, this effect was not sustainable due to high and rising domestic and foreign debt levels. Also the period from 1997 to 2006 save 2000 and 2007 were unsustainable.[35]

[35]The numerical results are shown in appendix 3.

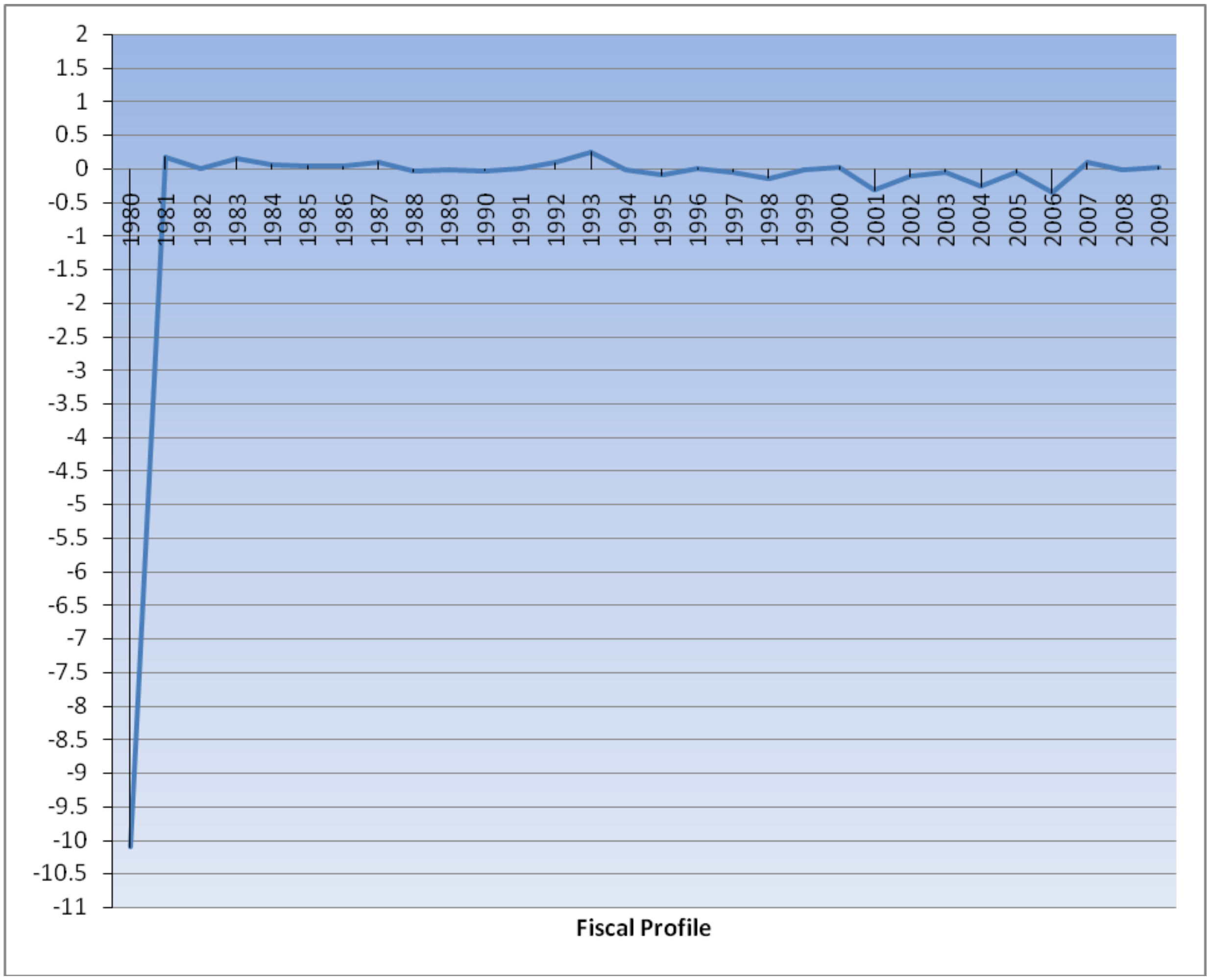


Figure 5.1. Baseline Fiscal Profile, 1980 - 2009

Source: Author's construct from Fiscal Profile

Fosu and Aryeetey (2008) noted that the inconsistency between monetary and fiscal policies reached its peak in 1997 with the decision to adopt the exchange rate as the nominal anchor without the fiscal restraint needed to support such a policy. The result was a speculative assault and a real depreciation of 174.0% nominal; 106.0% real. They further indicated that in 1999, all macroeconomic targets were off by quite substantial margins and the trend continued into 2000. The decision drawn from the empirical results finds support from Rutayasire (1990), Ariyo (1993) and the methodology by Talvi and Vegh (1998).

Similarly, plausible reasons for the situation presented above can be observed in the framework. The domestic balance, measured as the budget balance exclusive of grants as a percentage of GDP improved from negative 10.0% in 1980 to negative 0.3% in 1996. It has since deteriorated to negative 12.0% in 2009. Reducing the deficits is important, though this tends to discourage private investment. This financing comes in the form of external debt, with debt servicing costs; money creation, a likely inflationary process; or by the floatation of bonds, which tends to raise interest rates and increase the domestic debt. The latter two forms of financing the budget were prevalent in the 1990s and offer a feasible explanation for the results.

Furthermore, the government's demands on the Bank of Ghana have been the main sources of excess liquidity in the economy in the 1990s. Money supply as proportion of GDP increased from 9.2% in 1991 to strikingly high level of 22.2% in 2008. Issuing domestic debt has become the main source of finance since 1996. Domestic debt as a proportion of GDP increased from 9.4% in 1995 to 23.2% in 1996. This increasing position is maintained. This plummeted to a 33.3% level as percentage of GDP in 2009. The extent of fiscal constraint was evident when interest payments rose from 4.2% as proportion of GDP to 7.5% as proportion of GDP by the year 2000.

5.2.2 Effect of oil revenue allocation to the budget on the fiscal stance

An exchange rate change of 51.0% was recorded between 1984 and 1985 in the period of study and this led to the highest exchange rate appreciation of 43.0% in the study period. This rate is used for the simulation to account for the likely effect of oil revenue on the fiscal stance. Following the estimated expenditure equation, 50.0% and 70.0% increase in revenue will result in 10.0% and 15.0% increase in expenditure respectively. These percentage changes in revenue find support from the 2011 budget statement. The budget implicitly assumed that 30.0% of total oil revenue would be saved in the Stabilization and Heritage Funds, and 70.0% would be used to fund the annual budget and activities of Ghana National Petroleum Council (GNPC).

For instance, the impact of oil revenue allocation to the budget on the fiscal stance of the Ghanaian economy is quite illuminating as shown by figure 5.2. The simulation has shown a remarkable deviation of the fiscal profile from the baseline scenario. An exchange rate appreciation of beyond 43.0% rendered the fiscal stance unsustainable. Only 3 years comprising 1981, 1983 and 1984 were sustainable in the period as compared with 12 years in the base case. Unsustainability took on a permanent stance from 1984 onwards to 2009. This therefore indicates that the fiscal stance would move toward an unsustainable path with allocation of oil revenue budget.

Of course, this situation is the possible spending effect in which public expenditures financed by oil revenues might lead to changes in relative prices, resulting in an appreciation of the real exchange rate.[36] This phenomenon, known as the Dutch Disease, where the spending of oil resources on the non-oil sectors of the economy with resulting exchange rate appreciation and the competition for domestic goods cause a reduction in the competitiveness of the non-oil sectors and reduce both their production and exports.[37]

[36] In the case of a flexible exchange rate system, there would be pressure for the appreciation of the nominal exchange rate.

[37] A real appreciation of the currency, by reducing the domestic purchasing power of foreign exchange and therefore of oil fiscal revenue, will typically weaken the overall fiscal balance of countries heavily dependent on oil for their fiscal revenues, see Barnett and Ossowsky (2003).

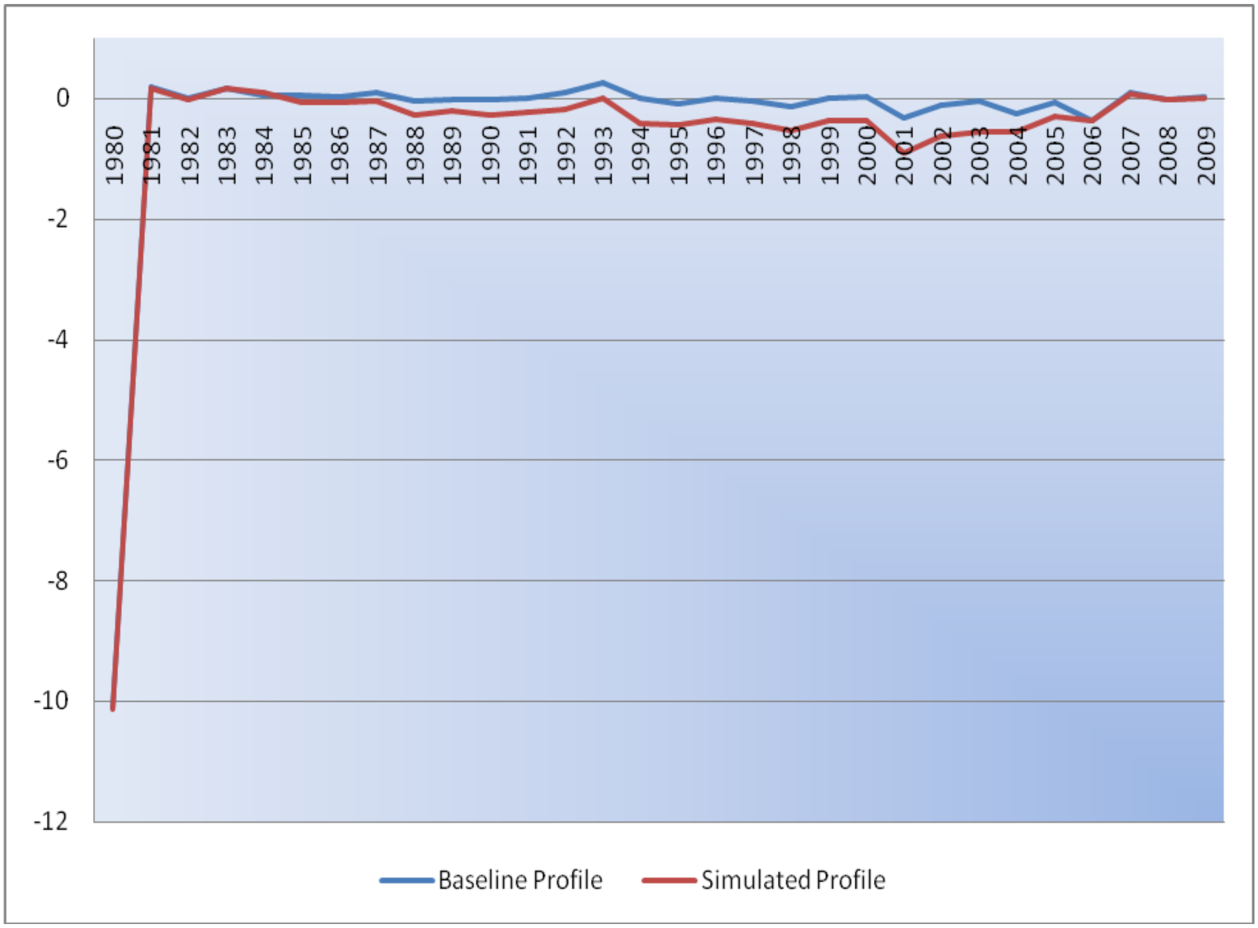


Figure 5.2. Simulation of effect of oil revenue on fiscal stance

Source: Author's construct from Fiscal Profile

5.2.3 Simulation exercises on debt

The results of a 50% increase in debt are equally dramatic as shown in appendix 4. A rather short continuous sustainable position is maintained from 1981 to 1987. Thereafter, years of unsustainability are rampant and assumed a stable disposition from 2001 to 2006. The implication of this is clear for the fact that interest payments are a part of government spending, accumulation of debt over time will require payments in future; the increase in interest payments will require tax increases and these tax increases will discourage entrepreneurship and economic activity by putting pressure on the citizens and thus on the growth performance of the economy.

5.2.4 Sensitivity analysis

This section is provides a better understanding of the conditions that would turn the basic stance of fiscal policy into an unsustainable path. To perform this sensitivity analysis, the values used for four key parameters of the model; real interest rate, real GDP growth rate, deficit and external debt departed from the values as in the basic simulation. In the first exercise, both the real interest rate and real GDP growth rate were modified, keeping the other parameters of the model constant at their basic simulation values. In the second exercise, the deficit and external debt are changed, but now keeping constant all others at basic values.

From panel A of Table 5.1 it is observed that the basic simulation has ample room in three dimensions before becoming unsustainable. Thus, ceteris paribus, with an initial real interest rate of 10.0% of GDP, fiscal policy is still sustainable. With a reduction in the GDP growth rate to 3.0%, an increase in real interest rate to 7.0% keeps fiscal policy sustainable. A GDP growth rate below 4.0% and an interest rate of above 11.0% will undermine the attainment of fiscal sustainability in the Ghanaian economy. Higher non-inflationary real GDP growth rates should be matched with increasing real interest rates for sustainability. They should thus be managed simultaneously.

Similarly, as shown in panel B of Table 5.1, an increase in the deficit to 9.0% of GDP allows for 35.0% external debt as a ratio of GDP for sustainability. However, the manoeuvre room is very tight when the deficit is considered. In this regard, a deficit of 10.0% of GDP would place fiscal policy in an unsustainable path. Also, increase in external debt should be matched by a reduction in deficit for sustainability. This result confirms the simulation in the previous section about the importance of government spending.

Table. 5.1 Sensitivity analysis of fiscal profile

Panel A: Sensitivity of fiscal sustainability to real interest rate and real economic growth

	Realinterest rate												
GDP growth rate	0.015	**0.02**	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.11	0.12	0.13
0.07	√	√	√	√	√	√	√	√	√	√	√	√	√
0.06	√	√	√	√	√	√	√	√	√	√	√	√	√
0.05	√	√	√	√	√	√	√	√	√	√	√	√	√
0.04	**√**	**√**	**√**	**√**	**√**	**√**	**√**	**√**	**√**	**√**	**x**	**x**	**x**
0.03	√	√	√	√	√	√	√	x	x	x	x	x	x
0.02	√	√	√	√	x	x	x	x	x	x	x	x	x
√: Sustainable, x: Unsustainable													

Panel B: Sensitivity of fiscal sustainability to external debt and deficit

		External debt						
		0.10	0.15	**0.30**	0.35	0.40	0.45	0.50
	-0.10	×	×	**×**	×	×	×	×
	-0.09	√	√	**√**	√	×	×	×
	-0.085	√	√	**√**	√	√	√	√
	-0.08	√	√	**√**	√	√	√	√
	-0.075	√	√	**√**	√	√	√	√
Deficit	**-0.071**	**√**	**√**	**√**	**√**	**√**	**√**	**√**
	-0.07	√	√	**√**	√	√	√	√
	-0.065	√	√	**√**	√	√	√	√
√: Sustainable, ×: Unsustainable								

Source: Author's Construct from Fiscal Profile

5.3 Estimation results of ARIMA and Expenditure models

The results of the expenditure function and ARIMA Models estimated are presented in Table 5.2. Identification and selection of ARIMA models involved the running of twenty four regressions on each variable. Each regression corresponding to a specific ARIMA (p,d,q) order. The Akaike Information Criterion (AIC) and Schwarz Criterion (SC) were the additional sets of results employed for model selection. The model with the lowest SC is chosen for forecasting. This is because the SC imposes a stricter penalty than the AIC. Theil's inequality coefficients as reported are not significantly different from zero and indicate good forecasting quality of models.

Table 5.2. Estimated ARIMA Models

1. Revenue ARIMA (4,1,1) Model $\ln T_t = 0.295 + 0.721\mathrm{T}_{t-1} - 0.046\mathrm{T}_{t-2} + 0.024\mathrm{T}_{t-3} - 0.060\mathrm{T}_{t-4} - 1.742\varepsilon_{t-1}$ Adjusted R^2 = 0.65, AIC = -1.49, SC = -1.20, DW = 2.38, Theil's = 0.009
2. Aid ARIMA (414) Model $\ln A_t = 0.333 + 0.148\mathrm{A}_{t-1} + 0.206\mathrm{A}_{t-2} - 0.077\mathrm{A}_{t-3} + 0.081\mathrm{A}_{t-4} - 1.343\varepsilon_{t-1} - 0.134\varepsilon_{t-2} - 0.383\varepsilon_{t-3} - 0.479\varepsilon_{t-4}$ Adjusted R^2 = 0.60, AIC = 0.60, SC = 1.04, DW = 2.53, Theil's = 0.018
3. Interest payments ARIMA (2,1,3) Model $\ln IP_t = 0.271 + 0.215IP_{t-1} - 0.670IP_{t-2} - 0.571\varepsilon_{t-1} + 2.226\varepsilon_{t-2} + 0.869\varepsilon_{t-3}$ Adjusted R^2 = 0.79, AIC = -0.87, SC = -0.58, DW = 2.29, Theil's = 0.05
4. Seignorage ARIMA (3,1,1) Model $\ln M_t = 0.285 + 0.126M_{t-1} - 0.263M_{t-2} - 0.125M_{t-3} - 1.572\varepsilon_{t-1}$ Adjusted R^2 = 0.69, AIC = 1.07, SC = 1.31, DW = 2.27, Theil's = 0.02
5. Expenditure Function $\ln G = 0.143 + 0.205\ln T + 0.883\ln A + 0.068\ln M + 0.134\ln rB_{t-1} + 0.062\ln G_{t-1}$ (3.11) (2.382) (3.144) (2.849) (2.432) (0.482) Adjusted R^2 = 0.63 DW = 2.214 Theil's = 0.0047

Source: Author's construct from ARIMA Models and Expenditure Function

The summary statistics of the ARIMA models are shown in appendix 5. The Theil's coefficients reported in equation 4 are very close to zero, implying good performance of forecasting models. In the expenditure function, the DW test statistic is inappropriate for the detection of serial correlation. When one or more lagged dependent variables are present, the DW statistic will be biased towards 2. This means that even if serial correlation is present it may be close to 2. Durbin suggests a test that is strictly valid for large sample but often used for small samples. This test for serial correlation when there is a lagged dependent variable in the equation is based on the *h* statistics. Durbin has shown that the *h* statistics is approximately normally distributed with a unit variance, hence the test for first order serial correlation can be done using the standard normal distribution. It should be noted, however, that the *h-test*[38] cannot be applied.

5.4 Forecasts and simulations

5.4.1 Forecasts of variables in Expenditure Equation

Forecasts of the determinants of the utility maximizing levels of expenditure are presented in Table 5.3. This is imperative to inform the need to setting spending targets in the future. The level of expenditure thus achieved will guide as a limit for spending beyond which level it would be wasteful in the coming years.

[38] The Durbin-h statistic is defined and written as $h=\left(1-\frac{DW}{2}\right)\sqrt{\frac{T}{1-T\left[Var(\hat{\beta})\right]}}$. For the expenditure function, $T[Var(\hat{\beta})]=6.97$. The $T[Var(\hat{\beta})]$ is greater than one and the ratio with the square root becomes negative.

Table 5.3. Forecasts of ARIMA Models

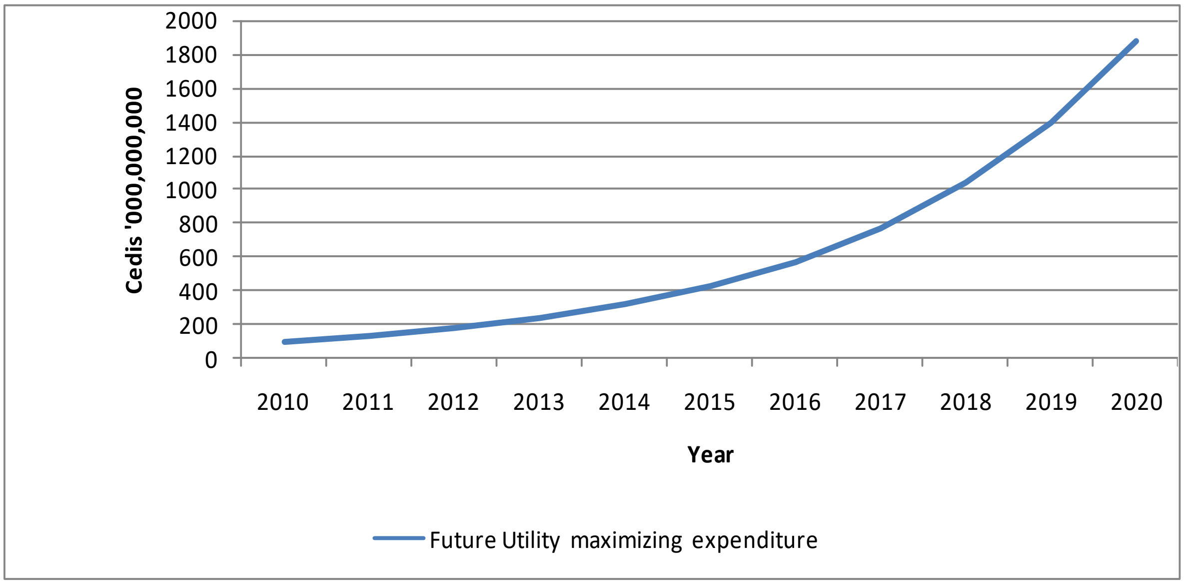
	Fiscal and macroeconomic variable forecasts				
	Rev less aid ¢M	Aid¢M	Interest payments	Seigniorage¢M	Oil revenueUSD M*
2010	70,078,739.84	18,175,949.95	3,819,348.33	14,089,954.39	
2011	92,979,860.78	25,345,926.09	5,021,294.98	18,731,130.95	899.70
2012	123,364,819.90	35,344,629.64	6,590,127.30	24,901,081.19	1,010.80
2013	163,679,263.20	49,287,351.99	8,632,793.93	33,103,425.41	1,083.00
2014	217,168,048.60	68,730,472.46	11,317,647.70	44,007,629.96	1,483.80
2015	288,136,420.37	95,843,314.64	14,859,682.58	58,503,648.64	1,796.30
2016	382,296,532.84	133,651,882.67	19,505,601.86	77,774,596.47	1,804.10
2017	507,227,214.50	186,375,049.72	25,576,036.60	103,393,334.29	1,587.40
2018	672,983,978.34	259,896,712.44	33,533,377.67	137,450,828.21	1,400.40
2019	892,908,377.33	362,421,174.26	43,999,513.24	182,726,786.65	1,213.30
2020	1,184,701,849.41	505,389,805.01	57,744,346.48	242,916,530.98	1,053.30

Source: Author's calculations

*World Bank Staff Calculations

Substituting the forecasted values into the utility maximizing condition gives a future path of utility maximizing level of expenditure as shown in panel A of figure 5.3 . This suggests that government actual expenditure might be below the utility maximising path, in which case, it would be sub-optimal, or lie on the path. The implication is that government expenditure should be financed by budget sources only. To demonstrate, actual values for the period of study are fitted in to the utility maximizing level of expenditure and compared with the actual expenditure as shown in panel B of figure 5.3. Actual government expenditure for the period is below the utility maximising level.

Panel A: Future Path of Utility Maximising Expenditure



Panel B: Utility Maximising Expenditure and Actual Expenditure Paths

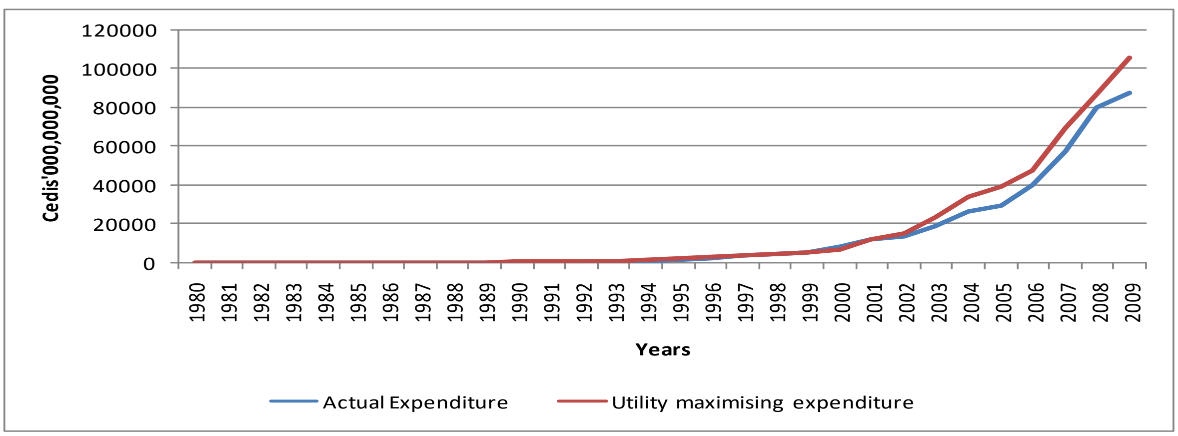


Figure 5.3 Future Oil Revenue and Past utility maximising Expenditure Paths

Source: Author' construct from Bank of Ghana and Statistical Service

5.4.2 Dynamic Simulation

A within the sample dynamic simulation was performed for the expenditure function in order to assess the goodness of fit of the model. The graphs of the simulated and actual expenditure outcomes indicate that the model is fairly accurate in capturing the historical movements of the variables in the model.

The simulation exercise is started by solving the expenditure model. Forecasted exogenous variables from ARIMA Models are then saved and used to simulate expenditure for the period 2010 to 2020. The simulation results are shown in figure 5.4 as the control solution in which no particular assumptions are made about the exogenous variables. This base solution would provide a basis for comparing alternative scenario solutions. The future path of government expenditure from 2010 to 2020 is characterized by periods of stability throughout.

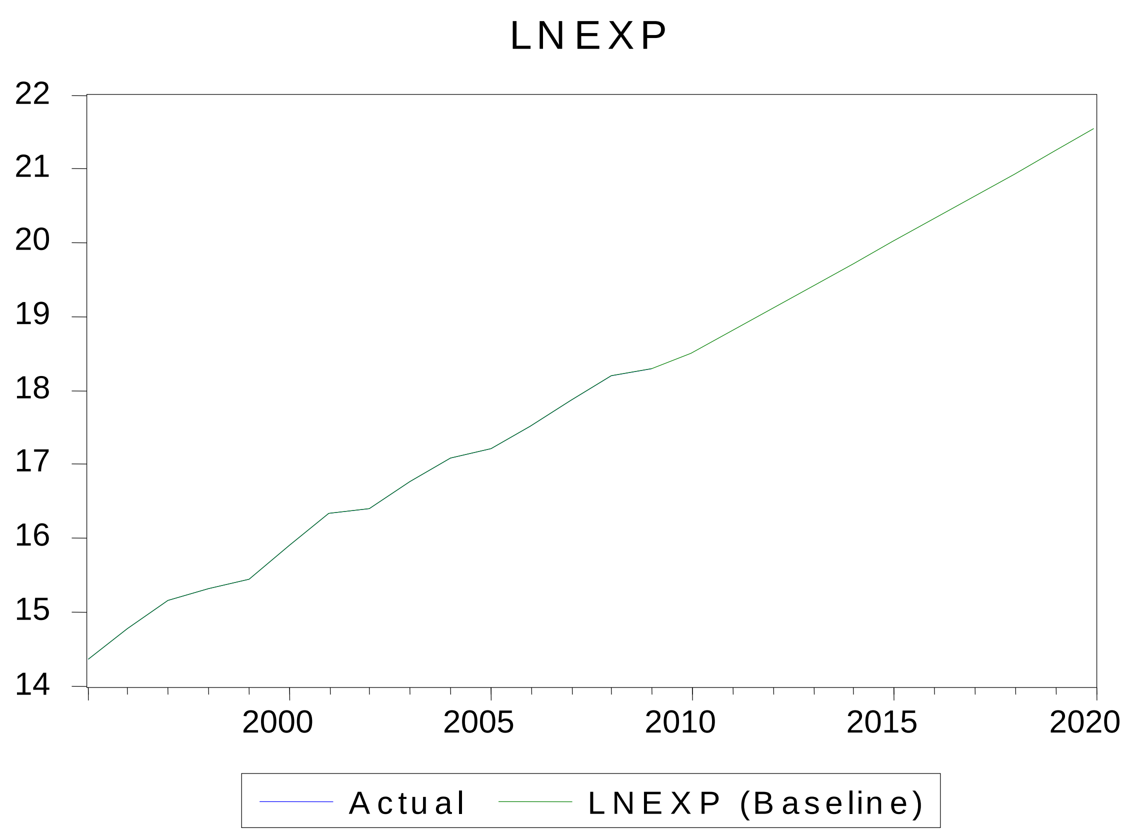


Figure 5.4. Dynamic simulation of future time-path of expenditure

Source: Author's Construct from Expenditure Equation and Forecasts

Reflecting the dominant influence of revenue on expenditure, the allocation of various percentages of oil revenue to the budget is simulated under various scenarios. The first scenario is based on the assumption that all the oil revenue is allocated into the budget. The outcome is shown in figure 5.5. In this scenario, a 100% allocation of oil revenue into the national budget of Ghana will result in an episodic jump in expenditure. This suggests that higher government revenue induces higher spending.[39] This effect will linger for a period of close to a year and remains stable though at a higher level throughout the period of simulation up to the year 2020.

[39] This issue is discussed in Fasano and Wang (2001).

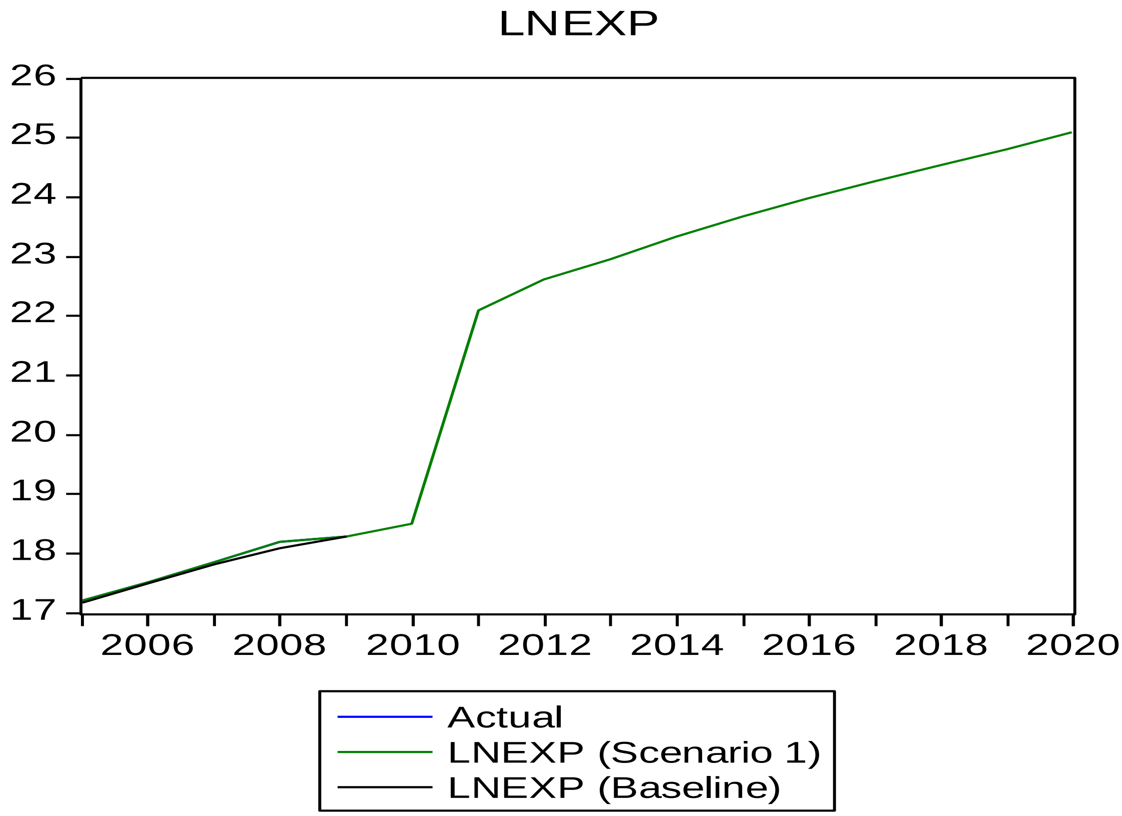


Figure 5.5. Dynamic simulation of impact of oil revenue allocation: 100%

Source: Author's construct from Expenditure Equation

The alternative scenarios are shown in figure 5.6. Scenario 2, 3 and 4 reveal the effects of allocating half, a third and two-thirds of oil revenue respectively into the government budget. Evident from the simulation is an apparent spurt in expenditure in all scenarios. This increase I expenditure is much less pronounced, the lower the allocation and vice versa.

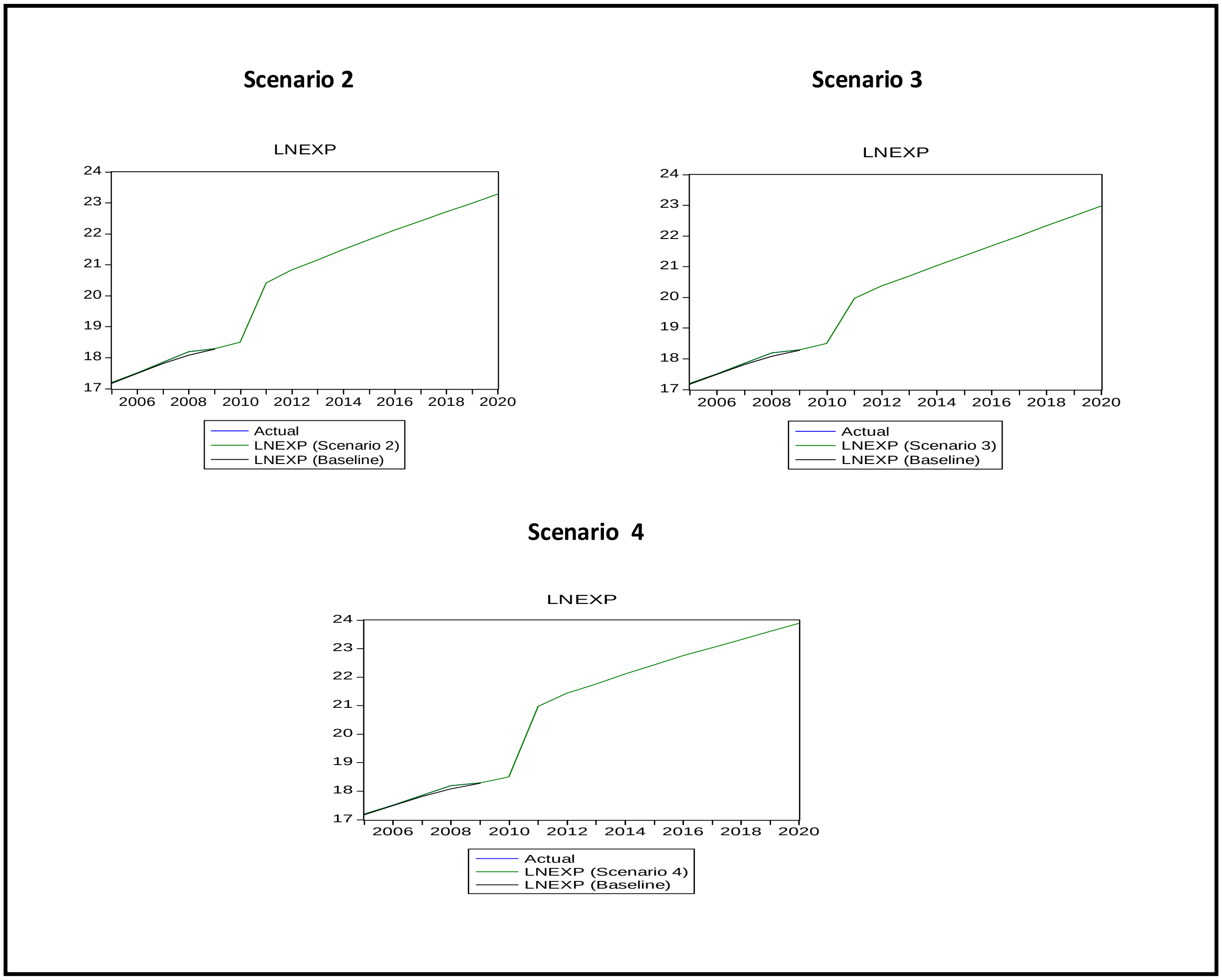


Figure 5.6. Dynamic simulation of impact of revenue allocation under various scenarios

Source: Author's construct from Expenditure Equation

5.5 Choice of optimum fiscal policy

Following the effect of oil revenue on expenditure and using the optimum fiscal policy framework, the discussion of optimal fiscal policy issues is facilitated. From the framework, the sustainability depends on:

- The initial level of public debt, b.
- Thetax revenue, τ.
- The real interest rate on public debt, r.
- The rate of growth of output, g.
- The inflation rate, π.

To illustrate, the dynamic fiscal rule formulated is used to determine the optimal expenditure and deficit level for the economy using the baseline assumptions. All variables as defined earlier. In this instance, the deficit level is 12.7% GDP. This figure coincides with the deficit level for 2009 with the exclusion of aid. The corresponding long-run share of expenditure in product is 26.7%. Table 5.4 shows this position.

Table 5.4. Baseline Assumptions of Optimal Expenditure, 2009

Policy Variable	
Debt (b)	0.55
Tax rate (τ)	0.27
Real Interest Rate (r)	0.045
GDP Growth rate (g)	0.04
Inflation (π)	0.19
Predetermined Variable	
Interest Payments	0.12925
Deficit (d)*	0.1265
CDebt (b)*	0.55
Optimal Expenditure (G*)	0.26725

Source: Author's Calculation

Hypothesis of basic scenario

- Low real interest rate of 4 .0% as 2009.
- Annual GDP growth rate of 6.6% estimated as the average of the observed rate for 2008 and 2009.
- Stable debt of 55.0% of GDP at 2009 value
- Tax revenue estimated as the growth rate over time.
- Inflation is maintained at the single digit value of approximately 9.0% as 2010 value.

Table 5.5 Baseline scenario (2010 – 2015)

	2009-base	2010	2011	2012	2013	2014	2015
Controllable Variable							
Debt (b)	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Tax rate (τ)	0.27	0.33	0.34	0.34	0.35	0.36	0.38
Uncontrollable Variable							
Real Interest Rate (r)	0.04	0.04	0.04	0.04	0.04	0.04	0.04
GDPGrowth rate (g)	0.04	0.066	0.066	0.066	0.066	0.066	0.066
Inflation (π)	0.19	0.17	0.15	0.13	0.11	0.09	0.07
Intermediate Variable							
Interest Payments	0.1265	0.1155	0.1045	0.0935	0.0825	0.0715	0.0605
Deficit (d)*	0.1265	0.1298	0.1188	0.1078	0.0968	0.0858	0.0540
CDebt (b)*	0.55	0.55	0.55	0.55	0.55	0.55	0.502
Optimal Expenditure (G*)	**0.27**	**0.3443**	**0.3543**	**0.3543**	**0.3643**	**0.3743**	**0.3943**

Source: Author's calculation

Based on the underlying assumptions of macroeconomic variables, the baseline path of government expenditure is presented in panel A of figure 5.7. The path of expenditure exhibits a fluctuating trend. This illustrates the effect of key vulnerabilities to the optimal expenditure path.

However, these assumptions may not hold in the future due to natural disasters, resource discovery and policy reforms. For resource discovery as it is in the case of Ghana, the framework allows the allocation of various amounts of oil revenue to the budget. This exercise elicits the deviation of expenditure from the baseline path. This is shown in panel A of figure 5.7. Spectacular effects of allocating oil revenue to the budget were obtained. With the allocation of oil revenue into the budget, the socially optimal government expenditure (SOGE) for 2011 rose from to 39.3% of GDP, but declined to 39.2% of GDP in 2012. Furthermore, the outcome for 2013 was 40.2% of GDP and this increased further to 42.2% and 44.8% of GDP in 2014 and 2015 respectively.[40] Similarly, the optimal levels of deficits for the period were: 8.1% of GDP in 2011, 7.0% of GDP in 2012, 7.4% of GDP in 2013, 5.3% of GDP in 2014 and 2.1% of GDP in 2015. Thus, the optimal deficit ratio (fiscal deficit as a proportion of GDP) required to finance these optimal expenditure levels consequently declined from 8.0% in 2011 to 2.1% in 2015 as shown in panel B of figure 5.7.

[40] A wise macroeconomic strategy in managing resource revenues is to impose a ceiling on the permitted rate of increase in spending, see Collier and Venables (2008).

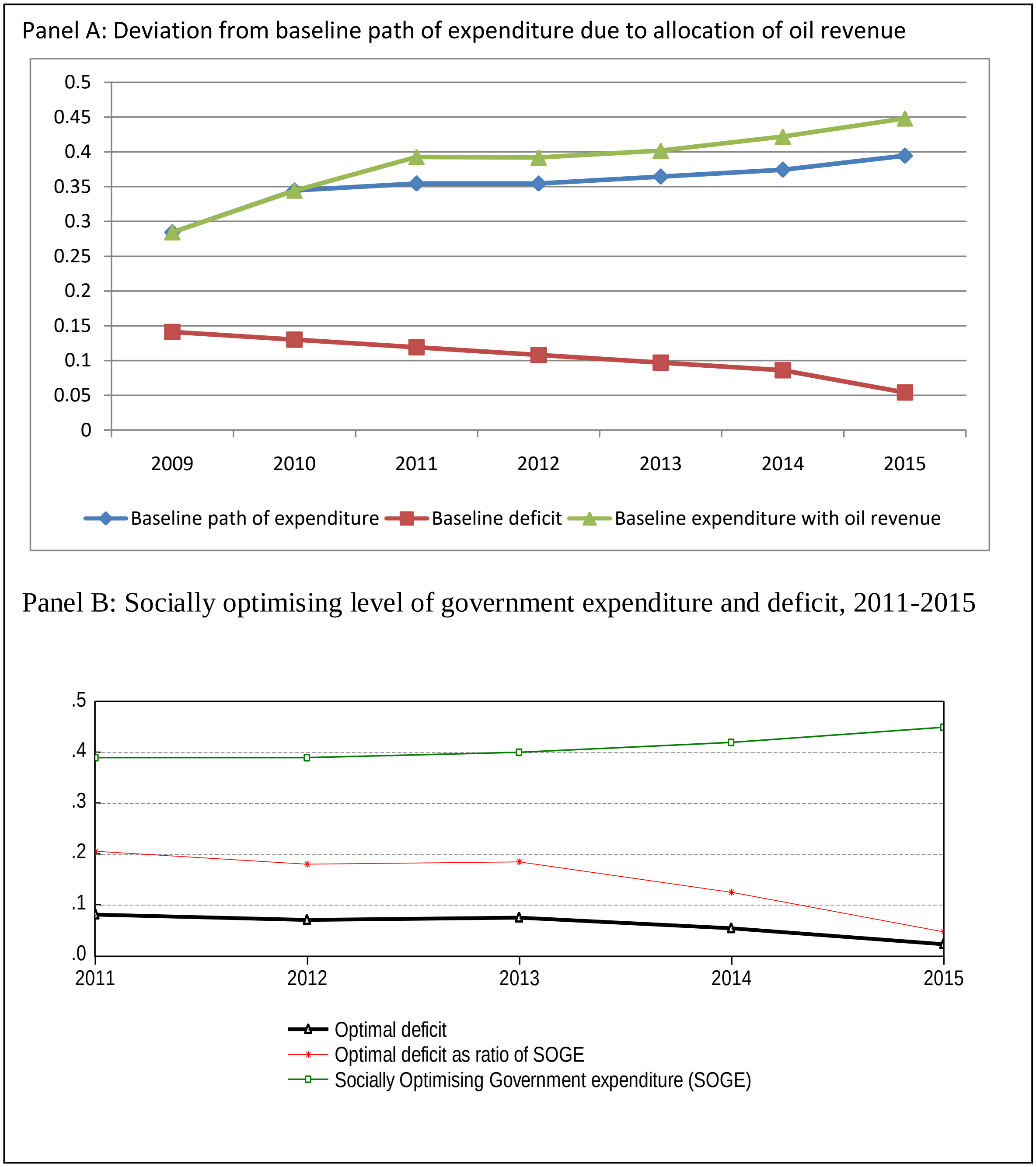


Figure 5.7. Baseline expenditure path with oil revenue and optimal expenditure with oil revenue allocation

Source: Author's construct from Optimal Expenditure Equation

5.5.1 Single factor sensitivity analysis

Further, the fluctuating nature of the optimal trajectory demonstrates impact of macroeconomic policy variables on the optimal path of expenditure. This permits a single factor sensitivity analysis to show how expenditure responds to variations in variables over time. This exercise is carried out in figure 5.8.

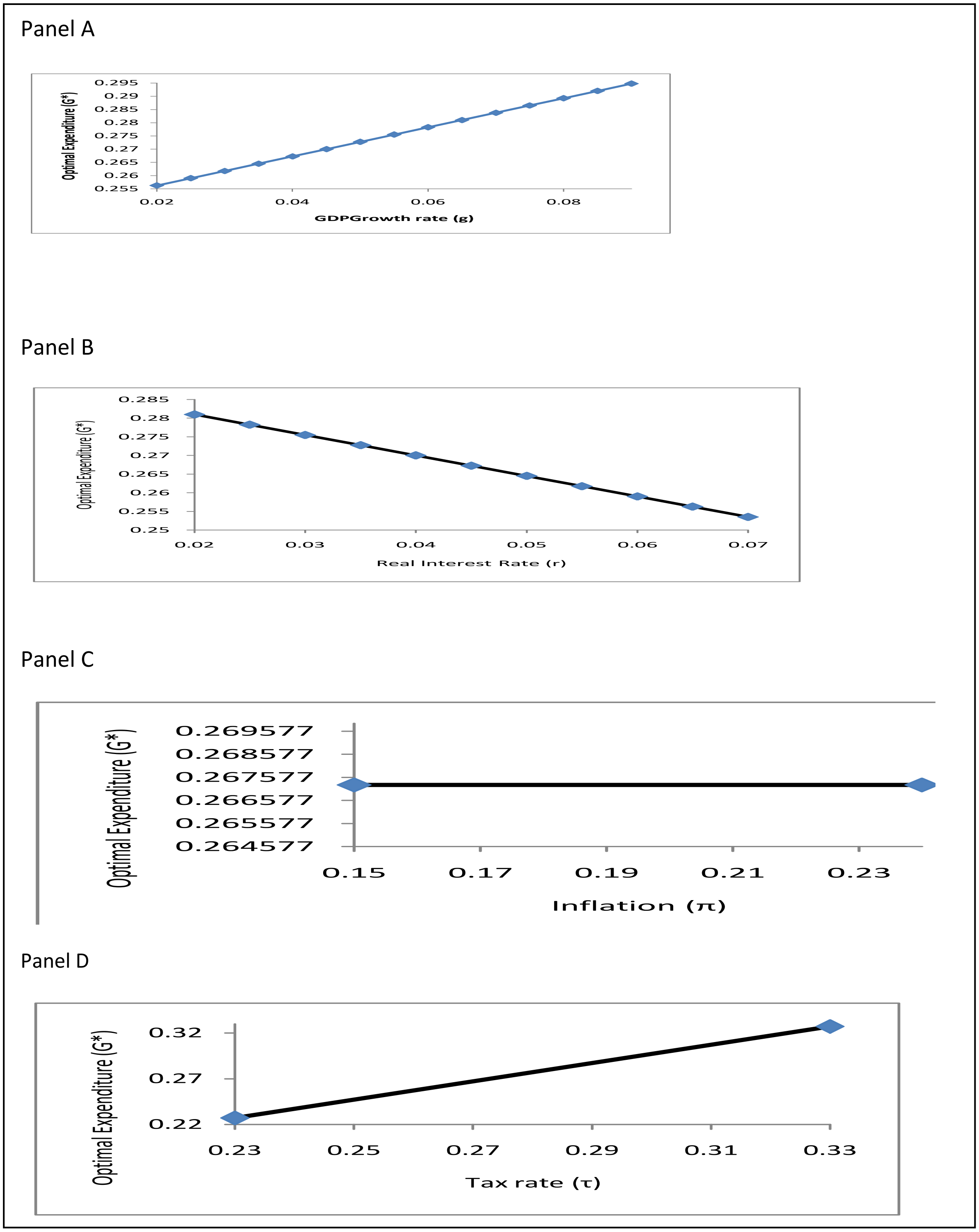


Figure 5.8. Single factor sensitivity analysis

Source: Author's construct from Optimal Expenditure Equation

Results of the Single factor sensitivity analysis reveal that both GDP growth rate andtax revenue exert a positive influence on expenditure as shown in panels A and D of figure 5.8. On the other hand, a change in real interest rate on the other hand has an inverse relation with expenditure as shown in panel B. Interestingly, the rate of inflation has no effect on optimal spending. This because the optimal expenditure path is in real terms. Panel C of figure 5.8 depicts this occurrence.

This outcome leads to further exercises on possible effects of the three macroeconomic variables; GDP growth rate, real interest rate and tax revenue on optimal expenditure with the allocation of oil revenue. These exercises would facilitate the discussion of key vulnerabilities of the economy. The choice of these variables for the exercises is derived from the single factor sensitivity analysis.

5.5.2 GDP growth rate and real interest rate exercises

Assuming that a higher GDP growth rate of 9.0% in 2011 onwards occurs, the expenditure level would rise above the level of 4.0% GDP growth rate at the base case. A lower GDP growth rate of 2.5% will cause the expenditure to fall considerably as shown in panel A of figure 5.9.

With the assumed allocation of oil revenue to the budget, a high interest rate of 10.0% from 2011 onwards results in dramatic fall in optimal expenditure. However, a lower interest rate of 3.5% contrariwise, leads to an increase in utility maximising level of expenditure. This is demonstrated in panel C of figure 5.9.

However if a higher growth is obtained in a scenario of lower real interest rates, the increase in expenditure is larger than a scenario with a higher interest rate. Panel B of figure 5.9 depicts the scenario.

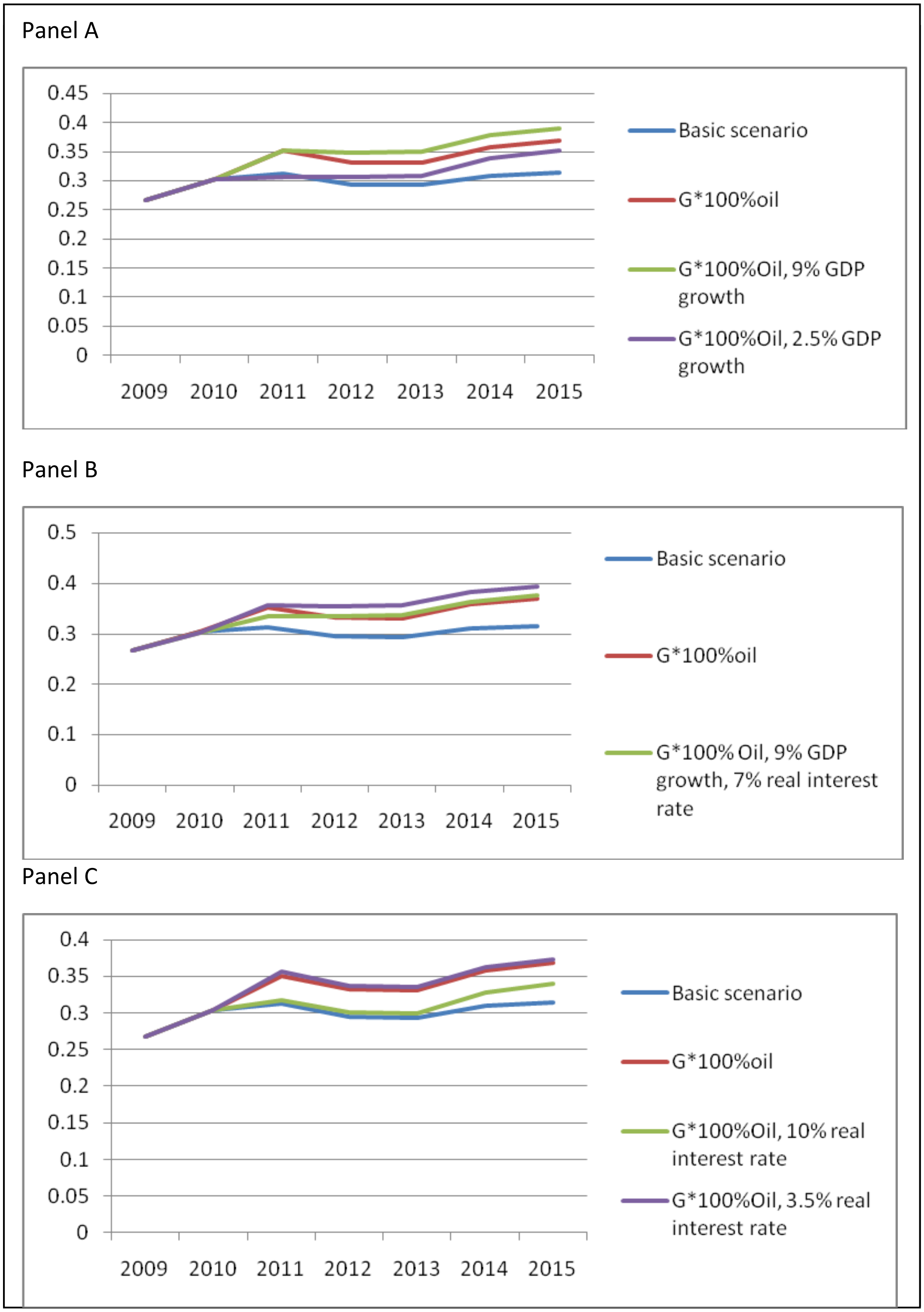


Figure 5.9. GDP and interest rate exercises

Source: Author's construct from Optimal Expenditure Equation

5.5.3 Effect of alternative financing sources on optimal utility

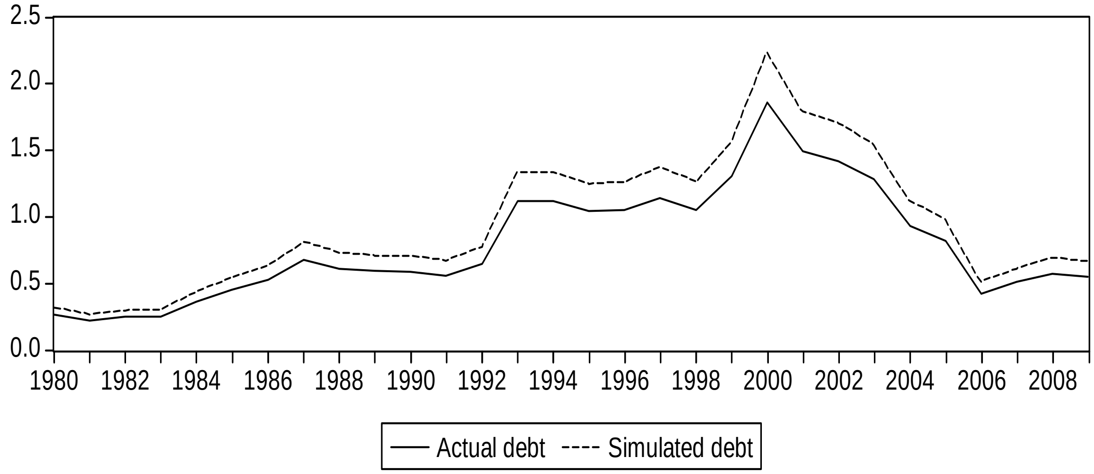
5.5.3.1 Effect of External Debt

The stress tests would consider the optimal financing mix of debt and aid considering the important role they play in the economy of Ghana. Here, increases in gross debt and domestic financing are considered followed by a decrease in aid financing.

Following the inception of HIPC in 2002, gross national debt, as a ratio of GDP dropped by 20.0%. A bill is passed in the Ghanaian parliament on the collateralisation of oil revenues. The effect of this is an increase in government borrowing. This forms the basis of a simulation of 20.0% increase in government debt on optimal utility. This will evaluate a situation where government finances expenditure via debt sources. The simulated debt in panel A of figure 5.10 reveals that between 1993 and 2003, a large dose of debt was accumulated.

The simulation of an increase in debt had no effect on utility in the years 1982, 1985 and 2004. Apart from two periods; 1991 to 1994 and 1996 to 2001 constituting ten years, the simulated utility exceeded the actual utility. This outcome is shown by panel B in figure 5.10. The results advocate the significance of debt in financing expenditure in the Ghanaian economy. Noticeably, prolonged utility increase from debt is usually followed by a utility decrease. Intuitively, this mimics a "debt induced utility cycle". Following this cycle, debt increase will lead to a reduction in welfare.

Panel A: Actual and simulated debt



Panel B: Actual and simulated utility

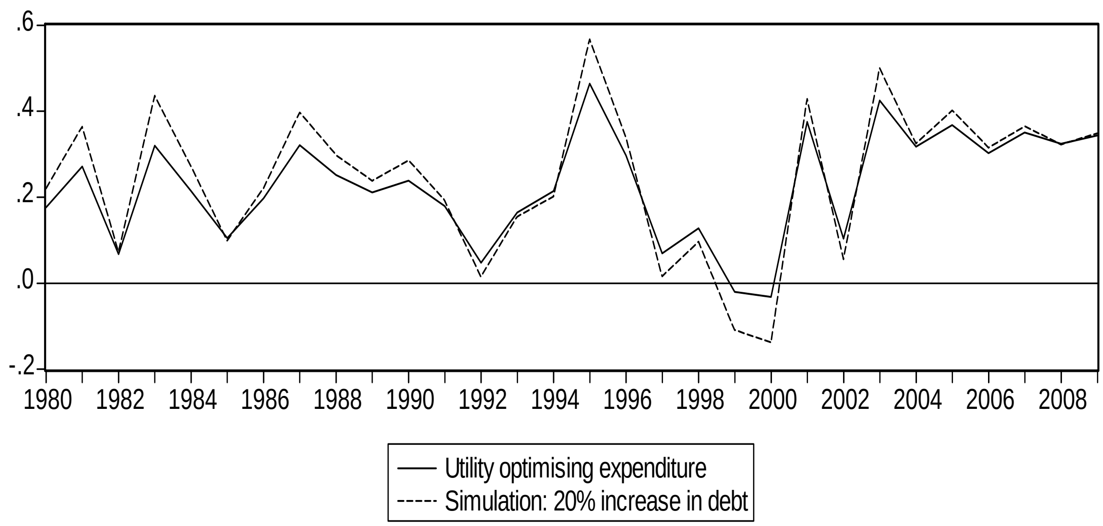


Figure 5.10. Simulated External debt and utility

Source: Author’s construct from Optimal Expenditure Equation

5.5.3.2 Effect of Domestic debt

From the simulation of a 20.0% increase in domestic debt, domestic resource mobilisation led to an increase in utility level above the optimal throughout the period. This is shown in figure 5.11. Based on the simulation analysis, external debt financing of government expenditure leads to a suboptimal utility level. An increase in domestic financing on the other hand results in an above optimal level of utility.

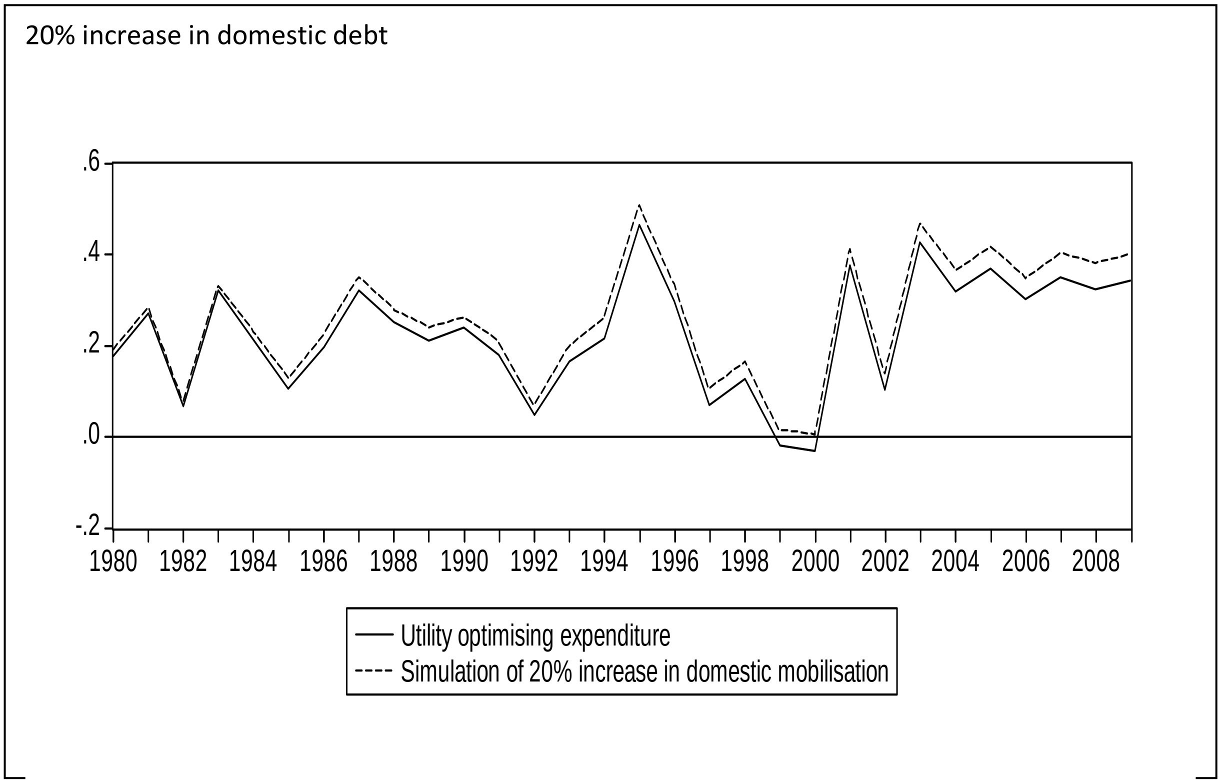


Figure 5.11. Simulation of domestic resource mobilisation

Sources: Author's construct from Optimal Expenditure Equation

5.5.3.3 Effect of Aid Financing

The effect of a 20.0% reduction in aid is considered as shown in panel A of figure 5.12. The choice is arbitrary considering the fact that aid flow to Ghana is likely to reduce due to the discovery of oil. Interestingly, the effect of aid on utility was not different from the actual utility level. However, from 2005 onwards, a reduction in aid led to a reduction in the optimal level of utility.

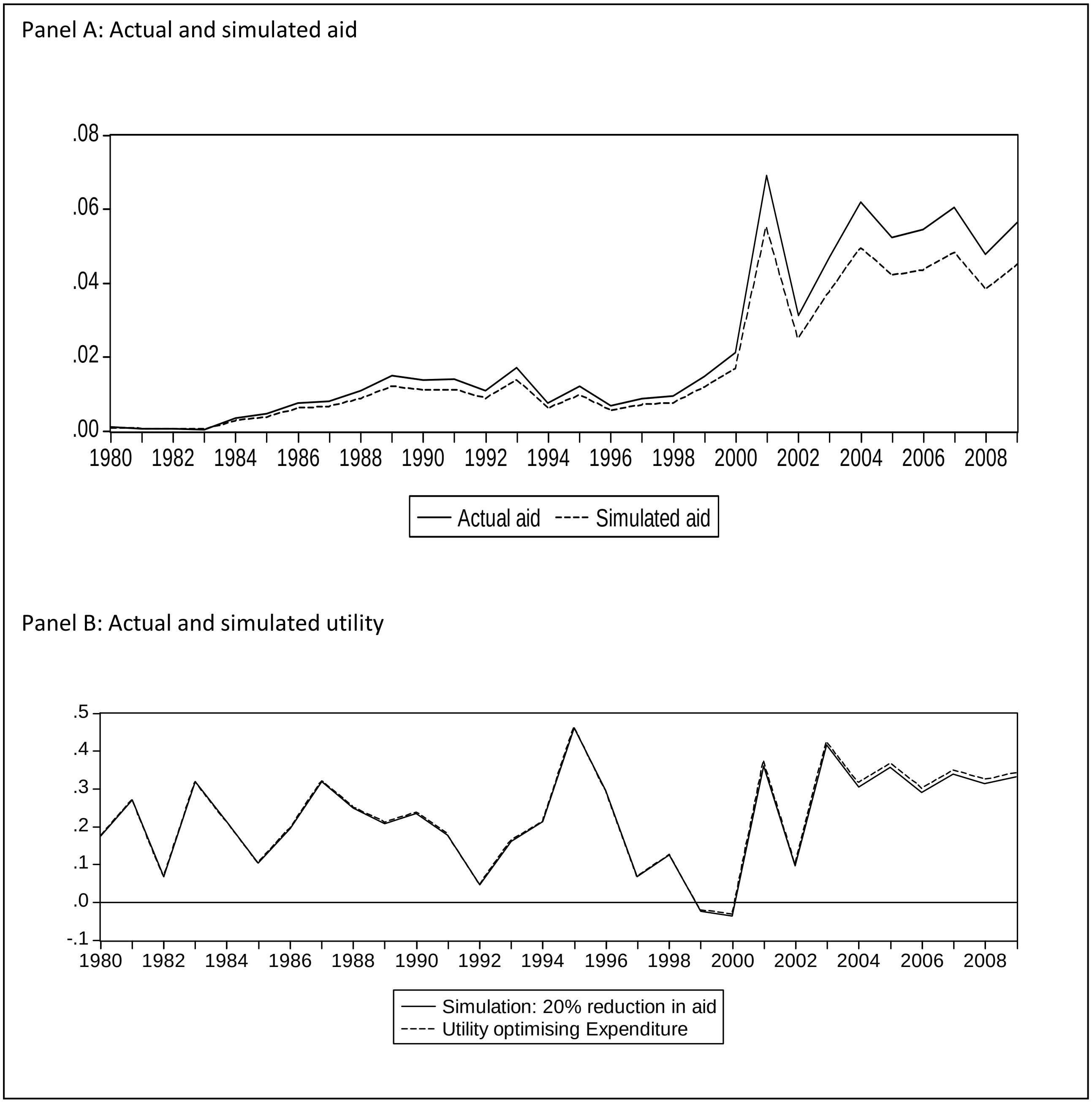


Figure 5.12. Effect of reduction in aid on utility

Source: Author’s construct from Optimal Expenditure Equation

5.6 Capacity of government capital investment for sustainability

As mentioned earlier, if public capital investment is the option available for spending the oil revenue, the benefits from government capital investment to the citizenry is paramount and therefore an issue of sustainability of public finances. The ICOR is used to assess the quality and efficiency of government's capital investment. For the Ghanaian economy in 2009, the ICOR was 8.5. This is rather high and showed that the economy was not in good shape. At the high ICOR of 8.5, the level of investment was approximately USD 5 billion with real economic growth of 4.0%.

If the ideal average ICOR of 5 is assumed for the period from 1980 to 2009, a comparison of the desired levels of public capital investment and the actual level of investment reveal that there was over investment in some of the years and this does not augur well for sustainability. This is shown in Appendix 6. Phases of overinvestment dominated in the period. However, a period of continuous sound investment dominated from the 1984 to 1993. This could be the result of a policy reform shock of ERP. This, however, could not be sustained.

5.6.1 Scenario analysis of investment growth rate of GDP and ICOR

In the implementation of spending programmes, it is imperative to consider the capacity of the government to absorb a flow of spending, be it consumption or investment. Figure 5.3 is helpful in depicting investment sensitivity to different assumptions on GDP growth rate and ICOR. Taking GDP as given, the figure illustrates the values of investment that would be obtained under different assumptions for GDP growth rate and the ICOR. Lower values of ICOR will allow for lower amounts of investment at a higher GDP growth rate.

At an ICOR of 8 in 2009, a 4.0% real economic growth was achieved with a capital investment of approximately GH¢ 5 billion. Correspondingly if investment was more efficient (at an ICOR of 5) for example, a real GDP growth of 7.0% was attainable the same level of investment. This is shown in the simulation analysis in figure 5.13. On the other hand, without efficiency gains, as the base case, a GH¢ 9 billion is required for the same GDP growth rate of 7.0%. Higher amounts of public spending on capital are required for relatively low real growth rates highlighting the influence of investment efficiency on public capital expenditure in the economy.

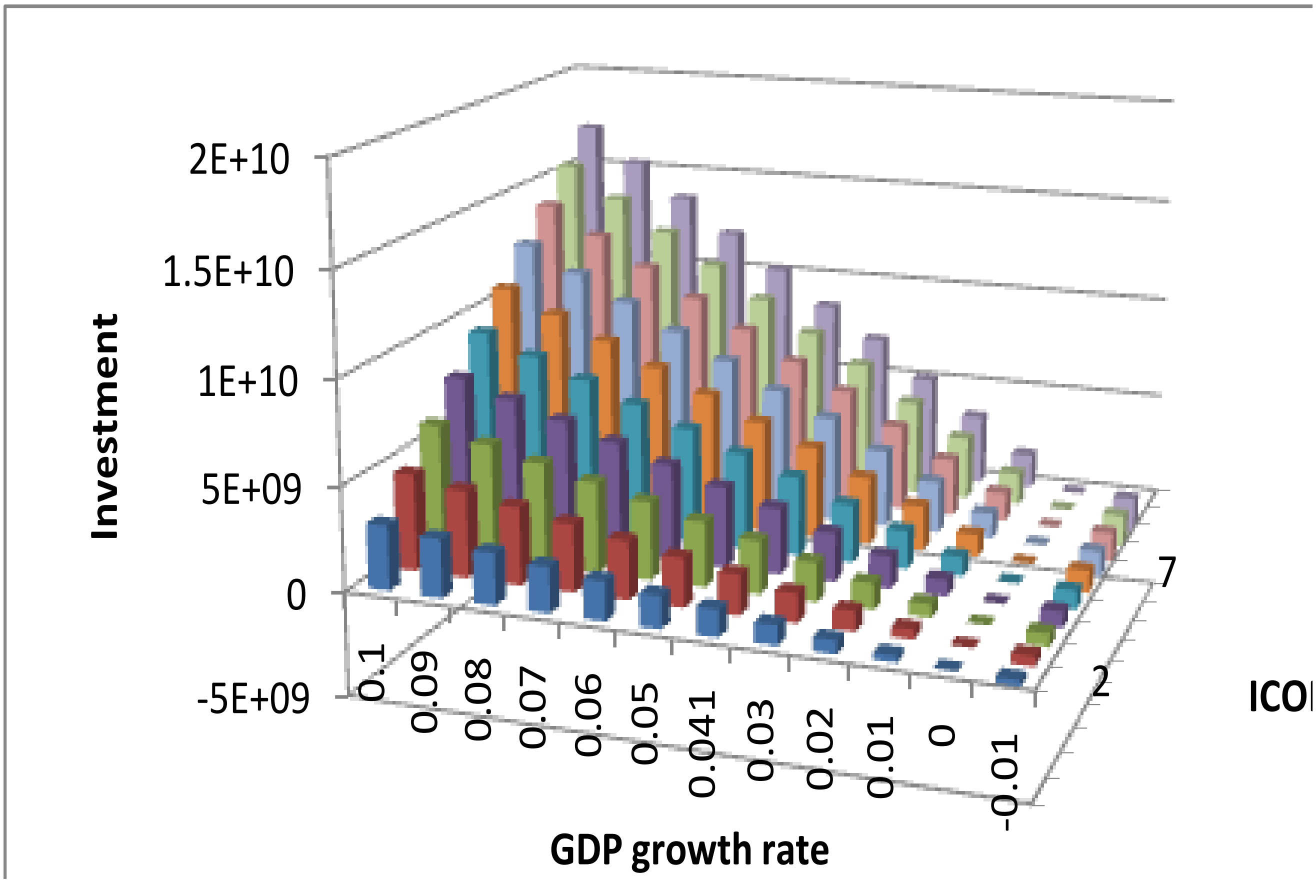


Figure 5.13. Investment Sensitivity Analysis

Source: Author’s construct from required Investment Function

5.7 Synthesis of empirical results and study objectives

Objective i:

To analyse the implications of the current fiscal stance for sustainable economic growth and development.

This objective is achieved by investigating the indicators of fiscal stance alongside the macroeconomic performance from the descriptive analysis. Further, challenges facing fiscal institutions and actors reveal the implications of current fiscal stance for future economic growth and development. Also, a sensitivity analysis of efficiency of capital investment and real GDP growth rate on investment reveals the inefficiencies for future economic growth and development. Remarkably, the overall fiscal balance is marked by chronic deficits. There was a brief respite thereafter when the government's fiscal position improved to register a surplus of less than 1% for the period 1986 to 1991. Thereafter, the overall fiscal balance has been in the negative plane and plummeted to 13.8% of GDP in 2008, and stood at 13.7% of GDP in 2009.

On the other hand, the primary balance which provides a measure of the current fiscal effort has been in deficit throughout the study period. This signals the case of potentially unsustainable rising indebtedness. This is because maturing loans and interest payment would have to be paid with further loans. In this process of capitalisation, additional interest becomes payable on interest already due and the debt problem threatens to get out of hand. The analysis reveals that from the latter part of 2004, the fiscal stance as measured by primary balance has followed a deteriorating course. Moreover, the pace of deterioration quickened considerably in 2005. This however improved marginally between 2008 and 2009.

The role of foreign financed expenditures is significant in the economy. Foreign financed expenditures tend to be volatile especially in the Ghanaian context. The economy of Ghana is hinged on aid. Aid as percentage of GDP maintained a second position as financing after tax revenue from 2000 to 2009. For a heavily aid-dependent economy, this volatility could be a serious destabilising factor as public investment is erratic. Following a tremendous decline in debt levels in the year 2000, there is a renewed surge in debt levels from 2006. Ironically, after the discovery of oil in Ghana, there is a collateralisation of oil revenue to facilitate the conditions of borrowing and thereby increase government debt holdings. Moreover, the economy is back to its pre-HIPC period after the HIPC completion point. Since the economy is now weaned off donor support and leans more toward non-concessional loans, the concerns for debt sustainability are forthcoming.

On the domestic scene, there is pressure on government to increase wages and salaries. The Single Spine Salary Structure (SSSS) which dates back to January 1, 2010 comes with payment of arrears. The 2011 budget statement admits that implementing the Single Spine Salary Structure would result in inadequate resources for funding of social intervention programmes on a sustainable basis. The electoral spending cycles need to be considered as Ghana is going to the poles in 2012. The electorate anticipate increases in government spending.

To conclude, a rising domestic and external debt, chronic primary deficit, heavy aid-dependence, inefficient public capital investment (measured by the ICOR), pressures on government to increase salary and the presence of electoral cycles all point to the fact that long run sustainable economic growth and development would be jeopardised by the current fiscal stance.

Objective ii:

To conduct a simulation on the likely effects of oil revenue earnings on the fiscal profile of Ghana.

To achieve this objective, a dynamic fiscal profile, based on the government budget constraint was developed for the economy. The model was calibrated using macroeconomic and fiscal indicators that address key vulnerabilities in the economy. An examination of the past fiscal record was thus made possible. An expenditure function estimated for the economy was used to determine the responsiveness of changes in expenditure due to changes in revenue. The relative percentage changes formed the bases for percentage changes in revenue and expenditure used for an ex-post simulation.

The likely effect of oil revenue earnings was modelled as foreign exchange increment to the national wealth. This was made possible through the identification of exchange rate appreciation episodes. The largest episode of exchange rate appreciation was used to account for possible exchange rate appreciation following oil discovery. The increase in revenue, expenditure and exchange rate appreciation in tandem would capture the expected effect of oil revenue allocation on the fiscal profile. This resulted in a deviation of the profile toward a path of unsustainability.

Objective iii:

To develop a fiscal framework for purposeful management of the fiscal effects of oil revenue in the Ghanaian economy.

The parameters of the estimated expenditure function were forecasted using Auto Regressive Integrated Moving Average (ARIMA) models. These forecasts including oil revenue projections by the World Bank were used to simulate the effect of allocating various amounts of oil revenue to the budget on expenditure. An optimization technique using Pontryagin Maximum Principle was employed to derive a utility maximising optimal expenditure path for the economy. A sensitivity analysis revealed the influence of model parameters on optimal expenditure.

Further, projections of fiscal and macroeconomic variables were used as the baseline for utility maximising optimal path of expenditure from 2011 to 2015. The allocation of various amounts of oil revenue to the budget showed varying levels of deviation from the optimal path. Low and high interest rate and GDP growth combinations were used as scenarios to ascertain the levels of deviation from the utility maximising level of optimal expenditure. Besides, scenarios of external debt increase, domestic debt increase and aid reduction considered as financing revealed the optimal mix on the utility maximising level of optimal expenditure.

CHAPTER SIX

Conclusions and Recommendations

6.1 Summary and conclusion

Sustainability of fiscal policy emerged as a major economic issue in Ghana following the high levels of debt experienced in the 1980s. The country's high public debt and debt servicing impair the capacity of the economy to achieve desired growth and development. A major threat to the national government's fiscal position is the large stock of government national debt and the associated costs of servicing the debt. Moreover, the record of chronic deficits led to the HIPC initiative to relieve the economy of its debt burden. Fortunately, Ghana is on the verge of becoming an oil rich country. Recently, crude oil was discovered off the shores of her Western Atlantic coast. Because oil revenues are large and in most countries accrue to governments, fiscal policy choices have a significant impact on economic performance indicators such as inflation, economic growth and current account balances.

Fiscal policy in oil exporting countries is facing a lot of challenges and this stems from the fact that, oil revenues, which constitute the bulk of government revenues are volatile, unpredictable, exhaustible and largely originate from external demand. The specific features of oil revenues pose challenges both in the short and the long terms. In the long term, the channels centre on the exhaustibility of oil reserves and concerns approximately intergenerational equity and fiscal sustainability whereas in the short term macroeconomic management and fiscal planning are of concern. Also, there is uncertainty about the future path of oil prices, oil reserves and its future extraction costs. Fiscal policy in oil producing countries tends to be procyclical. There is difficulty of maintaining fiscal expansions after a boom with concomitant political and social costs. Fiscal expansions typically follow booms, it is the difficulty associated with reducing spending during busts that relates to the political and social costs alluded to here.

Taking these into consideration, the study found it vital to address the following issues in the economy of Ghana: (i) analyse the implications of the current fiscal stance for sustainable economic growth and development, (ii) conduct a simulation on the likely effects of oil revenue earnings on the fiscal profile of Ghana and (iii) To develop a fiscal framework for purposeful management of the fiscal effects of oil revenue in the Ghanaian economy.

To this end, annual aggregate data spanning 1980 to 2009 was used for the analysis. Fiscal and macroeconomic variables were taken into consideration. A fiscal profile developed showed years of sustainable and unsustainable fiscal policy. Counterfactual policy simulations were carried out on the profile to facilitate the analysis of key vulnerabilities to the fiscal profile. The effect of allocating oil revenue to the budget revealed interesting results. The simulation has showed a remarkable deviation of the fiscal profile from the baseline scenario. Only 3 years comprising 1981, 1983 and 1984 were sustainable in the period as compared with 12 years in the base case. Unsustainability took on a permanent stance from 1984 onwards to 2009. This therefore indicates that the fiscal stance would move toward an unsustainable path with allocation of oil revenue budget.

Moreover, a framework to capture the fiscal effects of oil revenue was developed. This involved the use of intertemporal optimizing framework and representative agent assumptions. Auto Regressive Integrated Moving Average (ARIMA) forecasting methods were applied to forecast fiscal and macroeconomic variables. Simple Ordinary Least Squares (OLS) method of estimation was used to estimate an expenditure equation based on the optimization. The forecasted variables were then used alongside with the projected oil revenue from the World Bank to simulate the effect of allocating oil revenue to the budget.

Further, a socially optimal expenditure and deficit paths of fiscal policy was derived using the Pontryagin Maximum Principle. An extension of the model to capture the effect of oil revenue was made possible by considering the benefits of public capital investments. This formulation altered the income side of the deficit equation. The effect of allocating various amounts of oil revenue to the budget on the optimal expenditure path was demonstrated. An ex-post simulation of foreign debt, domestic debt and aid as financing on the optimal expenditure level was accomplished. These exercises showed that the utility levels that result from the various financing sources vary and also gives an idea of the optimal financing mix.

In addition, considering the likely choice of public capital provision by the Government, the quality of such investments for sustainable growth and development is investigated. A key concept used for this is the Incremental Capital Output Ratio (ICOR). The ICOR ties development financing to the capacity of the economy. Assuming an average ICOR for the period under investigation, periods of over-investment and under-investment occurred. The latter been unsustainable.

Significant findings were attained from the analysis. Among these is the result of the fiscal profile at base case, counterfactual simulation and sensitivity analysis. The results from the fiscal profile reveal that for the most part, fiscal stance was unsustainable. Ghana's fiscal profile has been unsustainable for eighteen years in the study period. The period from 1983 to 1887 was sustainable due to policy reform shock of the Economic Reform Programme (ERP) that experienced heavy capital flows. However, this effect was not sustainable due to high and rising domestic and foreign debt levels. Also the period from 1997 to 2008 save 2000 and 2007 were unsustainable.

The results of a 50.0% increase in debt were equally dramatic. A continuous sustainable position is maintained from 1981 to 1987. Thereafter, years of unsustainability are rampant and assumed a stable disposition from 2001 to 2006. The implication of this is clear for the fact that interest payments are a part of government spending, accumulation of debt over time will require payments in future; the increase in interest payments will require tax increases and these tax increases will discourage entrepreneurship and economic activity by putting pressure on the citizens and thus on the growth performance of the economy.

A sensitivity analysis showed that the basic simulation has ample room in three dimensions before becoming unsustainable. Thus, ceteris paribus, with an initial real interest rate of 10.0%, fiscal policy will still sustainable. With a reduction in the GDP growth rate to 3.0%, an increase in real interest rate to 7.0% keeps fiscal policy sustainable. Similarly, an increase in the deficit to 9.0% of GDP allows for 35.0% external debt as a ratio of GDP for sustainability. However, the manoeuvre room is very tight when the deficit is considered. In this regard, a deficit of 10.0% of GDP would place fiscal policy in an unsustainable path. This result confirms the simulation in the previous section about the importance of government spending.

The allocation of various amounts of oil revenue into the future revealed an episodic jump in the level of expenditure. Also, the spurt in expenditure is apparent in all scenarios, but is much less pronounced, the lower the allocation.

On the optimal fiscal policy, the baseline deficit level was 12.7% of GDP for 2009. This figure coincides with the deficit level for 2009 with the exclusion of aid. The corresponding long-run share of expenditure in product was be 26.7%. The expenditure for 2009 stood at 40.3% exceeding the derived value by 13.6%. At these levels of deficit and expenditure, public debt will remain at the constant relative level of 55.0%. Spectacular effects of allocating oil revenue to the budget were obtained. The optimal expenditure path under the base case for 2011 was 35.4% of GDP. The allocation of oil revenue to the budget resulted in an optimal path of 39.3% of GDP. The optimal path of expenditure increased to 44.8% of GDP by 2015.

Results of the Single factor sensitivity analysis reveal that both GDP growth rate andtax revenue exert a positive influence on expenditure. On the other hand, a change in real interest rate has an inverse relation with expenditure. Captivatingly, the rate of inflation has no effect on optimal spending.

Further simulations reveal that after allocating oil revenue to the budget, if a higher GDP growth rate of 9.0% in 2011 onwards occurs, the expenditure level would rise above the level of 4.0% GDP growth rate at the base case. A lower GDP growth rate of 2.5% will cause the expenditure to fall considerably.

With the assumed allocation of oil revenue to the budget, a high interest rate of 10.0% from 2011 onwards results in dramatic fall in optimal expenditure. However, a lower interest rate of 3.5% contrariwise, leads to an increase in expenditure.

However if a higher growth is obtained in a scenario of lower real interest rates, the increase in expenditure is larger than a scenario with a higher interest rate. Panel of figure 5.9 depicts the scenario.

Regarding the quality of public capital investments, if the ideal average ICOR of 5 is assumed for the period from 1980 to 2009, a comparison of the desired levels of public capital investment and the actual level of investment reveal that there was over investment in some of the years and this does not augur well for fiscal sustainability. It was observed that phases of overinvestment dominated. However, a period of continuous sound investment dominated from the 1984 to 1993. This could be the result of a policy reform shock of ERP. This, however, could not be sustained. This confirms the results of the fiscal profile for the economy.

A simulation analysis revealed that if the ICOR is 8, and if the country would like to grow at 7.0%, the level of investment should be USD$ 8.7 billion. Assuming a lower ICOR of say 6, USD$ 6.5 billion is required to achieve the same level of economic growth. What this suggests is that lower investments can lead to growth with a lower ICOR.

6.2 Policy recommendations

The findings of this study have a number of important implications for policy. It is recommended that:

- maintaining both a high real GDP growth rate alongside low real interest rate moves the economy toward the path of fiscal sustainability. High real GDP growth rates should be matched with lower real interest rates for fiscal sustainability. Also, an appropriate mix of development financing should be employed to move the economy toward sustainability; an increase in external debt should be matched with a reduction in deficit for the economy to move toward sustainability.
- intervening in the exchange rate market is required for a management of the national currency in a manner that avoids sustained exchange rate appreciation of the Cedi. This is equally important in ensuring that the economy is on the path to attaining fiscal sustainability. In this regard, appropriate economic policies and foreign exchange policies should be invoked to regulate the price of the cedi against other major currencies such as the U.S. dollar.
- reducing the accumulation foreign debt which comprises concessional and non-concessional debt would increase the welfare of citizens. The use of debt for financing development has not been consistent in generating the desired levels of welfare. Therefore, government should endeavour not to increase the external debt holdings using

oil revenue as collateral because since this would undermine the attainment of desired social welfare in the long run.

- adopting appropriate fiscal rules; socially optimising government expenditure and deficit rule will effectively manage the squander mania by governments in view of the volatile nature of oil revenues. Current fiscal developments coupled with the oil discovery therefore warrant the use of fiscal rules to reinforce fiscal discipline and sustainability in the long-term. In these circumstances, a spending rule would provide continual guidance to policy makers, under any and all economic and budget conditions. If budget results proved more favourable than expected, whether because of cyclical economic improvement or a positive productivity shock, the rule would allow no additional budgetary resources to the fiscal authorities. Therefore, unlike a deficit rule, under which a lower deficit or a higher GDP would allow greater spending or tax cuts, a spending rule would require that policy remain unchanged, and thus that the budgetary bonus be saved.

- keeping low interest rates will result in a higher socially optimal government spending and social welfare following the allocation of oil revenue into the budget. Even in the advent of a high GDP growth rate, maintaining a low interest rate is required that to maintain a higher utility maximising level of optimal expenditure.

- reducing the ICOR to a lower level is equally important in this regard to ensure efficiency in capital investment. This is in view of the fact that, ICOR is already high and renders capital investment inefficient. Lowering the ICOR would prevent wasteful spending in the light of long-term growth of the economy. Government spending on public capital should be regulated for sustainable economic growth. On the other hand, higher doses of investment are required for GDP growth. The desire of government to use oil revenue for infrastructural development is paramount since inadequate infrastructural is a characteristic of the Ghanaian economy.

6.3 Limitations of the study and suggestions for further work

A number of caveats need to be noted regarding this study. Among the most challenging long-term problems for fiscal policy is population ageing. Governments therefore have explicit and implicit liabilities that will condition future budget positions, such as payments of public pensions and healthcare benefits to retirees. Further research might explore the role of demographics in analysing fiscal sustainability. The rate of population growth and the age cohorts to account for the aged in future pension expenditure burden.

The research has dealt with both ex ante and ex post analysis of fiscal sustainability. The ex ante analysis is based on ex post algebra of fiscal sustainability. The indicators for the forward looking analysis required assumptions about macroeconomic variables which are implicitly assumed to be exogenous.

The research was not specifically designed to set a limit on government expenditure beyond which will render fiscal policy unsustainable. This is because no rule based fiscal criteria was applied in the study. It did not also determine how much oil revenue should be saved. The study could investigate the role of public sector efficiency and policy volatility in the relation between fiscal policy and growth.

The research has observed an interesting avenue concerning the definition of sustainability. So far economic literature has not defined a unique benchmark against which to assess sustainability. Moreover, the definitions proposed are based on partial equilibrium analysis and therefore point to necessary but not sufficient conditions for sustainability. For example, in Domar’s framework, in order to be sustainable the debt to GDP ratio must be stable, but not any stable level is necessarily sustainable. To assess the maximum sustainable debt level we should take the interaction of public finance and the economy into account.

For instance, in devising fiscal rules for EMU, when confronted with these difficulties, European Union countries adopted a pragmatic approach. The Treaty of Maastricht defines sustainability as non-violation of arbitrarily predetermined parametric standards; it defines the relevant variables taking into account the need to ensure comparability of national statistics and to allow a regular surveillance process. However, the Treaty and the Stability and Growth Pact do not deal with the development of sustainability indicators. They introduce a complex procedure ensuring monitoring of budgetary trends over the medium term, but do not envisage any long-term control. Compliance with these rules and guidelines ensures sustainability. If EU countries stick to the close-to balance guideline, they will converge to equilibrium low debt levels (significantly below the 60 per cent threshold). Some countries might even converge to negative debt levels. One might question whether a theory-based benchmark, if available, would have implied these results. This research has thrown up questions in need of further investigation.

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APPENDICES

Appendix 1**.** Unit root tests using Augmented Dickey-Fuller

	Augmented Dickey-Fuller Test Statistic			
Variable		Intercept	Trend and Intercept	Decision
lnTr	Level	-2.2234	-1.4986	I(1)
	First Difference	-4.2178**	-4.7745**	
ln *A*	Level	-1.9025	-3.1779	I(1)
	First Difference	-6.2273**	-6.546** 1	
lnM	Level	-0.9622	-4.3212	I(1)
	First Difference	-4.3457**	-4.4440**	
lnIP	Level	-1.3797	-0.9874	I(1)
	First Difference	-5.1407**	-5.1908**	

Critical Values for Augmented Dickey-Fuller		
	1%	**5%**
Regression with Intercept	-3.6892	-2.9719
Regression with Trend and Intercept	-4.3240	-3.5806

*5% significance

**1% sinificance

Appendix 2. Unit root tests using Phillips-Perron

	Phillips-Perron Test Statistic			
Variable		Intercept	Trend and Intercept	Decision
lnTr	Level	-3.5910**	-1.1961	I(1)
	First Difference	-4.2143	-4.7814**	
ln *A*	Level	-1.7557	-1.8554	I(1)
	First Difference	-6.2203**	-6.5691**	
lnM	Level	-0.8694	-4.5156	I(1)
	First Difference	-9.8141**	-10.7050**	
lnIP	Level	-1.3844	-1.0363	I(1)
	First Difference	-5.1420**	-5.1908**	

Critical Values for Augmented Dickey-Fuller	**1%**	**5%**
Regression with Intercept	-3.6892	-2.9719
Regression with Trend and Intercept	-4.3240	-3.5806

*5% significance

**1% sinificance

Appendix 3. Base case of fiscal profile (FP)

Base Case of FP in Ghana: 1980-2009

Item	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
t	0.07652	0.062581	0.053701	0.055646	0.083682	0.117508	0.143968	0.148855	0.146301	0.151362
Less g	0.180135	0.121774	0.113106	0.080175	0.098651	0.133404	0.138171	0.13691	0.14258	0.144059
SubTotal (A)	-0.10361	-0.05919	-0.0594	-0.02453	-0.01497	-0.0159	0.005796	0.011945	0.003721	0.007303
βd(rd-g)	-0.06652	-0.15414	-0.01113	-0.16725	-0.04379	0.003083	-0.01011	-0.01631	-0.00891	-0.0035
βf(rf+Δè-g)(1-A)	-0.00208	0.004533	0.005445	0.056395	0.137814	0.057445	0.087243	0.140549	0.034445	0.059286
SubTotal (B)	-0.0686	-0.14961	-0.00568	-0.11086	0.094027	0.060527	0.077134	0.124237	0.025536	0.055789
[Δβd +Δβf(1-A)]	-4.72433	-0.04642	0.028124	0.002181	0.110759	0.089045	0.071697	0.152132	-0.06878	-0.01744
Δm+m(g+πd)	-5.34531	0.134084	0.019412	0.068437	0.057015	0.029184	0.028537	0.05575	0.04621	0.054889
SubTotal ©	-10.0696	0.087667	0.047537	0.070618	0.167774	0.118229	0.100234	0.207882	-0.02257	0.03745
Overall total (A-B+C)	**-10.1047**	**0.178081**	**-0.00619**	**0.156948**	**0.058778**	**0.041806**	**0.028897**	**0.09559**	**-0.04438**	**-0.01104**

Continuation of **Base Case of FP in Ghana**

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
t	0.131589	0.151738	0.121728	0.187014	0.242312	0.230191	0.20006	0.189463	0.198777	0.182472
Less g	0.131656	0.136561	0.131876	0.212207	0.204921	0.221048	0.229642	0.272661	0.259413	0.247567
SubTotal (A)	-6.7E-05	0.015176	-0.01015	-0.02519	0.03739	0.009143	-0.02958	-0.0832	-0.06064	-0.0651
βd(rd-g)	-0.00484	-0.00094	0.004656	0.002443	0.002551	-0.02124	-0.02133	0.025629	0.017544	0.043663
βf(rf+Δè-g)(1-A)	0.040448	0.00733	0.023777	0.219618	0.093842	0.117635	0.041665	0.088644	-0.00421	0.170609
SubTotal (B)	0.035608	0.006395	0.028432	0.222061	0.096393	0.096391	0.020336	0.114273	0.013331	0.214272
[Δβd +Δβf(1-A)]	-0.0051	-0.0252	0.085551	0.461763	-0.00044	-0.07374	0.012406	0.092012	-0.09569	0.253549
Δm+m(g+πd)	0.010733	0.011008	0.045101	0.034997	0.050082	0.061312	0.043988	0.058946	0.023187	0.015985
SubTotal ©	0.005636	-0.01419	0.130652	0.49676	0.049642	-0.01243	0.056394	0.150958	-0.0725	0.269534
Overall total (A-B+C)	**-0.03004**	**-0.00541**	**0.092071**	**0.249506**	**-0.00936**	**-0.09968**	**0.006476**	**-0.04651**	**-0.14646**	**-0.00983**

Continuation of **Base Case of FP in Ghana**

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
t	0.210204	0.254428	0.211492	0.25487	0.299652	0.290523	0.273456	0.317961	0.328554	0.3323
Less g	0.296417	0.326672	0.272637	0.28691	0.328331	0.305429	0.343508	0.402121	0.468299	0.402634
SubTotal (A)	-0.08621	-0.07224	-0.06115	-0.03204	-0.02868	-0.01491	-0.07005	-0.08416	-0.13975	-0.07033
βd(rd-g)	0.037547	-0.02169	0.021635	-0.02732	-0.00402	-0.01786	-0.01714	-0.01696	0.002051	-0.00686
βf(rf+Δè-g)(1-A)	0.437216	-0.01905	0.024016	-0.04295	-0.04272	-0.03461	-0.00657	-0.00532	0.001053	0.010927
SubTotal (B)	0.474763	-0.04074	0.045651	-0.07027	-0.04674	-0.05247	-0.0237	-0.02228	0.003104	0.004067
[Δβd +Δβf(1-A)]	0.54516	-0.34412	-0.06943	-0.13853	-0.32565	-0.11185	-0.36719	0.082018	0.0632	0.084099
Δm+m(g+πd)	0.0425	0.05444	0.063763	0.049237	0.042661	0.010915	0.049716	0.070134	0.068878	0.01375
SubTotal ©	0.58766	-0.28968	-0.00567	-0.08929	-0.28299	-0.10093	-0.31748	0.152152	0.132078	0.097849
Overall total (A-B+C)	**0.026684**	**-0.32119**	**-0.11246**	**-0.05106**	**-0.26493**	**-0.06337**	**-0.36383**	**0.090268**	**-0.01077**	**0.023448**

Appendix 4. Debt exercise

Simulation of 50% increase in debt

Item	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
t	0.07652	0.062581	0.053701	0.055646	0.083682	0.117508	0.143968	0.148855	0.146301	0.151362
Less g	0.180135	0.121774	0.113106	0.080175	0.098651	0.133404	0.138171	0.13691	0.14258	0.144059
SubTotal (A)	-0.10361	-0.05919	-0.0594	-0.02453	-0.01497	-0.0159	0.005796	0.011945	0.003721	0.007303
βd(rd-g)	-0.09978	-0.23121	-0.01669	-0.25088	-0.06568	0.004624	-0.01516	-0.02447	-0.01336	-0.00525
βf(rf+Δè-g)(1-A)	-0.00311	0.006799	0.008167	0.084592	0.206721	0.086167	0.130865	0.210823	0.051668	0.088929
SubTotal (B)	-0.10289	-0.22441	-0.00852	-0.16629	0.141041	0.090791	0.115701	0.186355	0.038303	0.083683
[Δβd +Δβf(1-A)]	-4.72433	-0.06963	0.042186	0.003271	0.166139	0.133568	0.107545	0.228197	-0.10317	-0.02616
Δm+m(g+πd)	-5.34531	0.134084	0.019412	0.068437	0.057015	0.029184	0.028537	0.05575	0.04621	0.054889
SubTotal ©	-10.0696	0.064458	0.061599	0.071708	0.223153	0.162752	0.136083	0.283948	-0.05696	0.028731
Overall total (A-B+C)	**-10.0704**	**0.229677**	**0.010715**	**0.213469**	**0.067144**	**0.056065**	**0.026178**	**0.109537**	**-0.09154**	**-0.04765**

Continuation of Simulation of 50% increase in debt

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
t	0.131589	0.151738	0.121728	0.187014	0.242312	0.230191	0.20006	0.189463	0.198777	0.182472
Less g	0.131656	0.136561	0.131876	0.212207	0.204921	0.221048	0.229642	0.272661	0.259413	0.247567
SubTotal (A)	-6.7E-05	0.015176	-0.01015	-0.02519	0.03739	0.009143	-0.02958	-0.0832	-0.06064	-0.0651
βd(rd-g)	-0.00726	-0.0014	0.006983	0.003664	0.003826	-0.03187	-0.03199	0.038444	0.026316	0.065495
βf(rf+Δè-g)(1-A)	0.060672	0.010995	0.035665	0.329427	0.140763	0.176452	0.062497	0.132966	-0.00632	0.255913
SubTotal (B)	0.053413	0.009592	0.042649	0.333091	0.144589	0.144587	0.030505	0.17141	0.019997	0.321408
[Δβd +Δβf(1-A)]	-0.00765	-0.03779	0.128326	0.692644	-0.00066	-0.11061	0.01861	0.138018	-0.14353	0.380323
Δm+m(g+πd)	0.010733	0.011008	0.045101	0.034997	0.050082	0.061312	0.043988	0.058946	0.023187	0.015985
SubTotal ©	0.003088	-0.02679	0.173427	0.727642	0.049422	-0.0493	0.062598	0.196964	-0.12034	0.396309
Overall total (A-B+C)	**-0.05039**	**-0.0212**	**0.12063**	**0.369357**	**-0.05778**	**-0.18474**	**0.002511**	**-0.05764**	**-0.20097**	**0.009806**

Continuation of Simulation of 50% increase in debt

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
t	0.210204	0.254428	0.211492	0.25487	0.299652	0.290523	0.273456	0.317961	0.328554	0.3323
Less g	0.296417	0.326672	0.272637	0.28691	0.328331	0.305429	0.343508	0.402121	0.468299	0.402634
SubTotal (A)	-0.08621	-0.07224	-0.06115	-0.03204	-0.02868	-0.01491	-0.07005	-0.08416	-0.13975	-0.07033
βd(rd-g)	0.056321	-0.03254	0.032452	-0.04099	-0.00603	-0.02679	-0.0257	-0.02544	0.003077	-0.00773
βf(rf+Δè-g)(1-A)	0.655825	-0.02858	0.036025	-0.06442	-0.06408	-0.05191	-0.00985	-0.00797	0.00158	0.014927
SubTotal (B)	0.712145	-0.06111	0.068476	-0.10541	-0.07011	-0.0787	-0.03556	-0.03341	0.004656	0.007202
[Δβd +Δβf(1-A)]	0.81774	-0.51619	-0.10415	-0.20779	-0.48847	-0.16777	-0.55079	0.123027	0.094801	-0.04001
Δm+m(g+πd)	0.0425	0.05444	0.063763	0.049237	0.042661	0.010915	0.049716	0.070134	0.068878	0.01375
SubTotal ©	0.86024	-0.46175	-0.04038	-0.15855	-0.44581	-0.15686	-0.50108	0.193161	0.163678	-0.02626
Overall total (A-B+C)	**0.061882**	**-0.47288**	**-0.17001**	**-0.08519**	**-0.40438**	**-0.09306**	**-0.53557**	**0.142415**	**0.019277**	**-0.10379**

Appendix 5. ARIMA Model selection regression results

Appendix 5a: Revenue

		REVENUE				
S/N	**ORDER (p,d,q)**	**Adjusted R2**	**AIC**	**SIC**	**DW**	**No. of iterations**
1	2,1,0	-0.0454	-0.1442	-0.00022	1.457297	3
2	2,1,1	0.012906748	-0.17012	0.02186	1.822079	10
3	2,1,2	0.064785011	-0.19448	0.045488	1.944564	13
4	1,1,0	-0.004485627	-0.16891	-0.07375	1.921567	3
5	1,1,1	-0.041223279	-0.10078	0.041959	1.896788	11
6	1,1,2	-0.026437181	-0.08447	0.105842	1.657277	29
7	0,1,1	-0.005136296	-0.20683	-0.11254	1.980535	4
8	0,1,2	-0.041368877	-0.14019	0.001251	1.981055	11
9	3,1,0	0.012045822	-0.32589	-0.13234	2.28916	3
10	3,1,1	0.370624315	-0.7464	-0.50445	2.051421	30
11	3,1,2	0.348677193	-0.68399	-0.39366	1.90927	29
12	2,1,3	0.164707723	-0.27992	0.008042	2.230496	29
13	1,1,3	0.150317385	-0.24459	-0.0067	1.87159	27
14	0,1,3	0.217363637	-0.39607	-0.20748	1.763353	22
15	3,1,3	0.504356278	-0.9315	-0.59279	1.70302	63
16	4,1,0	-0.074522102	-0.38931	-0.14553	2.177095	3
17	4,1,1	0.654022232	-1.49386	-1.20133	2.377564	157
18	4,1,2	0.244962567	-0.68753	-0.34625	1.976411	18
19	4,1,3	0.48499957	-1.04729	-0.65725	2.429275	75
20	3,1,4	0.282528935	-0.53877	-0.15167	2.0212	23
21	2,1,4	0.344377377	-0.49683	-0.16088	2.089024	23
22	0,1,4	0.242172397	-0.40014	-0.1644	1.924073	
23	4,1,4	0.467429076	-0.99437	-0.55557	2.423593	77
24	1,1,4	0.278529521	-0.38118	-0.09571	2.009343	

Appendix 5b: AID

			AID			
S/N	**ORDER (p,d,d)**	**Adjusted R2**	**AIC**	**SIC**	**DW**	**No. of Iterations**
1	2,1,0	-0.012348698	2.054465	2.198446	1.997656	27
2	2,1,1	0.245999487	1.791344	1.98332	2.268439	9
3	2,1,2	0.485146909	1.439455	1.679424	2.156982	17
4	1,1,0	-0.000147095	1.981865	2.077022	1.953029	3
5	1,1,1	0.018474565	1.995278	2.138015	1.935529	22
6	1,1,2	0.085940901	1.954672	2.144987	1.666186	53
7	0,1,1	-0.007326203	1.963315	2.057611	2.022788	8
8	0,1,2	-0.020140733	2.007181	2.148626	2.026626	10
9	3,1,0	-0.054914348	2.157799	2.351353	1.283465	3
10	3,1,1	0.1182517	2.008894	2.250836	1.677794	22
11	3,1,2	0.459815129	1.547032	1.837362	1.770409	14
12	2,1,3	0.46676091	1.502097	1.790061	2.050757	36
13	1,1,3	0.370461335	1.610633	1.848527	2.162504	23
14	0,1,3	-0.049604634	2.065399	2.253992	1.979096	12
15	3,1,3	0.475501246	1.543193	1.881912	2.008064	66
16	4,1,0	0.001652167	1.427571	1.671346	2.548395	3
17	4,1,1	0.106249092	1.345603	1.638134	2.059576	
18	4,1,2	0.088902643	1.390759	1.732044	2.011926	15
19	4,1,3	0.179226286	1.309198	1.699238	1.903051	
20	3,1,4	0.475501246	1.543193	1.731337	2.008064	
21	2,1,4	0.498646105	1.465723	1.801681	2.190662	
22	0,1,4	0.433503239	1.476845	1.712586	2.400305	
23	4,1,4	0.601954357	0.604893	1.043688	2.531605	
24	1,1,4	0.356418627	1.659671	1.945144	2.343446	

Appendix 5c: Interest Payments

		Interest Payments				
S/N	**ORDER (p,d,q)**	**Adjusted R2**	**AIC**	**SIC**	**DW**	**Iterations**
1	2,1,0	-0.058383	0.686243	0.830225	1.958109	3
2	2,1,1	-0.104189	0.760125	0.952101	1.959235	13
3	2,1,2	0.232626	0.425856	0.665826	1.51837	18
4	1,1,0	-0.038349	0.609968	0.705125	1.914644	2
5	1,1,1	-0.069788	0.672004	0.81474	2.037672	13
6	1,1,2	-0.106186	0.736068	0.926383	1.980938	16
7	0,1,1	-0.036890	0.617272	0.711568	1.952073	7
8	0,1,2	-0.057941	0.668596	0.81004	1.979098	11
9	3,1,0	-0.094363	0.761308	0.954862	2.039361	3
10	3,1,1	-0.137394	0.830279	1.072221	2.021399	14
11	3,1,2	0.221318	0.47952	0.76985	2.032743	23
12	2,1,3	0.795368	-0.86835	-0.58039	2.293002	165
13	1,1,3	-0.144998	0.799422	1.037315	1.905115	32
14	0,1,3	0.223204	0.389439	0.578031	1.99002	47
15	3,1,3	0.799108	-0.84968	-0.51097	2.465559	322
16	4,1,0	-0.108046	0.844069	1.087844	1.945246	25
17	4,1,1	0.128889	0.632191	0.924722	1.675359	10
18	4,1,2	0.115705	0.673146	1.014431	1.65202	18
19	4,1,3	0.426628	0.262732	0.652772	1.886149	28
20	3,1,4	0.814712	-0.90769	-0.52058	2.030318	473
21	2,1,4	0.794933	-0.84094	-0.50499	2.330415	189
22	0,1,4	-0.070887	0.738647	0.974388	2.124773	29
23	4,1,4	0.474185	0.195521	0.634316	1.671446	26
24	1,1,4	0.079434	0.608229	0.893702	2.048224	85

Appendix 5d: Seignorage

		Seignorage				
S/N	**ORDER (p,d**	**Adjusted R^2**	**AIC**	**SIC**	**DW**	Iterations
1	**2,1,0**	0.121887	2.073645	2.217627	2.061265	3
2	**2,1,1**	0.388469	1.74335	1.935326	1.981434	21
3	**2,1,2**	0.484823	1.601518	1.841487	1.851539	112
4	**1,1,0**	0.007556	2.183837	2.278995	2.025439	3
5	**1,1,1**	0.608555	1.285719	1.428456	1.922974	90
6	**1,1,2**	0.321034	1.867053	2.057368	1.818157	23
7	**0,1,1**	0.354821	1.733844	1.82814	1.67607	30
8	**0,1,2**	0.35518	1.764514	1.905958	1.959246	17
9	**3,1,0**	0.16914	2.032378	2.225932	2.159851	3
10	**3,1,1**	0.690636	1.07484	1.316781	2.26984	38
11	**3,1,2**	0.501773	1.579509	1.869839	1.847305	197
12	**2,1,3**	0.418796	1.749664	2.037628	1.870873	84
13	**1,1,3**	0.536058	1.515109	1.753003	2.182845	69
14	**0,1,3**	0.454341	1.627281	1.815874	1.528445	40
15	**3,1,3**	0.198406	2.080685	2.419403	2.228035	14
16	**4,1,0**	0.188815	2.07391	2.317685	2.005648	2
17	**4,1,1**	0.680735	1.170142	1.462672	2.138767	94
18	**4,1,2**	0.664039	1.247048	1.588333	2.251804	100
19	**4,1,3**	0.622769	1.385751	1.775791	2.436983	178
20	**3,1,4**	0.389829	1.830678	2.217784	1.849371	500
21	**2,1,4**	0.260653	2.015612	2.35157	2.079202	15
22	**0,1,4**	0.4664	1.633076	1.868817	1.905065	53
23	**4,1,4**	0.597225	1.470649	1.909445	2.42365	144
24	**1,1,4**	0.536718	1.540662	1.826135	2.219067	61

Appendix 6: Actual verses required investment

	gdpgr	Icorusd	**GDPUSD**		I*		I
1980	0.004	5	3,253,406,845		65,068,136.90	U	271,058,074.99
1981	-0.04	5	3,434,307,254		- 686,861,450.80	U	199,418,603.25
1982	-0.07	5	3,391,224,434		- 1,186,928,551.90	U	142,530,341.98
1983	-0.05	5	3,364,445,125		- 841,111,281.25	U	152,601,406.06
1984	0.09	5	3,792,649,142		1,706,692,113.90	S	302,372,472.74
1985	0.05	5	4,108,105,243		1,027,026,310.75	S	429,240,431.79
1986	0.05	5	4,418,034,633		1,104,508,658.25	S	532,410,144.36
1987	0.05	5	4,757,708,764		1,189,427,191.00	S	525,766,238.04
1988	0.06	5	5,197,860,751		1,559,358,225.30	S	583,897,809.73
1989	0.05	5	5,251,712,390		1,312,928,097.50	S	690,559,264.24
1990	0.03	5	6,229,223,539		934,383,530.85	S	846,773,730.08
1991	0.05	5	7,003,722,397		1,750,930,599.25	S	1,044,279,210.67
1992	0.04	5	6,887,463,595		1,377,492,719.00	S	816,711,991.43
1993	0.05	5	5,969,522,285		1,492,380,571.25	S	1,418,975,138.61
1994	0.03	5	5,443,651,121		816,547,668.15	U	1,228,167,337.03
1995	0.04	5	6,461,664,313		1,292,332,862.60	U	1,364,512,237.96
1996	0.05	5	6,929,562,782		1,732,390,695.50	S	1,405,789,968.52
1997	0.04	5	6,887,728,769		1,377,545,753.80	U	1,640,841,947.42
1998	0.05	5	7,477,924,113		1,869,481,028.25	S	1,671,456,112.71
1999	0.04	5	7,713,957,799		1,542,791,559.80	U	1,578,001,318.70
2000	0.04	5	4,980,206,911		996,041,382.20	U	1,149,706,877.65
2001	0.04	5	5,312,020,160		1,062,404,032.00	U	1,439,998,828.58
2002	0.04	5	6,162,934,018		1,232,586,803.60	S	1,156,455,431.32
2003	0.05	5	7,628,268,342		1,907,067,085.50	S	1,748,749,260.52
2004	0.06	5	8,876,587,112		2,662,976,133.60	S	2,517,616,119.60
2005	0.06	5	10,726,091,285		3,217,827,385.50	S	3,109,129,779.37
2006	0.06	5	12,729,215,094		3,818,764,528.20	U	4,411,164,569.16
2007	0.06	5	15,156,150,519		4,546,845,155.70	U	4,953,021,276.60
2008	0.07	5	16,558,210,010		5,795,373,503.50	U	6,119,680,499.10
2009	0.04	5	15,513,000,000		3,180,165,000.00	U	5,122,231,686.54

U = unsustainable

S = sustainable