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DEVELOPING AND TESTING NEW MEASURES OF EXCHANGE MARKET PRESSURE IN SUB-SAHARAN AFRICA

PhD Dissertation

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DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my own original work undertaken under the guidance of my supervisor; and with the exception of references to other people's work which have been duly cited, this dissertation has neither in part nor in whole been submitted for another degree in this university or elsewhere.

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Supervisor' Declaration

I hereby declare that the preparation and the presentation of this thesis was supervised in accordance with the supervision of thesis laid down by the University of Szeged.

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ABSTRACT

Attempts by economists to identify exchange rate crisis have led to the development of the exchange market pressure (EMP) index, which has been modified to include the interest rate variable, to better capture pressure on domestic currencies. The index in this state (current) is more appropriate for countries who operate an inflation targeting (IT) monetary policy framework or a policy framework close to it. This observation among others makes the EMP index sensitive to some assumptions if sub-Saharan African countries (SSA) are involved. SSA countries employ different monetary policy frameworks making the usage of the EMP index across board misleading. Using different variations of the model specified by authors specialised in the subject, this study identified an EMP index which will be effective in identifying currency crisis in 32 sub-Saharan African (SSA) countries for which data is available. Using a ridge regression model and a dynamic OLS model as a control, the study showed that the original EMP index was good in explaining changes in the exchange rate variable in SSA if the changes in reserves are adjusted for by broad money. The explanatory power is further enhanced if the components are normalised by their standard deviations without adjusting for the money variable. It was discovered that the current version of the index which includes the interest rate variable is not good at explaining changes in the exchange rate variable in SSA even though it had some explanatory effect. Using a discrete threshold regression model this study resolves two major problem associated with the use of the exchange market pressure index in identifying exchange rate crisis. The results point to un-even implementation of the Inflation Targeting framework in the study countries.

Dwelling on the assumption that a country will be able to wade of speculative attack on its currency if it has reserves that can cater for previous year's imports or short-term external debt or broad money, this study proposes two variations to the original index by Girton and Ropper (1975). Using a Generalised Method of Moments (GMM) regression model and a ridge regression model, this study found the index with the reserve variable adjusted for by imports to have the most explanatory effect on the exchange rate variable in SSA. This study recommends a combination of these indexes since the phase of economic development is not static.

In testing the EMP indexes on the banking crisis in Ghana, the retail prices of premium gasoline in Ghana and Kenya and also testing the impact of the exchange rate variable in the debt sustainability of Ghana and Kenya. This study found that the exchange rate

played a significant role in the banking sector and fluctuations in the retail price of premium gasoline in Ghana in the long run. It was also found to be putting increasing pressure on the gross debt of both Ghana and Kenya. The study recommends the creating of domestic buffers leading to the accumulation of the needed reserves to smoothen volatilities in the exchange rate of the study countries.

LIST OF ABBREVIATIONS

AQR – Asset Quality Review

ARDL – Autoregressive Distributed Lag

BDCs – Bulk Distribution Companies

BoG – Bank of Ghana

CAR – Capital Adequacy Ratio

CBG – Consolidated Bank Ghana

CEMAC – Central African Economic and Monetary Community

CMA – Constrained Market Access

CPIA – Country Policy and Institutional Assessment

DFM – Deepening Financial Markets

DOLS – Dynamic Ordinarily Least Square

DSA – Debt Sustainability Analysis

ECM – Error Correction Model

ECM – Error Correction Model

EIA – Energy Information Administration

EMP – Exchange Market Pressure

ERPT – Exchange Rate Pass-Through

FCDLTG – Foreign-Currency-Denominated Loans to Total Gross Loans

FDIC – Federal Deposit Insurance Corporation

FED – Federal Reserves

FMOLS – Fully Modifies Ordinary Least Square

FSI – Financial Soundness Indicators

FX – Foreign Exchange

GARCH – Generalized Autoregressive Conditional Heteroskedasticity

GAT – Ghana Amalgamated Trust

GCB – Ghana Commercial Bank

GLCD – Variance Inflation Factor

GMM – Generalized Method of Moments

GPP – globalpetrolprices.com;

HIPC – Ordinary Least Square

IDS – International Debt Statistics

IFS – International Finance Statistics

IMF – International Monetary Fund

IT – Inflation Targeting framework

MACs – Market Access Countries

MDRI – Multilateral Debt Relief Initiative

MMA – Mature Markets Access

NARDL – Non-linear Autoregressive Distributed Lag

NPA – National Petroleum Authority

NPLs – Non-performing Loans

OCA – Optimal Currency Area

OLS – Ordinary Least Square

ROA – Return on Assets

ROE – Return on Equity

SDR – Special Drawing Rights

SoEs – State-owned Enterprises

SSA – Sub-Saharan Africa

VAR – Vector Autoregressive

VIF – Variance Inflation Factor

WAEMU – West African Economic and Monetary Union

WB – World Bank;

WEO – World Economic Outlook

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DEDICATION

I dedicate this thesis to my father who believed in my capabilities and supported me throughout my academic journey. His death in 2020 was a defining moment in my life and academic career. May his humble soul rest in perfect peace.

ACKNOWLEDGEMENT

CHAPTER 1: INTRODUCTION

1.1 Introduction

Traditionally, a common source of instability in both the exchange rate and the price level is the high creation of money. It does follow that price inflation and exchange rate depreciation should be closely linked in the presence of large monetary shocks. This relationship is very important in an unstable monetary environment (López-Villavicencio and Mignon, 2017). In fact, most of the major monetary shocks have in some way involved a fixed or pegged exchange rate regime. Thus, countries that did not have pegged rates – as observed also by Obstfeld and Rogoff (1995) – have avoided this type of crises that affected mostly emerging market countries (Fischer, 2001).

Despite this, monetary authorities involved in dealing with these crises have warned strongly against the use of adjustable pegs and other soft pegged exchange rate regimes for countries open to international capital flows. Fischer (2001) proposes that a wide variety of flexible rate arrangements remain available considering the fact that policy conditions in most countries will not be indifferent to exchange rate movements.

The breakdown of the Bretton Woods System, and the brief experiment with floating exchange rates that followed it, led to most countries adopting some form of intermediate exchange rate system. By this, policy authorities seek to neutralise the impact of its foreign exchange market transactions on the domestic market through the purchase or sale of foreign exchange to prevent a collapse of the domestic currency.

Monetary policy in Sub-Saharan Africa (SSA) went through significant transformation over the same period. Literature points to the fact that SSA countries that were presumed to have been freed from fiscal dominance, became capable of pursuing inflation and stabilization objectives through market-based policies (Berg et al. 2015).

Since the late nineteenth century, most economies experimented – with the exception of Germany and perhaps Japan – and are still experimenting with monetary policy regimes. The regimes include the use of 'pragmatic monetarism' – the way in which monetary aggregates enter the operating procedures – and Inflation Targeting (Benati and Goodhart, 2010). The appropriateness of these two monetary policy rules is still a subject of debate among economists. von Thadden (2012), makes this point more forcefully in his study of monetary policy rule. The point here is that monetary policy is specified through money stock and/or nominal interest rate (von Thadden, 2012).

For instance, in emerging economies certain structural characteristics make them more vulnerable to external shocks. This have made emerging economies more concerned about the level of appreciation or depreciation of their exchange rate. As a result, these countries will use both monetary policy and possibly foreign exchange intervention policy to respond to exchange market pressures (Fischer, 2001).

Though most countries in SSA operate managed floats and are committed to transparency (except for political interference) in the conduct of monetary policy but the economies within which they operate differ sharply from those in developed economies (Kiss and Pontet, 2015). Shocks play an important role in SSA countries due to the fact that they are mainly commodity exporters (oil) and rely heavily on remittances and foreign aid or borrowings (Berg et al, 2015).

1.2 Motivation

These volatilities can among others lead to instability in commodity prices, the banking system and the debt sustainability of these countries – as was the case in Ghana and Kenya. Between 2013/14, the impact of the currency depreciation and the slowdown in economic activity in Ghana had started to feed through a deterioration in asset quality in the country's banking sector, reflecting in a pick-up in Non-performing Loans (NPLs). The NPLs reached its peak of 21.6 per cent of total loans by end 2017. In fact, as the NPL kept rising in 2014, both the Return on Assets (ROA) and the Return on Equity (ROE) started falling from their peaks of 6.4 and 32.2 to 4.3 and 18.6 in 2017 respectively (see Appendix Figure 1). Regulatory forbearance meant that the necessary action needed to tackle the problem will have to be postponed until the passage of both the Bank of Ghana (Amendment) Act, 2016 (Act 918) and the Banks and Specialized Deposit-Taking Institutions Act, 2016 (Act 930) which were intended to give the Bank of Ghana (BoG) the authority to properly deal with bank insolvency issues. It was however not surprising when the BoG intervened in 2017 to sanitize the sector, following the completion of an updated Asset Quality Review (AQR) in March 2017. Nine banks were identified as undercapitalized. The AQR showed substantial provisioning shortfalls in a subset of banks. These contributed to a decline in credit to the private sector (see Appendix figure 1) and higher lending rates spreads, undermining the transmission of the monetary policy rate to the economy through market rates (IMF, 2018). This led to a banking crisis in 2017/18 costing the public purse some GHc 16.4 billion – 5 per cent of GDP – excluding interest payments on the bonds issued to deal with the crisis (BoG, 2019).

Figure 1: US $ Exchange Rate and International Reserves in Some Selected SSA Countries
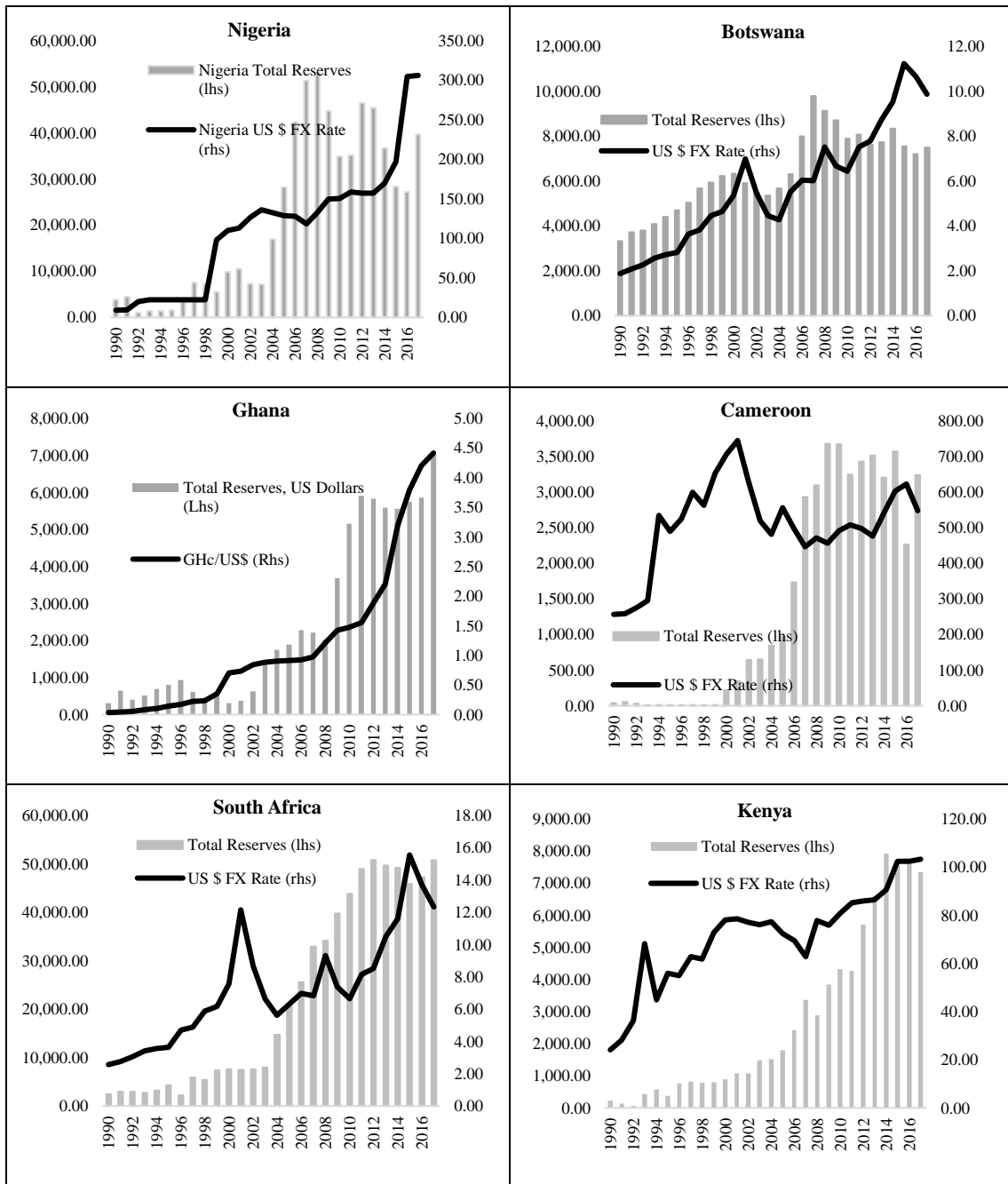
Source: IMF and Author's Construction

Also, as demand for oil has all but dried up as lockdowns – due to Coronavirus pandemic – across the world have brought economic activities to its lowest point in recent times. Governments across the World are torn between the decision to either fully pass through these sharp deviations to domestic consumers or absorb them through subsidies or savings. Subsidies come with huge costs to the fiscal budget whereas savings deny domestic consumers the needed relief through price reductions (del Granado, Coady and Gillingham, 2012). The oil industry has been struggling with this tumbling demand and

in-fighting among producers about the reduction of output. This phenomenon – sharp increases or decreases – has been re-occurring over the course of history. Between December 2003 and June 2008, nominal international fuel prices increased more than fourfold, with most of the increase occurring during 2007 and the first half of 2008 (del Granado, Coady and Gillingham, 2012). Countries at the receiving end of this are commodity exporters who rely on the foreign exchange to shore up their reserves.

Due to these characteristics, SSA countries like other developing countries mainly keep a parallel foreign exchange system – Ghana, Tanzania and Zambia have been noted to have high parallel premiums – in other to prevent volatilities in their exchange rates or exchange rate crisis (Kiguel and O'Connell, 1995). This observation may be driven by the rule of thumb of keeping reserves of up to three months of import cover. This leads to an implicit limit on how far countries can afford to rely on their reserves to defend their currencies. Under such a situation a full-blown exchange rate crisis can occur. Also, with a lot of foreign denominated debt, SSA countries may not be able to afford large depreciations of their currencies as it will mean more foreign exchange to service those debts. This as history has shown can trigger an exchange rate crisis (Jonas and Mishkin, 2004). This is the motivation of the study as also shown in Figure 1 above. The figure shows how SSA countries (Nigeria, Botswana, Ghana, Cameroon, South Africa and Kenya) lose a lot of reserves whenever there are sharp depreciations (increase) in their domestic currencies.

Studies – Nakatani (2018) – have found that the effects of these shocks on the probability of a crisis are larger for floating exchange rate regimes and that capital controls mitigate the effects of some of the shocks in pegged regimes. Soe and Kakinaka (2018), also found that an IT regime helps stabilize pressure on a currency. Goldfajn and Gupta (2003) also found that a tight monetary policy facilitates the reversal of currency depreciation through nominal appreciation. These normally occur through foreign exchange interventions of the central bank. It usually requires a high level of foreign exchange reserves which in turn introduces a limit to the level of intervention (Krušković, 2017). This was what influenced Girton and Ropper (1977) to develop an exchange market pressure (EMP) index to identify periods were there were excess pressure on the exchange rate. This idea had been modified by subsequent authors to capture the reaction function of monetary authorities by adding the interest rate variable to the original index

developed by Girton and Ropper (1977). The EMP index has thus become the most common index in measuring pressure on a currency.

1.3 Objectives of the study

In identifying exchange rate crisis using the EMP index, most of these authors used extreme values of the EMP index to identify exchange rate crisis. The index is a simple average of exchange rate changes and a foreign reserve depletion indicator, and more recently an interest rate indicator – to capture policy reactions of monetary authorities. For most studies, a crisis is detected when the index exceeds 1.5 of the standard deviation and the sample mean of the EMP index. Others used various conventional methods based on a certain arbitrary number of standard deviations (usually ranging from 1.5 to 3 standard deviations) above the mean of the EMP index (Pontines and Siregar, 2008) – this I term the 'threshold problem'. This was also discovered by Pontines and Siregar (2008) and Bertoli et al. (2010). They cautioned against the use of the index as it is highly sensitive to the choice of the weighting scheme for each component of the EMP index and the statistical parametric assumption used in the constructions of crisis thresholds. Also, the modification of the index to include the interest rate variable makes the index more suitable for countries implementing an IT framework as observed by Soe and Kakinaka (2018). However, with about eighteen (18) SSA countries using money targets and three (3) adopting the IT framework, it is obvious that the recent changes to the EMP index – to include the interest rate variable – will have to be adjusted to capture the type of monetary policy frame work that exist in SSA in other for it to effectively identify exchange rate crisis. The aim of this study will be to develop an EMP index that will effectively capture EMP in SSA – bearing in mind the different monetary and exchange rate regimes in SSA.

The research questions and hypothesis to be explored by this study will be the following:

I. Is the EMP index in its current form effective in identifying exchange rate crisis in SSA?

H0: The recent form of the EMP index has no significant positive relationship with changes in the nominal exchange rate.

H1: The recent form of the EMP index has a significant positive relationship with changes in the nominal exchange rate.

II. Is the new EMP index identified by this study effective in identifying exchange rate crisis in SSA?

H0: The proposed EMP index in this study has no significant relationship with changes in the nominal exchange rate.

H1: The proposed EMP index in this study has significant relationship with changes in the nominal exchange rate.

III. Is there a relationship between the EMP index and other macroeconomic variables in SSA?

- What is the effect of the EMP index on bank specific factors in Ghana?

H0: There is no significant relationship between the EMP index and other bank specific variables in Ghana.

H1: There is a significant relationship between the EMP index and other bank specific variables in Ghana.

- What is the effect of the EMP index on retail fuel prices in SSA?

H0: There is no significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya.

H1: There is a significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya.

- What is the effect of the exchange rate on the debt levels of countries in SSA?

H0: The exchange rate does not contribute to increases in the gross debt to GDP ratio in Ghana and Kenya.

H1: The exchange rate contributes to increases in the gross debt to GDP ratio in Ghana and Kenya.

Answers to these questions and hypothesis is going to help determine exchange market crisis in SSA and also explore policies to prevent their reoccurrence. In addressing the study gaps and the research questions illustrated above, this study is suggesting and testing different estimates of the EMP index with emphasis on the different monetary policy frameworks in SSA. In all six (6) different definitions – based on the literature – of the EMP was considered in other to answer the first research question *whether the EMP index in its current form is effective in identifying exchange rate crisis in SSA*.

Since the different indexes were computed using the exchange rate and reserves variable, the problem of multicollinearity was identified and dealt with by the use of a Ridge Regression and a Dynamic Ordinarily Least Square (DOLS) regression model

which has a better predictive power than the Ordinary Least Square (OLS) regression method – being mindful of the level of bias introduced (Ryan, 2008). The results showed that the recent definition of the EMP index is not largely good for capturing pressure on the exchange rate variable in SSA. The original version of the index, with its components normalised by their standard deviations without adjusting for the money variable was good in explaining the changes in the exchange rate in SSA. The recent form of the index had some explanatory power but was not significant. Suggesting that the IT framework had not been effectively implemented in SSA (Ghana and South Africa).

In dealing with the 'threshold problem', a discrete threshold regression model (a non-linear time series model with the local regimes switching) is used to identify crisis episodes in both South Africa and Ghana. In all twenty-eight (28) crisis episodes were identified for Ghana irrespective of the index used as the dependent variable. The crisis periods were more pronounced in 2008 to mid-2009, first half of 2012 and late 2013 to 2015. The maximum threshold variable for the two indexes used were significantly different confirming the diversity of the two indexes. For South Africa there were thirty-one (31) and twenty-seven (27) crisis episodes depending on the index used as the dependent variable. The crisis periods were more pronounced in 2008, late 2011 to the first half of 2012 and from 2013 to 2015. This confirms the use of the interest rate to dampen pressure on the exchange rate in South Africa since more crisis were discovered if the index adjusted for the interest rate is used.

Foreign exchange reserves play an important role in most economies the World over. Countries hold reserves among others to improve confidence in the national currency, counter disorderly market conditions, support the conduct of monetary policy, build assets for intergenerational purposes, or influence the exchange rate (IMF 2017). For financially integrated economies, the sudden disappearance of foreign exchange liquidity from the banking system presented the biggest threat, while capital flight and currency depreciation necessitate foreign exchange market intervention in other countries. Even though there could be varying reasons for which countries intervene in their exchange rate market, the objective to meet the expectations of financial markets has become the overarching goal (Antal and Gereben 2011).

Countries in SSA face substantial shocks compared to industrial and other emerging market countries. The main shocks facing SSA countries are a sharp change in their terms of trade due to exogenous movements in the prices of key exports or imports and a change in the net aid flows received by them. Also, in an ever-integrated global financial market,

they are subject to the problem of capital flight. Mainly due to the low levels of reserves in the sub-region (Drummond and Dhasmana 2008). The introduction of the Heavily Indebted Poor Country (HIPC) Initiative in 1996 and the Multilateral Debt Relief Initiative (MDRI) by the International Monetary Fund (IMF) and the World Bank will also mean that SSA countries have a unique characteristic when it comes to its external debt vulnerability.

Based on results from the first objective and also consistent with previous studies (Fischer, 2001: Nowak, Hviding and Ricci, 2004: Antal and Gereben, 2011: Hossfeld and Pramor, 2018), it is evident that the EMP index with the reserve variable alone and the reserve variable adjusted for by broad money is good at explaining changes in the exchange rate variable. However, due to the uniqueness of SSA and the absence of studies that have used the theory of reserve adequacy to develop an EMP index, this paper attempts to develop and propose two new measures of the EMP index that will be very robust in identifying exchange market pressure in SSA. This will help answer the second research question *whether the new EMP index identified by this study is effective in identifying exchange rate crisis in SSA*.

Using a GMM estimation regression model and a ridge regression model – appropriate in handling variables with multicollinearity problems – as a control experiment, this study found all three approaches to be significant in explaining changes in the exchange rate variable. The index with the reserve variable adjusted for by imports of goods and services had the most explanatory power followed by the index with the reserve variable adjusted for by the broad money supply.

Viewing these results more as indicative than definitive will mean that a combination of these indexes will be more appropriate since the phase of economic development is not static. As economies in SSA become sophisticated the causes of exchange rate crisis may shift from the current account to the capital accounts. Therefore, depending on how sophisticated a country's economy is any of the indexes proposed may be important as they were all significant in determining changes in the exchange rate variable in SSA.

After establishing these facts, this study goes ahead to find the effect of the EMP index on some macroeconomic indicators in SSA. The focus is on *whether the EMP index is a good indicator of banking crisis and retail prices of gasoline in SSA – third research question*. First, relying on and modifying the approach used by Makri, Tsagkanos and Bellas (2014), I sort to find out whether there were significant relationships between bank

specific factors (including the EMP index) and the NPL ratio over the period 2008 to 2019, and whether these could have explained the 2017-18 banking crisis in Ghana. The study also seeks to establish whether the remedial measures taken by the Bank of Ghana (BoG) qualify as an effective way of dealing with banking crisis. Also, as demand for oil has all but dried up as lockdowns – due to Coronavirus pandemic – across the world have brought economic activities to its lowest point in recent times. Governments across the World are torn between the decision to either fully pass through these sharp deviations to domestic consumers or absorb them through subsidies or savings. Subsidies come with huge costs to the fiscal budget whereas savings deny domestic consumers the needed relief through price reductions (del Granado, Coady and Gillingham, 2012).

A GMM model estimated confirmed significant negative relationship between the NPL ratio and the EMP index and the ROE. A significant positive relationship was discovered between the NPL and the Gross Loans to Customer Deposit ratio. These results confirmed the effect of NPLs on bank equity which affected the capital of banks during the crisis period. Since the measures adopted by the BoG cost the public purse an amount equivalent to about 5 per cent of GDP, it deprived the efforts as meeting the requirement of an effective bank resolution regime judging by the definition of Chennells and Wingfield (2015). This study also recommends the use of a 'bail-in' that is orderly in nature, showing clearly how bank resolution should be undertaken effectively without requiring public sector support. This is after it was discovered in this study that remedial measures stipulated in the Specialized Deposit-Taking Institutions Act, 2016 (Act 930) were not in any particular order – specifically section 102 of the Act. In other for the proposed bail-in to be effective bank supervision must be stepped up to ensure that there are loss absorbing capacities in the right amounts, right form and right place within the banking sector. In other words, there must be something for the resolution authority to bail-in, bearing in mind that this was a major contributory factor to the crisis in Ghana.

In investigating the impact of the EMP index on the retail prices of gasoline in SSA – third research question, this study used a Non-linear Auto-Regressive Distributed Lag (NARDL) model which is used to measure the effect of positive and negative changes on price variables, to test asymmetry between retail gasoline prices, international crude prices and the exchange rate effect. The results showed that the exchange rate – measured by the exchange market pressure index was significant in determining changes in the changes in the ex-pump price of petrol or gasoline in both the short and the long-run for Ghana and Colombia. The negative and positive effects of the international Brent crude

oil only led to a fall in the changes in ex-pump price of petrol or gasoline in Colombia. Both international Brent crude and the EMP index were not significant in determining changes in the ex-pump price of petrol or gasoline in Kenya.

Among others, the enormousness of the COVID-19 shock is judged on the contraction in output the World over. For most developing economies however it appears the impact of the pandemic on output was arguably contained. However, since most developing economies did not have the fiscal space to deal with the pandemic, it meant they had to resort to external borrowing to help deal with the fiscal effect of the pandemic. Ghana and Kenya are examples of countries that had to resort to external borrowing to help deal with the fiscal effects of the pandemic. The consequence of this action will mean that these countries will experience a worsening of their debt levels through also an exchange rate risk further worsening their already bad debt sustainability levels. With the success of the Highly Indebted Poor Countries (HIPC) initiative in reducing the debt to GDP ratios of most developing economies in Sub-Saharan Africa (SSA), there have been calls for a similar initiative to be repeated to help these developing countries overcome an eminent debt crisis. The draw back this time is that most of these countries have piled up private (commercial) debts which is constraining any talk of debt forgiveness. In other to understand *the effect of the exchange rate on the debt levels of countries in SSA (Ghana and Kenya) – third research question*, this study uses the IMF's framework for fiscal policy and public debt sustainability analysis (DSA) in market-access countries (MACs) to determine the fiscal impact of the pandemic on Ghana and Kenya – both countries are lower-middle income countries in SSA.

The results show that most of the increase in external debt in the study countries is due to reserve build-up or capital outflow. The framework for fiscal policy and public debt sustainability analysis used in this study shows that on average the exchange rate is the major contributor to the increase in the change in gross debt in Ghana followed by the primary balance from the period 2000 to 2020.

This study recommends the accumulation of reserves as an immediate solution to prevent exchange rate shocks for the study countries. This solution will however come with the opportunity cost of using these reserves for the much-needed investments in these countries. This should be guided by the need to create fiscal buffers domestically to ensure the fulfilment of the developmental needs of these countries and future debt service obligations.

The rest of the thesis is broken down into the empirical and theoretical review chapter which compares and contrast the various ideas underlying exchange rate theory, the methodological chapter which discusses the data, variables and methods used for the analysis, the empirical result chapter which the discusses the outcomes of the various methods used in this study and the conclusion chapter which summarises the entire study and make some policy recommendations.

CHAPTER 2: EMPIRICAL AND THEORETICAL REVIEW

2.1 Introduction

This chapter discusses the theoretical underpinnings of the exchange rate theory and the introduction of the EMP index to help deal with excessive exchange rate pressure – the type that leads to exchange rate crisis. The focus here is to explain how exchange rate theories have evolved through the breakdown of the Bretton Woods institutions in the late 1960s and early 1970s and the exchange rate crisis in the 1990s. Especially how the prescription has been for countries to adopt a floating exchange rate with the hope of wading off excess pressure on their currencies. Despite this, the literature review will show that this prescription has not been effective for developing countries especially. This has led to studies experimenting with different variations of the EMP index and in most cases assuming an all size fit all application for all countries. The application of the index as with many statistical applications is not devoid of weighting and threshold problems. A case is then made for the application of the index in SSA whiles attempting to deal with the weighting and the threshold problems associated with the index. The effect of the exchange rate is then discussed in the context of other macroeconomic variables leading to the establishing of the gap for which this thesis is seeking to fill.

2.2 Exchange Rate Theory and the EMP Index

In macroeconomic analysis, the exchange rate helps in determining the price that applies to examining international flow of capital and of goods and services. The price at which residents of different countries trade with each other determines the exchange rate between these countries (Mankiw, 2003).

In many policy evaluation models, the exchange rate is seen as an important variable in the transmission mechanism of many countries. Usually the exchange rate is part of an equation relating the interest rate in one country to the interest rates in other countries through the expected rate of appreciation or depreciation of the exchange rate. Its effects are wide and varying – it affects the flow of exports and imports and also the price of foreign goods sold in another country and its pass through to domestic prices (Taylor, 2001). These may have a powerful effect on the wealth of domestic citizens, and on the allocation of resources, which may not only have economic but also political effects (Fischer, 2001).

Traditional monetary theory regards high money creation as a common source of instability in both the exchange rate and the price level. Accordingly, in the presence of

large monetary shocks, price inflation and exchange rate depreciation should be closely linked. Indeed, the relation between nominal exchange rate changes and price inflation – the exchange rate pass- through – can be important in an unstable monetary environment in which nominal shocks fuel both exchange rate depreciation and high inflation (López-Villavicencio and Mignon, 2017).

Traditional currency crisis theories originate from the works of Salant and Henderson in 1978 and Krugman in 1979. Their models have countries shoring up their currencies with their foreign exchange reserves. Salant and Henderson (1978) on their part used the sales of gold to explain this phenomenon – selling their gold reserves to shore up their currencies.

Under such a regime – where a government operates a peg which Krugman (1979) assumes to be achieved through direct intervention in exchange rate market – a crisis occurs when the government runs a budget deficit which it covers with borrowing or accommodation from the central bank. Often this leads to inflation and the depreciation of the domestic currency. Due to the low reserves level of these countries, they are subject to speculative attacks, which are driven by the natural outcome of maximising the risk-averse behaviour of investors. The traditional currency theories did not consider policy adjustments by authorities in response to currency crisis. They however contend that, governments under this situation will be used to emergency borrowing to shore up reserves (Krugman, 1979).

The collapse of the Bretton Woods system in the late 1960s and early 1970s, the repeated crises of the European Monetary System in the 1980s and the successful attacks on currencies within the system in 1992 and 1993, and the emerging market crises of 1994 –2000 all drive home the lesson that exchange rate crisis is especially intense for countries that are more open to international capital flows (Fischer, 2001). Most of the major international capital market-related crises – Mexico, in 1994, Thailand, Indonesia and Korea in 1997, Russia and Brazil in 1998, and Argentina and Turkey in 2000 – has in some way involved a fixed or pegged exchange rate regime. At the same time, countries that did not have pegged rates – among them South Africa, Israel in 1998, Mexico in 1998, and Turkey in 1998 – avoided this type of crises that affected emerging market countries with pegged rates (Fischer, 2001). This observation was emphasized by Obstfeld and Rogoff (1995).

Friedman (1953) championed the modern case for flexible exchange rates. According to him real country-specific supply or demand shocks require adjustment of

relative price levels between countries. Thus, freely floating exchange rates allow the needed relative price adjustment to occur instantaneously when nominal goods price adjustment is sluggish. This argument has led to the policy recommendation that monetary policy authorities in open economies adopt flexible exchange rate regimes. This policy prescription relies on the notion that exchange rate movements have a large and immediate impact on aggregate demand, by allowing instantaneous adjustment of relative prices. Recent studies however find that the "expenditure switching effect" may be negligible. Thus, in the short-run there is very little response of consumer prices to changes in nominal exchange rates (Devereux and Engel, 2003; Gali, and Monacelli, 2005). López-Villavicencio and Mignon (2017) in estimating the exchange rate pass-through (ERPT) to import and consumer prices for a sample of 14 emerging countries over the 1994Q1-2015Q3 period, found that both the level and volatility of inflation, as well as the adoption of an inflation targeting framework or the transparency of monetary policy decisions clearly reduce ERPT to consumer prices.

As a result, policymakers involved in dealing with exchange rate crisis have warned strongly against the use of adjustable peg and other soft peg exchange rate regimes for countries open to international capital flows. Thus, it is either countries choose to peg their currencies hard or to allow their currencies to float, but that intermediate policy regimes between hard pegs and floating exchange rate regimes are not sustainable (Fischer, 2001).

According to Fischer (2001), soft exchange rate pegs are not sustainable for countries open to international capital flows. However, a wide variety of flexible rate arrangements remain available considering the fact that policy conditions in most countries will not be indifferent to exchange rate movements. This makes it clear that scholars are divided in terms of what the optimum policy option should be.

In emerging economies certain structural characteristics make them more vulnerable to external shocks. These includes constraints on the financing of investment through external borrowing and the speed by which exchange rate shocks feed through to domestic price levels (Devereux, Lane and Xu, 2006). This will leave emerging economies more concerned about the level of appreciation or depreciation of their exchange rate. Thus, they will often have what Calvo and Reinhart (2000) term a "fear of floating," because they are not willing to accept the extent of exchange rate fluctuations generated by a totally free float of the exchange rate. As a result, these countries will use both monetary policy and possibly foreign exchange intervention policy to respond to

exchange market pressures (Fischer, 2001). The motivation to defend the currency stems from trade facilitation and maintaining low inflation. However, if interest rates rise as the Central bank defends the currency, banks may get into trouble. Speculative attack is also possible under the scenario above (Obstfeld 1986).

Among emerging economies, this interest is further fuelled by the fact that many of the countries have introduced changes in their monetary policies and exchange rate policies, adopting inflation targeting that involves a floating exchange rate regime (Krušković, 2017). According to Miyajima (2013), intervention may not change the near-term exchange rate expectations. He contends that macroeconomic fundamentals are one important factor in dictating exchange rate expectation.

The effect of monetary policy shocks on the exchange rates has also been a debatable issue among scholars over the years. Most studies have found that maximum response of the exchange rate to shocks could only be observed with substantial delay (Kim and Lim, 2018). Eichenbaum, Johannsen and Rebelo (2017) studied how the monetary policy regime affects the relative importance of nominal exchange rates and inflation rates in shaping the response of real exchange rates to shocks. They found that the current real exchange rate predicts future changes in the nominal exchange rate. Despite this they also found that the real exchange rate is a poor predictor of future inflation rates. When they extended their analysis by introducing an open-economy model, they discovered that the key estimated shocks that accounts for the dynamics of exchange rates and their covariance with inflation are disturbances to the foreign demand for dollar-denominated bonds. This was the case during the 2009 financial crisis where there was a sharp appreciation of the US dollar against virtually all currencies globally. Fratzscher (2009) in studying this saw it as an unexpected outcome. He attributed this unexpected outcome to both macroeconomic fundamentals and financial exposure of individual countries to the US. Most importantly he found that countries with low foreign exchange reserves, weak current account positions and high direct financial exposure vis-a`-vis the United States experienced larger currency depreciations during the crisis overall, and to US shocks in particular (Fratzscher, 2009).

Nakatani (2018) analysed the relationships among shocks, exchange rate regimes, and capital controls in relation to the probability of a currency crisis. He found that both productivity shocks and risk premium shocks trigger currency crises. He also finds that the effects of these shocks on the probability of a crisis are larger for floating exchange rate regimes and that capital controls mitigate the effects of productivity shocks in pegged

regimes. Soe and Kakinaka (2018), also found that an IT regime helps stabilize pressure on a currency. This conclusion was reached by evaluating the role of IT regimes as a monetary policy framework in determining the EMP index in sixteen (16) developing IT economies. They used a propensity score matching method to establish this relationship. This confirmed the old argument that countries committed to an IT regime would not be required to intervene in the foreign exchange market to wade off exchange market pressure. Goldfajn and Gupta (2003) provides evidence on the relationship between monetary policy and the exchange rate in the aftermath of a currency crises. They found that a tight monetary policy facilitates the reversal of currency depreciation through nominal appreciation.

Currency crisis in in emerging and developing economies have extensively been analysed with a variety of analytical tools which are supposed to identify exchange rate crisis episodes. The exchange market pressure (EMP) index is one of the widely used indexes. The index was introduced in a seminar paper and later published by Girton and Roper (1977) to investigate independence of the interventionist stance by a central bank as a simple average of exchange rate changes and a foreign reserve depletion indicator. Girton and Roper (1977) used the monetary approach to the balance of payments to describe the monetary policy of the United States and Canada. They described a country's monetary policy to be judged only by reference to what is happening in the rest of the world. They applied the index to both fixed and flexible exchange rate regimes. When the index exceeds a threshold, excess pressure is flagged and a variable representing a crisis takes on a value of one for that period. General application of the index has been used in identifying 'crisis' periods, estimating the determinants of these crisis or on EMP itself, or testing for spill overs among exchange assets or commodity markets (Hegerty, 2018).

Few studies including Fiador and Biekpe (2015) have considered SSA countries in their application of the EMP index. They used a model similar to the model proposed by Girton and Ropper (1977) to determine the impact of monetary policy on the EMP index in 20 SSA countries. They used a dynamic panel model to test if a tight policy stance, deals with pressure on the currency these countries. They found this relationship to be significant and negative – they used the discount rate as a proxy for countries that do not implement an IT framework. The problem with this application of the index is that it assumed indirectly that all the 20 SSA countries use the interest rate as the main variable of monetary policy as would have been the case under an IT framework.

According to Krušković (2017), foreign exchange interventions of the central bank aimed at preventing exchange rate depreciation, require a high level of foreign exchange reserves which introduces a limit to the level of intervention. Krušković (2017) argues that if the source of the depreciation is weak fundamentals, then foreign exchange intervention will not stabilize the exchange rate in the long run, unless the central bank increases the interest rate. This move does not even secure the intervention due to large budget deficits (Krušković, 2017). This thinking was what influenced Girton and Ropper (1977) to develop an exchange market pressure (EMP) index to identify periods were there were an excess pressure on the exchange rate. This idea as mentioned earlier, had been modified by subsequent authors to capture the reaction function of monetary authorities by adding the interest rate variable to the original index developed by Girton and Ropper (1975).

To somewhat summarize, the EMP index is proposed as a measure of pressure on the exchange rate of various countries in attempt to help countries guard themselves against exchange rate crisis. However, due to the unique characteristics of developing countries – commodity exporters - the universal adoption of this measure has to be carefully looked at.

2.3 Modifications to the EMP Index

A lot of studies, including Sachs, Tornell, and Velasco (1996), Eichengreen et al. (1994, 1996), Kaminsky and Reinhart (1999), Stavarek (2010), (Hegerty, 2018) and Hossfeld and Pramor, (2018), have used the EMP index to identify crisis episodes in different economies.

Recent studies on currency crisis have focused more on the policy adjustment by authorities in response to the currency crisis. This was observed by Obstfeld in1986 but was also studied by Girton and Ropper (1977) through the traditional approach to the balance of payments. Thus, the relationship between the trade and capital accounts contained an implicit monetary condition. Using this approach, they assumed that the intervention necessary to achieve an exchange rate target is endogenous but explained it using the monetary equilibrium condition.

Eichengreen et al. (1994), added the interest rate spread to the index to describe possible monetary policy responses to disequilibrium in the foreign exchange market. They were among the first to apply the index to developed countries - where governments face low unemployment and conduct sound fiscal policies and do not resort much on

seiniorage. By this, the EMP index begun to be used to signal whether pressure on a currency is softened or warded off through monetary authorities' interventions or rather a currency crisis has originated (Bertoli et al. 2010). Hegerty (2018) also added the interest variable to the index but studied countries in Eastern Europe. He attributed the reason why previous studies did not consider the interest rate variable to the fact that most crisis at the time did not lead to large devaluations. *This raises a question whether the EMP index in this current form is effective in identifying exchange rate crisis in SSA – the first research question to be evaluated by this study.*

Before Hegerty (2018), Pentecost, Van Hooydonk and Van Poeck (2001) used a different method in measuring and estimating exchange market pressure in the EU. They used a principal component analysis to derive a measure of exchange market pressure. They tried to explain movements in their measure of EMP by a wealth augmented monetary model and concluded that money growth, the change in long-term interest rate differential, real depreciation, budget deficit and the current account can indeed explain EMP. Siklos and Weymark (2006) also introduced an index of ex-ante exchange market pressure that can be used as a benchmark against which to measure the effectiveness of sterilised intervention. They measured both an ex-ante and an ex-post exchange market pressure index and used the ratio of the two indexes to assess the effectiveness of sterilized intervention in Canada and Australia.

Stavarek (2010), in making a case for four euro-candidate countries to participate in the Exchange Rate Mechanism II, a criterion to be fulfilled before entry into the Euro, used a two-stage least square regression technique to estimate the EMP index. He found no evidence of serious relationship between EMP and de facto exchange rate regime.

Aizenman and Hutchison (2012) used the EMP index to find how the global financial crisis emanating from the US affected emerging economies. They found that emerging countries with higher total foreign liabilities, including short and long-term debt equities, FDI and derivative products had greater exposure and were much more vulnerable to the financial crisis. Countries with large balance sheet exposure – high external portfolio liabilities exceeding international reserves – absorbed the global shock by allowing greater foreign exchange depreciation and comparatively less revenue loss. According to them, this was despite the huge build-up of reserves by emerging economies prior to the financial crisis.

Few studies have considered SSA countries in their application of the EMP index. Fiador and Biekpe (2015), used a model similar to the model proposed by Girton and

Ropper (1977) to determine the impact of monetary policy on the EMP index. They did not consider the different monetary policy framework that exist in SSA in their estimation of the index. They instead used a dynamic panel model to test if a tight policy stance, deals with pressure on the currency of 20 countries in SSA. They found this relationship to be significant and negative – they used the discount rate as a proxy for countries that do not implement an IT framework.

Soe and Kakinaka (2018), also found that an IT regime helps stabilize pressure on a currency. This conclusion was reached by evaluating the role of IT regimes as a monetary policy framework in determining the EMP index in developing economies. They used a propensity score matching method to establish this relationship.

Bertoli et al. (2010), in their paper showed that the index is sensitive to some assumptions especially when developing countries are involved. They cautioned that one should be extra careful in subsequent econometric analysis where a dependent binary variable is built to identify crisis periods. Eichengreen, Rose and Wyplosz (1996) for instance used extreme values of the EMP index to identify exchange rate crisis – thus a crisis is detected when the index exceeds 1.5 of the standard deviation and the sample mean of the EMP index. They used this to test contagious currency crisis. Other studies also used various conventional methods based on a certain arbitrary number of standard deviations (usually ranging from 1.5 to 3 standard deviations) above the mean of the EMP index (Pontines and Siregar, 2008).

In dealing with the threshold problem Pontines and Siregar (2008) used a model that deals with the non-normality of the EMP index but still used an arbitrary number of standard deviations to identify crisis episodes. Pontines and Siregar (2008) also demonstrated that the identification of crisis episodes based on commonly applied exchange market pressure (EMP) indices are highly sensitive to the choice of the weighting scheme for each component of the EMP index and the statistical parametric assumption used in the constructions of crisis thresholds.

The threshold issue leads to a major consequence in modelling as the dependent variable of the model is actually the output of another model. This was a fundamental problem in the early works of the EMP index. Kaminsky et al (1998) was one of the first to propose a function relating leading indicators to the occurrence of an exchange rate crisis. They relied on a signalling approach. This paved the way for other studies to start applying the signalling approach in determining crisis period (Dumitrescu, 2012). Others also considered the Probit approach in signalling a crisis period. However, Berg and

Patilo (1999) compared the signalling approach to the probit approach and concluded in favour of the latter method.

The point here is that the EMP index has evolved to capture the reaction function of the central bank – an IT regime. Despite this, the EMP index still has threshold and weighting problems which makes the application of the EMP index in developing countries somewhat challenging. This is because developing countries – SSA – as motioned earlier are mainly commodity exporters and cannot afford to allow their exchange rate to freely float like expected under an IT regime.

2.4   The Role of International Reserves

In reforming the Bretton Woods system, primacy was placed by countries on adequacy of international reserves. "The concern then was that inadequate global liquidity would eventually drive the world economy into recession and would prevent countries from effectively protecting the values of their currencies" (Bird and Rajan 2003, pp 873). The International Monetary Fund's (IMF) Special Drawing Rights (SDR) was introduced to address this problem – a proposal considered by Mendoza (2004) when he studied international reserve-holding in the developing world. During this period studies focussed on how countries can avoid exchange rate crisis even though Girton and Roper (1977), who combined changes in the exchange rate variable and international reserves to identify Exchange Market Pressure (EMP) in post-war Canada, had already considered such a phenomenon.

These efforts notwithstanding, emerging economies – Mexico, Thailand, Korea, Indonesia, Malaysia, Russia, Brazil and Argentina – experienced series of currency crises during the 1990s and early 2000s. Studies that investigated these crises at the time pointed to rapid reserve depletion as a defining feature, making the reserve variable a significant variable in studies examining the predictability of currency crises (Bird and Rajan 2003). Hossfeld and Pramor (2018) in studying global liquidity and exchange market pressure in emerging market economies, used the EMP index with just changes in the exchange rate and the reserve variable. Their decision was based on the fact that it was highly correlated with other variations of the index despite its ease of interpretation, and its availability over the full sample period. In testing new measures of exchange market pressure in Sub-Saharan Africa (SSA), I also found that the reserve variable plays an important role in SSA countries even though broad money appears as an intermediate target in most countries in SSA. This was despite the different monetary policy

frameworks (de jure) used by SSA countries. Also, Lane and Burke (2001) found some evidence that financial deepening is associated with an increase in the reserve's ratio. According to Lane and Burke (2001), smaller and more volatile industrial countries hold larger reserves than their larger, less volatile counterparts. For developing countries, they found that those that are indebted tend to have smaller reserve ratios.

In the era of capital mobility developing countries cannot be faulted for putting a lot of stall on reserve accumulation – augmented sometimes through borrowings. Most developing countries do not control the sources of capital and as a result are mostly guarding against economic and financial crisis that occur as a result of volatile international capital flows. The problem is not the capital flow itself but the rapid reversal of capital as has been happening in recent times. Evidence favours countries with large reserves to be able to withstand currency crisis than those with smaller reserves (Bird and Rajan, 2003; Aizenman and Lee, 2007; Jung and Pyun, 2016; Silva Jr, 2016). Nowak, Hviding and Ricci (2004) confirmed this assertion when they studied the role of foreign exchange reserves in reducing currency volatility for emerging market countries – 28 countries over the period 1986–2002. Their results provided ample support for the proposition that holding adequate reserves reduces exchange rate volatility. They found this effect to be strong and robust but nonlinear and appears to operate through a signalling effect. Thus, in the presence of volatile borrowing conditions, indebted government are expected to hold a sizable stock of international reserves (Bianchi, Hatchondo and Martinez, 2018).

This section has highlighted the importance of international reserves in wading of pressure on a country's currency. The importance of international reserves is more apparent for developing countries who due to their characteristic as price takers cannot afford to allow their currencies to be volatile.

2.4.1   The EMP index and the reserves adjuster problem

When Girton and Roper (1977) developed the EMP index, they adjusted the reserve variable by a domestic money base. The purpose was to explain the quantity of base money that the authorities are induced to create or destroy – and the autonomy they sacrifice – in order to stabilize the exchange rate. By deflating the rate of change of international reserves valued in domestic currency by domestic base money, Girton and Roper (1977) obtained a real measure of the balance of payments. In their view this was essential to convert the nominal measure of the official intervention into real terms to determine the size of the balance of payments.

The choice of which variable against which to adjust international reserves by has been a subject of debate among economists over the years. Acknowledging that international reserves are considered an inventory held against uncertain future course of the balance of payments, it is important to recognise the ever-changing dynamics of the origin of a particular balance of payments deficit. Balance of payments problems have evolved from being related to current account deficits to issues of the capital and financial accounts when developing countries are involved. *This paves the way for a new EMP index to be developed and tested to see if it is effective in identifying exchange rate crisis – as postulated by the second research question and its hypothesis.*

Since the currency crisis in the 1990s, literature has focused on two classes of benefits arising from a high level of reserves – an attempt to deal with crisis that arise from both the current account and also the capital and financial accounts of the balance of payments. According to these studies, a high level of reserve adequacy has been shown to reduce the likelihood of currency crises or a "sudden stop" – a sudden unwillingness by international lenders to renew their credit lines at times of market uncertainty. Also, higher reserve adequacy tends to be associated with lower external borrowing costs. This works through improved confidence and improved credit ratings on sovereign foreign currency debt, since the government's default risk is perceived to diminish with higher reserves (Nowak, Hviding and Ricci, 2004). Aizenman and Lee (2008) however argued that monetary mercantilism and precautionary hoarding may be mutually complementary. Thus, the competitiveness benefit of holding reserves may reduce the effective cost of hoarding reserves and induce governments to prefer reserve-hoarding over the alternative.

Moore and Glean (2016) asserts that the notion of reserve adequacy is not static and is intimately associated with the occurrence of financial crises as well as exogenous shocks. The traditional benchmarks in international macroeconomics is that a country should maintain reserves that can cover at least three (3) months of imports. Therefore, the reduction in reserves below this benchmark is considered a sign of fragility. In their study they - Moore and Glean (2016) – found that in small states, the optimal holding of foreign exchange reserves is approximately 25 weeks of imports, approximately 13 weeks higher than the traditional rule-of-thumb. They also found that countries with a prudent public expenditure management framework in place are able to hold a smaller stock of reserves. Bird and Rajan (2003), in studying the adequacy of international reserves in the aftermath of a crisis, recognises that the use of reserves-to-imports ratio – derived from a trade-related approach to the balance of payments and reserve needs – lost some relevance

after the crises in 1990. This according to Bird and Rajan (2003), opened the door for a more superior and operationally expedient alternative. In fact, short-term indebtedness was found to be a key indicator of illiquidity and a predictor of financial crises. This was attributed to the former Deputy Minister of Finance of Argentina, Pablo Guidotti, who proposed that "countries should manage their external assets and liabilities in such a way as to be capable of living without foreign borrowing for up to one year" (Bird and Rajan, 2003, pp 881).

As mentioned earlier, extreme reversibility of short-term debt in the event of negative shock exposes borrowers (countries) to liquidity runs leading to systemic crises. In view of the observation made by Pablo Guidotti, proposals were made to resurrect the idea of expressing a country's reserves in relation to its short-term external debt – ratio of reserves-to-short-term external debt. It follows from currency theory that usable foreign exchange reserves should exceed scheduled external amortisation for one year. This ratio however is constrained to capital flight that occurs on external debt only. With an ever-increasing non-resident participation in domestic debts in developing countries, this ratio may not capture capital flight by both residents and non-residents in the domestic debt market. This shortfall has been dealt with by adjusting the reserve variable by a broad money supply measure like the one used by Girton and Roper (1977) in identifying exchange market pressure.

Since then studies have tried to incorporate these revisions in their study of exchange rate volatility. Using a data set of 112 emerging economies and developing countries, Bussière, Cheng, Chinn and Lisack (2015) addressed the question whether the accumulation of international reserves has effectively protected countries during the 2008-09 financial crisis. They found that the level of reserves matters and that countries with high reserves relative to short-term debt suffered less from the crisis, particularly when they have a less open capital account. Nowak, Hviding and Ricci (2004) used the ratio of reserve assets to short-term debt, ratio of reserve assets to imports and to GDP as explanatory variables to help determine the adequacy of reserves in a study of emerging countries. Qian and Steiner (2017) in confirming the conclusions reached by Bussière et. al. (2015) found that international reserves positively affect the share of long-term external debt. This effect according to Qian and Steiner (2017) holds for both private and public external debt.

Chong, He and Hinich (2008), in developing a new early-warning system for international currency crises discovered that rapid reserve depletion appeared to be a

prominent feature before the collapse of an exchange rate system. Using a threshold autoregressive model they compared the ratio of reserves-to-imports, reserves-to-short-term external debt and reserves-to-broad money to the exchange market pressure index estimated by Eichengreen et al. (1996), Frankel and Rose (1996) and Sachs et al. (1996) and suggested that when the Reserves-to-Short-Term External Debt falls by more than 29.1%, or if the Reserves-to-M2 ratio drops by more than 24.3% within six months, the likelihood of a crisis increases.

Hashimoto (2008) also studied these three ratios but adjusted imports, short-term debt and the broad money supply by the reserve variable. Unlike Chong, He and Hinich (2008), Hashimoto (2008) studied whether recent foreign reserve accumulation in Asian economies has been too extraordinary for them to recover from the rapid depletion that characterised the currency crisis in the late 1990s. Using a Brownian motion model with an absorbing barrier, Hashimoto (2008) discovered that most Asian economies appeared to have larger reserves – Imports-to-reserves and broad money supply-to-reserves ration – than the estimated threshold at the time of the crisis of 1997. However, reserves in terms of short-term external debt did not appear to be sufficient to avoid speculative attacks.

Less attention has been given to countries in SSA in all these studies. Drummond and Dhasmana (2008) are among the very few authors who have conducted studies on SSA. Specifically, they studied the adequacy of reserves in sub-Saharan African countries in light of the shocks they face. Using a two-good endowment economic model, they concluded that the optimal level of reserves depends on the size of these shocks, their probability, and the output cost associated with them. The high inflow of capital from developed countries to developing and emerging countries during and after the 2008-09 crisis cannot also be overlooked (Dooley, Folkerts-Landau and Garber, 2009).

Glocker and Towbin (2012) drew attention to the use reserve requirements as an additional policy instrument by a number of countries. Using a vector autoregressive (VAR) model for the Brazilian economy they discovered interest rate and reserve requirement shocks. They concluded that reserve requirement policy can complement interest rate policy in pursuing a financial stability objective, but cannot be its substitute when it comes to the price stability objective.

The accumulation of reserves to guard against currency crisis is not entirely a rosy picture. Reserves are an expensive insurance mechanism, with costs coming from many different – and often difficult to quantify – sources. Green and Torgeson (2007) in studying the motivations and costs of foreign exchange reserve accumulation among the

world's largest emerging market holders of reserves, found that the net marginal return to additional reserves is low supporting the proposition that the largest reserve holders are holding foreign exchange reserves exclusively for precautionary purposes. They advocated for the removal of distortions - such as limited exchange rate flexibility – that lead to excess reserve accumulation in the first place. Rodrik (2006) however discovered that the income loss to countries who accumulate reserves for insurance purposes amounts close to 1% of GDP. For Rodrik (2006) this does not seem too steep a price to pay for holding foreign exchange reserves. The conclusion is that while reserves are accumulated as insurance and/or buffer stocks against financial crises, they also attract those types of foreign debt that reduce arguably the vulnerability to sudden stops and capital outflows (Qian and Steiner, 2017).

The IMF argues that considerations underpinning a country's reserve needs depend on its economic and financial structure. To this end the IMF groups countries into mature markets (MMA), deepening financial markets (DFM), and constrained market access (CMA) – which largely correspond to the commonly used per capita income classification – to help it assess their reserve adequacy for precautionary purpose. The IMF proposes a measure that combines the reserve-to-import ratio, reserve-to-short-term external debt ratio, reserve-to-broad money ratio and other liabilities to reflect other portfolio outflows. Alberola, Erce and Serena (2016) also proposes a measure that can effectively capture the role of resident investors as according to them international reserves facilitate financial disinvestment overseas by residents.

Table 1: Rules of thumb foreign reserve adequacy monitored by credit rating agencies and investment banks

Agencies	Import Rule	Guidotti Type Rule	M2 Rule	Gross Ext Debt	Gross External Financing Needs
Fitch					
Moody's		*	*	*	
Standard & Poor's					*
Deutsche Bank	*	*	*		
Goldman Sachs			*		
Citibank		*	*		
Barclays		*			*

Source: Antal and Gereben 2011

It has thus been shown that an important component of the EMP index is the variable to adjust the reserve variable with. The literature summarized above propose

three variables – imports, short-term external debt and broad money – as being important to this effect. As shown in Table 1, most of the rating agencies make use of these variables in determining the credit worthiness of countries.

2.5   Exchange Rate and Banking Crisis

Banks are presumed to know the creditworthiness of their borrowers better than anyone else. Deposits are redeemable at par and depositors also assume that they can get immediate access to liquidity – only if not everyone tries to withdraw funds simultaneously (Goldstein & Turner, 1996). As most bank products or services include a promise to pay in the future, it thus takes time for a bank's inability to fulfil its contracts to become evident. Banks can conceal problems by rolling over bad loans or by raising more deposits and increasing the size of their balance sheet (Caprio and Klingebiel, 1996). In the words of Demirgüç-Kunt and Detragiache (1998), "banks are financial intermediaries whose liabilities are mainly short-term deposits and whose assets are usually short-and-long- term loans to businesses and consumers. When the value of their assets falls short of the value of their liabilities, banks are insolvent" (page 84). One of the main tasks of a commercial bank is also to offer loans making credit risk their main source of risk i.e. the uncertainty associated with repayment of loans (Goldstein and Turner, 1996). Thus, the value of a bank's assets may drop because borrowers become unable or unwilling to service their debt leading to a crisis (Demirgüç-Kunt & Detragiache, 1998).

Davis and Karim (2008), defined banking crisis as the occurrence of severely impaired ability of banks to perform their intermediary role. According to them the collapse of a few banks constitutes a localized crisis whereas a collapse of the banking system constitutes a systematic crisis. A crisis also has significant direct and indirect costs. Bailouts costs on average 10% of GDP with some crisis much costlier. For instance, the Mexican Tequila crisis in 1994 cost the government 20% of GDP whereas the crisis in Jamaica cost about 37% of GDP (Caprio and Klingebiel, 1996 cited by Davis and Karim, 2008; Hall, 2009).

Over the years, a vast majority of banking crisis have been caused by financial institutions underestimating their common exposure to broad economic risks. The interest rate, credit, liquidity and market risk – high non-performing loans – have been key determinants of banking crisis from the late-90s to the early 2000s (Englund, 1999; David & Karim, 2008; O'Sullivan & Kennedy, 2010). Cox and Wang (2014) who examined the

financial crisis in the US found similar characteristics between the banks that went bankrupt during the financial crisis of 2008-2010. These banks among others had higher amounts of real estate loans, larger asset size, inferior return of assets and more non-performing loans. To further substantiate the evidence of Davis and Karim (2008), Cox and Wang (2014) concluded that the cause of the bank failures in the US stemmed from inadequate equity capitalization and excessive investment in real estate loans with unwarranted collateral valuations. This according to them resulted in loan losses dragging down profits and further reducing the equity cushion (Hoshi & Kashyap, 2010; Cox and Wang, 2014; Cleary and Hebb, 2016).

Interest rate risk also forms an inherent part of banking activities since assets have longer duration than liabilities. Pre-payment risks may also arise if long-term rates decline and borrowers refinance at lower rates. Crisis are less likely when interest rates are low which are usually associated with economic booms. During economic booms banks may use low cost deposit financing to invest heavily in a particular sector which appear profitable and where collateral values are high. This increase appetite for long-term projects means a duration mismatch and interest rate risk are likely to accumulate during the boom phase so that unexpected interest rate increases or moves towards Inflation Targeting (IT) in the down turn could lead to systematic interest rate risk materializing. Hence the inclusion of interest rate in early warning systems (Davis and Karim, 2008).

In the same vain, Demirgüç-Kunt and Detragiache (1998) studied factors associated with the emergence of systematic banking crisis in a large sample of developed and developing countries from 1980 to 1994 using a multivariate logit econometric model. They concluded that crises tend to erupt when growth is low and inflation is high. High real interest rate according to them is associated with systematic banking sector problems. They also raised the issue of a balance of payment crisis – but its effect was weak. They postulated that countries with an explicit deposit insurance scheme were particularly at risk as were countries with weak law enforcement. The US is a clear example of a country with a clear deposit insurance scheme supervised by the Federal Deposit Insurance Corporation (FDIC). This notwithstanding, the number of bank failures continued to increase during the financial crisis in 2008. Cox and Wang (2014), observed that bank failures increased from three (3) in 2007, twenty-five (25) in 2008, one hundred and forty (140) in 2009 and one hundred and fifty-seven (157) in the year of 2010. The estimated costs of increasing bank failures through purchase and assumption by the FDIC was US$ 0.21 billion, US$ 19.86 billion, to US$ 37.35 billion in 2007, 2008 and 2009 respectively.

Cleary and Hebb (2016) reports a higher figure over these periods which according to them led to the FDIC's funds falling into red – representing its first negative balance since the savings and loans crisis in the 1990s. This necessitated the call for banks to increase their capital requirement and also an increased in fees charged by the FDIC for deposit insurance (Cleary and Hebb, 2016). Others have argued that a higher capital requirement will lead to banks taking more risks knowing they have a 'backing' in a higher Capital Adequacy Ratio (CAR). However, this is the main reason why there is also the need for a higher CAR compared to not having it and to be hit by a crisis. A higher CAR in the short-term will hurt credit to the private sector, which in turn hurts economic growth. Higher CAR and prudent provisioning policy seem to reduce the level of problem loans (NPLs). Regulatory devices do not significantly reduce problem loans for countries with weak institutions and corrupt environment (Abou-El-Sood, 2016).

2.5.1 The Effect of NPLs on Banking Crisis

Another determinant of a banking crisis is increased credit risk or the probability that a borrower will default – converting an asset into a bad or non-performing loan (NPL). Usually risk assessment by banks deteriorates during pre-crisis periods. Also, during these periods, asymmetry information does not restrict credit availability because bank managers succumb to the behaviour of using biased information sets to make investment decisions. As a result, they ignore the potentially high default probabilities that could occur under recessionary states and under-price credit risk. These behavioural responses can be attributed to difficulties in measuring time series of credit risk and also to incentive based managerial contracts which reward loan volumes (Davis & Karim, 2008).

Non-performing loans eat into the profits of banks. Karim, Chan and Hassan (2010), in investigating the relationship between non-performing loans and bank efficiency in Malaysia and Singapore, found that higher non-performing loans reduce cost efficiency. This conclusion was reached by the use of a stochastic cost frontier approach and assuming a normal-gamma efficiency distribution model. They posited that as foreign banks take a greater role in the market, the strength of the local banks will be put to the test. The effect of these competitive pressure on banks will depend on their ability to adapt and operate efficiently in the new environment. In their view banks that fail to do so will be driven out of the market by the more efficient ones – they will have a competitive advantage. According to Karim, Chan and Hassan (2010), the NPL effect extends also to the macroeconomic environment.

In identifying the determinants of non-performing loans for a sample of eight (8) banks in Italy, Greece, and Spain for the period of 2004-2008, Ahmed, Takeda and Thomas (1999), found that problem loans were negatively associated with the growth rate of GDP, the profitability of bank assets and positively associated with the unemployment rate, the loan loss reserves to total loans and real interest rate.

Makri, Tsagkanos and Bellas (2014), identified factors affecting the NPL of Eurozone banking system for the period 2000-2008, just before the recession. Their findings revealed strong correlation between NPLs and various macroeconomic and bank specific factors. In their view competition increased bank's credit risk through a relaxing of borrowing criteria. According to them, one of the most common indicators used to identify credit risk is the ratio of non-performing loans (NPLs).

Sosa-Padilla (2018), discovered that Sovereign defaults and banking crises have been recurrent events in emerging economies. Thus, whenever a country decides to default or defaults on its debt there is an adverse impact on the domestic economy, largely through disruptions of the domestic financial sector. Referencing the Russian and the Argentine example, Sosa-Padilla (2018) concluded that whenever bankers are exposed to government debt, a default generates a banking crisis, which triggers collapses in credit to the private sector leading to a decline in economic activity. This conclusion was reached by extending a traditional default framework to include banks who lend to both government and firms. Earlier studies by Fofack (2005) and a more recent study by Mpofu and Nikolaidou (2018) confirm the negative relationship between NPLs and economic growth.

2.5.2 Banking Crisis and Currency Crisis – The Twin Crisis

Studies have also studied the links between banking and currency crises (Gaies, Goutte and Guesmi, 2018; Matsuoka, 2018; Peria and Domaç, 1999; Glick and Hutchison, 2000; Eichengreen and Hausmann, 1999; Kaminsky and Reinhart, 1999; Chang and Velasco, 2000). Kaminsky and Reinhart (1999) discovered that problems in the banking sector typically precede a currency crisis. Thus, the currency crisis deepens the banking crisis. Theoretically, the relationship between banking and currency crises runs from balance-of-payments problems. An external shock combined with a commitment to fixed exchange rate regime, will typically result in the loss of reserves then leading to a currency crisis. If the financial sector is externally exposed then this may lead to a credit crunch and a banking crisis. Also, if a boom in imports and economic activity is financed by borrowing abroad, and the current account deficit continues to

widen, financial markets become convinced that the stabilization program is unsustainable, fuelling an attack on the domestic currency. As the capital inflows associated with the boom is usually financed by a surge in bank credit, an outflow will lead to an asset markets crash leading to a banking crisis.

Considering the link between currency and banking crisis, it thus becomes obvious that international reserves also plays a crucial role. Most balance-of-payments crises are resolved through a devaluation of the domestic currency. However most central banks resort to foreign-exchange market intervention and in some instances contractionary monetary policy – if the country implements an IT framework – to fight the speculative attack.

Chang and Velasco (2000), in studying financial fragility and exchange rate crises in Diamond Dybvig banks, discovered that a flexible exchange rate system implements the social optimum and eliminates bank runs, provided that the exchange rate and credit policies of the central bank are appropriately designed. Chang and Velasco (2000) came to this conclusion by viewing the banking system, the exchange rate regime, and central bank credit policy as parts of a mechanism intended to maximize social welfare. If the mechanism fails, banking and exchange rate crises become possible. According to them a currency board cannot implement a social optimum because it allows bank runs to occur. Also, a fixed exchange rate system may implement the social optimum but is only better than a currency board. Glick and Hutchison (2000) however thinks that the openness of emerging markets to international capital flows, combined with a liberalized financial structure make them particularly vulnerable to twin crisis. A situation like this according to them makes banking crisis a leading indicator of currency crisis in developing economies.

The underlining theme is that an exchange regime can undermine bank efficiency through speculative attacks leading to a downward adjustment of bank capital and a compromise in the central bank's ability to act as the lender of last resort.

2.5.3 Banking Crisis in Sub-Saharan Africa (SSA)

In SSA, 22 counties out of a possible 45 countries have experienced a banking crisis of one form or the other. On average this crisis cost the public purse some 9 per cent of GDP (for countries for which data is available) (Caprio and Klingebiel, 2002). The origin of banking crisis in the SSA sub-region gained prominence in the 1985-95 period. Unlike other regions of the World, the crisis in SSA was first associated with heavy government intervention and loose controls on connected lending which hurt bank profitability and

efficiency. This is despite the existence of the traditional causes – risk taking and delays in taking corrective actions – of banking crisis in the sub-region (Daumont, Le Gall and Leroux, 2004). A critical look at the crisis in the sub-region will however show that high NPLs preceded the crisis periods leading to bank insolvency (Caprio and Klingebiel, 2002).

2.5.4 Dealing with Banking Crisis

Despite extensive literature on the causes and prediction of banking crisis by early warning systems, their practical use by policy makers is limited. This according to Davis and Karim (2008) is a paradox because as more economies liberalize and develop their financial systems, the nature of banking risks also changes making the use of early warning systems for crisis prevention more necessary than ever. The most common approach by policy makers to deal with banking crisis has been to set a minimum ratio target which usually is an increase from what used to exist – as was in the US example explained above. Minimum equity or capital ratio requirements promote bank stability but Aiyar, Calomiris and Wieladek (2015) suggest compliance must be measured credibly and that these requirements must be commensurate with risk. A mix of higher book equity requirements, a carefully designed contingent capital requirement, cash reserve requirements and other measures, would address objectives better than book equity requirements alone. They criticized the Basel III's defined liquidity ratios. They also contend that raising minimum capital requirements will not be socially costless; bank profitability, share prices and loan supply are likely to suffer (Aiyar, Calomiris and Wieladek, 2015). The bone of contention here is that regulators face a trade-off between high capital requirements which impacts bank profitability and strict supervision which is costly to the tax payers either directly or indirectly (Buck and Schliephake, 2013). Buck and Schliephake (2013) proposes and effective combination of both in dealing with banking crisis.

In some instances, governments are required to bail-out failing banks. They do this because letting the banks fail and enter insolvency would have caused excessive disruption to the critical services that these institutions provide and to the wider financial system. Bailing out banks is costly and also likely to undermine the incentives for firms to be run in a prudent manner and for investors to monitor the activities of the firm to prevent excessive risk taking from jeopardizing their investment. By bailing out the banks, the cost of funding the bank in times of crisis by shareholders or owners is artificially lowered because the consequence of failure is at least partly borne by the

public sector (Chennells and Wingfield, 2015). Gerdrup et al. (2004), in analysing various studies, realized that an agency problem prevents lenders from observing how the funds are invested. This leads to a risk-shifting problem as borrowers shift downside risk to the lenders. The problems are then compounded when implicit guarantees from the government are used to bail out banks. Even when bail outs are carefully designed, they are often very costly for the budget, they may allow inefficient banks to remain in business and they are likely to create the expectation of future bailouts, thereby reducing incentives for adequate risk management by banks. It may also weaken managerial incentives by forcing healthy banks to bear the losses of ailing institutions. An attempt to deal with the problem with a loose monetary policy can be inflationary leading to a speculative attack on the domestic currency when the country is not implementing a flexible exchange rate regime (Demirgüç-Kunt and Detragiache, 1998). In most developing countries, forbearance had been used to delay capital provisioning requirements in some cases. In some instances, widely varying practices in loan classification, provisioning and loan restructuring creates an optimistic picture of profitability and masked weaknesses (Agbonkpolor, 2010).

According to Chennells and Wingfield (2015), a key attribute of an effective bank resolution regime is to ensure that banks could fail without disrupting the financial system, without interrupting the critical services they provide and importantly without requiring public sector support. One way of ensuring this is through a "bail-in" – part of a set of principles for managing the failure of systemically important financial institutions developed by the Financial Stability Board of the UK. By this the claim of shareholders and unsecured creditors of the failed bank are written down and or converted into equity in order to absorb the loses and recapitalize the bank or its successor. It is not negotiated, it is imposed on the bank and its creditors by the authorities responsible for resolution (see Figure 1). In a developing country setting, this solution will be difficult to implement considering corruption and weak law enforcement (Demirgüç-Kunt and Detragiache, 1998). This and other reasons make the situation in developing countries very unique. In SSA like any other developing region in the World, the procedure for recovering loans are lengthy and cumbersome. The time it takes for procedures to be initiated and the time a decision will be given by the courts could span more than a year. In situations where the court orders are given in favour of a creditor, lawyers among others delay the execution of the judgement by filling appeals that have no real grounds (Daumont, Le Gall, and Leroux, 2004). The literature on Ghana and SSA at large is limited and even so

most of the studies were short of proposing remedial measures that deal with the problem holistically.

The underlining theme is that an exchange regime can undermine bank efficiency through speculative attacks leading to a downward adjustment of bank capital and a compromise in the central bank's ability to act as the lender of last resort. This provides a gap that this study is seeking to investigate through the third research question and its hypothesis.

2.6   The Exchange rate and petroleum prices

Changes in oil prices are the result of a confluence of many factors. In international crude oil trading, the US dollar is mainly used as the invoicing currency. Therefore, fluctuations in the US dollar exchange rate are believed to underline volatilities of crude oil prices around the World. Its relative depreciation played a key role, for example, in soaring oil prices between 2002 and 2007 (Zhang et al. 2008).

Among many sources of real disturbances, such as oil prices, fiscal policy, and productivity shocks, real exchange rate movements can be mainly explained by oil price changes. Exchange rate fluctuations can be attributed primarily to non-monetary shocks. Clarida and Gali (1994) and Lastrapes (1992) found that real shocks can account for more than 50% of the variance of real exchange rate changes over all time horizons (Chen and Chen, 2007).

2.6.1   Effect of exchange rate shocks on oil prices

Using monthly panel data of G7 countries, Chen and Chen (2007) suggested that real oil prices may have been a dominant source of real exchange rate movements and that there is a link between real oil prices and real exchange rates. They used different measures of oil prices, UAE (United Arab Emirates) price of oil (Dubai), British price of oil (Brent), and the US West Texas Intermediate price of oil compared to other studies that have used only one.

On the other hand, Backus and Crucini (2000) found that oil accounts for much of the variations in the terms of trade over the last 25 years and its qualitative role varies significantly over time. The results of their dynamic general equilibrium model suggested that the economy responds differently to oil supply shocks than to other shocks.

Crude oil exporting countries may lose from a weak US dollar while benefiting from a strong US dollar. Hence, when the prospects of the US dollar are not considered promising, a large amount of money will flow to the oil market, driving up oil prices

(Zhang et al. 2008). A depreciation of the US dollar reduces oil price to foreigners relative to the price of their commodities in foreign currencies and thus escalating their purchasing power and oil demand, consequently pushing up the US dollar price of crude oil (Uddin et al. 2013).

Golub (1983) and Krugman (1983) note the role of oil prices in explaining exchange rate movements. Basically, a country exporting oil may face exchange rate appreciation when oil prices rise and depreciation when oil prices fall, whereas the case is the opposite for an oil-importing country. Oil is a homogenous and internationally traded commodity priced in US dollars.

2.6.2 Effect of crude oil prices on retail prices of gasoline

Most studies have sought to determine how retail prices of gasoline, diesel, or petrol adjust to increases or decreases in World crude oil prices. In testing the hypothesis put forward in the Monopolies and Mergers Commission's reports (1965), (1979), (1990) that the speed of adjustment of UK retail gasoline prices to cost changes is more rapid when costs rise than when they fall, Bacon (1991) found no evidence of faster and more concentrated response to cost increases between 1982 to 1989. Reilly and Witt (1998) extended the dataset to 1995 using monthly data and confirmed the conclusions of Bacon (1991). They claim that the asymmetry response by petrol retailers to crude oil price rises and falls is rejected by data over the period examined, and the same occurs for the exchange rate variable. Bettendorf–van der Geest and Varkevisser (2003) also studied asymmetry in the Dutch consumer petrol market and like Bacon (1991), found that the effect of asymmetry on the Dutch consumer costs is negligible.

Liu et. al. (2010) drew a different conclusion when they studied the New Zealand market. Using an asymmetric error correction model (ECM), they examined how pre-tax petrol and diesel prices respond to changes in crude oil prices. They revealed that oil companies adjusted diesel prices upwards faster than they adjusted them downwards and the difference was statistically significant. However, the authors also determined a significant relationship for petrol suggesting that diesel prices may not be as competitive, backing the call for government actions and monitoring.

2.6.3 Dealing with irregularities in the retail sector of premium gasoline

Households are generally against domestic fuel price increases. This is because such increases generally (directly or indirectly) lead to higher prices for fuels consumed for cooking, heating, lighting, and private transport with final consequences on the cost

of production and consumer prices. However, the degree of impact is dependent on the explanatory power of these factors across different income groups (del Granado, Coady and Gillingham, 2012).

Recent volatility in international fuel prices has highlighted the fiscal risk inherent in the current approach to fuel pricing in many developing and emerging countries (Coady et al. 2013). In most of these countries, domestic fuel prices are administratively determined and increases in international fuel prices are often not fully passed through to domestic consumers. This had often been in the form of unpaid subsidies leading to huge fiscal costs over long periods. These and other factors have increased the call for developing countries to implement a pricing formula that will ensure pass-through over the medium term and avoid sharp increases and decreases in domestic prices (Coady et al. 2013; Coady et al. 2017).

The foregoing solution is always a politically sensitive issue to implement in developing countries. This is because there is a lack of trust in the government to use savings from lower oil prices (if the country is a net importer of crude oil) or budget savings from higher oil prices (if the country is a net exporter of crude oil) for the benefit of the populace. Furthermore, high income groups arguably benefit the most from fuel subsidies and consequently poverty among lower income groups increases. Unless reform policies are able to deal with these problems in developing economies, subsidy reforms are less likely to succeed (del Granado, Coady and Gillingham, 2012). The problem is also compounded by the irregular nature of retail fuel prices in developing countries due mainly to the political aspect. Prices are not often adjusted downwards when there is a significant appreciation and/or a reduction in international crude oil prices. However, any slight depreciation and/or an increase in international crude oil prices is sufficient justification for the government and its agents to increase domestic retail fuel prices (Kojima, 2009). *This leads one to investigate the impact of the EMP index on this important macroeconomic variable – the third research question.*

2.7   The exchange rate and debt levels in SSA

Among other factors, the presence of external debt (denominated in foreign currency) may explain movements in the exchange rate and its impact on an economy. According to Devereux and Lane (2003) external financial liabilities have an important effect on desired bilateral exchange rate volatility for developing economies, above and beyond the standard optimal currency area (OCA) factors. Thus, exchange rate volatility

is negatively affected by the stock of external debt. For countries with low international reserves and access to the international capital market, the negative relationship between exchange rate volatility and the stock of external debt can greatly impact government resources. The effect on the financial sector and corporate balance sheets cannot also be overlooked. According to Asonuma (2016), emerging countries experience real exchange rate depreciations around default and this could occur alongside or as a result of the adoption of a floating exchange rate regime and the implementation of capital market liberalization by most developing economies (Sung, Park and Park, 2014).

The difference in short-term interest rates encourages the flow of speculative funds to the country with a higher short-term rate. This provides an incentive for foreign speculative investors to invest in the domestic market. A liberalized capital market will mean that these investors can easily repatriate their funds whenever they sense a risk or discover safer opportunities elsewhere. This act, on a sufficiently large scale, has the potential to magnify the effects of shocks on the economy and further increase exchange rate volatility (Barnhill et. al. 2004; Sung, Park and Park, 2014).

The Marshall-Lerner condition implies that an exchange rate depreciation can improve the current account balance and hence the balance of payments through an increase in net exports if the sum of demand elasticities for imports and exports is greater than one. Bahmani-Oskooee and Kara (2005) found that developing countries tend to have price elasticities of less than unity. In a situation where these developing countries have accumulated significant foreign currency denominated debt, currency depreciation might have an overall negative effect on the economy (Palić, Banić and Matić, 2018).

The 1997 Asian crisis and the 2008 financial crisis revealed that foreign capital flows and their effect on exchange rates play an important role in macroeconomic vulnerability. Thus, external borrowing in foreign currency was a major contributing element towards these crises. Studies by Eichengreen and Hausmann (1999) and Bordo et al. (2010) support this observation. In fact, as far back as the 1980s, Dornbusch (1984), in a study investigating the debt crisis in Latin America, found that the budget deficits that accommodate terms of trade deterioration and disequilibrium exchange rates are central to a complete explanation of the debt crisis. World crude oil prices, interest rates and world recession are often isolated as the chief causes of world debt crises. However, these factors may have only made the underlying disequilibrium more apparent, in a way that exchange rate overvaluation and/or budget deficits were perpetuated by excessive recourse to the world capital markets (Dornbusch, 1984; Combes and Saadi-Sedik, 2006).

Asonuma (2016), in studying sovereign defaults, external debt, and real exchange rate dynamics, found that low tradable goods shocks and a large share of foreign currency debt trigger defaults. The resulting output costs and loss of market access due to default lead to further real exchange rate depreciation. Devereux and Lane (2003), in examining bilateral exchange rate volatility, also found that for developing economies, external financial liabilities have an important effect on desired bilateral exchange rate volatility, above and beyond the standard optimal currency area factors.

2.7.1 Should developing economies worry about increasing debts?

Debt build-up does not necessarily match the transfer of resources from the lending partner to the borrower. In developing countries, part of the increased gross debt merely reflects capital flight and may not lead to a change in aggregate net foreign assets. This stems from the fact that the balance of payment account provides a link between the increase in gross external debt and the portfolio and spending decisions of the economy. From some perspectives, the increased gross debt reflects increased borrowing of the inflation component in nominal interest payments (Varga et. al. 2019). The transfer of these resources is also constrained by inflation (Combes and Saadi-Sedik, 2006).

A higher public debt is not problematic as long us a higher primary fiscal surplus can be generated to sustain it. The most important issue is whether the current debt exceeds an effective fiscal limit realized at any period, or not (Sung, Park and Park, 2014). Kraay and Nehru (2006) highlight the importance of periods in which countries resort to exceptional finance in any of these three forms – significant arrears on external debt, Paris Club debt rescheduling and non-concessional IMF lending. Fiscal limits in developing economies are relatively low (Bostan et. al. 2018). This is due in part to: a low effective tax rate (a combination of low taxes and smaller tax bases), which ultimately leads to lower revenues; weak governance indicators and corruption; and government expenditures growing faster than revenues, usually as a result of political pressures for a major capital formation program.

The deficits that arise from these deteriorations will have to be financed and, in most cases, governments prepare expenditure programs and then attempt to secure their financing from external sources when domestic sources are insufficient. This makes the financing of these deficits dependent on external borrowing. The availability of these external sources of funds can easily create a false sense of fiscal space that leads governments into developing an appetite for large fiscal deficits. The reality, however, is that these sources can be abruptly cut off when the seriousness of the deficits becomes

apparent to lenders (Klein, 1994; Colombo and Longoni, 2009; Barişik and Baris, 2017; Colombo and Longoni, 2009; Kaufmann et. al. 2007; Kim et. al. 2017; Imaginário and Guedes 2020).

The situation is further compounded by real exchange rate problems as indicated above. One of the reasons for this is the inability of developing countries to borrow (externally) in their own currencies. This, according to Eichengreen et. al. (2010), is due to the operation of international financial markets, which prevent countries from borrowing in their own currencies ('original sin'). This in turn leads to a currency mismatch on the country's balance sheet and causes serious macroeconomic and financial problems when the domestic currency depreciates relative to the foreign currency in which the external debt is issued. Whereas Ghana has adopted the Inflation Targeting (IT) framework, Kenya uses a stabilized arrangement. Many countries in Sub-Saharan Africa belong to belong to a monetary union (WAEMU and CEMAC) of some sort. Despite these different exchange rate arrangements, the choice is always going to be between allowing the exchange rate to float freely or not.

2.7.2 COVID-19 pandemic and its potential to cause a debt crisis

The COVID-19 pandemic is also an economic shock with similar or greater effects such as a low tradable goods shock. To put this in perspective, Altig et. al. (2020) in studying economic uncertainty concerning almost every aspect of the COVID-19 (implied stock market volatility, newspaper-based policy uncertainty, Twitter chatter about economic un-certainty, subjective uncertainty about business growth, forecaster disagreement about future GDP growth, and a model-based measure of macro uncertainty) pandemic noted the lack of close historic parallels of the economic impact of COVID-19 on countries and households. Sági, Chandler and Lentner (2020) cite the sudden decline in purchasing power of households alongside their climbing indebtedness as a threat to the outlook of businesses. Bearing in mind the job losses and contraction in output (GDP) on a quarter-to-quarter basis in developed economies, Altig et. al. (2020) stress the suddenness and enormity of the COVID-19 economic shock. For developing economies in Sub-Saharan African countries, the COVID-19 shock affected them more than developed countries (Arellano, Bai and Mihalache, 2020; Bolton et. al. 2020). Most Sub-Saharan African countries swiftly implemented national lockdowns to contain the virus and spare the region from the worst of the crisis. While this saved lives, it had a dramatic impact on local economies, affecting growth and adding to already high debt levels in Sub-Saharan Africa. Despite this, it appears that the impact on economic growth

has been contained for Ghana and Kenya. For Kenya, recent data indicate that output growth recovered from -5.5 percent in the second quarter of 2020 to -1.1 percent in the third quarter. For Ghana, output growth recovered from -3.2 percent in the second quarter of 2020 to -1.1 percent in the third quarter. Overall provisional growth figures for Ghana show a slightly positive growth of 0.9 propelled by the agricultural sector (i.e., the fisheries sub-sector). For Kenya, growth in 2020 was -0.1 percent. Both countries have had their fiscal and debt positions worsened, adding to difficulties (debt distress) that existed even before the COVID-19 shock (See Figure 2).

Figure 2: Growth and debt trends in Ghana and Kenya
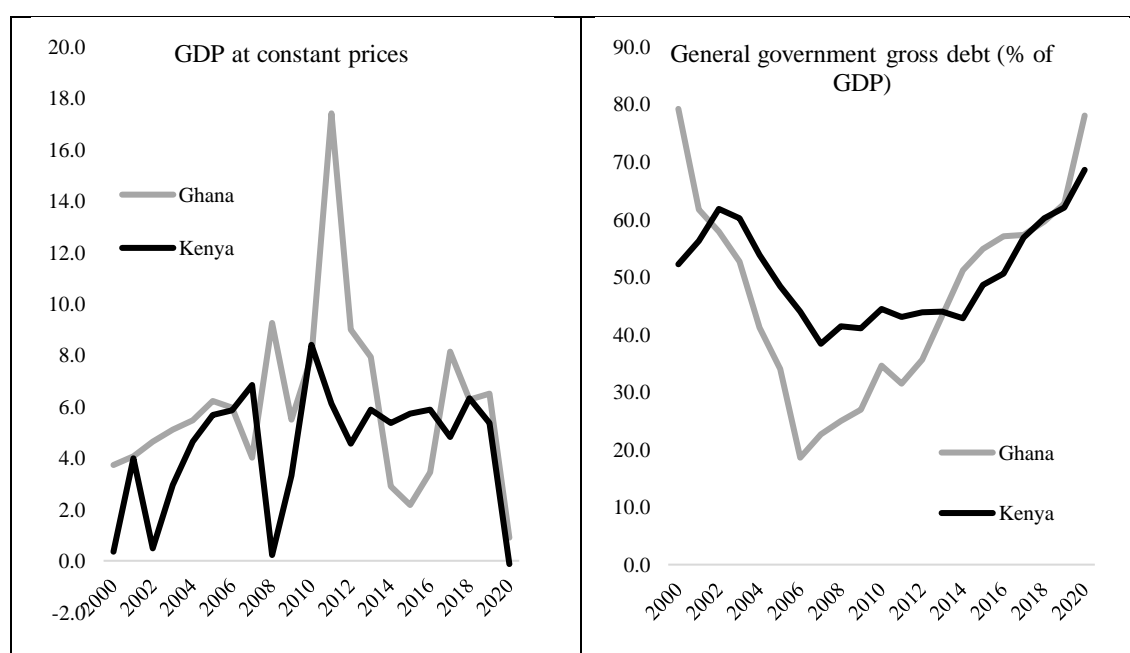
Source: Author's construction based on data from the IMF

2.7.3   The Ghana and Kenya case study

For Ghana and Kenya, the pandemic is likely to worsen their fiscal outlook and further plunge them into a debt crisis (Hevia and Neumeyer, 2020). El-Khishin and Mohieldin (2020) and Arellano, Bai and Mihalache (2020) stressed this fact when they studied external debt vulnerability in emerging markets and developing economies during the Covid-19 pandemic. According to them, emerging markets and developing economies are in a more troubled situation than they were during the global financial crisis and their current debt is under greater threat from debt architecture and volatile debt forms (primarily foreign currency-denominated bonds). According to the 2021 International Debt Statistics (IDS) by the World Bank Group, private creditors account for a relatively small share of external public debt for most countries in the world. However, for Ghana, private creditors account for 50 per cent of the external public debt which is denominated

in foreign currency (this figure is among the highest in Sub-Saharan Africa, second only to Cote d'Ivoire). In Kenya, private creditors account for 19 per cent of external public debt. The report goes further to state that countries will emerge from the COVID-19 crisis encumbered with a large debt that could take years to manage. El-Khishin and Mohieldin (2020) also warn of an excess demand for credit which, if not handled properly, could worsen their debt crisis, especially because most developing country debts have been denominated in foreign currencies. They advised developing countries to maintain stronger financial prudence in the circumstances of growing credit demand.

2.8   Conclusion

The observations of Pontines and Siregar (2008) and Bertoli et al. (2010) presents a gap in the literature which this study is seeking to fill. Previous literature on the subject have still not addressed the threshold problem identified by Pontines and Siregar (2008). Also, most studies did not dwell significantly on countries that have adopted the IT framework in SSA even though a significant addition to the original index by Girton and Ropper (1977) had been the interest rate variable which is very key in an IT framework. In other to fill this gap this study will adopt different versions of the EMP index and apply it to countries in SSA that have adopted the IT framework. By this, one seeks to address the first research question and its accompanying hypothesis.

Previous literature on the subject did not dwell significantly on the different monetary policy frameworks that exist in different countries. None, to the extent of my search have attempted to apply different estimates of the index to countries in SSA as a whole. In other to fill this gap this study will adopt different versions of the EMP index and apply it to countries in SSA considering also the different monetary policy frameworks that exist in the region. As noted above, interest rate is not the only operational monetary policy target in most developing countries, making it difficult to do a cross country analysis of all countries in SSA. The approach to be adopted by this study will mimic the approach used by Pontines and Siregar (2008) but will exclude the use of the index in making predictions – out of sample (See figure 3).

From the above literature it is also clear that the reserve-to-import, reserve-to-short-term external debt and the reserve-to-broad money supply ratios are all important in determining reserve adequacy which turn out to be an important component in identifying exchange market pressure as measured by the EMP index. The studies reviewed did not use a combination of these ratios in measuring exchange market pressure. The EMP index

developed by Girton and Roper (1977) only focused on the reserve-to-broad money supply ratio as was with other variations of the index that followed. However, the literature reviewed also showed that the sophistication of developing economies means that the other two ratios will have to be considered as well. To bridge the gap and also improve on the EMP index this study will consider the ratio of reserve-to-external debt and the ratio of reserves-to-imports ratio since the reserve variable has been found to play a very significant role in identifying EMP in SSA. The global experience also suggests that reserve levels may be a significant factor in helping to explain and predict currency crises (Fischer, 2001). Unlike Chong, He and Hinich (2008), this study will use these ratios to develop a new EMP index and also answer the second research question and its accompanying hypothesis.

In other to answer the third research question and sub-questions including its hypotheses, the literature reviewed shows that a country's ability to deal with a banking crisis effectively depends on whether it has the appropriate regulation and/ or whether it has the buffers to effectively bail out banks without disrupting the country's finances. Ghana did not have the buffers and the regulation needed to effectively handle a banking crisis if it manifested. These features make the crisis in Ghana unique in its own way. Studies on the banking crisis in Ghana is also lacking. In other to bridge the gap in the literature enumerated above, this study will examine the banking crisis in Ghana because of how recent it is and also its uniqueness in terms of the remedial actions taken to deal with the problem. Among other things this study will try to identify if the crisis in Ghana could have been detected earlier than 2017 and also by adopting the solution proffered by Chennells and Wingfield (2015), one will suggest solutions to future banking crisis in developing economies using Ghana as a case study. This will also be one of the first attempt to empirically examine the 2017-18 banking crisis in Ghana.

It is clear from the cited literature that the level of fuel price asymmetry is market specific. It is heavily dependent on effective monitoring and implementation of a good pricing mechanism. In countries that have this in place, retail prices of petrol or gasoline adjust to price increases or decreases at the same rate. Most studies have focused on countries that have deregulated their petroleum sub-sector to allow OMCs to set their own prices devoid of government interference. They mostly test asymmetry between the retail fuel prices and the international crude oil prices, eliminating the exchange rate effect in this regard. However, asymmetry can also be tested in situations where governments play a major role in setting retail prices of petroleum products and also based on the movement

of the US dollar exchange rate. This can test whether petroleum prices adjust more quickly to cost increases than to cost decreases. The current study examines the case of Ghana, Kenya, and Colombia, taking into consideration the fact that these countries – Ghana and Kenya – import more crude oil than they export.

Figure 3: Approach to estimating and testing a new measure of exchange market pressure
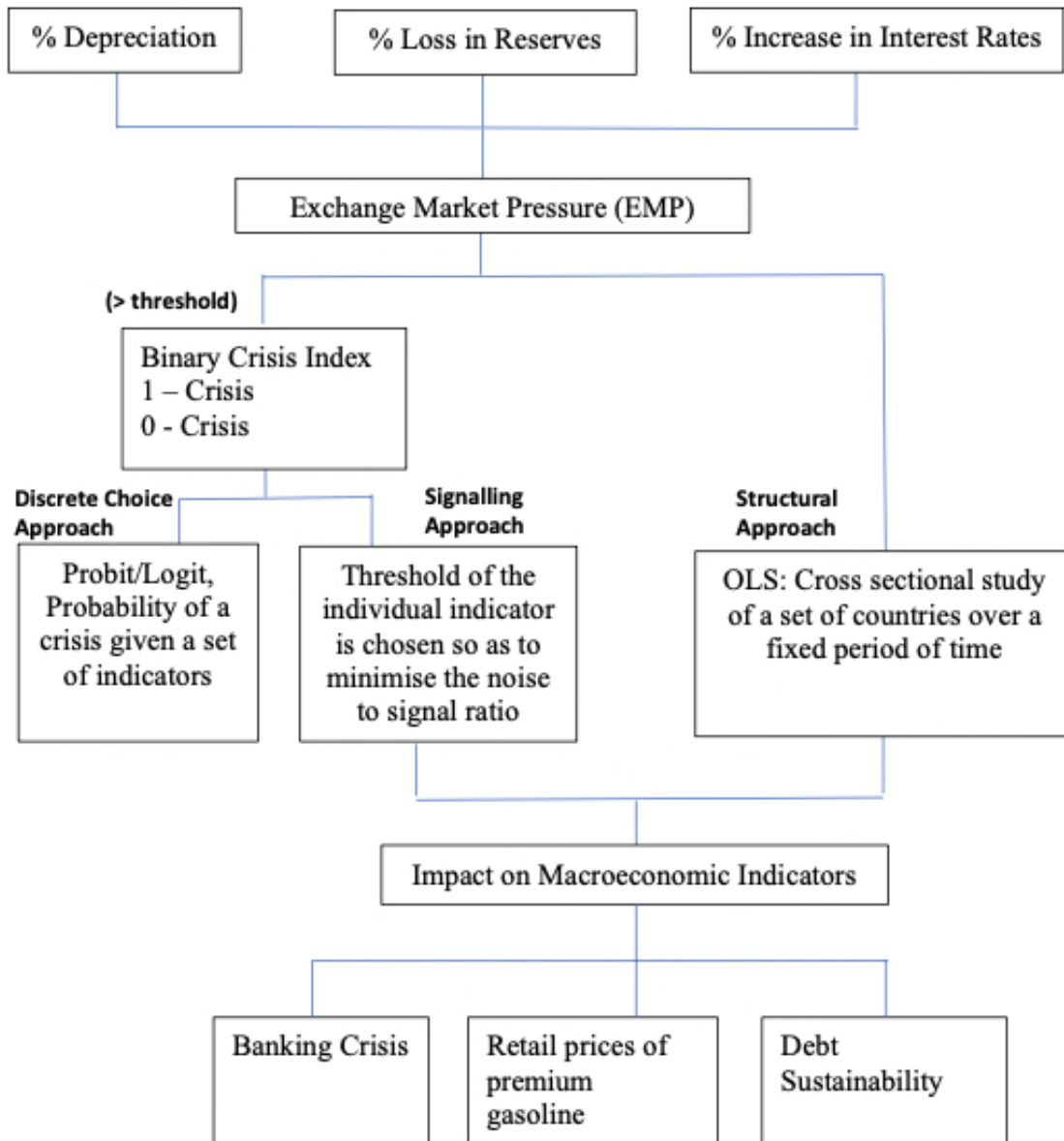
Source: Author's construction based on Pontines and Siregar (2008)

Ghana and Kenya are examples of developing countries with limited fiscal space (budgetary room to create and allocate funding for a certain purpose without prejudice to debt sustainability) and have had to ask for assistance externally to help them in dealing with the pandemic. In the wake of the crisis in 2020, most Sub-Saharan African countries relied to a greater extent on external funding from multilateral lenders (the International

Monetary Fund and the World Bank). This has contributed towards dropping to a record low in the average yield on emerging-market dollar bonds, according to Bloomberg's Barclays indexes. This will usually mean that the capital market is quite favourable for these countries for tapping into the Eurobond market for much-needed funds (Augustin et. al. 2021). This has also been occasioned by international investors hunting for yield to buy, not excluding domestic currency debt of emerging and developing economies. However, there could be constraints in market access in the longer term. Zambia, for example, missed a US$ 42.5 million coupon payment on one of its Eurobonds in November 2020, triggering a default after bondholders rejected Zambia's request for a six-month interest freeze so the country could restructure its debt. This implies that investors will likely pay even more attention to dynamics in other distressed countries within high-yield Sub-Saharan African countries. This situation also indicates that these countries will have to commit to a significant strengthening of their fiscal position to support the demand for a Eurobond issuance. A tighter condition in the Eurobond market could lead to lower output and a depreciation of the local currency (Henderson and Prinsloo, 2020). Faster consolidation could help solve the debt problem more quickly but, on the other hand, it could be more counterproductive in terms of reduced output (Stoian, 2010; Sung, Park and Park, 2014).

Dealing with COVID-19 in Sub-Saharan African countries will be especially daunting for the region's fragile health systems where the difficulty of preparing weak health systems for the outbreak could be compounded by reduced imports due to disruptions in global trade, giving rise to shortages of medical supplies and other goods and resulting in substantial price increases going forward.

Success in containing the virus comes at the price of slowing economic activity, irrespective of whether physical distancing and reduced mobility are voluntary or enforced. The more you implement stricter measures to deal with the pandemic, the more economic activities slow down and then ground to a halt. The only caveat to implementing a successful policy is if a country has enough fiscal or fiscal policy space to cushion those who will be affected by this shock. The absence of fiscal policy or fiscal policy space will mean a country's debt exceeds an effective fiscal limit realized in that period – a common characteristic of developing economies who according to Klein (1994) have very low fiscal limits – limited fiscal and fiscal policy space. Hills, Nguyen and Sab (2021), in studying the determinants of pre-pandemic demand for IMF's Concessional Financing, found that the external debt level, inflation, and real effective

exchange rate are the main economic variables influencing concessional borrowing for most eligible countries. Despite these undesirable effects, developing economies can efficiently use borrowing to stimulate aggregate demand and then growth (Panizza and Presbitero, 2014; Afonso and Alves, 2014).

The issue with debt build-up in these developing countries is further compounded by the fact that they have been at the centre of recent debt relief efforts such as the Highly-Indebted Poor Countries (HIPC) initiative (Kraay and Nehru, 2006; Asiedu, 2003). As a result, calls for debt forgiveness for debt distressed developing economies have not received much attention, even with the IMF's decision to make more Special Drawing Rights (SDRs) available to these countries. The appropriate question to ask is how these countries are going to service or reduce the debts they piled up in 2020 (15 per cent of GDP for Ghana and 6.6 per cent of GDP for Kenya) in response to the pandemic without hurting their economies. This has become more apparent as the COVID-19 pandemic is showing no sign of slowing down – according to the IMF, in July 2021, Sub-Saharan Africa faced a third wave with infections reaching more than 210,000 per week. Since the COVID-19 pandemic as decribed above qualifies as a negative terms of trade shock, we premise this study on the observation of Asonuma (2016), who found that low tradable goods shocks and a large share of foreign currency debt trigger debt defaults. Using Ghana and Kenya as examples, in the next section we investigate the debt dynamics of these countries and how the pandemic has impacted upon the debt sustainability of these countries whiles recognising the challenges of the DSA. This will allow us to recommend an appropriate policy option for these countries by drawing lessons from the HIPC initiative.

CHAPTER 3: DATA AND METHODOLOGY

3.1 Introduction

In this chapter, attention is paid to the area of study and the dynamics of the various themes discussed in the review of literature. The data sets for this thesis will also be introduced including their various sources. A justification for the data period will also be discussed before an attempt will be made on explaining the different regression models used for this thesis. Before determining this, this section makes an argument for the use of quantitative and deductive research method for this thesis as a branch of economics as a science. The addition to knowledge of this thesis which is dealing with the weighting and threshold problem in the application of the EMP index is effectively discussed. This section also discusses the methods used to introduce the two new variations of the EMP index in attempt to identify the best EMP index for SSA. The regression models used to estimate the effect of the EMP index on other macroeconomic variables is also discussed extensively.

3.2 Subject Area

In other to carry out an empirical analysis of the effects of different exchange rate choices, it is of course essential to have an appropriate classification of exchange rate regimes in Sub-Saharan Africa. The traditional method has been to rely on the IMF's Annual Report on Exchange Rate Arrangement and Restriction for this purpose. The publication reports the exchange rate regime each member country says it has adopted. As countries are under the obligation to inform the IMF of its choice – the approach is called the de jure approach (Ghosh et al. 2002).

An alternative has been proposed which has become known as the de facto approach (see Table 2), which attempts to classify countries according to what they actually practice rather than what they say they practice (de jure) – see Appendix Table 1. While in principle the de facto approach seems a superior way to classify exchange rate regimes compared to the de jure approach, the de facto approach is not easy to make operational (Ghosh et al. 2002). To this end this study will adopt the de jure approach in classifying exchange rate regimes in SSA – the choice of the approach will not affect the conclusions of this study.

Broad money appears as an intermediate target in most countries that target reserve money. While in principle this intermediate target is essential to monetary targeting, it can be bypassed in practice: not all money targetters look at broad money. Monetary

authorities in SSA include exchange rate stability as one of their policy objectives. This characteristic is not unique to SSA. There are concerns in most developing countries about the high pass-through of exchange rate fluctuations and how currency mismatches affect domestic balance sheets (Calvo and Reinhart, 2002).

Table 2: De Facto Monetary and Exchange Rate Regime (SSA)

FX Rate Arrangement No. of Countries	FX Anchor				Monetary Aggregate Target	IT	Other
	US$	Euro	Composite	Other			
No Separate Legal Tender							
Currency Board							
Conventional Peg							
Stabilized Arrangement	Angola	WAEMU[1], CEMAC[2]		Lesotho, Namibia	Tanzania, Malawi, Nigeria		Kenya
Crawling Peg			Botswana				
Craw like Arrangement					Burundi, Ethiopia, Rwanda		Mauritania
Other Managed Arrangement	Liberia, Zimbabwe				Congo, Democratic Republic of, The Gambia, Guinea, Sierra Leone		
Floating						Ghana, South Africa, Uganda	Mauritius, Mozambique, Zambia
Free Floating							Somalia

Source: IMF 2017

The theories underlying the estimation of the EMP index allows for all countries in SSA to be considered on the basis that they all have reserves that they can rely on to smoothen volatility in their currencies. For the purpose of this study we select thirty-two (32) countries in SSA (see Appendix Table 2) for which sufficiently long series of data are available in the IMF International Financial Statistics (IFS) for the variables used. Out of these 32 counties, 13 operate pegs, 15 use reserve money as their operational target

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[1] Benin, Burkina Faso, Côte D'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo
[2] Gabon, Cameroon, Central African Republic, Chad, the Republic of the Congo and Equatorial Guinea.

and two (2) have adopted the IT framework. The non-existence of a sufficiently long series of data can prove to be a limiting criterion (see Table 3).

Table 3: Composition of the EMP index, Study Area and Study Period

Variables	Monetary Framework	No. of Countries	Sample	Period
Fx & Res	All	44	31	2002M02 2015M06
Fx & Res	Pegs	23	13	2002M02 2015M06
Fx & Res	Reserve Money	18	16	2002M02 2015M06
Fx, Res & IR	IT	3	2	2002M02 2017M12
Fx, Res & RM	Reserve Money	18	3	2002M04 2017M02

Source: Author's construction

These classifications helped in deciding on the sample countries for the third objective which tried to measure the effect of the EMP index on other macroeconomic variables – retail gasoline prices, banking crisis and the changes in the gross debt to GDP.

Figure 4: Foreign reserves level of selected SSA countries in 2001 and 2017
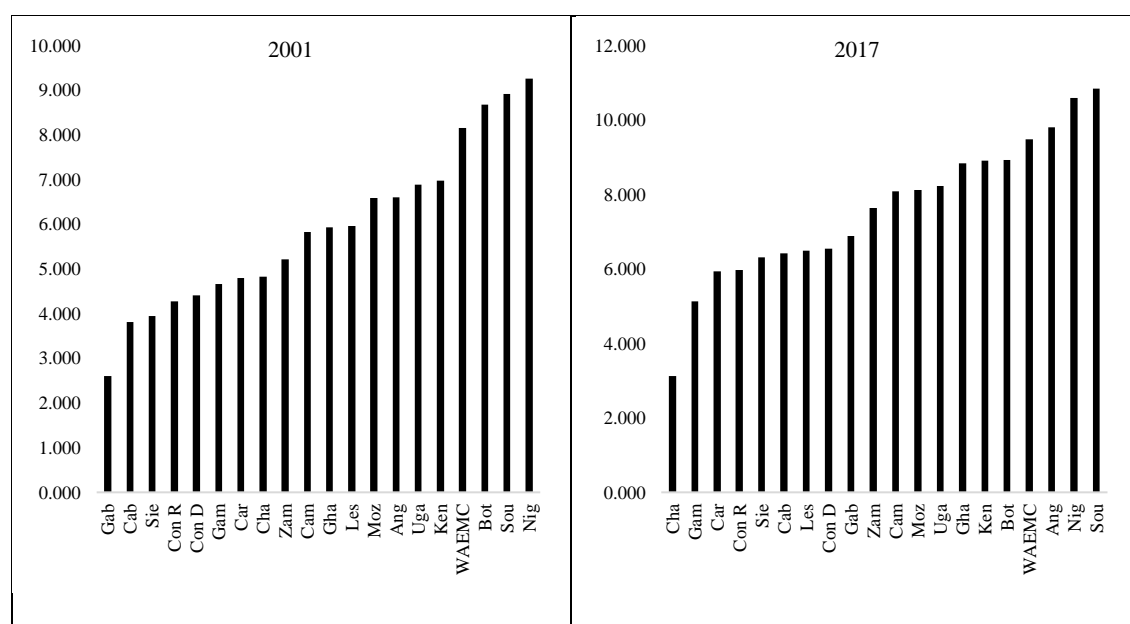
Source: Author's construction

SSA as a whole has reserve levels which are lower than their counterparts in the Middle East and North Africa, where reserves have served as a store of value in resource rich countries. Usually, the central banks of countries in SSA hold foreign reserves in trust for the government, making access to foreign exchange extremely controlled in most cases (Drummond–Dhasmana 2008). Among the sampled countries, Nigeria and South Africa had the highest foreign exchange reserves in 2001 and 2017 respectively. Gabon

and Chad had the lowest foreign reserves in 2001 and 2017 respectively (see figure 4 above).

3.2.1 Ex-Pump Price of Premium Gasoline in SSA - Ghana, Kenya and Colombia

Ghana and Kenya are all lower middle-income countries in Sub-Saharan Africa. As mentioned previously, both import more crude oil than they export, especially in terms of their share of crude oil receipts. As a result, these countries are expected to benefit/lose significantly when the price of crude oil falls/increases. On the other hand, Colombia is a middle-income country but also an oil producer with similar regulatory problems to Ghana and Kenya. The policy situations in the study countries in terms of how they have managed the retail crude oil/gasoline sub-sector are discussed below.

The governments of Kenya and Ghana, and to some extent Colombia, used to set the wholesale and retail prices of fuel with the main objective of ensuring low consumer pricing (subsidies). The tariff structure adopted by these countries aimed at the maximisation of government revenue and the subsidisation of kerosene. The argument was that low-income consumers had to be protected but the implementation of this tariff structure proved to be ineffective as it had no effect on the incomes of poor households. For these households, low incomes meant that there was no motivation to use more efficient fuels.

Between 1994 and 2005, Kenya deregulated their petroleum sub-sector. Oil marketers had the authority to import oil in crude or refined form. They adopted a pricing system that allowed them to set their own margins and consumer prices. The market was open to competition, which saw the entry of many small players but the government could not effectively monitor and control their operations on the ground due to lack of efficient licensing systems. As a result, there were increased cases of dumping, tax evasion, product adulteration, and substandard retail outlets (Mutero, 2017). In a bid to man-age this situation, the Kenyan Government introduced price regulation in the petroleum sector through the enactment of laws to tighten its control of the sector in 2006 (Mutero, 2017).

Prior to 2015, Ghana had also attempted to implement an automatic adjustment formula – to help deregulate the pricing of fuel or gasoline. However, this was not successful, mainly due to lack of political will to ensure pass-through when there were increases in the Brent crude oil prices. At the same time, the Government of Ghana signed a memorandum of understanding with OMCs and other distributors to import finished petroleum products through competitive tendering to supplement supply from the country's refinery (Tema Oil Refinery). The price at which these bulk distribution

companies (BDCs) supplied the economy with fuel was mostly different from the price at which the Government or the National Petroleum Authority (NPA) directed them to sell to the market. This led to price under- and over-recoveries – an under-recovery means that fuel consumers are paying too little for the product, whilst in an over-recovery situation, consumers are paying too much for that. Thus, the NPA sets prices that were lower than the supply contract price as per the NPA's supply contract formula. With under-recoveries, the government were indebted to the BDCs and vice versa if there were over-recoveries (IMF, 2015).

Figure 5: Ex-pump price of gasoline in study countries (US$/Lt) and EU Brent (US$/barrel)
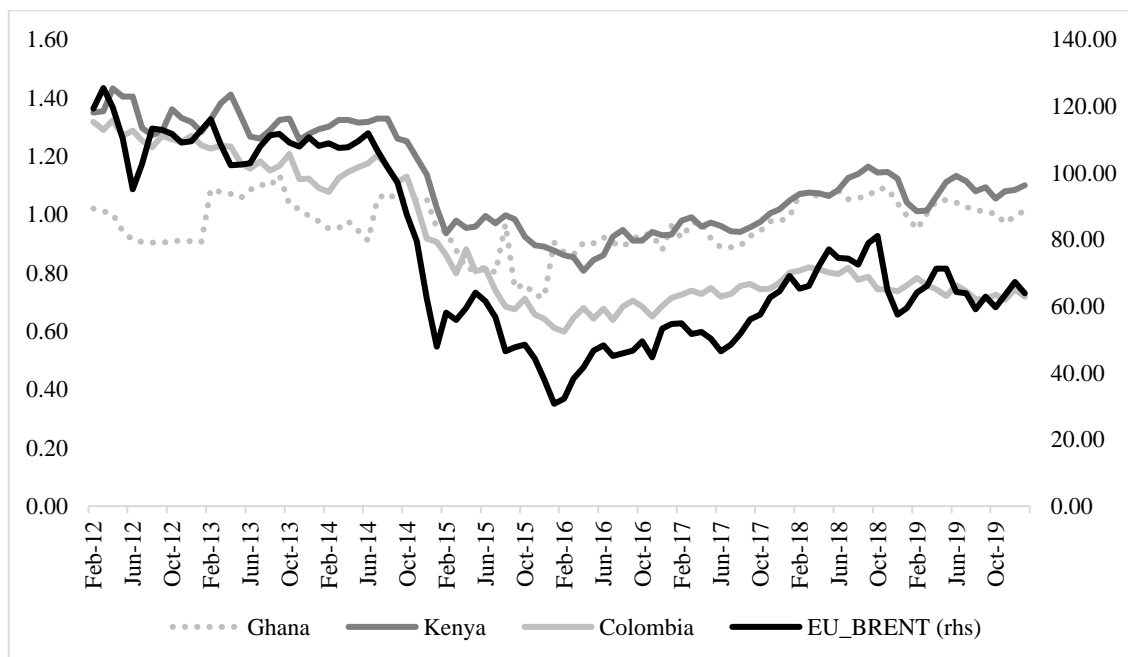
Source: NPA, Kenya National Bureau of Statistics, globalpetrolprices.com

An attempt by the Ghanaian Government to manage its Forex reserve also led to a new form of under-recovery known as foreign exchange (FX) loss under-recovery. This occurs when the FX rate used by the NPA or government in determining the ex-refinery price of retail fuel or gasoline is lower than the FX rate at which the NPA or government provide US dollars to the BDCs through the Bank of Ghana to pay for the imported or procured products. These and many factors brought about a huge debt in the sector that banks held as non-performing loans on their books. During these periods, compared to Kenya and Colombia, Ghana's ex-pump price of gasoline was the lowest. This was mainly due to low taxes and higher ex-refinery prices when Brent crude oil prices were falling in 2014 (see the figure 5 and the Appendix figure 2).

With a sharp fall in crude oil prices in 2014, Ghana seized an opportunity to deregulate the oil sub-sector. This paved the way for a successful implementation of the automatic adjustment formula. The Ghanaian Government argued that the deregulation would free scarce FX resources and government revenue for other development projects. In other words, the de-regulation of the petroleum downstream sector means removing government from control and regulation of petroleum downstream business.

In Colombia, gasoline and diesel have been explicitly or implicitly subsidised since 1983. Starting in 1998, the government had tried unsuccessfully to eliminate the fuel subsidy. In 2003, the government again attempted to gradually remove the subsidy. It based its decision on the fact that the subsidy was highly regressive and costly for the state. However, subsidies still exist, albeit at a lower level, and the last steps to eliminate them are proving difficult. Public opinion holds a very dim view of increases in fuel prices. Colombians do not understand why, despite its status as an oil producer and exporter, the country has the highest gasoline prices in Latin America behind Uruguay, Brazil, and Chile. Their obvious points of comparison are Venezuela and Ecuador, two countries with extremely low fuel prices and high government subsidies (Romero and Etter, 2013).

To avoid a re-occurrence of these situations (irregular implementation of subsidies and transparency fuel pricing), new formulas to calculate producer income regarding gasoline and diesel were implemented in Colombia in November 2011 and November 2012. While these formulas were also based on producers' opportunity costs, the way producers' income is set is more transparent compared to the past (Romero and Etter, 2013).

An interesting characteristic of a de-regularised petroleum market is that the products are similar, and the supplier costs structures are alike under a cooperative distribution system and with prices and margins set on an industry-wide basis (Liu et. al. 2010).

As noted in the Appendix, taxes and levies make up a significant portion of retail fuel prices in Ghana and any changes in government taxes and levies can therefore have a significant impact on retail diesel and petrol prices (Liu et. al. 2010). Through the deregulation that the country implemented, the Parliament of Ghana continues to determine petroleum taxes and levies by the issuance of an Act of Parliament. Rietveld and van Woudenberg (2005) refer to the differences in taxes as the reason why fuel prices differ from one country to the other.

3.3   Data

Data will be sourced from the IMF's International Financial Statistics (IFS) and the World Bank's World Bank's international debt statistics. The IFS is one of the IMF's principal datasets and has been available since 1948. It contains country data for most Fund members and even some non-sovereign territorial entities. It is a secondary data source.

To determine which country to include, we begin with all the SSA countries in the IMF's International Financial Statistics (IFS) database. Countries had to be eliminated because their data series were missing or mostly incomplete. This left me with a number of countries ranging from a maximum of 32 to a minimum of 2 depending on the specification of the regression and the monetary policy framework as shown in Appendix Table 2 above. In identifying crisis periods in SSA, the analysis is limited to two (2) countries – Ghana and South Africa – who according to the IMF's annual report on exchange arrangements and exchange restrictions 2019, were found to be using the IT framework for monetary policy thereby expected to adopt a floating exchange rate regime. This classification by the IMF is the de facto classification of exchange rate arrangements, as of April 30, 2019, and monetary policy frameworks. This classification may differ from what the countries officially announces as its exchange rate and monetary policy arrangement – thus market determination against official action.

For the second objective the sample was reduced to 26 out of a possible 45 due to availability of a comprehensive data set for the period – especially data on short-term external debt (see Appendix Table 3). Data for this objective was taken from both the IMF's International Financial Statistics (IFS) and the World Bank's international debt statistics. The data is in this case is an annual data which spans from the year 2002 to 2017. One had to settle on this study period mainly due to availability of a comprehensive data set for the period – especially data on short-term external debt. Short-term debt includes all debt having a remaining maturity of one year or less and interest in arrears on long-term debt. Total external debt is debt owed to non-residents repayable in currency, goods, or services. According to the IMF it is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt.

The variables for this objective also include the exchange rate variable, imports of goods and services, broad money, reserves and short-term external debt. The exchange rate data used were the end of period national currency per the US dollar for all countries.

The US dollar exchange rate was used because it is the biggest trading currency and also it is the currency of choice for most countries in SSA. All variables were converted to US dollar for consistency in the data since all the countries employ different currencies.

Due to the dynamic nature of countries in Sub-Saharan Africa (SSA), they became the region of choice for this study. Most of the countries in SSA are mainly commodity exporters, they also do not have developed capital markets compared to other regions of the world. Despite these characteristics, SSA countries have also benefited from the Heavily Indebted Poor Countries (HIPC) and the Multilateral Debt Relief Initiatives (MDRI) from the early 2000s. The only limitation to the selection of the 25 was the problem of data availability which did not or existed in part for the other twenty (20) countries not selected. Kenya, Mozambique and Zambia have no explicitly stated nominal anchor, but rather monitor various indicators in conducting monetary policy. Kenya, Nigeria and the Democratic Republic of Congo maintain a de facto exchange rate anchor to the US dollar. Kenya and Mozambique have taken preliminary steps toward inflation targeting. Though not sampled, Somalia is the only country without a monetary policy framework (IMF, 2017). Out of these 26 countries, eight (8) did not take part in the HIPC initiative with the remaining seventeen (17) reaching completion point in the process.

Most of the countries in SSA practice different monetary and exchange rate regime. These characteristics doesn't appear to have a significant effect on the importance of the reserve variable. As noted by Antal and Gereben (2011), countries with fixed exchange rate regimes use foreign exchange reserves to support daily operation, as it is necessary in order to maintain the exchange rate at its target. Countries with clean, floating exchange rate regimes uphold the possibility of intervention in the exchange rate market if required by extraordinary market circumstances, ensuring the liquidity and continuous operation of the foreign exchange market. In SSA, it appears there is always an extraordinary market circumstance warranting the need for exchange rate intervention (Antal and Gereben, 2011).

In SSA, countries with well-developed government bond markets, such as Ghana, Kenya, and South Africa, rely mainly on domestic bond issuance to finance budget deficits – with some of the financing coming from non-resident investors (IMF, 2013). The ability to attract new external funding from commercial sources to finance increased deficits is limited for most countries in SSA, except in the case of specific project finance. However, with the timing of project financing likely to be closely linked to project needs, rather than to budget financing needs, countries can only rely on bilateral and multilateral

loans during downturns. The ability of countries to raise additional financing from domestic sources has also become a function of both the depth of their domestic financial systems and the current role of the public sector in the use of domestic credit. In countries characterized by significant financial deepening and the lack of fiscal dominance in access to credit, governments are well positioned to tap credit markets for additional funding in a downturn.

Table 4: Variables and their Data Sources

Variables	Source	Time Period
Exchange Rates	IFS	1990 2020
Financial, Interest Rates, Monetary Policy-Related Interest Rate	IFS	2002 2020
International Reserves, Official Reserve Assets	IFS	1990 2019
Monetary, Broad Money	IFS	1990 2019
Monetary, Reserve Money	IFS	2002 2019
Total Reserves, US Dollars (Gold at Market Price)	IFS	1990 2019
Imports of Goods and Services	IFS	2002 2019
Short-Term External Debt	WB	2002 2019
GLCD	FSI	2008 2019
FCDLTG	FSI	2008 2019
ROA	FSI	2008 2019
ROE	FSI	2008 2019
Brent crude prices	EIA	2012 2019
Ex-pump price of fuel or gasoline	GPP	2012 2019
Gross domestic product, constant prices	WEO	2000 2020
Inflation, end of period consumer prices	WEO	2001 2020
General government primary net lending/borrowing	WEO	2002 2020
General government gross debt; public and publicly guaranteed	WEO	2003 2020
External debt stocks, public and publicly guaranteed	WB	2004 2020
Portfolio investment, liabilities	IFS	2005 2020
Current account (excludes reserves and related items)	IFS	2006 2020
Interest payments	WB	2007 2020

Source: IMF and Author's Compilation

Note: *IFS – International Finance Statistics; WB – World Bank; FSI – Financial Soundness Indicators; EIA – Energy Information Administration; GPP - globalpetrolprices.com; WEO – World Economic Outlook.*

The utilization of this existing secondary data provides a viable option due to limited time and resources. One seeks to perform a secondary analysis as a systematic method with procedural and evaluative steps, deduced from the research hypothesis stated

above and the identification of the dataset, and thorough evaluation the dataset (Johnston, 2017). The data sources and their variables are shown in Table 4 above.

For the third objective, the EMP index is used in addition to other bank specific variables to find their relationship with Non-Performing Loans (NPL) variable. Bearing in mind that the Ghanaian banking sector was characterized by understated exposures and the use of suspicious and non-existent capital, this study is mindful of the accuracy of the data been employed. The data used were sourced from both local (BoG) and international (IMFs Financial Soundness Indicators, 2019) secondary sources. This was done to verify and ensure that the data used are accurate and consistent. The study period spans the 2008Q1 to 2019Q2. The data represents data for the banking sector as a whole and is not broken down into individual banks as used in other studies. The sample period represents periods for which data was available in the IMFs Financial Soundness Indicator's data base.

Data for the impact of the EMP index on retail petrol prices, was sourced from the IMF's International Financial Statistics (IFS), Kenya National Bureau of Statistics and the globalpetrolprices.com. They track retail prices of motor fuel, electricity, and natural gas in over 150 countries. Each data point is cross-checked using multiple sources and without automation. For instance, the ex-pump price of fuel in Ghana was determined using data from the NPA and OMCs (total and allied); the NPA stopped providing data on monthly fuel prices since the sector was de-regulated in 2015. The data used for the analysis spans from February 2012 to December 2019. Data availability was one of the limiting criteria in deciding on the sampled countries – Ghana, Kenya and Colombia as a control study control.

The data for the impact of the exchange rate variable on the debt sustainability of Ghana and Kenya were sourced from the World Bank's development indicators and the International Monetary Fund's (IMFs) world economic outlook database. In addition to these, the Reuters investment data platform provided measures of riskiness in terms of the country's access to the capital markets. Besides these, the authors derived data from the individual country's ministry of finance database and reports to make up for the lack of data on the international data platforms. The data is annual data that spans from the year 2000 to 2020. The choice of the sample period was determined mainly because of the availability of data which did not exist for some of the variables outside these periods. Based on these datasets, this study employs the market-access country (MAC) debt

sustainability analysis (DSA) framework, to capture the debt dynamics of Ghana and Kenya.

3.4   Method of Data Analysis

This study seeks to combine economic theory with actual measurements using the theory and technique of statistical inference, making it unavoidable for econometric research to be employed. It is an attempt to supply a theoretical foundation for the analysis of theory (exchange market pressure) through statistical inference (Haavelmo, 1944).

Hendry (1980), defines econometrics as having its main objectives as the advancement of economic theory in its relation to statistics and mathematics. This study in trying to explain how policy authorities react to pressure on their domestic currencies, estimates an Exchange Market Pressure Index (EMP) which tries to capture periods were policy authorities feel it cannot tolerate further depreciation (crisis points) and tries to prevent it. By this one will analyse the relationship between economic variables – exchange rate, international reserves, interest rates and reserve money – by abstracting the main phenomena of pressure on a domestic currency in SSA and stating theories thereof in mathematical form. To do this, one will study the properties of data generation processes, techniques for analysing economic data, methods of estimating numerical magnitudes of parameters with unknown values, and procedures for testing economic hypothesis (Hendry, 1980).

The need for quantitative empirical knowledge to answer questions involving change in economic variables has adequately been made known by Schumpeter (1933) and other economists. With Schumpeter (1933) arguing that economics is really the most quantitative of all the sciences. Despite its obvious potential, Hendry (1980) makes the point that econometrics has not had an easy time from many who have made major contributions to the development of economics such as Keynes, Warewik, Brown, Leontief, Koopmans, Stone and etc

Currency crisis have been traditionally viewed as a retribution for governments that have mismanaged the economy or lack credibility. Most first-generation models broadly answer to this description. Recent crisis has questioned this view. Thus, most crisis economies enjoyed government surpluses and increasing foreign exchange reserves as well as low unemployment and booming exports (Aghion, Bacchetta and Banerjee, 2001).

As mentioned earlier, since the late nineteenth century, most economies

experimented – with the exception of Germany and perhaps Japan – and are still experimenting with monetary policy regimes. The regimes include the use of 'pragmatic monetarism' – the way in which monetary aggregates enter the operating procedures – and Inflation Targeting (Benati and Goodhart, 2010). The appropriateness of these two monetary policy rules is still a subject of debate among economists. von Thadden (2012), makes this point more forcefully in his study of monetary policy rule in an OLG with non-superneutral money. The point here is that monetary policy is specified through money stock and/or nominal interest rate (von Thadden, 2012).

Lucas (1976) criticised econometric models that were used for policy evaluation – more because he brought the invariance problem more forcibly to economist (Hoover, 1994). His argument was that shifts in economic policy, changes how policy affects the economy because agents in the economy are forward rather than backward-looking and adapt their expectations and behaviour to the new policy stance. Thus, past behaviour can be a poor guide for assessing the effects of policy actions. He concludes that reduced form econometric models cannot provide useful information about the actual consequences of alternative policies because the structure of the economy will change when policy changes, rendering the estimated parameters in reduced-form econometric models non-constant (Lindé, 2001). This can be thought of as denying that econometric models typically capture the true causal structure of the economy and also denying that models are identified in the econometricians usual sense (Hoover, 1994).

This led to the real business cycle (equilibrium business cycle) approach, where the models used for policy analysis are less susceptible to the Lucas Critique in that they are equilibrium models with forward looking properties e. g. Lucas (1975,1977) and Kydland and Prescott (1982). Many economists still favour backward-looking models. In recent times, backward-looking models have become prominent in monetary policy analysis. Works of Svensson (1997), Rudebusch and Svensson (1999), Taylor (1999) and Clarida, Gali and Gertler (2000) support this assertion.

Some economists still maintain that backward-looking behaviour seem to be a better approximation of reality in macroeconomic models than forward-looking behaviour. Estrella and Fuhrer (2003), argue that the Lucas critique is a testable hypothesis. They provide evidence that when there is a change in monetary policy regimes, some forward-looking models may be less stable than their better fitting backward-looking models.

Rudebusch (2005), in studying the behaviour of US monetary policymakers, acknowledged that their behaviour has changed over the past few decades. He discovered for that same period that statistical analysis of lagged representations of the economy such as VARs have not rejected the null of structural stability.

The Lucas Critique should be particularly relevant for monetary policy analysis. Thus, most studies that have tested Lucas Critique have done so by studying the reaction function of monetary authorities. Given the apparent policy shifts over time the Lucas Critique will suggest that lagged autoregressive models will be plagued by parameter instability and will make a poor choice for analysing monetary policy. Empirical autoregressive macroeconomics models without explicit expectations are still widely used for monetary policy analysis. The most prominent examples are the VARs in which lagged representations of the economy are treated as invariant structural models (Leeper and Zha, 2001). Leeper and Zha (2001), concludes that autoregressive models are relatively insensitive to significant changes in policy rule. However, Hoover (1994), proposes that a change in policy causes a change in the economy if the policy change can be used to control that aspect of the economy. This assertion he backs by using the example of a bond trader who is directly interested in the Federal Reserves (FED) policy but generally discounts the institutional structure of the FED.

The point here is that theoretical models are necessary tools in our attempt to understand and explain events in real life – a simple description and classification of real phenomena would probably not be possible or feasible without viewing reality through the framework of some scheme conceived a priori (Haavelmo, 1944). This is to limit one from speculating as the results of our theoretical (how policy authorities respond to currency pressure or exchange rate crisis) considerations are to be compared with some real phenomena (crisis episodes). "The problem is not to decide how the world must be to agree with theoretical principles but to describe how it is in fact" (Hoover, 1994).

The study of theory and facts will not be in a broad sense – one is concerned with a class of economic theories where the theoretical model consists of a system of equations (ordinary or functional) – equations between economic variables. The focus is always on a combination of definitional identities, technical relations and relations describing economic action. Technical relations refer to technical production functions and other natural or institutional restrictions which are usually taken as data in economic planning. This study will focus on the third group which are relations describing the behaviour of

individuals or collective units in their economic activity, their decision to produce and consume. In this case the variables can be adjusted into hypothetical relations to a set of economic variables.

We know that the decision to defend a currency depend on a number of factors some of which cannot be expressed in quantitative terms. Economists are divided on the concept of cause and also which concepts are appropriate for any circumstance or situation (Hoover, 1994). In other to deal with this issue, this study will try to measure the reaction function of monetary policy authorities as an attempt to approximate their decisions by means of certain parameters – bearing in mind that other studies did not consider this in developing the EMP index.

The exchange market pressure index will be used to signal a break up of an exchange rate crisis. The index, which was first, introduced by Girton and Roper (1977) is a simple average of exchange rate changes and a foreign reserve depletion indicator. When the index passes over a threshold, excess pressure is flagged and a binary variable representing a crisis takes on a value of one for that period. The index captures both depreciation and the type of pressure on a currency – as would happen in the presence of depreciation expectation – which is often softened or diverted through monetary authority interventions and does not normally show in the nominal exchange rate dynamics.

3.4.1 The Models

This will be done by modifying equation (1) to capture the different monetary policy frameworks and exchange rate regimes in SSA. First, we estimate a measure that only deals with changes in the exchange rate and the reserve losses. Secondly, I will estimate the EMP index to includes the money variable to capture the policy reaction of the eighteen (18) SSA countries that use money targets as their policy framework. Finally, I will estimate another measure that includes the interest rate differential to capture the three (3) SSA countries that have adopted the IT frame work. In addition, the study considers also other variations of the index as estimated by Hossfeld and Pramor (2018). The index in an enhanced or more recent form is expressed algebraically as the following:

$$EMP_t = \frac{1}{\sigma_{\Delta e}}(e_t - e_{t-1}) - \frac{1}{\sigma_{\Delta res}}\frac{\Delta RES_t}{Money_{t-1}} + \frac{1}{\sigma_{\Delta r}}\Delta(r_t - r_t^{us}) \qquad (1)$$

Where $e_t - e_{t-1}$ is the monthly changes in the nominal exchange rate – local currency per US \$. $\frac{\Delta RES_t}{Money_{t-1}}$ are the monthly reserve losses (changes in RES, scaled by a measure of the narrow money supply) and $\Delta(r_t - r_t^{us})$ is the changes in the short-term

interest-rate differential against that of the United States. As is standard in the literature, each component is normalized by its own standard deviation so that the most volatile part does not dominate the index ($\frac{1}{\sigma_{\Delta e}}$, $\frac{1}{\sigma_{\Delta res}}$ and $\frac{1}{\sigma_{\Delta r}}$).

The original index as developed by Girton and Roper (1977) explained both exchange rate movements and official intervention. It was developed to hold for all exchange rate regimes. Their version of the index is shown in equation 2 below.

$$EMP_t = \frac{e_t - e_{t-1}}{e_{et-1}} - \frac{RES_1 - RES_{t-1}}{Mon_{t-1}} \qquad (2)$$

Using the traditional approach to the balance of payments, Girton and Ropper (1977) postulated that the relationship between the trade and capital accounts contained an implicit monetary condition. The caveat however is that the condition would not hold if money supply and demand functions are developed explicitly. In an attempt to measure monetary independence, unlike in equation (1), we look at the degree to which alterations in the domestic source of monetary base lead to changes in the demand for domestic base and thereby the total quantity outstanding. Thus, the most obvious way that domestic monetary authorities can offset the demand for their liabilities is by changing reserve requirements. This relationship is captured in equation (2) by adjusting broad money for reserve requirement changes. A monetary authority will be judged to be independent if it has the ability to change this adjusted base.

An exchange rate might at times be allowed to depreciate or a central bank might intervene. This will be captured by changes in the EMP components. If the exchange rate dominates during certain periods then it highlights a less active central bank (Hegerty, 2018). Exchange market pressure index with high positive values are associated to pressure on the domestic currency as a combination of a nominal depreciation, a widening of the interest rate spread or a loss of foreign reserves (Bertoli et al. 2010).

Other studies have proposed different estimation of the EMP index. Most notable are the models by Sachs, Tornell, and Velasco (1996), Eichengreen et al. (1994, 1996), Kaminsky and Reinhart (1999), Stavarek (2010), (Hegerty, 2018) and Hossfeld and Pramor, (2018). The most commonly used among these is the model used by (Hegerty, 2018), which was based on Eichengreen et al. (1994, 1996), a variation of which is shown in equation (1) above. Eichengreen et al. (1994, 1996) includes money stock or monetary base in his estimation of the EMP index but as a ratio of foreign reserves. Sachs et al. (1996) and Kaminsky and Reinhart (1999) did not include the money variable in their

estimation of the EMP index. Hossfeld and Pramor (2018) on the other hand considered various versions of the EMP index and chose the best one for their analysis. The best index in their case was the EMP index based on just the changes in the exchange rate and international reserves as specified in equation (3) below. The different variations of the index are shown below:

$$EMP_t = \frac{e_t - e_{t-1}}{e_{et-1}} - \frac{RES_1 - RES_{t-1}}{RES_{t-1}} \qquad (3)$$

$$EMP_t = \frac{e_t - e_{t-1}}{e_{et-1}} - \frac{RES_1 - RES_{t-1}}{Mon_{t-1}} + \frac{r_t - r_{t-1}}{r_{t-1}} \qquad (4)$$

$$EMP_t = \frac{1}{\sigma_{\Delta e}} (e_t - e_{t-1}) - \frac{1}{\sigma_{\Delta res}} (RES_t - RES_{t-1}) \qquad (5)$$

$$EMP_t = \frac{1}{\sigma_{\Delta e}} (e_t - e_{t-1}) - \frac{1}{\sigma_{\Delta res}} (RES_t - RES_{t-1}) + \frac{1}{\sigma_{\Delta Mon}} \Delta(Mon_t - Mon_{t-1}) \qquad (6)$$

These equations will be tested against changes in the exchange rate to identify which one of them is good at explaining it. *This is primarily going to lead one to answer the first research question and its hypothesis posed by this study*. Since the indexes where derived using the exchange rate variable, multicollinearity among the various indexes cannot easily be assumed away – in fact multicollinearity were identified and were dealt with the use of a Ridge Regression model and a Dynamic Ordinary Least Square (DOLS) model regression estimation which were used to test for the explanatory effect of these indexes on the changes in the exchange rate variable (see Appendix Table 4). It is worth noting that the multicollinearity was not identified in all cases.

In order to test theory against facts, or to use it for prediction, either the statistical observations available have to be corrected or the theory itself has to be adjusted so as to make the facts we consider the 'true' variable relevant to the theory. This is due to the fact that theories are often compared with data which cannot at all be considered as observations obtained by following the design of experiment one had in mind when constructing the theory (Haavelmo, 1944). Hoover (1994), notes this as the root of the problem in relating theory to reality. The problem according to him becomes worse in the presence of random shocks to the functions.

Mill (2008), re-echoed this concern when explaining the difference that exist in the application of scientific method. He stressed on the difference between theory and practice or experience. He described practice or experience as a scientific method that is inductive in nature and described theory as being a mixed method of induction and ratiocination (a priori). The method of practice or experience he stressed requires as the

basis of its conclusion – not mere experience – but specific experience. This he acknowledged is difficult to do.

Studies in exchange rate as an abstract science has its methods as the method of a priori. Mills (2008), ascribes this definition to political science which he defines as the science that traces the laws of such of the phenomena of society as arising from the combined operations of mankind for the production of wealth. Its reasons must not necessarily reason from facts but it is proper that what is assumed in every particular case must be brought to bear in its fullest by being formally stated as a general theory (Mill, 2008). By using the method of a priori – reasoning from an assumed hypothesis, inference will be made from estimating the EMP index with reference to how policy authorities react to EMP – making the study deductive in nature.

3.4.1.1 *Dealing with multicollinearity in the choice of an appropriate index*

This study employed the use of a ridge regression model to deal with the multicollinearity problem. The ridge regression is a technique for analysing multiple regression data that suffer from multicollinearity. It was the only option left after other methods of dealing with the problem were explored. The assumptions underpinning the ridge regression are the same as those used in regular multiple regression: linearity, constant variance (no outliers), and independence. Since ridge regression does not provide confidence limits, normality need not be assumed (Marquardt and Snee, 1975).

The different variations of the index are regressed on the changes in the exchange rate variable considering the various monetary policy frameworks in SSA. The derivation of the ridge estimate is based on the fact that OLS regression coefficients are estimated by the following:

$$\hat{\underline{B}} = (EMP'EMP)^{-1}EMP'\underline{DFX} \tag{7}$$

The expected value of the estimates are the population values if the estimates are unbiased. That is,

$$E(\hat{\underline{B}}) = \underline{B} \tag{8}$$

The variance-covariance matrix of the estimates is given by,

$$V(\hat{\underline{B}}) = \sigma^2 R^{-1} \tag{9}$$

Since the variables are standardized the $EMP'EMP = R$ where R is the correlation matrix of the independent variables. Also $\sigma^2 = 1$. Therefore

$$V\left(\widehat{b}_j\right) = r^{jj} = \frac{1}{1-R_j^2} \tag{10}$$

Were R_j^2 is the R-squared value obtained from regressing EMP_j on the other independent variables. Here the variance is the same as the Variance Inflation Factor (VIF). As the R-squared gets closer to one, the VIF will get larger. The rule of thumb cut-off value for VIF is 10. Solving backwards, this translates into an R-squared value of 0.90. Hence, whenever the R-squared value between one independent variable and the rest is greater than or equal to 0.90, you will have to face multicollinearity.

Now, ridge regression proceeds by adding a small value, λ, to the diagonal elements of the correlation matrix. (This is where ridge regression gets its name since the diagonal of ones in the correlation matrix may be thought of as a ridge.) That is,

$$\underline{\widetilde{B}} = (R+\lambda I)^{-1} EMP'\underline{DFX} \tag{11}$$

λ is a positive and in most cases less than one. The amount of bias in this estimator is given by

$$E(\underline{\widetilde{B}}-\underline{B}) = \left[(EMP'EMP+\lambda I)^{-1} EMP'EMP-I \right] \underline{B} \tag{12}$$

Its correspondent covariance matrix is given by

$$V\left(\underline{\widetilde{B}}\right) = (EMP'EMP+\lambda I)^{-1} EMP'EMP \left((EMP'EMP+\lambda I)^{-1} \right) \tag{13}$$

It can be shown that there exists a value of λ for which the mean squared error (the variance plus the bias squared) of the ridge estimator is less than that of the least square's estimator (Marquardt and Snee, 1975). Unfortunately at the time of the thesis, the appropriate value of λ depends on knowing the true regression coefficients (which are being estimated) and an analytic solution had not been found that guarantees the optimality of the ridge solution. Therefore the choice of λ is left to the discretion of the researcher. However, In the latest version of the Eviews software the Lasso Regression has now been introduced which automatically determines the λ value.

After dealing with multicollinearity and selecting the appropriate EMP index to use for the rest of the analysis, I employed the use of a discrete threshold regression model to help identify crisis episodes in both South Africa and Ghana. This is going to help deal with the threshold problem pointed out by Pontines and Siregar (2008) in the literature reviewed above. The threshold regression model is a non-linear time series model with the local regimes switching. In this case the coefficients are constant in each regime but

could change between regimes. The switching from one regime to the other is triggered by specific observed data series. Thus, the main goal is to find a value of values of the data series that triggered the regime change – exchange rate crisis. The assumptions underlining this model is similar to Hansen (2000) and Bai and Perron (2003).

Using a standard multiple linear regression model with T observations and m potential thresholds – producing $m + 1$ regimes. The linear regression specification for the observations in regime $j = 0, 1, \ldots, m$ is given by the equation below.

$$y_t = X_t'\beta + Z_t'\delta_j + \epsilon_t \tag{14}$$

The X variables are those whose parameters do not vary across regimes, while the Z variables have coefficients that are regime-specific. Assuming that q_t is the observable threshold variable and strictly increasing threshold values such that we are in regime j if the values of the threshold variable is at least as large as the j-th threshold value but not as large as the $(j + 1)$-th threshold. For instance, in the single threshold two regime model we have:

$$y_t = X_t'\beta + \sum_{j=0}^{m} 1_j(q_t, \gamma) * Z_t'\delta_j + \epsilon_t \tag{15}$$

Where y_t is a single threshold, two regime model using an indicator function $1(.)$ Which takes the value 1 if the expression $-\infty < q_t < \gamma_1$ and $\gamma_1 \leq q_t < \infty$ is true for the two regimes and 0 otherwise. The two models are combined into a single equation as shown in the expression above. The identity of the threshold variable q_t and the regressors X_t and Z_t will determine the type of TR specification.

The resulting non-linear least squares equation as defined by the sum-of-squares objective function shown below.

$$S(\delta, \beta, \gamma) = \sum_{t=1}^{T} \left(y_t - X_t'\beta - \sum_{j=0}^{m} 1_j(q_t, \gamma) * Z_t'\delta_j \right)^2 \tag{16}$$

Threshold regression estimates can be obtained by minimizing $S(\delta, \beta, \gamma)$ with respect to the parameters. In essence, threshold regressions can be thought of as breakpoint least squares regressions with data reordered with respect to the threshold variable. Alternately, breakpoint regressions may be thought of as threshold regressions with time as the threshold variable. The Eviews software was used for the estimations based on the methodologies of Bai and Perron (1998).

3.4.1.2 Developing a New Index

Using the original form of the EMP index, this study will also develop new

variations of the index as shown in the equations below.

$$emp17_t = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{RES_t - RES_{t-1}}{Imp_{t-1}} \tag{17}$$

$$emp18_t = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{RES_t - RES_{t-1}}{SED_{t-1}} \tag{18}$$

$$emp19_t = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{RES_t - RES_{t-1}}{Mon_{t-1}} \tag{19}$$

where $\frac{e_t - e_{t-1}}{e_{t-1}}$ represents changes in the exchange rate variable e_t, $\frac{RES_t - RES_{t-1}}{Imp_{t-1}}$ represents the change in foreign exchange reserves scaled by the one-period-lagged value of imports of goods and services Imp_{t-1}, short-term external debt SED_{t-1} and broad money Mon_{t-1} for equation 17, 18 and 19 respectively. Equation 19 represents the index as defined by Girton and Ropper (1977). However, based on the literature , the assumption here is that a country will be able to ward off speculative attacks on the currency if it has reserves that can cater for previous year's imports or short-term external debt or broad money. Despite this assumption, note is taken of the fact that Bianchi et. al. (2018) advocate that the optimal amount of reserves should be large enough to cover 16 months of coming debt obligations. The focus of this study on variations of the reserve variable is born from the fact that the first objective, which considered previous variations of the index, favoured the index with just the reserve variable and the reserve variable adjusted for by the money variable. This led to the conclusion that the reserve variable still plays a very important role in SSA even though SSA is characterised by countries with different monetary policy frameworks.

Table 5: Correlation result of proposed EMP index and change in exchange rate variable

	DLNFX	EMP17	EMP18	EMP19
DLNFX	1	0.314638	0.046853	0.299928
EMP17	0.314638	1	0.007846	0.961455
EMP18	0.046853	0.007846	1	0.004298
EMP19	0.299928	0.961455	0.004298	1

Source: Author's construction

The next step after estimating these indexes will be to test their significance and explanatory power against changes in the exchange rate variable. In other order for this to be done, the exchange rate variable (dependent variable) was converted to natural log and then differenced. This makes it easy for the main objective of this study to be achieved by finding how changes in the exchange rate variable react to the various

exchange market pressure indexes estimated in equations 17-19 earlier reacts to changes in the exchange rate variable. Additionally, due to the fact that most of the sampled countries participated in the HIPC initiative, there were significant reductions in their short-term external debt after they had reached the completion point. This necessitated the inclusion of a HIPC dummy (dummy 1) with value one (1) for periods with no short-term external debt and value zero (0) elsewhere. This study employed the use of a GMM estimation and a dynamic panel estimator regression model for this purpose. As a control experiment, a ridge regression is also used for the same purpose. The choice of these regression models is based on the fact that a variant of the dependent variable is included in the proposed indexes and the reserve variable is also a common variable in their computation. As a result, multicollinearity cannot be assumed away. The GMM model for instance adds the lag of the dependent variable to the explanatory variables which serves as a limiting effect on the level of multicollinearity. The ridge   regression on the other hand is designed purposely too deal with models that suffer from multicollinearity problems – using the Variance Inflation Factor (VIF). Since we are focusing on the explanatory effect of the proposed indexes to the changes in the exchange rate variable, the ridge regression is usable compared to a more robust variant called the lasso regression. These are considered only after other ways of dealing with multicollinearity has have been explored.

The GMM model is an extension of models that can be estimated using panel techniques. The panel regression form of the problem may be written as:

$$Y_{it} = f(X_{it}, \beta) + \delta_i + \gamma_t + \epsilon_{it} \tag{20}$$

Assuming a linear conditional mean specification implies that:

$$Y_{it} = \alpha + X_{it}'\beta + \delta_i + \gamma_t + \epsilon_{it} \tag{21}$$

Where Y_{it} is the change in the natural log of the exchange rate variable – the dependent variable, and X_{it} is a k-vector of regressors – $emp17_t$, $emp18_t$, $emp19_t$ and $dummy\ 1$ –   and ϵ_{it} are the error terms for $i = 1, 2, ..., M$ cross-sectional units observed for dated periods $t = 1, 2, ..., T$. α is the overall constant while δ_i and γ_t are cross-section or period specific effects – random or fixed. Because the estimation above does not automatically allow for coefficients of the regressors to vary across cross-sections or period specific effects, this study employs a dynamic panel equation using a GMM technique (Woolridge, 2002; Balaji, 2005) shown in equation 22-23 below.

$$Y_{it} = \sum_{j=1}^{p} \rho_j Y_{it-j} + X_{it}'\beta + \delta_i + \epsilon_{it} \tag{22}$$

First-differencing this specification (equation 22) eliminates the individual effect (possible impacts of missing variables on the dependent variable) and produces the following equation.

$$\Delta Y_{it} = \sum_{j=1}^{p} \rho_j \Delta Y_{it-j} + \Delta X_{it}'\beta + \delta_i + \Delta\epsilon_{it} \tag{23}$$

For this equation to be efficient, a number of period specific instruments corresponding to the second lag of the dependent variable was introduced. In order to handle cross-section and fixed effects, an orthogonal deviation suggested by Arellano and Bover (1995) was employed to remove individual effects from the specification. As the model accounts for cross-section fixed effects, a white period weighting matrix was used to compute the Arellano-Bond 2-step estimator. This was done by assuming a contemporaneous correlation between cross sections. The dynamic instruments associated with the log of the exchange rate variable include available lags from two (2) to the number of periods in the sample. The constant was added to the instrument list.

For the GMM regression estimate, we consider the J-statistics which is simply the Sargan statistic of over-identifying restrictions. The Sargan statistic is used when the instrument rank is greater than the number of estimated coefficients. It is worth noting here that the J-statistic reported by a panel equation differs from that reported by an ordinary equation by a factor equal to the number of observations. The null hypothesis of the Sargan statistic is that the over-identifying restrictions are valid. The Eviews software was used for this purpose because of its robustness in providing good estimation results.

3.4.2 The impact of the EMP Index on other Macroeconomic Variables

3.4.2.1 Banking Crisis

Table 6: Bank specific variables

Variable	Interpretation	Apriori Sign
EMP	Exchange Market Pressure Index	-
GLCD	Gross Loans to Customer Deposit	+
FCDLTG	Foreign-Currency-Denominated Loans to Total Gross Loans	+/-
ROA	Return on Assets	-
ROE	Return on Equity	-

Source: Author's Construction

For the impact of the exchange rate on banking crisis, the literature reviewed showed that banking crisis usually occur due to a deterioration of bank asset quality.

However, the notion that crisis can occur on the liability side cannot also be overlooked. In this case, changes in asset prices or a large increase in non-performing loans (NPLs) could be used to mark the onset of the crisis.

Using a variation of the model specified by Makri, Tsagkanos and Bellas (2014), this study will determine how the NPL determines bank specific factors in Ghana.

$$NPL_t = \alpha_0 + \beta_1 X_t + \varepsilon_t \tag{24}$$

Where NPL_t is the Non-performing Loans to Total Gross Loans, X_{it} denotes bank specific variables shown in table 6 above. In extending the analysis a lag of the dependent variable was added to the equation above to capture the dynamics of these variables over the previous years. This is shown in the equation below:

$$NPL_t = \alpha_0 + \beta_0 NPL_{t-1} + \beta_1 X_t + \varepsilon_{it} \tag{25}$$

The model specified by Makri, Tsagkanos and Bellas (2014) in some other terms can be seen as trying to identify determinants on the NPL. This is somewhat contrary to the view that the NPL and other bank specific variables determine either the ROE or the ROA. To prevent any doubt, we estimate another equation that uses the ROE and ROE as dependent variables and maintaining the other bank specific variable as explanatory variables as shown below.

$$ROE_t = \alpha_0 + \beta_1 X_t + \varepsilon_{it} \tag{26}$$

$$ROA_t = \alpha_0 + \beta_1 X_t + \varepsilon_{it} \tag{27}$$

From the literature discussed above it is clear that high NPLs erodes bank capital constraining growth and innovation in the banking sector. They also affect cost efficiency of banks. Since bank asset quality and operating performance are positively related, inadequate asset quality will also mean an increase its bad debt loss as well as banks spend more resources on the collection of NPLs. Therefore, the efficiency of the banking sector can somehow be measured by the level of NPLs in the sector as bad management in the sector leads to lower credit ratings for approved loans and high probability of default resulting in higher non-performing loans (Karim, Chan, & Hassan, 2010).

The core function of banking is deposit-taking and lending. These two functions are closely related. These functions also reflect the liquidity transformation function of banks. Hence the inclusion of the Gross Loans to Customer Deposit (GLCD) ratio in the variable list. It is a core indicator for liquidity mismatch risk. The GLCD ratio is a proxy measure for the coverage of loans with stable funding, usually deposits from households and non-financial companies. Unlike other liquidity measures the GLCD is less prone to

interpretation and simpler to understand. A high GLCD ratio is usually not desirable for the banking sector as a whole (Van den End, 2016).

As mentioned earlier a sharp depreciation of the domestic currency preceded the surge in NPLs over the study period. In that vein it was important to include a measure that captures the proportion of loans held in foreign currency in the sector over the study period. The Foreign-Currency-Denominated Loans to Total Gross Loans (FCDLTG) is expected to be a proxy for this measure.

The ROA is an indication of the operational efficiency of a bank while the ROE is a measure of equity holder returns and the potential growth on their investment. As regards the ROE, banks hold capital in order to prevent bank failure and meet bank capital requirements set by the regulatory authorities. However, they do not want to hold too much capital because by doing so they will lower the returns to equity holders. Therefore, a higher NPL is likely to eat into bank profit leading to a negative effect on both the ROA and ROE (Petersen & Schoeman, 2008).

This study like Makri, Tsagkanos and Bellas (2014) employs the Generalized Method of Moments (GMM). This is because an OLS estimation showed signs of serial correlation between the variables and the error term. This is because the lag of the dependent variable is included as a regressor which violates the exogeneity assumption for regressors so a more sophisticated and dynamic econometric technique is required to produce unbiased estimators. To deal with this situation the equation is estimated using instrument variables regressions. Thus, finding a set of variables that are both correlated with the explanatory variables in the equation, and uncorrelated with the error term. These will be used to eliminate the correlation between the variables and the disturbances. The GMM is just one of the approaches used to deal with the effect of variable and residual correlation. The moment condition can be written as:

$$E\big(m(y_t, \beta)\big) = 0 \tag{28}$$

The assumption here is that there are a set of L moment conditions that the K dimensional parameters of interest, should satisfy. Equation 28 represents also the vector of $L \geq K$ moment conditions.

Relying on moment conditions expressed as an orthogonality condition between the residuals of the equation to be estimated, $\mu_t(\beta) = \mu(y_t, X_t, \beta)$ and a set of K instruments Z_t, equation 28 becomes:

$$E\big(Z_t U_t(\beta)\big) = 0 \tag{29}$$

The traditional Method of Moments estimator is defined by replacing the moment conditions in Equation 28 with their sample analogue shown in equation 30 below.

$$m_T(\beta) = \frac{1}{T}\sum_T Z_t U_t(\beta) = \frac{1}{T}Z'\mu(\beta) = 0 \qquad (30)$$

The Eviews software is used by this study to find the parameter vector β which solves the set of L equations. When there are more moment conditions than parameters $L > K$, the system of equations given in Equation 28 may not have an exact solution. Such as system is said to be overidentified. The Generalized Method of Moments estimate is defined as the β so that the sample moment $m_T(\beta)$ is as "close" to zero as possible. The weighting matrix for the model was the HAC - Newey-West weighting matrix. This weighting matrix deals with heteroskedasticity and autocorrelation problems which is consistent with the long-run covariance matrix of $Z_t U_t(\beta)$ based on an initial estimate of β (Hansen et. al. 2008). A unit root test (Augmented Dickey-Fuller Test Equation) conducted was not significant for all variables. Therefore, the null hypothesis that the variables had a unit root was not rejected. The EMP index used did not have a unit root as expected.

3.4.2.2 *Retail Prices of Gasoline*

Various methods have been used to examine asymmetry in the petroleum sub-sector. Bacon (1991) proposed a quadratic quantity adjustment mod-el to test this hypothesis. Most studies including Reilly and Witt (1998), Bettendorf, van der Geest and Varkevisser (2003), and Liu et al. (2010), applied the ECM for this purpose. Radchenko (2005) used both the partial adjustment model and the vector auto-regressive model for the construction of the gasoline price impulse response and asymmetry measures. Karantininis, Katrakylidis and Persson (2011), Greenwood, Nimmo and Shin (2013), Atil, Lahiani and Nguyen (2014), Alsamara et. al. (2017), and Kisswani (2019) among others, have recently adopted the NARDL model to measure price asymmetry especially in the oil sub-sector. The popularity of this model is based on the fact that it is one of the simplest forms of non-linear ECMs (Greenwood, Nimmo and Shin, 2013).

Before the adoption of the NARDL model, its predecessor, the auto-regressive distributed lag (ARDL) model was also popularly used. The ARDL model like the one specified in Equation 31, assumes a linear combination of y_t and x_t, which indicates a symmetric adjustment in the long- and the short-run (Alsamara et al. 2017).

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \theta x_{t-1} + r w_t + \sum_{i=0}^{p-1} \alpha_i \Delta y_{t-1} + \sum_{i=0}^{q-1} \delta_i \Delta x_{t-1} + \mu_t \qquad (31)$$

where α is the intercept, while $\rho,\ \theta,\ r,\ \alpha$ and δ are coefficients associated with a linear trend. p and q are the lag variables of the dependent and explanatory variables, respectively. w_t is a vector of deterministic variables and μ_t is an *iid* stochastic process. We say that the two variables y_t and x_t in equation (31) are not co-integrated if $\rho = \theta = 0$.

The relationship between these variables can also be non-linear, which makes the use of a linear model misleading. The ECM and NARDL models were proposed to deal with this problem. Since the ARDL is a cointegrated model, it was thus suggested that an ECM provides a more appropriate specification for testing asymmetric price transmission. Proponents of these models make tests for cointegration and the existence of a cointegrated relationship a must because if there is no cointegration, then there is no price transmission, which means there cannot be any asymmetric price transmission either, and the results will have no economic meaning since the two prices have no relationship (Karantininis, Katrakylidis and Persson, 2011). This strict application of the ARDL model has been relaxed by recent studies. The reason was that a long-run relationship between two series will prevent them from drifting apart. This means that the test for asymmetry can only be prudent in the short-run with respect to the speed of adjustment. Analysis of the magnitude of the asymmetry is not possible. This is because such asymmetry means that there is a permanent divergence between positive and negative price changes, which in the long-run means that the series cannot be cointegrated. Another disadvantage is that if there is asymmetry in the series, this may confuse the standard tests such as the Dickey-Fuller unit root test and the Johansen test for cointegration (Karantininis, Katrakylidis and Persson, 2011).

Due to these shortfalls in some of the models illustrated above, this study adopts the NARDL model used by Alsamara et al. (2017) because it can be applied irrespective of the order of integration of the regressors. This allows for statistical inferences on long-run estimates, which are not possible under alternative cointegration techniques. Based on the ARDL model in Equation 31, the NARDL is developed by first breaking the x_t variable into negative and positive partial sums as shown in Equation 32:

$$\mathrm{x}_t = x_0 + x_t^+ + x_t^- \tag{32}$$

Where $\qquad x_t^+ = \sum_{i=1}^{t} \Delta x_t^+ = \sum_{i-1}^{t} max(\Delta x_i, 0) \qquad$ and $\qquad x_t^- = x_t^+ = \sum_{i=1}^{t} \Delta x_t^- = \sum_{i-1}^{t} max(\Delta x_i, 0)$.

The non-linear asymmetric co-integration regression can be expressed as

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + \mu_t \qquad (33)$$

where β^+ is the long-run coefficient associated with the positive change in x_t and β^- is the long-run coefficient associated with the negative change in x_t. Shin, Yu and Greenwood-Nimmo (2014) revealed that by substituting Equation (33) in the ARDL (p,q) model presented in Equation (31), we obtain the following non-linear asymmetric conditional ARDL:

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + rw_t + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-1} + \sum_{i=0}^{q-1} (\delta_t^+ x_{t-1}^+ + \delta_t^- x_{t-1}^-) + \mu_t \qquad (34)$$

Where $\theta^+ = \frac{-\rho}{\beta^+}$ and $\theta^- = \frac{-\rho}{\beta^-}$

Equation 34 is estimated using the standard ordinary least squares, checking for cointegration between the levels of the series, and testing the long- and short-run symmetry using the Wald test. The equation is used to derive dynamic multipliers m_h^+ and m_h^- associated with changes in x_t^+ and x_t^-.

The dependent variable is the change in the natural log of the ex-pump price of premium gasoline (*DLNGAS*). The independent variables are the natural log of Brent crude oil prices (*LN_BRENT*), the benchmark used by Europe and the rest of the World, and the EMP index. The EMP index used in this study is similar to that introduced by Girton–Roper [1977]. Before settling on this, different versions of the index were estimated and the one with the simple average of exchange rate changes and a foreign reserve depletion indicator to capture the reaction function of policy authorities was identified as the most responsive (EMP_2). The Eviews software was used for the estimation and also used to automatically select the appropriate lags for de-pendent and the explanatory variables.

3.4.2.3 Modelling the effect of the exchange rate on debt levels

The analysis is derived from the constructs of the balance of payments (as recommended, for example, by Pellechio and Mathisen, 2006) and the DSA for market-access countries. Thus, the link between the increase in gross external debt and portfolio investments can be explained through the balance of payments accounts. This will allow us to know if debt build-up in the study countries corresponds one-for-one to resource transfer from lending countries. This can be shown in equation (35) below.

$$R = CA\ surplus + NDLP + FB - PCO \qquad (35)$$

R represents changes in official reserves, $CA\ surplus$ is the current account surplus, $NDLP$ refers to the net-incurrence of liabilities of portfolio investments – mainly

in the form of equity and investment fund shares, FB refers to the foreign borrowing proxied by external debt and PCO is the amount of gross private capital outflows. Making FB the subject will mean that increased gross external debt will reflect a current account deficit ($CA\ deficit$), reserve build-up or capital outflows or a net-outflow of direct and portfolio capital. This relationship is shown in equation (36).

$$FB = CA\ deficit + (R + PCO) - NDLP \qquad (36)$$

Applying equation (36) to the eligible countries shows that most of the increase in external debt is due to reserve build-up or capital outflow (the residual) (see Table 7). This confirms the evidence of reserve build up whenever these countries issue new debts in the capital markets, as well as a reduction in reserves whenever investors withdraw their investments.

Table 7: Components of the increase in gross external debt – 2000 to 2019

	Increase in Gross External Debt	Current Account	Direct and Portfolio Capital Inflow	Residual
Ghana	20,486	(1,864)	6,178	24,800
Kenya	30,069	(5,559)	3,600	28,109

Source: Author's construction

Note: All figures are in millions of US dollar

The above analysis is limited to the external debt position. It only indicates the link between external debt and portfolio investment through the balance of payments. To establish a wholistic view we now consider the factors that contribute to the increase in gross public debt. Studies of this phenomenon have used different methods in measuring the relationship between debts, the exchange rate and other contributing factors. Authors such as Sung, Park and Park (2014) relied on simple least squares regression, by employing the generalized autoregressive conditional heteroskedasticity (GARCH) model, and the two-stage least squares estimation methods. Recognising that exchange rate volatility varies across various periods with increasing trends, Sung, Park and Park (2014) adjusted their volatility measure by estimating a GARCH (1, 1) to deal with the heteroskedasticity problem in the error term. They also used a two-stage least squares estimation method to control for possible reverse causality problems that are related to the short-term debt variable they used. However, the application of their model was mainly to corporations and financial institutions. Asonuma (2016), focusing on emerging economies, also used a two-step generalized method of moment (GMM) estimation to determine default probability using credit ratings on foreign currency debt. This,

including other techniques, helped Asonuma (2016) to establish the link between real exchange rate depreciation and default probability around payment defaults. These methods require a longer series of data that is scarce for the sampled countries, and thus makes the estimation of a dynamic model almost impossible.

In order to effectively measure the relationship between the exchange rate and external debt, I rely on the framework for fiscal policy and public debt sustainability analysis (DSA) in market-access countries (MACs). The Debt Sustainability Analysis (DSA) of the IMF and World Bank is one of the most relied on framework for accessing the debt sustainability of countries. The European Commission also uses a similar framework. The similarity is derived from the fact that the components (debt levels, deficits and interest rates costs) are linked by universal accounting relationships. Studies (Guzman and Heymann, 2015; Corsetti, 2018) have however criticised the use of the DSA ,especially the projections of the framework, as being biased leading to delays in sovereign debt restructuring. The framework, which was originally developed and employed in 2002 with the purpose of identifying vulnerabilities in the debt structure of the examined countries, was revised by the Executive Board of the IMF in August 2011. The review responded to shortcomings in identifying fiscal vulnerabilities and assessing risks to debt sustainability against the backdrop of increased concerns over fiscal policy and public debt sustainability in many economies (IMF, 2011). The market-access country's (MAC) debt sustainability analysis (DSA) framework is based on an identity characterizing the evolution of the stock of public debt. The framework is shown in equation 3 below.

$$d_t - d_{t-1} = \frac{1}{\rho_t} \left[d_{t-1} * \left(i_t - \pi_t * (1 + g_t) \right) + \varepsilon_t * \left(1 + i_t^f \right) * d_{t-1}^f - d_{t-1} * g_t \right] - pb_t + o_t + res_t \tag{37}$$

Where d_t is the gross debt as a percentage of GDP, i_t is the total effective interest rate, π_t is the year-on-year inflation rate, g_t is the growth rate at constant prices, i_t^f is the effective nominal interest rate on foreign currency-denominated debt, d_t^f is the stock of external debt, pb_t is the primary balance, $d_{t-1} * \left(i_t - \pi_t * (1 + g_t) \right)$ is the contribution of the effective interest rate to the change in gross debt, whereas $\varepsilon_t * \left(1 + i_t^f \right) * d_{t-1}^f$ is the contribution of the exchange rate, $d_{t-1} * g_t$ is the contribution of real GDP growth, and $pb_t + o_t$ is the contribution of the primary balance and other factors to the change in gross debt. res_t is the is a residual variable ensuring that the identity holds. Also

$$i_{t+1} = \frac{i_{t+1}^f * d_t^f}{d_t} + \frac{i_{t+1}^d * d_t^d}{d_t} \tag{38}$$

$$\rho_{t+1} = (1 + g_{t+1}) * (1 + \pi_{t+1}) \tag{39}$$

$$\varepsilon_{t+1} = \frac{e_{t+1}}{e_t} - 1 \tag{40}$$

Where i_t^d is the effective nominal interest rate on local currency-denominated debt, d_t^d is the stock of local currency-denominated debt and e_t is the nominal exchange rate. For the purpose of this study, we use a concept of public debt which differs from the Fund's definition in its Debt Sustainability Analysis (DSA) – shown in equation 41 below. This concept of debt is derived from the sampled country's government's budget analysis. As noted by Dabbicco (2018), there could be differences with what the IMF and the various countries deem as the actual debt level should be. As is in the case of the sampled countries, they exclude non-government guaranteed external debt contracted by State-owned Enterprises (SoEs) which the IMF includes in its analysis. This is because in these countries, the responsibility for external debt recording and payment is divided among different agencies making debt reporting systematically inconsistent in most cases. Equation 41 adds the other factors to the residual.

$$d_t - d_{t-1} = \frac{1}{\rho_t}\left[d_{t-1} * \left(i_t - \pi_t * (1 + g_t)\right) + \varepsilon_t * \left(1 + i_t^f\right) * d_{t-1}^f - d_{t-1} * g_t\right] - pb_t + res_t \tag{41}$$

Following this framework, we identify four sources of changes in gross government debt over the period 2000 to 2020. These are the effective interest rate (defined as the current-year interest payments divided by previous period debt stock), the nominal effective exchange rate (defined as the nominal conversion rates to the USD), real GDP growth, the primary balance (PB) (defined as the overall deficit excluding interest payments), and other residual factors (Res). Some of these variables determine how a country's debt level is evolving both in the short and long term. The higher the level of public debt, the more likely it is that fiscal policy (budget deficit) and public debt are unsustainable. This is because – other things being equal – a higher debt requires a higher primary surplus to sustain it. Moreover, higher debt is usually associated with lower growth and higher interest rates, thus requiring an even higher primary balance to service it (Friedman, 1978 and 1985). The exchange rate, if allowed to float normally, depreciates and therefore we expect the exchange rate depreciation to contribute to increasing the debt ratio. Also, the primary balance, which is a measure of the fiscal accounts leaving out interest payments, is expected to contribute towards increasing the

debt ratio. We expect GDP to put downward pressure on the debt ratio bearing in mind that lower growth would tend to lead to higher debt to GDP ratio. The effective interest rate measured adjusts for inflation and the GDP growth factor. This is because countries have been known to inflate their way out of debt and there are instances where the growth in the GDP may be higher than the growth in interest rate (Edoun and Motsepe, 2016).

It is worth noting that the DSA prepared by the IMF and the World Bank includes a Country Policy and Institutional Assessment (CPIA) which measures the county's policy and institutional quality in managing its debts and the economy as a whole. Based on this measure, both Ghana and Kenya are moderate performers. However, Kenya has a higher score than Ghana and this means that the risks are more tilted towards Ghana. Since 2012, Kenya outperforms Ghana in areas of debt policy, economic management, efficiency of revenue mobilization, equity of public resource use, fiscal policy rating, etc. (see Appendix Table A2). Colombo and Longoni (2009) and Imaginário and Guedes (2020) also found that institutional and socio-political variables are one of the several factors explaining the level of external debt in developing countries.

Despite this, Guzman and Heymann (2015) raise concerns about the DSA framework as it may provide an international validation of excessive borrowing costs and potential repayment difficulties for countries and the lack of the frameworks for facilitating orderly resolutions of crises. These problems associated with the DSA are limited to the forecast abilities of the framework for which this study is not seeking to evaluate. Moreover, the DSA framework is an identity which is assumed to be true for the variables provided they are properly measured. This assumption may not always be the case in practice. Therefore, there is a need to subject the variables to a regression analysis whose result will be conditional on the significance of the variables to be used. There are also interactions between some of the variables (the inflation rate and the growth variable). As a result of these interactions and other challenges with the DSA this study employs the use of an extended Fully Modifies Ordinary Least Square (FMOLS) model used by Phillips and Hansen (1990) to estimate the following equation based on the various contributions to the change in gross debt estimated in equation 41.

$$\Delta d_t = \alpha_0 + \beta_1 \text{o/w Int}_t + \beta_2 \text{o/w FX}_t + \beta_3 \text{o/w GDP}_t + \beta_4 \text{o/w PB}_t + \varepsilon_{it} \quad (42)$$

Where the change in gross debt as a percentage of GDP (Δd_t) is dependent on the contribution from the interest payments (o/w Int_t), the exchange rate (o/w FX_t), the GDP (o/w GDP_t) and the primary fiscal balance (o/w PB_t).

The extension was motivated by the works of Phillips and Moon (1999), Pedroni (2001) and Kao and Chiang (2001). The FMOLS was used in other to eliminate the problems caused by long run correlations between cointegrating equations and stochastic regressors innovations. The FMOLS estimator is given by equation 8 below.

$$\hat{\theta} = [\sum_{i=1}^{N} \sum_{t=1}^{T} Z_{it} Z'_{it}]^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} (Z_{it} \hat{Y}_{it}^{+} - \hat{\lambda}_{12}^{+'}) \qquad (43)$$

Where Z is a function of the independent variables and the deterministic trend. Given estimates of the average long-run covariances, $\hat{\lambda}$ and $\hat{\Omega}$, the modified dependent variable and serial correlation correction terms are defined in equation 44 and 10 below.

$$\hat{Y}_{it}^{+} = \hat{Y}_{it} - \hat{w}_{12} \Omega_{22}^{-1} \hat{\mu}_2 \qquad (44)$$

$$\hat{\lambda}_{12}^{+} = \hat{\lambda}_{12} - \hat{w}_{12} \Omega_{22}^{-1} \hat{\lambda}_2 \qquad (45)$$

Where Y_{it} and X_{it} are the corresponding data (dependent and independent variables) purged of the individual deterministic trends and $\hat{w}_{12}$ is the long-run average variance of μ_{1it} conditional on μ_{2it}. Y_{it} and X_{it} are also the demeaned variables in the leading case of individual specific intercepts. As a result of the use of FMOLS model, the sample was adjusted to 2002 to 2020. Eviews software was used to estimate the results.

The regression analysis will serve as a supporting analysis bearing in mind that we are constrained by data availability, thereby leading to a small sample problem. This is also occasioned by the fact that the COVID-19 pandemic is recent and any attempt to over-extend the data series may also distort analysis of the phenomena (Faber and Fonseca, 2014). Therefore, the study will mainly rely on the results from the DSA shown in equation 41.

According to Mills (2008), the method of practice or experience is of great importance not as a means of discovering truth but of verifying the truth. As one can never predict with absolute certainty but only with less or greater degree of probability in other words, one cannot overlook any one cause.

However, by comparing the findings of this study with recorded periods of currency crisis in the selected SSA countries, this study will be reducing to the lowest point the uncertainty arising from the complexity of this study.

By estimating and developing these measures of the EMP index this study is trying to specify the linkages among observable variables, including those implied by their statistical relations to observable variables, thereby attempting to observe the invariance (Hoover, 1994).

The use of econometric analysis in this study has helped to consider the various concerns of Hoover (1994) and Mills (2008). This, as discussed earlier, has got to do with how various econometric models are able to reach conclusions which are close to reality. By testing and developing new methods of estimating the EMP index, to suit the various monetary policy frameworks in SSA, this study deals with aspect of the Lucas Critique which is concerned with how policy changes affect the efficiency of econometric models. This will be reinforced by comparing the new estimate of the EMP index to actual or recorded episodes of currency crisis. This approach will agree with the conclusions of Mills (2008) – an attempt not to overlook any one cause – and Hoover (1994) – to describe how the world (monetary policy framework in SSA) is in fact.

Table 8: Research questions, hypothesis and the method of analysis

Research Question	Hypothesis	Method of analysis
I	H0: The recent form of the EMP index has no significant positive relationship with changes in the nominal exchange rate. H1: The recent form of the EMP index has a significant positive relationship with changes in the nominal exchange rate.	Dynamic Ordinary Least Square (DOLS), Ridge Regression and Threshold Regression
II	H0: The proposed EMP index in this study has no significant relationship with changes in the nominal exchange rate. H1: The proposed EMP index in this study has significant relationship with changes in the nominal exchange rate.	Generalized Method of Moments (GMM), Ridge Regression
III	H0: There is no significant relationship between the EMP index and other bank specific variables in Ghana. H1: There is a significant relationship between the EMP index and other bank specific variables in Ghana.	Generalized Method of Moments (GMM)
	H0: There is no significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya. H1: There is a significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya.	NARDL model
	H0: The exchange rate does not contribute to increases in the gross debt to GDP ratio in Ghana and Kenya. H1: The exchange rate contributes to increases in the gross debt to GDP ratio in Ghana and Kenya.	Framework for fiscal policy and public debt sustainability analysis (DSA) in market-access countries (MACs)

CHAPTER 4: EMPIRICAL RESULTS

4.1 Introduction

In this chapter, the various results of the three main objectives of the thesis are discussed. This includes the various diagnostic test conducted and the policy implications for the results realised.

4.2 Evaluation of Results

4.2.1 The appropriate EMP index for SSA

Table 9 shows the ridge regression results and their Variance Inflation Factor (VIF). The coefficients of the variables (raw ridge) are shown in parenthesis. A λ of 0.04 was used in all the estimation to reduce the level of bias. The choice of the best index is guided by first the VIF and then the sign and size of the coefficients. The relationship between the EMP index and the changes in the log exchange rate (dependent variable) is expected to be positive. Thus, a positive raw ridge coefficient which indicates how much change in the dependent variable (changes in the log of the exchange rate) occurs for a one-unit change in an EMP index when the remaining indexes are held constant.

Table 9: Dependent Variable – Changes in the Log of the Exchange Rate

| Variables | Monetary Framework | Independent Variables | | | | | |
		EMP 1	EMP 2	EMP 3	EMP 4	EMP 5	EMP 6
Fx & Res	All		0.003	-0.007		0.009	
			(1.046)	(1.169)		(1.262)	
Fx & Res	Pegs		-0.002	-0.037		0.013	
			(1.178)	(1.782)		(2.075)	
Fx & Res	Reserve Money		0.005	-0.004		0.008	
			(0.985)	(1.078)		(1.079)	
Fx, Res & IR	IT	0.006	0.874	-0.209	-0.037	-0.001	
		(2.559)	(3.817)	(3.426)	(2.518)	(-0.062)	
Fx, Res & RM	Reserve Money		0.174	-0.107		0.005	0.001
			(3.540)	(2.742)		(2.650)	(1.918)

Source: Author's Estimation

Note: VIF in parenthesis ()

The results show that among the six variations of the EMP index considered, equation two (2) and five (5) could explain changes in the log of the exchange rate better than the other estimates because their VIF did not shrink the fastest as the lambda/ bias approached 0.04 in all five situations considered and their coefficients were positively

related to changes in the exchange rate variable. The difference between equation two (2) and five (5) is that in equation (2) the reserve variable is adjusted for by the broad money whereas that is not the case in equation (5). Also, in equation (5) the components are normalised by their own standard deviation. Since all the respective VIFs are lower than five (5), equation 5 appears to have the largest, positive explanatory power in three out of the six possible cases. This is true if: all 31 countries are considered as a whole based on just the exchange rate variable and their reserves; out of the 31 countries we consider the 14 countries that use reserve money as their operational target based on also just the exchange rate variable and the reserve indicator; three (3) of the countries that use the reserve money as an operational target based on the changes in the exchange rate, the reserve indicator and the reserve money variable. These results mimic the initial DOLS model estimated. If primacy is given to variables that have significant positive relationship with the change in the log of the exchange rate variable (see Appendix Table 4).

By this result one could say that the current definition of the index as defined in equation (1), does not do a good job of explaining and predicting changes in exchange rate in SSA if countries that have adopted the IT framework are involved. For those countries' equation (2) which considers the degree to which alterations in the domestic source of broad money lead to changes in the demand for domestic base and thereby the total quantity of reserves outstanding. This raises issues about the autonomous of monetary authorities in these countries and also if they are implementing the IT framework effectively.

In other to clear all doubts, I dwell on the IT countries in SSA (Ghana and South Africa). Here we use the same criteria as stated above, by testing the different estimates of the EMP index to the log changes of the exchange rate variable to identify which of the index will be good at explaining it. The focus here will be on the EMP index that will have a positive and significant relationship with the log changes of the exchange rate variable. The results of the DOLS regression and the ridge regression model (see Table 10) shows that the original index developed by Girton and Ropper (1977) – EMP_2 – had more explanatory power on the log changes of the exchange rate variable in both South Africa and Ghana. This confirms the result from table 9. The recent form of the index defined in equation 1 – EMP_1 – had some explanatory power but was not significant. Some of the other variations of the EMP index considered were also significant (EMP_3 and EMP_4) for Ghana and all countries pooled as one. These other indexes though

significant will not be considered, as the relationship between them and the log changes of the exchange rate variable was negative. Generally, these results were consistent with the result from the estimated Ridge Regression.

These results will generally suggest that the IT framework has not been effectively implemented in both Ghana and South Africa. This is because the variation of the index that considers the resection of the Central Bank through the use of the interest rate (EMP_1) was not significant in explaining the changes in exchange rate variable (see Table 10). As mentioned earlier Ghana and South Africa announce that they use Inflation Targeting (IT) – De jure – and is assumed to have a freely floating exchange rate regime but De facto, it heavily manages or targets the exchange rate (Knedlik, 2006: Mminele, 2013). These two targets two instruments situation could be complicating the identification of the policy framework and analysis of monetary policies of these countries.

Table 10: The best EMP index for South Africa and Ghana

	DOLS Regression			Ridge Regression		
	South Africa	Ghana	All	South Africa	Ghana	All
EMP_1	0.004	0.012	-0.001	0.005	0.008	0.006
	(0.168)	(1.059)	(-0.318)	(3.899)	(2.287)	(2.559)
EMP_2	1.003	1.750	1.254	0.754	0.480	0.874
	(5.703)*	(2.454)**	(16.646)*	(3.281)	(4.137)	(3.817)
EMP_3	-0.018	-0.551	-0.470	0.157	-0.085	-0.209
	(-0.060)	(-1.339)	(-8.641)*	(3.759)	(3.492)	(3.426)
EMP_4	-0.085	-0.398	0.014	-0.037	-0.155	-0.037
	(-0.254)	(-1.955)***	(0.439)	(2.971)	(2.800)	(2.518)
EMP_5	-0.001	-0.006	0.002	-0.003	0.000	-0.001
	(-0.128)	(-0.678)	(1.138)	(2.717)	(3.652)	(3.317)
C	-0.001	-0.007				
	(-0.278)	(-1.988)***				
R-squared	0.9999	0.9937	0.9518	0.9916	0.8530	0.8755
Adjusted R-squared	0.9991	0.9556	0.9482			

NB: *For DOLS, t-statistics is in parenthesis (). Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%. For Ridge Regression VIF is in parenthesis ().*

As indicated in the literature review, the interest rate and the exchange rate are more important for small-open developing economies. Developing economies that practice full capital mobility, exchange rate targeting will incapacitate the central bank's use of interest rate or monetary quantities as operating or an intermediate policy target. In this

case changes in the exchange rate and foreign interest rate will now determine the level of domestic interest rate and therefore monetary conditions. In other words, the two target two instrument policy will be effective if there is imperfect capital mobility in these countries. Since Ghana and South Africa have capital controls on a majority of capital transactions, the analysis shows that they have been successful in dealing with exchange rate pressures as they occur despite the improper implementation of the IT framework. This somewhat confirms the works of Kakinaka (2018) and Goldfajn and Gupta (2003). But unlike Kakinaka (2018) the case for exchange rate stability was not established.

4.2.2 Dealing with the threshold problem associated with the EMP index

In identifying crisis periods in SSA (Ghana and South Africa), the discrete threshold regression was estimated for the countries individually. As a result, the sample period was adjusted based on the instrument variables – 2003M01 to 2017M12 for EMP 1 and 2002M11 2017M12 for EMP_2. The threshold value used is the highest positive threshold among the five (5) thresholds estimated (see Appendix Table 5). Even though the original EMP index developed by Girton and Ropper (1977) – EMP_2 had the most explanatory effect on the changes in the exchange rate variable, for the threshold analysis, I also considered the variation of the index which is intended to capture the use of the interest rate as a tool for preventing or reducing pressure on the exchange rate (EMP_1).

In all twenty-eight (28) crisis episodes were identified for Ghana irrespective of whether EMP_1 or EMP_2 is used as the dependent variable (see Figure 5). This will suggest that the use of the interest rate as a reaction function by the Central Bank was not effective in reducing exchange rate pressure. The crisis periods were more pronounced in 2008 to mid-2009, first half of 2012 and late 2013 to 2015. The maximum threshold variable for the two indexes used were significantly different confirming the diversity of the two indexes. For South Africa there were thirty-one (31) and twenty-seven (27) crisis episodes when the EMP_1 and the EMP_2 are respectively used as dependent variables. The crisis periods were more pronounced in 2008, late 2011 to the first half of 2012 and from 2013 to 2015. This confirms the use of the interest rate to dampen pressure on the exchange rate in South Africa since more crisis were discovered if the index adjusted for the interest rate is used. This observation is not as pronounced as one will expect under an IT regime (see Figure 6).

Figure 6: Exchange rate crises episodes in South Africa and Ghana (2002-2017)
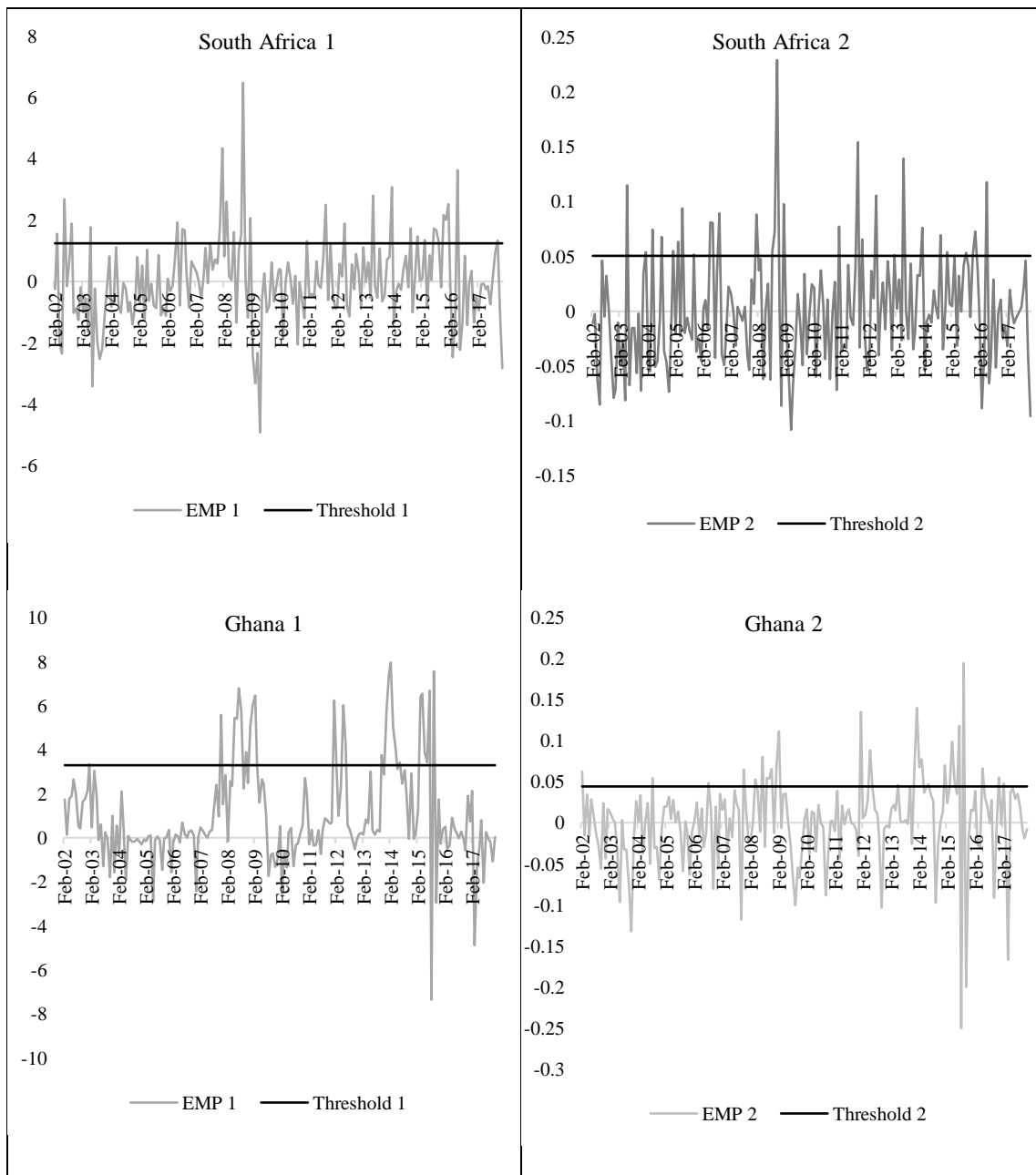
Source: Author's Construction

These periods of crisis episodes correspond favourably with reported episodes of exchange rate pressure in South Africa and Ghana as reported by the media and other authors. For instance, the IMF, in its Annual Report on Exchange Arrangements and Exchange Restrictions, reports that volatility in major exchange rates has increased more than during any similar period since the global financial crisis in 2015. This according to the report led to most central banks intervening to counter the rapid depreciation on their local currencies. This affected most of the de facto exchange rate arrangement reclassifications during the period. South Africa for instance eased some requirements in

other to effectively monitor the use of foreign exchange purchased for certain advance payments for imports. Over the same period Ghana strictly prohibited offshore foreign exchange deals by resident and non-resident companies in order to reduce foreign exchange market pressure by enhancing the repatriation of foreign exchange earnings and the use of the domestic currency – most of these measures were later reversed when the pressure still persisted (IMF, 2015, 2018).

The diagnostic test conducted rejected the null hypothesis of normality, serial correlation and heteroskedasticity in the case of South Africa. The normality assumption for Ghana was not met as the null hypothesis of normality was accepted in this case.

4.2.3   A new EMP index for SSA

The conclusion from the reviewed literature generally confirmed that reserve adequacy could be expected to vary amongst developing countries depending on their economic circumstances – the reason for the use of three approaches for judging the adequacy of reserves. Events in the 1990s and beyond also showed the defects in earlier approaches to judging the adequacy of reserves (Bird and Rajan, 2003). For the second objective, the reserve adequacy theory however presents some new perspectives on the subject matter. Since the reserve adequacy measure was used in this case to help access the ability of countries in SSA to use their reserves to wade off currency pressure after they have catered for previous period's imports, short-term external debt and the broad money. This differs significantly from most of the studies conducted in the subject area.

Table 11 below shows the output result of the GMM and Ridge regression models used in this study. The results show that all the explanatory variables were significant. All had the expected positive signs with the exception of the EMP 19 which had a negative sign on the log changes of the exchange rate variable. Broad money is regarded by many as the measure of money. It is defined as the sum of currency, checking deposits, savings deposits, retail money market mutual funds, and small-time deposits. The negative relationship between the EMP 19 and the log changes of the exchange rate variable could mean that most of the measure of broad money in SSA are not 'reservable' or are not effectively captured as checking deposits and so are not liabilities of depository institutions (Carpenter and Demiralp, 2012). The frequency of the data set can also be a contributory factor – yearly rather than monthly data.

The EMP 17 explained most of the dependent variable followed by EMP 19 then EMP 18 and dummy 1. The significance of the dummy variable confirms the influence of debt forgiveness (HIPC) in SSA. EMP 18 had the least explanatory power possibly

due to the role the HIPC initiative played in reducing external debt in SSA. Even if one combines the HIPC dummy to EMP 18, it still falls shorts of the explanatory effect of EMP 17 and EMP 19.

Table 11: Regression output for the changes in the log of the exchange rate

Explanatory Variables	GMM	Ridge
DLNFX (-1)	0.025359	
	(5.142612)***	
EMP 17	0.381147	0.020125
	(22.20398)***	(3.36821)
EMP 18	2.85E-08	8.13E-09
	(2.933026)***	(0.924959)
EMP 19	-0.170155	0.003671
	(-13.28273)***	(3.369471)
DUMMY1	0.014937	-0.007894
	(3.010565)***	(0.925975)
Instrument rank	26	
J-statistic	25.86409	
Prob (J-statistic)	0.211679	

NB: *For GMM, t-statistics is in parenthesis (). Symbols *, **, *** indicates statistical significance at 10%, 5% and 1%*

For Ridge Regression VIF is in parenthesis ()

The ridge regression used as a control had all variables having a positive effect on the log changes of the exchange rate variable. Most of the explanatory effect came from EMP 17 with the others following the same order as was in the case of the GMM regression model. The VIF of the explanatory variables were all below 5. This was after the lambda – level of bias – was set at 0.04. Since the index as estimated in equation 17, 18 and 19 include the exchange rate variable itself it does mean any regression with the log difference of the exchange rate variable as the dependent variable is likely to suffer from multicollinearity. The use of the two models deals with this effect. The ridge regression especially is considered the last option in dealing with multicollinearity in any model. EMP 18 had the lowest VIF considering the fact that the HIPC initiative meant uneven completion points and debt relief among sampled countries in SSA. According to the ridge regression EMP 17 had the most explanatory effect on the log changes of the exchange rate variable. This was followed by EMP 19 and EMP 18 respectively.

For the GMM regression output we consider the J-statistics which is simply the Sargan statistic. In other words, it represents the value of the GMM objective function at

the estimated parameters. The value of J-statistic in this case is not significant so we accept the null hypothesis that the over-identifying restrictions are valid. The instrument rank (26) is also greater than the number of estimated coefficients – a key criteria in assessing the appropriateness of the GMM model.

4.2.4 The EMP index and the banking crisis in Ghana

In investigating the impact of the EMP index on some macroeconomic indicators in SSA, this study looks at the 2017-18 banking crisis in Ghana. Before establishing the causes of the crisis in Ghana, I try to determine the best EMP index for Ghana to be used for the analysis.

Table 12: The best EMP index for Ghana

Independent Variables	OLS Model	Ridge Regression
C	-0.002	
	(-0.976)	
EMP_1	0.028	0.019
	(10.014)*	(2.355)
EMP_2	1.020	0.330
	(9.718)*	(3.422)
EMP_3	-0.170	-0.071
	(-4.359)*	(3.156)
EMP_4	-0.427	-0.130
	(-8.157)*	(3.534)
EMP_5	-0.009	0.005
	(-2.878)**	(3.680)
EMP_6	0.001	-0.002
	(0.578)	(2.698)
R-squared	0.963	0.901
Adjusted R-squared	0.957	
Durbin-Watson stat	1.966	

NB*: For OLS, t-statistics is in parenthesis (). Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%. For Ridge Regression VIF is in parenthesis ()*
Source: Author's Construction

To be sure on the appropriate EMP index for Ghana, we construct six different versions of the EMP index based on the index proposed by Girton and Roper (1977) and then regress these variations of the index on the log changes of the exchange rate variable in Ghana. The results of the regression output are shown in table 12 above.

The criteria here will be to choose the index with a significant positive relationship with the log changes of the exchange rate variable and also has the most explanatory effect. For both the OLS model and the Ridge Regression (see table 12), it is evident that EMP_1 and EMP_2 met these criteria. The Durbin-Watson statistics will mean that there is no sign of serial correlation of the residuals. To confirm this assertion a Breusch-Godfrey Serial Correlation LM Test was conducted using the fourth lag. The results accepted the null hypothesis of no serial correlation among the residuals of the model. Therefore, the equation model need not be re-specified. As a control however, the ridge regression which deals with multicollinearity problems was also used to confirm the results of the OLS model. The Variance Inflation Factors (VIF) after employing the Ridge Regression model were all below 5.

As shown in appendix Table 6, the results for equation 26 shows that the NPL, the EMP and the FCDLTGL were significant in explaining the ROE. The negative sign of the NPL confirms theory that high NPLs lead to the erosion of profits in the sector. Also, the negative sign of the EMP index will also mean that depreciation of the domestic currency also affects bank profit consistent with literature. For equation 27 only the GLCD and the FCDLTGL were significant in explaining the ROA. They both had the right signs as an increase in these indicators – all things being equal – will lead to an increase in the profit indicator (ROA and ROE).

The results of the GMM regression for equation 25 showed that the NPL has a significant negative relationship with the EMP index and the ROE confirming the apriori signs (see Table 13). The NPL on the other hand had a positive relationship with its own lag (NPL(-1)), the ROA and the GLCD. The relationship between the NPL and the FCDLTGL was not significant over the study period. The GMM model used in this study is a good model as the R-squared and Adjusted R-squared are all appropriate at 0.9329 and 0.9243 respectively. The Sargan statistic – J-statistic – is not significant so the null hypothesis that the over-identifying restrictions are valid is accepted. There were as many instruments as there are parameters in the model. The instrument rank (7) is also greater than the number of estimated coefficients confirming the value of the J-statistic. This is a key criterion in assessing the appropriateness of a GMM model.

The results suggest that the high NPL ratios in Ghana affected bank profit negatively through their Return on Equity (ROE) during the study period (crisis period). This finding is consistent with findings of Cox and Wang (2014), and Cleary and Hebb (2016) who also studied the financial crisis in the US. As discussed earlier, the ROE is a

measure of shareholder's returns and the potential growth on their investment. This is because shareholder's equity can be seen as company's assets less its debt. It was thus of no surprise that some of the banks were found to have obtained their licenses under false pretences through the use of suspicious and non-existence capital. Resulting in a situation where their reported capital was un-accessible to them for their operations (BoG, 2019).

Table 13: GMM Regression result – Dependent variable is the NPL

Variable	Coefficient
NPL(-1)	0.8692
	(25.4253)*
EMP_1	-0.3064
	(-2.1167)**
ROA	0.5564
	(2.4299)*
ROE	-0.1533
	(-3.6284)*
GLCD	0.0611
	(4.6782)*
FCDLTGL	-0.0271
	(-0.5429)
R-squared	0.9329
Adjusted R-squared	0.9243
Durbin-Watson stat	1.8074
Instrument rank	7
J-statistic	0.0070
Prob(J-statistic)	0.9331

NB: For GMM, t-statistics is in parenthesis (). Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%

This could explain the unexpected positive relationship between the ROA and the NPL. Banks hold capital in order to prevent bank failure and meet bank capital requirements set by the regulatory authorities. The fall in the ROE over the study period (see Figure 7) made it difficult for banks in Ghana to handle the crisis as it unfolded even though regulatory capital requirement was increased at end-2018. Previous year's NPL also influenced current period's NPL during the study period – thus an unresolved NPL problem compounds the NPL problem in the current period. It is also an indication of delays by banks to deal with the increasing NPL ratio over the study period. Over the study period also Gross Loans to Customer Deposits (GLCD) increased significantly as

NPLs increased. This ratio hovered around 77 per cent between 2013 to 2015. It is however of no coincidence that there was significant pressure on the Ghanaian currency prior to the increase in the NPL and the fall in the ROE in 2015. This is confirmed by the significant relationship between the EMP variable and the NPL ratio. Even though the Foreign Exchange Act, 2006, (Act 723) prohibits the pricing, advertising and receipt or payment for goods and services in foreign currency in Ghana, it is a known fact that most items are indirectly pegged to the US dollar. It is for this reason that the BOG came out with a directive in May of 2019 to caution the public about the pricing, advertising and receipt or payment for goods and services that are contracted locally in any foreign currency. The BoG followed up with the dispatch of a task force in September 2019 to caution firms that are doing so. Therefore, if loans were procured to purchase goods and services that have an imported component or are pegged to the US Dollar then any sharp depreciation of the domestic currency will affect the ability of bank customers to service their loans. The negative relationship means that depreciation pressures affects the NPL ratio. The depreciation of the currency in 2014 was the highest over the study period especially in the first quarter of 2014. The increasing NPL meant bank capital and profit where been eroded as Gross Loans to Customer Deposits (GLCD) continue to hover around 70 per cent until the first quarter of 2018. One would have expected the banks to have reduced their exposure as NPLs continue to rise.

The IMF attributed the increase in the NPL in 2015 to varying practices in loan classification which created an optimistic picture of profitability and masked weaknesses. They warned of the risks in the Ghanaian banking sector but the absence of a legislations at the time – to provide the BOG with the authority for prompt corrective action, liquidity support instruments, clear triggers for bank resolution and a range of bank resolution tools – meant a delay in dealing effectively with these risks in the sector. In fact, it took a year (2015 to 2016) for these legislations to be submitted and approved by parliament (IMF, 2015).

It is thus clear also that aside the NPL problem there was also significant problems with bank supervision. This was perverse as some of the banks even after receiving substantial liquidity support (over GHc 2.2 billion) from the BoG, to meet its recurring liabilities, still continued to grant new loans and incurred new capital expenditures when the law does not allow them to considering their state. Also, a key shareholder of one of the troubled banks managed to obtain liquidity support from the BoG using third party banks as its agents making BoG's exposure to the bank underestimated (BoG, 2019).

Figure 7: Bank specific factors for Ghana – 2008 to 2018
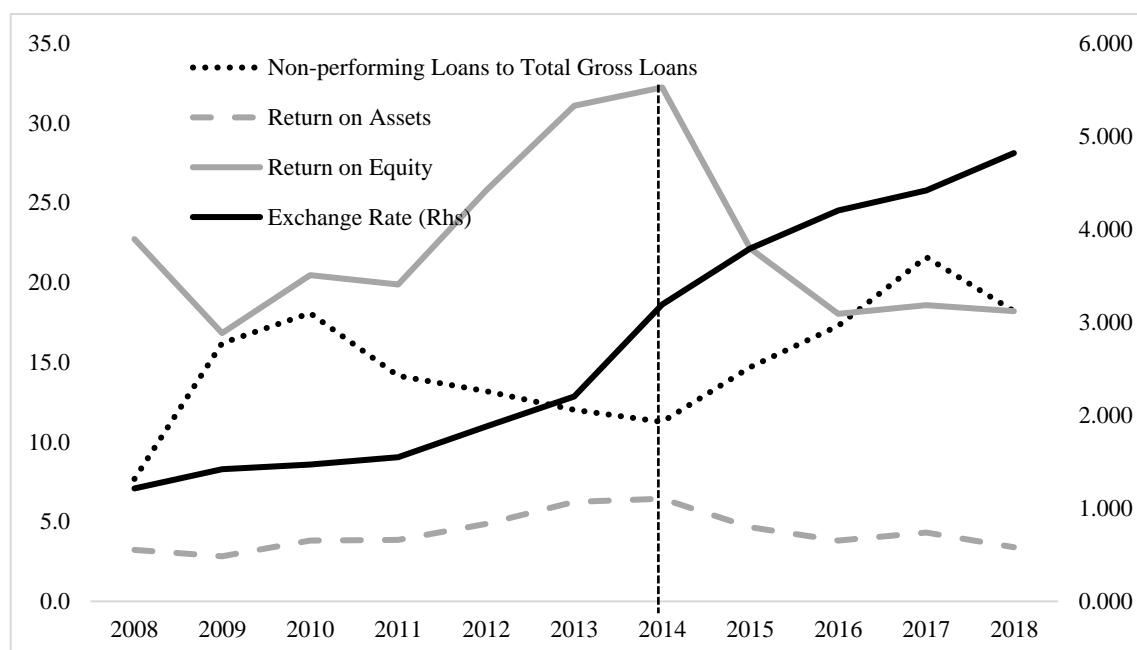
Source: IMF Financial Soundness Indicators, 2019

In dealing with the crisis, the BoG employed a lot of tools which at the end cost the public some GHc 16.4 billion – 5 per cent of GDP – from 2017 to 2019. This figure excludes interest payments on the bonds issued (MoFEP, 2019). The IMF puts this figure at GHc 15.8 billion equivalent also to 5 per cent of GDP. The resolution tools – traditional and non-traditional – included purchase and assumption by existing banks and the setting up of a bridge bank, increase in minimum paid up capital in the banking sector from GHc 120 million to GHc 400 million by end-2018 and the injection of capital in five[3] indigenous banks from private pension funds in Ghana through a special purpose holding company called the Ghana Amalgamated Trust (GAT) Limited. These measures were attempts by the government and the BoG to save depositors and investors whose funds were locked up with the failed financial institutions. Thus, it was necessary for authorities to intervene to limit the disruption from failing banks and other financial institutions – most of which included the use of public funds to safeguard the deposits held by universal banks that were resolved by Bank of Ghana, and to set up the bridge bank, Consolidated Bank Ghana (CBG) Limited, mentioned earlier. Aside the fiscal cost of these interventions the effect on government debt could not also be overlooked.
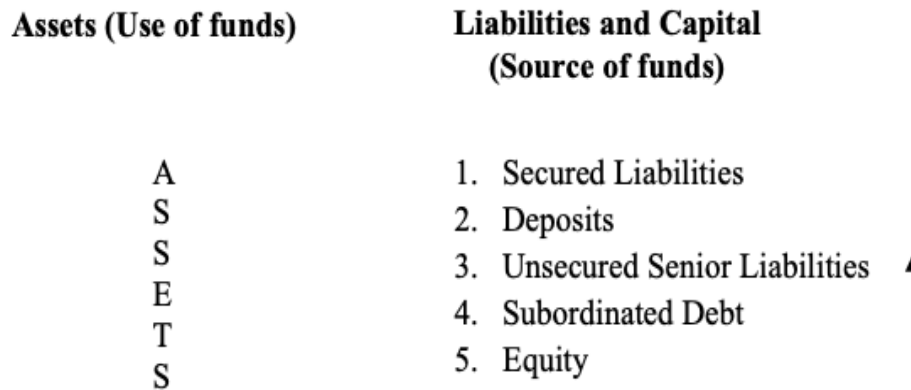
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[3] Agricultural Development Bank (ADB), National Investment Bank (NIB), Omini Bank/Bank Sahel Sahara, Universal Merchant Bank (UMB) and Prudential Bank.

As noted in the literature review of this study and even discussed in the Ghanaian situation, even when bail outs are carefully designed, they are often very costly for the budget. They may allow inefficient banks to remain in business and they are likely to create the expectation of future bailouts, thereby reducing incentives for adequate risk management by banks (Demirgüç-Kunt and Detragiache, 1998) as happened in the US during the 2008 financial crisis. It may also weaken managerial incentives by forcing healthy banks to bear the losses of ailing institutions as happened in the early stages of the crisis in Ghana where Ghana Commercial Bank (GCB) had to take over the good assets of UT and Capital Bank in 2017. An attempt to deal with the problem with a loose monetary policy can be inflationary leading to a speculative attack on the domestic currency when the country is not implementing a flexible exchange rate regime (Demirgüç-Kunt and Detragiache, 1998).

Bailouts without direct consequence on handlers of financial institutions or banks is likely to lead to moral hazards in the banking sector. The managers and owners received the benefit of profits earned from banking activities carried out in the run-up to the crisis but when the crisis occurred losses are mostly shared by the public sector rather than being absorbed entirely by owners and unsecured creditors of the banks. Thus, these owners are protected from some or all of the adverse consequences. The Banks and Specialized Deposit-Taking Institutions Act, 2016 (Act 930) as discussed above has made it possible for remedial measures to be taken if risks including crisis occur in the banking sector. This Act though appropriate does not put the remedial actions as remunerated in section 102 of the Act, in any particular order. It gives the authority to the BoG to use its discretion to decide on which of the remedial actions to use at any particular time. This is contrary to an alternative position by Chennells and Wingfield (2015) which advocates for the management of such crisis in an orderly manner including preserving financial stability, ensuring the continuity of critical economic functions, and protecting depositors and public funds. The resolution measures adopted by the Ghanaian authorities met all but failed in protecting public funds. The 'stabilization' in the sector could have been achieved through a bail-in that restructures the capital position of the failing bank – similar to what the Ghanaian authorities are implementing (open bank bail-in) through the establishment of the bridge bank (CBG). Unlike the open bank bail-in, a closed bank bail-in ensures that the liabilities that are to be absorbed remain in the original bank that is put into an insolvency process while the good assets are transferred to a newly created entity.

In a bail-in, the claims of shareholders and unsecured creditors are written down and/or converted to equity to absorb the losses of the failed bank and recapitalize its successor. It does not depend on the authorities finding a willing and able purchaser for all or part of the bank in a short period of time.

Figure 8: The structure of a bail-in

Assets (Use of funds)	Liabilities and Capital (Source of funds)
A S S E T S	1. Secured Liabilities 2. Deposits 3. Unsecured Senior Liabilities ↑ 4. Subordinated Debt 5. Equity

Source: Chennells and Wingfield (2015)

The bank's assets include loans that it has made to households and businesses, lending to other financial institutions and holding of securities such as government and corporate bonds and its holding of cash. The bank's liabilities are what it owes to others. They include funds that the bank has borrowed in the form of issuing debt – bonds. In Figure 5 above, the liabilities have been arranged in order of seniority in the hierarchy of creditors, with the most senior liabilities at the top and the most junior, which are first to be absorb losses, at the bottom. Those liabilities that have been secured against assets on the other side of the balance sheet are liabilities considered senior – cash deposits and high-quality debt. Equity, which is fully loss absorbing, is the banks' capital.

It may happen that the original shareholders may not have been wiped out completely but their interest in the banks to be bailed-in will be severely diluted. In this regard those next in the liability hierarchy from the bottom as shown in figure 8, will be converted to equity to replenish the low or non-existent capital.

4.2.5 The impact of the EMP index on retail prices of gasoline in SSA

The NARDL model presented in Table 14 breaks the independent variables into two parts. Thus, measuring both the positive and negative changes in Brent crude oil prices and the EMP index, the following is sought to be investigated: Whether the effect of increasing Brent crude oil prices is the same as that of decreasing Brent crude oil prices, and whether the effect of the in-creasing EMP index is the same as that of the decreasing

EMP index. According to Table 14, in the short-run, the previous second, fifth and ninth months all have significant negative effect on fluctuations in the ex-pump price of premium gasoline in Ghana. In Kenya, changes in ex-pump premium gasoline prices have a significant negative relationship with previous ex-pump gasoline prices. This conclusion is not different from the control experiment that uses Colombia as the study country.

Table 14: Non-Linear ARDL model for the changes in the log of Gasoline prices

Variable	Ghana		Kenya		Colombia	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
DLNGAS(-1)	-0.162	-1.400	-0.343	-2.919*	-0.250	-4.241*
DLNGAS(-2)	-0.306	-2.522**	-0.423	-3.708*	-0.129	-3.400*
DLNGAS(-3)	-0.123	-0.955	-0.191	-1.775***		
DLNGAS(-4)	-0.074	-0.582	-0.373	-3.465*		
DLNGAS(-5)	-0.280	-2.290**				
DLNGAS(-6)	0.070	0.640				
DLNGAS(-7)	-0.058	-0.563				
DLNGAS(-8)	-0.102	-1.097				
DLNGAS(-9)	-0.190	-2.109**				
LN_BRENT_POS	0.090	0.500	0.077	0.885	0.008	0.201
LN_BRENT_POS(-1)	0.117	0.539	-0.054	-0.472	0.017	0.333
LN_BRENT_POS(-2)	0.154	0.682	0.109	1.003	0.030	0.587
LN_BRENT_POS(-3)	-0.272	-1.146	-0.144	-1.828***	-0.062	-1.358
LN_BRENT_POS(-4)	-0.371	-1.637			-0.028	-0.617
LN_BRENT_POS(-5)	0.290	1.296			0.064	1.414
LN_BRENT_POS(-6)	0.261	1.090			-0.074	-2.352**
LN_BRENT_POS(-7)	-0.293	-1.555				
LN_BRENT_NEG	0.004	0.034	-0.013	-0.213	0.011	0.35
LN_BRENT_NEG(-1)	0.127	0.649	0.280	2.974*	0.077	1.816***
LN_BRENT_NEG(-2)	-0.086	-0.442	-0.037	-0.38	0.024	0.575
LN_BRENT_NEG(-3)	0.230	1.154	0.052	0.535	-0.074	-2.491**
LN_BRENT_NEG(-4)	-0.023	-0.110	-0.134	-1.586		
LN_BRENT_NEG(-5)	-0.211	-1.063	-0.074	-0.911		
LN_BRENT_NEG(-6)	-0.165	-0.843	-0.085	-1.05		
LN_BRENT_NEG(-7)	0.478	2.332**	-0.061	-0.739		
LN_BRENT_NEG(-8)	-0.493	-2.616**	-0.028	-0.332		
LN_BRENT_NEG(-9)	0.237	1.885***	0.084	1.634		
EMP_2_POS	-0.489	-2.344**	-0.252	-1.667	-1.044	-19.755*
EMP_2_POS(-1)	-0.003	-0.011	0.055	0.314		
EMP_2_POS(-2)	-0.453	-1.720***	-0.020	-0.121		
EMP_2_POS(-3)	0.764	3.003*	0.303	1.818***		
EMP_2_POS(-4)	-0.520	-2.399**	-0.331	-1.998***		
EMP_2_POS(-5)			-0.001	-0.004		
EMP_2_POS(-6)			-0.257	-1.554		
EMP_2_POS(-7)			0.315	1.765***		
EMP_2_POS(-8)			0.394	2.324**		
EMP_2_POS(-9)			-0.343	-2.368**		
EMP_2_NEG	-0.494	-4.472*	-0.147	-1.089	-0.912	-15.617*
EMP_2_NEG(-1)	0.181	0.790			-0.253	-3.011*
EMP_2_NEG(-2)	-0.072	-0.279				
EMP_2_NEG(-3)	-0.815	-3.206*				
EMP_2_NEG(-4)	0.811	3.179*				
EMP_2_NEG(-5)	-0.641	-2.913*				
EMP_2_NEG(-6)	0.208	1.927***				
C	0.032	1.882***	0.008	0.519	0.026	6.933*
R-squared	0.775		0.745		0.945	
Adjusted R-squared	0.581		0.611		0.933	
Durbin-Watson stat	1.917		2.116		2.156	

*NB: Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%*

Increases in the Brent crude oil prices did not have any significant effect on the changes in the ex-pump price of premium gasoline in Ghana. over the study period. However, in Kenya and Colombia, the third and the sixth lags were positively significant

with ex-pump price changes, respectively. The significance level was 10% for Kenya and 5% for Colombia. The first lag of negative changes in the Brent crude oil prices was significant with the changes in the ex-pump price of premium gasoline in Kenya. This is similar to the case in Colombia but also included a significant relationship with the third lag of the negative changes in Brent crude oil prices and the changes in the ex-pump price of premium gasoline in Colombia. This was also true for the seventh, eighth and ninth lags in the case of Ghana.

Both positive and negative lag movements of the EMP index were mostly significant with fluctuations in the ex-pump price of premium gasoline for Ghana, Kenya, and Colombia. This highlights the importance of the exchange rate and the policy response in terms of retail gasoline prices in these three countries in the short-run.

The long-run form of the estimated NARDL model (see Table 15) largely confirms the findings in the short-run form in Table 14. The results indicate that, except for Colombia, there was no significant relationship between positive/negative changes in Brent crude oil prices and fluctuations in the ex-pump price of premium gasoline over the study period. For Colombia, a unit increase in Brent crude oil prices led to a 0.033 fall in the ex-pump price of premium gasoline. In addition, a unit decrease in Brent crude oil prices resulted in a 0.028 fall in the ex-pump price of premium gasoline, because we are dealing with negative changes. This is expected as, despite reforms in 2012, fuel prices in Colombia are still subsidised. It is further compounded by the fact that its neighbours sell fuel at far lower prices at the pumps (Romero and Etter, 2013).

In the long-run also, there were significant relationships between positive/negative movements in the exchange rate (EMP_2) and the ex-pump price of premium gasoline in Ghana and Colombia, but not in Kenya. In Ghana and Colombia, a unit increase in the EMP (appreciation pressure) index brought about a 0.315 and 0.757 fall in the ex-pump price of gasoline, respectively. On the other hand, a unit fall in the EMP (depreciation pressure) index induced a 0.370 and 0.845 increase in the ex-pump gasoline prices, respectively.

The long-run results reveal that the exchange rate was very significant in determining the ex-pump price of gasoline in the study countries except for Kenya. The situation in Kenya could be due to the country moving back and forth in the regulation of the retail fuel sub-sector; price regulation prior to 1994, price deregulation from 1994 to 2005, and then back to price regulation from 2006 onwards. A Wald test conducted on the positive and negative changes of the EMP index did not suggest that these effects

were significantly different from each other for all countries. The study period corresponds mostly with the period of price deregulation in Ghana, that is, since 2015. This may have accounted for the significance of the EMP index and the acceptance of the null hypothesis of the Wald test on the equal effects of the positive and negative movements of the EMP index on the changes in the ex-pump premium gasoline prices.

Table 15: Long-run form of the NARDL

	Ghana		Kenya		Colombia	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
LN_BRENT_POS	-0.010	-0.485	-0.005	-0.685	-0.033	-3.653*
LN_BRENT_NEG	0.044	1.193	-0.007	-0.736	0.028	2.599*
EMP_2_POS	-0.315	-2.799*	-0.059	-0.806	-0.757	-14.362*
EMP_2_NEG	-0.370	-3.384*	-0.063	-1.091	-0.845	-17.023*
C	0.015	2.093**	0.004	0.523	0.019	6.959*

NB: *Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%*

The diagnostics tests accepted the null hypothesis of no autocorrelation and no heteroscedasticity between the residuals of the models estimated. Furthermore, the null hypothesis of normality was accepted for all cases except for the model for Colombia.

4.2.6 The impact of the exchange rate on debt levels in SSA

The framework for fiscal policy and public debt sustainability analysis used in this study concludes that on average the exchange rate is the major contributor to the increase in the change in gross debt followed by the primary balance in Ghana from 2000 to 2020. However, in Kenya, the primary balance came out as the major contributor to the increase in the change in the gross debt followed by the exchange rate over the period 2000 to 2020. Over the same period, the interest rate and GDP growth contributed to a decreasing pressure on the change in gross debt in both Ghana and Kenya. (Table 16). This result is true if the identity of the DSA is true for all variables.

If we assume that the DSA of the study countries is only true if it is conditional on the independent variables, then the FMOLS regression result shows that a 1.438 change in the exchange rate leads to a significant unit change in the change in the gross debt in Ghana. Also, a 1.822 change in the effective interest rate leads to a significant unit change in the gross debt. The other variables were not significant in determining the changes in the gross debt in Ghana. However, In Kenya, a unit increase in the change of the gross debt leads to a 2.509 increase in the GDP. A 2.468 increase in the primary balance also leads to a significant unit increase in the gross debt. The other variables were not

significant in determining changes in gross debt in Kenya (see Table 17). The results from table 17 will have to be applied with care due to the small sample size which, in other words, suits the recent nature of the phenomena (COVID-19) being studied.

Table 16: Contributions to changes in the gross debt in Ghana and Kenya (2000-2020) in percentage of GDP

	Ghana 2000-2020	Kenya 2000-2020
Δd	1.1	0.6
o/w Int.	-2.6	-0.3
o/w FX	3.7	0.4
o/w GDP	-2.1	-1.9
o/w PB	2.3	2.1
o/w Res	-0.3	0.3

Source: Authors' construction

The diagnostic tests conducted showed that the residuals were normally distributed and were not correlated. A group unit root test conducted rejected the presence of a unit root in the variables. This was the case for the FMOLS models estimated for both Ghana and Kenya.

Table 17: Regression output for the change in gross debt as a percentage of GDP

Independent Variable	Ghana			Kenya		
	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
O_W_FX	1.438	3.009	0.009	0.289	0.463	0.650
O_W_GDP	1.418	1.499	0.155	2.160	2.509	0.024
O_W_INT_	1.822	5.172	0.000	0.378	0.837	0.416
O_W_PB	0.696	1.505	0.153	0.889	2.468	0.026
C	2.199	0.629	0.539	3.254	1.661	0.118
R-squared	0.676			0.516		
Adjusted R-squared	0.589			0.387		
Jarque-Bera	4.929			1.667		
Probability	0.085			0.435		

Source: Authors' construction

To further understand the dynamics, this study breaks the study period into three sections (2000 to 2006 to evaluate the contributions to the change in the gross debt during the HIPC initiative, 2007 to 2013 to evaluate periods prior to the commodity crisis in 2014 and 2014 to 2020 to evaluate periods after the commodity shock in 2014) and then analyses 2020 separately in order to highlight the significance of the pandemic (Table

18). The analysis shows that from 2000 to 2006 both Ghana and Kenya witnessed a fall in the change in the gross debt fuelled by the effective interest rate and the GDP growth. This result confirms the effect of the HIPC initiative on the debt levels of these countries. The initiative, as has been widely reported, led to debt forgiveness which saw Ghana's gross debt reduce to 18.6 per cent of GDP in 2006 from 79.2 per cent of GDP in 2000. Kenya's gross debt to GDP also reduced from 52.2 per cent of GDP to 44.0 per cent of GDP over the same period. This evidence forms the basis for advocates pushing for a similar package for developing countries after 2020.

*Table 18:* Contributions to changes in the gross debt in Ghana and Kenya (2000-2020), by sub-periods

	Ghana				Kenya			
Variable	2000-2006	2007-2013	2014-2020	2020	2000-2006	2007-2013	2014-2020	2020
Δd	-5.3	3.5	5.0	15.2	-1.4	0.0	3.5	6.6
o/w Int.	-6.6	-0.4	-0.8	0.1	-0.8	-1.0	0.8	1.0
o/w FX	6.2	1.5	3.4	1.3	-0.1	0.6	0.8	2.4
o/w GDP	-2.1	-2.1	-2.1	-0.5	-1.7	-1.9	-2.1	0.1
o/w PB	0.7	4.5	1.7	7.4	-0.7	2.3	4.6	4.5
o/w Res	-3.5	0.0	2.8	7.0	1.8	0.0	-0.5	-1.4

Source: Authors' construction

After witnessing a substantial decline in the debt levels from 2000 to 2006 (as shown in Table 18, both Ghana and Kenya witnessed declines in changes in their gross debt of -5.3 and -1.4 percent of GDP), Ghana especially embarked on a borrowing spree, this time involving more private investors (via Eurobonds). This is confirmed by a positive change in the gross debt for both Ghana and Kenya from 2007 to 2013 and from 2014 to 2020 (see Table 18). This policy shift has been promoted by the adequacy of and/or the cost of conditionalities attached to aid for developing countries, who need a consistent flow of funds for their growth and developmental agenda. Despite this, grants and aid unquestionably provide more fiscal space than borrowing. The apparent source of funds to finance these funding gaps in developing countries did not matter to policy advisors in Ghana after the completion of the HIPC initiative in 2006. Access to international capital market financing was (and still is) seen as an opportunity for these countries to pursue their own development priorities without the usual donor conditionalities. Notwithstanding that, the capital markets are probably more ruthless in punishing bad policies than donor institutions. There was also the argument that when one priced in the delays involved in accessing donor funds and the conditionality attached,

the real price of aid funds was actually not concessional (Bawumia, 2010, page 168). With this policy shift, the decreasing effect of the effective interest rate started to reduce as interest cost started to increase in these countries, especially from 2014 to 2020 with 2020 being the driver (see Table 18). Without the supervisory role of the Bretton Woods institutions, the primary balance as shown in Table 18 started exerting increasing pressure on the change in the gross debt from 2007 to 2013. Kenya was more cautious with its borrowings over the 2007 to 2013 period. From the 2014 to 2020 period, the situation became worse with the COVID-19 pandemic arguably playing a significant role. There was a huge increase in the change in the gross debt over this period as shown in Table 18 (5.0 per cent of GDP for Ghana and 3.5 per cent of GDP for Kenya).

Figure 9: Interest rate to tax revenue ratio in Ghana and Kenya (2000-2020)
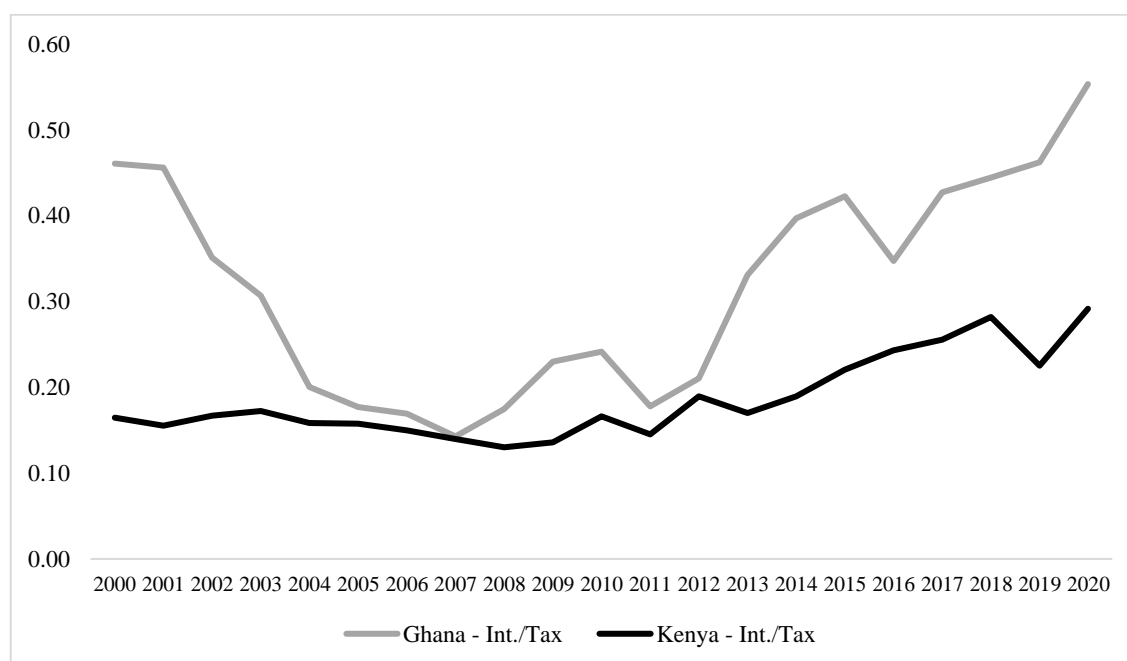
Source: Author's construction

For Ghana, the exchange rate, the primary balance and the residual were the main reasons for the increase in the change in the debt ratio. For Kenya, in comparison, the effective interest rate, the exchange rate and the primary balance were the main causes of similar trends in the gross debt. This complements the findings of Eichengreen and Hausmann (1999) and Bordo et al. (2010) that external borrowing in foreign currency is a major reason behind public debt problems. In 2020, almost all the indicators contributed to increasing the gross debt ratio confirming the observations of Altig et. al. (2020), Arellano, Bai and Mihalache (2020) and Bolton et. al. (2020) of the negative impact of the COVID-19 pandemic on developing economies. The change in the gross debt in 2020

was 15.2 per cent of GDP and 6.6 per cent of GDP for Ghana and Kenya respectively. For both Ghana and Kenya, the effective interest rate contributed positively to the increase in the change of gross debt. The primary balance was the main contributor to the increase in the debt ratio in 2020 for both Ghana and Kenya. The residual – which may also be a pointer to arrears accumulation – also played a critical role in the increase in gross debt in Ghana. The 2020 outcome means that these countries cannot continue to pile up expensive debts. The situation is worse if we compare the ratio of the interest cost to tax revenue for these countries. The ratio is now 55 per cent and 29 per cent for Ghana and Kenya respectively (Figure 9). Ghana's quest to embark upon liability management since 2015 doesn't appear to be working as the debt ratio to GDP also keeps rising.

4.3 Conclusion

Table 19: Research questions, hypothesis and results

Research Question	Hypothesis	Result
I	H0: The recent form of the EMP index has no significant positive relationship with changes in the nominal exchange rate. H1: The recent form of the EMP index has a significant positive relationship with changes in the nominal exchange rate.	Reject Null Hypothesis
II	H0: The proposed EMP index in this study has no significant relationship with changes in the nominal exchange rate. H1: The proposed EMP index in this study has significant relationship with changes in the nominal exchange rate.	Reject Null Hypothesis
III	H0: There is no significant relationship between the EMP index and other bank specific variables in Ghana. H1: There is a significant relationship between the EMP index and other bank specific variables in Ghana.	Reject Null Hypothesis
	H0: There is no significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya. H1: There is a significant relationship between the EMP index and the retail price of premium gasoline in Ghana and Kenya.	Reject Null Hypothesis
	H0: The exchange rate does not contribute to increases in the gross debt to GDP ratio in Ghana and Kenya. H1: The exchange rate contributes to increases in the gross debt to GDP ratio in Ghana and Kenya.	Reject Null Hypothesis

The analysis chapter confirms the importance of the exchange rate variable in Sub-Saharan Africa (SSA). Analysis for the first objective showed that the EMP index with the reserve variable adjusted by the broad money (EMP_2 and EMP_5) was more responsive to changes in nominal exchange rate. Due to this conclusion, the theory of reserve adequacy was applied to the EMP index in other to develop a new EMP index for SSA. Out of the three new indexes considered, the EMP index with the reserve variable

adjusted by the imports of goods and services was more responsive to changes in the exchange rate variable – the other modifications were also significant. After establishing these facts, the various EMP indexes were tested on macroeconomic variables – bank specific variables, retail gasoline prices and debt sustainability of selected countries in SSA. The results as discussed above, confirmed the importance of the exchange rate variable on these macroeconomic variables in SSA. The null hypothesis for all the hypothesis were rejected confirming the importance EMP index in SSA (see Table 19).

CHAPTER 5: CONCLUSION

5.1   Summary

This study has highlighted the importance of the exchange rate variable. The literature reviewed discussed the historical antecedents that led to emerging economies moving towards the adoption of a flexible exchange rate system. This policy prescription as discussed is quite challenging for developing economies. Thus, in emerging economies certain structural characteristics make them more vulnerable to external shocks. These includes constraints on the financing of investment through external borrowing and the speed by which exchange rate shocks feed through to domestic price levels (Devereux, Lane and Xu, 2006). Countries in SSA like other developing countries, as was shown in this study, insure themselves against current account shocks (volatilities in the exchange rate) using international reserves. Even though in some instances current account imbalances have increasingly been financed through portfolio investment (Eurobonds) inflows, helping to ease pressure on reserves (IMF, 2018), the results from this study shows that most countries in SSA still rely heavily on these reserves to wade off pressure on their currency.

Despite cautions – specifically about the selection of the appropriate threshold for identifying crisis episodes – about the use of the EMP index, models that have been used to measure exchange market pressure have indirectly assumed that most countries adopt the IT framework by including the interest rate in the reaction function of countries who experience exchange market pressure. In other to deal with the sensitivity issues raised by Pontines and Siregar (2008) and Bertoli et al. (2010), different variations of the EMP index were thus estimated and tested against changes in the exchange rate variable to identify which one of them is good at explaining the log changes in the exchange rate variable in SSA. This was also to answer the first objective of this study. The Dynamic Ordinary Least Square (DOLS) and the ridge regression result showed that the definition of the index to include the interest rate (equation 1) does not do a good job of explaining the changes in the ex-change rate variable in countries that have adopted the IT framework in SSA (Ghana and South Africa) – in fact the result is mixed if you consider these two countries individually. The index as defined in equation 2 and equation 5 are dominant in explaining changes in the log of the exchange rate variable in SSA. Both equations rely heavily on the reserve variable and to some extent broad money. In other words, the original index by Girton and Ropper (1977) has some explanatory power in

explaining the changes in exchange rate in SSA if the changes in reserves is adjusted for by broad money. The explanatory power is further enhanced if the components are normalised by their standard deviations without adjusting for the money variable. As discussed earlier broad money appears as intermediate target in most countries in SSA that target reserve money but the importance of reserve money cannot be overlooked. These results will generally suggest that the IT framework has not been effectively implemented in both Ghana and South Africa – SSA. This is because South Africa and Ghana practice a two targets two instruments monetary policy system which could be complicating the identification of the policy framework and the analysis of monetary policy. Even though the appropriate level of international reserves is still a subject of debate among economist, this study confirms the important of this variable in SSA.

In dealing also with the threshold problem pointed out by Pontines and Siregar (2008), the threshold regression model, a non-linear time series model with the local regimes switching, was used to identify crisis episodes in South Africa and Ghana. Twenty-eight (28) crisis episodes were identified for Ghana irrespective of whether EMP_1 or EMP_2 is used as the dependent variable. The crisis periods were more pronounced in 2008 to mid-2009, first half of 2012 and late 2013 to 2015. The maximum threshold variable for the two indexes used were significantly different confirming the diversity of the two indexes. For South Africa there were thirty-one (31) and twenty-seven (27) crisis episodes when the EMP_1 and the EMP_2 are respectively used as dependent variables. The crisis periods were more pronounced in 2008, late 2011 to the first half of 2012 and from 2013 to 2015. This confirms the use of the interest rate to dampen pressure on the exchange rate in South Africa. This will mean that developing countries (SSA) that even adopt the IT framework will not be in the position to allow their domestic currencies to freely float. Thus, emerging economies will be more concerned about the level of appreciation or depreciation of their exchange rate. Foreign exchange reserves have been viewed by SSA countries as the surest way to fight currency crisis. A shift to flexible exchange rate regimes and an ability to borrow in domestic currencies has been espoused as ways of easing pressure on the accumulation of reserves – as discussed in the review of literature on the subject. As pointed out by Bird and Rajan (2003) and Nowak et. al. (2004), emerging economies continue to struggle with maintaining adequate reserve levels – with the exception of some countries in Asia.

The conclusion from the first objective and the reviewed literature on reserve adequacy leads one to propose two new variations – adjusting the reserve variable by

either imports or short-term external debt – of the Exchange Market Pressure Index (EMP) first developed by Girton and Ropper (1977). In an attempt to develop a new EMP index for SSA – the second objective – the paper showed that the EMP index with the reserve variable adjusted for by imports of goods and services is more responsive to the changes in the log of the exchange rate variable. This conclusion confirms the observations by Nowak, Hviding and Ricci (2004) that the exchange rate crises in the sampled countries (emerging economies) emanates mostly from the current account of the balance of payments. This will imply that the reserve adequacy of these SSA countries can be judged by the size of trade flows as proxied by the value of imports. This conclusion notwithstanding, the significance and the explanatory power of the other two indexes including the HIPC dummy will mean that these other versions of the EMP index used in this study cannot be overlooked.

There are difficulties in implementing a theoretically superior approach to reserve adequacy (Fischer, 2001) in the event of an exchange rate crisis. Thus, even though the rule-of-thumb indicator has some theoretical shortcomings, it may still have some operational advantages – confirming the results of this study. This becomes more important if the new indexes proposed in this study are interpreted as merely indicative rather than definitive. Just like shown in table 1, this study recommends a combination of these indexes since the phase of economic development is not static. As economies in SSA become sophisticated the causes of exchange rate crises may shift from the current account to the capital accounts. Also, as these countries deepen their domestic capital markets, the effect of capital flights cannot be assumed away. Therefore, depending on how sophisticated a country's economy is, any of the indexes proposed may be important as they were all significant in determining changes in the exchange rate variable in SSA. An avenue for further studies will be to consider other scale free measures – for instance percentage changes – for the proposed indexes to test their significances on the exchange rate variable. This paved the way for one to test the effect of the EMP index on some selected macroeconomic indicators – the third objective.

The literature reviewed above also showed a link between banking and currency crises (Gaies, Goutte and Guesmi, 2018; Matsuoka, 2018; Peria and Domaç, 1999; Glick and Hutchison, 2000; Eichengreen and Hausmann, 1999; Kaminsky and Reinhart, 1999; Chang and Velasco, 2000). As a result, this proceeded to investigate this relationship in SSA using Ghana as a case study. First, it was evident that the happenings in the banking and financial sector of Ghana constituted a crisis, judging from the criteria proposed by

Demirgüç-Kunt and Detragiache (1998). The sector as discussed, experienced both a fall in ROA and ROE as NPLs increased. This was also after there was a sharp depreciation in the domestic currency in periods before the crisis (2015-2017). Even though the IMF warned of the crisis in 2015, it took a year for the accompanying regulatory reforms to be passed paving the way for the intervention in 2017. The GMM model estimated showed significance relationships between NPLs in Ghana, exchange market pressure, ROE and the gross loan to customer deficit, over the period 2008 to 2019. This means that an increase in NPLs eat into the return on shareholder's investment thereby affecting the capital base of banks in the sector. The high NPLs will mean that the credit worthiness of borrowers is not entirely assured before the granting of loans. As NPLs increased over the period, one would have expected regulators to have moved in to prevent or reduce the deterioration in bank equity or assets.

The remedial actions taken by the BoG as indicated in this study, are very costly to the country which has just exited an IMF program, and has reversed some gains made on debt sustainability. This is contrary to the alternative were an effective bank resolution regime would have ensured that banks could fail without disrupting the financial system, without interrupting the critical services they provide and importantly without requiring public sector support (Chennells & Wingfield, 2015). This study also found that the remedial measures stipulated in the Specialized Deposit-Taking Institutions Act, 2016 (Act 930) are not in any particular order – specifically section 102 of the Act.

Since the US dollar is mainly used as the invoicing currency of international crude oil trading, fluctuations in the US dollar exchange rate is believed to underline volatilities of crude oil prices the World over. This study investigated the problem of price asymmetry in the petroleum sub-sector of Ghana, Kenya, and Colombia. This was driven by the fact that the retail price of petrol or gasoline is expected to be affected by the World price of Brent crude oil and the US dollar exchange rate. In this respect, the literature discussed herein confirms the determining effect of these two variables on the ex-pump price of petrol or gasoline. How retail prices respond to changes in these important variables has often been discussed. The general perception is that prices are likely to adjust faster upwards than downwards. To measure this phenomenon, the present study adopted a relatively new method, NARDL, which is used to estimate the effect of positive and negative changes in various variables on a price variable. This model was chosen because it deals with the problem of non-linearity of the pricing variable and with both short- and long-run effects of the variables.

The results revealed that positive and negative movements in the US dollar exchange rate over the study period, measured by the EMP index, were significant in determining fluctuations in the ex-pump price of premium gasoline in both the short-run for Ghana, Kenya and Colombia and in the long-run for Ghana and Colombia. The null hypothesis of the equality of these effects was accepted. Increases and decreases in the international Brent crude oil prices all led to a fall in the changes in the ex-pump price of petrol or gasoline in Colombia in the long-run. This was due to the fact that Colombia's petroleum sub-sector is still regulated by the government even though its fuel price is still low among its neighbours. Both international Brent crude oil prices and the EMP index were not significant in determining changes in the ex-pump price of petrol or premium gasoline for Kenya in the long-run. This is due to the shift between regulation and deregulation in the petroleum sub-sector in Kenya over the study period.

In investigating the impact of the COVID-19 pandemic in worsening the debt sustainability of Ghana and Kenya, I found that both Ghana and Kenya had a limited fiscal space before the pandemic hit the continent in 2020. These countries were also judged to be in debt distress before and during the time of the pandemic, with private creditors holding significant portions of external debts in these countries. This according to the reviewed literature (low tradable goods shock and a large share of foreign currency debt) triggers a debt default.

The results show that the pandemic has worsened the debt sustainability of these developing economies – Ghana and Kenya. Using the IMF's framework for fiscal policy and public debt sustainability analysis (DSA) in market-access countries (MACs) and a Fully Modified Ordinary Least Square (FMOLS) model, the results showed that both Ghana and Kenya added 15.2 per cent of GDP and 6.6 per cent of GDP respectively to their gross debt in 2020 alone. The results also showed that the primary fiscal balance was a major contributor to the increase in the gross debt followed by the exchange rate. This debt overhang may slow investment and growth for years to come.

The path to recovery is going to be very complex and challenging, especially when these countries do not have the fiscal space to naturally bring down the debt levels. There have been significant calls for debt forgiveness as developing countries are facing debt sustainability problems. The IMF and the World Bank have called for a Debt Service Suspension Initiative (DSSI) and have made more Special Drawing Rights (SDRs) available to member countries. The solution of debt relief is however difficult to implement mainly because of significant reliance on private funding sources. During the

HIPC initiative, multilateral and bilateral donors held a chunk of the debt of these countries which made debt relief possible. The challenge now is that it will be difficult to bring private creditors onboard for any talk of debt relief, judging from the experience of Argentina and Ecuador. The problem of debt transparency and collateralized debt – debt with collateral-like features – which appears to be prevalent in developing countries cannot be overlooked in this regard (Georgieva, Pazarbasioglu and Weeks-Brown, 2020). Ghana and Kenya with capital market access may also choose not to participate in the DSSI due to concerns over future access and credit-rating downgrades by rating agencies.

5.2 Recommendations

The main policy recommendation for this thesis would have been for SSA countries to allow the ex-change rate to freely float but considering its effects, if there is excessive depreciation and appreciation pressure, the accumulation of reserves is recommended as an immediate solution to prevent exchange rate shocks. This is also because the new indexes proposed in this study were all significant in determining change in the exchange rate variable. However, this solution also comes with the opportunity cost of using these reserves for much-needed investments in these countries.

As pointed out in this study, there are costs to accumulating reserves. Accumulating reserves could be at the expense of stimulating the economy through the issuance of domestic bonds and investments in much needed infrastructure. This is because foreign exchange reserves in most SSA countries are managed and held by the central bank for the government. Since foreign reserve levels are already low in SSA countries, in my view, the benefits of accumulating reserves outweigh the cost of holding same due to the fact that SSA countries are still mainly commodity exporters and do not control the prices of these commodities. All measures of reserve adequacy come with the provision that other economic fundamentals remain sound. This is rooted in the fact that reserve accumulation may create a false sense of security if, for instance, fiscal deficits remain high crowding out private sector investments or create debt overhang problems. This may overwhelm the insulating effect of reserves and surprise a country previously considered secure (Green and Torgeson, 2007). Therefore, an avenue for further studies will be to explore the effect of fiscal policy measures on the proposed EMP indexes in this study.

For the impact of the EMP index on banking crisis, this study proposes a remedial measure similar to the one proposed by Chennells and Wingfield (2015) – the bail-in – in dealing with future banking crisis in Ghana. The key feature of this measure is that the

restructuring of the failing bank is done in an orderly conversion of liabilities into equities to replenish the low or non-existent capital. The liabilities are arranged in order of seniority with the owners' equity being the most junior of the liabilities.

For this measure to work effectively, there must be loss absorbing capacity in the right amounts, right form and right place within the banking sector. In other words, there must be something for the resolution authority to bail-in. Bearing in mind that this was a contributory factor to the crisis in Ghana – banks under stating their capital and reporting non-existent capital – one recommends an effective and efficient supervisory arm of the BoG. This will ensure that bank capital, as reported, is actually available in line with the Bank of Ghana Act 2002, Act 612, Bank of Ghana (Amendment) Act, 2016 (Act 918) and the Banks and Specialized Deposit-Taking Institutions Act, 2016 (Act 930). This will ensure that there are liabilities on the balance sheet that can be written down or converted into equity without disrupting the day-to-day functioning of the financial sector.

The only caveat is that if a bail-in occurs with one bank then the other banks holding the failing bank's debt could experience losses. However, if the size of a bank's holding of other bank's debt is limited by regulation then this will not be an issue. This study proposes for this to be included in the proposed amendment of the Banks and Specialized Deposit-Taking Institutions Act, 2016 (Act 930). Relying on voluntary efforts from banks to resolve NPLs may not be sufficient even when NPLs are recognized. Creating a good legal framework for Bank restructuring and timely disposal of NPLs is crucial, in particular when judicial capacity to deal with NPLs is lacking.

On the impact of EMP index on the retail price of premium gasoline, this study suggests that the exchange rate is likely to be an important variable in determining the ex-pump price of petrol or gasoline once the petroleum sub-sector moves towards deregulation, as is evident in the case of Ghana and Colombia. The effect of taxes cannot also be ignored once deregulation takes place – this is the case in Ghana. This makes the recommendations in the first and second objectives very relevant.

Kenya, in an attempt to recover from the shock posed by the pandemic, is seeking assistance from the IMF in the next phase of the country's COVID-19 response and a strong multi-year effort to stabilize and begin reducing debt levels relative to GDP. Ghana, on the other hand, is implementing a home-grown policy of some sort with the same purpose of economic recovery. Ghana's position is not surprising as the government had made capital out of the fact that they weaned the country out of an IMF programme in April 2019 and would not want to be seen as being the same government taking the

country through another IMF programme. As to whether the IMF will be willing to grant such assistance to Ghana considering the uneven implementation process that characterized the previous IMF programme is also another issue. The fact is that Kenya's programme with the IMF is likely to bring on board other development partners who see the IMF as an institution of restraint and provider of the needed credibility that will guarantee efficient use of resources. Without this type of assistance, Ghana will have to borrow from the capital market (at a higher cost) and aggressively cut spending on investment and social programs, making it more difficult for Ghana to achieve a durable and an inclusive recovery. Despite the different paths to recovery being implemented by these countries, the impact of fiscal consolidation for both countries would need to be softened by more efficient spending – ensuring that government spending is channelled to areas where it is most needed. This should be guided by the need to create fiscal buffers domestically, to ensure the fulfilment of future debt service obligations. The mistakes of the past should not be repeated, where developing countries are assured debt forgiveness and access to external funds is unabated. To build durable economic recoveries in these countries, the focus should be on the creation of domestic fiscal buffers (savings in the form of reserves) and fiscal space. This will ultimately lead to a reduction in the debt levels and reduce excessive borrowing and pressure on their domestic currencies.

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Appendix

Appendix figure 1: NPL and Private Sector Credit Growth – 2008Q1 to 2019Q1
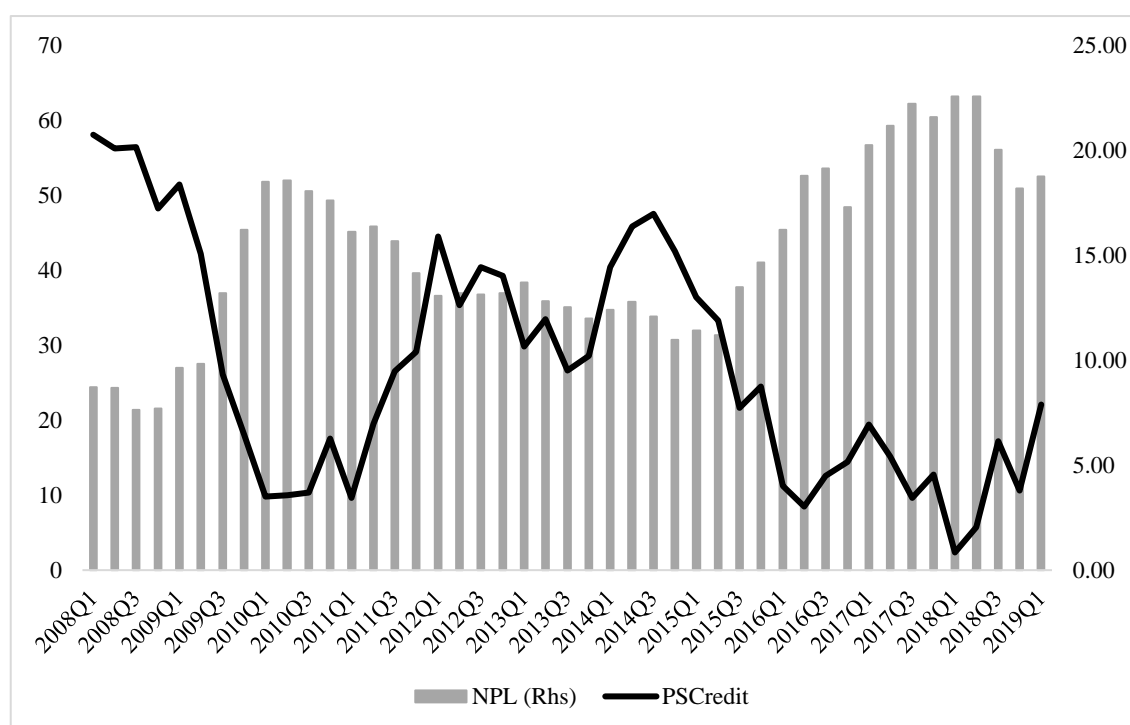
Source: BoG, 2019

Appendix table 1: Monetary Policy Frameworks in Sub-Saharan Africa

| Regimes	Policy Objectives	Intermediate	Operational Target	Main Instruments
Pegs (23)	Stability of the exchange rate regime (23) Price stability (23) Economic growth (12)	Private sector credit (1)	Exchange rate (23)	Open market operations Foreign exchange sales
Money targeting (18)	Price stability (all countries) External competitiveness (5) Exchange rate smoothing (12) Economic growth (9)	Monetary aggregates (16)	Reserve money (18)	Open market operations (17) Foreign exchange sales (18)
Inflation targeting (3)	Price stability (all countries) External competitiveness (1) Exchange rate smoothing (1)		Interest rates (3)	Open market operations (3) Foreign exchange sales (3)

Source: IMF, 2008

Appendix table 2: Sampled Countries

Variables	Monetary Framework	Countries
Fx & Res	All	Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Mozambique, Namibia, Niger, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia
Fx & Res	Pegs	Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Guinea-Bissau, Niger, Senegal, Togo
Fx & Res	Reserve Money	Angola, Botswana, Burundi, Cabo Verde, Democratic Republic of Congo, Gambia, Kenya, Lesotho, Mozambique, Namibia, Nigeria, Seychelles, Sierra Leone, Sudan, Tanzania, Zambia
Fx, Res & IR	IT	Ghana and South Africa
Fx, Res & RM	Reserve Money	Angola, Kenya, Sierra Leone

Source: Author's Construction

Appendix figure 2: Components of the Ex-pump Price of Premium Petrol in Ghana
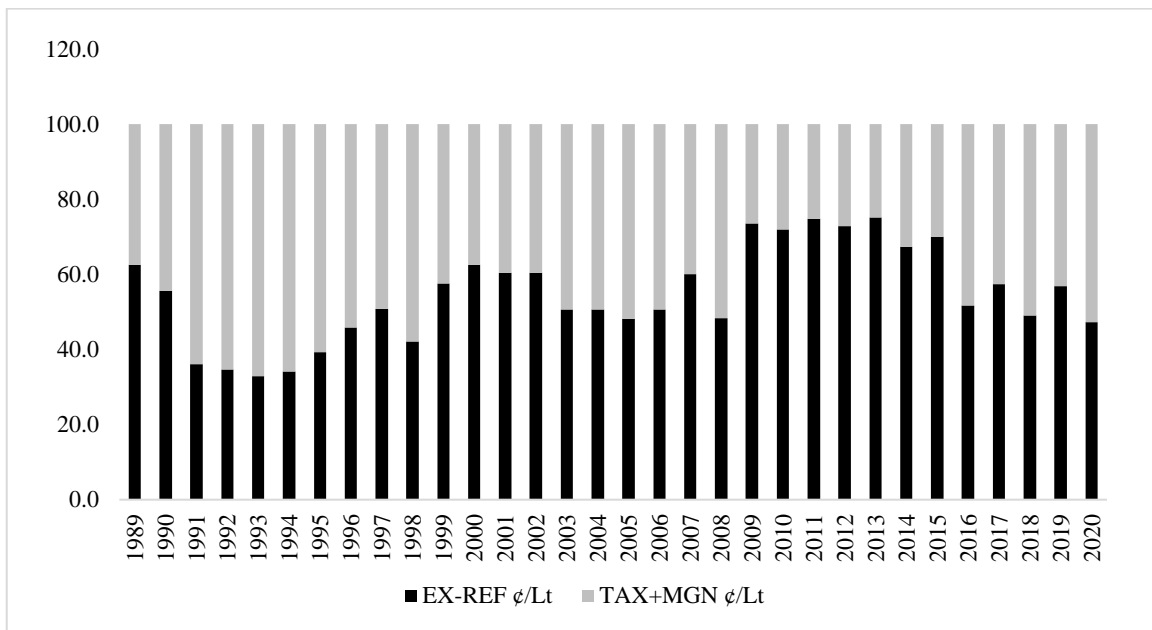
Source: NPA and Author's Estimates

Appendix table 3: HIPC Completion Point of Sampled Countries

No.	Countries	HIPC Completion Point
1	Angola	
2	Benin	Mar-03
3	Botswana	
4	Burkina Faso	
5	Cabo Verde	
6	Cameroon	Apr-06
7	Central African Republic	Jun-09
8	Chad	Apr-15
9	Congo, Democratic Republic of	Jul-10
10	Congo, Republic of	Jan-10
11	Côte d'Ivoire	Jun-12
12	Gabon	
13	Gambia, The	Dec-07
14	Ghana	Jul-04
15	Guinea-Bissau	Dec-10
16	Kenya	
17	Lesotho	
18	Mozambique	Sep-01
19	Niger	Apr-04

20	Nigeria	
21	Senegal	Apr-04
22	Sierra Leone	Dec-06
23	South Africa	
24	Togo	Dec-10
25	Uganda	May-00
26	Zambia	Apr-05

Source: IMF, 2019

Appendix table 4: Dynamic Ordinary Least Square (DOLS) for The Changes in the Log of the Exchange Rate Variable

		Independent Variables					
Variables	Monetary Framework	EMP 1	EMP 2	EMP 3	EMP 4	EMP 5	EMP 6
Fx & Res	All		0.000	-0.020		0.012	
			(-0.010)	(-4.061)*		(35.819)*	
Fx & Res	Pegs		-0.003	-0.038		0.014	
			(-2.033)**	(-3.726)*		(23.979)*	
Fx & Res	Reserve Money		0.002	-0.019		0.012	
			(0.587)	(-3.070)*		(25.055)*	
Fx, Res & IR	IT	-0.002	1.220	-0.464	0.036	0.002	
		(-0.915)	(14.742)*	(-7.867)*	(1.102)	(1.414)	
Fx, Res & RM	Reserve Money		0.327	-0.170		0.006	0.001
			(5.252)*	(-6.128)*		(5.083)*	(0.802)

Appendix table 5: Threshold regression result for South Africa and Ghana

	South Africa		Ghana	
	EMP_1	EMP_2	EMP_1	EMP_2
Variable chosen	EMP_1(-11)	EMP_2(-7)	EMP_1(-5)	EMP_2(-5)
Estimated number of thresholds	5	5	5	5
Threshold value used	1.245	0.051	3.292	0.044
R-squared	0.571	0.400	0.639	0.476
Adjusted R-squared	0.320	0.145	0.428	0.253
Jarque-Bera Normality Test	1.455	0.875	154.932	173.943
Probability	0.483	0.646	0.000	0.000
Breusch-Godfrey Serial Correlation LM Test				
F-statistic (Prob.)	0.880	0.926	0.673	0.511
Obs*R-squared (Prob)	0.813	0.894	0.527	0.379

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic (Prob.)	0.102	0.068	0.969	0.855
Obs*R-squared (Prob)	0.146	0.101	0.931	0.801

Source: Author's Construction

Appendix table 6: GMM model for the ROE and ROA

Variables	ROE	ROA
C	2.9044	-7.0784
	(0.2058)	(-2.7006)
NPL	-0.9143	0.0440
	(-2.6915)**	(0.6640)
EMP_1	-1.1428	-0.0415
	(-2.0567)**	(-0.3019)
GLCD	0.0953	0.0387
	(0.8825)	(1.7452)***
FCDLTGL	1.0316	0.2905
	(5.1123)*	(8.3392)*
R-squared	0.5211	0.6099
Adjusted R-squared	0.4707	0.5689
Instrument rank	7	7
J-statistic	1.9882	3.6434
Prob(J-statistic)	0.3701	0.1618

NB: *For GMM, t-statistics is in parenthesis (). Symbols *, **, *** indicates statistical significance at 1%, 5% and 10%*