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Budget Deficits and Economic Performance

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Dedication

To my daddy,

Late Elder Adeleke Muritala Aworinde

&

to my adorable wife Folashade Roseline Aworinde,

my two lovely boys

Oluwatofunmi Samuel Aworinde and Oluwatamilore Shadrach Aworinde.

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You dad I'm keeping in my mind,
I wished you could have stayed forever,
But I will never forget you oh not ever.
If dreams weren't dreams and dreams come true,
I wouldn't be here I'd be with you.
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A friend like you is like no other friend
A friend like you is a friend I don't regret meeting
A friend like you is like a friend I can't scream at or fight with
A friend like you is like having no worries in my life
A friend like you is a friend that I don't want to lose
A friend like you is like being in comfort all day
A friend like you is a friend I always wanted
A friend like you is awesomely awesome
A friend like you is random and funny
A friend like you is a friend that I love to death and I will never let go
A friend like you is a friend I can tell all my secrets to
A friend like you..
A friend like you is like having no dark days because you brighten them up
A friend like you is a friend that opens up my eyes and helps me avoid bad things
A friend like you is a friend I am proud to call my best friend...

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but you are also a loving mother too!
When things aren't going well
and life becomes hard to bear,
You always comfort me and do
little things to let me know you care.
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The way you take care of our
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Olalekan Aworinde
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Abstract

This thesis examines the effects of budget deficits on the current account imbalance and inflation in African countries. The aims of this thesis are; first, to use higher frequency data. Most studies in African countries use annual data; by contrast we use quarterly data. Second, to examine the dynamic interaction between fiscal deficits and current account imbalances using VAR models. Third, to explore the long-run relationship between the twin deficits, using the autoregressive distributed lag (ARDL) of Pesaran, Shin and Smith (2001). Fourth, to assess the long-run relationship between the twin deficits using the threshold autoregressive models of Hansen and Seo (2002). Fifth, to model inflation as being non-linearly related to fiscal deficits using the asymmetric cointegration approach of Enders and Siklos (2001).

The second chapter discusses the theoretical framework and review of the empirical literature on twin deficits and fiscal deficits and inflation. We find much evidence in support of the twin deficits hypothesis that increase in government deficits leads to increase in the current account deficits. There is little empirical study on the Ricardian equivalence hypothesis. From the twin deficits literature, we observe that where the twin deficits hypothesis holds there is a high degree of openness and also countries operates a flexible exchange rate. The empirical literature on fiscal deficits and inflation suggests that fiscal deficits are inflationary in high inflation economies and developing countries, but not in low inflation and developed countries.

The third chapter examines the time series properties of the series using the Augmented Dickey-Fuller test, the Phillip-Perron test and the Lee and Strazicich (2003) two-break unit root test. Results for the unit root test reveals that majority of the series are significant in their first differences. By contrast applying the LM two structural break test shows that the majority of the series are significant around two structural breaks.

The fourth chapter analyses the twin deficits hypothesis using a VAR model. Results show that a positive government deficit shock increases the current account deficit in Botswana, Egypt, Ethiopia, Ghana, Morocco, South Africa and Tanzania while the current account improves in response to a positive government deficit shock in Cameroon and Uganda. Also in response to a positive government deficit shock, the current account remains constant in Kenya, Nigeria and Tunisia.

The fifth chapter examine the long run relationship between the twin deficits hypothesis accounting for structural breaks using the Autoregressive Distributed Lags (ARDL) model. Results show that the fiscal deficit in the twelve African countries has long run impact on the current account deficit.

The sixth chapter examines the relationship between fiscal deficit and current account deficit using the bi-variate threshold cointegration model of Hansen and Seo (2002) for nine countries where the fiscal deficits and current account deficits were significant at first differences. We find evidence of a positive cointegrating relationship between the current account and the fiscal balances for Botswana, Cameroon, Egypt, Morocco, Nigeria and Tanzania; and a negative cointegrating relationship in Ethiopia, Kenya and Uganda.

The seventh chapter examines the long-run relationship between fiscal deficits and inflation in eleven African countries using the TAR and M-TAR models of Enders and Siklos (2001). Results show that fiscal deficits and inflation are asymmetry in Botswana, Egypt, Ethiopia, Ghana, Kenya, Morocco and Tanzania.

This thesis centres on the twin deficits and fiscal deficits and inflation in African countries. Conclusions from the empirical chapters indicate that large fiscal deficits is the cause of current account deficits, and that fiscal deficits are inflationary. This study further suggests that African countries should spend their resources on projects that will accelerate the level of growth and development.

Chapter 1

Introduction

1.1 Motivation

Budget deficits have been a subject of great interest and debate among economists for many years, and so the issues surrounding fiscal deficits are certainly not new, but have led to renewed interest in fiscal themes. In developed countries, the continued growth of the U.S. deficit has provided the impetus for a reassessment of the effect of fiscal deficits on economic activity. In developing countries, fiscal policy, particularly the reduction of fiscal deficits, has been one of the cornerstones of short-term stabilization and medium-term adjustment programs.

Macroeconomic theory concerning fiscal deficits has undergone a considerable transformation since Keynes emphasized fiscal policy in his General Theory. Rational expectations and the proposition of Ricardian equivalence have put the effectiveness of traditional demand management policies into question. Much of the discussion over fiscal policy in the past addressed the question of whether fiscal deficits and the way in which they are financed will have an effect on economic activity. While the theoretical debate continues, in practice fiscal deficits continue to be an important issue. In developing countries, recent economic stabilization programmes have emphasized reductions in fiscal deficits. The idea that fiscal deficits are something that can be measured and controlled is implicit in that assumption, yet as experience in both developed and developing countries shows, deficits may not be so easy to measure nor to control.

Fiscal deficits and their financing are the major problem and source of concern for politicians and policy makers in African countries. Large fiscal deficits have adverse effects on the economy arising from large current account imbalances, and a high dependence on an unstable oil price and exports of raw materials implies

greater vulnerability of these African economies to adverse external shocks and the consequent economic disruption. Also in these countries, budgetary administration has been characterized by irregular release of budgeted funds and poor monitoring of government expenditure.

The structural adjustment programme was conceived and born as a result of the debt crisis that struck most developing countries in the 1980s. The causes of the debt crisis in these countries are; the oil crisis of the 1970s, sloppy lending policies, increase in the interest rate in the United States, falling prices of commodities prices and large withdrawal of funds from indebted countries.

During the early part of 1970s, the oil producing countries under the umbrella of the Organisation of Petroleum Exporting Countries (OPEC) teamed up to increase the price of oil so as to gain additional revenue. The additional revenue was then invested with banks in developed countries. The banks later on lend money to developing countries to purchase goods from the developed countries. By so doing, the loans lent to these developing countries helped to arouse production in the developed countries (Toussaint and Comanne 1995). During this period, both the International Monetary Fund and the World Bank advocated for debt as the gateway towards the much need growth. Consequently, the politicians borrowed huge sums of money without any conceived plan to invest the money into a productive project that will generate the much needed growth (George 1995).

Also, during the 1970s loans were given to developing countries spontaneously at a very low interest rates but this changed in the early 1980s. The United States of America increased the interest rates significantly so as to control inflation. However, countries that took loans from the US banks had to pay huge interests. Also, majority of the banks in Europe did same, and the debt crisis came into being. Due, to the drastic increase in interest rates developing countries where unable to service their debts and were obligatory to take up new loans to service their debts (George 1995).

Touissaint and Comanne (1995) pointed out that in 1980, the total debt of developing countries was US$567 billion, and in between 1980 and 1992 they paid US$1662 billion to service their loans, an amount almost triple the principal. By, 1992 the debt increased to US$ 1419 billion despite the repayment of US$ 1662 billion. Yearly, developing countries debt repayments gulps about US$160 billion and this almost triple the development aid that they receive from developed countries. This suggests the flow of capital from developing countries to developed countries is greater than the flow of capital from the developed countries to the developing countries.

Owing to the inability of the developing countries to pay and service their debts, the IMF and the World Bank came to their rescue, with the task to make sure they

continue to pay their debts by offering new loans with some conditionality attached, thus the emergence of the structural adjustment programme.

The structural adjustment programme is a policy that places emphasis on the market system as the main allocator of economic resources and lesser government participation. The structural adjustment programme can be categorized into three major policy areas.

First, foreign exchange with emphasis on devaluation of the currency, so as to deal with overvalued currencies which generate an increase in import and domestic prices as well as inflationary trends.

Second, reduction in government spending with a focus to reduce budget deficits as well as shifting of economic activities and resources from the public sector to the private sector.

Third, trade liberalization and globalization; emphasis is on the production of tradable goods over non-tradable goods. The purpose is to compete in international markets so as to solve the debt crisis.

In sum, the structural adjustment programme represents deep economic and social changes amounting to; a) increasing the productivity levels; b) eradicating government waste and inefficiency; c) achieving a higher degree of openness to foreign competition and integration in the global economy through trade and financial liberalization, and d) achieving the objective of an acceptable level of economic growth and stability.

Thus, the Structural Adjustment Programmes introduced by the International Monetary Fund (IMF) and the World Bank to African countries in the early 1980s focused on reducing the size of the public sector and on promoting private sector involvement. This study intends to find out, whether the policy introduced in these economies actually reduced government participation in the economy by cutting down the fiscal deficits. However, despite the intention to cut public expenditure in these countries, government expenditure has continued to increase owing to the disjointed combination of a quick fix solution to African economic crises. The programme arguably failed because of its inability to recognise the mono-cultural production of these economies, as well as a rural production base with ill-adapted technology, deficient basic and social infrastructures, undeveloped human capacity and weak institutional framework.

There are five aims behind this thesis. The first is to use higher frequency data. Most studies in developing countries use annual data; by contrast we use quarterly data. This is the typical frequency used in the business cycle studies in developed countries.

The second aim of this study is to examine the dynamic interaction between fiscal

deficits and current account imbalances using VAR models. Studies on twin deficits in Africa mostly examined the long-run relationship and the direction of causation. This study uses impulse response functions and variance decomposition of forecast errors. This has rarely been used in the empirical literature in Africa countries.

Thirdly, we know that most time series have structural breaks and that ignoring this can lead to spurious regression. Perron (1989) argued that failing to account for structural breaks may bias unit root tests towards non-rejection of the null leading to the conclusion that the series contains a unit root, when in fact, the series may be stationary around a structural break. This study uses the Lee and Strazicich (2003) LM two structural break test because of its superiority over other structural break tests. The Lee and Strazicich (2003) test is superior because it allows for two endogenous breaks both under the null and alternative hypothesis. The advantage of the LM two structural breaks test is that it does not suffer from spurious rejection of the null hypothesis and possesses greater power that the Lumsdaine and Papell (1997) test which treats the null hypothesis as a unit root process. Here, the autoregressive distributed lag (ARDL) of Pesaran, Shin and Smith (2001) is used to examine the long-run relationship between the twin deficits, accounting for breaks in the model.

Fourth, most studies on twin deficits have focused on symmetric adjustment, using standard cointegration techniques, such as Engle-Granger (1987) and Johansen and Juselius (1990). This has been criticized on the ground that they ignore the role played by transactions costs (Balke and Fomby 1997). This study takes account of transactions costs by allowing for asymmetric adjustment of twin deficits through threshold autoregressive models which have been ignored in most empirical evidence on twin deficits, except Holmes (2011) who examined the twin deficits using the Hansen and Seo (2002) threshold cointegration for the United States.

Lastly, studies on the relationship between fiscal deficits and inflation have largely examined their time series properties, as well as the long-run relationship and the direction of causation. Earlier studies assume the relationship between the fiscal deficits and inflation to be linear, except Catao and Terrones (2005) who model inflation as being non-linearly related to fiscal deficits through the inflation tax. This study however, examined the relationship between fiscal deficits and inflation using the asymmetric cointegration approach of Enders and Siklos (2001).

A VAR model is used to evaluate dynamic interactions between fiscal deficits and the current account imbalance. Impulse response function and variance decomposition are used to observe the stability of the VAR systems and the response of the variables to the shocks to the system. This study uses the VAR model because it has a number of advantages. First, the VAR model offers a way of analysing the dynamic relationships between fiscal deficits and current account imbalances; it also allows us

to take into account delayed responses with a parsimonious lag structure. Second VAR models provide a convenient framework for examining the relationships between fiscal deficits and current account imbalances. Thirdly, the VAR approach addresses the endogeneity problem by treating all variables as endogenous. This study uses quarterly data for the sample period 1980-2009. The choice of this sample period is premised on the fact that the majority of these African countries operates a flexible exchange rate regime for the period (see Ahmad, Pentecost and Harvey 2011) as well as availability of data.

To test the presence of co-integration the ARDL procedure developed by Pesaran, Shin and Smith (2001) is used. In this study, the ARDL methodology is used taking into account the presence of structural breaks in estimating the long-run impact of budget deficits on macroeconomic variables. An error correction model is also used to find out the speed of adjustment towards long-run equilibrium in response to any shocks. The ARDL approach has several advantages over other methodologies; The Autoregressive Distributed Lag (ARDL) approach developed by Pesaran, Shin and Smith (2001) for testing the presence of cointegrating relationship has peculiar advantages over other symmetric cointegration tests. First, the ARDL approach can be applied to variables of a different order of cointegration (Pesaran and Pesaran, 1997). Second, the approach is applicable for small or finite sample size (Pesaran et al 2001). Third, the short and long-run parameters are estimated concurrently. Fourth, the approach can accommodate structural breaks in time series data.

Threshold cointegration will also be used to examine non-linearity between fiscal deficits and current account imbalances on one hand, and fiscal deficits and inflation on the other hand. The econometric advantages of this are that first; the estimates of the threshold are endogenously determined; second, it does not impose any a priori parametric (non-linear, quadratic or cubic) relationships; third, the adjustment process to the long-run equilibrium can be analysed (Esteve and Tamarit 2012).

The main findings of the thesis can be summarised as follows;

Chapter two discusses the theoretical framework and review of the empirical literature on twin deficits and fiscal deficits and inflation. The results from the empirical literature are inconclusive. This reflect differences in methodologies used, varying from well-specified theoretical models to using simple one-to-one relationships and also a failure to account for structural breaks.

Chapter three analyses the time series properties of the series. Traditional unit root tests reveal that majority of the series is significant in their first differences. By contrast applying the LM two structural break test reveals that the majority of the series were significant around two structural breaks.

In chapter four the VAR model is employed to examine the dynamic interactions

between the twin deficits. We find that an increase in government deficits leads to an increase in the current account balance in Botswana, Egypt, Ethiopia, Ghana and Tanzania, and this is in conformity with the twin deficits hypothesis. However, we find different results in Cameroon and Uganda where an increase in the fiscal deficits leads to a decline in the current account deficit. Also, in response to an increase in the government deficit, the current account deficit remains constant in Kenya, Nigeria, South Africa and Tunisia.

From an empirical perspective, chapter five uses the autoregressive distributed lag model and accounts for structural breaks. We find that fiscal deficits have a positive and statistically significant effect on current account deficits only in Botswana, Egypt, Nigeria and Tanzania while a negative and statistically significant relationship are found in Ethiopia and Kenya.

In chapter six, the bi-variate Hansen and Seo (2002) threshold cointegration approach is used. In contrast to standard cointegration test that reveal no evidence of linear cointegration in some countries, the threshold cointegration test of Hansen and Seo suggests the presence of threshold cointegration.

Chapter seven examines possible asymmetric relationships between fiscal deficits and inflation using the threshold autoregressive (TAR) and the momentum threshold autoregressive (M-TAR) of Enders and Siklos (2001). The results reveal the presence of asymmetric cointegration in Botswana, Egypt, Ethiopia, Ghana, Kenya, Morocco and Tanzania.

The remainder of this thesis is organised as follows; chapter two reviews extensively the literature examining the relationship between fiscal deficits and current account deficits on one hand, and fiscal deficits and inflation on the other hand, concentrating on theoretical debates and empirical studies from both developed and developing countries. Chapter three presents data and stationarity. Chapter four examines the effects of fiscal deficits on current account imbalances using the VAR methodology. Chapter five examines the long run and short run relationship between the twin deficits using the ARDL methodology in the presence of structural breaks. Chapter six investigates the relationship between fiscal deficits and current account deficits based on a nonlinear threshold autoregressive models. Chapter seven examines the relationship between fiscal deficits and inflation using the asymmetric cointegration approach of Enders and Siklos (2001). Finally, chapter eight concludes.

Chapter 2

Literature Review and Theoretical Framework

2.1 Introduction

This chapter examines theoretical and empirical debates linking fiscal deficits and macroeconomic variables. In particular, the theoretical relationship between fiscal deficits and current account deficits and inflation are explored. The chapter also examines the empirical studies relating to fiscal deficits and the listed macroeconomic variables.

2.2 Theoretical Framework

2.2.1 Fiscal Deficits and Current Account Deficits: The Twin Deficits Debate

The relationship between the fiscal deficits and the current account balances can be explained using the national income identities. For, an open economy, gross domestic product (Y), is the sum of private consumption expenditures (C), gross private domestic investment expenditures (I), government expenditures (G), and exports (X), less imports (M);

$$Y = C + I + G + X - M \tag{2.1}$$

Alternatively, Y equals private consumption expenditures, C, savings, S, and taxes, T:

$$Y = C + S + T \tag{2.2}$$

Substituting (2.2) in (2.1) and rearranging terms yields:

$$(X - M) = (S - I) + (T - G) \tag{2.3}$$

Equation (2.3) states that net exports equal private and public savings. Assuming there is a balanced fiscal budget (T-G = 0) and balanced trade (X-M = 0), then equation (2.3) suggests that private domestic saving equals private domestic investment. This is necessarily the case in a closed economy where domestic investment is constrained by domestic saving. However, in an open economy, such a relationship may not always exist. An economy with a foreign sector has access to international financial markets. From equation (2.3), the current deficit is the sum of excess of savings over investment and the government deficit. When the budget deficit is the cause of the current account deficit, domestic absorption exceeds domestic output. Governments can achieve external balance through a reduction in its expenditures or raises taxes. In most developing countries, budget cutting is difficult for political reasons. Also, the scope of substantially raising taxes is very limited due to the prevalence of poverty and problems of tax collection (Egwaikhide, 1999).

Egwaikhide (1999) argued that most developing countries rely on bank credit to finance their budget deficits and gives two effects of budgetary policy. The first effect is that an expansion of government expenditure caused by bank credit to the government has a positive effect on aggregate demand; as increases in government expenditure affect private sector income through the multiplier effect. The second effect works through the money supply. The central bank credit to the government is a component of high-powered money, and thus, the growth in bank credit directly expands the domestic money supply.

Based on the well-known Keynesian absorption theory that an increase in the fiscal deficit will lead to an increase in the current account deficits. The theory suggests that an increase in the budget deficit would increase domestic absorption and hence import expansion, causing a current account deficit. Another theoretical rationale is the Mundell–Fleming framework. The Keynesian proposition is that an increase in the budget deficit would place upward pressure on interest rates, causing capital inflows and the exchange rate to appreciate. The appreciated exchange rate would make exports less attractive and increase the attractiveness of imports, subsequently worsening the current account. From the above, the Keynesian proposition can be summarized that there exists a unidirectional Granger causality that runs from fiscal deficit to current account deficit.

However, causality from the current account to budget deficits also may exist.This outcome occurs from deterioration in the current account that leads to the budget deficit increases. This is especially true for small open economies that highly depend on foreign direct investment as a way to boost their economic growth. In other words, the budgetary position of a country will be negatively affected by large capital inflows or through debt accumulation. This reverse causality running from current account deficits to fiscal deficits is termed as Current Account Targeting Hypothesis (CATH) by Summers (1988).

However, there are other hypotheses on the twin deficits noted in the literature. These includes; the investment hypothesis, the productivity hypothesis and the risk premium hypothesis. The investment hypothesis is credited to Sachs (1982) who explains "that if the home country is an attractive source of foreign investment because of expected high returns due to favourable business atmosphere, political stability, technological changes or an overall increase in productivity, the investment inflows produce a financial account surplus which is associated with current account deficits".

Lovett (1988) developed the productivity hypothesis because the United States current account deficits and fiscal deficits moved into different directions during the 1980s. The hypothesis states "that productivity gains in the economy attract foreign investors which triggered investment and later induced a current account deficit". The risk premium hypothesis is due to Bachman (1992). It argues that an appreciation of the real exchange rate increases the purchasing power of domestic incomes in terms of imported goods, increases the relative value of financial, real estate and other assets held by domestic residents, which tend to reduce domestic savings and increase consumption, reduce competitiveness of a country's export in international markets, thereby causing current account deficits. This implies that the exchange rate can also impact the twin deficits by changing the relative price of nontradable. Large government spending on nontradable such as services or real estate sector can induce a real appreciation which in turn increases consumption toward tradable thereby leading to current account deficits.

Korsu (2009) also argued that fiscal deficits affect the current account deficits through the monetary sector. He argues that increase in fiscal deficits increase the supply of money when the deficits is financed by means of seigniorage. Increase in money supply increases the price level, which in turn appreciates the real exchange rate and deteriorates the current account.

In contrast to the traditional Keynesian view, the Ricardian Equivalence Hypothesis of Barro (1974, 1989) argues that the fiscal deficits and the current account balance are not related. The hypothesis states that, "for a given expenditure path,

the substitution of debt for taxes has no effect on aggregate demand nor on interest rates. As a result, it implies that a tax increase would reduce the budget deficits but would not alter the external deficits since altering the means that the government uses to finance its expenditures does not affect private spending nor national savings" (Marinheiro, 2008). In other words, the REH negates any link between fiscal deficits and trade deficits which imply the absence of any Granger causality relationship between the two deficits.

From the above, the following are the major channels through which fiscal deficits affects the current account deficits;

1. Direct impact through demand, that is large fiscal deficits induce domestic absorption and hence import expansion, causing a current account deficit.

2. Impact through the interest rate, increase in the budget deficit induce an upward pressure on interest rates, causing capital inflows and exchange rates to appreciate thereby worsening the current account.

3. Impact through the exchange rate, the fiscal deficits affect the current account by changing the relative price of nontradables. Large government spending on nontradables such as services or real estate sector can induce a real appreciation which in turn increases consumption toward tradable thereby leading to current account deficits.

4. Direct impact through money supply, large fiscal deficits leads to increase in money supply increases the price level, which in turn appreciates the real exchange rate and deteriorates the current account.

2.2.2 Fiscal Deficits and the Inflation Debate

The relationship between government fiscal deficits and inflation has attracted enormous debate over the years. The major channels of interaction between fiscal deficits and inflation are;

1. A direct impact through aggregate demand, an increase in aggregate demand leads to inflation (Patinkin 1965).

2. A direct impact through the money supply, large fiscal deficits lead to increases in the money supply which in turn increase the price level (Sargent and Wallace 1981).

3. An impact through interest rates, increases in fiscal deficits lead to higher interest rates which crowd out private investment, and hence reduce aggregate supply, which leads to price increases (Miller 1983).

4. Higher inflation expectations lead to higher real interest rates and higher debt-service costs which leads to increases in fiscal deficits (Barro 1978, 1979).

The first and the most direct relationship is the aggregate demand approach of

Patinkin (1965) and Friedman (1968). Patinkin (1965) argues that a rise in the real value of the stock of bonds increases perceived private wealth, and therefore, spending leading to inflation. Friedman (1968), argues that if the economy is at its full employment level, an increase in aggregate demand will be reflected in increases in the price level.

The second link is proposed by Sargent and Wallace (1981). They argue that seigniorage, is central to deficit finance; the central bank will be obliged to monetize the deficit. Such a monetization results in an increase in the money supply and the rate of inflation. Thus, Sargent and Wallace (1981) believe that the direction of causation is from fiscal deficits to money supply and then from the money supply to inflation.

The third connection is expounded by Miller (1983). He argues that government deficits are necessarily inflationary irrespective of whether the deficits are monetised or not because there are different channels through which fiscal deficits leads to inflation. He argues that even if the Central Bank does not monetise the deficit through printing of money, deficits are still inflationary through crowding out effects. This is because non-monetised deficits lead to higher interest rates. Higher interest rates crowd out private investment, and thus reduce the rate of growth of real output, which leads to price increase.

A fourth link, put forward by Barro (1978, 1979) suggests reverse causation. He argues that deficits are a result of inflation. The deficit is the change in the nominal value of outstanding government bonds. If the anticipated inflation rate increases, then the nominal value of bonds must also increase, that is the government will run a deficit to keep the same anticipated real amount of bonds. Patinkin (1993) argues that the relationship between fiscal deficits and inflation might be negative, because of indexation and postponement of wages and salaries of workers. He argues that during periods of inflation governments delay payment of wages and salaries and this delay then produces a substantial decline in government expenditure.

In conclusion, the inflationary effect of government deficits depends upon the means by which the deficit is financed and the impact of the deficit on aggregate demand. If the government attempts to finance budget deficits through bond issues, it could lead to inflation if tight monetary policy is used and otherwise. If seigniorage revenue is used to finance deficits, the implication is that fiscal deficits will lead to inflation. From the analysis discussed above, we can conclude that at the theoretical level, there is a close link between deficits and monetary growth on one hand and inflation on the other.

2.3 Empirical Studies:

2.3.1 Fiscal Deficits and Trade Deficits: The Twin Deficits

The results of the empirical literature on the twin deficits are inconclusive; however, most studies suggest that fiscal deficits cause current account imbalances. For, most of the empirical work reviewed in this section there is evidence in favour of the Keynesian theory on twin deficits that increase in government deficits leads to increase in the current account deficits. There is limited empirical investigation on the Ricardian equivalence hypothesis. There is also sparse evidence in favour of the current account targeting hypothesis that increases in the current account deficits leads to increase in fiscal deficits. From the empirical literature reviewed below we observed that where the twin deficits hypothesis holds there is a high degree of trade openness and such country also operates a flexible exchange rate.

For purposes of clarity, the empirical literature reviewed in this chapter is classified into six, and it is structured based on the methodological approach used. The first part, we discuss the empirical evidence based on single equation techniques. The second part discusses evidence on the twin deficits relationship based on the Granger causality test and VAR models. The third part discusses the twin deficits relationship based on the long-run relationship while the fourth part reviews the empirical linkage between the twin deficits based on structural changes. The fifth part discusses the empirical linkage based on panel data and the last part is on asymmetric cointegration.

First, Milne (1977), Bernheim (1988), Zietz and Pemberton (1990), Egwaikhide (1999), Salvatore (2006) among others use single equation and simulations to examine the relationship between fiscal deficits and current account deficits. They arrived at different conclusions.

Milne (1977) examines the direct relationship between the twin deficits for 38 countries for the period 1960 to 1975 by regressing the current account deficits on the fiscal deficits. The result shows a positive and statistically significant relationship between the trade deficit and the fiscal deficits.

Bernheim (1988) examines the relationship between fiscal policy and current account for the United States and five of its major trading partners, Canada, the United Kingdom, West Germany, Mexico and Japan for the period 1960-84. In examining this relationship a numbers of control variables that might influence the patterns of trade are included. The variables used are; the net saving for government fiscal deficits expressed as a percentage of GDP, current account deficits expressed as a percentage of GDP, current and lagged values of real GDP growth and government

consumption expenditure. The estimates revealed that a $1 increase in the fiscal deficits roughly leads to about $0.30, $0.20, $0.32, $0.33 and $0.75 increase in the current account balance respectively for the US, West Germany, UK, Canada and Mexico. This result is consistent with the Keynesian argument that fiscal deficits cause the current account deficits. By contrast, a $1 increase in the fiscal deficits explain about $0.13 decline in the current account deficits; this can be traced to the stringent controls that the Japanese government placed on international trade and flow of capital.

Zietz and Pemberton (1990) employ a structural simultaneous equation framework to examine the relationship between US budget deficits and trade deficits over the period 1972:4-1987:2. They estimate eight equations for treasury bills rates, commercial paper rates (short-term interest rates); the real trade-weighted exchange rate; domestic absorption; exports; imports; the domestic inflation rate; and trend domestic absorption. Model estimates revealed the following; first, fiscal deficits affect the trade deficits through the impact of rising domestic absorption rather than the real interest rates and the real exchange rates. Second, slow foreign income growth contributes to the United States trade deficits in the eighties.

Egwaikhide (1999) examines the effects of budget deficits on the trade balance in Nigeria using annual data for 1973–93. He constructed a model similar to Mansur (1989) which recognises 5 channels of interactions between revenue and expenditure, money supply, price level, import and trade balance. He estimate nine equations and found that budget deficits worsen the trade balance whether financed by printing of money or external borrowings.

Salvatore (2006) examined whether large fiscal deficits cause current account deficits for the G-7 countries (United States, Japan, Germany, United Kingdom, France, Italy and Canada) using annual data for the period 1973-2005. He employed five variables; the current account balance as a percentage of GNP, the general government budget balance as a percentage of GNP, the growth of real GNP in the nation, the growth of real GNP in the rest of the world and the current account balance lagged one year. The estimates suggest that higher domestic growth worsens the current account balance in all countries; higher foreign growth improves the nation's current account balance. The fiscal deficits lagged by one year for all countries are positively related and statistically significant to current deficits. This result suggests that lagged fiscal deficits lead to current account deficits. The study also examined the impact of global structural imbalances arising from the petroleum shocks which resulted into double digit inflation of the 1970s by using a dummy variable which assumes value of 0 for the period 1973-1980 and the value of 1 for the period 1981-2005. The results show that the coefficients of the dummy variable is statistically

insignificant and does not change the sign, size, as well as the statistical significance of the earlier results.

Second, Darrat (1988), Islam (1998), Kouassi, Mougoue and Kymn (2004), Abell (1990), Enders and Lee (1990), Kearney and Monadjemi (1990), Bachman (1992), Rosenweig and Tallman (1993), Anoruo and Ramchander (1998), Kaufmann, Scharler and Winckler (2002), Corsetti and Müller (2006), Baharumshah, Lau and Khalid (2006), Kim and Roubini (2008), examine the twin deficits phenomena using Granger Causality and Vector Autoregressive (VAR) model and reached different conclusions.

Darrat (1988) examined whether large fiscal deficits cause rising trade deficits in the US using quarterly data for the period covering 1960:I-1984:IV. He argued that the failure for lack of empirical support in the earlier study is due to the conclusion reached concerning the direct relationship used for the fiscal deficits and current account deficits, as well as correlation based approach. However, he used the indirect approach by examining the theoretical linkage between the twin deficits with the following additional variables; monetary base, real output, inflation, labour cost, exchange rate, short-term interest rates, long-term interest rates and foreign income. He found a bi-directional causal relationship between the twin deficits. More importantly he used the multivariate Granger-causality test in order to avoid distorting the causality inferences due to the omission of relevant variables. The Granger causality results show that the exchange rate, the interest rates, the monetary base and the fiscal deficit cause changes in the trade deficit.

Islam (1998) examines the direct relationship between fiscal deficits and trade deficits in Brazil for the period 1973-1991. Using Granger-Causality, the study shows the presence of bi-directional causality between trade deficits and budget deficits.

Kouassi, Mougoue and Kymn (2004) examine causal relationships between fiscal deficits and current account imbalances using international data for 10 developed countries and 10 developing countries. The developed countries included in the study includes, Australia, Austria, Canada, France, Italy, Netherlands, New Zealand, Sweden, United Kingdom and United States. The sample of developing countries consists of Columbia, Dominican Republic, India, Israel, Korea, Malaysia, Singapore, South Africa, Thailand, and Venezuela. The countries included in their study are based on availability of data and high ratios of fiscal deficits and current account deficits expressed as a percentage of GDP, although this may bias the conclusion. The variables considered in the study are fiscal deficits as a percentage of GDP and current account deficits as a percentage of GDP. Three unit root test were carried out to examine the time series properties of the forty series considered in the study, and it was revealed that the majority of the series are stationary in their first differences, which is a condition for cointegration. Examining the long run relationship, the multivariate

Johansen cointegration approach was used, and they found that the twin deficits are only cointegrated only in the United Kingdom for the developed countries. However, there is a long-run relationship between the twin deficits in nine countries out of ten countries considered in developing countries. Granger causality which is the kernel of this study reveals that in developed countries, there is evidence of unidirectional causality from current account deficits to fiscal deficits only in Italy. Also, there is no evidence of unidirectional causality from fiscal deficits to current account deficits in all the ten developed countries considered. Results for developing countries reveal evidence of bi-directional causality only in Thailand, and a unidirectional causality from fiscal deficits to current account deficits only in India and Israel. However, a unidirectional causality from current account deficits to fiscal deficits is found only in Korea. The authors argue that uni-directional causality from current account deficits to fiscal deficits in Korea and Thailand is largely due to the level of external debt in relation to the GDP, interest burden on external debt, level of exports to GDP, level of the real exchange rate, national savings and investment as well as the fiscal balance. They conclude that the solution to the twin deficits in these countries lies mainly in policy measures that focus on improvement on productivity, exchange rate and the monetary stance that will complement contractionary fiscal policy.

Abell (1990) employed a vector autoregressive model to examine the link between the twin deficits in the US using monthly data for the period 1979.02-1985.02, which corresponds to the period of dollar appreciation in the early 1980s. The variables included are the federal government budget deficit, the U.S. merchandise trade balance, the M1 money supply, Moody's AAA bond yield, the Dallas Federal Reserve Bank 101-country trade-weighted dollar exchange rate, real disposable personal income, and the consumer price index. The estimates reveal that fiscal deficits influence trade deficits and that causation runs from fiscal deficits through the interest rate and the exchange rate to the trade deficits. Impulse response functions revealed a positive response of the interest rate to a shock to the budget deficit. Also, a shock to interest rates leads to an increase in the exchange rate and a shock to the dollar exchange rate leads to a broadening of the trade gap. The variance decomposition reveals that fiscal deficits explains 25 per cent of the forecast error variance of interest rates, this argument further lends support to the literature that deficits caused interest rates. Fiscal deficits also explain 20.3 per cent of the forecast error variance of the money growth, which further suggest that fiscal deficits influence trade deficits through money growth, and this is in support of the monetary approach transmission channel.

Enders and Lee (1990) examine the relationship between fiscal deficits and current account imbalances in the U.S. for the post war period 1947:III – 1987:I using

an unconstrained vector autoregressive model. Using six variables namely; federal government purchases, tax/debt policies, real consumption, the current account, exchange rates, and the real interest rate, their findings suggest that shocks in government spending generate a persistent current account imbalance. However, when the authors imposed theoretical restrictions drawn largely from the Ricardian Equivalence Hypothesis (REH) they were unable to reject the assertion that fiscal deficits substitution of taxes for government debt issue does not result in a current account deficit.

Kearney and Monadjemi (1990) examine the dynamic interactions of the twin deficits for eight countries (Australia, Britain, Canada, France, Germany, Ireland, Italy, and the United States) using quarterly data over the period of floating exchange rates from 1972:1-1987:4. The variables considered for the VAR are government expenditure, tax revenue, monetary creation, exchange rate and the current account of the balance of payment. "The findings that emerge from empirical analysis of eight countries can be summarised as indicating the existence of a temporary twin deficits relationship between the stance of fiscal policy and performance on the current account of the balance of payments, which does not persist overtime. Examination of the impulse response functions confirms that fiscal expansions will lead to prolonged periods of improved current account performance as the economy adjusts towards its long run equilibrium. The twin deficits relationship varies internationally in magnitude and duration, and it is not independent of the government's financing decision" (Kearney and Monadjemi, 1990, p. 216).

Bachman (1992) examines US current account deficits using a Vector Autoregressive (VAR) model for the period 1974:1-1988:4. The author tests four hypotheses namely; the Feldstein hypothesis, the investment hypothesis, the productivity hypothesis and the risk premium hypothesis to examine the rationale behind large current account deficits in the US. The variables used include; the federal government surplus, gross domestic investment, US relative productivity and the risk premium. A bivariate VAR was estimated because the interrelationship between the twin deficits is not the focus of the study, rather to show which variables can be empirically eliminated as a possible explanation and also to determine which hypothesis best explains what happened to the current account deficits. Granger causality tests reveal that only the federal government surplus Granger-causes the current account deficit and there are no evidence that the current account deficit Granger-causes federal government surplus, gross domestic investment, US relative productivity and the risk premium. The impulse response functions show that a shock to government budget surplus causes the current account balance to rise by almost 0.4 per cent of GNP after about two and half years while investment, relative productivity and

the risk premium show little effect which indicates that it is unlikely they caused any substantial change in the current account deficits. The variance decomposition also supports the test that positive shocks to the federal government surplus lead to increases in the current account deficits.

Rosenweig and Tallman (1993) examine the relationship between U.S. fiscal deficits, exchange rates and trade balances for the period 1961:I-1989:IV, using a five –variable VAR system namely government purchases, federal balances, trade balance, real interest rates and the real exchange rates. They include two measures of fiscal policy so as to help to differentiate between a Mundell-Fleming and a Ricardian interpretation of the role of fiscal policy. The Mundell-Fleming model implies that fiscal deficits affects trade deficits. The REH argues that it is government purchases not government balances that impact on trade deficits. The variance decomposition shows that government balance innovations explain 42.2 per cent of trade balance variance at 16 quarter horizon, implying that fiscal deficits leads to trade balance. By contrast, trade balance innovations are only associated with 8 per cent of government balance variance. This result is consistent with the Mundell-Fleming model that causality runs from fiscal deficits to trade balance. Testing the REH, government purchase innovations are associated with only 6.4 per cent of trade balance thus this evidence is not consistent with the REH that government purchases impacts on trade balances. The impulse response functions show that positive shocks to the federal government balances lead to increases in the trade balance. Given the support for the twin deficits, the authors also investigate the indirect transmission mechanism of the twin deficits; evidence is found that a positive shock to the federal government balances lead to decline in the real exchange rate, and innovations in the real exchange rate are associated with a decline in the trade balance. This implies that fiscal deficits are associated with an appreciation of the real exchange rate and support the "twin deficit" notion that government deficits contribute to trade deficits.

Anoruo and Ramchander (1998) use a VAR approach to examine the twin deficits phenomena in five developing Southeast Asian countries namely; India, Indonesia, Korea, Malaysia and the Philippines. The sample period is annual; it varies across countries based on the availability of data. For India and Philippines 1957-1993, Malaysia 1960-1993, Korea 1967-1993 and Indonesia 1970-1993. The variables included in the model are; budget deficits, trade deficits, and control variables which includes; short term interest rates, exchange rates, real output and inflation. Granger causality tests reveal that fiscal deficits Granger-cause the trade deficits in Malaysia. However, there is evidence that trade deficits Granger-cause fiscal deficits in all the five countries under study. This implies that there is evidence of bi-directional relationship in Malaysia. They argue that evidence of uni-directional causality from

the trade deficits to budget deficits may be explained by an increase in government spending so as to reduce the damaging economic and financial consequences of trade deficits. Also, movement in the interest rate has a direct effect on both the trade deficits and fiscal deficits in all the five countries, in addition exchange rate and inflation rates Granger-causes the fiscal deficits. Therefore, any policy attempts to lessen the twin deficits, measures to influence the interest rates, exchange rates and inflation must be considered.

Using a VAR model, Kaufmann, Scharler and Winckler (2002) examine dynamic interactions between fiscal deficits and current account deficits in Austria for the period 1976:1-1998:4. The variables they employed includes, the budget surplus, current account balance, real GDP, index of German industrial production, government spending, long-term interest rate, labour productivity and the terms of trade. The index of German industrial production was included as a measure of foreign income because Germany is Austria major trading partner. The study revealed evidence of long-run relationship for twin deficits. However, the variance decomposition shows that in the long run, labour productivity and government spending account for about 25 per cent of the forecast error variance in the current account deficits while the interest rate and the fiscal deficits explain no substantial part, this suggest that there is no evidence of twin deficits in Austria. This conclusion is further supported by the impulse response function that shocks in labour productivity and government spending have a positive effect on current account deficits, and this is consistent with the REH that government spending impacts on the current account deficits.

Corsetti and Müller (2006) address the question whether of fiscal innovations move fiscal deficits and current account deficits in the same direction for the US, UK, Canada and Australia. The sample of the study is quarterly data, ranging from 1979:1-2005:3 for the US, 1979:1-2005:2 for UK and Canada and 1979:1-2004:2 for Australia. They predicted that there can be twin deficits only if the economy is relatively open and fiscal expansion is persistent. Employing a Structural VAR model, the variables considered include government spending and output both in logs of real per capita, primary budget balance expressed as a percentage of GDP, inflation, long-term nominal interest rate, log of terms of trade and trade balance expressed as a percentage of GDP. Their results reveal that in the US, which is a large and relatively closed economy, fiscal expansion has a negligible or even positive effect on the trade balance and therefore there are no twin deficits. In UK and Canada which are more open, there is evidence that a fiscal deficit shock deteriorates the trade balance by 0.5 per cent in the UK and 0.17 per cent for Canada. Also, Australia which is less open to the UK and Canada, there is no evidence that fiscal expansion deteriorates the trade balance.

Baharumshah, Lau and Khalid (2006) examine the twin deficits hypothesis in four ASIAN countries namely; Indonesia, Malaysia, Philippines and Thailand for the period 1976:1-2000:4. Their objective is to examine the transmission channel between the twin deficits which has received less attention in ASIAN countries. The variables employed include the fiscal deficits, current account deficits, short-term interest rate and the nominal exchange rate. The Johansen cointegration test revealed that there is a symmetric long run relationship in Indonesia, Malaysia and Thailand except Philippines where there is no long-run relationship. However, a long-run relationship was obtained for Philippines when adjustment is made for structural break using Gregory and Hansen (1996) cointegration with structural breaks. The Granger-causality test revealed bi-directional causality between the fiscal deficits and current account deficits in Malaysia and Philippines while there is evidence of uni-directional causality from fiscal deficits to current account deficits in Thailand and a reverse uni-directional causality from current account deficits to fiscal deficits in Indonesia. There is evidence of indirect causality from the fiscal deficits to interest rates to exchange rates as to current account deficits except for Philippines. The variance decomposition reveal that shocks in the current account deficits contribute more in explaining the forecast error variance in fiscal deficits for Malaysia, Thailand and Philippines, and this is consistent with the Granger causality test that fiscal deficits Granger-causes current account deficits in these countries. The impulse response functions show that positive shocks to the federal government balances lead to increases in the current account deficits in Malaysia, Thailand and Philippines.

Kim and Roubini (2008) examine the effect of government deficits on the current account and the real exchange rate in the US for the post Bretton Wood period of flexible exchange rate covering 1973:1-2004:1 using a VAR. The variables include government deficits expressed as a percentage of the GDP, the current account deficits expressed as a percentage of GDP, the real interest rate and the real exchange rate. They also include the log of real gross domestic product to control for the cyclical component of the fiscal deficits. The ordering of their VAR model is given as (RGDP, GOV, CUR, RIR, RER). Contrary to Keynesian theory, their results suggest that an expansionary government budget deficit shock improves the current account and depreciates the real exchange rate. They argue that increases in private savings and falls in investment contribute to the current account improvement while the nominal exchange rate depreciation, as opposed to the relative price level changes, is mainly responsible for the real exchange rate depreciation. They further argued that the reason for the evidence of twin divergent in the US was because of its relatively closed open economy, which increase the level of private savings. A fiscal expansion may lead to an increase in real interest rate, which in turn crowd out private investment

but stimulate private savings.

Third, Dibooglu (1997), Khalid and Guan (1999), Vamvoukas (1999), Alkswani (2000), Onafowora and Owoeye (2006), Marinheiro (2008), Lau and Tang (2009), Mohammadi and Mosrefi (2012), explore long-run relationships between the twins and reach somewhat different conclusion.

Dibooglu (1997) re-examines the relationship between the current account and a number of key macroeconomic variable in the US for the period 1960:1-1994:4. The study investigates the income-expenditure and the intertemporal approach to the current account using the Johansen cointegration approach. The choice of the model which includes the current account, government spending, terms of trade, long-term real interest rate, budget surplus, foreign income, domestic income and productivity is motivated by factors emphasised in the income-expenditure and the REH approaches in the current account. The Johansen cointegration approach reveals evidence of four long-run relationships. However, the likelihood ratio test was conducted to examine whether all variables belong to the system, the results indicates that all the variables belong to the system; they therefore, conclude that the cointegration results suggest that the data generating mechanism in the eight dimensional system should be modelled as a VECM. At the 20-quarter forecast horizon, innovations in budget surplus account for about 37 per cent of the forecast error variance in the current account. The terms of trade accounts for 11 per cent, real interest rate explained about 7 per cent, foreign income account for about 6 per cent while other variables included in the model account for less than 5 per cent. This result is consistent with the traditional view of the current account where innovations in budget surplus, real interest rate, term of trade plays a significant role in explaining variations in the current account. However, government spending and productivity shocks explains less that 3 per cent of the variations in the current account and this finding lends little support for the REH approach of current account. Also, when a sensitivity analysis was carried out by re-ordering the variables, there was no significant changes, the results show that current account and the macroeconomic variables included in the model are not sensitive to ordering and also that they are still in support of the income-expenditure approach of current account. The impulse response function revealed that the budget surplus shock has a permanent effect on the current account, and this is consistent with the income-expenditure approach of current account reported earlier.

Khalid and Guan (1999) use cointegration techniques to examine the relationship between budget and current account deficits in five developed countries (US, UK, France, Canada and Australia) and five developing countries (India, Indonesia, Pakistan, Egypt and Mexico). The study was conducted using data for 1950 to 1994

for developed countries and using data for 1955 to 1993 for developing countries. The authors employed four variables in their study namely; the budget deficits as a percentage of GNP, current account deficits as a percentage of GNP, trade-weighted exchange rate and the nominal GNP growth rates[1]. The results suggest a strong long-run relationship between the two deficits for developing countries, but no long-run relationship in developed countries. Also, the direction of causality for developing countries is mixed. For example, for India the direction of causality is bi-directional. The results for Indonesia and Pakistan indicate that the direction of causality runs from current account deficits to budget deficits. This is because much of the current account deficit was financed by internal and external borrowings thus contributing further to the huge national debt. Interest payments on these debts have increased over the year, leading to these countries running bigger budget deficits.

Vamvoukas (1999) investigates the relationship between budget and trade deficits in Greece for the period 1948-1993. Within the framework of cointegration analysis, error-correction modelling and Granger causality, the paper evaluates the validity of the Keynesian proposition. The kernel of their study is that they used trivariate causality tests to examine the twin deficits hypothesis. They argue that bivariate causality tests suffer from methodological problem of a third missing variable. The study therefore, includes output and inflation rate as control variables and found that there is strong evidence of the twin deficits phenomena in Greece, with causality from the budget deficit to trade deficit.

Alkswani (2000) examines the relationship between fiscal deficits and trade deficits in Saudi-Arabia for the sample period 1970-1999. The study used the trade deficits and the budget deficits in their model. In examining the long-run relationship using the Johansen cointegration approach, they found evidence of a long-run relationship. Granger causality tests reveal that trade deficits cause fiscal deficits because of the important role of the oil industry in the economy.

Onafowora and Owoeye (2006) examine the long run relationship between the fiscal deficits and the trade deficits in Nigeria using annual data for the period 1970-2001. The variables included in their model include; trade deficits expressed as a percentage of GDP, budget deficits expressed as a percentage of GDP, broad money supply as a percentage of GDP, industrial production as a proxy for domestic income, three-month discount rate and the real exchange rate. The Johansen multivariate cointegration technique indicates the existence of a long-run equilibrium relationship between the fiscal deficit and the trade deficit. Estimating the VECM it was discovered that the error correction is negative and statistically significant, implying convergence to equilibrium. Granger causality tests imply that the trade balance

[1]They authors used nominal GDP so as to avoid distortions in pricing.

Granger-causes the budget deficit. They argued that it could be attributed to the fact that Nigeria is an oil dependent economy, which accounts for 90 per cent of its export earnings, 40 per cent of GDP and 80 per cent of government revenue.

Marinheiro (2008) investigates the Ricardian equivalence and twin deficits in Egypt for the period 1974-2003. The REH is examined using a reduced-form consumption function where the real per capita consumption is regressed on GDP, budget deficits, public consumption, government debt and private wealth. The results do not support REH. This implies that an increase in the fiscal deficit for is not fully offset by an increase in private savings. The twin deficits hypothesis was also examined using Granger causality tests; there is evidence for causation from the current account deficit to the fiscal deficit.

Lau and Tang (2009) examine the direct relationship between fiscal deficits and current account deficits in Cambodia for the period 1996:1-2006:2. They started by examining the correlation coefficient which does not state the direction of causality, and they found a positive correlation of about 83 per cent. The Johansen cointegration tests indicate there is the presence of long-run relationship and this support the theoretical view of twin deficits. The Granger causality test revealed that there is evidence of bi-directional causality, but with fiscal deficits coefficients statistically different from zero and absolutely large chi-squared statistics more than the current account deficits at 5 per cent level of significant. Innovations in fiscal deficits explain about 50 per cent of current account deficits while innovations in the current account deficits explain about 14 per cent in fiscal deficits.

Mohammadi and Mosrefi (2012) examine the long-run and short-run dynamics of fiscal policy and current account deficits using time series data for four East Asian countries -South Korea, Malaysia, Singapore and Thailand[2]. They employed six variables in their empirical study namely; fiscal deficits as a percentage of GDP, current account as a percentage of GDP, government expenditure as a percentage of GDP, natural log of real GDP, real exchange rate and real interest rate. Applying the Augmented Dickey-Fuller (ADF) unit root test, the study failed to reject the null hypothesis of unit roots at levels, most of the variables were stationary in their first differences. Using both the maximum eigenvalue and trace tests, there is evidence of long-run relationship in favour of all the four countries. The coefficient of the lagged error correction term is negative in three out of four countries (South Korea, Singapore and Thailand) but only statistically significant in Thailand. This implies that there is evidence of long-run causality from fiscal deficits to current account deficits only in Thailand. Examining the dynamic interactions of current account

[2]The quarterly time series data used vary across countries and depends on data availability. They are 1976–2007 for Korea, 1976-2003 for Malaysia and Thailand and 1975-2008 for Singapore.

deficits using the impulse response function and the variance decomposition, it was discovered that after 16 quarter forecast horizon, the response of current account deficits to innovations in fiscal deficits is not statistically different from zero in all the four countries. The variance decomposition shows that variations in the current account deficits are explained by innovations in the current account deficits itself ranging from 51 per cent in Korea, 66 per cent in Malaysia, 73 per cent in Singapore and 61 per cent in Thailand. Both the results of impulse response functions and the variance decomposition are consistent with the Ricardian Equivalence Hypothesis (REH).

Fourth, Marashdeh and Saleh (2006), Baharumshah and Lau (2009), Daly and Siddiki (2009), Grier and Ye (2009), Holmes and Panagiotidis (2009), Holmes, Panagiotidis and Sharma (2011), Makin and Narayan (2012), Kalou and Paleologou (2012), investigates the long-run relationship between the twin deficits accounting for structural breaks, and reach distinctive conclusions.

Marashdeh and Saleh (2006) re-examine the direct relationship between the twin deficits in Lebanon for the period 1970-2004 by accounting for structural breaks which was omitted in previous studies in Lebanon. They argued that the traditional unit root test is biased towards the non-rejection of the unit root null hypothesis in the presence of structural breaks. Their study therefore, test for unit root in the presence of structural breaks at an unknown time of the break and used the Autoregressive Distributed Lag (ARDL) to examine the long-run relationship. The results of the Perron (1997) innovative outlier model 2 revealed that the fiscal deficits is stationary around the break and that time of break is 1983 which is after the Israeli invasion which prompted large government expenditure on military services and weapons. The current account deficit is found to be difference stationary, and the break occurred in 1980 which is the period Lebanon was in the middle of civil war and this severely affect the export sector during this period. The result also reveals that trade deficits has a long run impact on budget deficits in Lebanon and that a one per cent increase in trade deficits will lead to 22 per cent increase in fiscal deficits. The error correction term also suggests that the variables adjust back to equilibrium.

Using cointegration test with structural breaks and Granger causality Baharumshah and Lau (2009) examine the twin deficits phenomena in seven East Asian countries namely; Singapore, Korea, Malaysia, Thailand, Indonesia, the Philippines and Japan for the period 1980:1-2006:4. One major contribution of their study is the consideration of both investment and fiscal deficits as determinants of current account accounts. Therefore, they include three variables in their model namely; fiscal deficits as a percentage of GDP; current account deficits as a percentage of GDP

and investment as a percentage of GDP. Employing the Zivot and Andrew (1992) endogenous one break test and found that the series has structural breaks mostly during the Asian financial crisis of 1997. Applying the Gregory and Hansen (1996) cointegration test with structural break, they found evidence of long-run relationship in Korea, Malaysia, Thailand, Indonesia, the Philippines and Japan and detected a structural break during the period between 1996-98 which correspond with the Asian financial crisis. However, in Singapore there is no evidence of long-run relationship, implying that there is the absence of twin deficits phenomena. Granger causality tests reveal that fiscal deficits Granger-cause current account deficits in Indonesia, Korea, Malaysia, the Philippines and Thailand. Also, there is evidence that current account deficit Granger-cause fiscal deficit in Malaysia. However, there is no evidence of twin deficits in both Singapore and Japan. Besides, there is evidence that investment Granger-cause the current account deficits in Singapore, Thailand, Indonesia, and the Philippines.

Daly and Siddiki (2009) investigate whether or not government fiscal deficits and real interest rates have a long-run relationship with current account deficits in 23 OECD countries[3] using cointegration analysis with structural breaks. The study started by examining the time series properties of the variables, and found that the current account deficits, the fiscal deficits and the real interest rates have a unit root. They found evidence of long-run relationship in seven countries (Austria, Australia, Greece, Iceland, Ireland, Italy and Spain)[4]. However, using the Gregory and Hansen (1996) cointegration test with structural break, there is evidence of long-run relationship in 12[5] out of 23 countries. From, this results, it is evident that cointegration are altered when structural break is permitted. They argued that there is a tendency to discover cointegration more often when structural breaks are not permitted, but in their study when structural breaks were not permitted fewer cointegration were discovered than when regimes shifts were permitted. They concluded that earlier studies which did not allow for structural breaks may have been methodologically biased in favour of supporting the Ricardian Equivalence Hypothesis (REH).

Grier and Ye (2009) re-examine the twin deficits in the United States largely because previous studies have failed to account for structural breaks. The variable they used for their study includes current account deficits, fiscal deficits and the real

[3]The countries included in the study are; Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and USA.

[4]Spain is the only country where the sign of the coefficient on the fiscal deficits is contrary to the Keynesian expectation.

[5]The 12 countries where cointegration is found includes; Austria, Australia, Denmark, France, Greece, Iceland, Ireland, Luxembourg, New Zealand, Norway, Portugal and Spain.

interest rate ranging from 1948:1-2004:1. In testing for unit root with structural breaks, they used Bai and Perron (2003) multiple structural breaks and found that fiscal deficits and current account deficits are stationary around the breaks. The study revealed that there is the presence of two breaks in the current account deficits and it occurs in 1982Q4 and 1999Q2, while there is the presence of one break in fiscal deficits and it occurs in 1974Q2. In considering the long-run relationship, the authors argued that if the series are related in the long run, secular changes in fiscal deficits should be related to secular changes in the current account deficits. Comparing the number of the breaks and the timing of the breaks, first, the two series have different numbers of breaks; there is one break in the fiscal deficits and two breaks in the current account deficits. Second, the timing of the break differs. They pointed out if truly the fiscal deficit is the driving force behind the current account deficits, the number of the breaks should be the same and that the break dates should be close. Based on the above, they conclude that there is no long run relationship between the US current account deficits and fiscal deficits. Using the impulse response function and the variance decomposition, there is evidence that the fiscal deficit is significant and positively related with the current account deficits. Also, changes in real interest rates have a lesser impact on the current account, this point to the fact that the interest rate has a weak relationship to the twin deficits. They conclude that there is a family resemblance in the short and no twin deficits in the long run.

Holmes and Panagiotidis (2009) examine the behaviour of the U.S. current account for the 1960q4-2007q2. They employed three variables namely; export expressed as a percentage of net output, import expressed as a percentage of net output and the current account also expressed as a percentage of net output. The Saikonnen and Lutkepohl (2002) endogenous structural break test found evidence that all the series were stationary at first difference and that time of the break coincides with the effects of Tokyo round aimed at removing non-tariff barriers. Using the Johansen (1995) and Johansen et al (2000) that accounts for structural breaks, results show that there is evidence in favour of a long-run relationship between export and import. Examining the non-linearity of the current account, the asymmetric short-run dynamics shows that adjustment towards long-run equilibrium between exports and imports is driven by US exports responding to current account deficits.

Holmes, Panagiotidis and Sharma (2011) examine the sustainability of India's current account for the period 1950-2003. The variables employed in their study include; imports expressed as a percentage of GDP, exports expressed as a percentage of GDP and the current account deficits expressed as a percentage of GDP. Using four unit root tests namely; the ADF, the Phillip-Perron, the Breitung (2002) and Breitung and Taylor (2003), and Lanne et al. (2002) and Saikkonen and Lutkepohl

(2002) that is robust to structural breaks. There is evidence that both imports and exports are integrated of order one. The timing of the break is in 1958 for both exports and imports, and the date coincides with the period of overvalued rupee and high inflation period of the 1950s. Using a recursive procedure two regime was identified, and they are 1950-1989 and 1990-2003. The parametric and nonparametric tests for cointegration reveal evidence of cointegration in the 1990s, and this is the period of liberalization of the Indian economy. However, in the first regime there is no evidence of current account sustainability.

Makin and Narayan (2012) re-examine the relationship between fiscal deficits and foreign borrowing in Australia for the period 1983:1-2009:1. They employed three variables in their model namely; budget imbalance expressed as a percentage of GDP, foreign borrowing as a percentage of GDP and real trade weighted exchange rate. Evidence of structural breaks where seen when the series were plotted, based on this evidence the recently developed two-break unit root test of Narayan and Popp (NP, 2009) were used. They considered two different models; first, a model that allows for two breaks in the level called M1, second, a model that allows for two breaks in both level and slope called M2. Conducting both tests on the three series, they found that foreign borrowing, fiscal deficits and real exchange rate are all integrated of order one. The Gregory and Hansen (1996) and the Hatemi-J (2008) test for one and two structural break co-integration tests were performed on net borrowing, fiscal deficits and real exchange rate since they were characterized by unit root. Based on the Gregory and Hansen (1996) one break cointegration test and the Hatemi-J (2008) two break cointegration tests there is clear evidence of long-run relationship between the three variables. They also found that the break dates reflects important dates in Australia. They argued that the break of mid-1980s coincides with significant structural reforms among which are abolition of exchange rate controls and financial deregulation while the early 1990s break coincides with the beginning of inflation targeting policy and that the early 2000s break coincides with the global recession, causing huge capital outflow thereby leading fall in Australian dollar. The authors also examine the long-run elasticity impact of fiscal deficits, and real exchange rate on foreign borrowing and found that a 1 per cent increase in fiscal deficits lead to about 10 per cent increase in foreign borrowing, and a 1 per cent an appreciation of the exchange rates lead to about 27 per cent increase in net borrowing. The error correction term is negative and statistically significant, implying that the system adjusts back to equilibrium following a shock.

Kalou and Paleologou (2012) re-examine the twin deficits hypothesis in Greece for the period 1960-2007. The kernel of their study is using multivariate Vector Error Correction Model (VECM) by including the endogenous break dates to determine

the causal relationship between the fiscal deficits and current account deficits. In their study, they employed the indirect relationship between the twin deficits by employing four variables namely, budget deficit as a percentage of GDP, short-term interest rate, nominal effective exchange rate and the current account deficits as a percentage of GDP. They begin their estimation by examining the time series of the variables and found that all the series are stationary only in their first differences. The Lanne, Lutkepohl and Saikkonen (2002, 2003) endogenous break test revealed that the variables were stationary in their first differences and that the break dates correspond with significant happenings in Greece. First, 1974 break is due to the oil crisis; second, 1981 is due to Greece's EU accession; third, in 1986 attributed to a dramatic increase in the current account deficits that almost lead Greece into bankruptcy and lastly, in 1990 due to the liberalization of the Greek banking sector. Using, the both test of the Johansen cointegration test, there is evidence of long-run relationship between the twin deficits. The error correction term of the budget deficits equation is significant at 5 per cent level of significance, implying that there is a long-run relationship through the ECT, from the short-term interest rate, exchange rate and the current account deficits to the budget deficits; this implies that causality runs from the current account deficits to fiscal deficits. They concluded that there is evidence for the Current Account Targeting Hypothesis (CATH) in Greece and this can be explained by the fact that Greece is a debtor country and high debt to GDP ratio.

Fifth, Katircioglu, Fethi and Fethi (2009), Holmes, Otero and Panagiotidis (2010a), Holmes, Otero and Panagiotidis (2010b), Magazzino (2012) among others explore the relationship between fiscal deficits and current account deficits using panel data and attain divergent conclusions.

Katircioglu, Fethi and Fethi (2009) examine the twin deficits hypothesis in 24 small island states[6] for the period 1970-2004.The main objective of their study is to focus on the roles and direction of twin deficits which they see as the drawback for economic growth and development in these economies. The variables used in their study include; budget deficits as a percentage of GDP and current account deficits as a percentage of GDP. Using panel econometrics approach, they examine the unit root properties using Levin, Lin and Chu (LLC) (2002), Im, Pesaran and Shin (IPS) (2003) and Maddala and Wu (M-W) (1999) approaches. The panel unit root test revealed that the null hypothesis of the presence of unit root was rejected;

[6]The small island states includes Bahamas, Barbados, Comoros, Dominica, Fiji, Grenada, Cyprus, Iceland, Malta, Mauritius, Papua New Guinea, Dominican Republic, Haiti, St Lucia, Solomon Islands, Sri Lanka, St. Vincent and the Grenadines, Seychelles, Madagascar, Maldives, Tonga, Trinidad and Tobago, Vanuatu and New Zealand.

this implies that the series were stationary at levels. Examining the direction of causation using the bivariate causality approach, the results suggest that there is evidence of uni-directional causality from current account deficits to fiscal deficits. They concluded by saying that foreign trade dependency and overall budget balance are needed for a sustainable long-term growth.

Holmes, Otero and Panagiotidis (2010a) examine the sustainability of the fiscal deficits in thirteen EU countries using annual data for the period 1971-2006 and the fiscal deficits variable is expressed as a percentage of the GDP. The study used the Hadri and Rao (2008) AR-based bootstrap technique that allows to test for the presence of cross-sectional dependence among the countries in the panel and the identification of structural breaks which previous studies have omitted. Results show that the EU fiscal deficits are stationary irrespective of whether they are member of the union or not. They suggest that in the long-run fiscal prudence is not only limited to the EU countries.

Holmes, Otero and Panagiotidis (2010b) examine the stationarity of the current account in thirteen European countries and eight non-European union countries. The sample period considered is 1975q1-2005q4 and the current account deficits is expressed as a percentage of the gross domestic product. The main kernel of their study is to allow for the presence of cross-sectional dependencies which has been neglected on panel stationarity of the current account deficits. Using the Hadri (2000) AR-based bootstrap approach that account for both serial correlation and cross-sectional dependency, their results show that the current account deficits of the European union countries are sustainable in the long-run. Also, the EU countries were categorized into the following; i) EU-6 based on the founding states i.e. Germany, France, Italy, Belgium and Luxembourg excluding the Netherlands; ii) EU-9 after the 1973 expansion; iii) EU-12 after the 1981 and 1986 expansion; iv) EU-15 after the 1995 expansion of the member states. Results show that evidence is weaker in favour of current account deficits stationarity for the largest EU panel or the non-EU panel. They concluded that the strongest evidence is limited to the core, more established EU members while countries outside or those that newly joined the union, are regarded as unsustainable and may also put the workings of the EU under pressure.

Magazzino (2012) explores the relationship between fiscal deficits, current account deficits and private consumption in 33 European countries using annual data for the period 1970-2010. The objective of their study is to examine empirically the validity of the Keynesian theory concerning twin deficits and Ricardian Equivalence Hypothesis (REH), and this is governed by the choice of variables included in the model. The variables employed includes; current account balance expressed as a

percentage of GDP, private consumption expressed as a percentage of GDP, fiscal deficits as a percentage of GDP, government consumption as a percentage of GDP, public debt as a percentage of GDP, GDP growth and population growth. Results show that a one per cent increase in the fiscal deficits will worsen the current account deficits by 21 per cent and this is consistent with the twin deficits phenomena. Also, a one per cent rise in fiscal deficits is associated with 21 per cent in private consumption. The author also used both the difference GMM and the systems GMM. The difference GMM shows that the lags of current account deficits are significant and also that the fiscal deficits past values affect the current account deficits supporting the twin deficits hypothesis, but the systems GMM does not show any evidence that the lags of public deficits affect the current account deficits. Also, the lagged values of fiscal deficits affect the private consumption by a rise of 11 per cent for difference GMM while systems GMM indicates that the past values of fiscal deficits does not affect private consumption. Granger causality tests reveal that there is a bi-directional causality between fiscal deficits and current account deficits in four countries, a uni-directional causality from fiscal deficits to current account deficits in seven countries, a uni-directional causality from the current account deficits to fiscal deficits in six countries, and there is no presence of a causal relationship between fiscal deficits and current account deficits in thirteen countries.

Sixth, Holmes (2011) examines the relationship between the current account and budget balances in the US for the period 1947:1-2009:4. The main contribution of the study to the twin deficits literature is that asymmetric cointegration was employed. He argue that the possible reasons for lack of consensus provided in the twin deficits literature is that many studies employed cointegration analysis, without addressing the issue of structural breaks or regime change. The study employed the Hansen and Seo (2002) threshold cointegration approach where the short-run dynamics comprises of two regimes based on a threshold in the size of the lagged error correction term. The study begins by examining the time series properties of the series, and found that the fiscal deficits and the current account deficits were stationary in their first differences. Employing the Perron (1997) endogenous structural break test, it was revealed that the fiscal deficit is stationary around the break, while the current account deficit is stationary at first difference. Also, symmetric long-run relationship was examined using the Engle-Granger (1987) and the Phillips-Ouliaris (1990), and at best long-run relationship achieved using the Phillips-Ouliaris (1990) at 10 per cent level of significance. Holmes argue that the major reason for the presence of low test power is failure to account for structural break. Based on this limitation, the Gregory and Hansen (1996) cointegration test with structural break was used to examine the long-run between fiscal deficits and current account deficits and found

evidence of long-run relationship. Assessing the evidence of threshold, they used the sup LM test. The results point to the presence of threshold cointegration with a test statistic of 28.4. Also, the results point to a threshold -based cointegrating relationship between the fiscal deficits and the current account deficits linked by a positive long-run coefficient of 0.42. Implying that 1 per cent increase in the fiscal deficits leads to 42 per cent increase in the current account deficits and this consistent with the Keynesian theory on twin deficits. The error correction term in the model is statistically significant in the usual regime, implying that the variables adjust back to the system.

Thus, overall, the empirical evidence on the twin deficits is inconclusive. This occurred for many reasons. For example, the methodology used to analyse the above issue varied from well-specified theoretical models to using simple one-to-one relationships between the budget deficit and current account deficit. Milne (1977), Bernheim (1988), Abell (1990), Darrat (1988), Zietz and Pemberton (1990), Islam (1998), Egwaikhide (1999), Salvatore (2006), Kearney and Monadjemi (1990), Arora and Dua (1993), Rosensweig and Tallman (1993), Islam (1998), Khlalid and Guan (1999), Bachman (1992), Baharumshah, Lau and Khalid (2006), Digboolu (1997), Vamvoukas (1999), Lau and Tang (2009), Mohammadi and Mosrefi (2012), Baharumshah and Lau (2009), Daly and Siddiki (2009), Grier and Ye (2009), Makin and Narayan (2012), Holmes (2011) and Magazzino (2012) among others found evidence to support the Keynesian view that fiscal deficits Granger-causes current account deficits. By contrast, Anoruo and Ramchander (1998), Onafowora and Owoeye (2006), Marinheiro (2008), Marashdeh and Saleh (2006), Katircioglu, Fethi and Fethi (2009) and Kalou and Paleologou (2012) found evidence to support the Current Account Targeting Hypothesis (CATH) where current account deficits Granger-causes fiscal deficits. Enders and Lee (1990), Khalid and Guan (1999), Kaufmann, Scharler and Winckler (2002), Corsetti and Müller (2006) and Kim and Roubini (2008) among others found no evidence for the link between the twin deficits.

From the above review, it is observable that the results are inconclusive, and these can be explained by the difference in the choice of methodology, use of different time frame and that structural break and regime shift were ignored except on few studies in the US and Asian countries. There is no study to the best of our knowledge who has examined twin deficits and account for structural breaks in African countries. A major gap filled in this study is that the structural breaks ignored in earlier studies were considered using the Lee and Strazicich (2003) test which is superior that the one used by Marashdeh and Saleh (2006). We also used a uniform time which is from 1980-2009, and during these periods all the countries of choice tends to move towards a flexible exchange rate (see Ahmad et al 2011). Another major gap be filled

in this study is on the possibility that there exist threshold effect and regime change behind any long-run relationship and short-run dynamics involving fiscal deficits and current account imbalances.

2.3.2 Fiscal Deficits and Inflation

The theoretical literature has argued that fiscal deficits lead to inflation [see Patinkin (1965); Friedman (1968); Sargent and Wallace (1981): Miller (1983); among others]. However, empirical examination of the relationship between fiscal deficits and inflation has not reached a consensus.

For purposes of clarity, the empirical literature reviewed in this chapter is classified into three. In the first part, we discuss empirical evidence from developed countries. The second part discusses empirical evidence from developing countries. The third part discusses empirical evidence based on panel data for both developing and developed countries.

First, empirical studies in developed countries (Hamburger and Zwick, 1981; Dwyer, 1982; Ahking and Miller, 1985; King and Plosser, 1985; Giannaros and Kolluri, 1986; Protopapadakis and Siegel, 1987; Hondroyiannis and Papapetrou, 1994; Darrat, 2000) have not yielded conclusive results on the deficit–inflation relationship.

Hamburger and Zwick (1981) examine the relationship between fiscal deficits and money growth in the United States for 1954-1976. The choice of variables included in the model estimation is governed by the Barro money supply model, and they are; fiscal deficits as a percentage of GNP, unemployment, government expenditure and money growth. Their results indicate that fiscal deficits have a significant positive impact on money growth and hence on inflation.

Using a VAR model to capture the dynamic interactions between fiscal deficits and inflation for the United States, Dywer (1982) employs six variables namely; the level of prices, the level of national income, the nominal quantity of money, the three-month treasury bill interest rate, the nominal quantity of government debt held by the Federal Reserve and the nominal quantity of government debt held by the public for the period 1952:1-1978:4. The author investigates three possible explanations of the link between fiscal deficits and inflation. The first, is that a deficit increases prices through a wealth effect, second, that a deficit results in the Federal Reserve purchasing debt, thereby resulting in increases in the money supply and prices and third, that expected inflation increases the deficit. Results from the VAR model show that there are no wealth effects from changes in government debt; thus there is no effect of debt on inflation. Also, there is no evidence that persistent fiscal deficits increase prices, government spending, interest rates and money supply. In contrast,

evidence is found that debt issued by the government and held by the public is a function of past inflation rates.

Ahking and Miller (1985) estimate a trivariate VAR model for government deficits, money growth and inflation in the United States for three sub-samples; 1950:2-1960:4, 1961:1-1970:4 and 1971:1-1980:3. Granger causality tests indicate that for the first and third sub-samples, all the variables are casually related. This implies that for the first and third sub-samples fiscal deficits are inflationary. However, for the second subsample there is no feedback relationship between fiscal deficits and inflation, but both fiscal deficits and inflation Granger-cause money growth. Using the variance decomposition to validate the Granger causality test, results indicate that deficit cause inflation in both the first and third sub-sample periods but not in the second period.

King and Plosser (1985) investigate the government deficit-seigniorage relationship for the post war period 1953-1982 for the United States. A VAR model is used to capture dynamic interactions between fiscal deficits and seigniorage. They employ four variables; the money supply as a percentage of GDP, deficits as a percentage of GDP, government debt as a percentage of GDP and government consumption expenditure as a percentage of GDP. The results show little evidence of a relationship between government deficits and seigniorage. To make cross-country comparisons King and Plosser (1985) also investigate connections between government deficits and factors that determine inflation for twelve countries[7] for the period 1948-1980. The results reveal no significant positive relationship between government deficits and seigniorage except for Argentina, Chile, Mexico and Brazil. Examining the dynamic interaction between fiscal deficits and seigniorage, only six countries[8] where used because of lack of data. They find no significant positive relationship from government deficits to money supply in five out of the six countries considered. The only country where there is evidence of a relationship is Switzerland. The authors conclude that fiscal deficits and the money supply in these countries are independent.

Giannaros and Kolluri (1986) examine the proposition that government fiscal deficits lead to increase in money growth and excessive money growth lead to higher inflation rate for ten developed countries.[9] The variables considered in their study

[7]The twelve countries include the United Kingdom, France, West Germany, Italy, Switzerland, Japan, Spain, Argentina, Brazil, Chile, Mexico and Korea.

[8]The six countries used are; the United Kingdom, France, West Germany, Switzerland, Italy and Japan.

[9]The developed countries considered in their studies includes; United Sates, Canada, Japan, United Kingdom, West Germany, France, Italy, Netherlands, Belgium and Switzerland for the period 1950-1981. The sample period for Belgium and Japan is from 1955-1981 and 1951-1981 for Italy.

include; fiscal deficits as a percentage of the GDP, the money supply as a percentage of GDP, the consumer price index and government expenditure as a percentage of GDP. The estimated money supply equation shows that fiscal deficits are a significant determinant of the money supply in the US, Belgium and Japan. The results also show that only in Japan do increases in government spending have a significant impact on money growth. The direct and the indirect relationships between fiscal deficits and inflation are examined in the inflation equation, and the results reveal that increases in government deficits leads to price inflation in four (Italy, Netherlands, Switzerland and the US) countries. Concerning the direct relation between money growth and inflation, the results indicate that money supply leads to inflation only in Italy and the US. The authors conclude that the differences between the US and other developed countries are a "reflection of different institutional structures and different policy priorities of these countries" Giannaros and Kolluri (1986) pp. 415.

Protopapadakis and Siegel (1987) investigate whether money growth and inflation are related to government deficits for ten developed countries[10] for the period 1952-1983. Three variables are included in the study; debt as a percentage of GNP, the money supply as a percentage of GNP and inflation. Tests reveal that government deficits are not related to money growth, but there is weak evidence that money growth is related to inflation.

Hondroyiannis and Papapetrou (1997) examine the direct and indirect effects of budget deficits on inflation in Greece for the period 1957-1993. The variables considered include; the money supply, the consumer price index and budget deficits as a percentage of GDP. There is evidence of a positive long-run relationship between inflation and money supply. The results reveal that a 1 per cent increase in the money supply will lead to an increase of 1.25 per cent in the price level. Examining the direction of causation, the result indicates that there is a unidirectional causality from the money supply to inflation. The indirect effects of budget deficits on inflation are examined whether an increase in fiscal deficits leads to money supply and increases in the money supply leads to inflation. Using the error correction model; the results reveal that all the estimates were statistically significant except the estimates of the deficits. Based, on this results the authors conclude that there is a strong indirect effect of fiscal deficits on inflation and that there is an absence of a direct relationship between fiscal deficits and inflation.

Darrat (2000) re-examines whether budget deficits are inflationary in Greece for the period 1957-1993. The variables employed include; the money supply, the con-

[10]The ten developed countries includes; Canada, Finland, France, Germany, Holland, Italy, Japan, Switzerland, the United Kingdom and the United States

sumer price index and the budget deficits as a percentage of GDP. The study criticizes the results of Hondroyiannis and Papapetrou (1997) (HP thereafter) denying any direct impact of fiscal deficits on inflation. They argue that their evidence lacks weight due to modelling and estimation problems. First, the study re-examines the time series properties of the series and found that the price level is not stationary at first difference I(1), but rather stationary at second difference I(2). They further argue that the first difference of the price level and the levels of the money supply and fiscal deficits ought to be included when examining the long-run relationship. Another flaw noted in the study of HP is that when examining the long-run relationship, they omit the fiscal deficit, whereas the main focus is on whether deficits are inflationary. Thus, the study re-examine cointegrating relationship among the three variables using the Johansen-Juselius cointegration test and found that there is one cointegrating relationship between fiscal deficit, the money supply and the price level. The study also conducts the long-run exclusion test to check whether any variable does not belong to the system, and the test shows that all the three variables belong to the system. Third, the study also argues that in estimating the error-correction model one lag period was used for all the variables, rather the Hendry general-to-specific approach was used to obtain a more parsimonious model and also to solve the problem of multicollinearity. Using this approach, all the variables included in the model were all significant and the estimate of fiscal deficits is positive and statistically significant. This implies that there is a direct relationship between fiscal deficits and inflation as opposed to the results of HP. .

Second, empirical investigations for developing countries, include; De Haan and Zelhorst (1990), Choudhary and Parai (1991), Ghartey (2001), Tekin-Ozmen (2003), Wolde-Rufael (2008), Oladipo and Akinbobola (2011), also record inconclusive results on the deficits-inflation relationship.

De Haan and Zelhorst (1990) investigate the impact of government deficits on money growth in 17 developing countries[11] for the period 1961-1985. The variables considered in the model are; the debt-GNP ratio, the deficit-GNP ratio, real GNP growth, inflation rate and the money supply as a percentage of GNP. Using a VAR, the results show that government fiscal deficits do not affect the money supply in most of the countries, except in four countries, El-Salvador, India, Malaysia and Pakistan where fiscal deficits have a negative significant relationship with money growth. The study also indicates that fiscal deficits have a positive significant relationship with inflation during acute inflation periods.

[11] The 17 developing countries included in the study are; Columbia, Dominican Republic, Ecuador, El Salvador, Greece, Guatemala, Honduras, India, Korea, Malaysia, Nepal, Pakistan, Peru, Philippines, Sri Lanka, Thailand and Venezuela.

Choudhary and Parai (1991) explore the role of fiscal expansions on inflation in Peru for the period 1973:1-1988:1. The quarterly data observations included in the model are the consumer price index, narrow money supply and government deficits. The results reveal that large fiscal deficits and money supply have positive and significant impact on inflation. The study gave two policy implications that emerge from the study, first, in order to check high inflation rates in Peru government need to reduce the level of her participation by privatizing public enterprises. Second, that the Peruvian experience of near hyper-inflation and huge fiscal deficits would send a signal to newly democratic countries in South America and Eastern Europe that democracy by itself could not solve economic problem unless concrete and immediate actions are taking to install private initiatives in every sphere of economic life.

Ghartey (2001) examines macroeconomic instability and inflationary financing in Ghana for the period 19 70:2-1992:4. The motivation behind their study is that Ghana went through an Economic Recovery Programme (ERP) in 1988 which led to liberalization and privatization of government enterprises. The recovery programme has resulted to persistent inflation and depreciation which have not yielded the desired results. The variables considered in the study include; the log of the nominal monetary base, credit claims of the private sector, the price level, real output, the exchange rate and the budget deficit as a percentage of GDP. Granger causality tests reveal that the money supply growth Granger-causes inflation and also there is evidence of bi-directional causality between fiscal deficits and inflation. One can therefore, conclude that inflation in Ghana is as a result of monetary authorities printing money to finance her deficits. The multivariate cointegration test reveals that there is evidence of long-run relationship among all the variables included in the model. The error-correction term of the VECM is correctly signed and statistically significant, indicating adjustment towards long-run equilibrium. Employing both the impulse response function and the variance decomposition to gather more information of the on the short-run and long-run dynamics of the data. The impulse response functions show that an increase in fiscal deficits leads to an increase in both the money supply and the price level. The variance decomposition reveals that innovations in fiscal deficits own shock account for about 65 per cent and 18 per cent of variance in fiscal deficits is due to the price level. Also, innovation in the price level own shock account for 6 per cent and innovation in money supply explained about 67 per cent. This finding further corroborates earlier findings that the money supply growth Granger-cause inflation. The study concludes that seigniorage as a source of revenue to finance fiscal deficits should be curtailed as it crowds out private investment and reduces the level of growth.

Tekin-Koru and Ozmen (2003) examine the long-run relationship between budget

deficits, inflation and monetary growth in Turkey for the period 1983:1-1999:4 using two alternative trivariate models corresponding to the narrowest and the broadest monetary growth. The first model includes fiscal deficits, the price level and currency in circulation, the Johansen cointegration test reveals that there is one cointegration relationship in the system. The LR exclusion test shows that the fiscal deficit is statistically insignificant, implying that the cointegrating vector explains long-run monetary growth-inflation relationship with fiscal deficits having no significant role. The second model where fiscal deficits, inflation and the broad money supply are considered reveals that there are two cointegrating relationship. The LR long-run exclusion test shows for the first cointegrating vector all the variables except fiscal deficits are significant, which implies that long-run is only between inflation and broad money growth. The second cointegrating vector shows that broad money growth increases with fiscal deficits and inflation. In conclusion, it shows that no direct relationship exists between fiscal deficits and inflation in Turkey, but that an indirect relationship does exist.

Wolde-Rufael (2008) examines the causal relationship between fiscal deficits, money growth and inflation in Ethiopia for the period 1964-2003.The variables employed in the study includes; fiscal deficits as a percentage of GDP, the consumer price index and money growth as a percentage of GDP. Using four cointegration approaches; the Autoregressive Distributed Lag (ARDL) of Pesaran et al (2001), the Dynamic Ordinary Least Squares (DOLS) of Stock and Watson (1993), the Fully Modified Ordinary Least Squares (FMOLS) and the Johansen cointegration for two models, where narrow money (M1) and broad money (M2) were included separately in each model. The four approaches show that there is evidence of long-run relationship between fiscal deficits and inflation. By contrast, fiscal deficits do not have any significant effect on inflation in the short-run in both models. However, the error correction term was correctly signed and statistically significant. The significance of the error correction term implies that deviations from the system adjust back to equilibrium. Granger causality tests show that fiscal deficits Granger-cause inflation in both models and there are no evidence of reverse causation. Also, evidence is found that the money supply (M1 and M2) Granger causes inflation and there is no evidence that fiscal deficits Granger cause the money supply. He argues that the non-causality relation found between fiscal deficits and money growth suggests that monetary and fiscal policies are independent. Also, variance decomposition was used to ascertain the Granger causality test, and there is strong evidence that shocks in fiscal deficits account for about 43 to 65 per cent variance in inflation and this is in conformity with the Granger causality test that causation is from fiscal deficits to inflation. The study conclude that government should improve the tax collection

system so as to reduce the inflationary pressure due to fiscal deficits.

Oladipo and Akinbobola (2011) examine the causal relationship between fiscal deficits and inflation in Nigeria for the period 1970-2005. Investigating the causal relationship they used four variables; fiscal deficits as a percentage of the GDP, the consumer price level, the real exchange rate and the real GDP growth. Results show that there is evidence of one cointegrating relationship among the macroeconomic variables in the system. Granger causality test reveals a unidirectional causality from fiscal deficits to inflation and no evidence of reverse causation. The study also shows that the gross domestic product and the exchange rate have a causal effect on inflation, with causation from GDP to inflation; and the exchange rate to inflation. They concluded that since there is evidence of unidirectional causality from fiscal deficits to inflation, the government of Nigeria should employ a mix of fiscal policy instrument, monetary policy, industrial policy and commercial policy to achieve sustainable growth and development.

Third, studies on panel data for both developed and developing countries among which include; Karras (1994), Cottarelli, Griffiths and Moghadam (1998), Loungani and Swagel (2001), Domac and Yucel (2005), Catao and Terrones (2005), Kwon, Mcfarlane and Robinson (2009) and Lin and Chu (2013) also have conflicting results.

Karras (1994) investigates the effects of fiscal deficits on money growth, inflation, investment and real output growth in 32 developed and developing countries using annual data for the period 1950-1989. The results suggest that fiscal deficits have no significant relationship with money growth. He argues that deficits are "generally not monetized and therefore, they do not produce inflation through monetary expansion" (Karras 1994, pp. 208). Findings from the study show that; first, deficits are not inflationary, but money growth has a significant effect with inflation. Second, deficits have a negative significant relationship with the growth rate of real output, and third, persistent and large deficits crowd-out investment.

Cottarelli, Griffiths and Moghadam (1998) examine the determinants of inflation in 47 countries for the period 1993-1996. They employed ten variables; the consumer price index, the current account deficits, fiscal deficits, the import ratio, the fixed exchange rate regime, wage indexation, government securities market, independence of central bank, problems in the banking system and domestic government debt. The results suggest the following; first, government deficits have a significant effect on inflation. Second, wage indexation has no significant effect on inflation. Third, there is no evidence that current account deficits affect inflation. Fourth, central bank independence and fixed exchange rate regime have a significant effect on inflation.

Loungani and Swagel (2003) examine the sources of inflation in 53 developing countries for the period 1964-1998. Using panel VAR, they estimate the model con-

sisting of oil price growth, non-oil commodity price growth, the output gap, money growth, exchange rate growth and past realizations of inflation. The findings suggest that money growth and exchange rate explain about two-thirds of the variance of inflation at both short-run and long-run periods. There is also evidence that inflation expectations play a dominant role in the inflation process in these economies. Performing a sensitivity analysis, where the impact of shocks to fiscal deficits on inflation were examined, the results suggest that deficits matter much more when they are large and conclude that an increase in fiscal deficits leads to a statistically significant increase on inflation.

Domac and Yucel (2005) investigate the causes of inflation in fifteen emerging market economies[12] for the period 1980-2001. The variables employed in their study include; the consumer price index, the output gap, changes in food production index, a democracy indicator (measured as the weighted average on the competitiveness of political participation), regime durability, government deficits as a percentage of GDP, and net private capital flows as a percentage of the GDP. Results indicate that increases in the output gap, the food production index and persistent fiscal deficits are factors that trigger inflation in these economies. The study concludes that to achieve single digit inflation necessary for sustainable growth in these countries; there should be a reduction in government consumption expenditure and also that policy that will improve food production should be employed.

Catao and Terrones (2005) investigate whether fiscal deficits are inflationary in 107 countries for the period 1960-2001. The 107 countries are grouped into developed, developing, low-inflationary and high-inflationary countries. Examining the effects of budget deficits, GDP and the money supply on inflation; results indicate that fiscal deficits are inflationary in both developing and high-inflation economies and that fiscal deficits are not inflationary in low-inflation and developed economies.

Kwon, Mcfarlane and Robinson (2009) investigate the relationship between fiscal policy, money growth and inflation in 71 countries for the period 1963-2004. The kernel of their study is that rather than focussing on the effect of budget deficits in determining inflation and inflation expectations, the focus is on the effect of public debt on inflation. The variables considered in their study include; the logarithm of consumer price index, the logarithm of the money stock, the logarithm of public debt and the logarithm of real GDP. Using both the dynamic fixed effect and the difference GMM, the results show that there is evidence of a strong and stable positive effect of public debt on inflation in developing countries but not in developed countries. A per cent increase in government debt will lead to a 0.2 per cent increase in inflation

[12]The fifteen emerging market economies include; Argentina, Brazil, Columbia, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, Philipines, South Africa, Thailand, Turkey and Venezuela.

for developing countries, and a 1 per cent increase in public debt will lead to 0.01 per cent increase in inflation for developed countries. Also, the study sub-divided the 57 developing countries into high debt economies and low debt economies; the results show that public debt growth has a significant effect on highly indebted developing countries. Using annual data for the period 1980-2004, the variables considered in their study include; the real GDP, the money supply, the consumer price index, public debt and the exchange rate. The results show that public debt significantly determines inflation in Jamaica and that the price level is positively affected by both the money supply and public debt. The results for Jamaica are consistent with the panel data estimates for developing countries that government debt significantly affects inflation.

Lin and Chu (2013) examine the fiscal deficit-inflation relationship in 91 countries[13] for the period 1960-2006. The variables considered in their model include; inflation measured as the annual change in the consumer price index, fiscal deficits as a percentage of narrow money, fiscal deficits as a percentage of GDP,[14] the annual change in the money stock, annual change in the real GDP per capita, the annual change in oil prices, openness measured as the ratio of annual imports plus exports to GDP and the exchange rate regime[15]. The study is made-up of 4 groups. Group 1 includes all the 91 countries, group 2 includes 81 countries with the exchange rate regimes, group 3 consist of 24 OECD countries and group 4 is made-up of 67 non-OECD countries. Investigating the relationship between fiscal deficits and inflation in the first group for the period 1960-2006, using Dynamic Generalized Method of Moment (DGMM) and Dynamic Panel Quantile Regression (DPQR) from 1-9 quantiles; where fiscal deficits are expressed as a percentage of narrow money, they find that the effects of current and lagged deficits are positive implying that fiscal deficits are inflationary. The DPQR estimates from quantiles 1-9 also increase regularly in magnitude and significance. This implies that fiscal deficits are inflationary in high-inflation episodes and less in low-inflation episodes. Investigating the relationship between fiscal deficits and inflation, several control variables were included in the model, and this includes; oil price inflation, openness, growth and the exchange rate regime index for all the countries in group 1. The results show that deficits have a positive impact on inflation and increases steadily along with quantiles. The DGMM and DPQR estimates of the real GDP per capita are all negative, implying that there

[13]The 91 countries comprise of 24 OECD countries and 67 non-OECD countries.

[14]Fiscal deficits expressed as a percentage of GDP is used to test the robustness of the empirical results and the results revealed that deficits-to-GDP ratio is much higher than those using a deficit-to-M1 ratio.

[15]The exchange rate regime index ranges from 1 (extreme inflexibility) to 6 (extreme flexibility).

is an inverse relationship between growth and inflation. Also, the estimates of oil price inflation for both the DGMM and DPQR are all positive and increase consistently along the quantiles, this implying that oil price shock is an inflationary factor. The estimates of trade openness for DGMM and DPQR are all negative and the negative relationship is stronger in high inflation episodes and weaker in low-inflation episodes.

Exploring the relationship between fiscal deficits and inflation using group 2, where exchange rate regimes is included. The DGMM and DPQR estimates show that fiscal deficits are inflationary after controlling for exchange rate regime. Additionally the DGMM and DPQR estimates for exchange rate regime are all positively related to inflation and statistically significant. Considering the third group, where 24 OECD are included in the model, the results show that the DPQR estimates for deficits are all positively related to inflation along the quantiles; estimation of 67 non-OECD countries revealed that the estimates for fiscal deficits for both DGMM and DPQR are positively related to inflation, implying the fiscal deficits are inflationary in developing countries. More importantly, the DPQR estimates of fiscal deficits increase steadily along with the quantiles in magnitudes and significance. The difference between the OECD and non-OECD is that estimates of fiscal deficits on inflation in DPQR are homogeneous across quantiles in OECD countries and heterogeneous across quantiles in non-OECD countries. The study concludes that the reasons why the fiscal deficits estimates are heterogeneous in non-OECD countries may be because of low taxable capacity, political instability, less independent central bank and limited access to domestic and external debt financing which resulted in printing of money to finance their deficits.

A possible reason for the lack of consensus in the literature is that several methodologies have been used. Most studies examine the unit root properties of fiscal deficits and inflation with a focus on the presence of a long-run, causality testing etc. Other authors used a single equation while other used system of equations to examine the dynamic interactions between fiscal deficits and inflation, thus empirical literature offers mixed evidence and the results are inconclusive. A key aspect of this is that previous studies assume symmetry, that is, they have employed cointegration analysis, but have not adequately addressed issues of structural breaks or asymmetric cointegrating relationships. This remains a major gap to be filled in the empirical literature for African countries. Thus, this study considers the possibility that there exist asymmetric adjustment towards long-run relationship.

Table 2.1: Empirical Studies of Budget Deficits and Current Account Imbalance

Study	**Sample**	**Country**	**Methodology**	**Findings**
Milne (1977)	1960-1975	38 countries	OLS	There is a positive and significant relation between fiscal deficits and trade deficits.
Bernheim (1988)	1960-1980	US, UK, Canada, West Germany, Mexico & Japan	OLS	There is evidence that fiscal deficits worsen the current account deficits, but there is evidence that fiscal deficits improves the current account deficits in Japan.
Zietz and Pemberton (1990)	1972:4-1987:2	US	Simultaneous equation	Fiscal deficits affect the trade deficits through domestic absorption rather than the real interest rates and the real exchange rates.
Egwaikhide (1999)	1973-1993	Nigeria	OLS	Budget deficits worsen the trade balance.
Salvatore (2006)	1973-2005	G-7 countries	GLS	Lagged fiscal deficits lead to current account deficits.
Darrat (1988)	1960:1-1988:4	US	Granger Causality	Evidence of bi-directional causal relationship between the twin deficits.
Islam (1998)	1973-1991	Brazil	Granger Causality	Evidence of bi-directional causal relationship between the twin deficits.
Kouassi, Mougoue & Kymn (2004)	Different years	10 developed & 10 developing	Granger Causality	No evidence of causation found in developed countries except only in Italy where causation is from current account deficits to fiscal deficits. For developing countries there is evidence of causation from fiscal deficits to current account deficits.

Table 2.2: Empirical Studies of Budget Deficits and Current Account Imbalance (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Abell (1990)	1979:I-1985:II	US	VAR	Fiscal deficits influence trade deficits and causation is from fiscal deficits through the interest rate and exchange rate to the trade deficits.
Enders & Lee (1990)	1947:III-1987:I	US	VAR	No evidence of twin deficits, but government spending generate a persistent current account imbalance.
Kearney & Monadjemi (1990)	1972:I-1987:IV	8 developed Countries	VAR	There is existence of a temporary twin deficits relationship.
Bachman (1992)	1974:I-1988:IV	US	VAR	Federal government surplus Granger cause the current account deficits
Rosenweig & Tallman (1993)	1961:I-1989:IV	US	VAR	Fiscal deficits lead to a decline in the real exchange rate and innovations in the real exchange rate is associated with trade deficits.
Anoruo & Ramchander (1998)	1957-1993	5 ASEAN Countries	VAR	Trade deficits Granger cause fiscal deficits in all the countries of study.
Kaufmann, Scharler & Winckler (2002)	1976:I-1998:IV	Austria	VAR	There is no evidence of twin deficits
Corsetti & Miller (2006)	1979:I-2005:III	US,UK, Canada & Australia	SVAR	In UK and Canada there is evidence of twin deficits, while in the US and Australia there is evidence of twin divergence

Table 2.3: Empirical Studies of Budget Deficits and Current Account Imbalance (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Baharumshah, Lau & Khalid (2006)	1976:I-2000:IV	4 ASEAN Countries	Granger Causality	There is evidence of a bidirectional causality between the twin deficits in Malaysia & Philippines, while fiscal deficits Granger cause the current account deficits in Thailand, and in Indonesia, the current account deficits Granger cause the fiscal deficits.
Kim & Roubini (2008)	1973:I-2004:I	US	VAR	Expansionary deficits shock improves the current and depreciates the real exchange rate.
Dibooglu (1997)	1960:I-1994:IV	US	Cointegration Technique	There is evidence of a long-run relationship between the twin deficits.
Khalid & Guan (1999)	1950-1994	5 developed & 5 developing countries	Cointegration Technique	There is presence of a long-run relationship between the twin deficits in developing countries and no evidence of a long-run relationship in developed countries.
Vamvoukas (1999)	1948-1993	Greece	Cointegration Technique	Evidence of long-run relationship and causality is from fiscal deficits to trade deficits.
Alkswani (2000)	1970-1999	Saudi Arabia	Cointegration Technique	There is evidence of a long-run relationship between the twin deficits and causality is from trade deficits to fiscal deficits.
Leachman & Francis (2002)	1948:I-1992:II	US	Cointegration Technique	The twin deficits is cointegrated and the direction of causation is from fiscal deficits to current account deficits.
Onafowora & Owoeye (2006)	1970-2001	Nigeria	Cointegration Technique	There is presence of a long-run equilibrium relation between the twin deficits, and that the trade deficits Granger cause the fiscal deficits.

Table 2.4: Empirical Studies of Budget Deficits and Current Account Imbalance (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Marinheiro (2008)	1974-2003	Egypt	Cointegration Technique	There is evidence of a long-run relationship between the twin deficits and causality runs from trade deficits to fiscal deficits.
Lau & Tang (2009)	1996:I-2006:II	Cambodia	Cointegration Technique	There is evidence of a long-run relationship and evidence of a bi-directional Granger causality.
Mohammadi & Mosrefi (2012)	Different years	4 ASEAN Countries	Cointegration Technique	There is evidence of long-run relationship in favour of all the four countries.
Marashdeh & Saleh (2006)	1970-2004	Lebanon	Structural breaks & Cointegration	Trade deficits has a long-run impact on budget deficits.
Baharumshah & Lau (2009)	1980:I-2006:4	7 ASEAN Countries	Structural breaks & Cointegration	There is evidence of a long-run relation only in Korea, Malaysia, Thailand, Indonesia, the Philippines and Japan, but not in Singapore.
Daly & Siddiki (2009)	Different years	23 OECD Countries	Structural breaks & Cointegration	Evidence of long-run relation between the twin deficits in 12 out of the 23 countries considered.
Grier & Ye (2009)	1948:I-2004:I	US	Structural breaks & Cointegration	There is no evidence of a long-run relationship between the US government deficits and current account deficits, but in the short-run there is a family resemblance.

Table 2.5: Empirical Studies of Budget Deficits and Current Account Imbalance (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Makin & Narayan (2012)	1983:I-2009:I	Australia	Structural breaks & Cointegration	There is evidence of a long-run relation between the twin deficits.
Kalou & Paleologou (2012)	1960-2007	Greece	Structural breaks & Cointegration	Fiscal deficits have a long-run relationship with the current account deficits, and causation is from current account deficits to fiscal deficits.
Katricioglu, Fethi & Fethi (2009)	1970-2004	24 small island states	Panel Granger Causality	There is evidence of a unidirectional causality from the current account deficits to fiscal deficits.
Magazzino (2012)	1970-2010	33 European countries	GMM	Fiscal deficits affect the current account deficits.
Holmes (2011)	1947:I-2009:IV	US	Threshold cointegration	There is evidence of a threshold-based cointegrating relationship between the fiscal deficits and the current account deficits.

Table 2.6: Empirical Studies of Budget Deficits and Inflation

Study	**Sample**	**Country**	**Methodology**	**Findings**
Hamburger & Zwick (1981)	1954-1976	US	OLS	Fiscal deficits have a positive significant impact on money growth.
Dywer (1982)	1952:I-1978:IV	US	VAR	There is evidence that debt issued by the government and held by the public is a function of past inflation rates.
Ahking & Miller (1985)	1959:II-1980:IIII	US	VAR	There is evidence that fiscal deficits are inflationary.
King & Plosser (1985)	1953-1982	US	VAR	Little evidence of a signif relationship between government deficits and seigniorage.
King & Plosser (1985)	1948-1980	12 Countries	VAR	There is a significant and positive relation between fiscal deficits and seigniorage only in Argentina, Chile, Mexico and Brazil.
Giannaros & Kolluri (1986)	Different years	10 developed countries	OLS & 2SLS	Fiscal deficits is a significant determinant of money supply in US, Belgium and Japan.
Protopapadakis & Siegel (1997)	1952-1983	10 developed countries	OLS	Fiscal deficits is not related with money growth, but there is a weak evidence that money growth is related to inflation.

Table 2.7: Empirical Studies of Budget Deficits and Inflation (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Hondroyiannis & Papapetrou (1997)	1957-1993	Greece	Cointegration technique	There is evidence of a positive long-run relation between inflation and money supply.
Darrat (2000)	1957-1993	Greece	Cointegration technique	There is a cointegrating relationship between fiscal deficits, money supply and inflation.
De Haan & Zelhorst (1990)	1961-1985	17 developing countries	VAR	Fiscal deficts have a positive significant relation with inflation during acute inflation periods.
Choudhary & Parai (1991)	1973:I-1988:I	Peru	VAR	Large fiscal deficits and high growth rates have positive and significant impact on inflation.
Ghartey (2001)	1970:II-1992:IV	Ghana	Granger Causality	There is evidence of a bi-directional causal relation between fiscal deficits and inflation and a uni-directional causality from money growth to inflation.
Tekin-Koru & Ozmen (2003)	1983:I-1999:4	Turkey	Cointegration technique	There is a long-run cointegrating relation between fiscal deficits, money growth and inflation.
Wolden- Rufael (2008)	1964-2003	Ethiopia	Cointegration technique	There is evidence of a long-run relationship between fiscal deficits and inflation.
Oladipo & Akinbobola (2011)	1970-2005	Nigeria	Granger Causality	There is evidence of a uni-directional causality from fiscal deficits to inflation.

Table 2.8: Empirical Studies of Budget Deficits and Inflation (Cont'd)

Study	**Sample**	**Country**	**Methodology**	**Findings**
Karras (1994)	1950-1989	32 developed & developing countries	Panel data regression	Fiscal deficits have no significant relation with money growth.
Cottarelli, Griffiths & Moghadam (1998)	1993-1996	47 developing countries	Panel data regression	Government deficits have significant effect on inflation.
Loungani & Swagel (2003)	1964-1998	53 developing countries	Panel VAR	Increase in fiscal deficits lead to a significant increase on inflation.
Domac & Yucel (2005)	1980-2001	15 emerging market economies	Pooled probit	Increases in output gap, food production index and persistent fiscal deficits triggers inflation.
Catao & Terrones (2005)	1960-2001	107 Countries	Panel data Regression	Fiscal deficits are inflationary in both developing and high inflation economies, but not in low- inflation and developed economies.
Kwon, Mcfarlane & Robinson (2009)	1963-2004	71 Countries	GMM	There is evidence of a strong and stable positive effect of public debt on inflation in developing countries, but not in developed countries.
Kwon, Mcfarlane & Robinson (2009)	1980-2004	Jamaica	VAR	Inflation is affected by both money supply and public debt.
Lin & Chu (2013)	1960-2006	91 countries	DPQR	Fiscal deficits are inflationary in both developing and high inflation economies, but not in low-inflation and developed economies.

Chapter 3

Data and Stationarity

3.1 Introduction

Prior to any econometric analysis of time series, it is necessary to examine the stationarity properties of the variables. This is because economic activity is subject to changes such as change in government policy, currency crisis and war. Many econometric techniques are based on the assumption that the mean and variance are constant over time, this implies they are applicable only to stationary series. By contrast, for a non-stationary series the mean and variance change over time, this implies that it does not have the tendency to return to a long-run deterministic path and the variances of the series are time dependent. Therefore, the inclusion of a non-stationary series in a standard classical estimation context might lead to a spurious regression, interpretation of which is meaningless.

The traditional Augmented Dickey-Fuller and Phillips-Perron unit root tests are used to assess the order of cointegration. The major weakness of these tests is failure to reject the unit root hypothesis if the series has a structural break. This implies that series that are found to be I(1) may in fact be stationary around the structural break; that is, I(0) but mistakenly classified as I(1). Perron (1989) shows that failure to allow for break leads to a bias that reduces the ability to reject a false unit root hypothesis. To overcome this problem, Perron proposed allowing for a known or exogenous structural break in the Augmented Dickey-Fuller (ADF) tests. Based on the short coming of this approach, Zivot and Andrews (1992) and Perron (1997) propose determining the break point 'endogenously'. Lumsdaine and Papell (1997) extended the Zivot and Andrews (1992) model to accommodate two structural breaks. However, Lee and Strazicich (2003) criticized the endogenous break point tests for their treatment of breaks under the null hypothesis. Lee and Strazicich

(2003) propose a two break minimum Lagrange Multiplier (LM) unit root test for structural breaks both under the null and the alternative hypothesis that do not suffer from the spurious rejection of the null hypothesis.

The objective of this chapter is to examine stationarity and structural breaks for fiscal deficits, current account imbalance, real interest rates, real exchange rate, real gross domestic product and inflation rates in selected African countries. Emphasis is on the Augmented Dickey-Fuller (ADF) and the Phillip-Perron (PP) unit root tests, as well as the Lee and Strazicich (2003) two break test. The remaining part of the chapter is structured as follows; data and its sources are discussed in section 3.2. This is followed by data definition in section 3.3 while stylised facts of the selected countries are discussed in section 3.4. The Augmented Dickey-Fuller and Phillip-Perron tests are discussed in section 3.5. Section 3.6 considers structural break test while section 3.7 applies the data to the Augmented Dickey-Fuller test and Phillip-Perron test and section 3.8 applies the Lee and Strazicich two break testing procedures.

3.2 The Data and Sources of Data

The data set is obtained from the International Financial Statistics (IFS), Government Finance Statistics (GFS) and the Balance of Payment Statistics (BOPS) of the International Monetary Fund as well as the World Bank Development Indicators. The fiscal deficits[1] and the current account balance consist of annual observations sourced from GFS and BOPS respectively, the gross domestic product is from the World Bank Development Indicator and the series is also annual. The interest rate, the exchange rate and the inflation rate were quarterly data from IFS.

Due to the non-availability of quarterly data for the fiscal deficits, the current account balance and the gross domestic product, the series were interpolated to derive quarterly data from the available annual data. The interpolation method used in this study can be found in the works of Lisman and Sandee (1964), Goldstein and Khan (1976), Wymer (1979), Suliman (1995) and Moosa (1995). Suliman (1995) explained that there exist a number of methods to generate quarterly data from annual observations. He classified them into those which require and use the existence of time series at quarter and annual frequencies and those which depend on numerical methods. The first method is based on regression techniques, and the idea is to use annual series to estimate a regression of Y on X and then use the estimated

[1]For some countries where the fiscal deficits variable is not available, we used the fiscal deficits reported by the Central Banks of these countries.

coefficients to predict the quarterly series of the dependent variable Y. However, this method seems simple and straightforward but is subjected to a lot of problems; one of these is that the structure of the error term of the annual observation regression may be so complicated (due to measurements error, omitted variables etc.) as to put the estimates reliability at stake. Another problem is the difficulty in the selection of explanatory variables which are based totally on data availability rather than on theory (Suliman 1995). Based on the above, we use the numerical methods to generate quarterly series for this study. The advantage of this method is that it does not require the use of additional variables nor do they use it and as such any errors that might exist in the additional data will not be transmitted to the quarterly data to be estimated.

Equation (3.15) is used to generate the quarterly data for fiscal deficits, current account balance and the gross domestic product using the standard techniques in EVIEWS.

One major advantage that interpolated data series has over the aggregated data is that a more precise analysis of the condition of an economy is achieved, making it easier to anticipate changes and react to them, while in aggregated data, it is quite possible that a distorted view of parameters values, lag structures and seasonal components could be reached and as a consequence, poor models and or forecasts could be obtained and wrong decision taken, hence the choice of quarterly data.(see Casals et al 2008; Zellner et al 1971; Lutkepohl 1984; & Nijman & Palm 1988).

3.3 Data Definition

(i) The fiscal deficit (FD)is constructed, and it is the difference between total revenue and total expenditure and expressed as a percentage of the gross domestic product.

(ii) The current account balance (CAB) is the sum of the balance of trade (exports minus imports of goods and services), net factor income (such as interest and dividends) and net transfer payments (such as foreign aid) and expressed as a percentage of the gross domestic product.

(iii) The real exchange rate is constructed from the nominal exchange rate using $RER_t = E_t + P_t^* - P_t$,(all variable are in logs) where RER_t is the real exchange rate, E_t is the nominal exchange rate, P_t^* foreign prices (the foreign prices is taken to be that of the US), P_t, is the domestic prices from IFS line AE 616

(iv) The real interest rate (RIR) employed here is the lending rate minus the inflation rate, we use lending interest rate because in some countries, both the short

term and long term interest rates were not available and where they are available the series are not complete. The lending rates is from IFS ZF 60

(v) The inflation rate ($INFR$) is the quarterly percentage changes in consumer prices from IFS line AE 64

(vi) The gross domestic product (GDP) is expressed in log, and they are in real values.

All data are transformed to their growth rates, and their frequency is quarterly. The sample period runs from 1980 to 2009 making a total of 120 observations. The sampled countries include Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia, and Uganda. The criteria for choosing these countries were based on the size of gross domestic product which accounted for about 75 per cent of African countries GDP, availability of data, relative economic and financial development, presence of capital market and that the majority of these African countries operate a flexible exchange rate regime (see Ahmad, Pentecost and Harvey 2011).

3.4 Stylized Facts

There are twelve African countries covered in this study; Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia and Uganda. The fiscal deficits and the current account balances are both expressed as a percentage of the GDP for the study period 1980Q1-2009Q4. The current account deficits in all the countries under study surpassed 5 per cent critical level, it was in Botswana and Ethiopia, Nigeria and Tunisia were there was a current account surplus, and it was around the early nineties, and this can be attributed to increase in their export. There was a slight improvement for countries like Botswana, Nigeria, Morocco, in the late nineties and early 2000; this is partly due to the increase in the price of diamond for Botswana and increase in the price of barrels of crude oil for Nigeria because of the gulf war which made prices of crude oil rise. However, in 2006-2008 all countries have a current account deficits, and it was above the 5 per cent critical level majorly because of the global recession which engulfed all countries of the world.

The fiscal deficits expressed as a percentage of the GDP also have a somewhat similar trend for the countries under study. In Botswana, the fiscal deficits were all positive throughout the period only in 2007 and 2008 were it was negative, and this was because of the decline in revenue from diamond. However, during the early nineties Nigeria and Cameroon also have a sharp increase in the fiscal deficits and nosedive in 2007 partly because of the recession of 2008. In other countries, the

fiscal deficits were huge, and a thing of concerns because expenditure is greater than the tax revenue. One major problem which developing countries (African countries inclusive) faced is the inadequate and inefficient tax collection system which made most corporate firms and companies evade tax which ought to have contributed to the tax revenue of these economies, it is strongly recommended that government of these economies should pursue prudent fiscal policies that will enhance income generation.

Over the sample period from 1980-2009 average annual inflation rates across the twelve countries was around 14 per cent and this was unequally distributed across the countries, low inflation countries with single digit inflation (Cameroon 5 per cent, Morocco 5 per cent and Tunisia 6 per cent) and high inflation countries with double digit inflation (Ghana 34 per cent, Nigeria 21 per cent, Tanzania 16 per cent and Uganda 40 per cent). The main cause of which is both the fiscal and monetary issues, as well as poor performance of the agricultural sector. For example in Ghana, the most prevalent source of inflation is the increase in the money supply, between 1996 and 1997 inflation rate stood at 25% and 40% respectively. Another crucial factor responsible for the failure to control inflation is the devaluation of the currency and the poor performance of the agricultural produce.

The average growth rate of all the twelve economies was about 4.3 per cent, with Botswana with the outstanding performance of about 7.1 per cent, followed by Uganda with 6 per cent and Egypt with approximately 5 per cent per annum. Nigeria's average growth rate was approximately about 3.4 per cent, there was no evidence of steady growth, the only period where there is an upward growth was in 2003, where it grew from 1.5 per cent in 2002 to about 10.3 per cent and later nosedived to 7 per cent in 2009. However, South Africa which appears to be the most developed economy in the sample, had the lowest average growth rate of about 2.4 per cent. This group of countries are predominantly agricultural economies, with the exception of South Africa where agriculture makes up just 2.7 per cent of GDP in 2005, and finance, real estate and business services represent about 21.1 per cent of GDP in 2005. Mining, mostly of diamonds, accounts for about one-third of Botswana GDP, more than 50% of total export earnings and around 50% of government revenues. The 2008-09 global economic crisis hit demand for diamonds, with production down by some 50% to 17.73 million carats in 2009. That year, the GDP share of mining dropped to 28.3% from 36.5% in 2008.

Nigeria also had a significant growth both in the mining and the agricultural sector. The agricultural sector represents about 37.2 per cent of GDP in 2009 and employed about 70 per cent of the labour force. The mining sector makes up of about 29.8 per cent of GDP and 95 per cent of export. However, there is a decline in

the mining sector from 39 per cent in 2005 to 29.8 per cent of GDP in 2009, mainly because of violent uprising in the Niger Delta region of the country. Agriculture however is the leading sector for the other economies, in 2009 agriculture made up of 23 per cent of GDP of Cameroon and employed about 70 per cent of the labour force, and the service sector represents about 22 per cent of her GDP and employed about 17 per cent of the labour force in 2001. It accounted for 30 per cent of GDP in Ghana in 2005 and 56 per cent of the labour force; it was 47 per cent of GDP and employed about 85 per cent of the labour force. However, in Kenya, Tanzania and Uganda agriculture made up of 23 per cent, 28 per cent and 22 per cent of GDP respectively and employed approximately 75 per cent, 80 per cent and 82 per cent of the labour force for Kenya, Tanzania and Uganda respectively. In Morocco, the manufacturing sector accounted for about 32 per cent and employed about 20 per cent of the labour force while the service sector represents 51 per cent of GDP and employed about 56 per cent of the labour force. However, in Tunisia, the service sector accounted for 55 per cent of GDP and employed about 50 per cent of the labour force; and the manufacturing sector represents about 35 per cent of GDP and employed about 32 per cent of the labour force.

African countries have since the collapse of the generalized fixed exchange rate regime and the adoption of a generalized floating system by the industrialized countries in 1973, experimented with various types of exchange rate arrangements, ranging from a peg to a single currency, weighted currency basket, managed floating, independently floating exchange rate system and monetary zone arrangements, such as the CFA Franc Zone and the Common Monetary Area (CMA) of Southern Africa. The experiences of various African countries with the exchange rate arrangements and management have, therefore, been diverse and varied as these countries have sought to find an "optimal and sustainable" exchange rate regime. Indeed, exchange rate management and determining an optimal and sustainable exchange rate arrangement have been some of the policy challenges facing many monetary authorities in African countries. As part of the reforms of these economies over the period 1980-2009 there has been a gradual movement towards exchange rate flexibility, occasioned with financial liberalization in the mid-1980s and mid-1990s moving to a more flexible exchange rate except Botswana that remained pegged to the South Africa rand. Also, majority of these economies experienced structural reforms which gave rise to greater fiscal discipline, privatization and commercialization of public enterprise, as well as liberalization of trade and financial services.

3.5 Unit Root Test

If a series is non-stationary in a regression, then all the regression results suffer from spurious regression problem (see Bai & Perron 1998; 2003). To avoid this problem, the study begins the analysis with prior determination of unvaried properties of the time series. Thus, the data set used in this analysis was subjected to the standard Augmented Dickey-Fuller (ADF) and Philip Perron (PP) tests.

3.5.1 The Augmented Dickey-Fuller (ADF) Test

Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger set of time series models. The ADF takes the form;

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta_0 X_{t-1} + \sum_{i=1}^{k} \beta_i \Delta X_{t-i} + \eta_t \tag{3.1}$$

Where Δ is the first difference operator; t is the time trend; k denotes the number of lags used and η is the error term; α_s and β_s are parameters. The null hypothesis that series X_t is non-stationary can be rejected if β_0 is statistically significant with a negative sign.

3.5.2 The Phillips-Perron (PP)Test

The PP test differs from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric auto- regression to approximate the autoregressive moving average structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression. The PP tests are specified as;

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta_0 X_{t-1} + \eta_t \tag{3.2}$$

Where Δ is the first difference operator; t is the time trend; and η is the error term; α_s and β_s are parameters. The null hypothesis that series X_t is non-stationary can be rejected if β_0 is statistically significant with a negative sign.

3.5.3 Unit Root with Trend Cases

When testing for unit roots, it is crucial to specify the null and alternative hypotheses appropriately to characterize the trend properties of the data. The two most common

trend cases are summarized below,

Case I: Constant Only

The test regression is given as;

$$y_t = c + \phi y_{t-1} + \varepsilon_t \tag{3.3}$$

this includes a constant to capture the nonzero mean under the alternative.

The hypotheses to be tested are

$H_0 : \phi = 1 \Longrightarrow y_t \sim I(1)$ without drift

$H_1 : |\phi| < 1 \Longrightarrow y_t \sim I(0)$ with nonzero mean

This formulation is appropriate for non-trending financial series like interest rates, exchange rates, and spreads.

Case II: Constant and Time Trend

The test regression is given as;

$$y_t = c + \delta t + \phi y_{t-1} + \varepsilon_t \tag{3.4}$$

and this includes a constant and deterministic time trend to capture the deterministic trend under the alternative. The hypotheses to be tested are

$H_0 : \phi = 1 \Longrightarrow y_t \sim I(1)$ with drift

$H_1 : |\phi| < 1 \Longrightarrow y_t \sim I(0)$with deterministic time trend

This formulation is appropriate for trending time series like asset prices or levels of macroeconomic aggregates like real GDP.

3.6 Structural Break Tests

In this section emphasis is on the unit root test subject to two endogenously determined structural breaks of Lee and Strazicich (2003)[2]. The minimum Lagrange Multiplier (LM) unit root test proposed by Lee and Strazicich (2003) not only endogenously determines structural breaks but also avoids the problems of bias and spurious rejections which other tests are criticized of. Furthermore, the Lee and Strazicich (2003) procedure corresponds to Perron's (1989) exogenous structural break (Model C) with change in the level and the trend. Lee and Strazicich's (2003) model allows for two endogenous breaks both under the null and the alternative hypothesis. They

[2]The methodology on the structural breaks is from Lee and Strazicich (2003)

show that the two-break LM unit root test statistic which is estimated by the regression according to the LM principle will not spuriously reject the null hypothesis of a unit root.

To avoid problems of bias and spurious rejections, the study utilizes the endogenous two breaks LM unit root test derived in Lee and Strazicich (2003). The two-break minimum LM unit root is described as follows. According to the LM (score) principle, a unit root test statistic can be obtained from the following regression:

$$\Delta y_t = d'\Delta z_t + \phi \tilde{S}_{t-1} + \sum \gamma_i \Delta \tilde{S}_{t-i} + \varepsilon_t \tag{3.5}$$

where $\tilde{S}_t$ is a de-trended series such that $\tilde{S}_t = y_t - \tilde{\psi}_x Z_t \tilde{\delta}, t = 2, ...T$. δ is a vector of coefficients in the regression of Δy_t on Δz_t and $\tilde{\psi}_x = y_1 - z_1\tilde{\delta}$, where z_t is defined below; y_1 and z_1 are the first observation of y_t and z_t respectively, and Δ is the difference operator. ε_t is the contemporaneous error term and is assumed independent and identically distributed with zero mean and finite variance. $\Delta\tilde{S}_{t-i}, I = 1, ...k$, terms are included as necessary to correct for serial correlation. z_t is a vector of exogenous variables defined by the data generating process. Corresponding to the two-break equivalent of Perron's (1989) Model C, with two changes in level and trend, z_t is described by $(1, t, D_{1t}, D_{2t}, DT^*_{1t}, DT^*_{2t})'$, where $D_{jt} = 1$ for $t \geq T_{BJ} + 1$, $j = 1, 2$,and zero otherwise, $DT^*_{jt} = t$ for $t \geq T_{BJ} + 1$, $j = 1, 2$, and zero otherwise, and T_{BJ} stands for the time period of the breaks. The LM unit root tests statistics is given by: $\tau = t$-statistics for testing the null of a unit root ($\phi = 0$). To endogenously determine the location of two breaks $\left(\lambda_j = \frac{T_{BJ}}{T}, j = 1, 2\right)$, the minimum LM unit root for selecting all plausible break points for the minimum statistic is as follows;

$$LM_\tau = Inf_\lambda \tilde{\tau}(\lambda) \tag{3.6}$$

Since the critical values for Model C depend on the location of breaks (λ_j), the critical values that correspond to the location of the breaks were utilised . To implement the test, the number of augmentation terms $\Delta\tilde{S}_{t-i}, I = 1, ...k$, that correct for serial correlation in Eq. (3.14) were first determined. At each combination of break points $\lambda = (\lambda_1, \lambda_2)$ in the time interval $[0.1T, 0.9T]$ (to eliminate end points), where T is the sample size, k was determined by following a "general to specific" procedure. Starting with a maximum number of lagged first-differenced terms max $k = 8$ and examine the last term to see if it is significantly different from zero at the 10% level (critical value in an asymptotic normal distribution is 1.645). If insignificant, the maximum lagged term is dropped and the model re-estimated with $k = 7$ terms and so on, until either the maximum term is found or $k = 0$, at

which point the procedure stops. This technique has been shown to perform well as compared to other data-dependent procedures that select the number of lagged augmented terms. Advantages of the two-break minimum LM unit root test can be summarized as follows. First, the break points are endogenously determined from the data. Second, test is not subject to spurious rejections in the presence of a unit root with break(s). Third, when the alternative hypothesis is true and spurious rejections are absent, Lee and Strazicich (2003) demonstrate that the two-break minimum LM test has greater or comparable power to the LP test.

3.7 Unit root test results

The Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests are reported in Tables 3.1 and 3.2 respectively. The ADF test shows that the real GDP and the current account balance were significant at levels for some countries and examining their first differences they were found to be less significant. It was decided to test the series using the PP test because they are robust to general forms of heteroskedasticity in the error term. Table 3.2 shows that for Botswana, Cameroon, Egypt, Ethiopia, Morocco, Nigeria, Tanzania and Uganda the real GDP, fiscal deficits, current account balance, the real interest rate and the real exchange rate show strong evidence of a stochastic trend but proved to be significant in their first differences.

Results for Ghana indicate the real GDP, fiscal deficits, the real interest rate and the real exchange rate rejected stationarity at levels, but failed to reject stationarity in their first differences. However, the current account balance is significant at level. Results for Kenya, indicates that all the series were significant in their first differences, but the real interest rates is significant at levels.

Results for South Africa show the real GDP, fiscal deficits, the real exchange rate, and the real interest rate reject the null hypothesis of a unit root in their first differences, and also reject the null hypothesis of a unit root in their levels for the current account balance. In Tunisia, the null hypothesis of a unit root was rejected at levels for fiscal deficits while the real GDP, current account balance, real exchange rate, and the real interest rates were all significant at their first differences. For all the countries under study, the inflation rate was significant in their first differences, except Egypt and Tanzania where they are significant at levels.

3.8 Structural Breaks Test Results

One of the main concerns in this study is the implications of structural breaks on unit roots. Given the inability of standard ADF and PP to capture the impact of structural breaks, to circumvent this, the LM (2003) two breaks test which has greater or comparable power to the Lumsdaine and Papell test was used and the result is presented in Tables 3.3 to 3.14

In Botswana and Egypt, all the series indicate that there is no additional evidence against the null hypothesis of a unit root compared to the PP tests, except for Egypt where the inflation rate is significant at levels. However, in Ghana and Cameroon the series were all significant at level. In Ethiopia, the two-break LM test results shows that the current account balance, the real interest rates and inflation rate were all significant at levels, whereas the PP test shows they were all significant in their first differences. Also, in Kenya and South Africa the two break tests result shows that all the series were significant at levels, except the current account balance for Kenya and the fiscal deficits for South Africa. Similar results were also reported in Morocco, Nigeria, Tanzania and Uganda, where the PP test suggests that all the series are I(1), but the LM two-break test shows that in Morocco, the fiscal deficits and real exchange rates are I(0), in Nigeria fiscal deficits and real interest rates are I(0), in Tanzania income and fiscal deficits were I(0) series and in Uganda income, inflation rate and the real interest rates were all I(0) variables. In Tunisia, the traditional unit root reported that it is only the fiscal deficits that are significant at level; however the LM two-break test showed that it is income and the real exchange rate that were not significant at levels. The LM structural break model finds additional evidence of no unit root in some countries, and this is contrary to the results given by ADF and PP unit root tests. This shows that the ADF and PP tests suffer from power deficiencies when there is a structural break in the data. The structural break dates were shown to have taken place mostly around the late eighties and nineties and this period is identified by various external shocks, as well as changes in the institutional framework. Other reasons might be traced to the volatility of oil prices, deregulation of the financial sector, exchange rate regime changes, global recession and devaluation of the currency all of which may cause non-stationarity of economic variables.

3.9 Timing of the Structural Breaks

This section explores the timing of the LM two structural breaks test for the twelve countries considered in the study. The test revealed that majority of the break dates are around the 1980s and the 1990s. Results indicate that structural changes coincide

with a host of significant event for the study period 1980-2009. However, the events can generally be categorised as;

- Economic reforms of the late 1980s
- Civil unrest
- Elections
- Economic booms and recession.

However, in interpreting this result significant issue to consider is the lags between announcement of a policy and any actual changes which might occur in the economy. In addition to the timing of the breaks, we also explain in brief the component of the GDP of each countries as well as the genesis of the external debt crisis.

Tables 3.23-3.34 below gives a number of significant events in each country that could correspond with the break points identified by the LM two structural breaks test.

3.9.1 Botswana

Botswana is a public sector driven economy with consistent sound macroeconomic policy and good governance. Since independence in 1966 there has been tremendous progress in the economy, it has one of the fastest growths in the world and a negligible amount of foreign debt. The impressive growth recorded in Botswana is traced to the huge revenue generated from diamond mining, and thus fiscal surplus and current account surplus were recorded, it was during the recent global economic crisis where the growth rate nosedive, and also deficits were recorded.

Due to the efficient use of the revenue generated from diamond mining and a cautious foreign policy, which in turn fuelled growth and development, the Botswana did not qualify for the IMF and the World Bank loan.

Concerning the timing of the break, the LM two structural break test for the gross domestic product, the fiscal deficits, the current account deficits and the interest rate signal evidence of structural breaks during the economic boom characterized by large revenue from the proceed of diamond mining. The exchange rate signal evidence of the structural breaks during the period of elimination of the exchange rate control of 1999 and the currency devaluation of 2005. The inflation rate also suggests that the structural break occurred during the election of Ketumile Masire in 1989, and also because of the introduction of trade liberalization in 2001.

3.9.2 Cameroon

Cameroon is a country that is rich in both mineral resources and agriculture. Both the mining sector and the agricultural sector helped the economy to record an appreciable and sustainable growth. In 2001, the mining sector accounted for about 9 per cent of the GDP and generated almost half of her export earnings.

However, the economy suffered a setback during the period 1987-1993 largely because of the decline in oil production, and fall in the prices of major commodity exports coupled with an astronomical increase of about 40 per cent in the real effective exchange rate of the CFA Franc. This economic crisis led to a fall in per capita GDP, price instability, high level of unemployment, thus resulting into external borrowing.

An attempt to reverse this ugly trend, the government of Cameroon looked inward by cutting her expenditure, increase tax; privatize state-owned enterprises, all of which is backed by the IMF and the World Bank.

The timing of breaks reveals that all the variables considered support evidence of structural breaks during the economic reforms era and the devaluation of the CFA in 1994. There is also evidence that the conduct of election in 1996 and 2007 have a significant impact on the break dates for the GDP and the fiscal deficits respectively.

3.9.3 Egypt

Egypt pursued a public-sector driven economy during the period 1950-1990, and this is characterized by import substitution policies and ownership of major sectors of the economy, which led to a resilient and dominant role of government enterprises. During the period, the economy did well owing to dramatic increase in the price of oil. However, the decline in oil prices, higher interest rates and drastic fall of economic activities in the 1980s resulted into bail out of the Egyptian government by the IMF and the World Bank.

Due to this external shock crisis, there was a collapse of the export price of crude oil from \$34 to \$12 per barrel in 1986. Followed with this were huge fiscal deficits and current account deficits and this paved way for amassing external debt. In between, 1980-1990, her external debt rose from \$22.1 billion to \$31.1 billion. Also, the inflation rate rose to more than 20 per cent and the level of unemployment also rose to about 10 per cent by the year 1990.

Responding to the crisis, the Egyptian government approached the IMF and the World for a bail out, and in May 1991 the structural adjustment programme came into being. The economic reform embarked upon by the Egyptian government during the period 1991-2007 thus creates more role for the private sector involvement in this economy and were all tailored to meet the conditionality of their lenders and donors.

As touching the timing of the breaks in Egypt, the two break test for the gross domestic product variable indicates structural breaks during the period of economic reforms of the IMF and the World Bank. The fiscal deficits and the current account deficits show evidence of structural breaks during the external debt crisis while the real exchange rate, the real interest and inflation rate shows evidence of structural breaks both during the external debt crisis and the economic reforms period.

3.9.4 Ethiopia

The republic of Ethiopia is predominantly an agrarian economy which account for about 42% to GDP and with more than 80% of exports and employs 80% of the working population. Coffee is the major agricultural commodity export and provides about 65 per cent of foreign exchange earnings in the 1980s but fell to about 26 per cent in the mid-1990s because of increase in other exports.

The agriculture sector of Ethiopia agriculture is beset by soil degradation, periodic drought, deforestation, poor and underdeveloped water resources as well as poor transport system, thus, making it difficult and expensive to get the agricultural produce to the market.

However, owing to the dependent on agricultural commodity product for her foreign exchange earnings, there was an economic recession in the 1990s, which culminated into lower growth rates, distortion of macroeconomic stability. This makes the government to embark on economic reforms among which includes privatization of state owned enterprises, reducing government spending and the rationalization of government regulation. It should be noted, that despite economic reforms, there is little foreign direct investment and the government is still largely involved in the economy.

Regarding the timing of the breaks, the gross domestic product, the fiscal deficits, the current account deficits, the real exchange rates, the real interest rates and the inflation rate indicates evidence of structural breaks during the economic recession of the 1990s. There is also evidence that the conduct of election of 2005 influence the gross domestic product. The cross border war of 1998-2000 with Eritrea also has significant impact on the fiscal deficits and inflation. There is considerable evidence that the economic reforms of 1999-2005 also impacted on the current account deficits, the interest rates and the inflation rate.

3.9.5 Ghana

Ghana is an economy that is endowed with rich and relatively diverse natural resources. Among the natural resources endowed with are diamonds, oil, gold, manganese ore and bauxite. Despite the oil and mineral wealth, agriculture remains a mainstay of the economy, accounting for more than one-third of GDP and generates about 55% employment. Cocoa is the main cash crop and generates about one-third of export earnings. Ghana's primary cash crop is cocoa, which typically provides about one-third of all export revenues. Other products include timber, coconuts and other palm products, shea nuts, and coffee.

However, due to collapse of cocoa prices in the 1960s there was an economy recession in Ghana which culminated into huge external debts, macroeconomic imbalances such as price instability, large fiscal deficits, unsustainable current account deficits, and low level of growth. Coupled with the recession is the political instability with series of coup for over seventeen years.

In April 1983, the Rawlings' government embarked on an austerity and structural adjustment programme supported by the IMF and the World Bank. The aim of the programme is to maintain fiscal prudence, and this includes budget cuts, removal of subsidies, enhanced tax collection and introduction of cost saving measures. On the monetary side, there was a contractionary monetary policy involving high interest rates to curtail the level of money stock. Also, implemented by the Rawlings' government is the income policy where there was a limit to the public wage bill; institutional reforms which involves retrenchment, and redeployment of labour and the transfer of state owned enterprise into private enterprise.

Concerning the timing of the breaks in Ghana, the LM two structural break tests for the gross domestic product, the fiscal deficits, the current account deficits, the inflation rate, the exchange rate and the interest rate indicates evidence structural breaks during the period of economic reforms of the IMF and the World Bank. There is also evidence that the conduct of election in 1992 impacted on the fiscal deficits while the current account deficits show signs of structural break during the economic recession period in Ghana prior to the introduction of the structural adjustment programme.

3.9.6 Kenya

Kenya is an economy that is endowed with a relatively diverse and rich in natural resources. The service sector contributes about 60 per cent of GDP while the contribution of industry and commerce are put at 16.7 per cent of the GDP and the agriculture sector accounts for 23.8 per cent of the GDP. Principal agricultural

products include coffee, tea, corn, wheat, rice, hides and skins and dairy products.

There was a moderate high growth rate of about 7 per cent annually during the 1960s and 1970s, with agricultural production having an annual growth of about 5 per cent. However, during the period from 1980s and 1990s the growth rate nosedived because of the oil price shocks as well as the external debt crisis. Also, agricultural production also dwindled and inflation spiral into double digit.

Due to the downward economic trend, the Kenyan government in the mid-1990s implemented various economic reform measures to stabilize the economy and restore sustainable growth. However, there was an annual average growth of about 1.5 per cent between 1997 and 2002; this is due to inappropriate agricultural and industrial policies, increased government participation and import substitution strategies which made the manufacturing sector not to be competitive. Due to the partial compliance of the conditionality of the IMF and World Bank loan given to Kenya, the support was suspended in 1997. However, with election of President Kibaki in 2002, the government began a new economic reform program in conjunction with the IMF and the World Bank with focus to reduce government spending and reduce corruption.

The timing of the structural breaks shows that the LM two structural break tests for the gross domestic product, the fiscal deficits, the current account deficits, the inflation rate, the exchange rate and the interest rate have evidence of structural breaks during the period of Kenya economic recession (1982-1993) and the economic reforms of the IMF and the World Bank. There is also evidence that the conduct of election in 2002 impacted on the gross domestic product.

3.9.7 Morocco

In Morocco, the service sector represents over half of the GDP, followed by the industrial sector made up of construction, mining and manufacturing. The agricultural sector only account for about 15 per cent of GDP and employs about 40-45 per cent of the Moroccan working population. This sector is confronted with crude irrigation system because of the semi-arid climate of Morocco.

In the early 1980s, Morocco experience both macroeconomic and financial imbalances because of the fall in the price of phosphate in the world market, as well as the oil crisis and the global recession that followed. During this period, both the fiscal deficits and the current account deficits grew above the acceptable 5 per cent of the GDP. The external debt grew by $ 11.6 billion in between 1975-1983, and this represents about 96 per cent of the GDP and the debt service ratio was put at 40 per cent.

To correct this anomalies, the Moroccan government implemented various eco-

nomic reforms to stabilize the economy among which includes budgetary cut backs, privatization of state owned enterprise and tight monetary policies. However, growth has been slow because of the volatility in the rainfall-dependent agriculture sector and the diversification of the economy has made the economy tougher.

As touching the timing of the breaks in Morocco, the LM two structural breaks test for the gross domestic product and the real exchange rates variables, indicate structural breaks during the period of Morocco economic recession and economic reforms of the IMF and the World Bank. The fiscal deficits, the current account deficits, the real interest rates and the inflation rate shows evidence of structural breaks during the various economic reforms implemented by the Moroccan government.

3.9.8 Nigeria

Nigeria is Africa's most populous country with a population of about 150 million. The oil sub-sector account for about 80 per cent of government revenue and 95 per cent of foreign exchange earnings. Prior, to the discovery of oil in the South –South region in Nigeria in the 1970s, agriculture is the mainstay of the economy contributing over 50 per cent of the GDP.

By the year 1980, the oil subsector had grown from just 3 per cent of GDP in the 1970s to about 30 per cent of GDP. During, this period, oil exports was put at US$25 billion (96 per cent of total exports), and per capita income was well over US$1,100.

With the discovery and exploration of oil, there was a gradual decline in non-oil tradable goods and this was reflected in decline of agricultural exports. Owing, to the dramatic increase in oil revenue, the government failed to curtail her expenditure, and this led to fiscal deficits. The financing of the deficits led to increase in money stock and thus inflation.

The collapse of oil prices in the early 1980s, led to huge external debt and various macroeconomic imbalances among which include lower growth, double digit inflation, high level of unemployment, unsustainable fiscal deficits and high level of poverty. To reverse this trend, the government embarked on structural adjustment programme in 1986 with emphasis on budgetary cut-backs and privatization and commercialization of state owned enterprise.

The timing of the breaks for the LM two structural breaks test revealed that the gross domestic product, the fiscal deficits, the current account deficits, the interest rate, the exchange rate and the inflation indicates structural breaks during the economic reform period of 1986-2009 in Nigeria.

3.9.9 South Africa

South Africa is a mixed economy with a high rate of poverty and low GDP per capita. Agriculture and mining accounts for 7 per cent of the GDP, the industrial sector account for 20 per cent, while the service sector represents 73 per cent of the GDP. The South Africa economy is fully diversified with key economic sectors including mining, agriculture and fisheries, vehicle manufacturing and assembly, food processing, clothing and textiles, telecommunication, energy, financial and business services, real estate, tourism, transportation, and wholesale and retail trade.

Prior to 1990, South Africa was governed by their colonial masters. The transition to a democratically elected government started in early 1990, and this stimulated a discussion on the direction of economic policies to achieve sustainable growth not forgetting address the socio-economic problems created by the apartheid.

In the 1996-2000, the South African government embarked on policies that are committed to open markets, privatization, and a favorable investment climate through a program called Growth, Employment and Redistribution (GEAR) strategy. The neoliberal economic strategy brought greater fiscal discipline and macroeconomic stability into the economy, but failed to deliver in key areas. The unemployment rate soared and their greater income inequality.

The timing of the breaks for the LM two structural breaks test revealed that the gross domestic product, the fiscal deficits, the interest rate, the exchange rate and the inflation indicates structural breaks during the economic reform. The conduct of election in 1990 also has a significant impact on the gross domestic product. The break test also reveals that the current account deficits indicates structural breaks during the external debt crisis period of 1982-1989

3.9.10 Tanzania

Tanzania economy is predominantly agriculture, and it accounts for more than half of the GDP, with about 75 per cent of export and employs about 75 per cent of the working population. The second important sector is the mining sector which has fast amount of mineral among which are gold, diamonds, coal, iron, uranium, nickel, chromium, tin, platinum, coltan, niobium, natural gas, and represents about 11 per cent of the country's GDP.

The collapse of the oil prices as well a fall in agricultural commodities prices in the 1970s, increased her external debt and thus leading to macroeconomic imbalances of fiscal deficits, high inflation among other. To salvage this downward economic trend, the Tanzania government in 1986 embarks on adjustment programs by restructuring

state owned enterprises. Also, included in the program is the depreciation on the currency, liberalization of trade regime and budgetary cut backs.

Concerning the timing of the breaks for the LM two structural breaks test, it shows that the gross domestic product, the interest rate, the exchange rate and the inflation indicates structural breaks both during the external debt crisis and the economic reforms of the IMF and the World Bank. The fiscal deficits and the current account deficits suggest evidence of structural break only during the external debt crisis period of 1982-1989.

3.9.11 Tunisia

Tunisia has a diverse economy, ranging from agriculture, mining, manufacturing, and petroleum products, to tourism. The agricultural sector contributes 11.6% of the GDP and provides employment for 22 per cent of the labour force, the industrial sector account for 25.7% of the GDP, with labour force of 55 per cent, and the service sector represents 62.8% of the GDP accounting for 23 per cent of the labour force. The industrial sector is mainly made up of clothing and footwear manufacturing, production of car parts, and electric machinery. Although Tunisia managed an average 5% growth over the last decade, it continues to suffer from a high unemployment especially among youth.

Due to the external debt crisis of the early 1980s, the Tunisian government was faced with a lot of problems among which includes; escalating budget deficit, decline in non-oil revenue, expansionary monetary policy maintained by the financial needs of the budget and public enterprises as well as real interest rates too, public sector inefficiency, rising external current account deficit.

To solve all these problems, the government in 1986, initiated a policy of liberalization of the economy imposed by IMF in order to adjust the whole economy and introduce a free market based economy.

Regarding the timing of the breaks for the LM two structural breaks test, it shows that the gross domestic product, the fiscal deficits, the current account deficits, the exchange rate and the inflation indicates structural breaks both during the external debt crisis and the economic reforms of the IMF and the World Bank. The interest rate suggests evidence of structural break only during the economic reforms period of 1986-2006.

3.9.12 Uganda

In the year 2009, the service sector was the largest contributor of GDP representing about 51 per cent, followed by the manufacturing sector accounting for 24.7 per cent of GDP and the agriculture sector represents 24.3 per cent of the GDP. Despite the dwindling shares of agriculture in Uganda's GDP, it employs about 80% of the labour force.

Prior to 1986, the Uganda economy was characterised by high inflation running at annual rate of 240 per cent, high dependence on one export crop with coffee contributing 70% of export earnings. The economy was largely public sector driven, with private sector mainly subsistence and also rely on aid to meet her financial commitments. Due to the fall in agricultural commodity price and the oil price shocks of the 1970s, the government embarked on structural adjustment program to salvage the situation. The policy was first introduced in 1981 but failed to take off and was reintroduced in 1987.

The timing of the breaks for the LM two structural breaks test shows that the gross domestic product, the fiscal deficits, the current account deficits, the exchange rate, the interest rate and the inflation indicates structural breaks both during the external debt crisis and the economic reforms of the IMF and the World Bank. Other events noted to have significant impact on the variables is the civil unrest of 1986 and the elections held in 2001 and 2006.

Table 3.1: Augmented Dickey Fuller Unit Root Test (ADF)

Country	GDP	ΔGDP	FD	ΔFD	CAB	ΔCAB	RER	ΔRER	RIR	ΔRIR	INF	ΔINF
Botswana	-0.64	-2.34	-1.80	-3.61*	-3.16	-3.38	-3.24	-5.86 **	-3.91*	-7.17**	-1.60	-7.57**
Cameroon	-2.08	-2.96	-3.17	-5.01**	-3.36	-3.43*	-0.01	-11.69 **	-3.47*	-6.64**	-2.93	-6.79**
Egypt	-4.05**	-3.49*	-0.62	-6.15**	-2.63	-2.24	-1.73	-9.14 **	-1.14	-10.60*	-1.31	-10.96**
Ethiopia	-0.55	-3.17	-2.63	-4.09**	-2.54	-3.07	-1.82	-4.08 **	-3.13	-9.05*	-3.50*	-9.30**
Ghana	0.91	-5.37**	-5.87**	-5.63**	-3.79*	-4.97**	-3.41	-7.82 **	-2.50	-4.56*	-3.04	-4.40**
Kenya	-2.71	-2.76	-2.55	-3.80*	-2.47	-2.64	-2.22	-6.16 **	-3.56*	-11.08**	-3.27	-4.87**
Morocco	-1.16	-2.29	-2.09	-3.83*	-2.37	-2.99	-0.63	-6.34 **	-1.30	-8.63**	-2.50	-10.33**
Nigeria	-1.94	-3.09	-3.34	-4.36**	-2.42	-5.58**	-2.61	-5.42 **	-2.96	-4.69**	-3.25	-4.49**
South Africa	-2.33	-3.11	-2.34	-4.08**	-3.03	-16.06**	-3.16	-5.33 **	-2.82	-8.82**	-2.60	-9.63**
Tanzania	-3.40	-3.98*	-1.66	-4.13**	-2.43	-3.87*	-2.14	-11.13 **	-2.08	-7.99**	-2.25	-8.51**
Tunisia	-1.99	-3.65*	-4.06**	-5.31**	-3.75*	-3.16	-2.71	-9.39**	-2.16	-8.83**	-1.62	-10.45**
Uganda	-4.38**	-3.38	-2.75	-4.12**	-2.61	-3.43*	-2.20	-9.09 **	-2.35	-3.39*	-3.11	-3.27

Note: *and ** denote significant at 5 and 1 per cent levels respectively. The results are generated using EVIEWS software.

Table 3.2: Phillips-Perron Unit Root Test (PP)

Country	GDP	ΔGDP	FD	ΔFD	CAB	ΔCAB	RER	ΔRER	RIR	ΔRIR	INF	ΔINF
Botswana	-0.35	-3.71*	-1.70	-5.08**	-2.00	-7.87**	-2.39	-8.25**	-3.15	-17.66**	-2.97	-10.65**
Cameroon	-2.19	-3.96*	-2.91	-8.88**	-2.51	-8.75**	-1.03	-11.70**	-2.87	-16.63**	-2.97	-17.88**
Egypt	-2.07	-4.99**	-2.90	-6.71**	-3.04	-5.05**	-2.22	-8.55**	-3.12	-14.06**	-3.46*	-13.37**
Ethiopia	-0.62	-5.30**	-2.48	-5.34**	-2.88	-5.60**	-2.32	-5.65**	-2.72	-9.57**	-2.63	-10.29**
Ghana	-2.78	-4.13**	-2.78	-5.97**	-4.18**	-4.84**	-3.15	-7.39**	-3.03	-6.63**	-3.35	-6.53**
Kenya	-1.79	-4.16**	-2.32	-3.89*	-2.56	-5.43**	-2.85	-10.09**	-4.21**	-14.99**	-3.07	-6.75**
Morocco	-2.77	-7.60**	-2.12	-4.57**	-1.88	-4.85**	-0.37	-10.91**	-2.64	-7.22**	-3.22	-21.12**
Nigeria	-2.60	-4.90**	-2.66	-4.39**	-2.82	-4.76**	-0.68	-9.44**	-2.81	-6.00**	-2.18	-5.71**
South Africa	-1.23	-4.16**	-2.3	-4.02**	-6.12**	-16.43**	-2.67	-6.00**	-2.23	-8.80**	-2.82	-10.53**
Tanzania	-3.18	-5.43**	-2.56	-4.56**	-2.05	-4.94**	-2.03	-11.13**	-2.72	-15.07**	-4.67**	-27.64**
Tunisia	-2.04	-6.16**	-4.45**	-6.29**	-2.67	-5.09**	-2.71	-9.56**	-2.35	-15.72**	-2.84	-8.27**
Uganda	-2.08	-4.75**	-1.99	-6.35**	-3.39	-4.69**	-2.28	-9.70**	-2.64	-11.46**	-2.85	-11.85**

Notes: See Table 3.1.

Table 3.3: Botswana Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	5	1988:3, 2006:2	-4.880	λ(0.20, 0.80)	$\Delta LRGDP$	8	1985:4, 1988:1	-5.912**	λ(0.20, 0.27)
FD	6	1987:1, 2004:1	-4.868	λ(0.20, 0.80)	ΔFD	7	1990:3, 2006:1	-5.673**	λ(0.40, 0.80)
CAB	6	1985:3, 2004:4	-5.038	λ(0.20, 0.80)	ΔCAB	7	1986:1, 2004:3	-6.805***	λ(0.20, 0.80)
RIR	6	1988:2, 2002:2	-4.349	λ(0.20, 0.80)	ΔRIR	7	1989:4, 1991:4	-9.848***	λ(0.30, 0.40)
RER	7	1999:2, 2005:4	-4.703	λ(0.40, 0.80)	ΔRER	3	2005:1, 2007:1	-8.030***	λ(0.80, 0.90)
$INFR$	8	1989:1, 2001:4	-3.092	λ(0.31, 0.73)	$\Delta INFR$	7	1993:3, 2005:1	-9.471***	λ(0.46, 0.84)

Notes: *, ** and *** denote significant at 10, 5 and 1 per cent levels respectively. The results are generated using RATS software. The codes for the Lee and Strazicich (2001) two structural break test were obtained from the ESTIMA website.

Table 3.4: Cameroon Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	8	1989:1, 1996:3	-5.540*	λ(0.40, 0.60)	$\Delta LRGDP$	3	1991:4, 1994:1	-6.856***	λ(0.40, 0.50)
FD	7	2003:2, 2007:1	-10.232***	λ(0.78, 0.90)	ΔFD	7	2002:4, 2005:3	-12.042***	λ(0.76, 0.85)
CAB	8	1996:1, 2005:4	-5.466*	λ(0.60, 0.80)	ΔCAB	7	2004:4, 2006:2	-6.561***	λ(0.83, 0.88)
RIR	2	1993:4, 1996:1	-6.158**	λ(0.40, 060.)	ΔRIR	7	1993:3, 1995:3	-11.906***	λ(0.45, 0.51)
RER	7	1996:2, 1999:2	-7.399***	λ(0.55, 0.65)	ΔRER	8	1987:4, 1999:3	-10.365***	λ(0.27, 0.66)
$INFR$	8	1993:3, 1995:3	-6.343**	λ(0.46, 0.53)	$\Delta INFR$	7	1993:3, 1995:3	-13.548***	λ(0.46, 0.53)

Notes: See Table 3.3.

Table 3.5: Egypt Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	5	1991:3, 2001:4	-4.969	λ(0.40, 0.80)	$\Delta LRGDP$	8	1999:4, 2003:4	-5.372*	λ(0.67, 0.80)
FD	7	1983:3, 1989:2	-4.912	λ(0.20, 0.40)	ΔFD	7	1985:4, 1987:4	-7.196***	λ(0.20, 0.26)
CAB	2	1983:4, 1990:1	-4.510	λ(0.20, 0.40)	ΔCAB	7	1985:4, 1992:4	-5.345*	λ(0.20, 0.40)
RIR	7	1989:4, 2003:3	-5.102	λ(0.40, 0.80)	ΔRIR	3	1985:3, 1990:2	-11.671***	λ(0.20, 0.40)
RER	7	1989:3, 2003:3	-5.082	λ(0.40, 0.80)	ΔRER	3	1984:3, 1986:1	-9.496***	λ(0.20, 0.21)
$INFR$	7	1990:1, 2000:4	-6.089**	λ(0.34, 0.70)	$\Delta INFR$	3	1985:3, 1990:2	-11.512***	λ(0.20, 0.35)

Notes: See Table 3.3.

Table 3.6: Ethiopia Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	8	1990:4, 2005:3	-4.720	λ(0.40, 0.80)	$\Delta LRGDP$	8	1984:4, 1987:4	-5.174	λ(0.16, 0.27)
FD	8	1995:4, 1998:3	-5.225	λ(0.53, 0.63)	ΔFD	8	1996:4, 1999:4	-5.351*	λ(0.56, 0.67)
CAB	6	1997:3, 2004:1	-5.425*	λ(0.60, 0.80)	ΔCAB	7	2000:4, 2002:1	-7.442***	λ(0.70, 0.74)
RIR	6	1989:4, 2001:2	-5.254	λ(0.40, 0.80)	ΔRIR	3	1983:2, 1992:2	-9.097***	λ(0.11, 0.41)
RER	3	1996:1, 2000:2	-5.878**	λ(0.40, 0.68)	ΔRER	0	1998:3, 2004:4	-9.161***	λ(0.63, 0.83)
$INFR$	6	1990:2, 2001:2	-5.777**	λ(0.35, 0.72)	$\Delta INFR$	3	1993:2, 2004:1	-8.762***	λ(0.45, 0.81)

Notes: See Table 3.3.

Table 3.7: Ghana Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	7	1984:3, 2002:2	-6.046**	λ(0.20, 0.80)	$\Delta LRGDP$	7	1983:2, 1989:4	-6.898***	λ(0.11, 0.33)
FD	7	1983:4, 1991:4	-12.285***	λ(0.20, 0.40)	ΔFD	7	1984:3, 1994:4	-20.037***	λ(0.16, 0.50)
CAB	2	1982:4, 2005:4	-5.310	λ(0.20, 0.80)	ΔCAB	7	1984:1, 2002:4	-7.469***	λ(0.14, 0.76)
RIR	7	1984:2, 1996:3	-7.503***	λ(0.20, 0.60)	ΔRIR	3	1985:1, 2004:1	-11.716***	λ(0.17, 0.80)
RER	2	1984:2, 2006:4	-6.500***	λ(0.20, 0.90)	ΔRER	6	1983:2, 1985:1	-9.241***	λ(0.12, 0.18)
$INFR$	7	1984:2, 1996:3	-7.147***	λ(0.20, 0.56)	$\Delta INFR$	3	1985:1, 1988:3	-12.835***	λ(0.20, 0.29)

Notes: See Table 3.3.

Table 3.8: Kenya Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	6	1987:4, 2002:4	-5.992**	λ(0.20, 0.80)	$\Delta LRGDP$	8	1992:1, 1992:4	-5.538*	λ(0.41, 0.43)
FD	6	1990:3, 1996:1	-7.638***	λ(0.40, 0.60)	ΔFD	7	1992:4, 1997:3	-7.749***	λ(0.43, 0.60)
CAB	8	1995:3, 2000:1	- 4.368	λ(0.60, 0.80)	ΔCAB	8	1998:4, 2002:3	-7.145***	λ(0.63, 0.76)
RIR	1	1990:1, 1998:2	-7.975***	λ(0.40, 0.60)	ΔRIR	3	1993:1, 1995:1	-14.586***	λ(0.44, 0.51)
RER	6	1986:1, 1994:3	-5.763*	λ(0.20, 0.50)	ΔRER	3	1993:3, 1995:1	-8.153***	λ(0.45, 0.51)
$INFR$	5	1991:4, 1994:4	-6.028**	λ(0.40, 0.50)	$\Delta INFR$	3	1993:3, 1995:4	-10.202***	λ(0.46, 0.53)

Notes: See Table 3.3.

Table 3.9: Morocco Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	8	1987:1, 1991:4	-3.614	λ(0.20, 0.40)	$\Delta LRGDP$	8	1985:4, 2001:1	-5.712**	λ(0.20, 0.71)
FD	6	1997:3, 2005:3	-5.713*	λ(0.60, 0.80)	ΔFD	7	1984:2, 2004:4	-6.245**	λ(0.15, 0.83)
CAB	5	1990:4, 2004:2	-4.441	λ(0.40, 0.80)	ΔCAB	7	1988:2, 2006:4	-7.367***	λ(0.28, 0.90)
RIR	5	1994:2, 1996:4	-6.071**	λ(0.40, 0.60)	ΔRIR	3	1988:2, 1990:4	-10.982***	λ(0.28, 0.37)
RER	6	1987:2, 1991:1	-4.611	λ(0.20, 0.60)	ΔRER	3	1996:4, 2004:4	-10.689***	λ(0.65, 0.83)
$INFR$	5	1991:4, 1996:4	-6.073**	λ(0.40, 0.57)	$\Delta INFR$	3	1987:4, 1990:4	-11.158***	λ(0.27, 0.37)

Notes: See Table 3.3.

Table 3.10: Nigeria Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	8	1987:1, 1991:4	-3.614	λ(0.20, 0.40)	$\Delta LRGDP$	8	1989:4, 2003:1	-4.803	λ(0.33, 0.79)
FD	6	1997:3, 2005:3	-5.713*	λ(0.60, 0.80)	ΔFD	7	1986:2, 2006:4	-6.426*	λ(0.21, 0.90)
CAB	5	1990:4, 2004:2	-4.441	λ(0.40, 0.80)	ΔCAB	7	1985:1, 2003:2	-7.215***	λ(0.18, 0.80)
RIR	5	1994:2, 1996:4	-6.071**	λ(0.40, 0.60)	ΔRIR	7	1988:4, 1998:3	-7.094***	λ(0.30, 0.62)
RER	6	1987:2, 1991:1	-4.611	λ(0.20, 0.60)	ΔRER	3	1986:2, 1988:3	-9.539***	λ(0.22, 0.29)
$INFR$	5	1991:4, 1996:4	-6.073**	λ(0.40, 0.57)	$\Delta INFR$	7	1988:4, 1998:2	-7.263***	λ(0.30, 0.62)

Notes: See Table 3.3.

Table 3.11: South Africa Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	5	1991:3, 2005:2	-5.321*	λ(0.40,0.80)	$\Delta LRGDP$	7	1988:2, 1992:4	-5.787**	λ(0.28, 0.43)
FD	5	1997:1, 2005:1	-4.355	λ(0.60, 0.80)	ΔFD	5	1983:2, 2006:4	-8.776***	λ(0.12, 0.90)
CAB	5	1984:1, 1988:2	-5.340*	λ(0.20, 0.40)	ΔCAB	8	1998:4, 2003:3	-5.579*	λ(0.63, 0.80)
RIR	5	1985:2, 1996:1	-5.675*	λ(0.20, 0.60)	ΔRIR	3	1984:2, 1986:1	-8.807***	λ(0.15, 0.21)
RER	8	1999:3, 2003:2	-5.671*	λ(0.60, 0.80)	ΔRER	3	2001:1, 2003:1	-9.482***	λ(0.70, 0.79)
$INFR$	7	1992:2, 2007:1	-5.930**	λ(0.42, 0.91)	$\Delta INFR$	3	2000:1, 2005:1	-10.151***	λ(0.68, 0.84)

Notes: See Table 3.3.

Table 3.12: Tanzania Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	2	1984:4, 1988:2	-6.533***	λ(0.20, 0.40)	$\Delta LRGDP$	7	1988:3, 1989:2	-9.578***	λ(0.29, 0.32)
FD	5	1990:4, 1995:1	-5.458*	λ(0.40, 0.60)	ΔFD	8	1992:4, 1993:4	-5.413*	λ(0.43, 0.46)
CAB	5	1990:3, 2002:4	-4.176	λ(0.40, 0.80)	ΔCAB	7	1993:3, 2006:3	-5.363*	λ(0.45, 0.89)
RIR	7	1987:2, 1994:1	-4.964	λ(0.20, 0.40)	ΔRIR	4	1983:2, 1985:1	-9.258***	λ(0.11, 0.17)
RER	6	1986:4, 2002:3	-4.280	λ(0.20, 0.80)	ΔRER	3	1990:4, 1993:2	-8.702***	λ(0.37, 0.45)
$INFR$	7	1988:2, 1993:2	-4.161	λ(0.28, 0.45)	$\Delta INFR$	5	1992:2, 1995:1	-8.568***	λ(0.42, 0.51)

Notes: See Table 3.3.

Table 3.13: Tunisia Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	6	1988:1, 2006:3	-5.290	λ(0.20, 0.80)	$\Delta LRGDP$	7	1988:4, 1993:1	-7.625***	λ(0.30, 0.44)
FD	6	1984:1, 1993:1	-5.414*	λ(0.20, 0.40)	ΔFD	7	1992:1, 1995:4	-6.251**	λ(0.41, 0.53)
CAB	6	1986:1, 1991:1	-5.495*	λ(0.20, 0.40)	ΔCAB	7	1984:4, 1990:4	-6.778***	λ(0.17, 0.37)
RIR	2	1994:3, 2003:2	-6.878***	λ(0.40, 0.80)	ΔRIR	3	1993:1, 1993:4	-9.396***	λ(0.44, 0.46)
RER	6	1987:1, 1998:4	-5.303	λ(0.20, 0.60)	ΔRER	3	1998:3, 2000:3	-10.514***	λ(0.63, 0.69)
$INFR$	6	1987:4, 2001:2	-5.461*	λ(0.27, 0.72)	$\Delta INFR$	3	1988:3, 1993:4	-11.313***	λ(0.29, 0.47)

Notes: See Table 3.3.

Table 3.14: Uganda Two-Break Minimum LM Unit Root Test - Sample period 1980:1-2009:4

Series	k	TB	Test Statistic	Critical value Break Points	Series	k	TB	Test Statistic	Critical value Break Points
$LRGDP$	7	1986:4, 2005:4	-5.959**	λ(0.20, 0.80)	$\Delta LRGDP$	7	1993:1, 1993:4	-9.299***	λ(0.44, 0.46)
FD	5	1997:4, 2006:4	-3.988	λ(0.60, 0.90)	ΔFD	8	1983:4, 1994:3	-5.233	λ(0.13, 0.49)
CAB	5	1984;1, 2001:3	-4.993	λ(0.20, 0.80)	ΔCAB	3	1983:3, 2000:4	-6.984***	λ(0.12, 0.70)
RIR	8	1986:3, 1991:1	-8.966***	λ(0.20, 0.40)	ΔRIR	7	1988:2, 1990:3	-10.781***	λ(0.30, 0.36)
RER	8	1987:1, 1993:4	-5.014	λ(0.20, 0.40)	ΔRER	3	1992:4, 1995:1	-10.789***	λ(0.43, 0.51)
$INFR$	8	1986:3, 1990:4	-8.623***	λ(0.23, 0.37)	$\Delta INFR$	7	1988:2, 1990:3	-10.492***	λ(0.28, 0.36)

Notes: See Table 3.3.

Table 3.15: LM Critical Values

Break Points $\lambda\left(\frac{T_{B1}}{T}, \frac{T_{B2}}{T}\right)$	Critical values 1%	5%	10%
λ=(0.20, 0.40)	-6.16	-5.59	-5.270
λ=(0.20, 0.60)	-6.40	-5.74	-5.320
λ=(0.20, 0.80)	-6.33	-5.71	-5.330
λ=(0.40, 0.60)	-6.46	-5.67	-5.310
λ=(0.40, 0.80)	-6.42	-5.65	-5.320
λ=(0.60, 0.80)	-6.32	-5.73	-5.320

Note: k is the optimal number of lagged first-differenced terms included in the unit root test to correct for serial correlation. TB denotes the estimated break points. Critical values are shown below for the two-break minimum LM unit root test with linear trend (Model C) at the 1, 5 and 10 per cent levels for a sample of size T = 100, respectively. The critical values shown below come from Table 3 Panel M in Lee and Strazicich (2003). *, ** and *** denote significant at 10, 5 and 1 per cent levels respectively.

Table 3.16: Summary for Unit Root Tests

	ADF						PP						LM					
Country	GDP	FD	CAB	RER	RIR	INF	GDP	FD	CAB	RER	RIR	INF	GDP	FD	CAB	RER	RIR	INF
Botswana	I(2)	I(1)	I(2)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Cameroon	I(2)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Egypt	I(0)	I(1)	I(2)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)
Ethiopia	I(2)	I(1)	I(2)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(2)	I(1)	I(0)	I(0)	I(1)	I(0)
Ghana	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)
Kenya	I(2)	I(1)	I(2)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)
Morocco	I(2)	I(1)	I(2)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)	I(0)
Nigeria	I(2)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(2)	I(0)	I(1)	I(1)	I(0)	I(0)
South Africa	I(2)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)
Tanzania	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(1)
Tunisia	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(0)	I(0)
Uganda	I(0)	I(1)	I(1)	I(1)	I(1)	1(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I1()	I(0)	I(0)

Note: ADF = Augmented Dickey Fuller test, PP = Philip-Perron test, LM = test with two structural breaks, FD = Fiscal deficits, CAB = current account deficits. I(0) indicates significant at levels, I(1) indicates at first differences and I(2) indicates at second differences

Table 3.17: Descriptive Statistics for Fiscal Deficits

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	5.39	7.61	-16.10	22.07
Cameroon	2.51	7.61	-4.16	43.47
Egypt	-3.65	6.94	-17.89	8.03
Ethiopia	-4.18	1.91	-9.39	0.13
Ghana	-11.76	20.07	-97.77	12.35
Kenya	-4.15	4.04	-16.91	1.53
Morocco	-3.48	4.16	-14.44	4.08
Nigeria	11.05	10.81	-12.19	35.96
South Africa	-0.90	3.26	-7.46	7.69
Tanzania	-2.24	2.14	-8.01	1.78
Tunisia	-2.26	1.09	-5.71	0.04
Uganda	-0.46	1.91	-5.60	3.23

Note: The descriptive statistics and the plots of the figures are generated using the STATA software.

Figure 3.1: Botswana, Cameroon, Egypt and Ethiopia Fiscal Deficits

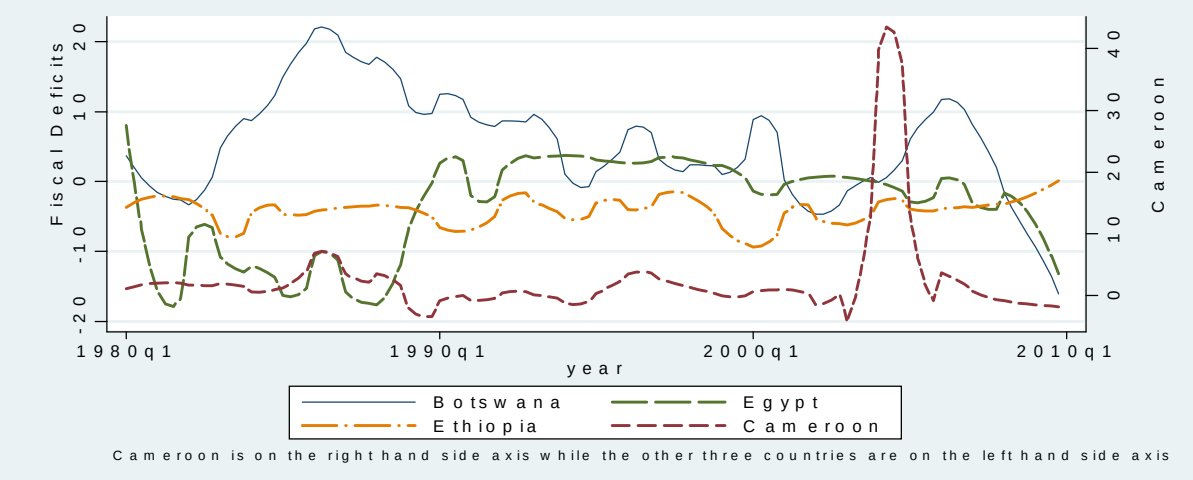


Figure 3.2: Ghana, Kenya, Morocco and Nigeria Fiscal Deficits

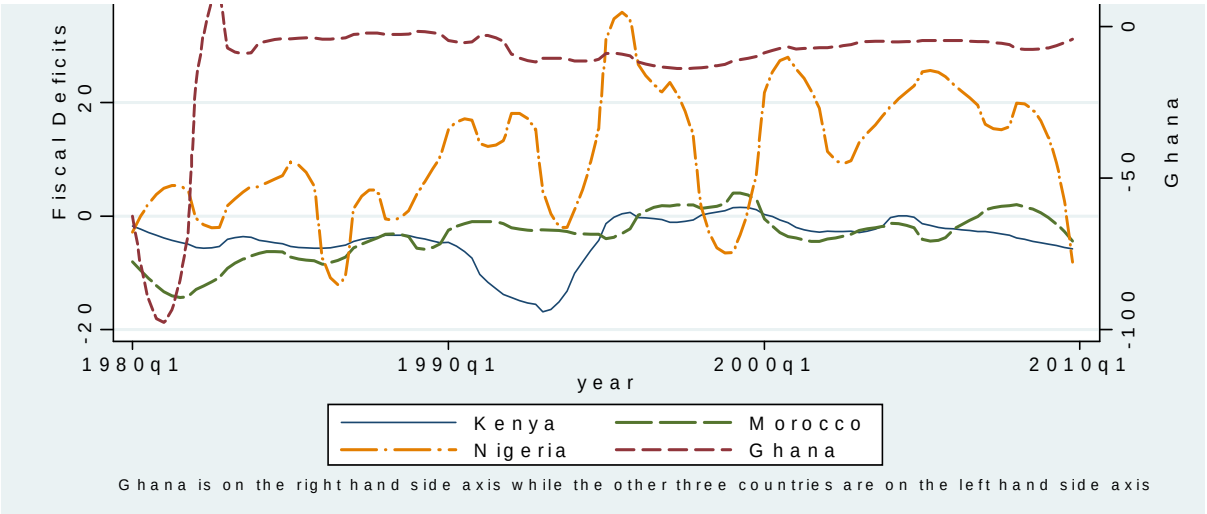


Figure 3.3: South Africa, Tanzania, Tunisia and Uganda Fiscal Deficits

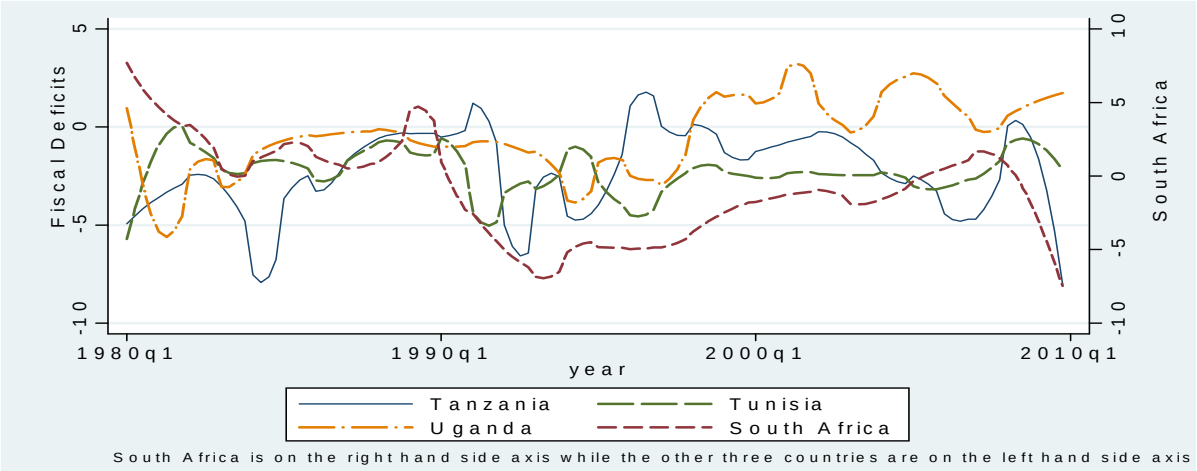


Table 3.18: Descriptive Statistics for Current Account Deficits

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	5.02	11.31	-29.18	34.67
Cameroon	-3.49	2.30	-7.54	1.94
Egypt	-0.73	3.87	-9.76	6.86
Ethiopia	-2.93	3.48	-13.62	2.07
Ghana	-4.94	3.87	-12.91	8.05
Kenya	-5.72	5.39	-20.94	1.01
Morocco	-2.17	4.26	-12.88	4.96
Nigeria	4.40	11.56	-15.05	33.19
South Africa	-0.79	3.64	-9.60	14.11
Tanzania	-9.08	4.82	-25.25	-0.59
Tunisia	-3.99	2.55	-9.56	2.39
Uganda	-4.48	3.53	-14.11	3.13

Notes: See Table 3.17.

Figure 3.4: Botswana, Cameroon, Egypt and Ethiopia Current Account Deficits

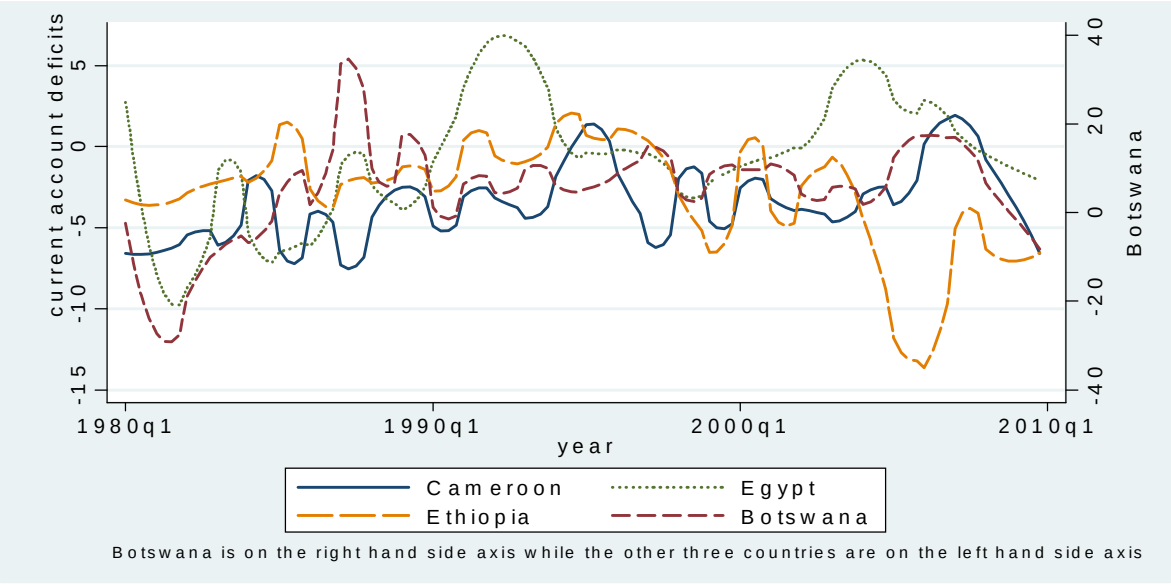


Figure 3.5: Ghana, Kenya, Morocco and Nigeria Current Account Deficits

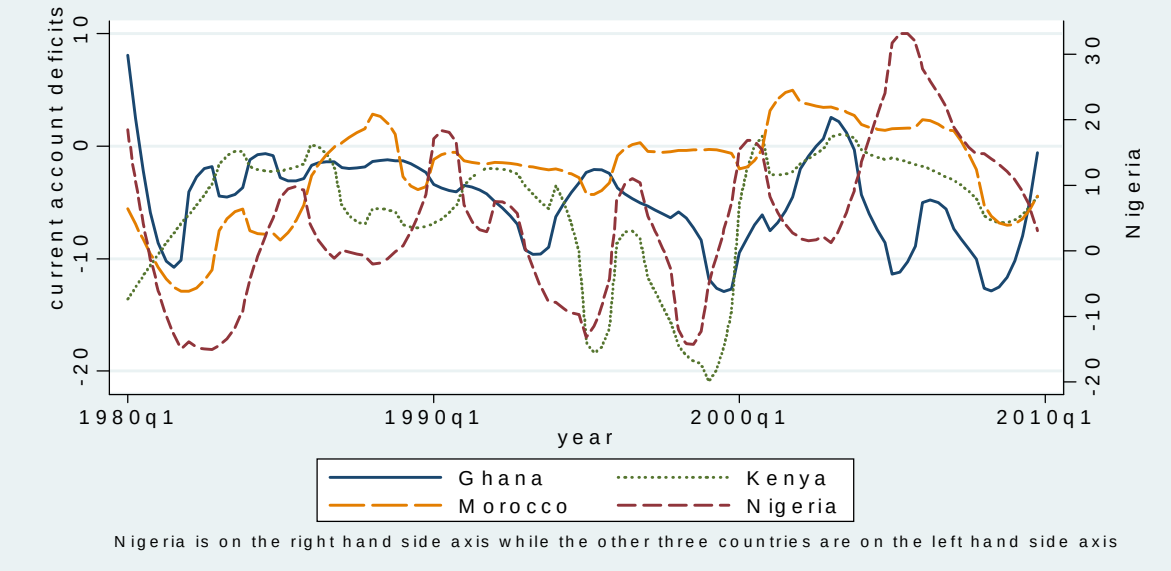


Figure 3.6: South Africa, Tanzania, Tunisia and Uganda Current Account Deficits

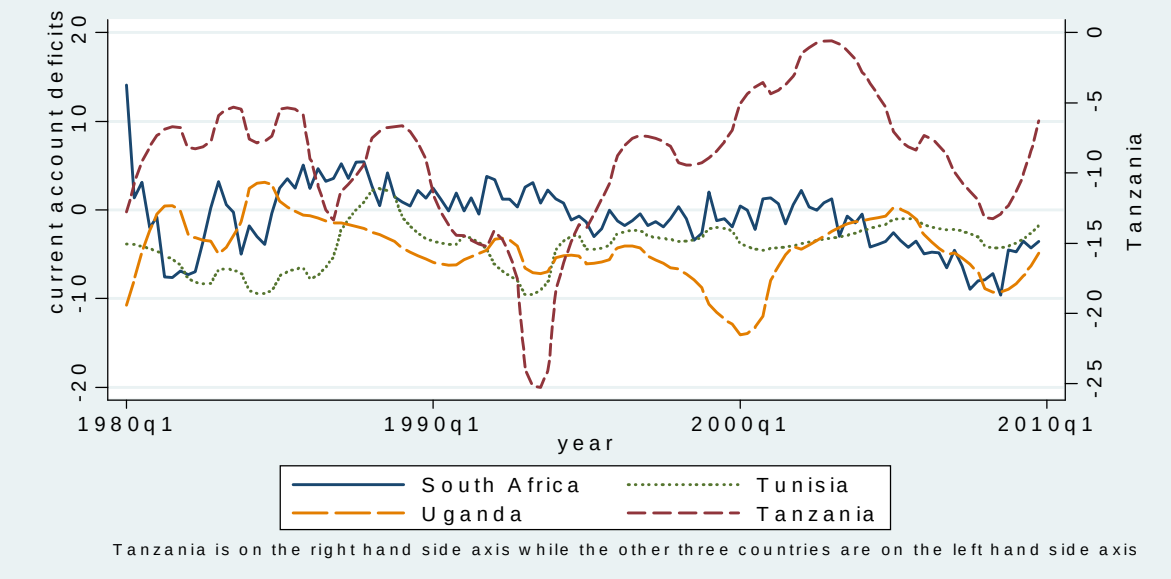


Table 3.19: Descriptive Statistics for Inflation Rates

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	9.94	7.26	-6.11	22.89
Cameroon	4.83	5.59	-3.39	16.09
Egypt	10.37	6.41	0.87	31.14
Ethiopia	7.27	9.94	-6.12	31.78
Ghana	33.69	23.48	11.15	123.06
Kenya	10.39	7.77	0.93	41.98
Morocco	4.77	3.92	-0.60	15.22
Nigeria	21.25	20.42	-5.55	83.62
South Africa	11.42	4.62	5.44	24.91
Tanzania	19.99	11.35	4.74	36.15
Tunisia	5.91	3.73	1.94	16.01
Uganda	38.53	53.70	-3.17	189.98

Notes: See Table 3.17.

Figure 3.7: Botswana, Cameroon, Egypt and Ethiopia Inflation Rates

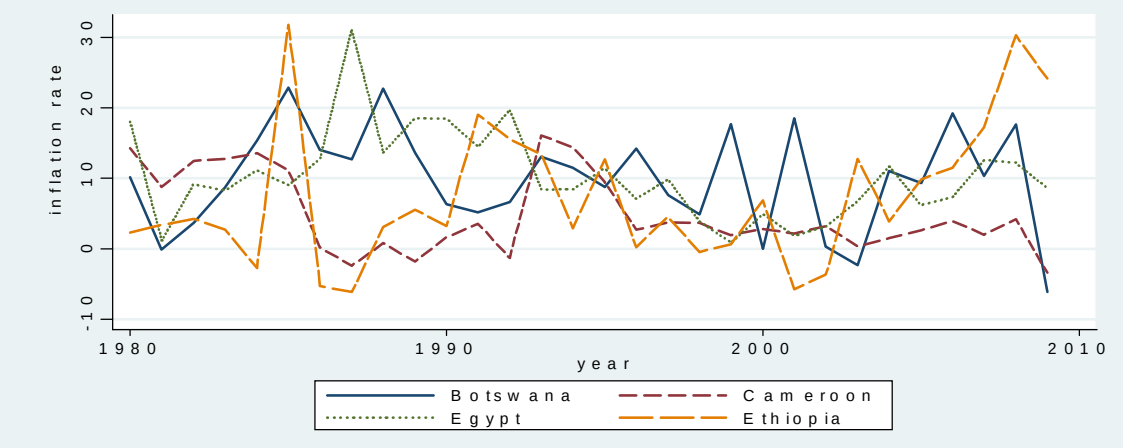


Figure 3.8: Ghana, Kenya, Morocco and Nigeria Inflation Rates

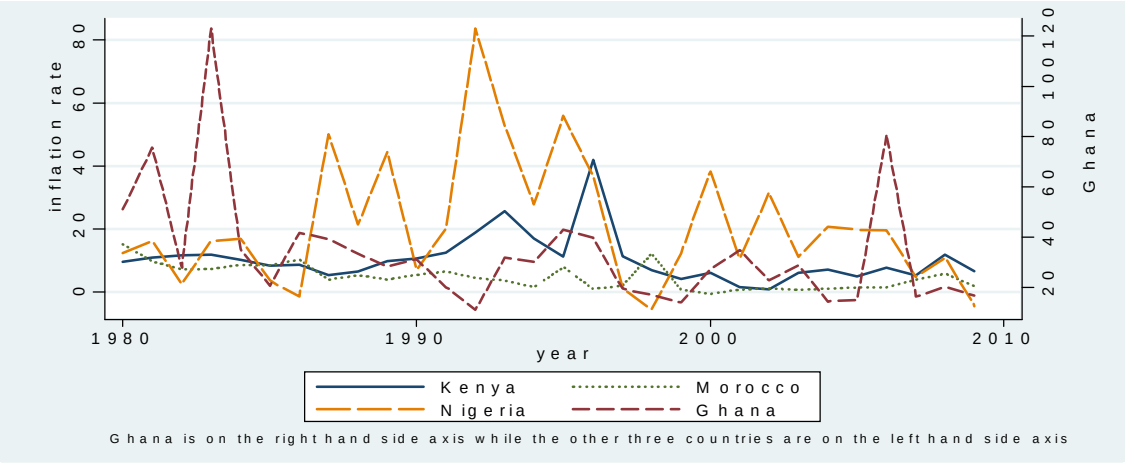


Figure 3.9: South Africa, Tanzania, Tunisia and Uganda Inflation Rates

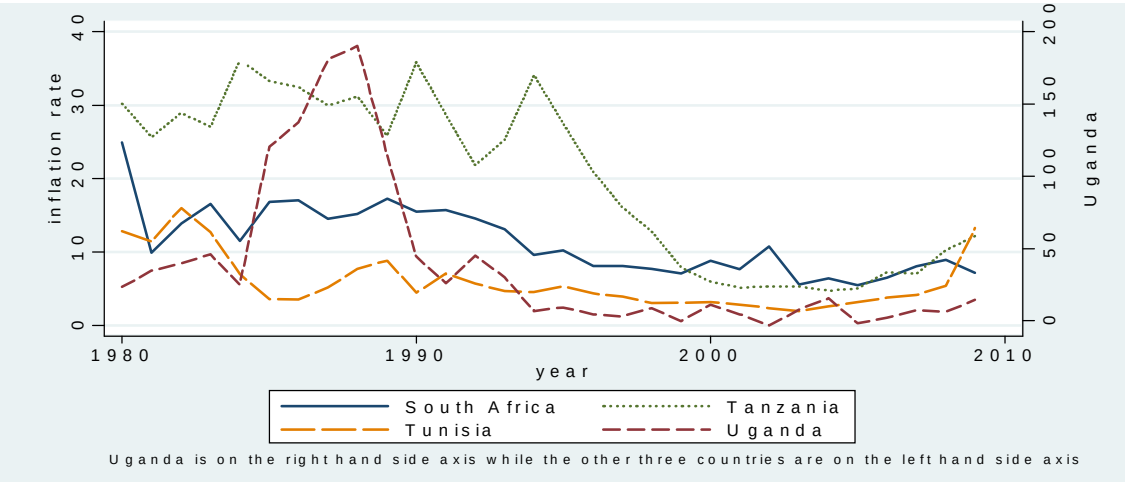


Table 3.20: Descriptive Statistics for GDP Growth Rates

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	7.10	4.61	-4.93	19.44
Cameroon	2.62	5.04	-7.82	17.08
Egypt	5.13	2.08	1.07	10.01
Ethiopia	4.25	6.89	-11.14	13.85
Ghana	3.91	3.39	-6.92	8.64
Kenya	3.36	2.20	-0.79	7.18
Morocco	3.81	4.67	-6.57	12.21
Nigeria	3.39	5.04	-13.12	10.60
South Africa	2.42	2.54	-2.14	6.62
Tanzania	3.93	2.51	0.35	7.82
Tunisia	4.33	2.41	-1.44	7.94
Uganda	5.72	3.24	-3.30	11.52

Notes: See Table 3.17.

Figure 3.10: Botswana, Cameroon, Egypt and Ethiopia GDP Growth Rates

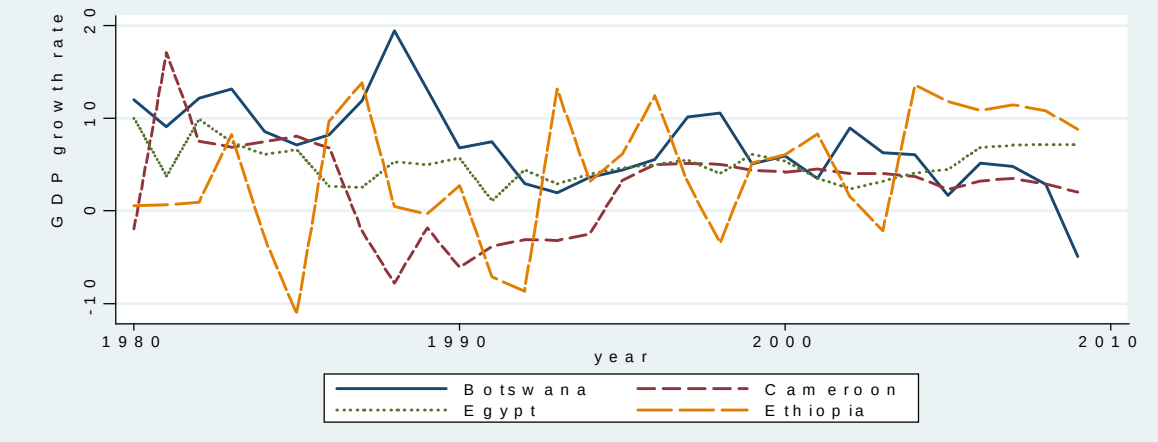


Figure 3.11: Ghana, Kenya, Morocco and Nigeria GDP Growth Rates

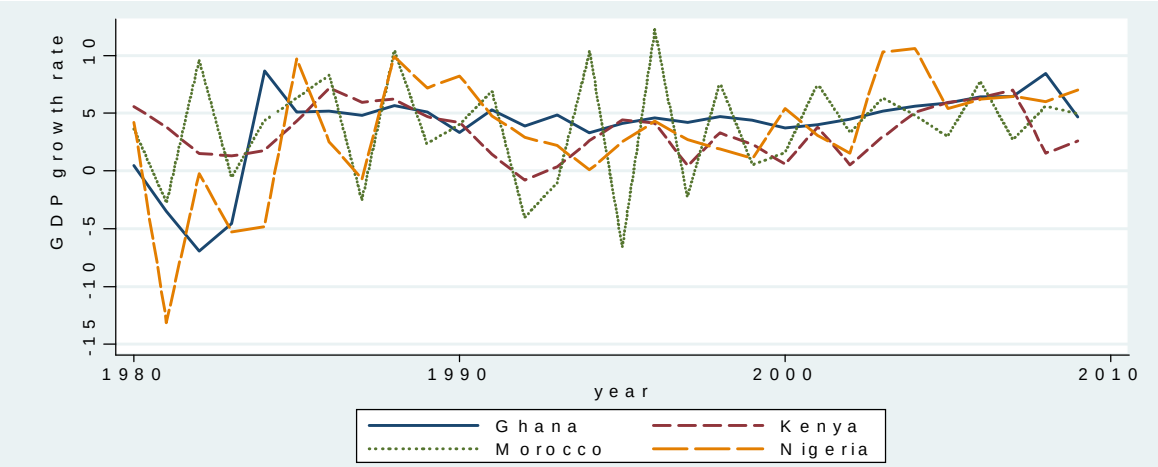


Figure 3.12: South Africa, Tanzania, Tunisia and Uganda GDP Growth Rates

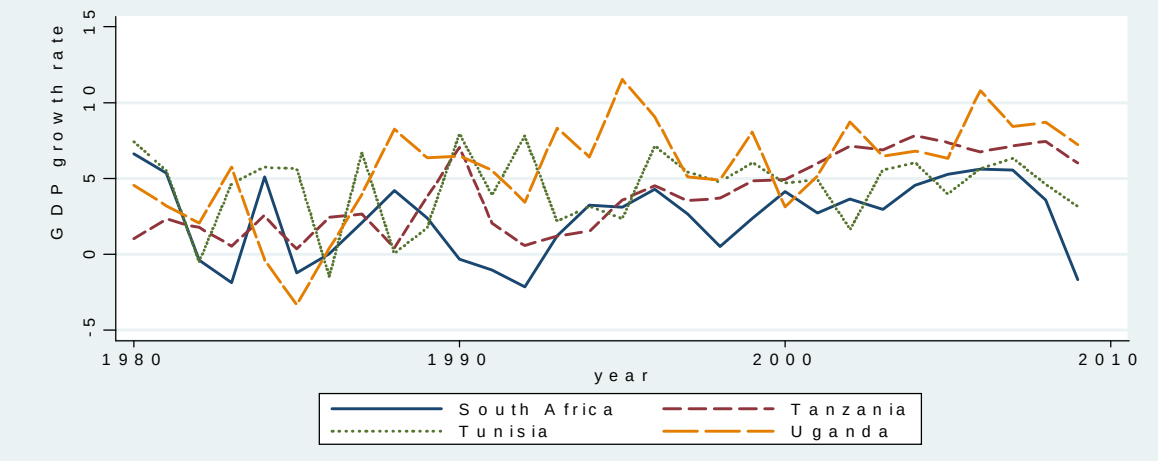


Table 3.21: Descriptive Statistics for Exchange Rates

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	3.40	1.98	0.78	0.16
Cameroon	450.04	147.59	211.28	733.04
Egypt	3.03	1.96	0.70	6.19
Ethiopia	5.41	3.17	2.07	11.77
Ghana	0.35	0.43	0.002	1.41
Kenya	46.24	27.05	7.42	79.17
Morocco	8.81	1.54	3.93	11.30
Nigeria	50.99	56.14	0.55	148.90
South Africa	4.43	2.74	0.78	10.54
Tanzania	537.54	461.59	8.19	1320.31
Tunisia	1.01	0.278	0.40	1.44
Uganda	957.39	755.45	0.07	2030.49

Notes: See Table 3.17.

Figure 3.13: Botswana, Cameroon, Egypt and Ethiopia Exchange Rates

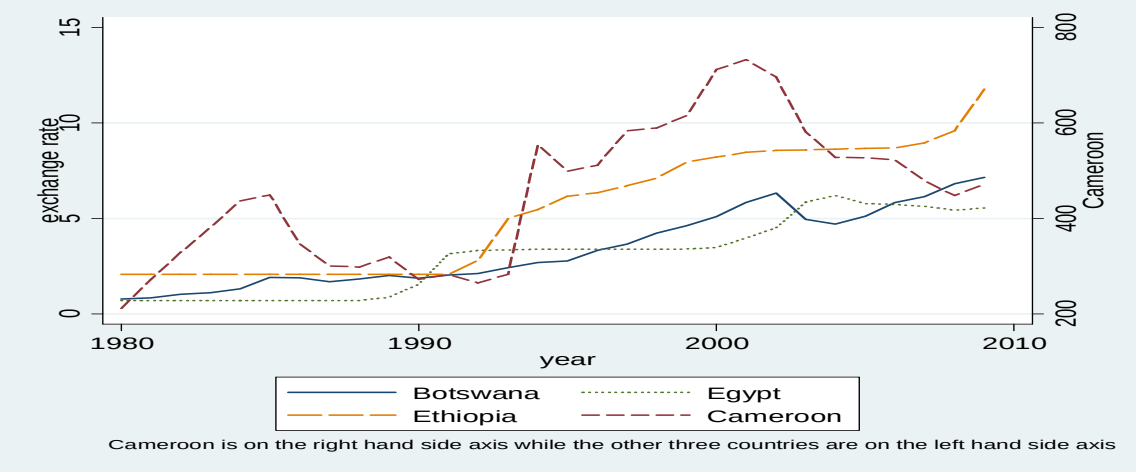


Figure 3.14: Ghana, Kenya, Morocco and Nigeria Exchange Rates

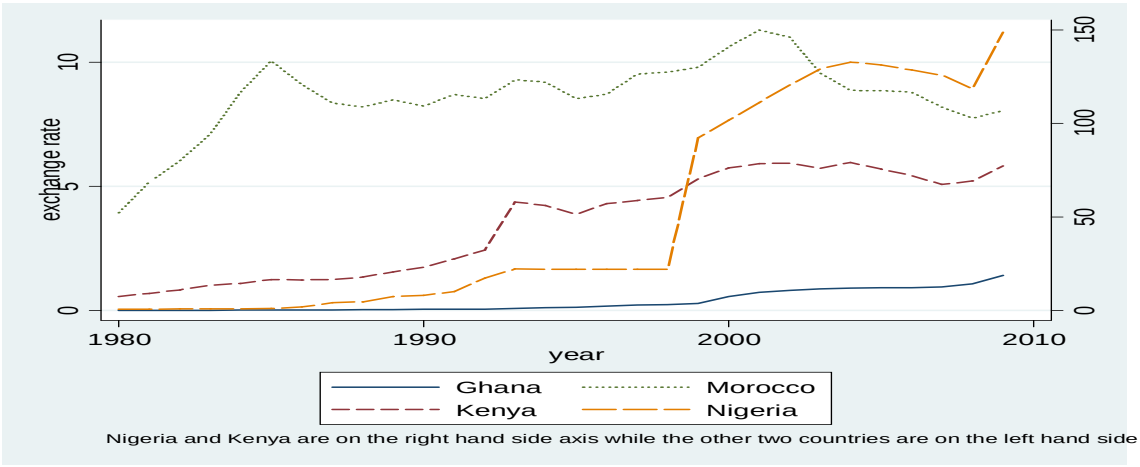


Figure 3.15: South Africa, Tanzania, Tunisia and Uganda Exchange Rates

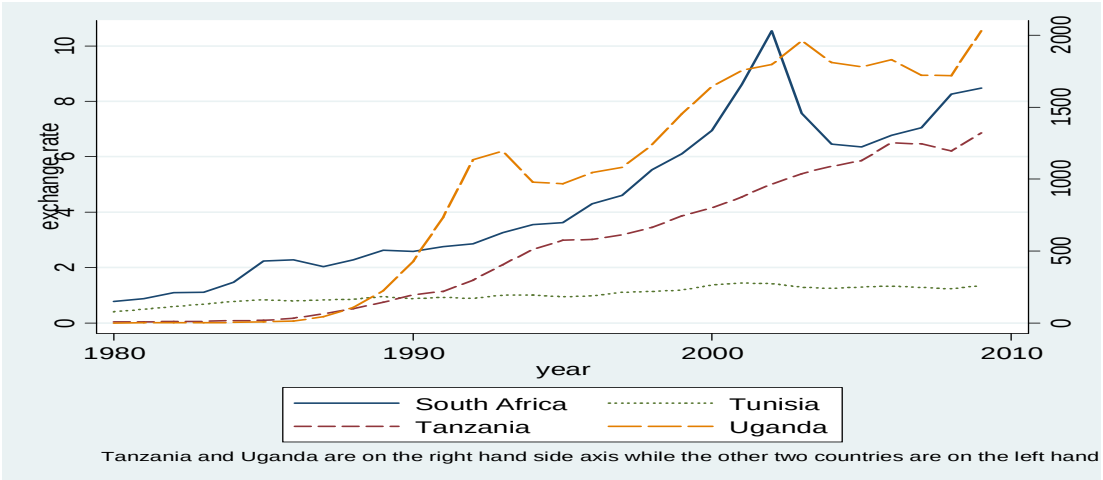


Table 3.22: Descriptive Statistics for Interest Rates

Country	Mean	Standard Deviation	Minimum Value	Maximum value
Botswana	13.59	3.46	7.67	24.21
Cameroon	16.88	3.05	13.00	22.00
Egypt	14.94	2.19	11.98	20.33
Ethiopia	8.63	2.77	5.70	15.08
Ghana	18.66	7.81	8.88	35.76
Kenya	18.99	7.05	10.58	36.24
Morocco	10.25	2.20	6.70	13.5
Nigeria	17.70	5.70	8.43	31.65
South Africa	16.21	3.66	9.50	22.33
Tanzania	21.89	9.03	11.50	42.83
Tunisia	7.73	2.38	4.23	11.88
Uganda	24.05	7.88	10.80	40

Notes: See Table 3.17.

Figure 3.16: Botswana, Cameroon, Egypt and Ethiopia Interest Rates

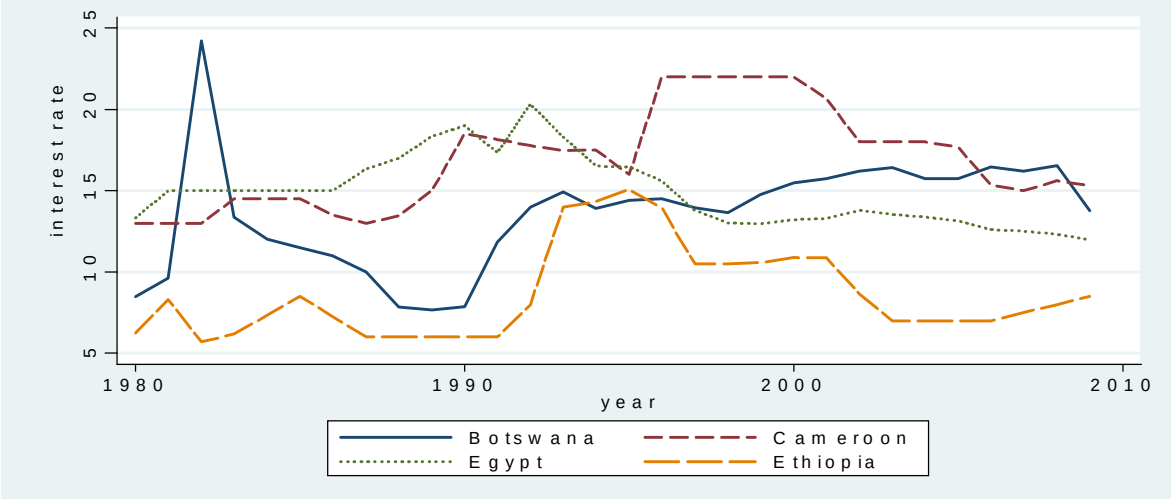


Figure 3.17: Ghana, Kenya, Morocco and Nigeria Interest Rates

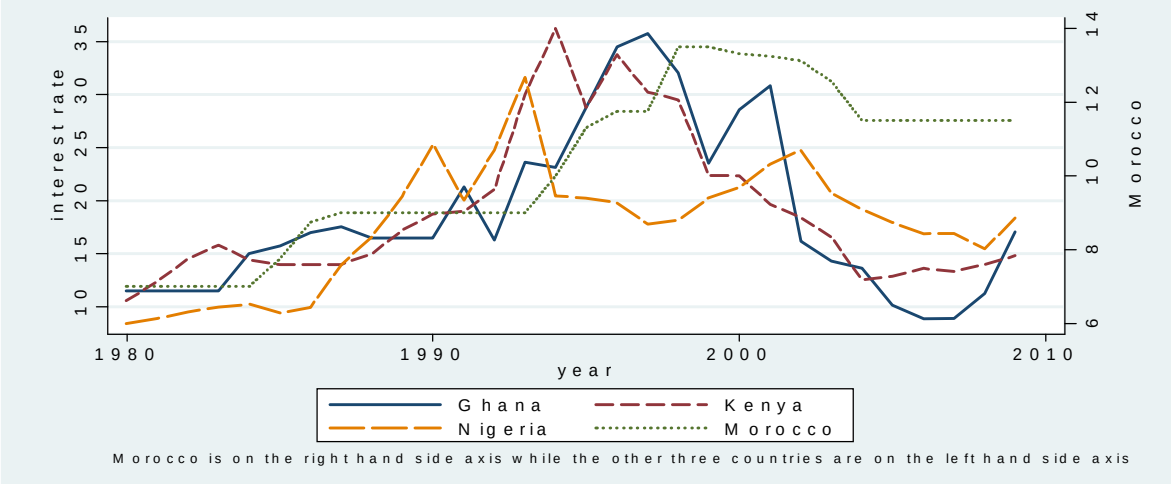


Figure 3.18: South Africa, Tanzania, Tunisia and Uganda Interest Rates

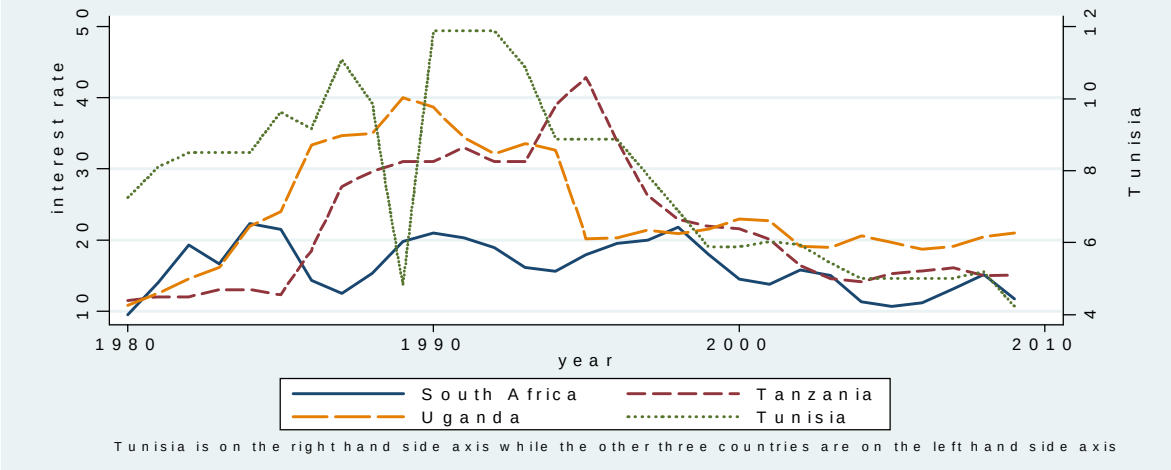


Table 3.23: Botswana - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1988:3, 2006:2	Economic boom (1980-2006)
FD	1987:1, 2004:1	Economic boom (1980-2006)
CAB	1985:3, 2004:4	Economic boom (1980-2006)
RIR	1988:2, 2002:2	Economic boom (1980-2006), VAT (2002)
RER	1999:2, 2005:4	Elimination of exchange rate controls (1999), Currency devaluation (2005
INFR	1989:1, 2001:4	Election (1989), Trade liberalization policy (2001)

Source: Author's calculation

Table 3.24: Cameroon - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1989:1, 1996:3	Economic recession (1989) Election (1996)
FD	2003:2, 2007:1	Economic reforms (1987-2008), Election (2007)
CAB	1996:1, 2005:4	Economic Reforms (1987-2008)
RIR	1993:4, 1996:1	Economic reforms (1987-2008)
RER	1996:2, 1999:2	Economic reforms (1987-2008), Currency devaluation (1994)
INFR	1993:3, 1995:3	Economic reforms (1987-2008)

Source: Author's calculation

Table 3.25: Egypt - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1991:3, 2001:4	Economic Reforms (1991-2007)
FD	1983:3, 1989:2	External debt crisis (1982-1990)
CAB	1983:4, 1990:1	External debt crisis (1982-1990)
RIR	1989:4, 2003:3	External debt crisis (1982-1990), Economic Reforms (1991-2007)
RER	1989:3, 2003:3	External debt crisis (1982-1990), Economic Reforms (1991-2007)
INFR	1990:1, 2000:4	External debt crisis (1982-1990), Economic Reforms (1991-2007)

Source: Author's calculation

Table 3.26: Ethiopia - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1990:4, 2005:3	Economic recession (1990-1999), Election (2005)
FD	1995:4, 1998:3	Economic recession (1990-1999), Border war (1998-2000)
CAB	1997:3, 2004:1	Economic recession (1990-1999), Economic reforms (1999-2005)
RIR	1989:4, 2001:2	Economic recession (1990-1999), Economic reforms (1999-2005)
RER	1996:1, 2000:2	Economic Reforms (1992-1996), Border war (1998-2000)
INFR	1990:2, 2001:2	Economic recession (1990-1999), Economic reforms (1999-2005)

Source: Author's calculation

Table 3.27: Ghana - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1984:3, 2002:2	Economic reforms (1983-1989, 2001-2007),
FD	1983:4, 1991:4	Economic reforms (1983-1989), Election (1992)
CAB	1982:4, 2005:4	Economic recession (1982), Economic reforms (2001-2007)
RIR	1984:2, 1996:3	Economic reforms (1983-1989, 1996)
RER	1984:2, 2006:4	Economic reforms (1983-1989, 2001-2007)
INFR	1984:2, 1996:3	Economic reforms (1983-1989, 1996)

Source: Author's calculation

Table 3.28: Kenya - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1987:4, 2002:4	Economic recession (1982-1993), Election (2002)
FD	1990:3, 1996:1	Economic recession (1982-1993), Economic Reforms (1995-1997)
CAB	1995:3, 2000:1	Economic Reforms (1995-1997, 2001)
RIR	1990:1, 1998:2	Economic recession (1982-1993), Economic Reforms (1994-2001)
RER	1986:1, 1994:3	Economic recession (1982-1993), Economic Reforms (1994-2001)
INFR	1991:4, 1994:4	Economic recession (1982-1993), Economic Reforms (1994-1997)

Source: Author's calculation

Table 3.29: Morocco - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1987:1, 1991:4	External debt crisis (1982-1989), Economic reforms(1985-1991)
FD	1997:3, 2005:3	Economic reforms(1992-1997, 2000-2007)
CAB	1990:4, 2004:2	Economic reforms(1985-1991, 2000-2007)
RIR	1994:2, 1996:4	Economic reforms(1992-1997)
RER	1987:2, 1991:1	External debt crisis (1982-1989), Economic reforms(1985-1991)
INFR	1991:4, 1996:4	Economic reforms(1985-1991, 1992-1997)

Source: Author's calculation

Table 3.30: Nigeria - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1987:1, 1991:4	Economic Reforms (1986-2009)
FD	1997:3, 2005:3	Economic Reforms (1986-2009)
CAB	1990:4, 2004:2	Economic Reforms (1986-2009)
RIR	1994:2, 1996:4	Economic Reforms (1986-2009)
RER	1987:2, 1991:1	Economic Reforms (1986-2009)
INFR	1991:4, 1996:4	Economic Reforms (1986-2009)

Source: Author's calculation

Table 3.31: South Africa - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1991:3, 2005:2	Election (1990), Economic reform (2000-2007)
FD	1997:1, 2005:1	Economic reform (1996-2000,2001-2007)
CAB	1984:1, 1988:2	External debt crisis (1982-1989)
RIR	1985:2, 1996:1	External debt crisis (1982-1989), Economic reform (1996-2000)
RER	1999:3, 2003:2	Election (1999), Economic reform (1996-2000, 2001-2007)
INFR	1992:2, 2007:1	Trade liberalization (1990-1994), Economic reform (2001-2007)

Source: Author's calculation

Table 3.32: Tanzania - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1984:4, 1988:2	External debt crisis (1982-1989), Economic reforms (1986-2007)
FD	1990:4, 1995:1	Economic reforms (1986-2007)
CAB	1990:3, 2002:4	Economic reforms (1986-2007)
RIR	1987:2, 1994:1	External debt crisis (1982-1989), Economic reforms (1986-2007)
RER	1986:4, 2002:3	External debt crisis (1982-1989), Economic reforms (1986-2007)
INFR	1988:2, 1993:2	External debt crisis (1982-1989), Economic reforms (1986-2007)

Source: Author's calculation

Table 3.33: Tunisia - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1988:1, 2006:3	External debt crisis (1982-1989), Economic reforms (1986-2006)
FD	1984:1, 1993:1	External debt crisis (1982-1989), Economic reforms (1986-2006)
CAB	1986:1, 1991:1	External debt crisis (1982-1989), Economic reforms (1986-2006)
RIR	1994:3, 2003:2	Economic reforms (1986-2006)
RER	1987:1, 1998:4	External debt crisis (1982-1989), Economic reforms (1986-2006)
INFR	1987:4, 2001:2	External debt crisis (1982-1989),Economic reforms (1986-2006)

Source: Author's calculation

Table 3.34: Uganda - Timing of the Structural Breaks

LM Two-Break Test		
Variable	Break Points	Event(s)
LRGDP	1986:4, 2005:4	External debt crisis (1982-1989), Civil unrest (1986), Election (2006)
FD	1997:4, 2006:4	Economic reform (1992-1997), Election (2006)
CAB	1984;1, 2001:3	External debt crisis (1982-1989), Election (2001)
RIR	1986:3, 1991:1	Civil unrest (1986),Economic reforms (1987-1991)
RER	1987:1, 1993:4	External debt crisis (1982-1989), Economic reforms (1992-1997),
INFR	1986:3, 1990:4	Civil unrest (1986), Economic reforms (1987-1991)

Source: Author's calculation

3.10 Appendix A

Data Interpolation

Consider a flow variable Y_t which has a time path represented by the function $Y_t = f(t)$. An observation on the variable at the end of year 1 does not indicate that the annual value of the variable is realised at the end of the year, but rather that it accumulates over the period 0-1. Hence, the annual observation can be conceived to be the area under the curve in the interval 0-1, which means that it can be expressed mathematically as;

$$Y_1 = \int_0^1 f(t)\, dt \tag{3.7}$$

Interpolation in this case amounts to partitioning the area under the curve to obtain quarterly observations. Thus, the first quarter observation of year 1 is the area under the curve in the interval 0-0.25. This is given by

$$Y_1^1 = \int_0^{0.25} f(t)\, dt \tag{3.8}$$

Assume now that the time path of Y_t can be approximated by a quadratic function of the form

$$f(t) = at^2 + bt + c \tag{3.9}$$

where a, b and c are parameters to be estimated. It follows that

$$Y_t = \int_{t-1}^{t} \left(at^2 + bt + c\right) dt \tag{3.10}$$

By evaluating the definite integral given by (3.4) for t=1,2,3, we have the integrals of the form;

$$Y_{t-1} \int_0^1 \left(at^2 + bt + c\right) dt$$

$$Y_t \int_1^2 \left(at^2 + bt + c\right) dt \tag{3.11}$$

$$Y_{t+1} \int_2^3 \left(at^2 + bt + c\right) dt$$

we end up with the following system of simultaneous equations

$$\mathbf{Z} = \mathbf{XA}$$

$$\begin{bmatrix} Y_{t-1} \\ Y_t \\ Y_{t+1} \end{bmatrix} = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 \\ \alpha_2 & \beta_2 & \gamma_2 \\ \alpha_3 & \beta_3 & \gamma_3 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} \tag{3.12}$$

By solving equation (3.6), we obtain the values of a,b and c as

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 1/2 & -1 & 1/2 \\ -2 & 3 & -1 \\ 11/6 & -7/6 & 1/3 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Y_t \\ Y_{t+1} \end{bmatrix} \tag{3.13}$$

Having obtained the values of a,b and c, the interpolated quarterly observations are calculated from the definite integral:

$$\begin{aligned} Y_t^i \int_{t_1}^{t_2} \left(at^2 + bt + c\right) dt \\ Q_1 = \int_1^{1.25} \left(at^2 + bt + c\right) dt \\ Q_2 = \int_{1.25}^{1.50} (at^2 + bt + c) dt \\ Q_3 = \int_{1.50}^{1.75} (at^2 + bt + c) dt \\ Q_4 = \int_{1.75}^{2.00} (at^2 + bt + c) dt \end{aligned} \tag{3.14}$$

Upon integration and substitutions for a,b and c from (3.14), give the following fundamental equations for interpolating annual observations into quarterly figures;

$$\begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \\ Q_4 \end{bmatrix} = \begin{bmatrix} 0.0547 & 0.2344 & -0.0391 \\ 0.0078 & 0.2656 & -0.0234 \\ -0.0234 & 0.2656 & 0.0078 \\ -0.0391 & 0.2344 & 0.0547 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Y_t \\ Y_{t+1} \end{bmatrix} \tag{3.15}$$

In each quarter, the present year (t)has more weights that either the previous $(t-1)$ or the latter year $(t+1)$years. For the first two quarters, year $(t-1)$ has

more weights than $(t+1)$, with weights reversed for the last two quarters. For all quarters, the present year has more weights than the former and the latter, with more weights for the present year in the second and third quarters when compared with the first and fourth quarters. Moreover, for each quarter, the weights sum to **0.25** so that quarterly figures sum to the value of the corresponding annual observation.

Chapter 4

Twin Deficits Hypothesis – VAR Approach

4.1 Introduction

The reoccurrence of large fiscal deficits and current account deficits in both developed and developing countries has generated a renewal of interest among researchers not least because the control of these deficits is a necessary condition for sustainable economic growth. A major source of concern in developing countries particularly in Africa is how government expenditure has been used, expenditure on white elephant projects that do not generate enough income to offset the interest and principal on loans incurred to finance the deficits. Over the past two decades, most African countries have witnessed low growth production capacity, and output and a sustained high level of unemployment; all this may be traced to excessive government spending to un-productive sectors of the economy as well as unstable polity, and this call for the need to assess the empirical relationship between the twin deficits.

This study extends the existing literature on twin deficits in two main ways. First, higher frequency data is used. Most studies in developing countries use annual data; by contrast we use quarterly data which is the typical frequency used in business cycle studies in developed countries. Second, the study uses the VAR models to examine the dynamic interaction between fiscal deficits and current account imbalances. Studies on twin deficits in Africa mostly examined long-run relationships and the direction of causation. This study uses impulse response functions and variance decomposition of forecast errors. This has rarely been used in the empirical literature in Africa countries.

Following the literature we also use Granger causality test to examine four proba-

ble hypotheses namely, first, fiscal deficits do Granger-cause current account deficits. Second, current account deficit does Granger-cause fiscal deficits. Third, there is no causal relationship between fiscal deficits and current account deficits. Finally, there is bi-directional causal relationship between fiscal deficits and current account deficits.

This chapter proceeds as follows. Section 4.2 presents the methodology and variables included in the model. Section 4.3 explained the criteria for selecting the appropriate lag length. Results of VAR Granger causality are discussed in section 4.4. This is followed by impulse response function in section 4.5 while the variance decomposition is considered in section 4.6; section 4.7 entails a sensitivity analysis of the twin deficits hypothesis, while concluding remarks is presented in section 4.8.

4.2 Methodology and Variable Description

The VAR approach[1] that this study utilizes to examine the relationship between macroeconomic variables, and fiscal deficits allows an interaction between all the specified variables. The variables included in the VAR are the logarithm of real GDP (RGDP), the fiscal deficits expressed as a percentage of GDP (FD), current account balance expressed as a percentage of GDP (CAB), the real exchange rates (RER) and the real interest rates (RIR). The VAR model takes each of the variables in the system and relates its variation to its own past history and the past values of all the other variables in the system. A typical VAR model in standard form can be written as;

$$Y_t = C + \sum_{i=1}^{p} A_i Y_{t-1} + \varepsilon_t \tag{4.1}$$

where Y_t denotes the (5x1) vector of the five endogenous variables given by $Y_t = [lrgdp_t, fd_t, cab_t, rir_t, rer_t]'$, c, is a (5x1) vector of intercept terms, A_i is the matrix of autoregressive coefficients of order i, and the vector of random disturbances $\varepsilon_t \equiv \left[\varepsilon_t^{lrgdp}, \varepsilon_t^{fd}, \varepsilon_t^{cab}, \varepsilon_t^{rir}, \varepsilon_t^{rer}\right]'$ contains the reduced-form ordinary least squares residuals. The lag length of the endogenous variables, p, will be determined by using the information criteria.

By imposing a set of restrictions, it is possible to identify orthogonal shocks, η, for each of the variables in (4.1), and to compute these orthogonal innovations through the random disturbances:

[1]The results for the VAR models were generated using EVIEWS 7 software.

$$\eta_t = B\varepsilon_t \tag{4.2}$$

The estimation of (4.1) allows Cov(ε) to be determined. Therefore, with the orthogonal restrictions and by means of an adequate normalisation

$$Cov(\eta) = I$$

where $I = (5 \times 5)$ identity matrix, therefore;

$$Cov(\eta_t) = Cov\left(B\varepsilon_t\right) = BCov\left(\varepsilon_t\right)B' \tag{4.3}$$

$$I = BCov\left(\varepsilon_t\right)B' \tag{4.4}$$

Since B is a square (n x n) matrix, which has dimension five, B has then 25 parameters that need to be identified. By imposing orthogonality, from (4.4) only 15 parameters can be determined, essentially from the five variances and the ten covariances. For the complete identification of the model, ten more restrictions are needed. The use of a Choleski decomposition of the matrix of covariances of the residuals, which requires all elements above the principal diagonal to be zero, provides the necessary additional ten restrictions, and the system is then exactly identified.

A lower triangular structure to B^{-1} is then imposed,

$$B^{-1} = D = \begin{bmatrix} d_{11} & 0 & 0 & 0 & 0 \\ d_{21} & d_{22} & 0 & 0 & 0 \\ d_{31} & d_{32} & d_{33} & 0 & 0 \\ d_{41} & d_{42} & d_{43} & d_{44} & 0 \\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55} \end{bmatrix} \tag{4.5}$$

The residuals ε_t are written as a function of the orthogonal shocks in each of the variables which gives equation (4.6);

$$\varepsilon_t = D\eta_t$$

The basic identification scheme uses a recursive VAR model (proposed by Sims (1980) in which the ordering of the variables is {LRGDP, GOV, CUR, RIR, RER}, where the contemporaneously exogenous variables are ordered first. The variable in the VAR is thus ordered from the most exogenous to the least exogenous one. The output was ordered first so that a shock in output may have an instantaneous effect on all the other variables not vice versa. However, output does not respond

contemporaneously to any structural disturbances to the remaining variables due, for instance, to lags in government decision-making. In other words, fiscal deficits, current account balance, real interest rates and real exchange rates affect output sequences with a one-period lag. For instance, a shock in fiscal deficits, the second variable, does not have an instantaneous impact on output only on current account balance, real interest rates and real exchange rates

This ordering implies that fiscal deficits respond to output in a contemporaneous way, but not to shocks to the other variables. Also, fiscal deficits affect current account balance contemporaneously. The real exchange rate is the least exogenous variable, and it is assumed that its shocks do not affect the other variables simultaneously. Moreover, it does react contemporaneously to shocks to the remaining variables in the model. The VAR were estimated using the levels of all the series for the twelve countries investigated.

4.3 Lag Order Selection for VAR

It is established in the literature that VAR analysis depends critically on the lag order selection of the VAR model. Sometimes, different lag orders can seriously affect the substantive interpretation of VAR estimates when those differences are large enough (see e.g. Hamilton and Herrera 2004, Kilian 2001). The strategy in empirical studies is to select the lag order by some pre-specified criterion and to condition on this estimate in constructing the VAR estimates.

In the econometric literature, a number of selection criteria have been proposed that can be used to determine the optimal lag order. The selection criteria considered in this study are the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC) and the Hannan-Quinn Criterion (HQC). Since these criteria may not always draw the same conclusion on the lag order, Ivanov and Kilian (2005) use Monte - Carlo simulations to compare these criteria. In their study, they conclude that for monthly VAR models, the AIC tends to produce the most accurate structural and semi-structural estimates for realistic sample sizes. For quarterly VAR models, the HQC appears to be the most accurate criterion if sample sizes are larger than 120. However, if sample sizes are smaller than 120, then the SIC becomes the most accurate criterion. For persistence profiles based on quarterly vector error correction models with known cointegrating vector, their results suggest that the SIC is the most accurate criterion for all realistic sample sizes.

The first three columns of Table 4.1 give the optimal lag order selected by the three criteria for each of the 12 African countries considered. The AIC selects a lag order of 6 for most countries, the SIC and HQ criteria select a lag order of 2 in most

cases. After considering that only quarterly VAR models are estimated in this study and the largest sample size is 120, it is more appropriate to use SIC to select lag order for each VAR.

Table 4.1: Specification of VAR orders and Diagnostic Test

	VAR order Minimizing			Chosen	Specification tests $(p-values)$[e]		
Country	**AIC**[a]	**SIC**[b]	**HQ**[c]	**VAR order**[d]	**Autocorrelation**[f]	**Heteroscedasticity**[g]	**Normality**[h]
Botswana	6	2	6	2	0.967	0.059	0.000*
Cameroon	6	2	2	2	0.794	0.093	0.000*
Egypt	6	2	6	5	0.779	0.086	0.000*
Ethiopia	6	2	2	2	0.286	0.063	0.000*
Ghana	8	7	7	7	0.931	0.132	0.000*
Kenya	6	2	2	2	0.492	0.089	0.000*
Morocco	6	2	5	2	0.549	0.054	0.000*
Nigeria	7	2	2	3	0.084	0.118	0.000*
South Africa	6	2	2	2	0.861	0.067	0.000*
Tanzania	7	2	6	3	0.397	0.135	0.000*
Tunisia	6	2	5	2	0.096	0.336	0.000*
Uganda	6	2	2	2	0.918	0.058	0.000*

Note: The results are generated using EVIEWS software

[a] Akaike information criterion (Akaike, 1974).

[b] Schwarz information criterion (Schwarz, 1978).

[c] Hannan-Quinn information criterion (Hannan and Quinn, 1979).

[d] The VAR order is chosen on the basis of the information criteria and on the basis of specification tests.

[e] The specification tests are based on the residuals from the estimation of an unrestricted VAR (p), where p is the integer reported in the column 'Chosen VAR order. * denotes statistical significance at 1 level.

[f] Multivariate autocorrelation LM test. For the null hypothesis of no serial correlation (of order 1) the test statistic has an asymptotic chi-square distribution with k2 degree of freedom

[g] Multivariate extension of White's (1980) heteroscedasticity test (Doornik (1996)). Under the null hypothesis of homoscedastic residuals the test statistic is asymptotically distributed chi-square with 10(8 p + 2) degrees of freedom, where p is the chosen VAR order.

[h] Multivariate residual normality test (Lütkepohl (1991: 155-158)). Under the null hypothesis of normally distributed residuals the test statistic is asymptotically distributed chi-square with 8 degrees of freedom.

Specification tests were also performed to check whether the lag length selected by the SIC criterion the residuals are free from first-order autocorrelation, homoscedastic and normally distributed. If the autocorrelation test indicates that the residuals are autocorrelated, the lag order is increased compared to the one selected by the SIC criterion until the autocorrelation test does not reject the null hypothesis of no serial correlation, but the SIC criterion is not dismissed if the normality test indicates that the residuals are non-normal, this is because the asymptotic properties of the VAR parameter estimators do not depend on the normality assumption (see Lutkepohl, 1991, p.358). The last three columns of Table 4.1 show the results of the specification tests for the chosen lag order for each of the 12 African countries considered. The results show that at the 5% significance level, there are no signs of residual autocorrelation and heteroscedastic residuals.

The VAR model also satisfies the stability condition for all countries because all the roots are within the unit circle. The empirical analysis is thus based on the lag orders in column 4 of table 4.1. Within the framework of the VAR system of equations, the significance of all the lags of each of the individual variables is examined jointly with an F-test. Since several lags of the variables are included in each of the equations of the system, the coefficients on individual lags may not appear significant for all lags. However, F-tests will establish the joint significance of all the lags of the individual variables.

In order to further consider the effect of fiscal deficits on economic performance we calculate the impact multipliers (impulse responses) for the estimated VAR model. We also decompose the forecast error variance to determine the proportion of the movements in the fiscal deficit that are a consequence of its own shocks and shocks to other variables. Then, if the F-test result for the lags of variable X in the equation for variable Y is not significant, we conclude that changes in variable X cannot cause subsequent changes in variable Y.

Table 4.2: Botswana VAR Granger Causality

Dependent Variable	Lags of GDP	Variables FD	CAB	RIR	RER
GDP	-	0.14	0.00	0.99	0.07
FD	0.01	-	0.01	0.73	0.79
CAB	0.00	0.00	-	0.01	0.02
RIR	0.04	0.66	0.74	-	0.48
RER	0.06	0.75	0.75	0.71	-

Note: The table gives marginal significance levels which test the hypothesis that all lags of a particular variable have no explanatory power for the dependent variable. For example, the figure 0.00 in the first row of the third column indicates that the null hypothesis that lags of the current account deficits have no explanatory power for the gross domestic product is rejected at the 1 per cent level.The numbers shown in the table represents probability values.

Figure 4.1: Botswana IRF

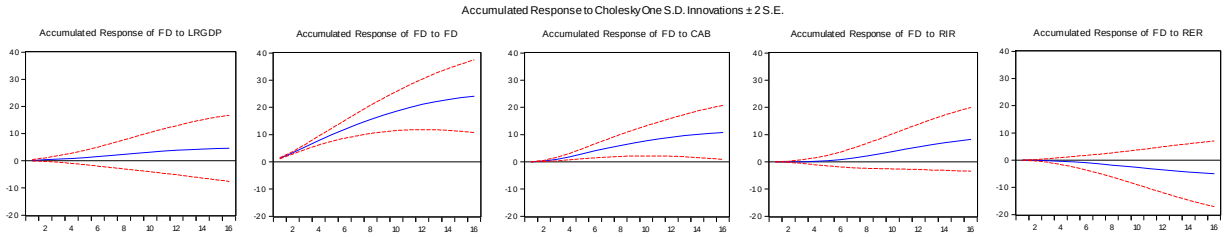


Table 4.3: Botswana Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to;**

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	1.64	98.36	0.00	0.00	0.00	1	3.14	3.10	93.76	0.00	0.00
4	1.13	90.66	7.82	0.08	0.32	4	2.89	6.84	82.86	0.67	6.75
8	1.90	79.21	14.51	2.90	1.48	8	6.06	37.10	42.94	5.69	8.21
12	2.47	72.61	14.98	7.37	2.57	12	6.43	40.14	36.96	9.01	7.46
20	2.47	68.55	14.68	10.74	3.56	20	6.83	38.53	34.04	13.07	7.52
30	3.50	67.16	15.05	10.73	3.57	30	6.85	38.40	33.84	13.37	7.54
40	4.74	65.17	15.51	11.14	3.45	40	6.99	38.33	33.77	13.42	7.49
50	5.34	64.19	15.67	11.41	3.39	50	7.05	38.26	33.75	13.4	7.47

Table 4.4: Cameroon VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.97	0.49	0.02	0.53
FD	0.58	-	0.29	0.26	0.02
CAB	0.16	0.67	-	0.01	0.01
RIR	0.37	0.87	0.76	-	0.26
RER	0.63	0.91	0.99	0.02	-

Notes: See Table 4.2

Figure 4.2: Cameroon IRF

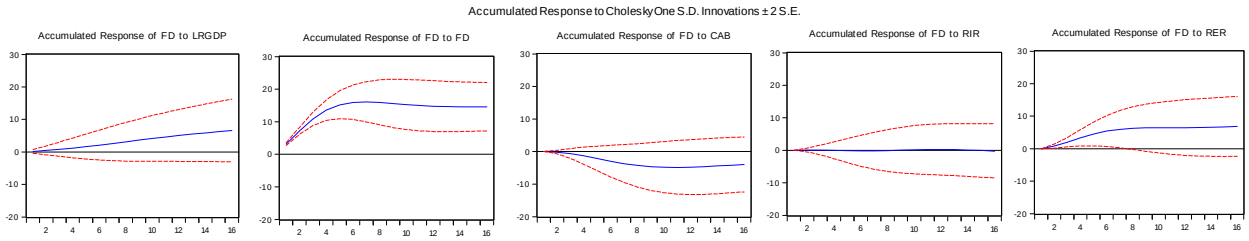


Table 4.5: Cameroon Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to**;

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	0.24	99.76	0.00	0.00	0.00	1	0.22	2.55	97.22	0.00	0.00
4	0.75	90.5	1.36	0.02	7.38	4	0.77	0.8	87.7	3.7	7.02
8	2.14	82.43	4.81	0.05	10.57	8	2.65	0.67	79.57	7.49	9.62
12	3.64	80.92	5.00	0.11	10.34	12	3.00	0.76	79.09	7.53	9.62
20	4.99	79.03	5.33	0.41	10.24	20	3.07	0.77	78.97	7.62	9.57
30	6.00	77.81	5.37	0.64	10.18	30	3.33	0.77	78.71	7.65	9.54
40	6.75	76.92	5.41	0.8	10.12	40	3.58	0.77	78.45	7.68	9.52
50	7.31	76.26	5.43	0.92	10.08	50	3.78	0.77	78.24	7.7	9.51

Table 4.6: Egypt VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.03	0.69	0.12	0.28
FD	0.69	-	0.29	0.07	0.2
CAB	0.09	0.00	-	0.66	0.82
RIR	0.19	0.04	0.87	-	0.68
RER	0.18	0.02	0.77	0.91	-

Notes: See Table 4.2

Figure 4.3: Egypt IRF

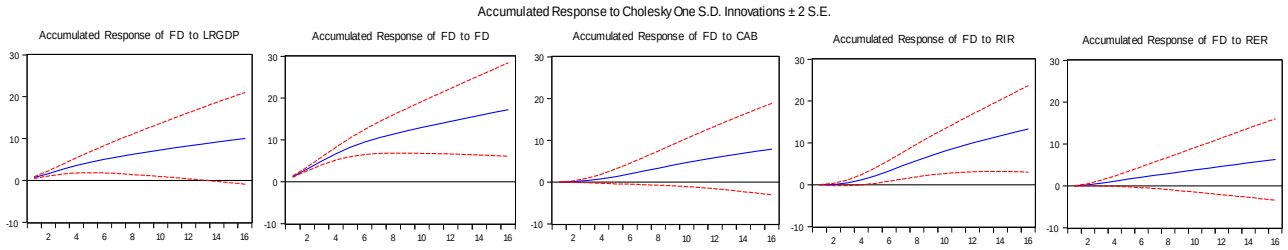


Table 4.7: Egypt Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to**;

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	22.40	77.60	0.00	0.00	0.00	1	1.03	5.04	93.94	0.00	0.00
4	20.03	71.69	1.57	4.01	2.69	4	0.35	2.61	96.60	0.04	0.40
8	15.96	54.6	6.04	19.32	4.07	8	0.22	13.35	83.94	0.94	1.55
12	14.59	46.96	8.42	25.2	4.83	12	0.22	18.69	75.37	3.81	1.91
20	13.65	42.3	9.66	28.52	5.87	20	0.55	20.11	70.30	6.97	2.06
30	13.05	40.45	10.14	30.04	6.32	30	1.05	20.1	68.63	7.95	2.26
40	12.63	39.88	10.42	30.62	6.45	40	1.25	20.12	67.87	8.37	2.39
50	12.32	39.75	10.60	30.86	6.46	50	1.34	20.14	67.50	8.58	2.45

Table 4.8: Ethiopia VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.81	0.84	0.2	0.38
FD	0.31	-	0.08	0.08	0.33
CAB	0.41	0.58	-	0.12	0.22
RIR	0.02	0.99	0.48	-	0.29
RER	0.02	0.81	0.48	0.00	-

Notes: See Table 4.2

Figure 4.4: Ethiopia IRF

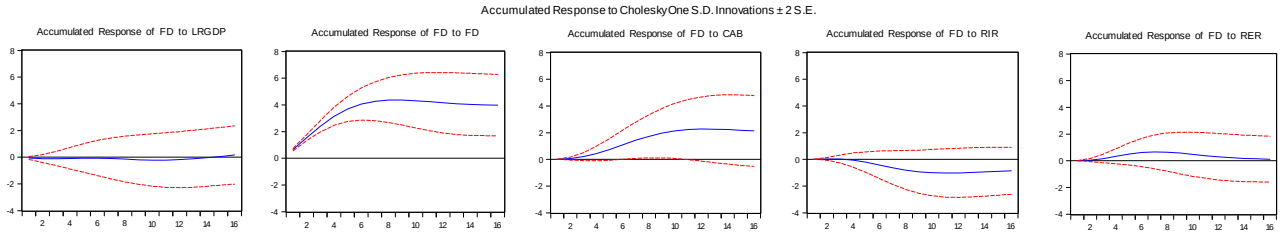


Table 4.9: Ethiopia Variance Decomposition

Fraction of fiscal deficits variance due to; Fraction of current account variance due to;

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	1.06	98.94	0.00	0.00	0.00	1	6.91	10.95	82.14	0.00	0.00
4	0.28	94.75	3.02	0.28	1.66	4	10.88	7.51	79.67	0.09	1.84
8	0.29	80.04	13.33	3.98	2.35	8	13.47	8.52	71.96	1.21	4.85
12	0.37	77.03	15.2	4.38	3.02	12	15.25	9.38	69.08	1.43	4.85
20	2.27	75.07	15.08	4.42	3.17	20	20.13	9.03	64.69	1.35	4.80
30	4.52	73.31	14.71	4.32	3.14	30	27.56	8.44	58.16	1.22	4.61
40	7.43	71.02	14.24	4.18	3.13	40	35.47	7.86	51.19	1.08	4.60
50	11.1	68.13	13.64	4.00	3.12	50	43.62	7.26	44.00	0.94	4.18

Table 4.10: Ghana VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.00	1	0.16	0.16
FD	0.09	-	0.97	0.00	0.56
CAB	0.46	0.31	-	0.18	0.72
RIR	0.00	0.00	0.81	-	0.56
RER	0.00	0.14	0.25	0.00	-

Notes: See Table 4.2

Figure 4.5: Ghana IRF

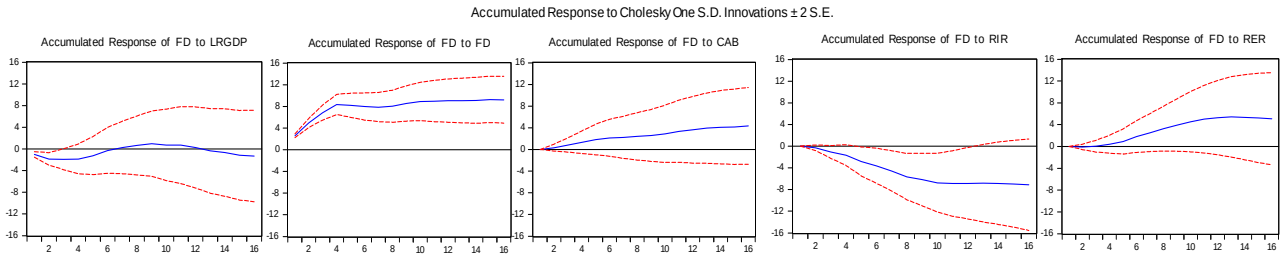


Table 4.11: Ghana Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to;**

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	13.08	86.92	0.00	0.00	0.00	1	21.59	9.12	69.29	0.00	0.00
4	8.12	83.74	2.71	4.69	0.74	4	25.23	1.72	70.94	1.34	0.77
8	11.62	60.67	3.30	16.85	7.56	8	25.97	3.14	54.58	10.68	5.64
12	11.59	56.61	4.30	17.29	10.21	12	25.82	3.02	50.32	15.29	5.54
20	13.44	54.71	4.83	16.83	10.20	20	29.17	3.53	45.6	13.48	8.22
30	13.56	54.36	5.10	16.77	10.22	30	29.82	4.01	44.41	12.41	9.35
40	13.68	54.22	5.17	16.72	10.21	40	29.94	4.09	44.41	11.99	9.57
50	13.68	54.18	5.22	16.72	10.21	50	30.09	4.23	44.19	11.78	9.72

Table 4.12: Kenya VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.08	0.16	0.98	0.23
FD	0.49	-	0.64	0.06	0.52
CAB	0.33	0.41	-	0.54	0.06
RIR	0.35	0.79	0.12	-	0.50
RER	0.07	0.03	0.65	0.71	-

Notes: See Table 4.2

Figure 4.6: Kenya IRF

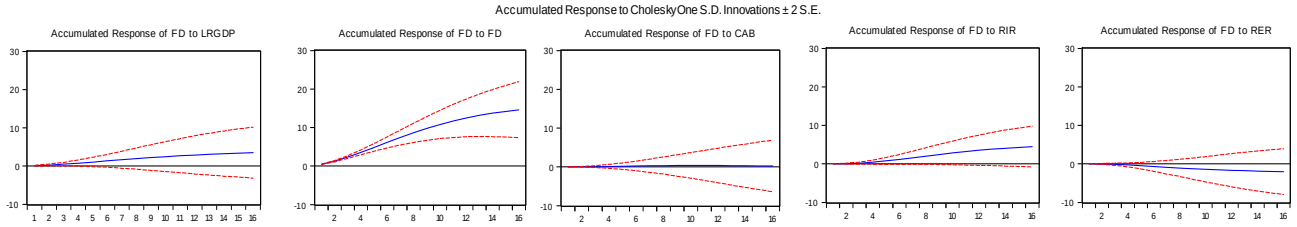


Table 4.13: Kenya Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to**;

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	3.99	96.01	0.00	0.00	0.00	1	0.48	9.10	90.42	0.00	0.00
4	4.17	92.63	0.12	2.2	0.88	4	0.86	15.95	81.18	0.71	1.29
8	4.44	87.24	0.15	6.45	1.72	8	1.04	18.89	71.05	0.64	8.38
12	4.64	85.37	0.11	8.11	1.78	12	1.00	18.07	69.21	0.65	11.08
20	4.81	84.37	0.17	8.82	1.83	20	0.98	18.41	68.06	1.08	11.47
30	4.81	84.34	0.19	8.83	1.83	30	0.99	19.16	67.17	1.36	11.32
40	4.80	84.33	0.20	8.84	1.83	40	1.01	19.17	67.13	1.37	11.32
50	4.82	84.31	0.21	8.84	1.83	50	1.04	19.18	67.10	1.37	11.31

Table 4.14: Morocco VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.83	0.79	0.91	0.47
FD	0.37	-	0.32	0.06	0.01
CAB	0.20	0.17	-	0.03	0.34
RIR	0.94	0.22	0.02	-	0.11
RER	0.70	0.83	0.31	0.69	-

Notes: See Table 4.2

Figure 4.7: Morocco IRF

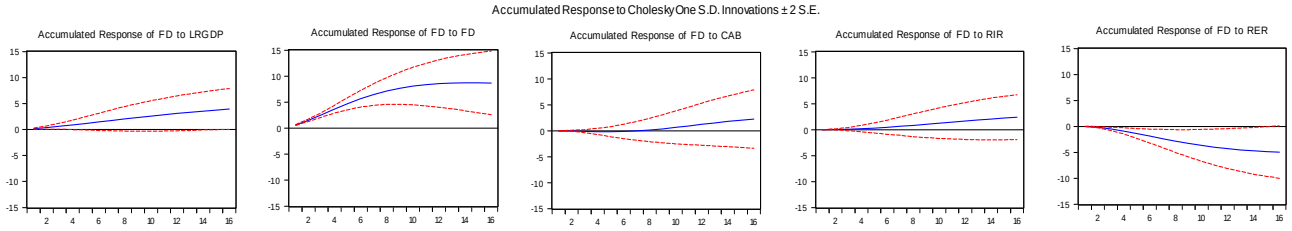


Table 4.15: Morocco Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to;**

Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	6.14	93.86	0.00	0.00	0.00	1	10.53	16.2	73.27	0.00	0.00
4	5.00	86.95	0.24	0.35	7.45	4	8.58	8.84	77.19	3.95	1.44
8	6.23	77.22	0.63	1.41	14.52	8	7.24	4.52	75.06	11.03	2.15
12	7.82	68.88	3.41	2.78	17.10	12	7.45	4.62	72.06	13.51	2.36
20	9.73	63.41	5.80	4.17	16.88	20	8.75	4.77	70.44	13.66	2.39
30	11.46	61.90	5.98	4.13	16.53	30	10.63	4.99	68.80	13.24	2.34
40	13.25	60.48	5.91	4.04	16.32	40	12.43	4.93	67.16	12.97	2.51
50	14.97	59.08	5.79	3.97	16.19	50	14.17	4.83	65.62	12.67	2.70

Table 4.16: Nigeria VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
LGDP	-	0.98	0.47	0.43	0.38
FD	0.61	-	0.38	0.02	0.06
CAB	0.27	0.49	-	0.67	0.98
RIR	0.87	0.37	0.14	-	0.66
RER	0.00	0.54	0.38	0.03	-

Notes: See Table 4.2

Figure 4.8: Nigeria IRF

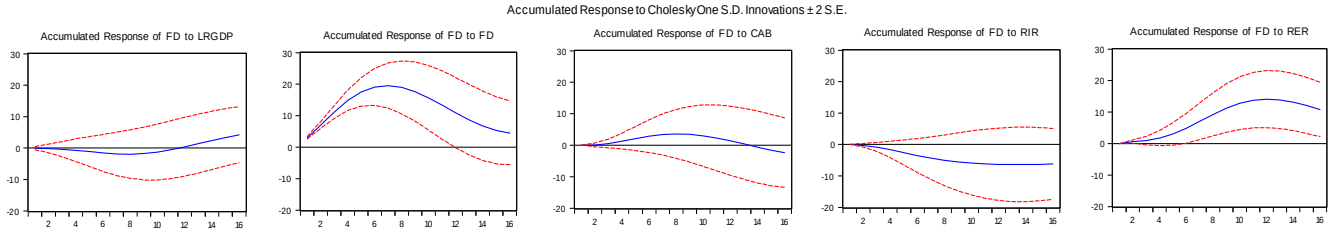


Table 4.17: Nigeria Variance Decomposition

Fraction of fiscal deficits variance due to;						**Fraction of current account variance due to;**					
Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	0.85	99.15	0.00	0.00	0.00	1	1.22	12.24	86.54	0.00	0.00
4	0.58	91.29	1.29	1.78	5.06	4	5.30	13.77	80.89	0.03	0.02
8	0.99	78.42	1.81	5.72	13.05	8	11.26	10.66	76.13	1.59	0.35
12	2.27	75.54	1.99	6.86	13.34	12	14.25	11.02	70.13	4.08	0.52
20	3.03	75.12	2.30	6.65	12.90	20	15.70	12.21	66.88	4.71	0.50
30	4.36	73.85	2.39	6.58	12.81	30	18.07	11.83	64.77	4.63	0.69
40	5.93	72.52	2.35	6.52	12.67	40	20.91	11.41	62.21	4.58	0.90
50	7.78	70.93	2.32	6.44	12.53	50	24.06	10.91	59.39	4.51	1.13

Table 4.18: South Africa VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.25	0.00	0.29	0.16
FD	0.16	-	0.74	0.47	0.64
CAB	0.07	0.61	-	0.03	0.67
RIR	0.73	0.09	0.23	-	0.68
RER	0.01	0.61	0.21	0.55	-

Notes: See Table 4.2

Figure 4.9: South Africa IRF

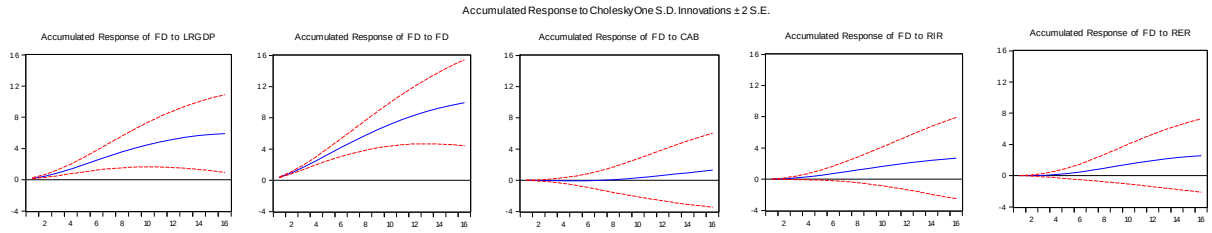


Table 4.19: South Africa Variance Decomposition

Fraction of fiscal deficits variance due to; **Fraction of current account variance due to**;

Qrts Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	16.24	83.76	0.00	0.00	0.00	1	2.81	0.00	97.18	0.00	0.00
4	23.72	74.09	0.05	1.71	0.42	4	11.73	0.37	84.82	2.77	0.31
8	26.60	66.94	0.14	3.52	2.81	8	17.89	0.37	77.08	2.48	2.19
12	25.73	64.36	0.93	4.44	4.54	12	19.53	0.79	73.28	2.91	3.49
20	23.87	63.46	2.31	5.34	5.02	20	19.97	1.67	71.46	2.95	3.95
30	24.97	62.04	2.47	5.38	5.15	30	20.53	1.76	70.70	2.99	4.02
40	25.83	60.53	3.06	5.27	5.31	40	20.91	1.86	70.20	2.99	4.04
50	26.29	59.71	3.44	5.23	5.34	50	21.37	1.99	69.62	2.95	4.06

Table 4.20: Tanzania VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.36	0.72	0.22	0.00
FD	0.02	-	0.54	0.93	0.06
CAB	0.84	0.41	-	0.73	0.77
RIR	0.33	0.00	0.01	-	0.00
RER	0.62	0.70	0.99	0.24	-

Notes: See Table 4.2

Figure 4.10: Tanzania IRF

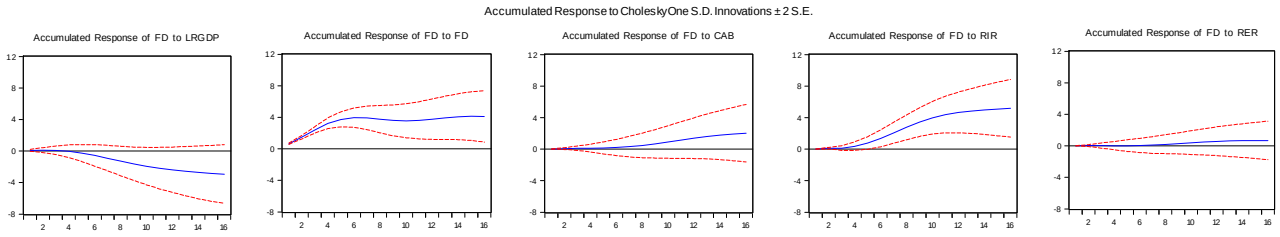


Table 4.21: Tanzania Variance Decomposition

Fraction of fiscal deficits variance due to;						**Fraction of current account variance due to;**					
Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	5.63	94.37	0.00	0.00	0.00	1	16.83	15.87	67.30	0.00	0.00
4	2.20	92.06	0.41	1.83	3.51	4	16.78	8.84	74.33	0.02	0.03
8	9.57	74.15	2.45	6.19	7.63	8	13.64	5.19	80.09	0.27	0.81
12	12.25	66.57	5.49	8.22	7.46	12	11.51	4.39	81.09	1.14	1.87
20	11.97	64.68	7.86	8.45	7.04	20	10.65	4.48	80.06	2.38	2.42
30	12.09	64.23	8.23	8.41	7.04	30	10.64	4.90	79.29	2.70	2.48
40	12.05	64.02	8.22	8.48	7.23	40	10.65	4.98	79.19	2.71	2.48
50	12.02	63.79	8.19	8.59	7.40	50	10.64	4.98	79.15	2.72	2.51

Table 4.22: Tunisia VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.00	0.58	0.07	0.31
FD	0.08	-	0.95	0.05	0.93
CAB	0.07	0.74	-	0.56	0.53
RIR	0.60	0.58	0.33	-	0.09
RER	0.05	0.86	0.39	0.15	-

Notes: See Table 4.2

Figure 4.11: Tunisia IRF

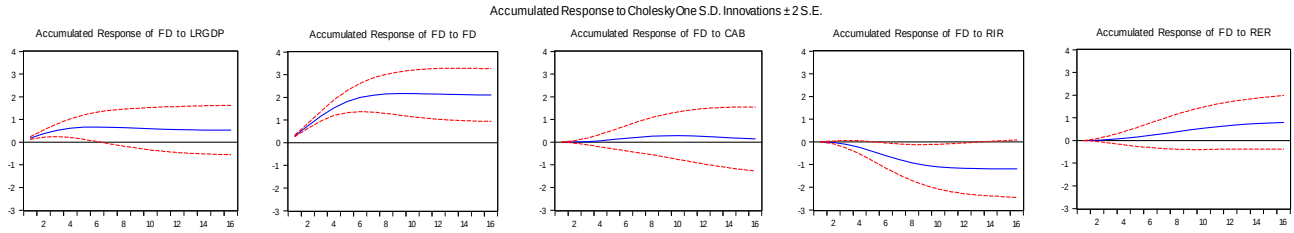


Table 4.23: Tunisia Variance Decomposition

Fraction of fiscal deficits variance due to;						**Fraction of current account variance due to;**					
Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	25.83	74.17	0.00	0.00	0.00	1	19.49	2.00	78.5	0.00	0.00
4	13.64	81.98	0.25	3.67	0.46	4	13.09	0.82	85.4	0.62	0.07
8	10.27	72.14	1.14	13.93	2.51	8	10.07	1.22	87.00	0.99	0.72
12	10.02	69.25	1.20	15.24	4.28	12	9.72	1.94	85.89	1.02	1.42
20	9.94	68.57	1.61	15.11	4.77	20	9.73	2.08	84.21	1.87	2.11
30	9.94	68.49	1.62	15.14	4.81	30	9.76	2.31	83.6	2.04	2.29
40	9.94	68.48	1.62	15.14	4.82	40	9.88	2.41	83.36	2.03	2.32
50	9.94	68.48	1.62	15.14	4.82	50	10.00	2.53	83.1	2.03	2.34

Table 4.24: Uganda VAR Granger Causality

		Lags of	Variables		
Dependent Variable	GDP	FD	CAB	RIR	RER
GDP	-	0.11	0.86	0.27	0.30
FD	0.00	-	0.36	0.74	0.83
CAB	0.47	0.46	-	0.58	0.20
RIR	0.03	0.57	0.41	-	0.02
RER	0.95	0.16	0.83	0.87	-

Notes: See Table 4.2

Figure 4.12: Uganda IRF

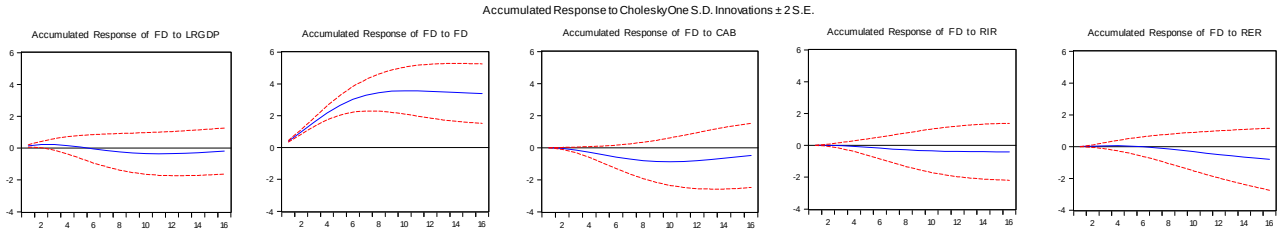


Table 4.25: Uganda Variance Decomposition

Fraction of fiscal deficits variance due to;						**Fraction of fiscal deficits variance due to**;					
Qtrs Ahead	GDP	FD	CAB	RIR	RER	Qtrs Ahead	GDP	FD	CAB	RIR	RER
1	10.28	89.72	0.00	0.00	0.00	1	17.73	4.73	77.54	0.00	0.00
4	2.23	95.18	2.33	0.17	0.08	4	11.21	3.57	84.45	0.08	0.69
8	3.71	89.36	5.47	0.75	0.70	8	7.68	4.01	83.87	0.71	3.74
12	3.91	87.28	5.63	0.90	2.29	12	6.88	4.51	80.02	1.04	7.55
20	4.83	82.89	7.56	0.86	3.85	20	6.61	4.41	75.90	1.03	12.06
30	6.42	80.79	7.67	0.96	4.16	30	6.50	4.32	74.48	1.02	13.68
40	7.84	79.34	7.64	1.09	4.09	40	6.47	4.30	74.03	1.02	14.18
50	9.24	77.90	7.56	1.19	4.11	50	6.48	4.29	73.88	1.02	14.32

4.4 Granger Causality Results

Prior to interpreting the Granger-causality test, it important to make a clarification on what the test does. The test does not provide an answer whether the movement of a variable can be ascribed to changes in other variable; rather it only explains that the movement of one variable is followed by another variable (Brooks 2008). F-tests for the null hypothesis that all of the lags of a given variable are jointly insignificant in a given equation are presented in the above tables. Here, we analyse the causal relationship between fiscal deficits and other variables and the results are classified as; {(FD LRGDP) (FD CAB) (FD RIR) (FD RER)}.

The tables show that the fiscal deficits Granger-cause the real GDP in Egypt, Ghana, Kenya and Tunisia, while there is evidence that the real GDP Granger-cause the fiscal deficits in Botswana, Ghana, Tanzania, Tunisia and Uganda. This implies that there is evidence of bi-directional causality in Ghana and Tunisia.

Fiscal deficits Granger-cause the current account deficits in Botswana and Egypt. There is evidence that the current account deficits Granger-cause the fiscal deficits in Botswana and Ethiopia. This implies that there is evidence of bi-directional causality of the twin deficits in Botswana. In Ethiopia where a degeneration of the current account deficits leads to fiscal deficits, it implies that they depend heavily on foreign capital inflows as a way to improve growth.

There is evidence that fiscal deficits Granger-cause the real interest rate in Egypt, Ghana, South Africa and Tanzania and also there is evidence that the real interest rate Granger-cause the fiscal deficits in Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria and Tunisia. From the above, it implies that there is the existence of bi-directional relationship of fiscal deficits and real interest rate in Egypt and Ghana.

Fiscal deficits Granger-cause the real exchange rate in Egypt and Kenya. There is evidence of uni-directional causality from the real exchange rate to the fiscal deficits in Cameroon, Morocco, Nigeria and Tanzania.

4.5 Impulse Response Function Results

Further information about the relationships between the pre-specified variables and fiscal deficits is generated by the impulse responses and variance decompositions. The ordering of the variables is important in the decomposition since it is effective equivalent to an identifying restriction on the primitive form of the VAR. Thus, we follow the orderings LRGDP, FD CAB, RIR, and RER. Here, the contemporaneously variables are ordered first. We identify the real GDP as the first variable because government budget deficits and other variables are likely to be endogenously affected

by the current level of economic activity within a quarter.

The impulse response functions shows the direction, magnitude and the time path of fiscal deficits shocks emanating from output growth, current account balance, real interest rate and the real exchange rate. The figures show the fiscal deficits profile for each of the 12 countries, where the dotted lines denote the five per cent confidence bands. Fiscal deficits of these countries do seem to be very sensitive to output growth. Only in four countries the fiscal deficits did not respond positively to output growth shock: Ethiopia, Ghana, Tanzania and Uganda. This effect is probably due to public sector spending inefficiency, which most developing countries were exposed to. In response to a positive government deficit shock, output increases in Botswana, Cameroon, Egypt, Kenya, Morocco, Nigeria, South Africa, and Tunisia. This is consistent with the traditional Keynesian theory that budget deficits will exert a positive effect on macroeconomic activity and this finding is consistent with Kim and Roubini (2008).

A positive government deficit shock leads to increase in the current account deficit in Botswana, Egypt, Ethiopia, Ghana, Morocco, South Africa, and Tanzania. This result is in conformity with the standard prediction of theoretical models that fiscal deficits will lead to a current account deficits; this means there is evidence of twin deficits. This finding is consistent with Holmes (2011). The current account improves in response to a positive government deficits shock in Cameroon and Uganda this is not consistent with the standard prediction of most theoretical models that an increase in government budget deficits would induce domestic absorption and hence import expansion thereby causing current account deficits. Also in response to a positive government deficit shock, the current account remains constant in Kenya, Nigeria and Tunisia and this consistent with the Ricardian Equivalent Hypothesis (REH). A major reason for the differences in this result is linked to the structure of these economies. For countries where the twin deficits hypothesis do not hold, it is suggested that these countries receive large inflow of aids and grants.

In response to a positive government deficits shock, the real interest rate increases in Botswana, Egypt, Kenya, Morocco, South Africa and Tanzania. This is consistent with the standard economic theory of the Neoclassical and the Keynesian that the impact of increased deficits on interest rates operates through the effects of higher spending and increased wealth on the demand for money. There is a decrease in the real interest rate in Ethiopia, Ghana, Nigeria, Tunisia and Uganda This result is consistent with the finding of Dai and Philippon (2006). There is a striking result in Cameroon where the real interest rate remains constant, and this is consistent with the Ricardian Equivalence Hypothesis which argues that the value of the new debt is simply perceived as the present value of the future tax liabilities. This means that

the government debt is not viewed as net wealth, and, as a result, money demand would not be affected. Consequently, interest rates remain unchanged as well. This finding is consistent with the works of Darrat and Sulaiman (1991).

In response to a government deficit shock, the real exchange rate appreciates in Botswana, Kenya, Morocco and Uganda, this is consistent standard theory that increases in the deficit may appreciate the exchange rate depending on the relative importance of wealth effects and relative asset substitution effects and that deficits combined with tight monetary policy, will cause the currency to appreciate Hakkio (1996). However, in response to a positive shock in government deficit shock, the real exchange rate depreciates in Cameroon, Egypt, Ghana, Nigeria, South Africa, Tanzania and Uganda and this violates the standard theory of macroeconomics. Froot and Rogoff (1991) assert that if the central bank is independent and deficits are not expected to be monetized, a fiscal package that results in an expansion of aggregate demand should appreciate the real exchange rate. The depreciation of the real exchange rate in response to a positive government spending shock in these countries is not unconnected with the fact that her central bank is not independent, and that deficits are monetized by their central bank.

4.6 Variance Decomposition Results

Impulse response analysis is useful in considering the signs and magnitude of responses to specific shocks; however, the relative importance of shocks for given variable fluctuations is better assessed through the variance decompositions. The above tables give variance decomposition of fiscal deficits and current account to real GDP, fiscal deficit, current account, real interest rate and real exchange rate shocks. The variance decomposition is used to examine the effects of innovations to current account deficits and fiscal deficits.

The variance decomposition of fiscal deficits indicates that between 74-99 per cent of the forecast error of fiscal deficits is accounted for by its own innovation in the first quarter of estimation while the influence from its own shock fell gradually to 39-84 per cent after the fiftieth quarter. The fluctuations in the current account balance explained between 1-16 per cent for all the countries with Kenya amounting to less than 1 per cent of the forecast error variance in fiscal deficits after the fiftieth quarter. Innovations in output contributed between 5- 27 per cent, while interest rates and exchange rates contributed between 1-30 per cent and 3-18 per cent respectively after a 50 quarter horizon.

The variance decomposition of current account balance indicates that between 69 - 98 per cent of the forecast error of current account balance is accounted for

by its own innovation in the first quarter of estimation while the influence from its own shock fell gradually to 33-84 per cent after the fiftieth quarter. The fluctuations in fiscal deficits explained about 1-38 per cent for all the countries of the forecast error variance in the current account balance after the fiftieth quarter. Innovations in output contributed between 1- 44 per cent while interest rates and exchange rates contributed between 1-14 per cent and 1-15 per cent after a 50 quarter horizon.

Reports show that the influence of real interest rates shock on fiscal deficit and current account balance varies across the twelve countries and its significantly low, accounting for 0-15 per cent in all countries, except for Egypt where it was about 31 per cent. The major reason for the low significant level is because of financial depression experienced by these countries.

A cross-check of the variance decomposition shows that fiscal deficits variance to current account balance is greater than the current account balance variance to fiscal deficits in Botswana, Egypt, Kenya, Nigeria and Tunisia; this implies that fiscal deficits shocks have a significant impact on current account balance and that the direction of causality runs from the fiscal deficits to the current account while in Cameroon, Ethiopia, Ghana, Morocco, South Africa, Tanzania and Uganda the current account balance have a significant impact on fiscal deficits indicating that causality runs from current account balance to fiscal deficits.

4.7 Sensitivity Analysis: Alternative Identification Assumptions

The identification approach for the benchmark model follows the institutional information about tax and transfer system as well as the timing of tax collections of Blanchard and Perotti (2002). The theoretical justification for the alternative ordering is premised on the fact that decision and implementation lags in fiscal policy have little or no discretionary response to movements in economic activity. Most especially in African countries where tax management is a problem and there is always a delay in the implementation of government policies and programmes. Thus, the fiscal deficits is ordered as the last variable.

The impulse response analysis may be sensitive to the ordering of variables in the VAR approach. In the benchmark VAR model analysed, the variables were ordered as follows: $Y_t = [lrgdp_t, fd_t, cab_t, rir_t, rer_t]'$. An analysis of all possible orderings will extremely be messy, we consider a single alternative ordering that places the fiscal deficits last in the list of variables: $Y_t = [lrgdp_t, cab_t, rir_t, rer_t, fd_t]'$. This implies that fiscal deficits is affected contemporaneously by shocks to all other variables but

that the other variables are unaffected contemporaneously by shocks to fiscal deficits. This can be regarded as an extreme departure from the benchmark case in which fiscal deficit was unaffected contemporaneously by shocks to current account balance, real interest rates and real exchange rates while the benchmark ordering of variables seems more plausible given the decision and implementation lags involved in fiscal policy, it would be reassuring if the results obtained for this alternative ordering were similar to those obtained in the benchmark case.

The impulse responses of fiscal deficits to shocks in output, current account balance, real interest and real exchange rates for the alternative ordering of variables shows that the results are qualitatively very similar to those obtained for the benchmark ordering of variables $Y_t = [lrgdp_t, fd_t, cab_t, rir_t, rer_t]'$. It therefore, suggests that the twin deficits effect is not sensitive to alternative orderings.

4.8 Conclusion

This chapter provides a VAR model to examine the indirect relationship between fiscal deficits and the current account deficits. Most importantly, the Granger causality test, impulse response function and the forecast error of variance decomposition is used to evaluate the relationship between the twin deficits. The Granger causality suggests that fiscal deficits Granger-cause the current account deficits in Botswana and Egypt and also the current account deficits Granger-cause the fiscal deficits in Botswana and Ethiopia, only in Botswana where we have evidence of bi-directional causality.

The impulse response function reveals that a positive government deficit shock increases the current account deficit in Botswana, Egypt, Ethiopia, Ghana, Morocco, South Africa, and Tanzania while the current account improves in response to a positive government deficits shock in Cameroon and Uganda. Also in response to a positive government deficit shock, the current account remainsconstant in Kenya, Nigeria and Tunisia and the outcome which is consistent with the Ricardian Equivalent Hypothesis (REH).

The variance decomposition shows that fiscal deficits variance to current account balance is greater than the current account balance variance to fiscal deficits in Botswana, Egypt, Kenya, Nigeria and Tunisia while in Cameroon, Ethiopia, Ghana, Morocco, South Africa, Tanzania and Uganda the current account balance have a significant impact on fiscal deficits.

Finally, a sensitivity analysis was examined if there is any significance difference in the ordering of the variables. We re-ordered the variables as $Y_t = [lrgdp_t, cab_t, rir_t, rer_t, fd_t]'$. The result reveals that they were qualitatively very similar to those obtained for

the benchmark ordering of variables $Y_t = [lrgdp_t, fd_t, cab_t, rir_t, rer_t]'$. It therefore, suggests that the twin deficits effect is not sensitive to alternative orderings.

Table 4.26: Summary of Results for the Twin Deficits Relationship

Country	Granger Causality	Impulse Response Functon
Botswana	✓	✓
Cameroon	×	×
Egypt	✓	✓
Ethiopia	×	✓
Ghana	×	✓
Kenya	×	×
Morocco	×	✓
Nigeria	×	×
South Africa	×	✓
Tanzania	×	✓
Tunisia	×	×
Uganda	×	×

Note: × = No evidence of twin deficits, ✓ = evidence of twin deficits

Chapter 5

Twin Deficits Hypothesis – ARDL Approach

5.1 Introduction

Over the past two decades widening fiscal deficits and current account imbalances has generated concern in developing countries largely because they are seen a measure of macroeconomic performance of a country. The attendant problems of large fiscal deficits and current account deficits have led researchers to investigate the connections. These connections are both direct and indirect as fiscal deficits may cause current account deficits by increases in the real interest rate, implying an increase in capital inflows and an appreciation of the exchange rate and thereby increasing current account deficits. However, results from the empirical literature suggest are inconclusive.

This study differs from the existing literature in two main ways. First, the indirect relationship between fiscal deficit and current account deficit is examined, by including the real interest rate and the real exchange rate. Second, issue of structural breaks is addressed; this has been omitted in previous studies on twin deficits in African countries. The Lee and Starzicich (2003) two structural break test is used.

The objective of this study is to use the Autoregressive Distributed Lag (ARDL) approach to cointegration and error correction. This approach provides the flexibility to accommodate structural breaks, to determine whether there is any evidence of long run relationships between the twin deficits and also to examine whether variables return to equilibrium following shocks. Following the introduction, we discuss the ARDL approach to cointegration in section 5.2. Section 5.3 addresses structural break modelling, section 5.4 is devoted to interpretation of results of the analytical

model, the welfare implications of fiscal deficits are discussed in section 5.5. Section 5.6 discuss the conclusion.

5.2 Methodology and Variable Description

In examining how the fiscal deficits and the current account deficits are related the Mundell-Fleming framework explain the transmission mechanism thus; an increase in the fiscal deficit will give rise to an increase in the interest rate that in turn causes capital inflows and an appreciation of the exchange rate which increases the current account deficit. From the above theoretical point of view, five variables is included in the model, and they are the fiscal deficits expressed as a percentage of the GDP, the current account deficits expressed as a percentage of the GDP, the real interest rates and the real exchange rates. The real gross domestic product (RGDP) is the key macro variable representing the broad economic performance, and it is included in the model to control for the cyclical components of the government budget deficit.

Thus, the twin deficit function takes the following form:

$$CAB_t = \beta_0 + \beta_1 \ln RGDP_t + \beta_2 FD_t + \beta_3 RIR_t + \beta_4 RER_t + \varepsilon_t \qquad (5.1)$$

where CAB is the current account balance expressed as a percentage of GDP, $RGDP$ is a measure of real income as a scale variable, FD is the fiscal deficits expressed as a percentage of GDP, RIR is the real interest rates and RER is the real exchange rate. Following macro theory, estimates of β_1, β_2 and β_3 is expected to be positive, an estimate of β_4 could be negative or positive. Given that the exchange rate is defined as the number of units of domestic currency per US dollar, an increase in the exchange rate means a depreciation of the domestic currency raises the value of the foreign assets in terms of domestic currency. If this increase is perceived as an increase in wealth, then the demand for domestic money increases yielding a positive estimate of β_4. However, if an increase in the exchange rate induces an expectation of further depreciation of the domestic currency, public may hold less of domestic currency and more of foreign currency. In this case, an estimate of β_4 is expected to be negative.

5.2.1 The Autoregressive Distributed Lag (ARDL) Testing Approach

The Autoregressive Distributed Lag (ARDL) approach developed by Pesaran, Shin and Smith (2001) for testing the presence of cointegrating relationship has peculiar

advantages over other symmetric cointegration tests. First, the ARDL approach can be applied to variables of a different order of cointegration (Pesaran and Pesaran, 1997). Second, the ARDL approach is applicable for small or finite sample size (Pesaran et al 2001). Third, the short and long-run parameters are estimated concurrently. Fourth, the approach can accommodate structural breaks in time series data.

In respect with the above advantages of the ARDL approach and coupled with the fact that the variables employed in this study have different order of integration and also because it is applicable to a small sample size, the study used the ARDL approach to examine the twin deficits hypothesis in twelve African countries. The Microfit software program was used to facilitate the estimation process.

The ARDL method involves four steps. The first step is to examine the presence of cointegration using the bounds testing procedure (Pesaran and Pesaran, 1997; Pesaran, Shin and Smith, 2001). The ARDL representation of current account balance, log of the real gross domestic product, fiscal deficits, real interest rates and the real exchange rate can be constructed as:

$$\begin{aligned}\Delta CAB_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta CAB_{t-i} + \sum_{i=0}^{p} \beta_2 \Delta \ln RGDP_{t-i} + \sum_{i=0}^{p} \beta_3 \Delta FD_{t-i} + \sum_{i=0}^{p} \beta_4 \Delta RIR_{t-i} \\ + \sum_{i=0}^{n} \beta_5 \Delta RER_{t-i} + \delta_1 CAB_{t-1} + \delta_2 \ln RGDP_{t-1} + \delta_3 FD_{t-1} + \delta_4 RIR_{t-1} + \\ \delta_5 RER_{t-1} + \varepsilon_t \qquad (5.2)\end{aligned}$$

where the variables are as defined in equation (5.1).

In this set up, the null of no cointegration defined by $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ is tested against the alternative of $H_1 : \delta_1 \neq 0,\ \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0, \delta_5 \neq 0$ by the F-test. The asymptotic distribution of the F-statistic is non-standard irrespective of whether the variables are I(0) or I(1). Pesaran et al. (2001) tabulated two sets of appropriate critical values. One set assumes all variables are I(1) and another assume that they are all I(0). This provides a band covering all possible classifications of the variables into I(0) and I(1) or even fractionally integrated. If the calculated F-statistic lies above the upper level of the band, the null is rejected, indicating that cointegration exists. If the F-statistic is below the lower critical bounds value, it implies no cointegration. Lastly, if the F-statistic falls into the bounds then the test becomes inconclusive.

5.3 Modelling the structural breaks in Twin Deficits Model

The statistically significant structural breaks $TB1$ and $TB2$[1] respectively for current account balances (CAB) in chapter 3 are modelled using two dummy variables, $DU1$and $DU2$. This are included in equations (5.3), which gives us the estimable equations. The dummy variable $DU1$ takes on a value of zero prior to the first break date of $TB1$ and unity thereafter up to the second break date that occurs in $TB2$ when $DU2$ takes on the value of unity and zero otherwise.

$$\Delta CAB_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta CAB_{t-i} + \sum_{i=0}^{p} \beta_2 \Delta \ln RGDP_{t-i} + \sum_{i=0}^{p} \beta_3 \Delta FD_{t-i} + \sum_{i=0}^{p} \beta_4 \Delta RIR_{t-i} + \sum_{i=0}^{p} \beta_5 \Delta RER_{t-i} + \delta_1 CAB_{t-1} + \delta_2 \ln RGDP_{t-1} + \delta_3 FD_{t-1} + \delta_4 RIR_{t-1} + \delta_5 RER_{t-1} + \delta_6 DU1_t + \delta_7 DU2_t + \varepsilon_t \quad (5.3)$$

The parameters $\delta_i, i = 1, 2, 3, 4, 5, 6$ and 7 are the long-run multipliers, parameters β_1 to β_5 are the short-run multipliers, and ε_t represents residuals.

The second step is to estimate the coefficient of the long run relationships identified in the first step. Having found long run relationships among the variables, in the next step the long run relationship is estimated using an appropriate lag selection criterion based on Schwarz Bayesian Criterion (SBC) for the ARDL model as only an appropriate lag selection criterion will be able to identify the true dynamics of the model.

The third step is to estimate the short run dynamic coefficients.

[1](a) A similar approach is adopted by Pesaran et al. (2001, p. 307) in their re-examination of the earnings equation (equation 30, p. 307) included in the UK Treasury macroeconometric model. They include 'two dummy variables to account for the effects of incomes policies on average earnings'. Pesaran et al. (2001, p. 307) emphatically claimed that 'The asymptotic theory developed in the paper is not affected by the inclusion of such "one-off" dummy variables'.

(b) Khorshed Chowdhury (2012, p. 59-60) examined the real exchange rate and the Balassa–Samuelson hypothesis in SAARC countries. They include two dummy variables to account for the effects of real exchange rate on labour productivity differentials.

(c) Chowdhury and Saleh (2007, p. 12-13) examined the twin deficit hypothesis in Sri-Lanka and they include one dummy variable to account for the effect of fiscal deficits on current account balance.

The fourth stage involves testing for the stability of the model, by using the CUSUM and CUSUMSQ. From the second stage, not only are estimates of long-run elasticities ($\delta_1 - \delta_5$) obtained, but also the CUSUM and CUSUMSQ tests are applied to the residuals of equation (5.3) to test for stability of long-run elasticities by taking into account the short-run dynamics.

5.4 Empirical Anaylsis

5.4.1 Cointegration Tests Results

To conduct the bounds test for co-integration approach within the UECM framework, the optimal lag order must be determined. According to Enders (2003) too many lags incorporated into the testing equation (i.e. UECM) may reduce the degree of freedom and the power of the test statistics, while too few lags may cause a misspecification problem. Following Lutkepohl (2005), the Schwarz Bayesian Criterion (SBC) performs better than other information criteria. Therefore, we used the SBC to find the optimal lag structures in the UECM. The results of the F bounds test in Table 5.1 implies that at 1%, 5% and 10% level, the null hypothesis of no cointegration among the variables in equation (5.3) was rejected for all the countries. Therefore, these variables co-moved in the long run.

Having found a long-run relationship between the fiscal deficits, national income, the current account balance, the real interest rates and the exchange rates, we then estimate the long-run elasticities. We investigate the impact of national income, fiscal deficits, real interest rates and real exchange rates on current account balance, In the ARDL estimation, a maximum of 2 lags was used (imax = 2) for all countries except Ghana where the maximum lag was 6. The empirical results for the model, obtained through normalizing the current account balance (CAB) in the short and long run are reported below.

Table 5.1: Bound Testing for Cointegration Analysis

Panel A	*Unrestricted intercept and no trend*
$F_{cab}(CAB/LRGDP, FD, RIR, RER)$	F-test Statistic
Botswana	5.80***
Cameroon	4.00*
Egypt	8.10***
Ethiopia	4.92**
Ghana	4.24**
Kenya	4.30**
Morocco	5.03**
Nigeria	6.82***
South Africa	3.80*
Tanzania	5.50***
Tunisia	5.09**
Uganda	3.90*

Panel B Critical Values

1%		5%		10%	
I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
3.817	5.122	2.850	4.049	2.425	3.574

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively. Critical values are obtained from Pesaran et al (2001). The results for the ARDL approach were generated using the MICROFIT software.

5.4.2 The Long-Run Dynamics

The estimated long-run coefficients (elasticities) for the UECM model are given in the tables below. In the long run, a one per cent increase in the real GDP leads to 21.59, 14.75, 6.2, 49.43, 41.82, 33.05, 10.46 and 18.29 decrease in the current account deficits in Botswana, Cameroon, Ghana, Kenya, Nigeria, South Africa, Tanzania and Uganda respectively. This implies that an increase in real GDP worsens the current account deficits in these countries. This is consistent with Kim and Roubini (2008) who found that a positive output shock worsens the current account balance in the US. However, one per cent increase in the real GDP will lead to 4.23, 27.97, 36.14 and 1.67 increases in the current account deficits in Egypt, Ethiopia, Morocco and Tunisia. The empirical evidence shows that real GDP have a negative statistically significant effect on the current account deficit only in Kenya, South Africa and

Uganda and a positive statistically significant effect only in Ethiopia and Morocco.

One per cent increase in the budget deficits will lead to 0.92, 0.04, 0.47, 0.16, 0.03, 0.34, 2.14 and 0.35 increases in the current account deficits in Botswana, Cameroon, Egypt, Ghana, Morocco, Nigeria, Tanzania and Tunisia. This result is in conformity with Saleh (2006), Onafowora and Owoye (2006), Beetsma et al (2007) and Abass et al (2010).

Also, one per cent increase in budget deficits lead to 0.56, 0.52, 0.05 and 0.52 decrease in the current account deficits for Ethiopia, Kenya, South Africa and Uganda. The empirical evidence shows that the fiscal deficits have a positive statistically significant effect on the current account deficit only in Botswana, Egypt, Nigeria and Tanzania and statistically insignificant in Cameroon, Ghana, Morocco and Tunisia. Fiscal deficits have a negative and statistically significant effect in Ethiopia and Kenya but not in South Africa and Uganda.

The effect of real interest rate on the current account is positive in Botswana, Ethiopia, Morocco, Nigeria and Uganda and negative in Cameroon, Egypt, Ghana, Kenya, South Africa, Tanzania and Tunisia. Implying that one per cent increase in real interest rate leads to a 1.62, 0.6, 0.8, 0.09 and 0.01 per cent increase in the current account deficit for Botswana, Ethiopia, Morocco, Nigeria and Uganda respectively; and also one per cent in the real interest rate leads to a 0.14, 0.15, 0.10, 0.02, 0.14, 0.17 and 0.47 decrease in the current account deficit for Cameroon, Egypt, Ghana, Kenya, South Africa, Tanzania and Tunisia respectively.

Considering the effect of real exchange rate on the current account, one per cent increase in real exchange rate leads to a 1.94, 4.58, 0.44, 0.96, 1.75 and 0.99 per cent increase in the current account deficit for Cameroon, Egypt, Kenya, Nigeria, South Africa and Tunisia respectively. In these countries, it implies that there is depreciation of the exchange rate which in turn improves the current account deficit because such countries experience a fall in the foreign price of its exports which appear more competitive and therefore a rise in the quantity of their exports, thereby improving the current account deficit. Similarly, depreciation of the exchange rate, will also lead to an increase in the cost of buying imports and this will lead to a fall in demand for imports and also help to reduce the current account deficit.

Table 5.2: Full Information Estimates for Botswana

Panel A Long-Run Coefficients Estimates

Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-21.593	15.016	-1.438
FD	0.924	0.138	6.703***
RIR	1.621	0.374	4.335***
RER	-1.638	5.071	-0.323
CONS	48.193	41.811	1.153
DU1	17.891	5.083	3.519***
DU2	21.201	7.279	2.912***

Panel B Short-Run Coefficients Estimates

Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.557	0.073	7.583***
$\Delta LRGDP$	-307.82	94.048	-3.273***
$\Delta LRGDP_{t-1}$	245.311	92.102	2.664***
ΔFD	-0.146	0.157	-0.926
ΔRIR	0.507	0.185	2.732***
ΔRIR_{t-1}	-0.692	0.173	-3.996***
ΔRER	-0.551	1.704	-0.323
$\Delta CONS$	16.221	13.482	1.203
$\Delta DU1$	-7.019	2.849	-2.464***
$\Delta DU2$	-8.101	3.904	-2.075**
$ECM(-1)$	-0.337	0.046	-7.188***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.1: Botswana Stability Test

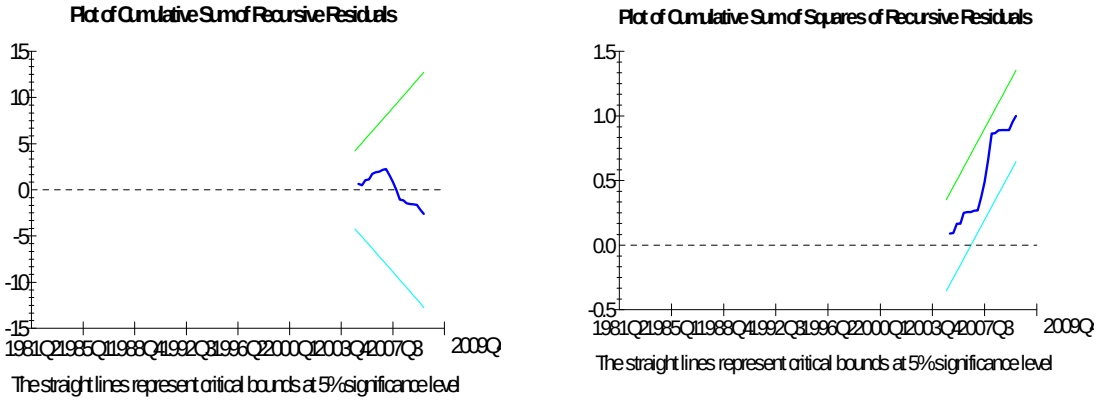


Table 5.3: Full Information Estimates for Cameroon

Panel A Long-Run Coefficients Estimates

Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-14.757	10.106	-1.460
FD	0.048	0.062	0.778
RIR	-0.141	0.081	-1.743*
RER	1.943	1.221	1.591
CONS	40.963	33.756	1.213
DU1	0.382	1.171	0.326
DU2	4.287	2.138	2.006**

Panel B Short-Run Coefficients Estimates

Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.492	0.085	5.776***
$\Delta LRGDP$	-2.845	2.005	-1.418
ΔFD	0.009	0.012	0.784
ΔRIR	-0.027	0.015	-1.837*
ΔRER	0.375	0.232	1.615
$\Delta CONS$	7.896	6.646	1.188
$\Delta DU1$	0.074	0.229	0.322
$\Delta DU2$	0.826	0.465	1.779*
$ECM(-1)$	-0.193	0.043	-4.465***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.2: Cameroon Stability Test

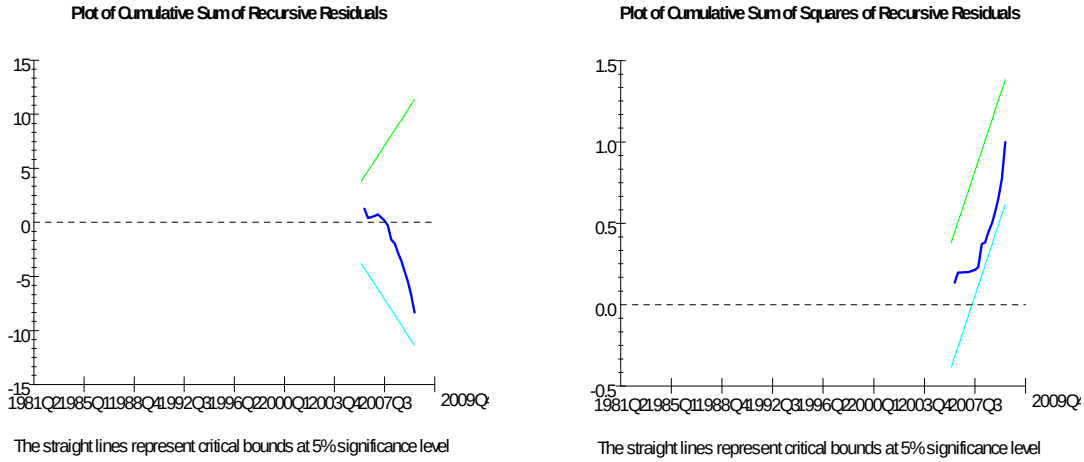


Table 5.4: Full Information Estimates for Egypt

Panel A Long-run coefficients estimates
Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	4.229	10.044	0.421
FD	0.474	0.147	3.223***
RIR	-0.158	0.201	-0.791
RER	4.583	3.184	1.439
CONS	-13.789	41.445	-0.333
DU1	3.597	2.349	1.532
DU2	-5.403	4.218	-1.281

Panel B Short-Run Coefficients Estimates
Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.505	0.073	6.949***
$\Delta LRGDP$	0.451	1.078	0.418
ΔFD	-0.078	0.039	-1.953*
ΔRIR	-0.017	0.021	-0.804
ΔRER	0.488	0.329	1.484
$\Delta CONS$	-1.469	4.447	-0.330
$\Delta DU1$	0.383	0.261	1.471
$\Delta DU2$	-0.576	0.428	-1.346
$ECM(-1)$	-0.107	0.022	4.871***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.3: Egypt Stability Test

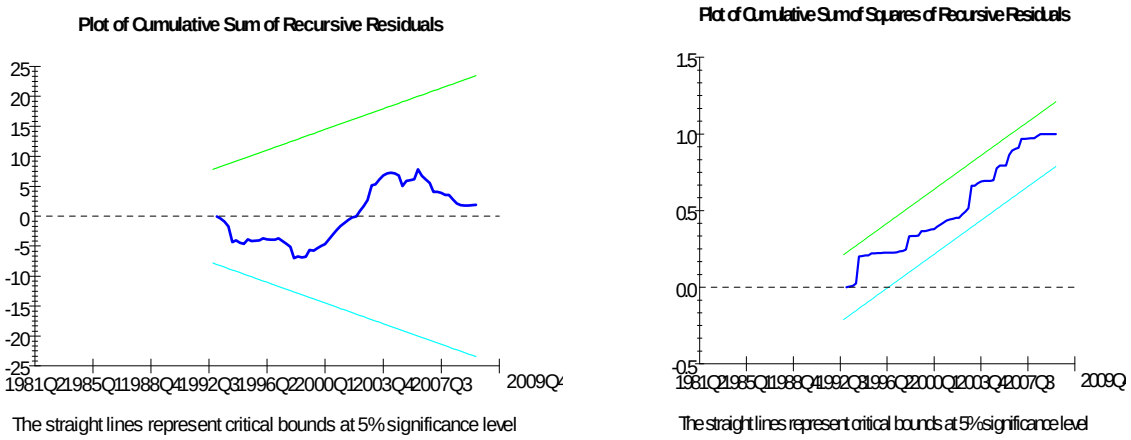


Table 5.5: Full Information Estimates for Ethiopia

Panel A Long-run coefficients estimates
Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	27.975	9.818	2.849***
FD	-0.560	0.319	-1.758*
RIR	0.066	0.072	0.911
RER	-1.611	1.659	-0.971
CONS	91.052	31.341	-2.905***
DU1	-6.718	1.945	-3.454***
DU2	-14.458	3.163	-4.571***

Panel B Short-Run Coefficients Estimates
Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.493	0.078	6.298***
$\Delta LRGDP$	-18.149	10.271	-1.767*
ΔFD	-0.468	0.125	-3.759***
ΔFD_{t-1}	0.325	0.119	2.725***
ΔRIR	0.012	0.013	0.959
ΔRER	-0.298	0.295	-1.012
$\Delta CONS$	-16.857	5.042	-3.343***
$\Delta DU1$	-1.244	0.319	-3.897***
$\Delta DU2$	-2.676	0.670	-3.922***
$ECM(-1)$	-0.185	0.038	-4.833***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.4: Ethiopia Stability Test

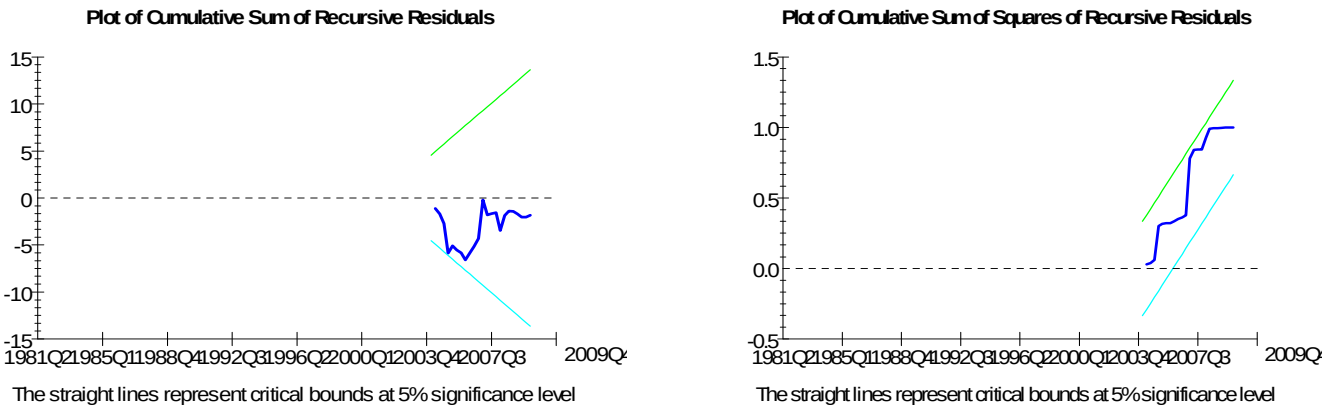


Table 5.6: Full Information Estimates for Ghana

Panel A Long-run coefficients estimates Dependent Variable: CAB Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-6.214	12.941	-0.480
FD	0.161	0.106	1.522
RIR	-0.103	0.053	-1.943*
RER	-0.616	2.004	-0.307
CONS	2.579	43.187	0.059
DU1	16.542	6.276	2.636**
DU2	18.817	6.502	2.894***
Panel B Short-Run Coefficients Estimates Dependent Variable: ΔCAB Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.612	0.093	6.584***
ΔCAB_{t-2}	0.194	0.080	2.411**
ΔCAB_{t-3}	0.111	0.082	1.348
ΔCAB_{t-4}	-0.387	0.093	-4.168***
ΔCAB_{t-5}	0.287	0.095	3.015***
$\Delta LRGDP$	-181.204	52.245	-3.468***
ΔFD	0.107	0.029	3.636***
ΔFD_{t-1}	-0.076	0.024	-3.136***
ΔRIR	0.001	0.011	0.107
ΔRER	-0.104	0.335	-0.309
$\Delta CONS$	0.435	7.339	0.059
$\Delta DU1$	2.792	0.913	3.059***
$\Delta DU2$	3.176	1.081	2.938***
$ECM(-1)$	-0.169	0.045	-3.741***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.5: Ghana Stability Test

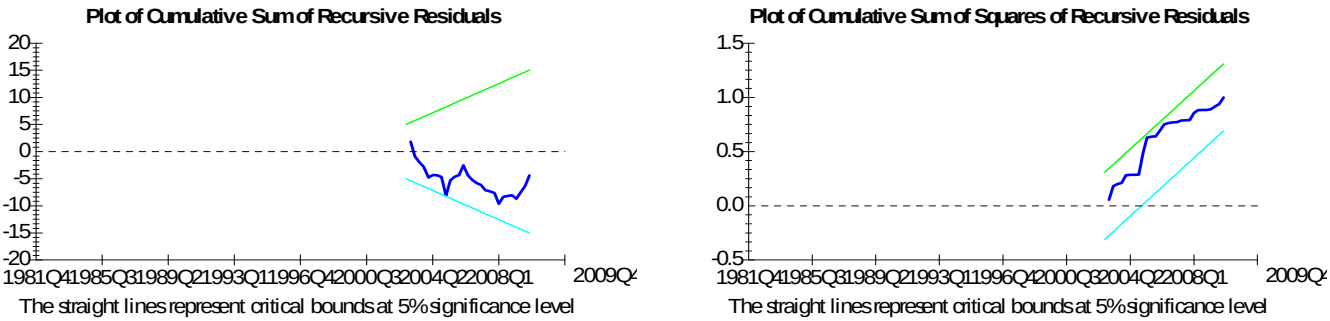


Table 5.7: Full Information Estimates for Kenya

Panel A Long-run coefficients estimates
Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-49.439	14.095	-3.508***
FD	-0.525	0.263	-1.994*
RIR	-0.021	0.121	-1.172
RER	0.443	3.713	0.119
CONS	157.568	46.969	3.355***
DU1	9.946	3.954	2.516**
DU2	14.801	4.138	3.577***

Panel B Short-Run Coefficients Estimates
Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.424	0.083	5.102***
$\Delta LRGDP$	-7.945	2.572	-3.089***
ΔFD	-0.622	0.177	-3.509***
ΔRIR	-0.003	0.019	-0.171
ΔRER	0.071	0.597	0.119
$\Delta CONS$	25.321	8.401	3.014***
$\Delta DU1$	1.598	0.618	2.587**
$\Delta DU2$	2.378	0.794	2.995**
$ECM(-1)$	-0.161	0.035	-4.567***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.6: Kenya Stability Test

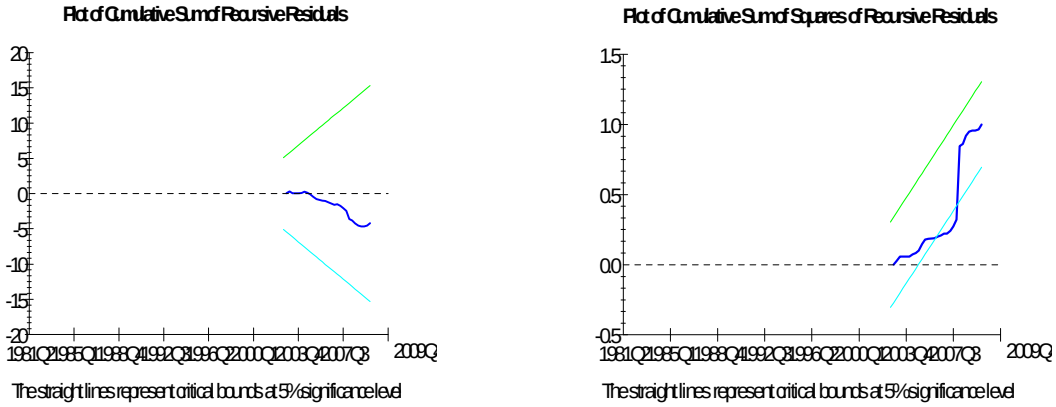


Table 5.8: Full Information Estimates for Morocco

Panel A Long-run coefficients estimates Dependent Variable: CAB Regressor	Coefficient	Standard error	T-Ratio
LRGDP	36.149	8.505	4.250***
FD	0.032	0.221	0.142
RIR	0.836	0.235	3.556***
RER	-2.534	1.769	-1.432
CONS	-138.626	31.788	-4.361***
DU1	-4.534	2.301	-1.970*
DU2	-13.922	3.873	-3.595***
Panel B Short-Run Coefficients Estimates Dependent Variable: ΔCAB Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.492	0.077	6.355***
$\Delta LRGDP$	22.616	7.976	2.836**
ΔFD	0.508	0.104	4.894***
ΔFD_{t-1}	-0.381	0.112	-3.397***
ΔRIR	0.109	0.032	3.414***
ΔRER	-0.332	0.229	-1.451
$\Delta CONS$	-18.167	4.987	-3.643***
$\Delta DU1$	-0.594	0.285	-2.085**
$\Delta DU2$	-1.825	0.535	-3.411***
$ECM(-1)$	-0.131	0.026	-4.980***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.7: Morocco Stability Test

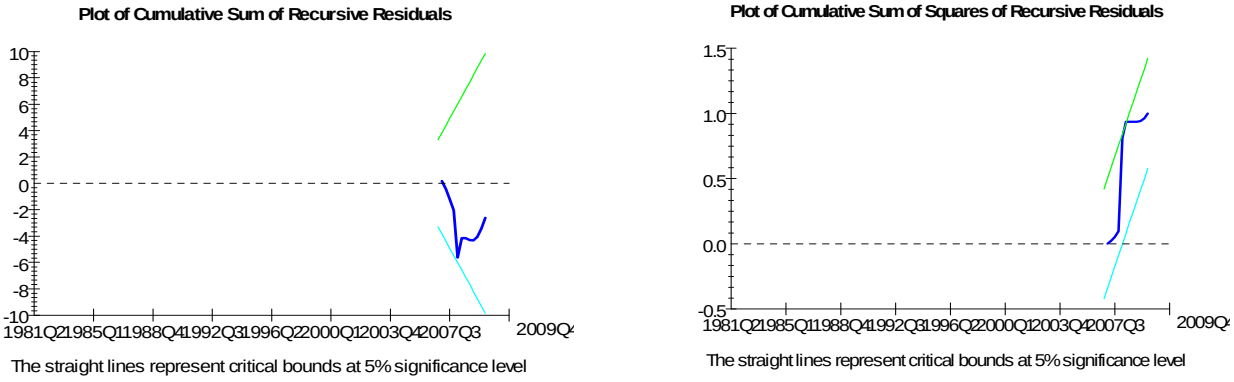


Table 5.9: Full Information Estimates for Nigeria

Panel A Long-run coefficients estimates
Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-41.821	31.497	-1.328
FD	0.349	0.174	2.012**
RIR	0.096	0.138	0.698
RER	0.962	5.137	0.187
CONS	153.769	121.763	1.263
DU1	10.913	5.387	2.026**
DU2	33.212	9.441	3.518***

Panel B Short-Run Coefficients Estimates
Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.568	0.068	8.394***
$\Delta LRGDP$	-6.351	4.986	-1.274
ΔFD	0.207	0.063	3.305***
ΔRIR	0.015	0.021	0.683
ΔRER	0.146	0.783	0.187
$\Delta CONS$	23.352	19.213	1.216
$\Delta DU1$	1.657	0.863	1.921*
$\Delta DU2$	5.044	1.663	3.032***
$ECM(-1)$	-0.152	0.032	-4.702***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.8: Nigeria Stability Test

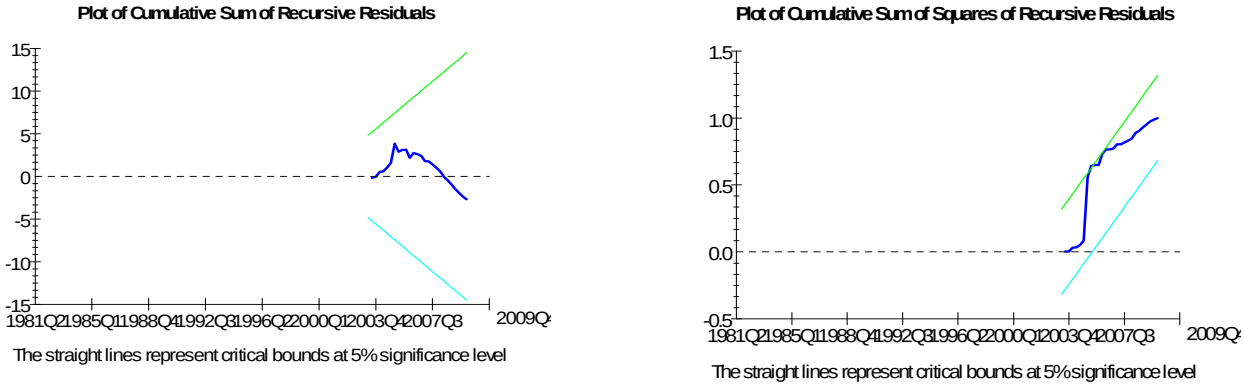


Table 5.10: Full Information Estimates for South Africa

Panel A Long-run coefficients estimates Dependent Variable: CAB Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-33.059	6.314	-5.236***
FD	-0.052	0.145	-0.361
RIR	-0.149	0.095	-1.567
RER	1.759	1.437	1.223
CONS	142.067	28.109	5.054***
DU1	7.801	1.459	5.344***
DU2	6.953	1.566	4.439***
Panel B Short-Run Coefficients Estimates Dependent Variable: ΔCAB Regressor	Coefficient	Standard error	T-Ratio
$\Delta LRGDP$	-181.879	62.687	2.901**
ΔFD	-0.026	0.072	-0.359
ΔRIR	-0.074	0.051	-1.460
ΔRER	0.876	0.733	1.195
$\Delta CONS$	70.746	18.726	3.778***
$\Delta DU1$	3.885	0.814	4.772***
$\Delta DU2$	3.462	0.913	3.794***
$ECM(-1)$	-0.498	0.078	-6.392***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.9: South Africa Stability Test

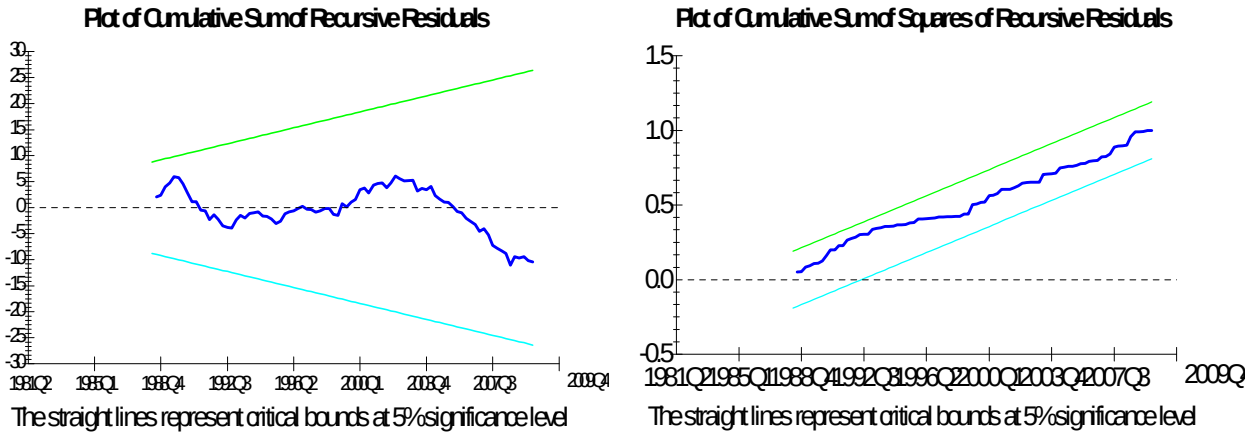


Table 5.11: Full Information Estimates for Tanzania

Panel A Long-run coefficients estimates
Dependent Variable: CAB

Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-10.466	25.540	-0.409
FD	2.143	1.252	1.711*
RIR	-0.172	0.349	-0.490
RER	-15.287	10.341	-1.478
CONS	34.607	77.849	0.445
DU1	36.059	16.211	2.224**
DU2	36.037	19.231	1.874*

Panel B Short-Run Coefficients Estimates
Dependent Variable: ΔCAB

Regressor	Coefficient	Standard error	T-Ratio
ΔCAB_{t-1}	0.338	0.079	4.271***
$\Delta LRGDP$	15.746	2.692	5.849***
ΔFD	-0.409	0.093	-4.380***
ΔRIR	-0.008	0.016	-0.476
ΔRER	-0.698	0.339	-2.058**
$\Delta CONS$	1.581	3.412	0.464
$\Delta DU1$	1.648	0.321	5.129***
$\Delta DU2$	1.647	0.475	3.469***
$ECM(-1)$	-0.046	0.018	-2.532**

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.10: Tanzania Stability Test

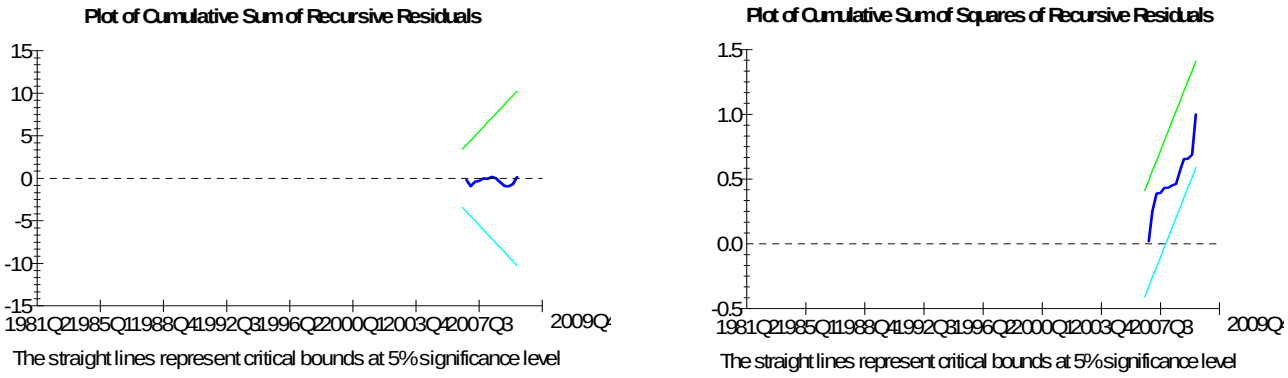


Table 5.12: Full Information Estimates for Tunisia

Panel A Long-run coefficients estimates Dependent Variable: CAB Regressor	Coefficient	Standard error	T-Ratio
LRGDP	1.673	6.497	0.258
FD	0.350	0.468	0.748
RIR	-0.470	0.332	-1.417
RER	0.996	2.005	0.497
CONS	-12.722	22.506	-0.565
DU1	6.263	1.694	3.694***
DU2	4.739	2.797	1.695*
Panel B Short-Run Coefficients Estimates **Dependent Variable: ΔCAB** **Regressor**	**Coefficient**	**Standard error**	**T-Ratio**
ΔCAB_{t-1}	0.627	0.075	8.345***
$\Delta LRGDP$	78.731	18.141	4.340***
$\Delta LRGDP_{t-1}$	-53.921	19.009	-2.837**
ΔFD	0.055	0.072	0.765
ΔRIR	-0.074	0.059	-1.247
ΔRER	0.157	0.331	0.474
$\Delta CONS$	-2.001	3.455	-0.579
$\Delta DU1$	0.985	0.377	2.616**
$\Delta DU2$	0.746	0.497	1.502
$ECM(-1)$	-0.157	0.036	-4.381***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.11: Tunisia Stability Test

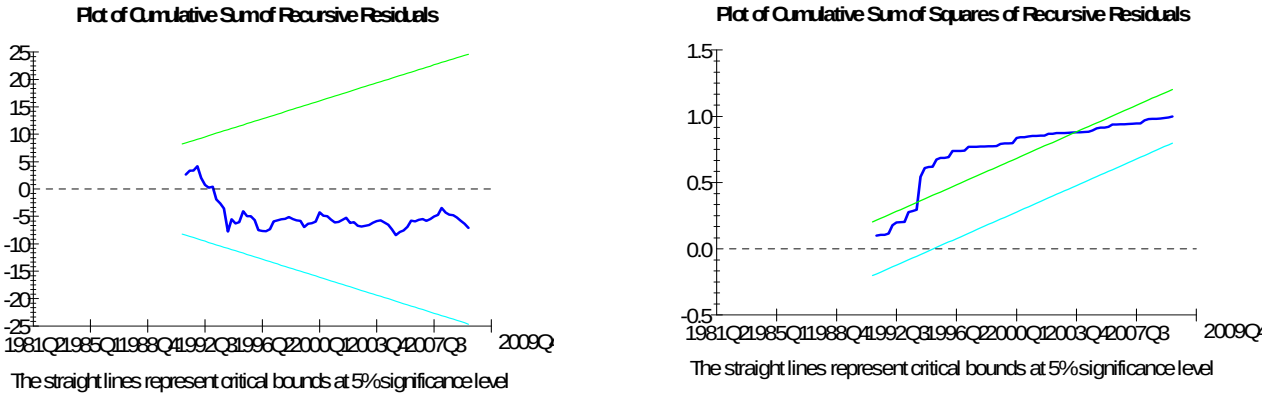
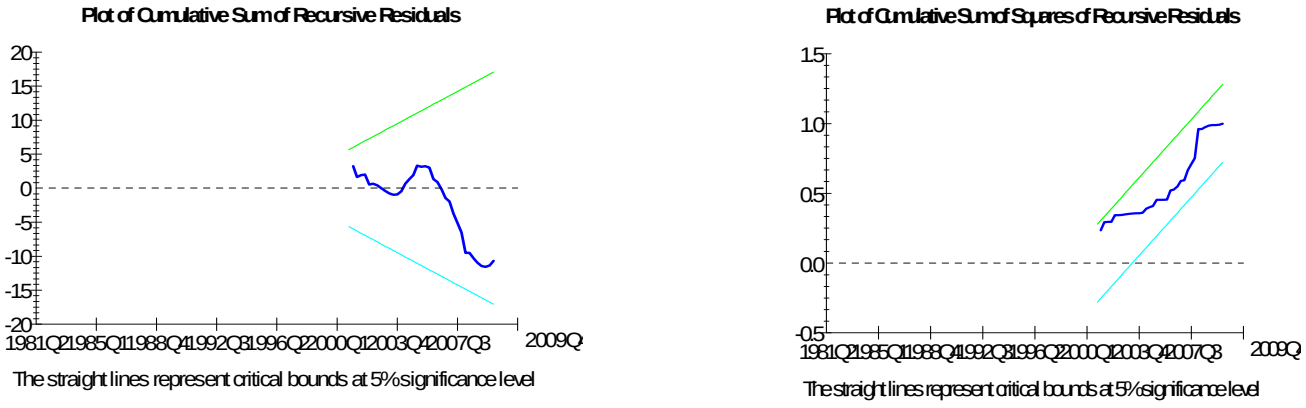


Table 5.13: Full Information Estimates for Uganda

Panel A Long-run coefficients estimates Dependent Variable: CAB Regressor	Coefficient	Standard error	T-Ratio
LRGDP	-18.291	5.680	-3.220***
FD	-0.518	0.344	-1.504
RIR	0.015	0.013	1.098
RER	-1.138	0.748	-1.521
CONS	47.465	16.506	2.876**
DU1	4.269	2.453	1.741*
DU2	14.916	3.504	4.257**
Panel B Short-Run Coefficients Estimates **Dependent Variable: CAB** **Regressor**	**Coefficient**	**Standard error**	**T-Ratio**
ΔCAB_{t-1}	0.522	0.063	7.487***
$\Delta LRGDP$	-56.851	12.931	-4.397***
$\Delta LRGDP_{t-1}$	32.349	13.439	2.407**
ΔFD	-0.071	0.049	-1.454
ΔRIR	0.002	0.001	1.116
ΔRER	-0.156	0.105	-1.487
$\Delta CONS$	6.526	2.376	2.746**
$\Delta DU1$	0.587	0.356	1.649
$\Delta DU2$	2.051	0.563	3.641***
$ECM(-1)$	-0.137	0.024	-5.750***

Note: *,** and *** indicate level of significance at 10, 5 and 1 per cent respectively.

Figure 5.12: Uganda Stability Test



However, one per cent increase in the real exchange rate leads to a 1.63, 1.61, 0.61, 2.53, 15.28 and 1.13 per cent decrease in the current account deficit for Botswana, Ethiopia, Ghana, Morocco, Tanzania and Uganda respectively; but the results are not statistically significant. In these countries, it appears that there is an appreciation of the exchange rate which in turn worsens the current account deficits.

The results also reveal that the endogenous structural break dummy variable, the first structural break (DU1) are positive and statistically significant in most countries, except in Cameroon and Egypt that is statistically insignificant, but Ethiopia and Morocco are both negative and statistically significant. In the second structural break (DU2) all the result are both positive and statistically significant except for Ethiopia and Morocco that were negative. However, in Egypt the result was both negative and statistically insignificant.

5.4.3 Short-run Dynamics

The short-run adjustment process is measured by the error correction term ECM_{t-1} and it shows how quickly variables adjust to a shock and return to equilibrium. For stability, the coefficient of ECM_{t-1} should carry the negative sign and be statistically significant. The estimated coefficient for the ECM_{t-1} is equal to -0.3365, -0.1927, -0.1065, -0.1851, -0.1687, -0.1607, -0.1310, -0.1518, -0.4979, -0.0456, -0.1573 and -0.1374 for the specified model and is highly significant, indicating that the deviation from the current account balance equilibrium path is corrected by nearly 33.65%, 19.27%, 10.65%, 18.51%, 16.87%, 16.07%, 13.10%, 15.18%, 49.79%, 4.56%, 15.73% and 13.74% over the following quarter for Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia and Uganda respectively. In other words, the adjustment process is fast. The statistical significance of the ECM_{t-1} confirms the presence of long-run equilibrium relationship between the current account deficits and the macroeconomic variables.

5.4.4 Stability Test

Finally, the results of CUSUM and CUSUMSQ tests proposed by Brown et al. (1975) are reported. The tests are applied to the residuals of the estimated model. The CUSUM test is based on the cumulative sum of recursive residuals based on the first set of N observations. It is updated recursively and is plotted against the break points. If the plot of CUSUM statistic stays within a 5% significance level (portrayed by two straight lines whose equations are given in Brown et al. (1975), then coefficient estimates are said to be stable. Similar procedure is used to carry

out for the CUSUMSQ, which is based on the squared recursive residuals. The plots of CUSUM statistic were all within the two straight line indicating stability of the model. However, the CUSUMSQ crosses the critical value line indicating some instability in the current account deficit in Kenya and Tunisia. However, the issue does not seem to be too serious because the instability that was observed in the late 1990s has vanished over time, and during the 2000s the plot of CUSUMSQ statistic is within the critical value bounds.

Also noted is that the graphs for the cumulative sum of recursive residuals and the cumulative sum of squares of recursive residuals for the twelve countries differs. The plots for South Africa start much earlier and the remaining eleven countries starting much later. This has to do with the timing of the structural breaks, the ARDL approach plots the CUSUM and the CUSUMSQ from where the second structural breaks occurs. For instance, in Botswana, the second structural break for the current account deficits variable starts from the fourth quarter of 2004 and that of South Africa starts from the second quarter of 1988. Hence, the reason why the plots of CUSUM and CUSUMSQ for Botswana starts much later and that of South Africa starts much earlier.

5.5 Welfare Interpretation of Deficit in African Countries.

Majority of developing countries maintained large fiscal deficits and current account deficits, with a host of them having the deficits over the acceptable critical level of 5 per cent. This generate concerns as regards the sustainability of these deficits and the subsequent debts accumulated to finance them. They also run current account deficits alongside low levels of investment and economic growth; this suggest that these economies maintains deficits that are not beneficial for the economy. As a result of this, foreign investors are more likely not to hold assets denominated in that country's currency(Osakwe & Verick 2007).

In Botswana, Cameroon, Egypt, Ghana, Morocco, Nigeria, Tanzania and Tunisia where an increase in the fiscal deficits leads to increase in the current account deficits, this implies that these countries employed an expansionary fiscal policy where government expenditure are increased, and taxes are lowered. The welfare implication of this is that there will be an increase in disposable income and an increase in consumption possibilities, this creates a higher welfare for these countries today. Concerning the increase in government expenditure questions needed to be asked what the deficits are used for because of the series of implications for the future

generations. If these deficits are not spent on investments that will bring in return in the long run, it spell doom for the future generation because debts incurred now has to be paid in the future and these are serious problems of African countries were leaders siphon resources for selfish interest.

For countries where an increase in fiscal deficits improves the current account deficits, it implies that there is depreciation of such currency which in turn improves the current account. The welfare implication of this is that there will be an increase in the demand for the country's export and decline in demand in the import and this will increase the level of output and employment as well. Generally it should be noted that the unfunded increase in government expenditure has to be offset by higher private savings because consumers realised that the extra government purchases have to be paid back in future, thereby reducing the consumption possibilities of the people.

The welfare cost of the US current account deficits on developing countries is also high, if the US borrows more money from the financial market, it reduces the amount of credit available to the developing countries largely because of her credit worthineness and this lowers capital inflows into these economies. This later have an adverse effect on the level of investment and output as well as the level of employment

5.6 Conclusion

The purpose of this chapter is to test the twin deficit hypothesis using time-series data from twelve African countries. This study adds new insights to the time-series literature on the twin deficits hypothesis. The study differs from previous studies in many ways: first, we estimated the twin deficits effect in a sample of twelve African countries using quarterly data set which is the typical frequency investigated in the business cycle studies.

Second, we test the time-series properties of the variables with the Lee and Starzicich (2003) unit-root test procedure in the presence of endogenous structural breaks. No previous studies have used these unit-root test procedures to the best of our knowledge. Third, the endogenous structural breaks were incorporated in the analytical model to capture the nonlinearity in the model. No previous studies have explicitly modelled the structural breaks, except Marashdeh & Saleh (2006) on Lebanon. Lastly, a flexible, robust econometric framework called the ARDL modelling was applied to estimate long- and short-term parameters of the twin deficit hypothesis. In this study, it was found that all the series have structural breaks and that in some countries the series where stationary at levels and some in their first differences.

Using the ARDL approach and the bound test, results for the long run coefficients show that there is a positive relationship between fiscal deficits and current account deficits in Botswana, Cameroon, Egypt, Ghana, Morocco, Nigeria, Tanzania and Tunisia. The empirical results in this study support the Keynesian view that there is a strong linkage between budget deficit and current account deficit during the period of 1980q1-2009q4 (See Saleh 2005, Marashdeh & Saleh 2006, Alkswani 2000, Onafowora & Owoye 2006). A negative relationship between fiscal deficits and current account deficits is found in Ethiopia, Kenya, South Africa and Uganda.

In addition, we found as well by using the bound test that the fiscal deficit in the twelve African countries has long run impact on the current account deficit. The short run dynamics of the model for the twelve African countries indicates that the shocks adjust back to equilibrium and that the adjustment process is fast and statistically significant.

Table 5.14: Summary of Results for the Twin Deficits Relationship

Country	Bound Test	Long-run coefficient between fiscal deficits & current account deficits	Outcome
Botswana	✓	Positive significant relationship	Twin deficits
Cameroon	✓	Positive insignificant relationship	Twin deficits
Egypt	✓	Positive significant relationship	Twin deficits
Ethiopia	✓	Negative significant relationship	Twin divergence
Ghana	✓	Positive insignificant relationship	Twin deficits
Kenya	✓	Negative significant relationship	Twin divergence
Morocco	✓	Positive insignificant relationship	Twin deficits
Nigeria	✓	Positive significant relationship	Twin deficits
South Africa	✓	Negative insignificant relationship	Twin divergence
Tanzania	✓	Positive significant relationship	Twin deficits
Tunisia	✓	Positive insignificant relationship	Twin deficits
Uganda	✓	Negative insignificant relationship	Twin divergence

Note: × = No evidence of long-run relation, ✓ = evidence of long-run relation

Chapter 6

Twin Deficits in African Countries: Threshold Cointegration Approach

6.1 Introduction

Persistent fiscal deficits and current account deficits are major policy concerns in both developed and developing countries. Large fiscal deficits result in crowding-out of private investment (this is because government expenditure were seen as a gross substitutes to private investment rather than a complement), increased borrowing, higher debt interest payments, inflation and thus affect economic growth. Large current account deficits result in currency crises, decline in competitiveness, transfer of wealth to foreign nationals and depletion of international reserves.

Connected to these concerns is the issue of how the two balances are related. The Mundell-Fleming framework argues that an increase in the fiscal deficit will give rise to an increase in the interest rate that in turn causes capital inflows and an appreciation of the exchange rate which increases the current account deficit. Another theoretical rationale is that an increase in the fiscal deficit will lead to an increase in the demand for imports, causing a worsening of the current account.

By contrast, there is the possibility to have a causality running from current account deficits to fiscal deficits. This reverse causality approach is called current account targeting and is due to Summers (1988). He argues that when a small open economy has the goal of eliminating external imbalances and uses the fiscal deficit as an instrument to achieve this, deterioration of the current account will cause a decrease in economic growth and lead to a worsening of the fiscal deficit. Another possibility is that is that causation can be bi-directional.

In contrast to the traditional Keynesian view, the Ricardian Equivalence Hy-

pothesis of Barro (1974, 1989) argues that the FD and CAB are not related. The hypothesis states that, "for a given expenditure path, the substitution of debt for taxes has no effect on aggregate nor on interest rates. As a result, it implies that a tax increase would reduce the budget deficits but would not alter the external deficits since altering the means that the government uses to finance its expenditures does not affect private spending nor national savings".

Empirical work is not conclusive, mainly because of differences in methodological approaches and sample periods employed. Darrat (1988), Abell (1990), Rosenweig &Tallman (1993), Corsetti & Muller (2006), Salvatore (2006) and Baharumshah & Lau (2007), Grier and Ye (2009), Holmes (2011), find that budget and current account deficits are closely linked and argue in favour of the Keynesian hypothesis.

By contrast, Enders and Lee (1990), Kaufmann et al. (2002), Kim & Roubini (2008), Mohammadi & Moshrefi (2012) found support for the Ricardian Equivalence Hypothesis (REH) that there is no systematic relationship between budget and current account deficits. Abell (1990), Kearney & Monadjemi, (1990), Khalid & Guan (1999), , Kouassi, Mougoue & Kymn (2004), Marinheiro (2008) and Katircioglu et al (2009) found support for the Current Account Targeting Hypothesis (CATH). Islam (1998) and also Kouassi et al. (2004) found evidence of bi-directional causality

In attempting to resolve the issue of how the balances are related, several approaches have been used in the empirical literature with a focus on the univariate properties of the fiscal deficit and current account balance and on the presence of a long-run, linear cointegrating relationship between them. Previous studies assume symmetric adjustment without addressing issues of structural breaks or regime change. The low power of tests of a non-cointegration null might in fact be attributable to the neglect of threshold effects in any long-run relationship between the FD and CAB in many of the existing studies (Holmes 2011).

At this point, it is pertinent to explain what threshold cointegration is. Balke and Fomby (1997) noted that in the concept of cointegration, there is the implicit assumption that the adjustment of the deviations towards the long-run equilibrium is made instantaneously at each period. However, movement towards equilibrium may not take place at every time due to the presence of adjustments cost on the side of the economic agents; hence, the concept of threshold cointegration was introduced as a way of combining non-linearity with cointegration. Threshold cointegration maintains that the cointegrating relationship does not hold within a certain threshold, but only when the system is outside the threshold.

In sharp contrast to previous work, this study considers the possibility that there exist threshold effects and regime change towards long-run relationship. There are numerous explanations that might justify the presence of threshold effects. First, in

the context of the Mundell–Fleming model it is possible that a given fiscal expansion may have a different impact on domestic interest rates; large fiscal deficits may give rise to larger interest rate increases, which in turn cause capital inflows and appreciation of the exchange rate which then leads to a worsening of the current account deficits. Another justification for this approach in African countries is that there exist an imperfect and underdeveloped market system and adjustment may be irregular and uncertain, therefore, previous studies have been misspecified.

The objective of this chapter is to provide evidence on the possibly nonlinear relationship between the twin deficits. To the best of our knowledge, this approach has not previously been used in the empirical literature on twin deficits in African countries. To this end, the study employs the Hansen and Seo (2002) threshold cointegration analysis where the short-run dynamics comprise two regimes based on a threshold in the size of the lagged error correction term between current account balances and the fiscal deficits. This approach is employed because it allows for asymmetric adjustment between the fiscal deficits and the current account imbalances.

The rest of the chapter is structured as follows. The following section outlines the methodology of the residual based cointegration test of Engle and Granger (1987) and Phillips and Ouliaris (1990), Johansen (1988) maximum likelihood cointegration test, followed by the methodology of Gregory and Hansen (1996) cointegration with structural breaks and lastly the approach of Hansen and Seo (2002) bi-variate threshold were discussed in details. Section 6.3 of the chapter discussed the analysis and interpretation of results, section 6.4 concludes the chapter.

6.2 Methodology

In this section emphasis is on the methodology used in the chapter. The section starts with the methodology of the Engle and Granger (1987) and the Phillips and Ouliaris (1990) residual cointegration test, the Johansen (1988) maximum likelihood cointegration test, the Gregory and Hansen (1996) cointegration test with structural breaks and lastly the Hansen and Seo (2002) bi-variate threshold. The major reason for the consideration of these cointegration tests before the Hansen and Seo threshold cointegration is that there might be a possibility of linear cointegration between the twin deficits of the selected African countries whose series are stationary in their first differences.

6.2.1 Testing for Cointegration - Residual-Based Tests

The Engle-Granger and Phillips-Ouliaris residual-based tests for cointegration[1] are simply unit root tests applied to the residuals obtained from single OLS estimation of;

$$y_t = \alpha + \beta x_t + e_t \tag{6.1}$$

Where α and β are coefficients, y_t and x_t are I(1). e_t is the error term, if e_t is I(0), then y_t and x_t is linearly cointegrated.

Under the assumption that the series are not cointegrated, all linear combinations of (y_t and x_t) including the residuals from simple OLS, are unit root nonstationary. Therefore, a test of the null hypothesis of no cointegration against the alternative of cointegration corresponds to a unit root test of the null of non-stationarity against the alternative of stationarity.

The two tests differ in the method of accounting for serial correlation in the residual series; the Engle-Granger test uses a parametric, augmented Dickey-Fuller (ADF) approach, while the Phillips-Ouliaris test uses the nonparametric Phillips-Perron (PP) methodology.

The Engle-Granger test estimates a -lag augmented regression of the form

$$\Delta \hat{u}_{it} = (\rho - 1)\, \hat{u}_{it-1} + \sum_{j=1}^{p} \delta_j \Delta \hat{u}_{1t-j} + v_t \tag{6.2}$$

Two standard ADF test statistics were considered, one based on the t-statistic for testing the null hypothesis of nonstationarity $(\rho - 1)$ and the other based directly on the normalized

autocorrelation coefficient $\hat{\rho} - 1$:

$$\hat{\tau} = \frac{\hat{\rho} - 1}{se(\hat{\rho})}$$

$$\hat{z} = T(\hat{\rho} - 1/ \left(1 - \sum_j \hat{\delta}_j \right) \tag{6.3}$$

where $se(\hat{\rho})$ is the OLS estimator of the standard error of the estimated $\hat{\rho}$

[1]The linear cointegration procedure for Engle-Granger, Phillips-Ouliaris and the Johansen multivariate cointegration are wholy adapted from EViews 7 Users Guide.

$$se(\hat{\rho}) = \hat{s}_v \left(\sum_j \hat{u}_{1t-1}^2 \right)^{1/2} \tag{6.4}$$

In contrast to the Engle-Granger test, the Phillips-Ouliaris test obtains an estimate of ρ by running the unaugmented Dickey-Fuller regression

$$\Delta \hat{u}_{1t} = (\rho - 1)\, \hat{u}_{1t-1} + \omega_t \tag{6.5}$$

The test statistics corresponding to Equation (6.3) are

$$\hat{\tau} = \frac{\hat{\rho}^* - 1}{se(\hat{\rho}^*)}$$

$$\hat{z} = T\,(\hat{\rho}^* - 1) \tag{6.6}$$

where

$$se(\hat{\rho}^*) = \hat{\omega}_\omega^{1/2} \left(\sum_t \hat{u}_{1t-1}^2 \right)^{1/2}$$

As with ADF and PP statistics, the asymptotic distributions of the Engle-Granger and Phillips-Ouliaris and statistics are non-standard and depend on the deterministic regressors specification, so that critical values for the statistics are obtained from simulation results.

However, one major deficiency of the two methods (Engle-Granger and Phillips-Ouliaris) is that one can only estimate a single cointegrating relationship. However, if one deals with more than two time series, it is possible that more than one cointegrating relationship will exist, which calls for the use of vector cointegration techniques like Johansen's procedure.

6.2.2 Johansen's Test for Cointegration

The Johansen test is a test for cointegration that allows for more than one cointegrating relationship, unlike the Engle-Granger and the Phillips-Ouliaris method. The methodology takes its starting point from the vector autoregression (VAR) of order p given by;

$$y_t = \mu + A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t \tag{6.7}$$

where y_t is an $n \times 1$ vector of variables that are integrated of order one and ε_t is an $n \times 1$ vector of innovations. This VAR can be re-written as

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \tag{6.8}$$

where

$$\Pi = \sum_{i=1}^{p} A_i - I$$

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j \tag{6.9}$$

If the coefficient matrix Π has reduced rank $r < n$ then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector. It can be shown that for a given r, the maximum likelihood estimator of β defines the combination of y_{t-1} that yields the r largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in equations (6.10) and (6.11) respectively.

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_1) \tag{6.10}$$

$$J_{\max} = -T \ln\left(\hat{\lambda}_{r+1}\right) \tag{6.11}$$

Here T is the sample size and λ_i is the ith largest canonical correlation. The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r + 1$ cointegrating vectors.

A major limitation of this method is that it assumes that the cointegrating vector remains constant during the period of study. In reality, it is possible that the long-run relationships between the underlying variables change. The reason for this might be technological progress, economic crisis, changes in people's preferences and behaviour accordingly, policy or regime alteration and institutional development. This

is especially the case if the sample period is long. To correct this, the Gregory and Hansen (1996) tests for cointegration with an unknown structural break is employed in this study.

6.2.3 Gregory and Hansen Cointegration Test with Structural Break

The Gregory–Hansen (1996) (**GH** henceforth) methodology is an extension of the Engle-Granger (1987) cointegration analysis (**EG** approach) and can be seen as a multivariate extension of the endogenous break test for a univariate series. The GH test allows to test the presence of cointegration among the variables of interest given the variables are integrated of order $I(1)$ i.e. difference stationary. Gregory and Hansen introduce four different models to take into account for the structural change in the cointegrating relationship under the alternative.

The first model is a level shift model, denoted as C and defined as:

$$Y_t = \alpha + \beta D_t + \delta X_t + u_t \tag{6.12}$$

where Y_t is a scalar variable, X_t is a vector of explanatory variables, u_t is the disturbance term, D_t is a step dummy variable defined as: $D_t = 1\,(t > Tb)$, where parameters α represents the intercept before the shift, and β represents the change in the intercept at the time of the shift, δ is the parameter of the cointegrating vector

The second model is the level shift with trend model, denoted as C/T

$$Y_t = \alpha + \beta D_t + \phi t + \delta X_t + u_t \tag{6.13}$$

where t is time trend.

The third model allows for a shift in the regime and it is denoted as C/S

$$Y_t = \alpha + \beta D_t + \delta X_t + \phi X_t D_t + u_t \tag{6.14}$$

where δ, denotes the cointegrating slope coefficients before the regime shift and ϕ denotes the changes in the slope coefficients.

In addition to these three models, Gregory-Hansen added fourth model where the model allows for a shift in both regime and trend denoted as C/S/T;

$$Y_t = \alpha + \beta D_t + \phi t + \delta X_t + \phi X_t D_t + u_t \tag{6.15}$$

A major advantage of the GH method over various types of unit root test with structural breaks is that the approach only has a single structural break point for

multivariate variables thus making it empirically easier to test the null of no cointegration with regime shift.

All the GH tests are residual based, and the null hypothesis of no cointegration corresponds to a unit root in the OLS residuals of models C, C/T, C/S and C/S/T, break point in the cointegrating relationship is calculated at the point where t-statistics is at minimum.

A major limitation observed in the cointegration tests discussed above is that it does not account for non-linearity, that is there is the possibility of a threshold cointegration, and this is now discussed in the subsequent sub- section and this remains a major gap to be filled in this study.

6.2.4 Hansen and Seo (2002) – Threshold Cointegration

The concept of threshold cointegration was introduced by Balke and Fomby (1997) as a feasible way to combine non-linearity and cointegration. As is well known, systems in which variables are cointegrated can be characterized by an error correction model (ECM), which describes how the variables respond to deviations from the equilibrium. In this way, the ECM can be characterized as the adjustment process through which the long-run equilibrium is maintained. The traditional approach, however, assumes that such a tendency to move towards the long-run equilibrium is present every time period. Balke and Fomby (1997) stressed the possibility that this movement towards the long-run equilibrium might not occur in every time period, due to the presence of adjustment costs. In other words, there could be a discontinuous adjustment to equilibrium so that, only when the deviation from the equilibrium exceeds a critical threshold, are the benefits of adjustment higher than the costs, and economic agents move the system back to equilibrium. Threshold cointegration would characterize this discrete adjustment as follows: the cointegrating relationship does not hold inside a certain range, but holds if the system gets 'too far' from the equilibrium; i.e., cointegration would hold only if the system exceeds a certain threshold.

When testing for threshold cointegration, Balke and Fomby (1997) proposed applying several univariate tests previously developed in the literature, to cointegrating residual (i.e., the error-correction term). Further contributions include Forbes et al. (1999), who developed a Bayesian estimation procedure; and Lo and Zivot (2001), who extended Balke and Fomby's approach to a multivariate threshold cointegration model with a known cointegrating vector, using Tsay's (1998) multivariate extension of Hansen's (1996) tests. More recently, Hansen and Seo (2002) have contributed further to this literature by examining the case of an unknown cointegration vector.

In particular, these authors proposed a vector error-correction model (VECM) with one cointegrating vector and a threshold effect based on the error-correction term and developed a Lagrange multiplier (LM) test for the presence of a threshold effect. This will be the approach followed in this chapter.

In order to test the validity of the twin deficits hypothesis in the context of cointegration theory, empirical studies have typically used a linear model such as[2],

$$CAB_t = \alpha + \beta FD_t + \varepsilon_t \tag{6.16}$$

The linear model above can be written as a bivariate cointegrating VAR model with one lag, l=1, as:

$$\begin{pmatrix} \Delta CAB_t \\ \Delta FD_t \end{pmatrix} = \mu + \alpha\omega_{t-1} + \Gamma \begin{pmatrix} \Delta CAB_{t-1} \\ \Delta FD_{t-1} \end{pmatrix} + \varepsilon_t \tag{6.17}$$

From equation 6.17, the long-run relationship is defined as $\omega_{t-1} = CAB_{t-1} - \beta FD_{t-1}$. The traditional linear approach to error correction modelling assumes that the speed of adjustment towards the long-run equilibrium is the same in every time period.

Hansen and Seo (2002) considered a two-regime threshold cointegration model, or a non-linear VECM of order $l + 1$, such as:

$$\Delta x_t = \begin{cases} A_1' X_{t-1}(\beta) + u_t & if \quad \omega_{t-1}(\beta) \leq \gamma \\ A_2' X_{t-1}(\beta) + u_t & if \quad \omega_{t-1}(\beta) > \gamma \end{cases} \tag{6.18}$$

with

$$X_{t-1}(\beta) = \begin{pmatrix} 1 \\ \omega_{t-1}(\beta) \\ \Delta x_{t-1} \\ \Delta x_{t-2} \\ . \\ . \\ \Delta x_{t-l} \end{pmatrix} \tag{6.19}$$

where x_t is a p-dimensional $I(1)$ time series which is cointegrated with one $p \times 1$ cointegrating vector β, $\omega_t(\beta) = \beta' x_t$ is the $I(0)$ error-correction term, u_t is an error term, A_1 and A_2 are coefficient matrices, and γ is the threshold parameter.

[2]The threshold cointegration procedure employed in this study is largely drawn from the discussion in Holmes (2011).

As can be seen, the threshold model (6.18) has two regimes, depending on whether deviations from the equilibrium (defined by the value of the error-correction term) are below or above the threshold, where A_1 and A_2 describe the dynamics in each of the regimes. In one of the regimes there might be no tendency for the variables x_t to revert to equilibrium (i.e., the variables would not be cointegrated); on the contrary, in the other regime there might be a tendency for the variables x_t to move towards some equilibrium (i.e., the variables would be cointegrated).

Next, Hansen and Seo (2002) proposed two heteroscedastic-consistent LM test statistics for the null hypothesis of linear cointegration (i.e., there is no threshold effect), against the alternative of threshold cointegration (i.e., model (6.18)). The first test would be used when the true cointegrating vector is known a priori, and is denoted as:

$$\sup LM^0 = \sup_{\gamma L \leq \gamma \leq \gamma U} LM(\beta_0, \gamma) \tag{6.20}$$

where β_0 is the known value of β (in the case analyzed below, $\beta_0 = 1$); whereas, the second test would be used when the true cointegrating vector is unknown, and is denoted as:

$$\sup LM = \sup_{\gamma L \leq \gamma \leq \gamma U} LM(\tilde{\beta}, \gamma) \tag{6.21}$$

where $\tilde{\beta}$ is the null estimate of β. In both tests, $[\gamma L, \gamma U]$ is the search region set so that γL is the π_0 percentile of $\tilde{\omega}_{t-1}$ and γU is the $(1 - \pi_0)$ percentile; Andrews (1993) suggested setting π_0 between 0.05 and 0.15. Finally, Hansen and Seo (2002) developed two bootstrap methods to calculate asymptotic critical values and p-values. In this study, we employ the second test where the cointegrating vector is unknown. Finally, we follow Hansen and Seo (2002) and employ two parametric residual bootstrap procedures to approximate the null distribution of the sup LM test and calculate asymptotic critical values and p-values.

For the purpose of clarity, in this chapter, we examine the time series properties of fiscal deficits and current account deficits in selected African countries and also allow for the possibility of regime changes as well as the existence of asymmetries in twin deficits for these countries. The following steps were used in the estimation process:

Step 1: We perform two standard unit root tests, namely the augmented Dickey–Fuller (ADF, 1979) and the Phillips and Perron (PP, 1988) on each series. However, because the two the ADF and the PP unit root tests do not allow for existing breaks in the series. We result to check for the presence of structural breaks in the series using the Lee and Strazicich (2003) unit root test with two breaks.

Step 2: We proceed by examining the long-run relationship between fiscal deficits and the current account deficits for I(1) series using the Engle-Granger and the Phillips-Ouliaris as well as the Johansen cointegration test.

Step 3: We also examine the long-run relationship between fiscal deficits and the current account deficits using the Gregory and Hansen (1996) residual-based test of cointegration, which allows the existence of one-time change in the cointegrating parameters.

Step 4: The Hansen and Seo (2002) bi-variate threshold cointegration were utilized as there could be some asymmetries in the adjustment process towards the long-run equilibrium using the sup LM test.

Step 5: If the sup LM test shows evidence of threshold cointegration we proceed to estimate the threshold VECM.

6.3 Result

Table 6.1: Unit Root Tests Summary table

Country	ADF		PP		LM	
	FD	CAB	FD	CAB	FD	CAB
Botswana	I(1)	I(2)	I(1)	I(1)	I(1)	I(1)
Cameroon	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
Egypt	I(1)	I(2)	I(1)	I(1)	I(1)	I(1)
Ethiopia	I(1)	I(2)	I(1)	I(1)	I(1)	I(0)
Ghana	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)
Kenya	I(1)	I(2)	I(1)	I(1)	I(0)	I(1)
Morocco	I(1)	I(2)	I(1)	I(1)	I(0)	I(1)
Nigeria	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
South Africa	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)
Tanzania	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
Tunisia	I(0)	I(0)	I(0)	I(1)	I(0)	I(0)
Uganda	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Note: ADF = Augmented Dickey Fuller test, PP = Philip-Perron test, LM = test with two structural breaks, FD = Fiscal deficits, CAB = current account deficits. I(0) indicates significant at levels, I(1) indicates at first differences and I(2) indicates at second differences

The table above reports the Augmented Dickey Fuller, the Philip Perron unit root test and the LM two structural breaks test conducted on the fiscal deficits and the

current account balance. In each case, the non-stationarity null cannot be rejected at the 5% significance levels for nine countries out of the twelve sampled countries, we therefore, perform the threshold cointegration for the nine countries and they are; Botswana, Cameroon, Egypt, Ethiopia, Kenya, Morocco, Nigeria, Tanzania and Uganda using the ADF and the PP.

The estimation of equation (6.16) as a potential cointegrating relationship by dynamic OLS (DOLS) and fully modified OLS (FMOLS) provides the following estimates for the twelve countries;

Table 6.2: Dynamic OLS and Fully Modified OLS

Country	$DOLS$	$FMOLS$
Botswana	0.822(3.102)***	0.789(3.356)***
Cameroon	-0.017(0.244)	-0.004(0.072)
Egypt	0.384(4.260)***	0.376(4.542)***
Ethiopia	-0.413(0.941)	-0.434(1.273)
Ghana	0.034(0.789)	0.017(0.528)
Kenya	-0.407(1.609)	-0.440(1.910)*
Morocco	0.651(3.798)***	0.649(4.126)***
Nigeria	0.700(3.518)***	0.647(3.832)***
South Africa	-0.115(0.556)	-0.061(0.316)
Tanzania	0.635(1.196)	0.554(1.277)
Tunisia	0.020(0.034)	0.044(0.096)
Uganda	-0.533(1.366)	-0.504(1.475)

Note: DOLS = Dynamic ordinary least square and FMOLS = Fully Modified ordinary least square. *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively. The results were generated using the EVIEWS software.

From the above cointegrating relationship, $\beta > 0$ in Botswana, Egypt, Ghana, Morocco, Nigeria, Tanzania and Tunisia and this lend support to the Keynesian viewpoint of the twin deficits hypothesis. However, in Cameroon, Ethiopia, Kenya, South Africa and Uganda $\beta < 0$.

Table 6.3: Cointegration Test on Fiscal Deficits and Current Account Balance

Country	τ(Engle-Granger)	τ(Phillips-Ouliaris)
Botswana	-2.779 (0.383)	-4.346** (0.013)
Cameroon	-3.418 (0.133)	-3.270 (0.176)
Egypt	-3.541 (0.104)	-2.987 (0.284)
Ethiopia	-2.526 (0.515)	-2.865 (0.339)
Kenya	-2.217 (0.677)	-2.544 (0.504)
Morocco	-3.117 (0.231)	-2.233 (0.668)
Nigeria	-2.664 (0.442)	-3.694* (0.074)
Tanzania	-2.315 (0.627)	-2.252 (0.659)
Uganda	-2.646 (0.451)	-3.318 (0.161)

Note: τ(Engle-Granger) and τ(Phillips-Ouliaris) refer to the non-cointegration tests advocated by Engle and Granger (1987) and Phillips-Ouliaris (1990). In each case, p-values are reported in parentheses

*, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively. Nine countries were examined because the fiscal deficits and the current account deficits variables were integrated of order one, and it is a condition for cointegration analysis. The results were generated using the EVIEWS software.

Table 6.3 reports test for non-cointegration based on equation (6.16) using procedures advocated by Engle and Granger (1987) and Phillip and Ouliaris (1990). The null of non-cointegration is only rejected at the 10% level of significance for Botswana and Nigeria. One possibility is that potential structural breaks have not been allowed for, and this is contributing to the presence of the low power of the tests reported in table 6.3.

Table 6.4: Johansen's Trace Test and Maximum Eigenvalue Results

Country		Null Hypothesis	Alternative Hypothesis	Test Statistic	5% level of Significance	Results
Botswana	J_{trace}	r = 0	r > 0	24.32	15.49	Reject H_0
		r = 1	r > 1	5.3	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	19.03	15.49	Reject H_0
		r = 1	r = 2	5.3	3.84	Reject H_0
Cameroon	J_{trace}	r = 0	r > 0	44.75	15.49	Reject H_0
		r = 1	r > 1	18.64	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	26.12	15.49	Reject H_0
		r = 1	r = 2	18.64	3.84	Reject H_0
Egypt	J_{trace}	r = 0	r > 0	26.63	15.49	Reject H_0
		r = 1	r > 1	6.95	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	19.68	15.49	Reject H_0
		r = 1	r = 2	6.95	3.84	Reject H_0
Ethiopia	J_{trace}	r = 0	r > 0	31.67	15.49	Reject H_0
		r = 1	r > 1	9.76	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	21.91	15.49	Reject H_0
		r = 1	r = 2	9.76	3.84	Reject H_0
Ghana	J_{trace}	r = 0	r > 0	58.86	15.49	Reject H_0
		r = 1	r > 1	19.13	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	34.73	15.49	Reject H_0
		r = 1	r = 2	19.13	3.84	Reject H_0
Kenya	J_{trace}	r = 0	r > 0	23.14	15.49	Reject H_0
		r = 1	r > 1	8.59	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	14.54	15.49	Reject H_0
		r = 1	r = 2	8.59	3.84	Reject H_0
Morocco	J_{trace}	r = 0	r > 0	25.11	15.49	Reject H_0
		r = 1	r > 1	7.43	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	17.68	15.49	Reject H_0
		r = 1	r = 2	7.43	3.84	Reject H_0
Nigeria	J_{trace}	r = 0	r > 0	31.57	15.49	Reject H_0
		r = 1	r > 1	13.98	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	17.58	15.49	Reject H_0
		r = 1	r = 2	13.98	3.84	Reject H_0
South Africa	J_{trace}	r = 0	r > 0	14.85	15.49	Reject H_1
		r = 1	r > 1	4.66	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	10.18	14.26	Reject H_1
		r = 1	r = 2	4.66	3.84	Reject H_0
Tanzania	J_{trace}	r = 0	r > 0	24.38	15.49	Reject H_0
		r = 1	r > 1	7.79	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	16.6	15.49	Reject H_0
		r = 1	r = 2	7.79	3.84	Reject H_0
Tunisia	J_{trace}	r = 0	r > 0	36.87	15.49	Reject H_0
		r = 1	r > 1	11.50	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	25.37	14.26	Reject H_0
		r = 1	r = 2	11.50	3.84	Reject H_0
Uganda	J_{trace}	r = 0	r > 0	23.96	15.49	Reject H_0
		r = 1	r > 1	11.31	3.84	Reject H_0
	$J_{\max}$	r = 0	r = 1	12.65	15.49	Reject H_0
		r = 1	r = 2	11.31	3.84	Reject H_0

Nine countries were examined because the fiscal deficits and the current account deficits variables were integrated of order one, and it is a condition for cointegration analysis. The results were generated using the EVIEWS software.

The cointegration test was conducted under the assumption that there is no deterministic trend in the data. From tables 6.4, it can be observed that the null hypothesis of no cointegration against the alternative of presence of one or more cointegrating vector is rejected at the 5% level of significance in both techniques (trace test and maximum eigenvalue). This implies that linear cointegration does exist between the current account imbalance and fiscal deficits in the selected African countries.

Table 6.5: Johansen Long Run Elasticities

Country	C	FD
Botswana	-1.677	0.652(2.161)**
Cameroon	-11.686	-5.871(5.267)***
Egypt	-0.732	0.399(4.211)***
Ethiopia	35.750	-7.768(4.828)***
Ghana	12.230	-0.654(5.712)***
Kenya	2.581	0.726(1.642)*
Morocco	-1.804	1.149(5.253)***
Nigeria	97.818	8.928(4.536)***
South Africa	0.655	0.262(0.748)
Tanzania	-5.038	6.546(4.139)***
Tunisia	-67.916	32.437(5.175)***
Uganda	3.724	1.389(1.924)*

Note: *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively. Nine countries were examined because the fiscal deficits and the current account deficits variables were integrated of order one, and it is a condition for cointegration analysis. The results were generated using the EVIEWS software.

The long-run elasticities of the impact of fiscal deficits on the current account deficits are reported in Table 6.5. The results are consistent with theoretical expectations that as fiscal deficits increases, it worsen the current account deficits in Botswana, Egypt, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia and Uganda.

Table 6.6: Gregory and Hansen (1996) cointegration tests

Country	C		Trend		Regime		Regime trend	
	T_b	t_x	T_b	t_x	T_b	t_x	T_b	t_x
Botswana	1992q02	-5.63***	2002q04	-6.76***	1992q01	-6.25***	1995q01	-6.72***
Cameroon	2002q01	-5.97***	2002q01	-6.09***	2002q01	-5.99***	2002q04	-8.66***
Egypt	1990q01	-4.50*	1989q02	-5.74***	1990q01	-4.36*	1989q02	-5.97**
Ethiopia	2005q01	-5.48***	1997q01	-5.71***	2005q01	-5.32**	2000q01	-6.21***
Kenya	1997q01	-3.49	1996q01	-3.68	2001q01	-3.56	1995q01	-4.45
Morocco	1988q01	-4.53*	2000q02	-4.75*	1988q01	-4.83*	1998q01	-5.26*
Nigeria	1988q01	-4.97**	1993q01	-5.28**	1988q01	-5.00**	1993q01	-6.15***
Tanzania	1986q01	-4.95**	1986q01	-6.22***	1986q01	-4.92*	1986q01	-6.18***
Uganda	1999q01	-5.54***	1999q01	-5.40**	1999q01	-5.13**	1999q01	-5.21

Note: The 1 , 5, and 10 per cent critical values are respectively -5.13, -4.61 and -4.34 for the level break model with no trend. -5.45, -4.99 and -4.72 for the level break model with trend, -5.47, -4.95 and -4.68 for the regime shift model, -6.02, -5.50 and -5.24 for the regime trend. Tb denotes the time of the break and tx denotes the minimum test statistic for a unit root. In each case, the lag length is determined by the SIC. *, **, and *** denotes rejection of the non-cointegration null at the 10, 5 and 1 per cent significance level respectively. Nine countries were examined because the fiscal deficits and the current account deficits variables were integrated of order one, and it is a condition for cointegration analysis. The results were generated using the STATA software

Table 6.6 reports four Gregory and Hansen (1996) cointegration tests based on structural breaks in the constant, linear trend, regime shift and regime trend. The results here are mixed. There is evidence of linear cointegration with acceptance of the alternative in all of the four models for Botswana, Cameroon, Egypt, Ethiopia, Morocco, Nigeria and Tanzania. There is also some evidence in favour of cointegration with rejections of the null in three of the four models for Uganda. However, we fail to reject the null for all the four models in Kenya, impyling no evidence of linear cointegration

However, at this point, we do find clear evidence of linear cointegration between current account deficits and fiscal deficits in these countries except in Kenya, therefore there is a need to examine the presence of threshold cointegration in these countries because the null hypothesis of Hansen and Seo (2002) test for linear cointegration.

Table 6.7: Tests for Threshold Cointegration

Country	supLM value	Bootstrap $p-$value	Threshold Parameter (γ)	Cointegrating vector $\left(\hat{\beta}\right)$
Botswana	21.27***	0.01	5.95	0.37
Cameroon	23.46***	0.01	-6.49	0.22
Egypt	16.38*	0.08	6.50	0.99
Ethiopia	15.81*	0.09	-38.78	-5.00
Kenya	18.25**	0.02	-13.62	-6.64
Morocco	19.19*	0.09	-6.55	3.04
Nigeria	18.60***	0.01	-53.26	2.97
Tanzania	21.83***	0.01	24.49	7.07
Uganda	19.84***	0.01	-14.38	-4.07

Note:The p-values for the sup LM test are obtained from a parametric residual bootstrap with 5000 replications. For both sup LM and $\hat{\beta}$, the value of γ is derived from a grid search procedure where the significance of γ is addressed through the sup LM test which rejects the null of cointegration with no threshold in favour of the alternative of cointegration with a threshold.

*, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively. Nine countries were examined because the fiscal deficits and the current account deficits variables were integrated of order one, and it is a condition for cointegration analysis. The results were generated using the GAUSS software. The codes were obtained from Hansen's web page for the Hansen and Seo (2002) threshold cointegration.

6.3.1 Hansen and Seo (2002) Threshold Cointegration

To assess the evidence for threshold cointegration, the study employed the sup LM test described above where the true cointegrating vector is unknown for the complete bivariate specification, and the results for all the countries rejected the presence of linear cointegration in favour of threshold cointegration. The $p-$values for this test is calculated using a parametric bootstrap computed with 5,000 simulation replications. The results are presented in table 6.16 and point to the presence of threshold cointegration for all countries. Contrary to the non-cointegration tests reported in the Engle-Granger and Phillips-Ouliaris cointegration tests reported in previous tables, this provides a strong rejection of the null of linear cointegration. The parameter estimates are calculated over a 200×200 grid on both the threshold parameter (γ) and the cointegrating vector ($\hat{\beta}$).

The estimated two-regime threshold cointegration for Botswana has an estimated

cointegrating vector of 0.37, and the estimated threshold is 5.95. This results points to a threshold –based cointegrating relationship between the CAB and FD which are linked by a positive long-run coefficient (0.37) characterized by a threshold of (5.95). The positive slope coefficient provides support for the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 0.37FD_t + 5.95$ that is when the current account balance is more than 5.95 percentage points above the fiscal deficits. This would be the majority regime, including 59 per cent of the observation, and this regime is relevant to 71 of the 120 quarterly observations. The second regime (with 41 per cent of the observations) is when $CAB_t < 0.37FD_t + 5.95$, and this is the minority regime, this would occur when the current account balance is more than 5.95 percentage points below the fiscal deficits.

For both the fiscal deficits and current account balance, asymmetry is implied in the sense that there is a stronger error-correction effect in the minority regime than the majority regime. The adjustment coefficients of current account balance are significant only in the minority regime, and the equilibrium error persists for current account balance in the majority regime because the adjustment coefficients are insignificant. Also, there is a significant error correction effect only in the minority regime in the fiscal deficits equation, when the deviation from the long run exceeds the threshold parameter. From figure 6.1, it can be seen that flat or near zero error correction effect on the left hand of the threshold parameter for both the FD and the CAB equation implies that the divergent between the FD and the CAB is persistent and do not respond to the error-correction term. However, on the right side of threshold parameter the response of the FD and the CAB to error correction is statistically significant. There is a sharp negative relationship for the CAB (CAB decreases as the error-correction term increases) and a slight positive relationship for the FD (FD increases as the error-correction term increases). The larger the size of the threshold, the greater is the persistence of disequilibrium, it can be observed that the estimated threshold for Botswana is 5.95 which is quite large to an extent, the huge threshold can be explained by constantly withdrawing from the high external reserves from diamond revenue to finance the fiscal deficits.

The Cameroon's result has an estimated cointegrating vector of 0.22, and the estimated threshold is -6.49. The positive slope coefficient of (0.22) provides support for the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 0.22FD_t - 6.49$, that is when the current account balance is more than 6.49 percentage points above the fiscal deficits. This would be the minority regime, including 21 per cent of the observation, and this regime is relevant to 25 of the 120 quarterly observations. The second regime (with 79 per cent of the observations) is when $CAB_t < 0.22FD_t - 6.49$, and this is the majority regime, this would occur

when the current account balance is more than 6.49 percentage points below the fiscal deficits.

The error correction appears to be statistically significant in both models of the minority regime and statistically significant in the current account balance equation in the majority regime, but the fiscal deficits equation in the majority regime are close to driftless random walk . In figure 6.1, the error-correction effect- the estimated regression functions of ΔCAB_t and ΔFD_t as a function of w_{t-1}, holding the other variables constant is plotted. In the figure, the fiscal deficits equation showed a strong positive error effects while the current account balance equation have a slight positive error on the left side of the estimated threshold. However, on the right side of the estimated threshold there is a near zero error correction effect for both the current account balance and the fiscal deficits equations. Above the threshold, the fiscal deficits increases as the error-correction term increases while, the current account balance decreases as the error-correction increases, this is to further confirm the negative relationship found between the FD and the CAB when estimating the dynamic OLS for Cameroon.

In Egyptian two-regime threshold cointegration, results indicate an estimated cointegrating vector of 0.99 and the estimated threshold is 6.50. This results revealed a threshold –based cointegrating relationship between the CAB and FD which are linked by a positive long-run coefficient (0.99) characterized by a threshold of (6.50). The positive slope coefficient provides further evidence to support the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 0.99FD_t + 6.50$, that is when the current account balance is more than 6.50 percentage points above the fiscal deficits. This would be the majority regime, including 78 per cent of the observation, and this regime is relevant to 94 of the 120 quarterly observations. The second regime (with 22 per cent of the observations) is when $CAB_t < 0.99FD_t + 6.50$, and this is the minority regime, this would occur when the current account balance is more than 6.50 percentage points below the fiscal deficits.

In the majority regime, both variables (FD and CAB) show minimal error-correction effects and minimal dynamics, indication of proximity to white noise. This implies that in the majority regime, the FD and the CAB are close to driftless random work. On the other hand, when the gap between the twin deficits is above a critical threshold is 6.50, the error-correction effect of the CAB model become statistically significant, this indicates that the error correction in this regime is based only on the adjustment of the current account balance and not on the budget balance. The error-correction effect, as plotted in figure 6.1 shows that the current account balance equations and the fiscal deficits equations recorded a near zero effects on

the left side of the threshold, implying persistent divergent between the FD and the CAB and also do not respond to the error-correction term, whereas on the right side of the threshold, both the current account balance and the fiscal deficits equations recorded a negative error correction effects, this implies that both the CAB and the FD decrease as the error-correction term increases. The threshold parameter of 6.50 can be explained by the persistent in the deficits which was as a result of decrease in total revenues; this decrease is attributable to the large informal sector and tax evasion of private business sector.

Ethiopian two-regime threshold VECM reveals an estimated cointegrating vector of -5.00 and the estimated threshold is -38.78. The negative slope coefficient of (-5.00) did not provide support for the Keynesian viewpoint of twin deficits relationship in Ethiopia and this result is somewhat similar from the dynamic OLS estimated where β= -0.413. The first regime occurs when $CAB_t \leq 5.00FD_t - 38.78$ that is when the current account balance is more than 38.78 percentage points below the fiscal deficits. This would be the minority regime, including 10 per cent of the observation, and this regime is relevant to 12 of the 120 quarterly observations. The second regime (with 90 per cent of the observations) is when $CAB_t > 5.00FD_t - 38.78$, and this is the majority regime, this would occur when the current account balance is more than 38.7 percentage points above the fiscal deficits.

Table 6.8: Botswana and Cameroon Threshold VECM

$\rightarrow$ *Botswana*	I^{st} Regime	($\hat{\omega}_{t-1} \geq 5.95$)	2^{nd} Regime	($\hat{\omega}_{t-1} < 5.95$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	0.917**	0.215	3.769**	-1.413**
	(0.359)	(0.138)	(1.767)	(0.562)
$\hat{\omega}_{t-1}$	-0.033	0.004	-0.516***	0.097**
	(0.036)	(0.009)	(0.179)	(0.041)
Δcab_{t-1}	0.326***	0.067**	0.555***	0.019
	(0.074)	(0.027)	(0.156)	(0.040)
Δcab_{t-2}	0.100	0.560***	-0.178	0.525***
	(0.166)	(0.156)	(0.145)	(0.141)
Δfd_{t-1}	0.077	0.051**	0.496***	-0.028
	(0.052)	(0.025)	(0.174)	(0.045)
Δfd_{t-2}	0.122	0.125	0.102	0.087
	(0.157)	(0.097)	(0.147)	(0.071)
% of Observation	59		41	
$\rightarrow$ *Cameroon*	I^{st} Regime	($\hat{\omega}_{t-1} \leq -6.49$)	2^{nd} Regime	($\hat{\omega}_{t-1} > -6.49$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	2.046***	25.992**	-0.458***	0.171
	(0.685)	(10.037)	(0.125)	(0.150)
$\hat{\omega}_{t-1}$	0.201**	3.445***	-0.101**	0.039
	(0.084)	(1.307)	(0.044)	(0.051)
Δcab_{t-1}	0.403***	0.457	0.475***	-0.053
	(0.109)	(0.643)	(0.102)	(0.087)
Δcab_{t-2}	0.004	0.493***	-0.053	0.421
	(0.006)	(0.157)	(0.041)	(0.297)
Δfd_{t-1}	0.087	-0.375	0.127**	-0.042
	(0.064)	(0.627)	(0.058)	(0.050)
Δfd_{t-2}	0.016	0.685**	-0.023	0.039
	(0.018)	(0.305)	(0.019)	(0.098)
% of Observation	21		79	

Notes: Notes: Eicker-White standard errors given in parentheses. The selection of a lag length of 2 in the threshold VECM is based on the use of the SIC applied to an unrestricted VAR comprising the CAB and FD *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively.

Table 6.9: Egypt and Ethiopia Threshold VECM

$\rightarrow$ *Egypt*	I^{st} Regime	($\hat{\omega}_{t-1} \geq 6.50$)	2^{nd} Regime	($\hat{\omega}_{t-1} < 6.50$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	0.086	-0.319***	1.169*	1.948
	(0.061)	(0.109)	(0.638)	(1.692)
$\hat{\omega}_{t-1}$	-0.008	-0.015	-0.128**	-0.044
	(0.013)	(0.022)	(0.056)	(0.130)
Δcab_{t-1}	0.777***	-0.203	0.434***	0.826***
	(0.161)	(0.213)	(0.160)	(0.293)
Δcab_{t-2}	-0.014	0.364***	0.107	1.242***
	(0.029)	(0.091)	(0.104)	(0.299)
Δfd_{t-1}	0.048	0.017	0.071	-0.648**
	(0.069)	(0.102)	(0.117)	(0.312)
Δfd_{t-2}	0.032	0.185**	-0.038	-0.061
	(0.021)	(0.076)	(0.104)	(0.211)
% of Observation	78		22	
$\rightarrow$ *Ethiopia*	I^{st} Regime	($\hat{\omega}_{t-1} \leq -38.78$)	2^{nd} Regime	($\hat{\omega}_{t-1} > -38.78$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	-16.892***	9.945***	-0.399*	-0.549***
	(6.342)	(1.462)	(0.213)	(0.152)
$\hat{\omega}_{t-1}$	-0.388**	0.204***	-0.017	-0.021***
	(0.151)	(0.033)	(0.011)	(0.006)
Δcab_{t-1}	-0.093	0.154***	0.477***	0.039
	(0.210)	(0.058)	(0.114)	(0.046)
Δcab_{t-2}	-0.527	0.823***	0.108	0.466***
	(0.224)	(0.106)	(0.090)	(0.088)
Δfd_{t-1}	-0.043	-0.058	0.081	0.067*
	(0.165)	(0.047)	(0.063)	(0.036)
Δfd_{t-2}	-0.096	0.375***	0.066	0.188***
	(0.296)	(0.092)	(0.071)	(0.063)
% of Observation	10		90	

Notes: Notes: Eicker-White standard errors given in parentheses. The selection of a lag length of 2 in the threshold VECM is based on the use of the SIC applied to an unrestricted VAR comprising the CAB and FD *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively.

Table 6.10: Kenya and Morocco Threshold VECM

$\rightarrow Kenya$	Ist Regime	$(\hat{\omega}_{t-1} \leq -13.62)$	2nd Regime	$(\hat{\omega}_{t-1} > -13.62)$
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	5.789	2.659	-0.188	-0.027
	(3.771)	(1.647)	(0.226)	(0.097)
$\hat{\omega}_{t-1}$	0.265	0.153*	0.012	-0.002
	(0.218)	(0.093)	(0.037)	(0.013)
Δcab_{t-1}	0.785***	0.001	0.341***	-0.004
	(0.250)	(0.121)	(0.071)	(0.022)
Δcab_{t-2}	0.276	0.765*	-0.273	0.589***
	(0.575)	(0.387)	(0.202)	(0.122)
Δfd_{t-1}	0.805***	-0.081	0.049	0.002
	(0.257)	(0.099)	(0.047)	(0.013)
Δfd_{t-2}	1.931***	-0.213	-0.440*	0.257**
	(0.668)	(0.274)	(0.244)	(0.100)
% of Observation	16		84	
$\rightarrow Morocco$	Ist Regime	$(\hat{\omega}_{t-1} \leq -6.55)$	2nd Regime	$(\hat{\omega}_{t-1} > -6.55)$
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	-2.588	3.018*	0.022	-0.079
	(2.251)	(1.551)	(0.075)	(0.065)
$\hat{\omega}_{t-1}$	-0.231	0.382**	0.004	0.015***
	(0.213)	(0.151)	(0.006)	(0.004)
Δcab_{t-1}	0.439*	-0.037	0.538***	-0.048
	(0.239)	(0.114)	(0.114)	(0.061)
Δcab_{t-2}	-0.002	1.013***	-0.134	0.529***
	(0.255)	(0.341)	(0.098)	(0.097)
Δfd_{t-1}	0.102	-0.332*	0.097	-0.007
	(0.157)	(0.197)	(0.066)	(0.046)
Δfd_{t-2}	-0.275	0.778**	-0.071	0.154***
	(0.320)	(0.317)	(0.088)	(0.066)
% of Observation	9		91	

Notes: Notes: Eicker-White standard errors given in parentheses. The selection of a lag length of 2 in the threshold VECM is based on the use of the SIC applied to an unrestricted VAR comprising the CAB and FD *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively.

Table 6.11: Nigeria and Tanzania Threshold VECM

$\rightarrow Nigeria$	Ist Regime	($\hat{\omega}_{t-1} \leq -53.26$)	2nd Regime	($\hat{\omega}_{t-1} > -53.26$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	-11.253***	9.164*	0.703**	1.555**
	(2.709)	(5.31)	(0.297)	(0.593)
$\hat{\omega}_{t-1}$	-0.151***	0.142**	0.027**	0.066***
	(0.041)	(0.069)	(0.012)	(0.020)
Δcab_{t-1}	0.171**	0.568	0.572***	0.009
	(0.084)	(0.369)	(0.138)	(0.118)
Δcab_{t-2}	-0.140	0.895**	-0.011	0.549***
	(0.077)	(0.379)	(0.071)	(0.144)
Δfd_{t-1}	0.189**	-0.171	0.143	0.058
	(0.091)	(0.218)	(0.100)	(0.093)
Δfd_{t-2}	-0.058	0.129	0.028	0.166*
	(0.086)	(0.156)	(0.056)	(0.092)
% of Observation	16		84	
$\rightarrow Tanzania$	Ist Regime	($\hat{\omega}_{t-1} \geq 24.49$)	2nd Regime	($\hat{\omega}_{t-1} < 24.49$)
Variables	CAB Model	FD Model	CAB Model	FD Model
Intercept	0.124	-0.155**	-4.726***	-1.783
	(0.096)	(0.078)	(1.668)	(1.336)
$\hat{\omega}_{t-1}$	-0.014**	0.018***	0.138***	0.070*
	(0.006)	(0.006)	(0.045)	(0.037)
Δcab_{t-1}	0.469***	0.009	1.258***	-0.902
	(0.089)	(0.054)	(0.276)	(0.340)
Δcab_{t-2}	0.107	0.431***	-0.205	1.392***
	(0.097)	(0.105)	(0.227)	(0.333)
Δfd_{t-1}	0.065	-0.003	0.791**	0.329
	(0.064)	(0.039)	(0.350)	(0.293)
Δfd_{t-2}	-0.032	0.177**	0.151	0.049
	(0.079)	(0.084)	(0.125)	(0.119)
% of Observation	90		10	

Notes: Notes: Eicker-White standard errors given in parentheses. The selection of a lag length of 2 in the threshold VECM is based on the use of the SIC applied to an unrestricted VAR comprising the CAB and FD *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively.

Table 6.12: Uganda Threshold VECM

Variables	I^{st} Regime CAB Model	($\hat{\omega}_{t-1} \leq -14.38$) FD Model	2^{nd} Regime CAB Model	($\hat{\omega}_{t-1} > -14.38$) FD Model
Intercept	0.439	-1.538***	-0.111	-0.058
	(0.704)	(0.464)	(0.074)	(0.042)
$\hat{\omega}_{t-1}$	0.056	-0.118***	-0.033***	-0.010
	(0.042)	(0.027)	(0.013)	(0.007)
Δcab_{t-1}	0.031	0.015	0.526***	0.034
	(0.114)	(0.125)	(0.123)	(0.046)
Δcab_{t-2}	-0.816	0.684***	0.063	0.382***
	(0.179)	(0.197)	(0.148)	(0.102)
Δfd_{t-1}	-0.267	0.005	0.178**	0.005
	(0.112)	(0.124)	(0.077)	(0.032)
Δfd_{t-2}	-1.046	0.479**	-0.026	0.075
	(0.208)	(0.217)	(0.087)	(0.051)
% of Observation	18		82	

Notes: Notes: Eicker-White standard errors given in parentheses. The selection of a lag length of 2 in the threshold VECM is based on the use of the SIC applied to an unrestricted VAR comprising the CAB and FD *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively.

The error correction appears to be statistically significant in both models of the minority regime and statistically significant in the fiscal deficits equation in the majority regime. In figure 6.1, the error-correction effect is reported. The figure shows that, the current account balance have a strong negative error correction effect on the left side of the threshold and also have a slight decline on the right side of the threshold. In contrast, fiscal deficits equation showed a strong positive error effects on the left side of the threshold and declined slightly on the right side of the threshold. The parameter threshold of -38.78 points to persistent deficits in this country, this can be explained by the structure of this economy which is majorly agrarian, and the revenue from the agricultural sector are subjected to the volatility of commodities prices which makes the revenue base to be on the decline.

In Kenyan two-regime threshold cointegration, the estimated cointegrating vector of -6.64 and the estimated threshold is -13.62. The negative slope coefficient of (-6.64) provide support for the Ricardian equivalence hypothesis in Kenya. The first regime occurs when $CAB_t \leq 6.64FD_t - 13.62$, that is when the current account balance is more than 13.62 percentage points below the fiscal deficits. This is the minority regime, including 16 per cent of the observation, and this regime is relevant

to 19 of the 120 quarterly observations. The second regime (with 84 per cent of the observations) is when $CAB_t > 6.64FD_t - 13.62$, and this is the majority regime, this would occur when the current account balance is more than 13.62 percentage points above the fiscal deficits.

The error correction appears to be statistically significant only in the fiscal deficits equations in the minority regime; in the majority regime none of the error term effects were statistically significant. This implies that in this regime, the CAB and the FD are close to white noise. Figure 6.2 reports the error-correction effect. The figure shows that, both the current account balance and fiscal deficits equations have a strong positive error correction effect on the left side of the threshold implying that as the error-correction term increase both the CAB and the FD also increases, whereas on the right side of the threshold, there is a near zero error-correction effects for both equations. The threshold parameter for Kenya is estimated at -13.64, this can be explained by the persistent in the deficits, this persistent can be explained by the volatility of commodity prices of their agricultural products, as well as the low capacity utilization rate of the manufacturing industries which negatively affect the revenue base.

The estimated two-regime threshold cointegration for Morocco has an estimated cointegrating vector of 3.04 and the estimated threshold is –6.55. The positive slope coefficient of (3.04) provides support for the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 3.04FD_t - 6.55$, that is when the current account balance is more than 6.49 percentage points above the fiscal deficits. This represents the minority regime, including 9 per cent of the observation, and this regime is relevant to about 11 of the 120 quarterly observations. The second regime (with 91 per cent of the observations) is when $CAB_t < 3.04FD_t - 6.55$, and this is the majority regime, this would occur when the current account balance is more than 6.55 percentage points below the fiscal deficits.

The error correction appears to be statistically significant in both the majority and the minority regime for the fiscal deficits equation, while the current account equations in both regimes remain statistically insignificant. One finding of great interest is that the estimated error-correction effects are positive, except in the minority regime, where the current account balance equation has a negative point estimate, but it is statistically insignificant and numerically very close zero. In figure 6.2, the error-correction effect- the estimated regression functions of ΔCAB_t and ΔFD_t as a function of w_{t-1}, holding the other variables constant is plotted. On the left side of the threshold, there is a clear evidence of asymmetry as the effect of the error correction term is positive (negative) for the FD (CAB).

However, on the right side of the estimated threshold there is a near zero error

correction effect for the current account balance equations and the fiscal deficits equation have a slightly positive error correction effects. At this point, it is pertinent to explain the reason for the larger size of the estimated threshold parameter of -6.55 in Morocco. In this economy, there are persistent deficits because of the low revenue from the prominent agricultural sector, as well as the services sector.

The estimated two-regime threshold for Nigeria has an estimated cointegrating vector of 2.97 and estimated threshold of –53.26. The positive slope coefficient of (2.97) provides support for the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 2.97FD_t - 53.26$, that is when the current account balance is more than 53.26 percentage points above the fiscal deficits. This is the minority regime, including 16 per cent of the observation, and this regime is relevant to 19 of the 120 quarterly observations. The second regime (with 84 per cent of the observations) is when $CAB_t < 2.97FD_t - 53.26$, and this is the majority regime, this would occur when the current account balance is more than 53.26 percentage points below the fiscal deficits.

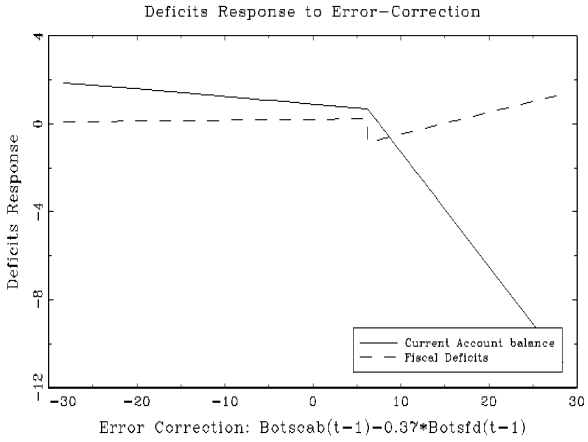
The error correction effects are significant in both the regimes for the current account balance and the fiscal deficits equations. Figure 6.2, plots the error-correction effect which is the estimated regression functions of ΔCAB_t and ΔFD_t as a function of w_{t-1}, holding the other variables constant is plotted. In the figure, the fiscal deficits equation showed a strong positive error effects, while the current account balance equation have a strong negative error correction effect on the left side of the estimated threshold. However, on the right side of the estimated threshold there is a slight positive error correction effects for both the current account balance and the fiscal deficits equations.

The threshold parameter of -53.26 for Nigeria can be explained by the persistence in the deficits. The persistence in the deficits is caused by the incessant strikes by the labour unions, as well as the instability of the polity, which affect the level of capital inflows negatively. These deficits are financed by the revenue from the excess crude oil.

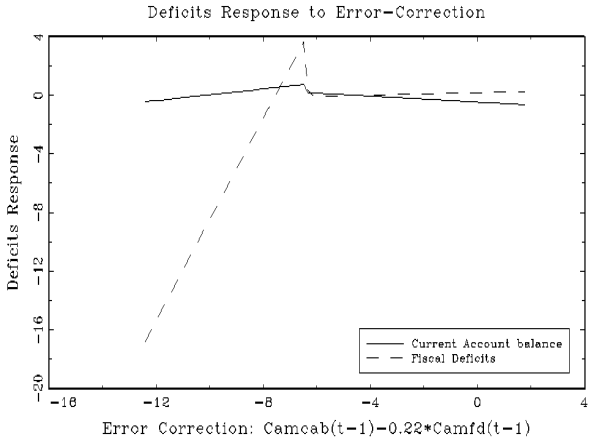
The estimated two-regime threshold cointegration for Tanzania has an estimated cointegrating vector of 7.07 and an estimated threshold of 24.49. This results points to a threshold-based cointegrating relationship between the CAB and FD which are linked by a positive long-run coefficient (7.07) characterized by a threshold of (24.49). The positive slope coefficient provides support for the Keynesian viewpoint of twin deficits relationship. The first regime occurs when $CAB_t \geq 7.07FD_t + 24.49$, that is when the current account balance is more than 24.49 percentage points above the fiscal deficits. This would be the majority regime, including 90 per cent of the observation, and this regime is relevant to 108 of the 120 quarterly observations. The

Figure 6.1: Current Account Balance and Fiscal Deficits Response to Error-Correction for Botswana, Cameroon, Egypt and Ethiopia

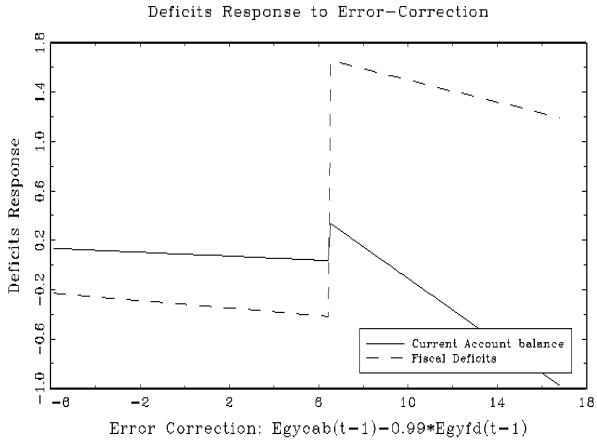
1. Botswana



2. Cameroon



3. Egypt



4. Ethiopia

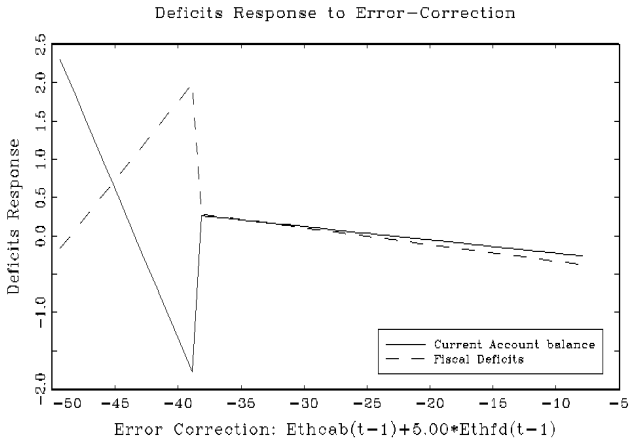
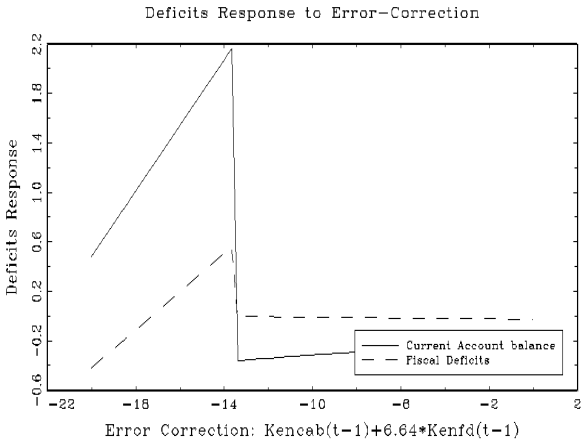
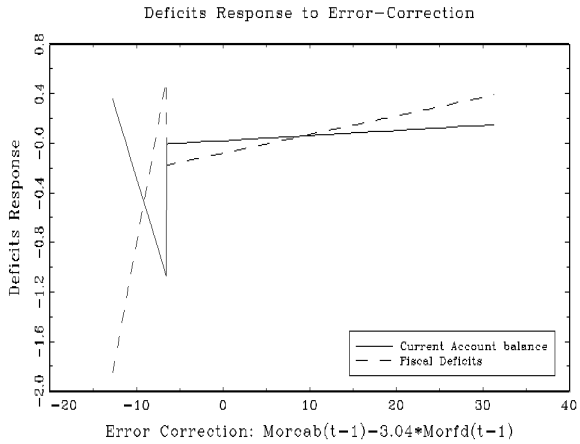


Figure 6.2: Current Account Balance and Fiscal Deficits Response to Error-Correction for Kenya, Morocco, Nigeria and Tanzania

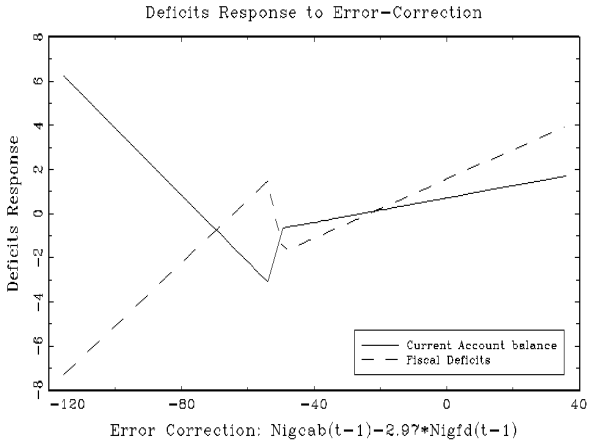
5. Kenya



6. Morocco



7. Nigeria



8. Tanzania

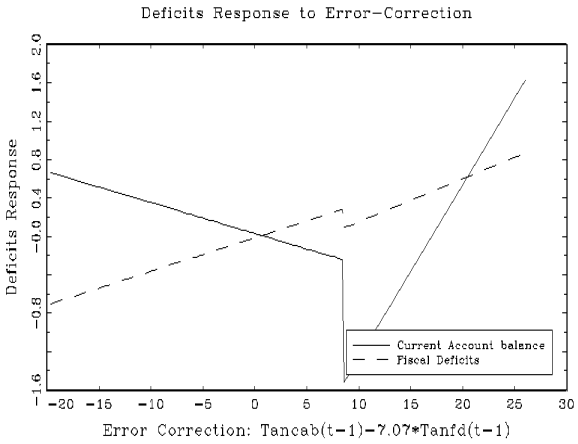
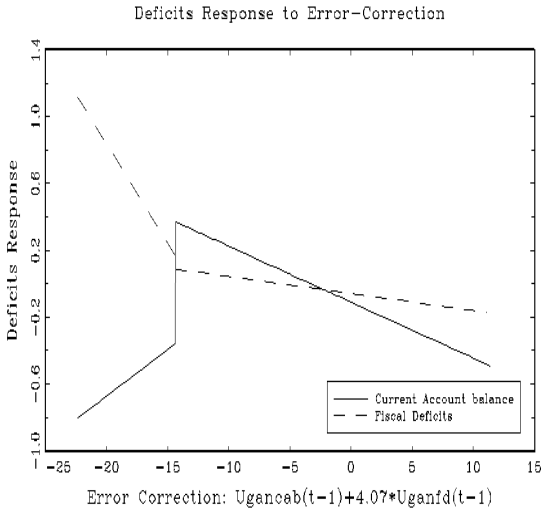


Figure 6.3: Current Account Balance and Fiscal Deficits Response to Error-Correction for Uganda

9. Uganda



second regime (with 10 per cent of the observations) is when $CAB_t < 7.07FD_t + 24.49$, and this is the minority regime, this would occur when the current account balance is more than 24.49 percentage points below the fiscal deficits.

The error correction appears to be statistically significant for both regimes. Figure 6.2 plots the error-correction effect, that is, the estimated response of current account deficits and fiscal deficits to the discrepancy between them in the previous period, holding the other variables constant. In the figure, there are negative error correction effects for the current account balance equations and a positive error correction effect for the fiscal deficits equations on the left side of the estimated threshold indication clear evidence of asymmetry. On the right side of the threshold, the current account balance has more positive effects than the fiscal deficit; this implies that both the CAB and the FD will increase as the error correction term increases after the threshold. The huge size of threshold parameter of 24.49 for Tanzania can be attributed to the low revenue from the agricultural sector as well as inefficient tax management lead to persistence of the deficits.

The Ugandan two-regime threshold VECM has an estimated cointegrating vector of -4.07, and the estimated threshold is -14.38. The negative slope coefficient of (-4.07) provide support for the Ricardian equivalence hypothesis in Uganda. The first regime occurs when $CAB_t \leq 4.07FD_t - 14.38$, that is when the current account balance is more than 14.38 percentage points below the fiscal deficits. This is the minority regime, including 18 per cent of the observation, and this regime is relevant to about 22 of the 120 quarterly observations. The second regime (with 82 per cent of the observations) is when $CAB_t > 4.07FD_t - 14.38$, and this is the majority regime, this would occur when the current account balance is more than 14.38 percentage points above the fiscal deficits.

The error correction appears to be statistically significant in the fiscal deficits equations in the minority regime; in the majority regime the current account deficits models is statistically significant. Figure 6.3 reports the error-correction effect. The figure shows that, the current account balance have a positive error correction effects while the fiscal deficits have a strong negative error correction effects on the left side of the threshold, whereas on the right side of the threshold, both equations display slight negative effects with the current account balance more negative than the fiscal deficits. This means that both the current account balance and the fiscal deficits will drastically decline after the threshold.

The huge size of the threshold parameter of -14.38 in the Ugandan economy is partly due to difficulties in the European and US economies, both important markets for Ugandan exports. The slow pace of growth in the advanced economies, together with financial instability in global markets, continued to dampen demand for

Uganda's exports and reduce foreign direct investment (FDI), remittances, and aid flows which consequently affects the revenue drive of the country, thereby persistent deficits.

At this point, it is appropriate to compare findings from other works on twin deficits. Egwaikhide (1999) used a macroeconomic model to investigate the effects of budget deficits on trade deficits in Nigeria, evidence from the policy simulations shows that budget deficits arising from increased government spending adversely affects the balance of trade in Nigeria irrespective of how it is financed. Other studies which employed simulation techniques and provide supportive evidence for the twin deficits hypothesis include Zietz and Pemberton (1990).

Examples of VAR models used to examine the relationship between the two deficits are as follows; Abell (1990) estimates a seven-variable VAR system with first-differenced data for the United States over the period 1979–1985. Based on Granger causality tests as well as impulse response analysis, the results suggest that the two deficits are twins and further indicates that budget deficits affect current account deficits through the transmission mechanisms of interest rates and exchange rates. Bachman (1992) and Rosensweig and Tallman (1993) also estimate unrestricted VAR in differences and find that government budget deficits have a sizable effect on trade deficits. Using quarterly data from 1947 to 1987 in the United States, Enders and Lee (1990) estimate a six variable structural VAR with the differenced data. However, their study supports the Ricardian equivalence hypothesis as it finds no evidence that budget deficits raise the trade deficit. Kim and Roubini (2008) estimate a VAR in levels for the post-Bretton-Woods period and find that increases in the U.S. government budget deficits actually improve the U.S. current account balance, which is completely opposite to the standard theoretical predictions.

Corsetti and Muller (2006) also examined the twin deficits hypothesis in Australia, Canada, United Kingdom and the United States using VAR their results revealed that 1 per cent increase in government expenditure deteriorates the trade balance in the UK and in Canada by 0.5 and 0.17 per cent of GDP respectively and that there is no significant effects for the US and Australia. Abass et al (2010) used panel VAR for 124 countries, their result revealed that 1 per cent increase I real government consumption expenditure worsen the current account by 0.3 per cent on GDP, however, the effects gradually declined, thus becoming insignificant after 2-4 years, but the impact is long lasting in emerging economies than in developed countries.

Since traditional unit root tests always find the two deficits to be non-stationary, other used another approach to look for linear cointegration between them. Bachman (1992) conducts cointegration tests for the U.S. current account and govern-

ment budget deficits but fails to find any evidence of cointegration. Khalid and Guan (1999) examined the twin deficits hypotheses for 5 developed countries and 5 developing countries, using the Engle-Granger two step procedures and the Johansen and Juselius maximum likelihood method, their results showed that there is no long-run relationship between the current account and the budget balance in developed countries, but there is evidence of long-run relationship in the developing countries.

Grier and Ye (2009) examined the long-run and the short-run relationship of the twin deficits in the United States. In their studies, they ascertained that there are different results on the two deficits mainly because of different samples, variables, and econometric models. As far as econometric techniques, they gave two factors for differences in results; first is the failure to allow for structural breaks in the two deficits series when examining the time series properties of the two variables. The second factor is failure to allow for the existence of volatility clustering in the current account deficits and government budget deficits. Putting these two factors into consideration their results showed that there is no long-run relationship between the two deficits. However, when the short-run connection is examined in the presence of conditional heteroskedasticity, both the impulse response function and the variance decomposition reveals a sizeable and fairly persistent positive relationship between the budget deficits and the current account balance.

From the above empirical evidence, all the studies examined the linearity of the two deficits without looking at the non-linearity of the twin deficits, which this study has examined. In contrast, the new results reported here provide strong evidence of cointegrated once threshold effects are allowed. There is evidence that a 1 per cent increase in fiscal deficits worsen the current account in Botswana, Cameroon, Egypt, Morocco, Nigeria and Tanzania while a 1 per cent increase in fiscal deficits improves the current account balance in Ethiopia, Kenya and Uganda.

On the issue of thresholds in the twin deficits relationship, using a dynamic panel threshold model for 22 developed countries, Nickel and Vansteenkiste (2008) examined the relationship between the twin deficits and their results shows that large fiscal deficits leads to current account imbalances. Holmes (2011) examined the twin deficits in the United States using the Hansen and Seo's (2002) threshold cointegration found that the budget deficits is more worsening that the current account deficits in the second regime.

In this study, the results revealed that in the first regime, the fiscal deficits is more worsened that the current account deficits in Cameroon, Ethiopia, Nigeria and Tanzania, while in the second regime the fiscal deficits is more worsened than the current account deficits in Botswana, Cameroon, Egypt, Nigeria, Tanzania and Uganda; and this offers support for the Mundell-Fleming and absorption approach.

6.4 Conclusion

This chapter examined the long-run sustainability of twin deficits using the threshold cointegration for a sample of African countries. The study started with the test for linear cointegration using the Engle and Granger (1987) and Phillips and Ouliaris (1990) residual cointegration test, Johansen (1988) maximum likelihood cointegration test and the Gregory and Hansen (1996) cointegration test with structural break tests, before the Hansen and Seo (2002) threshold cointegration. The major reason for conducting this test is to check for the likelihood of linear cointegration for the twin deficits in these countries before examining threshold cointegration. However, the linear cointegration tests conducted for these countries accept the alternative hypotheses of linear cointegration in most countries and hence the study proceeds to estimate the threshold cointegration.

The empirical methodology made use of Hansen and Seo (2002) threshold cointegration model that consider the possibility of a nonlinear relationship between the current account imbalances and the fiscal deficits. To assess the evidence for threshold cointegration, using the Hansen and Seo methodology, the study employed the sup LM test where the true cointegrating vector is unknown for the complete bivariate specification, and the results for all the countries estimated rejected the presence of linear cointegration in favour of a two-regime threshold cointegration, meaning that a long-run dynamic relationship between them exists. The study also confirmed the presence of positive cointegrating relationship between the current account and the fiscal balances for Botswana, Cameroon, Egypt, Morocco, Nigeria and Tanzania. This is consistent with the Keynesian viewpoint as explained by the Mundell-Fleming and absorption approaches. The study also discovered the presence of a negative cointegrating relationship between the two deficits in Ethiopia, Kenya and Uganda; this is consistent with the twin divergence proposed by Kim and Roubini (2008).

The error correction effects show how changes and adjustments take place within and between the series. In some cases, adjustments are higher in the current account balance and in some the fiscal deficits is higher. The threshold parameter varies from -53.26 in Nigeria to 24.49 in Tanzania, and this is a reflection of the way and manner fiscal policy issues are addressed in different countries. All depends on how efficient fiscal policy is used. Also, for the results, the short-run dynamics captured in the threshold vector error correction model suggest that long-run causality between the two balances can run in either direction depending on the size of the equilibrium error. According to the estimated dynamics for Botswana, Cameroon, Egypt, Morocco, Nigeria and Tanzania twin deficits, the internal balance has had to become large or

bad enough in relation to the external balance to enter a Keynesian-type regime. In this regime, short-run responses are mainly executed by the adjustment of the external balance. In other words, the Keynesian viewpoint would only prevail after the internal balance has reached this threshold. Below the estimated threshold, the external balance is comparatively large or worse in relation to the internal balance. In this regime, short-run responses are mainly executed by the adjustment of the internal balance.

Table 6.13: Summary of Cointegration Results for the Twin Deficits Relationship

Country	Engle-Granger	Phillips-Ouliaris	Johansen	Gregory-Hansen	Hansen-Seo
Botswana	×	✓	✓	✓	✓
Cameroon	×	×	✓	✓	✓
Egypt	×	×	✓	✓	✓
Ethiopia	×	×	✓	✓	✓
Kenya	×	×	✓	×	✓
Morocco	×	×	✓	✓	✓
Nigeria	×	✓	✓	✓	✓
Tanzania	×	×	✓	✓	✓
Uganda	×	×	✓	✓	✓

Note: × = No evidence of cointegration, ✓ = evidence of cointegration

Chapter 7

Are Fiscal Deficits Inflationary in African Countries? An Asymmetric Cointegration Approach

7.1 Introduction

Persistent government budget deficits and inflation are major concerns in both developed and developing countries. Part of the concern stems from the view that large fiscal deficits result in high real interest rates, thus crowding out private investment, hindering capital formation and adversely affecting economic growth and productivity. Another concern relates to the ability of monetary authorities to control the level of inflation in the face of large fiscal deficits, mainly because inflation erodes confidence in the system, erodes growth, loss of competition and the exacerbation of social tensions on fixed income earners.

In the theoretical literature, four different types of connection between the fiscal deficits and inflation are prominent. The first and the most direct relationship is the aggregate demand approach of Patinkin (1965). He argues that a rise in the real value of the stock of bonds increases perceived private wealth, and therefore, spending leading to inflation. Elmendorf and Mankiw (1999) elaborate on Patinkin argument and provide supporting empirical evidence. The second connection is proposed by Sargent and Wallace (1981). They argue that seigniorage assumes the central role for deficit finance; the central bank will be obliged to monetize the deficit. Such a monetization results in an increase in the money supply and in the rate of inflation.

The third is expounded by Miller (1983). He argues that large fiscal deficits lead to higher interest rates which crowd-out private investment, and hence, reduce aggregate supply, which leads to price increases. A fourth link put forward by Barro (1978, 1979) suggest reverse causation. He argues that deficits are a result of inflation. The government deficit is the change in the nominal value of outstanding government bonds. If the anticipated inflation rate increases, then the nominal value of bonds must also increase, that is the government will run a deficit to keep the same anticipated real amount of bonds.

Despite the theoretical view that fiscal deficits are inflationary, empirical studies have yielded conflicting results. Empirical studies in developed countries (Hamburger and Zwick, 1981; Dwyer, 1982; Darrat, 1985; Ahking and Miller, 1985; King and Plosser, 1985; Giannaros and Kolluri, 1986; Protopapadakis and Siegel, 1987;) have not yielded conclusive results on the deficit–inflation relationship. However, empirical studies for developing countries, such as those of De Haan and Zelhorst (1990), Loungani and Swagel (2003), and Domaç and Yücel (2005), generally indicate that the inflationary effect of deficit financing is insignificant, but do find a significant causality of fiscal deficits on inflation but only in high-inflation countries. Studies on panel data also yielded conflicting results. Karras (1994) investigates the relationship between fiscal deficits and inflation using a panel of 32 countries and finds that deficits are not inflationary. Cottarelli et al. (1998) note a significant impact of fiscal deficits on inflation in both industrial and transition economies using panel data. Fischer et al. (2002), using data set for 94 developing and developed countries from 1960 to 1995 find that the effects of fiscal deficits and inflation are only significant in high-inflation countries during high-inflation episodes and weak in low-inflation countries. Catao and Terrones (2005) using 107 countries over the 1960–2001 period and Lin and Chu (2012) using a data set of 91 countries from 1960-2006 find similar results.

A possible reason for the lack of consensus in the literature is that several methodologies have been used. Most studies examined the unit root properties of fiscal deficits and inflation with a focus on the presence of a long-run, causality testing etc. Other authors used a single equation, while other used a system of equations to look at the dynamic interactions between fiscal deficits and inflation. However, empirical literature offers mixed evidence and the results are inconclusive

A key aspect of this is that previous studies assume symmetry, that is they have employed cointegration analysis, but have not adequately addressed issues of structural breaks or asymmetric cointegrating relationship. Two or more series are cointegrated if there is a linear combination among them such that it generates non trending residuals. Models that are cointegrated have an error correction term that ensures that the variables return to equilibrium in the face of deviations; the error

correction term represents an adjustment process through which long-run equilibrium is achieved. It is useful at this point to give a brief discussion on asymmetric cointegration. Balke and Fomby (1997) describe asymmetric cointegration as a feasible way of combining non-linearity with cointegration. They argued that it is possible that adjustment towards equilibrium takes place at different time period because of adjustment costs. They maintain that the cointegrating relationship does not hold within a certain threshold, but only when the system is outside the threshold. This implies that asymmetric cointegration could capture a possible non-linear relationship between fiscal deficits and inflation in such a way that a mean-reverting dynamic behaviour of the inflation rate can be expected after exceeding the threshold.

In contrast to previous work, this study considers the possibility that there exist asymmetric adjustment towards long-run relationship. The justification for this approach in African countries is based on the context that there exist an imperfect and underdeveloped market system in these countries and adjustment may be sporadic and contingent, therefore previous studies in these countries have been mis-specified.

The objective of this chapter is to provide evidence on the relationship between fiscal deficits and inflation in an asymmetric framework that allows for different speeds of adjustment to the long-run relationship depending on whether fiscal deficits and inflation are above or below equilibrium. To the best of our knowledge this approach has not previously been used in the empirical literature on fiscal deficits and inflation. To this end, the study employs the Enders and Siklos (2001) cointegration and threshold adjustment methodology using the threshold autoregressive (TAR) and the momentum-threshold autoregressive (M-TAR) which allows for asymmetric adjustments. Here, the TAR model will be used to capture asymmetrically "deep" movements in the series of the deviations from the long-run equilibrium while the M-TAR model will be used to capture the possibility of asymmetrically "sharp" movements in the series (Sichel 1993). The M-TAR is useful when the adjustment exhibits more momentum in one direction than the other, that is, the speed of adjustment depends on whether the spread is increasing or decreasing.

The rest of the chapter is structured as follows. The following section outlines the methodology of Enders and Siklos (2001) cointegration and threshold adjustment. Section 7.3 of the chapter discussed the analysis and interpretation of results, section 7.4 concludes the chapter.

7.2 Methodology

To examine the probability of price stickiness between inflation and fiscal deficits the study uses the Enders and Siklos (2001) asymmetric cointegration methodology

which is based on the Engle-Granger (1987) two stage cointegration procedure. A linear relationship between inflation and fiscal deficits can be tested using the Engle and Granger (1987) methodology by estimating a long-run equilibrium relationship of the form;

$$INFR_t = \alpha_0 + \alpha_1 FD_t + \varepsilon_t \tag{7.1}$$

where $INFR_t$ is the inflation rate, FD_t represents the fiscal deficits as a percentage of the GDP, $= \alpha_0 + \alpha_1$ are parameters, ε_t is the stochastic error term. After, performing the long-run linear regression in equation (7.1), the next step is to perform the unit root test on the residual series ε_t which might be serially correlated. The standard Dickey and Fuller (1979)

$$\Delta\varepsilon_t = \rho\varepsilon_{t-1} + \upsilon_t \tag{7.2}$$

where $\{\varepsilon_t\}$ contains the regression residuals from equation (7.1) and assumed to be purely white noise with a zero mean and a constant variance and υ_t is an independent and identically distributed disturbance with zero mean. If the null hypothesis $\rho = 0$ can be rejected, then $\{\varepsilon_t\}$ is stationary. The model assumes a symmetric adjustment process. According to equation (7.2), the change in ε_t is $\rho\varepsilon_{t-1}$ regardless of whether ε_{t-1} is positive or negative. But, if the inflation rate and fiscal deficits adjustments are asymmetric, then equation (7.2) is mis-specified. Enders and Siklos (2001) propose two test of asymmetries; a threshold autoregressive (TAR) model and a momentum-threshold autoregressive (M-TAR) model. Following Enders and Siklos (2001) two different hypotheses can be tested.

The first hypothesis is that fiscal deficits causes inflation when they are temporarily above $\varepsilon_t \geq 0$, than when they are below the $\varepsilon_t < 0$. The first hypothesis is best tested with the use of threshold autoregressive (TAR) model modification of the Engle and Granger (1987) test given as;

$$\Delta\varepsilon_t = I_t\rho_1\varepsilon_{t-1} + (1 - I_t)\,\rho_2\varepsilon_{t-1} + \upsilon_t \tag{7.3}$$

where I_t is the Heaviside indicator such that

$$I_t = \left\{ \begin{array}{l} 1\ if\ \ \varepsilon_{t-1} \geq \tau \\ 0\ if\ \ \varepsilon_{t-1} < \tau \end{array} \right\} \tag{7.4}$$

where τ is the value of the threshold and it is endogenously determined using the Chan (1993) method. The Chan method arrange the values, (ε_t) and $(\Delta\varepsilon_t)$ for the TAR and the M-TAR models respectively in ascending order and excludes

the smallest and the largest 15% and τ is the consistent estimate which yields the smallest residual sum of squares over the remaining 70%.

The second hypothesis examines whether fiscal deficits deviations are corrected instantaneously when inflation rate increase relative to $\varepsilon_t \geq 0$, than when they decrease relative to the $\varepsilon_t < 0$. The second hypothesis is tested using the M-TAR model of Enders and Siklos (2001) which is of the form;

$$\Delta\varepsilon_t = M_t\rho_1\varepsilon_{t-1} + (1 - M_t)\,\rho_2\varepsilon_{t-1} + \upsilon_t \tag{7.5}$$

where M_t is the Heaviside indicator function of the form;

$$M_t = \left\{ \begin{array}{ll} 1\ if & \Delta\varepsilon_{t-1} \geq \tau \\ 0\ if & \Delta\varepsilon_{t-1} < \tau \end{array} \right\} \tag{7.6}$$

As stated by Petrucelli and Woolford (1984) the necessary condition for the stationarity of ε_t are that $\rho_1 < 0, \rho_2 < 0$ and $(1 + \rho_1)(1 + \rho_2) < 1$. If ε_{t-1} is above the long-run equilibrium value, then adjustment is at the rate ρ_1 and if ε_{t-1} is below long-run equilibrium value then adjustment is at the rate ρ_2. Adjustment is symmetric if $\rho_1 = \rho_2$. If the null hypothesis $H_0 : (\rho_1 = \rho_2)$ is rejected then using the TAR model we can capture signs of asymmetry. The M-TAR model is useful when the adjustment exhibits more momentum in one direction than the other, that is the speed of adjustment depends on whether $\Delta\varepsilon_{t-1}$ is increasing or decreasing. If $|\rho_1| < |\rho_2|$, then increases in $\Delta\varepsilon_{t-1}$ tend to persist, whereas decreases revert to the threshold quickly.

Enders and Siklos (2001) propose to test the two sets of tests using the null hypothesis $H_0 : \rho_1 = \rho_2$ for both the TAR and MTAR models. Here, the F-statistic does not follow a standard distribution it is compared with the ϕ_u for the TAR model tables and the ϕ_u^* tables for the M-TAR model computed through Monte Carlo simulation by Enders and Siklos (2001). If the null hypothesis is rejected, that is if cointegration is established it is possible to test for asymmetric adjustment. The F-statistic for the null hypothesis of symmetric adjustment is $H_0 : \rho_1 = \rho_2$, and this is compared to the standard F-distribution. Since there is no presumption whether to use TAR or M-TAR model, the recommendation is to use the AIC or SBC to select the best adjustment mechanism.

If the errors in equations (7.3) and (7.5) are serially correlated, equations (7.3) and (7.5) are replaced by

$$\Delta\varepsilon_t = I_t\rho_1\varepsilon_{t-1} + (1 - I_t)\,\rho_2\varepsilon_{t-1} + \sum_{i=1}^{p}\beta_i\Delta\varepsilon_{t-i} + \upsilon_t \tag{7.7}$$

$$\Delta\varepsilon_t = M_t\rho_1\varepsilon_{t-1} + (1 - M_t)\,\rho_2\varepsilon_{t-1} + \sum_{i=1}^{p}\gamma_i\Delta\varepsilon_{t-i} + \upsilon_t \tag{7.8}$$

Equation (7.7) is for the TAR model and equation (7.8) is for the M-TAR model

If cointegration is established between the inflation rate and the fiscal deficit as well as asymmetric adjustment, then the asymmetric version of the error correction model (ECM) is given as;

$$\Delta INFR_t = \rho_{11}I_t\varepsilon_{t-1} + \rho_{12}\,(1 - I_t)\,\varepsilon_{t-1} + \sum_{i=1}^{p}\delta_k\Delta FD_{t-i} + \sum_{i=1}^{p}\eta_k\Delta INFR_{t-i} + \upsilon_{1t} \tag{7.9}$$

$$\Delta FD_t = \rho_{11}I_t\varepsilon_{t-1} + \rho_{12}\,(1 - I_t)\,\varepsilon_{t-1} + \sum_{i=1}^{p}\varphi_k\Delta FD_{t-i} + \sum_{i=1}^{p}\psi_k\Delta INFR_{t-i} + \upsilon_{2t} \tag{7.10}$$

$$\Delta INFR_t = \rho_{11}M_t\varepsilon_{t-1} + \rho_{12}\,(1 - M_t)\,\varepsilon_{t-1} + \sum_{i=1}^{p}\delta_k\Delta FD_{t-i} + \sum_{i=1}^{p}\eta_k\Delta INFR_{t-i} + \upsilon_{1t} \tag{7.11}$$

$$\Delta FD_t = \rho_{11}M_t\varepsilon_{t-1} + \rho_{12}\,(1 - M_t)\,\varepsilon_{t-1} + \sum_{i=1}^{p}\varphi_k\Delta FD_{t-i} + \sum_{i=1}^{p}\psi_k\Delta INFR_{t-i} + \upsilon_{2t} \tag{7.12}$$

Equations (7.9 and 7.10) is for the TAR model and equations (7.11 and 7.12) represent the M-TAR model and they describe the dynamic relationship between fiscal deficits and inflation rate by examining the speed of adjustments back to equilibrium. The parameters ρ_{it} represent the error correction coefficients. If there is a deviation from long-run equilibrium, and the deviation happens to be positive, depending on the Heaviside indicator, then the speed of adjustment is given by ρ_{11} in equations (7.9 and 7.10) for the TAR model. Similarly for negative deviations defined by the Heaviside indicator, the speed of adjustment is given by ρ_{12}.

It is expedient to state clearly the major reason for the choice of Enders and Siklos (2001) asymmetric cointegration test in this study while others have used different econometric approach such as ordinary least square, vector autoregressive model in examining the relationship between fiscal deficits and inflation in African countries, there is no study to the best of our knowledge that have examined fiscal deficits and inflation in African countries using asymmetric cointegration.

7.3 Empirical Results

For the purpose of clarity, this chapter examines the time series dynamics of inflation and fiscal deficits as well as the possibility of the existence of asymmetry, and we use the following steps in the estimation procedure:

Step 1: We perform two standard unit root tests, namely the augmented Dickey–Fuller (ADF, 1979) and the Phillips and Perron (PP, 1988) on each series. However, because the ADF and PP fail to account for structural breaks. Thus, we use the Lee and Strazicich (2003) unit root test with two unknown breaks.

Step 2: We proceed by examining the long-run relationship between inflation and fiscal deficits only if the individual series are found to be nonstationary I(1), using the Engle-Granger residual based test of cointegration and the Gregory and Hansen (1996) structural break cointegration test.

Step 3: We utilize the threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) models of Enders and Siklos (2001) as there could be some asymmetries in the adjustment process towards the long-run equilibrium.

Step 4: If TAR and MTAR cointegration is found we estimate the threshold VECM.

The fiscal deficits and the inflation rate were subjected to unit root tests using the Augmented Dickey Fuller, the Philip Perron tests and the LM test with two structural breaks, and the summary of this is presented in table 7.1. The study therefore, conducts the asymmetric cointegration tests of Enders and Siklos (2001) on the eleven countries where both the fiscal deficits and inflation rates were I(1) variable, and they are; Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania and Uganda.

Table 7.1: Unit Root Tests Summary table

Country	ADF		PP		LM	
	FD	INFR	FD	INFR	FD	INFR
Botswana	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Cameroon	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
Egypt	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)
Ethiopia	I(1)	I(0)	I(1)	I(1)	I(1)	I(0)
Ghana	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)
Kenya	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
Morocco	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
Nigeria	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
South Africa	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)
Tanzania	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
Uganda	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)

Note: ADF = Augmented Dickey Fuller test, PP = Philip-Perron test, LM = test with two structural breaks, FD = Fiscal deficits, INFR = inflation rate. I(0) indicates significant at levels and I(1) indicates at first differences

Table 7.2: Dynamic OLS and Fully Modified OLS

Country	$DOLS$	$FMOLS$
Botswana	0.009(0.133)	0.022(0.336)
Cameroon	-0.158(0.710)	-0.143(0.823)
Egypt	-0.519(3.192)***	-0.526(3.360)***
Ethiopia	0.718(0.538)	0.558(0.530)
Ghana	-0.723(2.622)*	-0.719(3.376)***
Kenya	-1.771(6.087)***	-1.769(6.664)***
Morocco	-0.633(5.263)***	-0.631(5.646)***
Nigeria	0.218(0.387)	0.243(0.750)
South Africa	0.535(2.073)**	0.539(2.252)**
Tanzania	-3.009(2.484)**	-2.447(2.448)**
Tunisia	0.044(1.440)	0.516(1.309)
Uganda	-7.004(0.997)	-7.165(1.166)

Note: DOLS = Dynamic ordinary least square and FMOLS = Fully Modified ordinary least square. *, **, and *** denotes significance at the 10, 5 and 1 per cent significance level respectively. The results were generated using EVIEWS software.

Table 7.2 presents least square estimates of equation (7.1). This test is performed so as to know the cointegrating relationship between the inflation rate and the fiscal deficits. It was discovered that there is a positive and significant relationship between the inflation rate and the fiscal deficits in Nigeria and South Africa, and a positive and non-significant relationship in Botswana and Ethiopia. These results are consistent with the Tanzi's effect which predicts that when there is a decline in tax revenue inflation rises, and thus the budget deficit is higher at higher inflation rates. It may also imply that the economy is operating on the efficient side of the inflation tax Laffer curve, where a rise in the fiscal deficits requires a higher steady state of inflation. There is a negative and significant relationship between the inflation rate and fiscal deficits in Egypt, Ghana, Kenya, Morocco, Tanzania and Uganda, but a negative and insignificant relationship in Cameroon. This result is in conformity with the Patinkin's effect that there is a negative feedback between the inflation rate and fiscal deficits as a result of indexation and postponement of wages and salaries of workers.

Table 7.3: The Standard Cointegration Test

Country	p	AIC	Lags
Botswana	-0.170(-3.611)**	626.30	2
Cameroon	-0.251(-4.827)***	886.95	2
Egypt	-0.254(-4.671)***	849.67	2
Ethiopia	-0.229(-4.883)***	956.39	2
Ghana	-0.235(-5.348)***	1117.88	2
Kenya	-0.294(-5.055)***	881.72	2
Morocco	-0.236(-4.083)***	662.61	2
Nigeria	-0.111(-3.526)**	990.28	2
South Africa	-0.077(-2.552)	639.33	2
Tanzania	-0.086(-1.727)	985.62	3
Uganda	-0.071(-1.916)	1310.39	2

Note: The critical values of t-statistics for the null hypothesis p=0 with two variables in the cointegrationg relationship are -4.00, -3.37 and-3.02 and at 1, 5 and 10 per cent levels of significance respectively. *,**,*** indicate significance levels at 10, 5 and 1 per cent respectively. The results were generated using the RATS software. The codes were obtained from the ESTIMA website.

Having estimated the long-run relationship between the inflation rate and fiscal deficits in the sampled African countries from equation (7.1) presented in table 7.2, the residuals were saved to examine the presence of cointegration using the Engle-Granger approach. For a two variables cointegrating relationship, the critical values of the t-statistic for the null hypothesis of no cointegration, $\rho = 0$ is given as -4.00, -3.37 and-3.02 and at 1%, 5% and 10% levels of significance respectively. Table 7.3 produces the standard cointegration test of Engle-Granger (1987). The results shows that out of the countries examined, a long-run relationship exists for eight (8) countries, that is the null hypothesis of no linear cointegration was rejected for Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, and Nigeria at various levels of significance. This implies that there is a long-run relationship between the inflation rate and the fiscal deficits.

Table 7.4: Gregory and Hansen (1996) cointegration tests

Country	C		Trend		Regime		Regime trend	
	T_b	t_x	T_b	t_x	T_b	t_x	T_b	t_x
Botswana	1995Q1	-5.56***	1995Q1	-5.61***	1995Q1	-5.98***	1994Q2	-6.27***
Cameroon	1986Q3	-5.69***	1993Q1	-6.19***	1987Q2	-5.66***	1993Q1	-6.74***
Egypt	1996Q3	-5.78***	1996Q3	-6.60***	1996Q3	-6.61***	1996Q3	-6.27***
Ethiopia	2005Q2	-6.39***	1994Q2	-6.48***	2005Q2	-6.37***	1994Q4	-6.68***
Ghana	1984Q4	-7.52***	1984Q3	-7.80***	1984Q4	-7.52***	1994Q1	-7.31***
Kenya	1992Q4	-5.56***	1993Q3	-6.14***	1992Q4	-5.91***	1992Q4	-6.07***
Morocco	1998Q1	-5.84***	1986Q2	-6.39***	1995Q4	-6.39***	1997Q1	-6.40***
Nigeria	1998Q1	-4.44*	1997Q1	-4.84*	1996Q1	-4.58	1997Q1	-5.76**
South Africa	1993Q4	-5.54***	1993Q4	-5.48***	1993Q4	-5.93***	1993Q4	-6.02***
Tanzania	1997Q4	-6.82***	1997Q1	-6.77***	1997Q1	-7.17***	1997Q1	-7.18***
Uganda	1989Q3	-3.85	1989Q3	-3.84	1989Q3	-4.52	1989Q3	-4.71

Note: The 1 , 5, and 10 per cent critical values are respectively -5.13, -4.61 and -4.34 for the level break model with no trend. -5.45, -4.99 and -4.72 for the level break model with trend, -5.47, -4.95 and -4.68 for the regime shift model, -6.02, -5.50 and -5.24 for the regime trend. Tb denotes the time of the break and tx denotes the minimum test statistic for a unit root. In each case, the lag length is determined by the SIC. *, **, and *** denotes rejection of the non-cointegration null at the 10, 5 and 1 per cent significance level respectively. The results were generated using the STATA software.

Since the cointegration vector of a standard cointegration test assume that time are invariant, and rejection of cointegration may be attributed to regime changes in the cointegration vector. To account for such possibility, the study employs the residual-based cointegration tests of Gregory and Hansen (1996) which allows for the existence of one-time change in the cointegrating parameters. In this study, we allow for a shift in the level, trend, regime and regime trend.

The first model is a level shift model, denoted as C and defined as:

$$INFR_t = \alpha + \beta D_t + \delta FD_t + u_t \tag{7.13}$$

where $INFR_t$ is the inflation rate, FD_t is fiscal deficits, u_t is the disturbance term, D_t is a step dummy variable defined as: $D_t = 1\,(t > Tb)$, where parameters α represents the intercept before the shift, and β represents the change in the intercept at the time of the shift, while δ is the parameter of the cointegrating vector

The second model is the level shift with trend model, denoted as C/T

$$INFR_t = \alpha + \beta D_t + \phi t + \delta FD_t + u_t \tag{7.14}$$

where t is the time trend.

The third model allows for a shift in the regime, and it is denoted as C/S

$$INFR_t = \alpha + \beta D_t + \delta FD_t + \phi FD_t D_t + u_t \tag{7.15}$$

where δ, denotes the cointegrating slope coefficients before the regime shift and ϕ denote the changes in the slope coefficients.

The fourth model where the model allows for a shift in both regime and trend denoted as C/S/T;

$$INFR_t = \alpha + \beta D_t + \phi t + \delta FD_t + \phi FD_t D_t + u_t \tag{7.16}$$

The empirical results related to equation 7.13-7.16 and reported in Table 7.4 shows that inflation and fiscal deficits have a long-run significant relationship in almost all countries except in Uganda where there is no evidence of a significant long-run relationship.

Table 7.5: Threshold Cointegration Test for TAR Mode

Country	ρ_1	ρ_2	ϕ_μ	$\rho_1 = \rho_2$	AIC	Lags	τ
Asymmetric adjustment with $\tau = 0$							
Botswana	-0.184	-0.149	6.552*	0.158	622.88	2	0
Cameroon	-0.255	-0.240	11.559***	0.017	881.47	2	0
Egypt	-0.302	-0.196	11.481***	1.119	843.37	2	0
Ethiopia	-0.240	-0.208	11.902***	0.142	950.19	2	0
Ghana	-0.264	-0.119	15.374***	2.691*	1108.49	6	0
Kenya	-0.340	-0.221	13.493***	1.356	874.90	2	0
Morocco	-0.279	-0.187	8.717**	0.789	658.23	2	0
Nigeria	-0.100	-0.141	6.380*	0.394	983.53	2	0
South Africa	-0.086	-0.071	3.266	0.070	635.89	2	0
Tanzania	-0.177	-0.003	3.171	3.303**	975.95	3	0
Uganda	-0.087	-0.017	2.146	0.632	1300.68	2	0
Country	ρ_1	ρ_2	ϕ_μ	$\rho_1 = \rho_2$	AIC	Lags	τ
Asymmetric adjustment with $\tau =$ threshold							
Botswana	-0.152	-0.234	6.844**	0.683	622.34	2	-3.070
Cameroon	-0.226	-0.371	12.306***	1.258	880.19	2	-5.571
Egypt	-0.362	-0.169	13.098***	3.836**	840.62	2	7.422
Ethiopia	-0.242	-0.196	11.984***	0.278	950.06	2	-7.073
Ghana	-0.270	-0.105	15.831***	2.649*	1107.75	6	10.672
Kenya	-0.361	-0.170	14.706***	3.339**	872.87	2	-4.602
Morocco	-0.301	-0.175	9.129***	1.509	657.49	2	1.654
Nigeria	-0.098	-0.179	6.758*	1.074	982.83	2	-14.272
South Africa	-0.107	-0.057	3.613	0.728	635.21	2	2.435
Tanzania	-0.240	-0.003	4.256	5.415***	973.84	3	11.467
Uganda	-0.095	0.011	2.600	1.511	1299.78	2	37.620

Note: The selected lag length ensures that the residuals from the estimated regressions are serially uncorrelated. * **, *** indicates significance at 10, 5 and 1 per cent levels respectively. The results were generated using the RATS software. The codes for the Enders and Siklos (2001) asymmetric cointegration were obtained from ESTIMA website.

Enders and Siklos (2001) argue that the test for cointegration might be misspecified if adjustment is asymmetric, in their study they considered two alternatives specification, the threshold auto-regression (TAR) and the momentum-threshold auto-regression (M-TAR), and this is employed in the study. Table 7.5 reports the TAR and the consistent TAR model. The ρ_1 and ρ_2 estimates are presented, with the

ϕ_u statistics for null hypothesis $H_0 : (\rho_1 = \rho_2 = 0)$ of no asymmetric cointegration and the standard F-statistic test for the null hypothesis $H_0 : (\rho_1 = \rho_2)$ of symmetric cointegration. From table 7.5, the estimates of ρ_1 and ρ_2 are negative which are anticipated for stationarity of the error term, except for ρ_2 in Uganda for a consistent TAR which is positive. The ϕ_u test of no cointegration is rejected for eight countries for both the TAR and the consistent TAR models. This is consistent with the Engle-Granger test. In South Africa, Tanzania and Uganda the null hypothesis of no cointegration could not be rejected. The null hypothesis $H_0 : (\rho_1 = \rho_2)$ could not be rejected for nine countries, as we can only reject the null hypothesis of symmetric adjustment for Ghana and Tanzania when the threshold is zero. When a consistent TAR model is estimated the null hypothesis of a symmetric cointegration was rejected in Egypt, Ghana, Kenya and Tanzania. For, the TAR model when $\tau = 0$, only in Nigeria is $|\rho_1| < |\rho_2|$, this implies that when inflation and fiscal deficits are increasing, the disequilibrium between the inflation rate and the fiscal deficits are corrected at a slower rate relative to when they are both decreasing while in the remaining ten countries under study $|\rho_1| > |\rho_2|$ this also shows that when inflation and fiscal deficits are increasing, the disequilibrium between the inflation rate and the fiscal deficits are corrected at a faster rate relative to when they are both decreasing. Thus, inflation above the corresponding fiscal deficits are a relatively stronger attractor in these countries than when the situation is reversed. Using a consistent TAR model, $|\rho_1| < |\rho_2|$ in Botswana, Cameroon and Nigeria, this implies that fiscal deficits above inflation are a relatively attractor in these countries.

Table 7.6: Threshold Cointegration Test for MTAR Model

Country	ρ_1	ρ_2	ϕ^*_μ	$\rho_1 = \rho_2$	AIC	Lags	τ
Asymmetric adjustment with $\tau = 0$							
Botswana	-0.144	-0.192	6.639*	0.313	622.72	2	0
Cameroon	-0.219	-0.309	11.957***	0.678	880.79	2	0
Egypt	-0.262	-0.246	10.829***	0.024	844.50	2	0
Ethiopia	-0.199	-0.262	12.158***	0.566	949.76	2	0
Ghana	-0.208	-0.280	14.535***	0.577	1109.86	2	0
Kenya	-0.280	-0.324	12.766***	0.169	876.12	2	0
Morocco	-0.289	-0.167	9.064**	1.395	657.61	2	0
Nigeria	-0.114	-0.105	6.173	0.019	983.92	2	0
South Africa	-0.096	-0.046	3.585	0.673	635.27	2	0
Tanzania	-0.177	0.018	3.536	4.010***	975.24	3	0
Uganda	-0.096	-0.046	2.007	0.361	1300.96	2	0
Country	ρ_1	ρ_2	ϕ^*_μ	$\rho_1 = \rho_2$	AIC	Lags	τ
Asymmetric adjustment with $\tau =$ threshold							
Botswana	-0.047	-0.212	8.005**	2.765*	620.22	2	0.415
Cameroon	-0.219	-0.350	12.202***	1.085	880.37	2	-1.469
Egypt	-0.189	-0.436	13.729***	4.894***	839.56	2	-1.004
Ethiopia	-0.137	-0.288	13.659***	3.049***	947.23	2	4.687
Ghana	-0.166	-0.562	21.318***	11.422***	1099.19	2	-5.889
Kenya	-0.206	-0.351	13.877***	1.984	874.26	2	3.597
Morocco	-0.301	-0.106	10.124***	3.245**	655.73	2	-0.462
Nigeria	-0.139	-0.093	6.445	0.511	983.41	2	4.332
South Africa	-0.107	0.087	6.597	6.371***	629.55	2	-0.861
Tanzania	-0.378	0.029	9.203**	15.056***	964.68	3	1.369
Uganda	-0.006	-0.285	5.668	7.455***	1293.86	2	-8.515

Notes: See Table 7.5.

Table 7.6 reports the M-TAR models, the M-TAR model with $\tau = 0$ shows that the estimates of the autoregressive decay, ρ_1 and ρ_2 have negative signs, except in Tanzania where ρ_2 is positive. Column 4 shows the test for asymmetric cointegration. The null hypothesis of $H_0 : (\rho_1 = \rho_2 = 0)$ was rejected in seven countries at various levels of significance, it is only in Nigeria, South Africa, Tanzania and Uganda where the null hypothesis $H_0 : (\rho_1 = \rho_2 = 0)$ could not be rejected. Making use of the standard F-statistic for the null $H_0 : (\rho_1 = \rho_2)$ it shows that the null of symmetric cointegration was rejected only in Tanzania. Also, $|\rho_1| < |\rho_2|$, in

Botswana, Cameroon, Ethiopia and Ghana this implies that when inflation and fiscal deficits are increasing, the disequilibrium between the inflation rate and the fiscal deficits are corrected at a slower rate relative to when they are both decreasing. Using a consistent M-TAR model, the point estimates of ρ_1 and ρ_2 have negative signs except in South Africa and Tanzania where ρ_2 is positive. Also, the case for asymmetric adjustment is substantially strengthened when a consistent estimate of the threshold is used. For all 11 cases except Nigeria, South Africa and Tanzania, the null hypothesis of $H_0 : (\rho_1 = \rho_2 = 0)$ could not be rejected. However, symmetric adjustment $H_0 : (\rho_1 = \rho_2)$ is soundly rejected at various levels of significance in eight countries. The study also revealed that $|\rho_1| > |\rho_2|$, in Morocco, Nigeria, South Africa and Tanzania this implies that when inflation and fiscal deficits are increasing, the disequilibrium between the inflation rate and the fiscal deficits are corrected at a faster rate relative to when they are both decreasing.

In the TAR model from table 7.5, it is in Egypt, Ghana and Kenya where all the conditions are fulfilled, that is, there is the presence of non-linear cointegration, the null hypothesis $H_0 : (\rho_1 = \rho_2 = 0)$ was rejected and lastly the null hypothesis $H_0 : (\rho_1 = \rho_2)$ of symmetric adjustment were rejected. However, for the M-TAR model all the conditions were fulfilled in Botswana, Egypt, Ethiopia, Ghana, Morocco and Tanzania. Conducting a model selection test using the Alkaike information criterion, the study inferred that the M-TAR model is chosen for Botswana, Egypt, Ethiopia, Ghana and Morocco and Tanzania while the TAR model is chosen for Kenya. The implication of this is that adjustment is asymmetric for fiscal deficits and inflation in these seven countries and that the TAR and M-TAR specification have superior power properties than the Engle-Granger standard linear cointegration. Since cointegration exists and also that each cointegrating relationship is described by asymmetric adjustment for Botswana, Egypt, Ethiopia, Ghana, Kenya, Morocco and Tanzania, the study then proceeds to estimate an asymmetric error-correction model for these countries.

Table 7.7: Asymmetric Error-Correction Models

	Linear ECM	Threshold ECM				
Country	ρ	Lags	ρ_{11}	ρ_{12}	Flag	τ
Botswana					MTAR	
$\Delta INFR$	-0.155	5	-0.038	-0.178		0.415
	(-3.362)***		(-0.417)	(-3.665)***		
ΔFD	-0.031		-0.041	0.014		-1.535
	(-1.737)*		(-2.152)**	(0.386)		
Egypt		4			MTAR	
$\Delta INFR$	-0.121		-0.095	-0.240		-1.004
	(-2.250)**		(-1.685)*	(-2.399)**		
ΔFD	-0.023		-0.092	-0.006		1.632
	(-1.009)		(-1.948)*	(-0.214)		
Ethiopia		4			MTAR	
$\Delta INFR$	-0.129		-0.080	-0.178		4.687
	(-2.289)**		(-1.111)	(-2.479)**		
ΔFD	-0.106		-0.261	-0.037		0.364
	(-2.482)**		(-4.066)***	(-0.808)		
Ghana		6			MTAR	
$\Delta INFR$	-0.202		-0.205	-0.174		-5.889
	(-4.484)***		(-4.415)***	(-1.852)*		
ΔFD	-0.237		-0.276	0.133		-2.404
	(-4.505)***		(-5.500)***	(1.256)		
Kenya		4			TAR	
$\Delta INFR$	-0.226		-0.363	-0.071		-4.602
	(-3.102)***		(-3.940)***	(-0.730)		
ΔFD	-0.034		-0.069	-0.024		2.935
	(-1.840)*		(-1.911)*	(-1.191)		
Morocco		4			MTAR	
$\Delta INFR$	-0.108		-0.093	-0.037		-0.462
	(-1.922)*		(-2.976)**	(-1.364)		
ΔFD	-0.060		-0.279	-0.061		0.228
	(-2.701)***		(-1.336)	(-0.292)		
Tanzania		4			MTAR	
$\Delta INFR$	-0.048		-0.363	-0.198		1.369
	(-1.257)		(-2.353)**	(-1.268)		
ΔFD	-0.093		-0.294	-0.066		0.532
	(-2.321)**		(-3.552)***	(-1.644)		

Note: * **, *** indicates significance at 10, 5 and 1 per cent levels respectively with t-statistic in parentheses. The results were generated using EVIEWS software.

From table 7.7, the point estimates of ρ_{11} and ρ_{12} determine the speed of adjustment for positive and negative deviations for long-run relationship between fiscal deficits and inflation rate. In Botswana, estimates of ρ_{11} and ρ_{12} adjust back to equi-

librium, however, the t-statistic for the error correction indicates that the inflation rate adjusts to negative discrepancy, but does not adjusts to positive discrepancy. The result also shows that the inflation rate adjusts faster in the negative discrepancy than the positive discrepancy, and this is consistent with the M-TAR model on the speed of adjustment. The adjustment mechanism shows that when inflation is rising, deviations from equilibrium are corrected at a slower rate that is, 4 per cent of the deviations are corrected quarterly while when inflation is falling, 17 per cent of the deviations are corrected quarterly. Also, estimating equation (7.12), the error correction coefficients shows that fiscal deficits adjust by 4 per cent of a positive gap, and this shows that fiscal deficits responds to positive deviations but not negative deviations.

For the case of Egypt, estimates of ρ_{11} and ρ_{12} adjust back to equilibrium, and the t-statistic for the error correction term indicates that the inflation rate adjusts to both positive and negative discrepancy. The result also shows that the inflation rate adjusts faster to a negative discrepancy than to a positive discrepancy, and this is consistent with the M-TAR model on the speed of adjustment. The adjustment mechanism shows that when inflation is rising, 10 per cent of the deviations are corrected quarterly while when inflation is falling, about 24 per cent of the deviations are corrected quarterly. Also, fiscal deficits adjusts to a positive discrepancy, this implies that when fiscal deficits is increasing about 9 per cent of the deviations are adjusted back to equilibrium

Similar results were also reported for Ethiopia, the results indicate that a contemporaneous response of inflation changes is greater for negative discrepancy than positive discrepancy with 8 per cent of the deviations corrected when inflation is increasing, and 18 per cent of the deviation adjusted back to equilibrium when inflation is decreasing. However, fiscal deficits changes are greater for positive discrepancy than negative discrepancy, with approximately 10 per cent of the deviations corrected when fiscal deficits is increasing and 1 per cent of the deviations adjusted back to equilibrium.

However, in Ghana, the t-statistic for the error correction terms indicate that inflation adjusts to positive and negative discrepancies, whereas fiscal deficits only adjusts to positive discrepancy. Inflation adjusts faster when the discrepancy is widening, with 21 per cent of the deviation adjusted back to equilibrium, compared to when inflation is narrowing with approximately 17 per cent adjusting back to equilibrium. However, when the fiscal deficit is widening, 28 per cent of the deviation adjusts back to equilibrium, and 13 per cent of the deviations adjust back to equilibrium when fiscal deficits is narrowing.

Moving onto Kenya, the t-statistic for the error correction terms shows that

both inflation and fiscal deficits adjust to positive discrepancies, when inflation is increasing, about 36 per cent of the deviations adjust back to equilibrium, while when the fiscal deficit is increasing 7 per cent of the deviations adjust back to equilibrium. In the case of Morocco, we found that the speed of adjustment in the inflation rate is much more rapid under a widening discrepancy than when the deviation is narrowing, and this is consistent with the M-TAR model on the speed of adjustment reported in table 7.7. This implies that inflation adjust much more rapidly to a positive discrepancy than to a negative discrepancy. However, the t-statistic for the error correction term for fiscal deficits does not adjust to positive and negative discrepancies.

In Tanzania, the result also shows that the inflation rate adjusts faster in the positive discrepancy than negaitive discrepancy, and this is consistent with the M-TAR model on the speed of adjustment. The adjustment mechanism shows that when inflation is rising, deviations from equilibrium are corrected at a faster rate, with 36 per cent of the deviations corrected quarterly while when inflation is falling, 20 per cent of the deviations are corrected quarterly. The error correction term for the fiscal deficits adjust by 29 per cent of a positive gap, and this shows that fiscal deficits responds to positive deviations but not negative deviations.

However, the symmetric error correction model shows that only the error correction term on inflation for Egypt and fiscal deficit for Tanzania appears to be statistically insignificant.

From the results presented above, it was observed that there is asymmetric cointegration in seven countries out of eleven countries investigated. In countries where cointegration were found namely, Botswana, Egypt, Ethiopia, Ghana, Kenya, Morocco and Tanzania we observe that this might be attributed to the sound macroeconomic policies embarked upon by these economies as well as being less corrupt. In countries where the model does not perform better, we assume this can be traced to the level of corruption prevalent in these economies and non-implementation of government programmes and policies.

For example in Ghana, where the model performs better, the government of this country took decisive macroeconomic actions, among which includes fiscal, monetary and institutional reforms to achieve anticipated level of growth. The fiscal reforms involve a reduction of government expenditure, removal of subsidies, as well as improved system of tax collection. The monetary reforms include contractionary monetary policy, introduction of income policies as well as the reduction of import restrictions to allow the imports of much needed inputs and spare parts necessary for the production of goods and services. The institutional reforms engaged in include the retrenchment and redeployment of labour, as well as privatization and

commercialization of state-owned enterprise.

In countries where the model did not converge, the following are some of the reasons for its failure; unstable and distorted macroeconomic framework, bad governance, non-functional financial system, non-diversification on the economy, lack of internal factors capable of generating self-sustaining process of development, weak institutional capabilities, undeveloped human resources, and deficient basic and social infrastructure.

In sum, the asymmetric cointegration achieved in these countries can be traced to the proper implementation as well as adequate commitment given to the Structural Adjustment Programmes, which helps in trimming down the over bloated government expenditure, payment of foreign debts, exchange rate stability as well increase in the flow of foreign direct investment.

At this junction, it is useful to compare findings from other works on fiscal deficits and inflation. Eisner (1989) examined the impact of deficits on inflationary pressure to see if structural deficits contribute to inflation in the US for the period 1956-1966 and 1967-1985. His results suggest that there is no support for the proposition that the federal budget deficit, by any measure, contributes to inflation.

Examples of VAR models used to examine the relationship between the fiscal deficits and inflation includes; Ahking and Miller (1985) estimate a three variable VAR system for the United States. Their estimation results suggested for the 1950s and the 1970s, government deficits, money growth, and inflation are all causally related while in 1960s, both government deficits and inflation are not related. Dywer (1987) in a similar vein used the VAR to examine the relationship between fiscal deficits and inflation in the United Sates for the period 1952:I-1978:IV, their result revealed that budget deficits have no significant effect on inflation. Fischer et al (2002) used fixed effects in a panel of 94 developing and developed countries, their result revealed that one per cent improvement (deterioration) in the ration of the fiscal balance-to-GDP leads to a four and half decline (rise) in inflation, their results also revealed that fiscal deficits balances have no significant effect on inflationary effects in low-inflation countries.

Since traditional unit root tests always find the fiscal deficits and probably the inflation rate are non-stationary, other used another approach to look for linear cointegration between them. Darrat (2000) utilised an error correction model (ECM) to investigate if high budget deficits have any inflationary consequences in Greece over the period 1957-1993. Their empirical results found that the deficit variable exerts positive and statistically significant impact upon inflation in Greece. Ghartey (2001) also used error correction model to examine the relationship between fiscal deficits and inflation in Ghana, they found that fiscal deficits exerts a positive and significant

relationship with inflation. Lozano (2008) also analyzed the evidence of the causal long-term relationship between budget deficit, money growth and inflation in Colombia considering the standard (M1), the narrowest (M0-Base) and the broadest (M3) definitions of the money supply. Using a vector error correction (VEC) model with quarterly data over the period 1982:I-2007:IV, the study found a close relationship between inflation and money growth, and between money growth and fiscal deficit. Chimobi and Igwe (2010) examined the casual relationship between fiscal deficits, money supply and inflation in Nigeria, their results show that there is a bi-directional relationship between fiscal deficits and inflation.

From the above empirical evidence, all the studies examined linearity between the fiscal deficits and inflation without looking at the non-linearity which this study has examined using the Enders and Siklos (2001) cointegration test, based on the Engle and Granger linear cointegration, eight out of eleven countries showed evidence of long-run relationship, however based on the Enders and Siklos test we found that seven out the eleven countries considered showed evidence of a long-run relationship with asymmetric adjustment.

On the issue of thresholds in the fiscal deficits and inflation relationship, Catao and Terrones (2005) examined fiscal deficits and inflation for 107 countries for the period 1960-2001. They modelled inflation as non-linearly related to fiscal deficits through the inflation tax base and estimate this relationship as intrinsically dynamic, using panel techniques that explicitly distinguish between short- and long-run effects of fiscal deficits. Their results showed that there is a strong positive association between deficits and inflation among high-inflation and developing country groups, but not among low-inflation advanced economies.

7.4 Conclusion

This chapter repose the assumption of a symmetric adjustment process underlying the conventional cointegration and the error correction model approach when examining the relationship between inflation rates and the fiscal deficits. The study shows that the behaviour between fiscal deficits and inflation rates might be asymmetric. The threshold autoregressive (TAR) and the momentum-threshold autoregressive (M-TAR) developed by Enders and Siklos (2001) was used to ascertain the empirical linkage between the fiscal deficits and inflation rate.

In examining the empirical linkage between fiscal deficits and inflation rate, the study started by examining the time series properties of the series, by subjecting the series to unit root test, it was discovered that there is evidence of unit root in both series for Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco,

Nigeria, South Africa, Tanzania and Uganda, implying they were all I(1) variables. The study also examined the presence of structural breaks in the series using the Lee and Strazicich (2003) two break tests. The test shows that the non- stationarity null for fiscal deficits cannot be rejected in Botswana, Egypt, Ethiopia, South Africa and Uganda in their levels while the fiscal deficits were stationary at levels in Cameroon, Ghana, Kenya, Morocco, Nigeria, Tanzania and Tunisia. As for the inflation rate, the null hypothesis of non-stationarity were all rejected in Cameroon, Egypt, Ethiopia, Ghana, Kenya, Nigeria, South Africa, Tunisia and Uganda while the null hypothesis of non-stationarity cannot be rejected for Botswana, Morocco and Tanzania.

Based on the symmetric cointegration of Engle and Granger we found there is the presence of long-run relationship between fiscal deficits and inflation in eight out of eleven countries, however when the TAR model where considered we found that there is the presence of long-run relationship in Egypt, Ghana and Kenya, adopting the M-TAR the study revealed that there is asymmetric cointegrating relationship in six countries. Using the Alkaike information criterion, the study inferred that the M-TAR model is chosen for Botswana, Egypt, Ethiopia, Ghana and Morocco and Tanzania while the TAR model is chosen for Kenya. In conclusion, it was observed that the asymmetric error correction term shows that inflation adjust to both negative and positive discrepancy in most countries, whereas fiscal deficits adjust to only positive discrepancy.

Table 7.8: Summary of Cointegration Results for the Fiscal Deficits and Inflation Relationship

Country	Engle-Granger	Gregory-Hansen	Enders-Siklos
Botswana	✓	✓	✓
Cameroon	✓	✓	×
Egypt	✓	✓	✓
Ethiopia	✓	✓	✓
Ghana	✓	✓	✓
Kenya	✓	✓	✓
Morocco	✓	✓	✓
Nigeria	✓	✓	×
South Africa	×	✓	×
Tanzania	×	✓	✓
Uganda	×	×	×

Note: × = No evidence of cointegration, ✓ = evidence of cointegration

Chapter 8

Conclusions and Policy Recommendations

8.1 Introduction

As noted in chapter 1, fiscal deficits have been a subject of great interest and debate among macroeconomists for many years. Hence the issues surrounding fiscal deficits are certainly not new, but recent economic developments have led to heightened interest in fiscal themes. In developed countries, the continued growth of the US and the EU fiscal deficits has provided the impetus for a reassessment of the effects of fiscal deficits on economic activity. In developing countries, the reduction of fiscal deficits has been one of the cornerstones of short -term stabilization and medium-term adjustment programs. Based on these problems, this thesis has sought to assess the effects of macroeconomic variables on fiscal deficits. The summary and major conclusions drawn from the study are contained in section 8.2, which also includes the original contribution to the literature. Section 8.3 centres on policy implications and section 8.4 discusses the suggestion for further research.

8.2 Summary and Conclusions

Theoretical and empirical studies on fiscal deficits and current account deficits, as well as fiscal deficits and inflation were considered in chapter 2. The theoretical literature on twin deficits suggests that the transmission mechanism can be classified into four. The first theoretical explanation of the relationship between the fiscal deficits and the current account deficits is the Keynesian absorption theory. They

argue that an increase in fiscal deficits would induce domestic absorption and thus, import expansion, causing a worsening of the current account deficits. The second theoretical explanation is the Mundell-Fleming framework which suggests that an increase in fiscal deficits would place upward pressure on interest rates, causing capital inflows and the exchange rate to appreciate. The appreciated exchange rate would make exports less attractive and increase the attractiveness of imports, subsequently worsening the current account. The third theoretical explanation is the risk premium hypothesis of Bachman (1992). It argues that an appreciation of the real exchange rate increases the purchasing power of domestic incomes in terms of imported goods, increases the relative value of financial, real estate and other assets held by domestic residents, which tend to reduce domestic savings and increase consumption, reduce competitiveness of a country's export in international markets, thereby causing current account deficits. This implies that the exchange rate can also impact the twin deficits by changing the relative price of nontradable. Large government spending on nontradable such as services or real estate sector can induce a real appreciation which in turn increases consumption toward tradable thereby leading to current account deficits. The fourth theoretical explanation is the impact through money supply. Korsu (2009) argues that increase in fiscal deficits increase the supply of money when the deficits is financed by means of seigniorage. Increase in money supply increases the price level, which in turn appreciates the real exchange rate and deteriorates the current account.

Also, another theoretical explanation on the relationship between the fiscal deficits and the current account deficits is that the twin deficits are not related, and such view is known as the Ricardian Equivalence Hypothesis of Barro (1974, 1989) argues that the fiscal deficits (FD) and the current account balance (CAB) are not related. The hypothesis states that, "for a given expenditure path, the substitution of debt for taxes has no effect on aggregate demand nor on interest rates. As a result, it implies that a tax increase would reduce the budget deficits but would not alter the external deficits since altering the means that the government uses to finance its expenditures does not affect private spending nor national savings" (Marinheiro, 2008)

The theoretical literature on fiscal deficits and inflation also suggests four probable major channels of interaction. The first and the most direct relationship is the aggregate demand approach of Patinkin (1965). He argues that a rise in the real value of the stock of bonds increases perceived private wealth, and therefore, spending leading to inflation. The second link is proposed by Sargent and Wallace (1981). They argue that seigniorage, is central to deficit finance; the central bank will be obliged to monetize the deficit. Such a monetization results in an increase in the

money supply and the rate of inflation. Thus, Sargent and Wallace (1981) believe that the direction of causation is from fiscal deficits to money supply and then from the money supply to inflation. The third connection is expounded by Miller (1983). He argues that government deficits are necessarily inflationary irrespective of whether the deficits are monetised or not because there are different channels through which fiscal deficits leads to inflation. He argues that even if the Central Bank does not monetise the deficit through printing of money, deficits are still inflationary through crowding out effects. This is because non-monetised deficits lead to higher interest rates. Higher interest rates crowd out private investment, and thus reduce the rate of growth of real output, which leads to price increase. A fourth link, put forward by Barro (1978, 1979) suggests reverse causation. He argues that deficits are a result of inflation. The deficit is the change in the nominal value of outstanding government bonds. If the anticipated inflation rate increases, then the nominal value of bonds must also increase, that is the government will run a deficit to keep the same anticipated real amount of bonds.

Empirical investigation of the twin deficits hypothesis and the Ricardian equivalence hypothesis shows that a large proportion of studies use data from the United States and developed countries, with limited evidence on developing countries. The empirical evidence is mostly in favour of the twin deficits hypothesis that the fiscal deficit is the cause of current account deficit mainly because there is a high degree of openness and also countries operate a flexible exchange rate. Empirical investigation on fiscal deficits and inflation also suggests that fiscal deficits are inflationary in high inflation economies but not in low-inflation and developed economies. The empirical evidence seems to be conflicting probably because of differences in the samples, empirical techniques and data measures used.

Also noted in chapter 2 is that there is a major criticism levied on previous empirical studies due to the inability to account for structural breaks and regime shifts failure of which can lead to misleading results. This is particularly relevant to African countries which have been subjected to a lot of significant changes over the years. The 1980s and 1990s witnessed a period of economic reforms, with budgetary cut backs, devaluation of the currency, removal of subsidies, tight monetary policies as well as the investiture of private enterprise. A number of scholarly work have been conducted on structural changes and regime shift over the past decades, and this thesis has sought to make a contribution to the literature by applying the LM two structural breaks test.

Chapter three of this thesis discussed data and stationarity. It examined the time series properties of the series with particular reference to the structural changes that have wrought African economies. Following this, the Augmented Dickey-Fuller test

and the Phillip-Perron test and the Lee and Strazicich (2003) Minimum Lagrange Multiplier two-break unit root test were applied to the data. Results for the traditional unit root test revealed that the majority of the series are significant in their first differences. As pointed out by Perron (1989), that series that are found to be stationary at first differences may in fact be stationary around the structural break, but mistakenly classified as a first difference and that failure to allow for structural breaks leads to a bias that reduces the ability to reject a false unit root hypothesis. Based on this, the study applied the LM two structural break test and found that the majority of the series are stationary around two structural breaks. The structural breaks were then modelled for the twin deficits hypothesis using the ARDL approach. Concerning the timing of the breaks from the Lee and Strazicich (2003) two-break unit root test procedure, results showed that the structural break dates were mostly around the late eighties and nineties, and this period is accompanied by various external shocks, as well as changes in the institutional framework. Other reasons might be traced to the volatility of oil prices, deregulation of the financial sector, exchange rate regime changes, global recession and devaluation of the currency all of which may cause non-stationarity of economic variables. Also, considered in details in this chapter is the timing of the structural breaks for each country, and a brief description of the structure of these economies.

Chapter four examines the twin deficits hypothesis using a VAR model. A VAR model is used to evaluate dynamic interactions between fiscal deficits and the current account imbalance because it has a number of advantages. First, the VAR model offers a way of analysing the dynamic relationships between fiscal deficits and current account imbalances; it also allows us to take into account delayed responses with a parsimonious lag structure. Second, VAR models provide a convenient framework for examining the relationships between fiscal deficits and current account imbalances. Thirdly, the VAR approach addresses the endogeneity problem by treating all variables as endogenous.

Results suggest that a positive government deficit shock increases the current account deficit in Botswana, Egypt, Ethiopia, Ghana, Morocco, South Africa and Tanzania. This result is consistent with the Keynesian absorption theory that increase in the fiscal deficits would induce domestic absorption and thus, import expansion, causing a worsening of the current account deficits. However, in Cameroon and Uganda the current account improves in response to a positive government deficit shock. This is what Kim and Roubini (2008) referred to as twin divergence. The presence of twin divergence in these countries is because foreign aid and grants constitute a larger percentage of their revenue. Also in response to a positive government deficit shock, the current account remains constant in Kenya, Nigeria and Tunisia

and this outcome is consistent with the Ricardian Equivalent Hypothesis (REH).

The assessment of the analytical model in Chapter five was conducted with time series techniques that allow for the estimation of long run and short run dynamics. The long-run relationship of the twin deficits were examined using the bound testing techniques of cointegration. The standard cointegration test requires that all variables must be integrated of order one, and do not account for the possibility or the existence of structural breaks as well as regime shift in the data. Based on the fact that some of the variables considered in this study are not integrated of order one, the study used the autoregressive distributed lags (ARDL) approach because it is suitable to assess the long-run and the short coefficients irrespective of the order of integration. Other advantages of this approach over other symmetric cointegration are; first, the approach is applicable for small or finite sample size (Pesaran et al 2001). Second, the short and long-run parameters are estimated concurrently. Third, the approach can accommodate structural breaks in time series data. The bound test suggests there is evidence of long-run relation at various level of significant of significance for the twelve countries examined.

Results suggested that in the long run, one per cent increase in the budget deficits will lead to 0.92, 0.04, 0.47, 0.16, 0.03, 0.34, 2.14 and 0.35 increases in the current account deficits in Botswana, Cameroon, Egypt, Ghana, Morocco, Nigeria, Tanzania and Tunisia. This result is in conformity with Saleh (2006), Onafowora and Owoye (2006), Beetsma et al (2007) and Abass et al (2010). Also, one per cent increase in budget deficits lead to 0.56, 0.52, 0.05 and 0.52 decrease in the current account deficits for Ethiopia, Kenya, South Africa and Uganda. The empirical evidence shows that the fiscal deficits have a positive statistically significant effect on the current account deficit only in Botswana, Egypt, Nigeria and Tanzania and statistically insignificant in Cameroon, Ghana, Morocco and Tunisia. Fiscal deficits have a negative and statistically significant effect in Ethiopia and Kenya but not in South Africa and Uganda.

The short-run adjustment process is measured by the error correction term, and it shows how quickly variables adjust to a shock and return to equilibrium. For stability, the coefficient of the ECM should carry the negative sign and be statistically significant. The estimated coefficient for the is equal to -0.3365, -0.1927, -0.1065, -0.1851, -0.1687, -0.1607, -0.1310, -0.1518, -0.4979, -0.0456, -0.1573 and -0.1374 for the specified model and is highly significant, indicating that the deviation from the current account balance equilibrium path is corrected by nearly 33.65%, 19.27%, 10.65%, 18.51%, 16.87%, 16.07%, 13.10%, 15.18%, 49.79%, 4.56%, 15.73% and 13.74% over the following quarter for Botswana, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia and Uganda re-

spectively. In other words, the adjustment process is fast. The statistical significance of the ECM term confirms the presence of long-run equilibrium relationship between the current account deficits and the macroeconomic variables.

The estimation of the analytical model in Chapter six was performed with time series techniques that allow for threshold cointegration. There are numerous explanations that might justify the presence of threshold effects. First, in the context of the Mundell–Fleming model it is possible that a given fiscal expansion may have a different impact on domestic interest rates; large fiscal deficits may give rise to larger interest rate increases, which in turn cause capital inflows and appreciation of the exchange rate which then leads to a worsening of the current account deficits. Another justification for this approach in African countries is that there exist an imperfect and underdeveloped market system and adjustment may be irregular and uncertain.

As a preliminary test to the threshold cointegration, the study estimates the Engle and Granger (1987) and the Phillips and Ouliaris (1990) residual cointegration test, the Johansen (1988) maximum likelihood cointegration test, the Gregory and Hansen (1996) cointegration test with one structural break and before examining the presence of threshold cointegration of Hansen and Seo (2002). Results suggested that the Engel-Granger cointegration test could not reject the no cointegration for any of the countries. However, the Phillip and Ouliaris cointegration test only reject the null of non-cointegration only in Botswana and Nigeria. The study suggest that the reason for the rejection of the null of no cointegration is that potential structural breaks have not been allowed for and thus, contributing to the presence of the low power of the test.

Estimating the Johansen maximum likelihood cointegration test, the study rejects the null of no cointegration for all the nine countries examined. The Gregory and Hansen cointegration test based on structural breaks in the constant, linear trend, regime shift and regime trend revealed evidence of linear cointegration in eight out of the nine countries investigated. Having established the presence of linear cointegration, the study examined the threshold cointegration of Hansen and Seo using the Lagrange multiplier where the cointegration vector is unknown, and the results for all the countries rejected the presence of linear cointegration in favour of threshold conitegration. There is evidence of a positive cointegrating relationship between the current account and the fiscal balances for Botswana, Cameroon, Egypt, Morocco, Nigeria and Tanzania. This is consistent with the Keynesian viewpoint as explained by the Mundell-Fleming and absorption approaches. The study also discovered the presence of a negative cointegrating relationship between the two deficits in Ethiopia, Kenya and Uganda; this is consistent with the twin divergence view of

Kim and Roubini (2008).

Also, the short-run dynamics captured in the threshold vector error correction model suggest that long-run causality between the two balances can run in either direction depending on the size of the equilibrium error. According to the estimated dynamics for the nine African countries twin deficits, the results revealed that in the first regime, the fiscal deficits is more worsened that the current account deficits in Cameroon, Ethiopia, Nigeria and Tanzania while in the second regime, the fiscal deficits is more worsened than the current account deficits in Botswana, Cameroon, Egypt, Nigeria, Tanzania and Uganda; and this offers support for the Mundell-Fleming and absorption approach.

Based on the asymmetric cointegration model of Enders and Siklos (2001), chapter seven examined the long-run and short run relationship between fiscal deficits and inflation in eleven African countries using the TAR and M-TAR models. The rationale for using this approach over other symmetric cointegration are as follows; first, the estimates of the threshold are endogenously determined; second, it does not impose any a priori parametric (non-linear, quadratic or cubic) relationships; third, the adjustment process to the long-run equilibrium can be analysed (Esteve and Tamarit 2012).

Results from the symmetric cointegration test of Engle and Granger showed evidence of a long-run relationship between fiscal deficits and inflation in eight out of eleven countries; however, when the Gregory and Hansen residual cointegration were estimated, there is evidence that inflation and fiscal deficits have a long-run significant relationship in ten countries except in Uganda where there is no evidence of any significant long-run relationship.

Employing the threshold auto-regression (TAR) and the momentum threshold auto-regression (MTAR) model of Ender and Siklos (2001), there is evidence of a long-run relationship in Egypt, Ghana and Kenya using the TAR model. Adopting the M-TAR the study revealed asymmetric cointegrating relationships in six countries namely Botswana, Egypt, Ethiopia, Ghana, Morocco and Tanzania. Conducting a model selection test using the Alkaike information criterion, the study inferred that the M-TAR model is chosen for Botswana, Egypt, Ethiopia, Ghana and Morocco and Tanzania while the TAR model is chosen for Kenya. The short-run dynamics suggest that the asymmetric error correction term shows that inflation adjust to both negative and positive discrepancy in most countries, whereas fiscal deficits adjust only to a positive discrepancy.

Table 8.1: Summary of Results

	Twin Deficits Relationship			Fiscal deficits and Inflation relationship
Country	VAR IRF	ARDL	Hansen -Seo	Enders-Siklos
Botswana	✓	✓	✓	$\Longrightarrow$
Cameroon	×	✓	✓	$\not\Longrightarrow$
Egypt	✓	✓	✓	$\Longrightarrow$
Ethiopia	✓	×	×	$\Longrightarrow$
Ghana	✓	✓	−	$\Longrightarrow$
Kenya	×	×	×	$\Longrightarrow$
Morocco	✓	✓	✓	$\Longrightarrow$
Nigeria	×	✓	✓	$\not\Longrightarrow$
South Africa	✓	×	−	$\not\Longrightarrow$
Tanzania	✓	✓	✓	$\Longrightarrow$
Tunisia	×	✓	−	−
Uganda	×	×	×	$\not\Longrightarrow$

Note: × = No evidence of twin deficits, ✓ = evidence of twin deficits, $\Longrightarrow$ = Evidence of asymmetric cointegration, $\not\Longrightarrow$ = No evidence of asymmetric cointegration

Conclusively, this thesis examined the twin deficits hypothesis using three methodological approaches; the VAR model, the ARDL approach and the threshold cointegration of Hansen and Seo (2002). The thesis also examined whether fiscal deficits are inflationary in African countries using the asymmetric cointegration of Enders and Siklos (2001). Each approach has it's own merits, the VAR model have the following advantages; i. it offers a way of analysing the dynamic relationships between fiscal deficits and current account imbalances; ii. it provides a convenient framework for examining the relationships between fiscal deficits and current account imbalances; iii.it addresses the endogeneity problem by treating all variables as endogenous. The ARDL approach also has several advantages over other methodologies; i.it can be applied to variables of a different order of integration; ii. it is applicable for small or finite sample size; iii. the short and long-run parameters are estimated concurrently; iv. it can accommodate structural breaks in time series data. The econometric advantages of threshold cointegration are; i. the estimates of the threshold are endogenously determined; ii. it does not impose any a priori parametric (non-linear, quadratic or cubic) relationships; iii. the adjustment process to the long-run equilibrium can be analysed (Esteve and Tamarit 2012).

Using the VAR approach we find evidence of the twin deficits hypothesis in seven countries out of the twelve countries investigated, the ARDL approach that account for structural breaks shows additional evidence of the twin deficits hypothesis in eight

countries out of the twelve countries examined. The threshold cointegration approach of Hansen and Seo (2002) clearly indicates evidence of twin deficits in six countries out of nine countries examined. Also, the Enders and Siklos (2001) asymmetric cointegration shows evidence that fiscal deficits are inflationary and that the adjustment process are asymmetic in seven countries out eleven countries investigated.

8.2.1 Contribution to the literature

The results of this thesis have shown that the fiscal deficits and the current account deficits hypothesis hold for the majority of the African countries examined, there is also little evidence for the Ricardian Equivalence Hypothesis. There is also evidence that fiscal deficits are inflationary in African countries. The contributions of this thesis to the literature include:

- use of quarterly data set;
- providing a more up-to-date analysis on the twin deficits and fiscal deficits and inflation;
- accounting for structural change and regime shift in the time series properties of the data using endogenous structural break test;
- examining the dynamic interactions between fiscal deficits and current account deficits using VAR models;
- estimating the long-run and short-run relationship of the twin deficits using the ARDL approach that incorporates structural breaks;
- estimating the long-run and short-run relationship between fiscal deficits and current account deficits using threshold cointegration;
- estimating the relationship between fiscal deficits and inflation using an asymmetric cointegration approach of Enders and Siklos (2001).

The first contribution of this thesis focuses on data set employed, most studies in developing countries use annual data; by contrast the study use quarterly data for all the empirical analysis.

Chapter two of the thesis emphasized that little empirical work has been done in African countries on the validity of the twin deficits hypothesis and the relationship between the fiscal deficits and inflation. This thesis has provided a more up-to-date analysis on whether the twin deficits hypothesis holds in African countries and whether the fiscal deficits are inflationary. The results arrived at shows that fiscal prudence is important for sustainable growth and development in these economies.

Chapter three of the thesis revealed the importance of accounting for structural breaks when conducting time series analysis on African countries macroeconomic data, with the results showing evidence of two structural breaks. The timing of the

breaks were also considered in the chapter and found that the breaks coincides with the external debt crisis of the 1980s, the various economic reforms implemented by various economies in the late 1980s up-to-date, currency devaluation, trade liberalization, civil unrest as well as the conduct of election.

The fourth contribution of this thesis and explored in Chapter four deals with the examining of the dynamic interactions between the fiscal deficits and current account deficits using the VAR models. Studies on the twin deficits in Africa mostly examined the long-run relationship and the direction of causation. This study uses the impulse response function and variance decomposition of forecast errors and this approach has rarely been used in the empirical literature on twin deficits in African countries.

Chapter five of this thesis explored the ARDL approach to cointegration allowing for the estimation of the long-run and the short-run dynamics. Previous empirical works that have considered African countries have not modelled the twin deficits using quarterly data sets. Second, the approach accommodates the flexibility to account for structural breaks all of which is a new contribution to the empirical literature on twin deficits in African countries.

The sixth contribution of thesis is detailed in chapter six using the threshold cointegration of Hansen and Seo (2002) to examine the long-run and short-run relation of the twin deficits. Most studies on twin deficits in African countries have focused on symmetric adjustment, using standard cointegration techniques, such as Engle-Granger (1987) and Johansen and Juselius (1990). This has been criticized on the ground that they ignore the role played by transactions costs (Balke and Fomby 1997). This study takes account of transactions costs by allowing for asymmetric adjustment of twin deficits through threshold autoregressive models which have been ignored in most empirical evidence on twin deficits, except Holmes (2011) who examined the twin deficits using the Hansen and Seo (2002) threshold cointegration for the United States.

Finally, chapter seven explores the relation between the fiscal deficits and inflation. Studies on the relationship between fiscal deficits and inflation have largely examined their time series properties, as well as the long-run relationship and the direction of causation. They assume the relationship between the fiscal deficits and inflation to be linear, except Catao and Terrones (2005) who model inflation as being non-linearly related to fiscal deficits through the inflation tax. This study examined the relationship between fiscal deficits and inflation using the asymmetric cointegration approach of Enders and Siklos (2001). The justification for this approach in African countries is based on the context that there exist an imperfect and underdeveloped market system in these countries and adjustment may be sporadic and

contingent.

8.3 Policy Implications

The empirical results from this study have important policy implications in terms of managing the 'twin-deficit' problem effectively and the problem between fiscal deficits and inflation. From this study, it was observed that stabilising the current account deficit problem could assist in managing the budget deficit problem in these countries. In this case, the results provide a view that policy measures that reduce the current account deficit could assist in reducing the budget deficit. Furthermore, a majority of these African countries depend heavily on the agricultural sector, oil sector and the service sector such as tourism, finance, among others. Many of the services are exportable, and have the potential to contribute huge sums in foreign currency.

In addition, incentives (e.g. tax credits for R&D) should be provided to improve the level of innovation among industries and small medium enterprises (SME) in the countries. Policies to attract foreign direct investment (FDI) in key sectors of the economy should be enhanced by introducing various fiscal incentives such as lowering corporate tax in the country. Attempt to improve the current account imbalances in these countries; export promotion policies should be encouraged. In sum, the following are policy recommendations, which will favour export-led growth in these economies: (i) reform of import and export laws and regulations; (ii) making production competitive from the viewpoint of price and quality; (iii) increase in the export of manufactured and agricultural products and allocating certain proportion of production to exports; (iv) adoption of suitable tax and credit policies for export promotion; and (v) fight against non-official commodity exports (smuggling) through controlling borders, and the effective operation of free trade zones for promotion of exports.

Another policy implication is fiscal constitutional constraints. Although it is easier said than done that government should reduce her expenditure, more so for African countries whose growth path calls for increased government spending in the area of infrastructure such as power generation, good roads, and good health scheme. The provision of this government infrastructure should be tailored towards complementing the private investors rather that substitute, so as not to crowd-out private investment. Furthermore, government expenditure should be spent on viable and productive sectors, as most of this spending are on white elephant projects which do not yield much returns.

Also, the government of these countries should introduce timely needed fiscal

adjustment measures, enhance tax collection system and fight corruption. The introduction of tax reforms directed at widening the tax base through taxing of sectors that are both under-taxed and untaxed, reducing tax loopholes and minimizing tax avoidance and evasion, will go a long way in increasing the tax revenue so as to achieve both fiscal balance and current account balance.

Also important is stable, democratic and serious government. Most African countries are beset with political instability, civil unrest, nepotism and corruption. Economies that are beset with all these problems will not be a safe haven for foreign direct investment inflow but rather there will be capital flight.

The central banks of these economies should also pursue a prudent monetary expansion that reduces real interest rate and leads to real exchange rate depreciation; the depreciation of the local currency will reduce the demand for imports and increase the supply of exports which then improves the current account balance.

The maintenance of sound macroeconomic policies that provide incentives through diversification into other sector away from oil and other natural resources should be encouraged. Here, the government should pay more attention into agriculture, services, industry and the financial sectors

Conclusively, cutting government expenditure is not enough to have both internal and external balance, but rather government should pursue better synchronization of fiscal and monetary policies. In sum, to achieve both external and internal balance as well reducing the level of inflation the following policies should be adhered to;

i. pursue fiscal prudence and price stability;
ii. ensure a stable and democratic government;
iii. diversification into other sectors of the economy;
iv. specific sectorial policy to boost production;
v. inflation and interest rate targeting approach by the monetary authorities;
vi. tax reforms;
vii. promote investment, technologies and innovations in exporting sectors;
viii. putting in place good institutions to facilitate these policies.

8.4 Suggestions for further studies

There is clearly more potential research in this area as other continents could be examined. Most studies in developing countries use annual data; by contrast we use quarterly data. This is the typical frequency used in the business cycle studies in developed countries; this can also be replicated for other emerging and developing economies. The endogenous structural break test examined in this thesis is based on two structural break, and there is the likelihood for more than two breaks in the data.

At present, to the best of our knowledge the Lee and Strazicich (2003) two break test remain the only techniques for testing unit roots in time series data. Although, Bai and Perron (2003) have developed multiple structural breaks in time series, but it does not consider the unit root hypothesis. Allowing for the possibility of multiple structural breaks in the unit root test is suggested for further studies. Advances in asymmetric cointegration techniques that can accommodate more than a bi-variate series is also recommended for future studies. Asides from the time series approach, panel data can also be used to examine the sustainability of the fiscal deficits and current account deficits in these economies.

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